Mississippi Valley Conservation

RIDEAU VALLEY CONSERVATION AUTHORITY

AGENDA

Mississippi-Rideau Source Protection Committee (MRSPC)

March 4, 2010
11:00 am
Rideau Valley Conservation Authority, Monterey Boardroom
3889 Rideau Valley Drive, Manotick

		Pg.	
1.0	**Welcome and Introductions** a. Agenda Review b. Notice of Proxies c. Adoption of the Agenda (D) d. Declarations of Interest e. Approval of Minutes – February 4, 2010 (D) ► draft minutes attached as a separate document f. Status of Action Items – Staff Report Attached (D) …..……..……. g. Correspondence (I): …… 1. Minister re: Response to Well Aware Letter 2. MOE re: Consultation on Draft Source Protection Plan Regulation 3. Well Aware re: Source Protection Plan content	 1 4	*Chair Stavinga*
2.0	**Assessment Report Development** – Staff Report Attached ……..…..….. a. *Preliminary Draft* Assessment Report chapters (D): i. Chapter 1 – Introduction…… ii. Chapter 4 – Drinking Water Quality Threats and Issues Approach. iii. Chapter 5 – Groundwater Sources …….. ► chapter 5 figures (maps) attached as a separate document b. *Preliminary Draft* Surface Water Technical Studies (D): i. Carleton Place Surface Water Study …….. ii. Perth Surface Water Study ……... iii. Smiths Falls Surface Water Study ……..	11 23 35 49 Attached 117 138 159	*Staff and Consultants*
3.0	**Draft Source Protection Plan Regulation** – Verbal Update (I) a. Members receive a verbal update on the consultation session held in Kingston on February 19. b. Staff indicate if they have any concerns with the draft regulation (they are still in the process of reviewing it)		
4.0	**Community Outreach** – Staff Report Attached (D) ….…… a. Members & staff report on activities since the last meeting b. Discuss upcoming events & opportunities	180	*Chair Stavinga*
5.0	**Other Business**		*Chair Stavinga*
6.0	**Member Inquiries**		*Chair Stavinga*
7.0	**Next Meeting** – April 1, 2010, 1pm Rideau Valley Conservation Authority, Monterey Boardroom 3889 Rideau Valley Drive, Manotick		*Chair Stavinga*
8.0	**Adjournment**		*Chair Stavinga*

(I) = Information (D) = Decision

Delegations wishing to speak to an item on the Agenda are asked to contact Sommer Casgrain-Robertson at 613-692-3571 ext 1147 or sommer.robertson@mrsourcewater.ca before the meeting.

1.0 f) STATUS OF ACTION ITEMS

Date: February 23, 2010
To: Mississippi-Rideau Source Protection Committee
From: Sommer Casgrain-Robertson, Co-Project Manager
Mississippi – Rideau Source Protection Region

Recommendation:

1. That the Mississippi-Rideau Source Protection Committee receive the following report for information.

Staff & Chair Action Items:

	Issue	Action	Lead	Status
1	Ottawa IPZ studies	Distribute the draft study summaries to the Canadian Security Intelligence Service (CSIS) Determine plant capacity of Britannia and Lemieux Island	Sommer Casgrain-Robertson / Bev Millar Brian Stratton	**Complete** Sommer sent the draft study summaries to CSIS on February 9, 2010.
2	Ontario Drinking Water Standards	Learn how Ontario establishes and reviews its drinking water standards. Consider recommending that the tritium standard be increased	Mary Wooding Chair Stavinga	**In-Progress** Mary will give an overview of the process at the April meeting Chair Stavinga is preparing a motion for the April meeting.
3	Rural Clean Water Programs	Send a letter to Minister Gerretsen highlighting the value of long-term, province-wide funding for rural clean water programs	Sommer Casgrain-Robertson	**In-Progress** Sommer will provide a draft letter in the April/May agenda package for consideration
4	Vacant City of Ottawa seat on the MRSPC	Fill the vacancy on the MRSPC	Sommer Casgrain-Robertson	**In-Progress** City staff are working to fill the seat.
5	Vacant industry / commercial seat on the MRSPC	Fill a vacancy on the MRSPC	Sommer Casgrain-Robertson	**In-Progress** Application deadline is February 19, 2010.

	Issue	Action	Lead	Status
6	Ottawa River Watershed Inter-Jurisdictional Committee	Encourage MOE to take the lead role in establishing an Ottawa River watershed inter-jurisdictional committee	Mary Wooding	**In-Progress** MOE has organized a meeting for March 30 with municipal and MOE representatives from Ontario and Quebec along the Ottawa River.
7	Uranium	MVC and local Health Units work together to raise public awareness about naturally occurring uranium in drinking water	Sommer Casgrain-Robertson & Mary Wooding	**In-progress** Jean-Guy Albert will encourage Health Canada to release the "Uranium and Drinking Water" fact sheet they drafted.
9	Geothermal Systems	Determine if geothermal systems should be considered a threat to drinking water sources	Sommer Casgrain-Robertson	**On-Going** A lot of information has been collected on this topic, including a technical bulletin from MOE.
10	Issues of concern outside the scope of the *Clean Water Act*	Staff develop a section in the Assessment Report to document issues of concern that fall outside the scope of the *Clean Water Act*	Sommer Casgrain-Robertson	**Complete** Chapter 8 of the Assessment Report will capture these issues.
12	Compensation Models	Staff to collect other compensation models (e.g. Ottawa wetland policy, Alternate Land Use Services).	Sommer Casgrain-Robertson	**In-progress** Staff will build this in to their Source Protection Plan work plan (begin late 2010).

MRSPC Member Action Items:

	Issue	Action	Lead	Status
1	Members were concerned that attendance might be low at Assessment Report open houses and groups who should be involved in the process are not	Members were asked to provide Sommer with contact information for groups they feel should be involved in the process – they will be added to our mailing list.	All Members	**Ongoing**

2	OFEC Conference Calls & Training Sessions	Richard Fraser will provide the MRSPC with updates on OFEC conference calls & training sessions	Richard Fraser	**Ongoing**
3	Community Outreach opportunities	Members to notify Sommer of potential events and opportunities to engage the public about source protection	All members	**Ongoing**

1.0 g) CORRESPONDENCE

Date: February 23, 2010
To: Mississippi-Rideau Source Protection Committee
From: Sommer Casgrain-Robertson, Co-Project Manager
Mississippi – Rideau Source Protection Region

Attached Correspondence:

Correspondence From:		Regarding:	Response:
1	Minister of the Environment – January 21, 2010	The Minister responded to the letter sent by the MRSPC in support of the Well Aware program	None required
2	MOE – January 25, 2010	MOE invited Committees to submit comments on the draft Source Protection Plan regulation. They were also invited to send five members to a consultation session on February 19 in Kingston.	At their February 4 meeting, five Members were selected to attend the consultation session in Kingston.
3	Well Aware – February 9, 2010	Well Aware provided two statements that they would like included in Source Protection Plans pertaining to private wells and education programs.	Will carry forward as input into the Source Protection Plan

Ministry of the Environment

Office of the Minister

77 Wellesley Street West
11th Floor, Ferguson Block
Toronto ON M7A 2T5
Tel.: 416 314-6790
Fax: 416 314-6748

Ministère de l'Environnement

Bureau du ministre

77, rue Wellesley Ouest
11e étage, édifice Ferguson
Toronto ON M7A 2T5
Tél. : 416 314-6790
Téléc. : 416 314-6748

Ontario

ENV1283MC-2010-168

January 21, 2010

Ms. Janet Stavinga
Chair
Mississippi-Rideau Source Protection Committee
Box 599, 3889 Rideau Valley Drive
Manotick ON K4M 1A5

Dear Ms. Stavinga:

Thank you for your letter of January 14, 2010 with regard to the Mississippi-Rideau Source Protection Committee's support for the Well Aware program.

My ministry has provided multi-year funding to Green Communities Canada (GCC) to deliver the latest phase of the Well Aware program through local community organizations. The program's primary aim is to provide assistance and education to private well owners.

The current funding agreement between GCC and the ministry expires at the end of this fiscal year. Part of the current year's funding includes an assessment of the program through a third party to determine its effectiveness. Well Aware has provided us with a proposal about potential future deliveries of the program, which is currently under review.

I trust this information is helpful. Thank you for bringing your comments about the program to the attention of our government.

Sincerely,

John Gerretsen
Minister

c: The Honourable Carol Mitchell
Minister of Agriculture, Food and Rural Affairs

The Honourable Deborah Matthews
Minister of Health and Long-Term Care

Ministry of the Environment

Source Protection Programs Branch

8th Floor
2 St. Clair Ave. West
Toronto ON M4V 1L5

Ministère de l'Environnement

Direction des programmes de protection des sources

8e étage
2, avenue St. Clair Ouest
Toronto (Ontario) M4V 1L5

Ontario

Log: ENV1174IT-2010-19

January 25, 2010

Dear Source Protection Committee Chairs and Project Managers:

This letter is to advise you that the Ministry of the Environment has now posted a draft regulation to support the development and implementation of source protection plans under the *Clean Water Act, 2006* on the Environmental Bill of Rights' Environmental Registry (EBR) website www.ebr.gov.on.ca, # **010-8766**. The regulation proposal notice on the EBR provides a high level summary of the draft regulation. The purpose of the draft regulation proposal is to stimulate discussion on the development, content, and implementation of source protection plans so that the ministry can use the results of the discussion in finalizing the source protection plan regulation.

The goal of the Act is to protect existing and future sources of drinking water, as part of an overall commitment to human health and the environment. As required by the Act, regulations must be developed to enable local source protection committees (SPCs) to complete their respective source protection plans. The following is a summary of topics included in the draft regulation:

- Source Protection Plans
  - Form
  - Objectives
  - Other policies that may be included in a source protection plan
  - Identification of strategic action policies
  - Applying provisions of Part III of the Act to policies in a source protection plan
  - Additional plan contents
  - Prescribed instruments
  - Explanatory document
  - Records
  - Consultation
  - Hearings
  - Amendments

- Enabling Part IV Powers
  - Risk management plans
  - Prohibited activities
  - Provisions related to Section 59 of the Act
  - Training and qualifications
  - Records

- Annual Reports

…2

This draft regulation was preceded by a policy discussion paper posted on the EBR in June 2009 for a 90-day comment period (*Source Protection Plans under the Clean Water Act, 2006: A Discussion Paper on Requirements for the Content and Preparation of Source Protection Plans, EBR*# 010-6726). Focus groups and discussions with stakeholders in the summer of 2009, as well as written submissions on the policy paper were taken into consideration when developing the draft regulation.

I invite you and your committees to review the draft regulation on the EBR. Your input will be considered during the development of the final regulations on source protection plans. Comments are due by March 26, 2010. We urge you to share your comments early in this 60-day public comment period so that the ministry may gain an understanding of your preliminary views on the content of the draft regulation and thoroughly consider your comments while striving to meet the timeline noted above for the final regulation.

The ministry is organizing multi-stakeholder discussion sessions on the draft regulation. SPC Chairs, project managers, and representatives of SPCs (3-5 maximum per committee), industry, municipal, agricultural, and environmental non-governmental organizations are invited to participate. The dates, locations and anticipated committee representative participation are listed below.

Friday February 19	Kingston	Raisin-South Nation; Mississippi-Rideau; Cataraqui; Quinte
Monday March 1	Milton	Hamilton-Halton; CTC; Niagara; SGSNB
Friday March 5	Sudbury	Sudbury; Lakehead; Mattagami; North Bay-Mattawa; Sault Ste Marie
Wednesday March 10	Toronto	SGBLS; Trent
Friday March 12	London	Lake Erie; Ausable Bayfield Maitland Valley; Thames-Sydenham; Essex

We kindly ask each chair or project manager to send the names of your committee representatives that will be participating (3-5 maximum) and confirm your attendance by contacting Angelune Des Lauriers at (416) 212-4417 or Angelune.Deslauriers@ontario.ca. The ministry notes all SPC members are welcome to comment on the draft regulation even if they do not attend these discussion sessions in person. In addition, the ministry is planning outreach training sessions on the final regulation that will be open to all committee members and other interested stakeholders.

For your information, a copy of the EBR notice and draft regulation has been provided to the Chiefs of the First Nations with reserves in the current source protection areas and the First Nations representatives on your committees

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You may submit comments directly through the EBR posting of the draft regulation or to source.protection@ontario.ca. To submit written comments, please forward your response to:

SOURCE PROTECTION PLANS REGULATORY PROPOSAL
Ministry of the Environment
Source Protection Program Branch
2 St. Clair Avenue West, 8th Floor
Toronto, Ontario M4V 1L5
Fax: (416) 327-6926

If you have any questions, please do not hesitate to contact me at (416) 212-6459, or Debbie Scanlon, Senior Drinking Water Program Advisor, at (416) 212-8839.

Sincerely,

Ian Smith, Director
Source Protection Programs Branch
Ministry of the Environment

c: Charley Worte, Conservation Ontario
Keith Willson, Manager, Source Protection Programs Branch, MOE
Katie Fairman, Supervisor, Source Protection Programs Branch, MOE
Debbie Scanlon, Source Protection Programs Branch, MOE

Well Aware.ca

Green Communities CANADA

Janet Stavinga
Mississippi-Rideau Source Protection Region
Box 599,
Manotick
ON, K4M 1A5

9 February 2010

RE: Recommendation for community based private well stewardship programs.

Dear Ms Chair;

I understand that you are familiar with Well Aware and want to thank you for your effort in sending a letter of support to several Ministers earlier this year. As you know, Well Aware is a provincial program that supports and engages rural homeowners to be proactive about their well and water resource. Well Aware has created dialogue between neighbours and friends, provided practical steps and resources to homeowners to take positive action, educated front line staff to relay Well Aware messages and empowered individuals to achieve overall protection of the groundwater. Research has found that actions taken by program participants to protect the groundwater triple relative to non-participants.

At this stage of the process, I would like to applaud you all for your time and efforts in preparing the Assessment Reports. We understand that these will influence the direction of future source water protection activities because of the detailed work that has been done to identify the wellhead protection areas and vulnerability scoring.

If your Source Protection Plan(s) include recommendations related to potential threats throughout the watershed, we would like to suggest that:

- private wells be identified as an ongoing concern
- community education programs, Well Aware, be identified as beneficial to protect drinking water from private wells

Well Aware is well placed to continue to reach out to these individuals. The program staff, resources and key messages have proven very effective in assisting well owners in protecting our common drinking water source. Well Aware has been focused on private wells for nine years.

If you have further questions about the Well Aware program or would like to see an example of content, please do not hesitate to contact me at any time or see www.wellaware.ca.

You can also contact your local Well Aware contact, Susan Brandum from Rideau Environmental Action League at 613-283-9500 or sbrandum@cogeco.ca.

Best wishes as you move into the development of source protection plans in your Region.

Thank you for your consideration,

Heather Kirby
Program Manager, Well Aware
Green Communities Canada
705-745-7479x114

Cc: Ian Smith, Director, Source Protection Programs Branch, MOE
Paul Heeney, Manager, Source Protection Implementation, MOE
John Stager, Assistant Deputy Minister/Chief Drinking Water Inspector, MOE
Kim Yee, Coordinator, Water Wells Management Program, MOE
Jo-Anne Rzaki, Watershed Stewardship Coordinator, Conservation Ontario
Clifford Maynes, Executive Director, Green Communities Canada

2.0 Assessment Report Development

Date: February 23, 2010
To: Mississippi-Rideau Source Protection Committee
From: Sommer Casgrain-Robertson, Co-Project Manager
Mississippi – Rideau Source Protection Region

Recommendation:

1. That the Mississippi-Rideau Source Protection Committee approve the following chapters for inclusion in the *preliminary draft* Assessment Report:
   - **Chapter 1 – Introduction**
   - **Chapter 4 – Drinking Water Quality Threats and Issues Approach**
   - **Chapter 5 – Groundwater Sources**

Recommendation:

2. That the Mississippi-Rideau Source Protection Committee receive the following studies and their summaries as *draft* for public consultation:
   - **Carleton Place Surface Water Study**
   - **Perth Surface Water Study**
   - **Smiths Falls Surface Water Study**

March 4, 2010 – MRSPC Meeting
The MRSPC will review three *preliminary draft* Assessment Report chapters: Chapter 1 (Introduction), Chapter 4 (Drinking Water Quality Threats and Issues Approach) and 5 (Groundwater Sources). The Committee will provide comments and feedback that will be incorporated into the *preliminary draft* Assessment Report that will be reviewed and considered by the Committee at their June 3 meeting.

The MRSPC will also review three preliminary draft studies and their summaries: surface water studies for Carleton Place, Perth and Smiths Falls. If they receive them as *draft* for public consultation they will be presented to the Mississippi Valley and Rideau Valley Source Protection Authorities in March. Copies will also be provided to relevant municipalities and posted for public review and comment. Three public open houses would also be held in Carleton Place, Perth and Smiths Falls in April/May.

February 4, 2010 – MRSPC Meeting
The MRSPC reviewed a preliminary draft Assessment Report chapter: Chapter 2 (Watershed Characterization). The Committee provided feedback that will be incorporated into the *preliminary draft* Assessment Report that will be reviewed and considered by the Committee at their June 3 meeting.

The MRSPC also reviewed and provided feedback on a preliminary list of topics for inclusion in Chapter 8 (Topics for Additional Research). Staff will use this feedback to prepare a preliminary draft chapter for the Committee to review at their April 1 meeting.

January 7, 2010 – MRSPC Meeting
The MRSPC reviewed *preliminary draft* municipal surface water studies and study summaries for Britannia and Lemieux Island (the City of Ottawa's intakes on the Ottawa River). They received them as *draft* for public consultation and they were presented to the Mississippi Valley and Rideau Valley Source Protection Authorities in January and February. Copies were provided to relevant municipalities and will be posted for public review and comment. Two public open houses will be held near Britannia and Lemieux Island in late March.

December 3, 2009 – MRSPC Meeting
The MRSPC reviewed a *preliminary draft* Water Budget Chapter for the assessment report. This chapter is now undergoing a communications review and will be included in the *preliminary draft* Assessment Report to be presented to the Committee in June. Once the committee approves the report as *draft* for public consultation, it will be circulated and posted for municipal and public comments. Public open houses will also be held to solicit public feedback.

November 5, 2009 – MRSPC Meeting
The MRSPC reviewed a *preliminary draft* study and study summary that provided:

- An estimated inventory of existing land use activities that pose a potential significant threat to municipal groundwater source water; and
- A list of known documented groundwater quality issues.

This study and summary was approved as *draft* for public consultation and was presented to the Mississippi Valley and Rideau Valley Source Protection Authorities on December 2 and November 26 respectively. It will now be circulated to municipalities for their review and comment. Notices will be sent to property owners where a land use activity has been identified as a potential significant threat once a public consultation schedule has been finalized for the *draft* Assessment Report.

September 3, 2009 – MRSPC Meeting
The MRSPC reviewed *preliminary draft* studies and summaries that provided a Conceptual Water Budget (regional scale), Tier 1 Water Budget (subwatershed scale) and review of Climate Change knowledge. The Committee approved them as *draft* for public consultation. The summaries were presented to the Mississippi Valley and Rideau Valley Source Protection Authorities on September 16 and 24 respectively and will be circulated to municipalities for their review and comment. Summaries will then be posted and made available for public review and comment.

July 9, 2009 – MRSPC Meeting
The MRSPC reviewed *preliminary draft* studies and summaries identifying Highly Vulnerable Aquifers and Significant Groundwater Recharge Areas at the regional scale and approved them as *draft* for public consultation. They were presented to the Mississippi Valley and Rideau Valley Source Protection Authorities on September 16 and August 27 respectively and have been circulated to municipalities for their review and comment. Study summaries will be posted for public review and comment.

June 4, 2009 – MRSPC Meeting
The MRSPC reviewed *preliminary draft* municipal groundwater studies and summaries for Almonte, Munster, Richmond (King's Park) and Westport and approved them as *draft* for public consultation. Copies of the *preliminary draft* summaries were provided

to all relevant municipalities and source protection authority members in advance of the meeting. The approved *draft* study summaries were presented to the Rideau Valley and Mississippi Valley Source Protection Authorities on June 25 and July 15 respectively. Study results were then presented to the public at three open houses in late July: Richmond/Munster (July 20), Westport (July 21), and Almonte (July 22).

May 7, 2009 – MRSPC Meeting
The MRSPC reviewed *preliminary draft* municipal surface water studies and study summaries for Carleton Place, Perth and Smiths Falls. They will continue their deliberations at a later meeting following a technical briefing in late August with MOE staff and the study consultants. Once approved as *draft* for public consultation, these studies and summaries will be presented to the Mississippi Valley and Rideau Valley Source Protection Authorities, relevant municipalities and the public for review and comment. Three public open houses will be held in Carleton Place, Perth and Smiths Falls.

April 2, 2009 – MRSPC Meeting
The MRSPC reviewed *preliminary draft* municipal groundwater studies and summaries for Carp, Kemptville and Merrickville and approved them as *draft* for public consultation. These studies and their summaries were provided to municipalities and presented to the Mississippi Valley and Rideau Valley Source Protection Authorities on April 15 and 23 respectively. Study results were then presented at public open houses in Carp (June 8), Merrickville (June 10) and Kemptville (June 11).

Background

Source Protection Committees are required to produce Assessment Reports. These reports will map local sources of drinking water, determine how vulnerable they are to contamination and overuse, and identify what land uses and activities pose a risk. Committees will then use this science to develop Source Protection Plans because they will know where source protection policies are needed and what risks those policies need to address.

The Mississippi-Rideau Source Protection Committee (MRSPC) must develop two Assessment Reports: one for the Mississippi watershed, and one for the Rideau watershed.

The Assessment Reports will contain the following components (underlining means the study has been approved as *draft* for public consultation by the MRSPC):

- Watershed Characterization
- Water Budget
- Vulnerable area delineation
    - Significant Groundwater Recharge Areas
    - Highly Vulnerable Aquifers
    - Wellhead Protection Areas for:
        - Almonte, Carp, Kemptville, Lanark (future planned system), Merrickville, Munster Hamlet, Richmond (King's Park subdivision) and Westport
    - Intake Protection Zones for:

        - Carleton Place, Ottawa (Britannia & Lemieux Island), Perth and Smiths Falls
- Prescribed Threats Summary
- Inventory of existing Issues and Significant Threats for groundwater
- Inventory of existing Issues and Significant Threats for surface water
- Climate Change Review

Due Date
Proposed Assessment Reports are due to the MOE one year after Terms of Reference are approved. Source Protection Committees submit *proposed* Assessment Reports to their Source Protection Authorities, who in turn submit them to MOE for approval.

Terms of Reference were approved for the Mississippi Valley Source Protection Area on February 5, 2009, therefore, a *proposed* Assessment Report for the Mississippi watershed must be submitted to MOE by February 5, 2010. Terms of Reference were approved for the Rideau Valley Source Protection Area on March 16, 2009, therefore, a *proposed* Assessment Report for the Rideau watershed must be submitted to MOE by March 16, 2010.

Staff hope to combine the two Assessment Reports into one document for the purposes of public consultation because:
- Much of the information is regional and would be repeated in both versions;
- Many municipalities are shared between the Mississippi and Rideau watersheds and it would be onerous for them to review and comment on two stand alone documents;
- It is more convenient for the public and cost effective if both Assessment Reports undergo public consultation at the same time.

This means both Assessment Reports would have to have been completed by February 5, 2010.

The MRSPC requested a due date extension for a number of reasons (finalized Techincal Rules were delayed by the Province, technical studies were delayed by concerns raised by the Committee, more time was needed for effective public consultation). The MOE granted an extension. A *proposed* Assessment Report must now be submitted to MOE by **September 21, 2010**.

Future Amendment Required
The *proposed* Assessment Report that will be submitted by September 21, 2010, will not contain information about the future municipal drinking water system planned for Lanark Village. This information will be identified as a data gap and included in a revised Assessment Report submitted in 2011. Since it is a self contained study, and pertains to a municipal system that does not currently supply people with drinking water, it seemed appropriate to submit it as a future amendment.

Detailed Work Plan and Timeline
The following work plan and timeline breaks the process of developing Assessment Reports into three phases.

Phase 1:
- Completion of background technical studies
- SPC, SPA, municipal and public review of draft findings
- Development of *preliminary draft* Assessment Report chapters
- SPC review of *preliminary draft* chapters

Phase 2:
- Consolidation of chapters into a *preliminary draft* Assessment Report
- SPC review, amendment and approval as "draft for public consultation"
- SPA, municipal and public consultation on the *draft* Assessment Report

Phase 3:
- SPC review of public comments received on *draft* Assessment Report
- Development of *proposed* Assessment Report
- Public consultation on the *proposed* Assessment Report
- Submission of the *proposed* Assessment Report to MOE for approval

Phase 1 Technical Studies

Staff and consultants have been developing background technical studies for a couple of years now. These studies began based on draft technical guidance from MOE and are now being finalized to meet the approved Technical Rules. These studies contain the scientific information the MRSPC needs to complete Assessment Reports.

In spring 2008, a *preliminary draft* Watershed Characterization Report and *preliminary draft* Conceptual Water Budget (based on MOE's draft guidance) were presented to the MRSPC. These studies are currently being updated to meet the final approved Technical Rules and will be brought back to the MRSPC as outlined below.

Once technical studies are completed, and in many cases peer reviewed:

- Staff will develop a summary outlining the study's purpose, methodology and findings (some studies will be grouped into one summary).
- The summary will be presented to the MRSPC for review and possible amendment (the technical study will be provided on CD).
- The summary will be presented to the Source Protection Authorities, then circulated to municipalities, and then the public for review.
  - Summaries will be posted on the web site for comment
  - 11 public open houses will be held.
  - Each open house will focus on the local municipal drinking water system (wellhead protection area or intake protection zone) and provide an overview of regional information from the Watershed Characterization Report, Water Budget Reports and Highly Vulnerable Aquifer and Significant Groundwater Recharge Area studies as available.
  - Full technical studies will be available to anyone on CD
- Everyone will be encouraged to provide feedback and traditional and local knowledge at this early stage so it can be considered when the *preliminary draft* Assessment Reports are being developed.

Staff will develop a *preliminary draft* Assessment Report in collaboration with our neighbouring source protection regions to be consistent where possible. Individual *preliminary draft* chapters will be brought to the MRSPC for review and comment as soon as they are produced. Chapters will be amended to reflect MRSPC feedback and will be compiled into a *preliminary draft* Assessment Report.

Carp, Kemptville and Merrickville

Municipal Drinking Water Systems (groundwater)

Month	Task	Timeline
March 2009	Golder complete Wellhead Protection Area Studies	**Completed** Early March
	Staff complete Threats Summary	**Completed** Early March
	Staff develop study summaries (reviewed by municipal technical staff)	**Completed** March 16
April 2009	MRSPC review *preliminary draft* study summaries & technical studies (CD). Provide to municipalities before the meeting.	**Completed** April 2
May 2009	Send *draft* study summaries & technical studies (CD) to municipalities with invitation to attend open house	**Completed** May 21
	Advertise three open houses (Carp, Kemptville and Merrickville) and comment period	**Completed** May 21
	Send an open house invitation to every property in an area that could score significant threat	**Completed** May 22 - 25
	SPAs review study summaries	**Completed** April 15 & 23
	Make study summaries available at MVC & RVCA offices for public review	**Completed** May 22
June 2009	Hold Open houses for municipal staff & council (afternoon session) and public (evening session)	**Completed** June 8, 10 & 11
February 2010	Post study summaries on web site	February
	Collect comments on study summaries	February
	Staff review comments received on technical study findings	February
	Staff prepare *preliminary draft* AR chapter	February
March 2010	MRSPC review summary of public comments and *preliminary draft* AR Chapter	March 4

Carleton Place, Perth and Smiths Falls

Municipal Drinking Water Systems (surface water)

Month	Task	Timeline
April 2009	J.F. Sabourin complete Intake Protection Zone Studies	**Completed** Early April
	Staff complete Threats Summary	**Completed** Early April
	Staff develop study summaries (reviewed by municipal technical staff)	**Completed** April 21

Month	Task	Timeline
March 2010	MRSPC review *preliminary draft* study summaries & technical studies (CD). Provide to municipalities before the meeting.	March 4
	Send *draft* study summaries & technical studies (CD) to municipalities with invitation to attend open house	March/April
April 2010	Advertise three open houses (Carleton Place, Perth and Smiths Falls) and comment period	March/April
	Send an open house invitation to every property in an area that could score significant threat	March/April
	SPAs review study summaries	March/April
	Post study summaries on web site and make available at MVC & RVCA offices for public review	March/April
	Hold Open houses for municipal staff, council and public	March/April
	Collect comments on study summaries	April
	Staff review comments received on technical study findings and prepare *preliminary draft* AR chapters	April
	Staff prepare *preliminary draft* AR chapter	April
May 2010	MRSPC review summary of public comments and *preliminary draft* AR Chapter	May 6

Almonte, Munster, Richmond (King's Park), and Westport
Municipal Drinking Water Systems (groundwater)

Month	Task	Timeline
May 2009	Malroz complete Wellhead Protection Area Study for Westport; Intera / Golder complete other three studies	**Completed** Early May
	Staff complete Threats Summary	**Completed** Early March
	Staff develop study summaries (reviewed by municipal technical staff)	**Completed** May 19
June 2009	MRSPC review *preliminary draft* study summaries & technical studies (CD). Provide to municipalities before the meeting	**Completed** June 4
July 2009	Send *draft* study summaries & technical studies (CD) to municipalities with invitation to attend open house	**Completed** July 7
	Advertise three open houses (Almonte, Richmond and Westport) and comment period	**Completed** July 10
	Send an open house invitation to every property in an area that could score a significant threat	**Completed** July 7
	SPAs review study summaries	**Completed** June 25 & July 15
	Make study summaries available at MVC & RVCA offices for public review	**Completed** July 16
	Hold public Open Houses	**Completed** July 20, 21 & 22

Month	Task	Timeline
February 2010	Post study summaries on web site	February
	Collect comments on study summaries	February
	Staff review comments received on technical study findings	February
	Staff prepare *preliminary draft* AR chapter	February
March 2010	MRSPC review summary of public comments and *preliminary draft* AR Chapter	March 4

Significant Groundwater Recharge Areas & Highly Vulnerable Aquifers

Month	Task	Timeline
June 2009	Intera / Golder complete studies	**Completed** Early June
	Staff complete Threats Summary	**Completed** Early June
	Staff develop study summaries (reviewed by municipal technical staff)	**Completed** Mid June
July 2009	MRSPC review *preliminary draft* study summaries & technical studies (CD).	**Completed** July 9
	Send *draft* study summaries & technical studies (CD) to municipalities for review	**Completed** July 29
August 2009	SPAs review study summaries	**Completed** August 27 & Sept 16
February 2010	Post study summaries on web site	February
	Collect comments on study summaries	February
	Staff review comments received on technical study findings	February
	Staff prepare *preliminary draft* AR chapter	February
March 2010	MRSPC review summary of public comments and *preliminary draft* AR Chapter	March 4

Conceptual and Tier 1 Water Budget & Climate Change Review

Month	Task	Timeline
August 2009	Staff, Intera & Delcan complete Tier 1 Water Budget and staff revise Conceptual Water Budget. Jacqueline Oblak complete Climate Change Review	**Completed** August 14
	Staff develop summaries	**Completed** August 18
September 2009	MRSPC review technical studies (CD) and summaries	**Completed** September 3
	SPAs review summaries	**Completed** September 24
November 2009	Staff prepare *preliminary draft* AR chapter	**Completed** November 16, 2009

Month	Task	Timeline
December 2009	MRSPC review *preliminary draft* AR Chapter	**Completed** December 3
February 2010	Send summaries & technical studies (CD) to municipalities for review and comment	February
	Post summaries on web site for review and comment	February
March 2010	Collect comments on summaries	March
	Staff review comments received on technical study findings	March

Britannia & Lemieux Island (Urban Ottawa)

Municipal Drinking Water Systems (surface water)

Month	Task	Timeline
Winter 2009	Baird complete Intake Protection Zone Study	**Completed** December 21
	Staff complete Threats Summary	**Completed** Early April
	Staff develop study summary (reviewed by municipal technical staff)	**Completed** December 22
January 2010	MRSPC review study summay & technical study (CD). Provide to relevant municipalities before the meeting.	**Completed** January 7
February 2010	Send study summary & technical study (CD) to relevant municipalities with invitation to attend open house	February
	Advertise open house (urban Ottawa) & comment period	February
	SPAs review study summary	January 28 & March 24
	Post study summary on web site and make available at MVC & RVCA offices for public review	February
March 2010	Hold Open house	Late March
	Collect comments on study summaries	April
	Staff review comments received on technical study findings and prepare *preliminary draft* AR chapters	April
	Staff prepare *preliminary draft* AR chapter	April
	MRSPC review summary of public comments and *preliminary draft* AR Chapter	May 6

Groundwater Issues and Significant Threats Inventory

Month	Task	Timeline
October 2009	Dillon complete Threats & Issues Inventory for groundwater	**Completed** Early October
	Staff develop study summary (reviewed by municipal technical staff)	**Completed** October 20
November 2009	MRSPC review study summaries & technical studies (CD). Provide to municipalities before the meeting.	**Completed** November 5

Month	Task	Timeline
	SPAs review study summaries	**Completed** November 26 & December 2
February 2010	Send study summaries & technical studies (CD) to municipalities for review	February
	Post study summary on web site and make available at MVC & RVCA offices for public review – comments can be submitted during comment period for *draft* AR	February 2010
	Staff prepare *preliminary draft* AR chapter	February 2010
	MRSPC review *preliminary draft* AR chapter	March 4

Watershed Characterization Report

Month	Task	Timeline
Spring 2008	Staff complete Watershed Characterization report.	**Completed** March 2008
	MRSPC review preliminary draft technical study	**Complete** March, May and June 2008
January 2010	Staff complete Watershed Characterization report revisions and preliminary draft AR chapter	January
	MRSPC review technical study revisions and preliminary draft AR chapter.	February 4

Surface Water Issues and Significant Threats Inventory

Month	Task	Timeline
	Dillon complete Threats & Issues Inventory for surface water	March 2010
	Staff develop study summary (reviewed by municipal technical staff)	April 2010
	MRSPC review study summary (provide to municipalities before the meeting), technical study (CD) and preliminary dratft AR chapter.	May 6
	Send study summaries & technical studies (CD) to municipalities for review	May 2010
	SPAs review study summaries	May / June 2010
	Post study summary on web site and make available at MVC & RVCA offices for public review – comments can be submitted during comment period for *draft* AR	May / June 2010

Phase 2 *Draft* Assessment Reports

Staff will compile all *draft* Assessment Report chapters into a *preliminary draft* Assessment Report. The MRSPC will review all public comments received on individual technical studies and will consider them when developing a *draft* Assessment Report for public consultation.

Month	Task	Timeline
June 2010	SPC review *preliminary draft* AR. Consider publishing *preliminary draft* AR for public consultation (now *draft* AR)	June 3
	SPC publish *draft* AR on website and make available at MVC and RVCA offices	June 2010
	SPC send copy of *draft* AR to each municipal clerk for comment	June 2010
	SPC send notice of *draft* AR to each person known to be potentially engaging in a significant threat	June 2010
	SPC send copy of *draft* AR to each neighbouring SPC for comment	June 2010
	SPC issue notice* on website, in newspapers and at other locations advising the public of the opportunity to view and comment on the *draft* AR	June 2010
	SPC send copy of *draft* AR to SPAs for comment	June 2010
	SPC receive written comments on *draft* AR	July 2010
July 2010	SPC host 2 public meetings to consult on *draft* AR (one meeting in each Source Protection Area)	June / July 2010
	Staff prepare a summary of comments received on *draft* AR and prepare recommendations about how to address them	July 2010

Phase 3 *Proposed* Assessment Reports

Staff will summarize all comments received on the *draft* Assessment Report during public consultation and make recommendations about how these comments could be addressed. The MRSPC will consider all comments when making final revisions to the *draft* Assessment Report.

The MRSPC will forward their *proposed* Assessment Report to the SPAs and post it for a final public consultation period. SPAs will submit the *proposed* Assessment Report to MOE for review and approval along with any public comments they receive or comments they wish to make.

Month	Task	Timeline
August 2010	SPC review summary of comments received on *draft* AR and staff recommendations for proposed changes Consider submitting revised *draft* AR to SPAs and posting for public consultation (now *proposed* AR)	August 12
	Staff prepare *proposed* AR Staff prepare a summary of public comments received on *draft* AR and how they were addressed	August 2010
	SPC publish *proposed* AR on website and make available at MVC and RVCA offices	August 2010

Month	Task	Timeline
	SPC send copy of *proposed* AR to each municipal clerk for comment	August 2010
	SPC send notice of *proposed* AR to each person known to be potentially engaging in a significant threat	August 2010
	SPC send copy of *proposed* AR to neighbouring SPCs for comment	August 2010
	SPC send notice of *proposed* AR to each person who submitted comments on *draft* AR	August 2010
	SPC issue notice* on website, in newspapers and at other locations advising the public of the opportunity to submit written comments on *proposed* AR to SPAs	August 2010
	SPC submit *proposed* AR to SPAs along with a summary of comments received on the *draft* AR and whether they were addressed in the *proposed* AR	August 2010
September 2010	SPAs receive written comments on *proposed* AR	September 2010
	Staff compile comments received	September 2010
	SPAs submit to the Minister of the Environment: - p*roposed* AR - summary of comments received on *draft* AR and how they were addressed; and - new comments received on *proposed* AR	September 21
October 2010	SPAs provide SPC with copy of comments received on *proposed* AR	October 7
	Minister will review the package and approve *proposed* AR or require SPAs to amend them and resubmit	approval timeline unknown
	Once approved the Minister will publish a notice on the Environmental Bill of Rights Registry	Soon after approval
	SPAs publish *approved* AR on web site and make available at other locations	Soon after approval

* Notice will specify deadline for public comments, how to submit comments, locations of public meetings and locations where the ARs can be viewed (electronically and in hard copy).

Assessment Reports will be prepared in accordance with:

- *Clean Water Act, 2006*
- Ontario Regulation 287/07 "General" (amended by O.Reg. 386/08)
- *Technical Rules: Assessment Report* (dated December 12, 2008)

Attachments:

- *Preliminary Draft* Assessment Report Chapters 1, 4 and 5
- Preliminary Draft Surface Water Study Summaries for Carleton Place, Perth and Smiths Falls

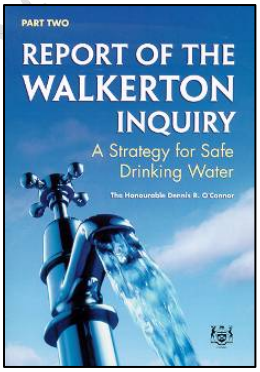
1 Introduction

Clean drinking water is essential to human health, the economy and the environment. That is why Ontario is the envy of jurisdictions around the world that face water shortages or polluted water sources. Ontario is fortunate to have an abundance of reliable sources of drinking water, from its thousands of lakes and rivers to vast underground aquifers. However, our water resources are by their very nature vulnerable to contamination and depletion. Over the past decade there have been incidents, large and small, of drinking water contamination. The result is often illness and costly clean-ups. With the good fortune of having abundant, clean water resources, comes the responsibility to protect them. We must remain vigilant.

This chapter outlines how Ontario's Clean Water Act will protect existing and future sources of drinking water, starting with the development of an Assessment Report.

1.1. Drinking Water Source Protection

The reality of what can happen to our sources of drinking water became all too apparent after the tragedy that occurred in Walkerton, Ontario in May 2000. A groundwater source of drinking water became contaminated and a treatment system failed, causing the death of seven people and ongoing illness in thousands.



The O'Connor Commission that looked into the tragedy made 121 recommendations to better protect Ontario's drinking water. The key conclusion was the need to have multiple layers of protection in place. A "multi-barrier approach" includes:

Multi-Barrier Approach

- **Drinking water source protection**
- Effective water treatment
- Secure distribution systems
- Monitoring & testing programs
- Response to adverse test results

In 2002, the Government of Ontario introduced the *Safe Drinking Water Act* to strengthen the rules and requirements around existing barriers (water treatment, distribution and testing). This and other measures fulfilled 99 of Justice O'Connor's recommendations. In 2006, the Government introduced the *Clean Water Act* to

implement watershed-based source protection which added a new barrier and fulfilled the remaining 22 recommendations.

1.2. Ontario's Clean Water Act

Purpose

The primary focus of the Clean Water Act is to ensure communities are able to protect their municipal drinking water supplies now and in the future from overuse and contamination. The Act requires municipalities, conservation authorities, First Nations, agriculture, business and industry, environmental groups, health units, government agencies and local residents to work together to:

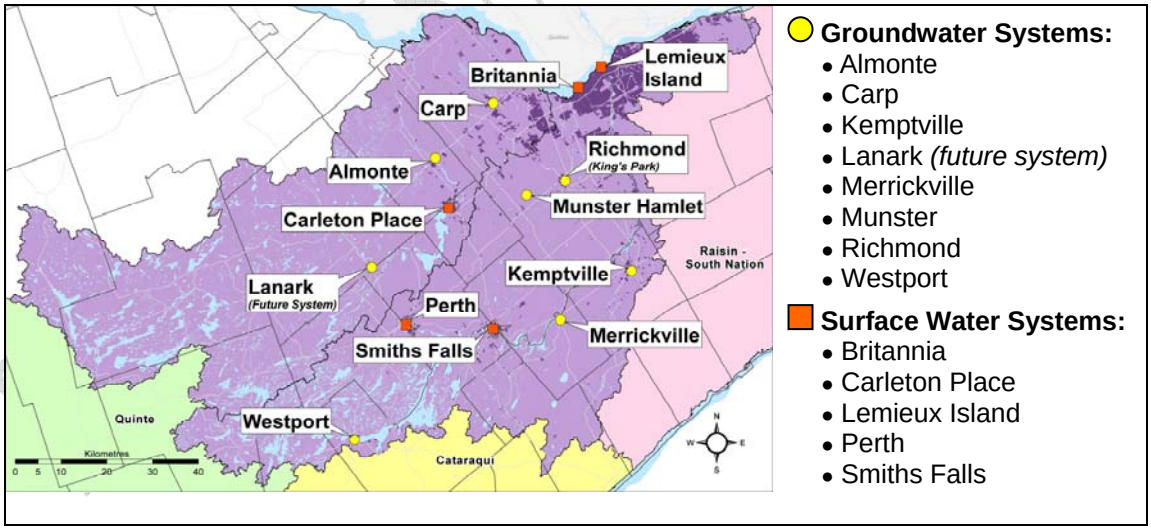
- Identify threats to source water in **Assessment Reports**; and
- Develop policies to address them in **Source Protection Plans**.

Source Protection Plans will be written locally, approved by Ontario's Minister of the Environment and implemented by municipalities, provincial Ministries and Conservation Authorities. The Plan will employ:

- Voluntary initiatives first;
- Negotiated solutions where possible; and
- Mandatory requirements when necessary.

Focus: Municipal Drinking Water

The *Clean Water Act* is not designed to protect all water resources. It is focused on protecting select areas of where water resources are supplying municipal residential drinking water systems (the large municipal systems that serve towns, villages and cities). These systems must be studied in Assessment Reports and protected through Source Protection Plans. The Mississippi-Rideau region has 13 municipal systems:



Future: Protecting Other Systems

The Act allows municipal councils or the Minister of the Environment to include two other types of drinking water systems in the source protection planning process:

- Clusters of six or more private wells or intakes; and
- Systems that supply public and private facilities (schools, community centres, trailer parks).

There are many potential clusters in the Mississippi-Rideau region and over 600 public and private facilities. Currently, neither the Minister nor local municipalities have chosen to include any other systems in this current round of planning for the Mississippi-Rideau region. The MOE has strongly advised municipalities to wait until they receive guidance from the MOE before deciding to include additional systems. This guidance will help municipalities prioritize which other systems they may want to include in the process and it will speak to potential funding to cover the cost of including additional systems.

Beyond the Act: Protecting Water Resources

The protection of municipal drinking water supplies is one piece of a broader environmental protection framework in Ontario. Water resources in Ontario are protected through the federal and provincial governments, municipalities, conservation authorities and public health units. These agencies are responsible for protecting and improving water quality, water quantity and aquatic habitats, providing land use planning and development rules to ensure that water resources are not negatively affected, providing flood management and responses to low water availability, and many others.

While there will undoubtedly be benefits to water quality beyond drinking water through the source protection process, it is important to keep the focus of the Clean Water Act on drinking water. The *Ontario Water Resources Act*, the *Environmental Protection Act* and other provincial and federal laws (such as the *Planning Act* and *Fisheries Act*) remain the chief vehicles for protecting Ontario's water resources. For more information on how water resources are protected in Ontario visit www.ene.gov.on.ca or call 1-800-565-4923.

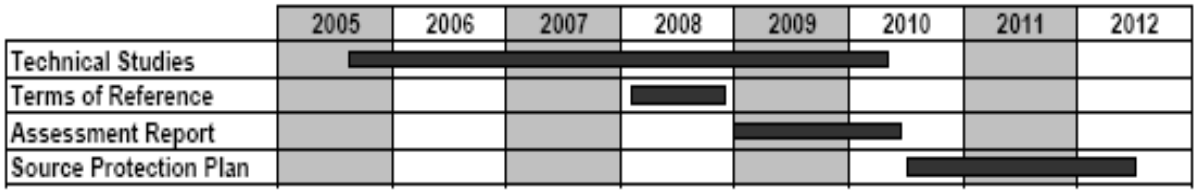
The Act and its Regulations

The *Clean Water Act* and its five regulations were written by the MOE. They were developed after rounds of public consultation with key stakeholders and the general public, including being posted on the Environmental Registry for review and comment. The following legislation can be viewed at www.e-laws.gov.on.ca:

- Clean Water Act, 2006
  - Ontario Regulation 287/07 – General
  - Ontario Regulation 231/07 – Service of Documents
  - Ontario Regulation 284/07 – Source Protection Areas and Regions
  - Ontario Regulation 288/07 – Source Protection Committees

1.3. The Source Protection Planning Process

The MOE is the lead agency for drinking water source protection activities across Ontario. The Ontario Ministry of Natural Resources (MNR) also assists with project management and aspects related to protecting quantities of water from overuse. Together they developed a source protection planning process through the Clean Water Act and its regulations that culminates in the creation of a Source Protection Plan by 2012.



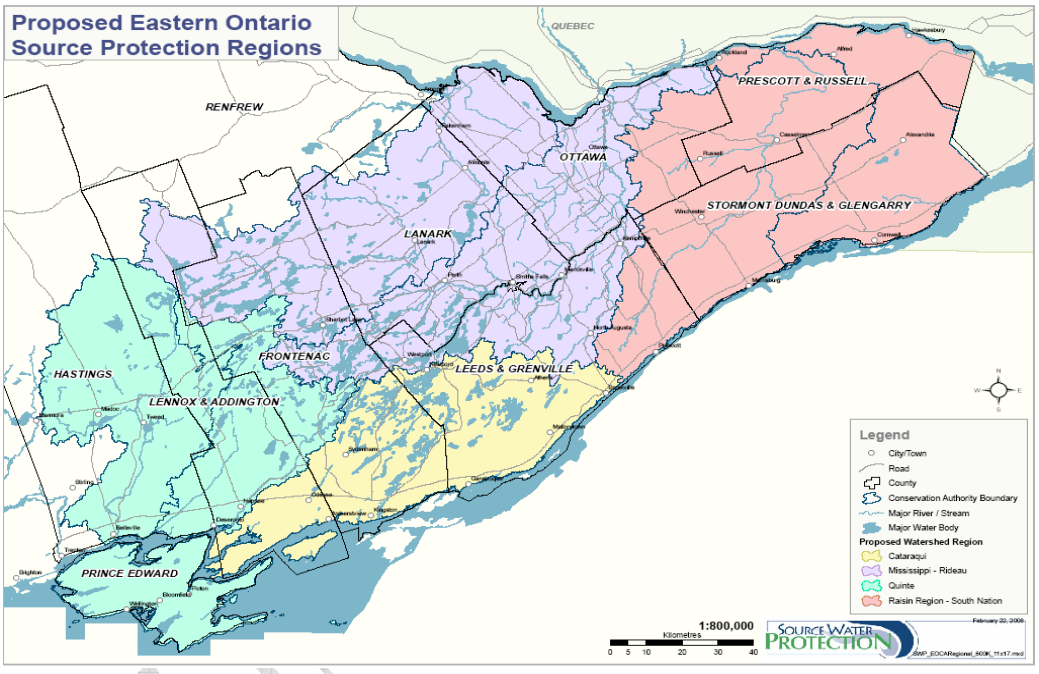
The Watershed Scale

The *Clean Water Act* divided most of the settled parts of Ontario into watershed-based Source Protection Areas. Most of these areas mirror conservation authority boundaries with a few including adjacent lands and waters. A total of 36 Source Protection Areas were created which the Clean Water Act then grouped into 19 Source Protection Regions. Regions were created so source protection staff and resources could be shared, therefore reducing costs.

Source Protection Areas and Regions

Eastern Ontario was divided into four source protection areas/regions:

- Cataraqui Source Protection Area;
- Quinte Source Protection Region;
- Mississippi-Rideau Source Protection Region; and
- Raisin-South Nation Source Protection Region.



The Mississippi-Rideau Source Protection Region is made up of:

- The Mississippi Valley Source Protection Area – the jurisdiction of the Mississippi Valley Conservation Authority
- The Rideau Valley Source Protection Area – the jurisdiction of the Rideau Valley Conservation Authority.

A description of the Mississippi-Rideau Source Protection Region is provided in Chapter 2 of this report.

Source Protection Authorities

Conservation authorities across Ontario are serving as Source Protection Authorities under the Clean Water Act. Their role is to administer the source protection planning budget, establish a local Source Protection Committee in each region and submit proposed deliverables completed by the Committee to the MOE for review and approval.

The Mississippi Valley Source Protection Authority (made up of the 15-member board of directors for Mississippi Valley Conservation) and the Rideau Valley Source

Protection Authority (made up of the 12-member board of directors for the Rideau Valley Conservation Authority) jointly administer the source protection program in the Mississippi-Rideau region.

Building Conservation Authority Capacity – 2005

In 2005 the MOE and MNR began funding Conservation Authorities in advance of the *Clean Water Act* to:

- begin some of the background technical studies required for the Assessment Report; and
- begin communications and public engagement activities to raise peoples awareness and knowledge about impending source protection legislation.

Source Protection Committees - 2007

In 2007 the Minister of the Environment appointed Janet Stavinga to Chair the Mississippi-Rideau Source Protection Committee. The Mississippi Valley and Rideau Valley Source Protection Authorities then appointed 15 Committee members. As per the *Clean Water Act*:

- 1/3 represented municipal interests;
- 1/3 represented economic interests; and
- 1/3 represented community interests.

The Committee is also joined at each meeting by three non-voting liaison members from the MOE, public health units, and the Source Protection Authorities. Biographies for each Committee members are included in Appendix A2, a list of Committee members is provided below.

Member	Sector	Representing
Janet Stavinga	Chair	
Scott Bryce	Municipal	Municipalities with groundwater based municipal drinking water systems
Paul Knowles	Municipal	Municipalities with surface water based municipal drinking water systems
Eleanor Renaud	Municipal	Municipalities with no municipal drinking water systems
Christine Leadman	Municipal	City of Ottawa
Vacant	Municipal	*City of Ottawa*
Richard Fraser	Economic	Agriculture
Peter McLaren	Economic	Agriculture
Drew Lampman	Economic	Aggregates Industry
Beverly Millar	Economic	Small Business
Vacant	Economic	*Business/Industry sector*
George Braithwaite	Community	Rural Public
Carol Dillon	Community	Environmental Non-Governmental Organizations
Patricia Larkin	Community	Non-Governmental Organizations
Randy Malcolm	Community	Algonquins of Ontario

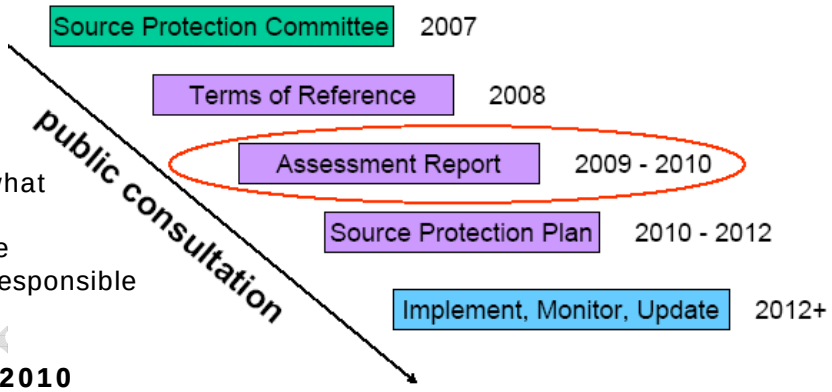
Mary Trudeau	Community	Ottawa Riverkeeper
Mary Wooding	Liaison	Ministry of the Environment
Alan Arbuckle, Mark Burnham, Ken Graham, Phil Sweetnam*	Liaison	Source Protection Authorities
Jean-Guy Albert	Liaison	Public Health Units

* The Chairs and Vice-Chairs of the Mississippi Valley and Rideau Valley Source Protection Authorities take turns filling the liaison seat.

The Clean Water Act requires each Source Protection Committee to develop three key documents: Terms of Reference, Assessment Report and Source Protection Plan.

Terms of Reference - 2008

Terms of Reference were written for the Mississippi-Rideau region in 2008 and approved by the Minister of the Environment in early 2009. Terms of Reference identified what needed to be done to complete Assessment Reports and Source Protection Plans and who was responsible for each task.



Assessment Report – 2009/2010

Information on vulnerable areas and potential drinking water threats is being collected in Assessment Reports. This document is the Assessment Report for the Mississippi-Rideau Source Protection Region. Assessment Report findings will be the basis for Source Protection Plan policies.

Source Protection Plan – 2010/2012

Source Protection Plans will be prepared by the summer of 2012. The plan will include policies that make use of implementation tools such as public education, incentives, municipal land use planning and by-laws, infrastructure, and provincial approvals and permits. Plan policies must ensure significant drinking water threats cease to be significant and no low or moderate threats become significant. The plan must also include requirements for monitoring local progress on source protection. Municipalities are expected to be involved in implementing source protection plans, in part through updates to their official plans and zoning by-laws. Conservation authorities and provincial ministries will also play a role in implementation.

Implement, Monitor and Update – 2012+

Once the Minister has approved Source Protection Plans the policies will be implemented by municipalities, conservation authorities and the Province. There is a requirement to monitor progress and report on it and the Minister will set a review date upon which the Committee will revisit their Terms of Reference, Assessment Reports and Plans to amend and update them where required.

The source protection planning process is intended to continue over the long-term, similar to activities by the provincial government and municipalities under Ontario's Planning Act.

Provincial Funding

The Provincial Government is funding 100% of the source protection planning process into 2012 when Source Protection Plans will be completed. This includes the cost of technical studies, consultants, peer review, source protection staff and the Source Protection Committee. It should be noted that many municipalities have generously contributed staff time in support of local source protection planning work and these costs have not been covered.

Currently the Province has not committed to pay for:

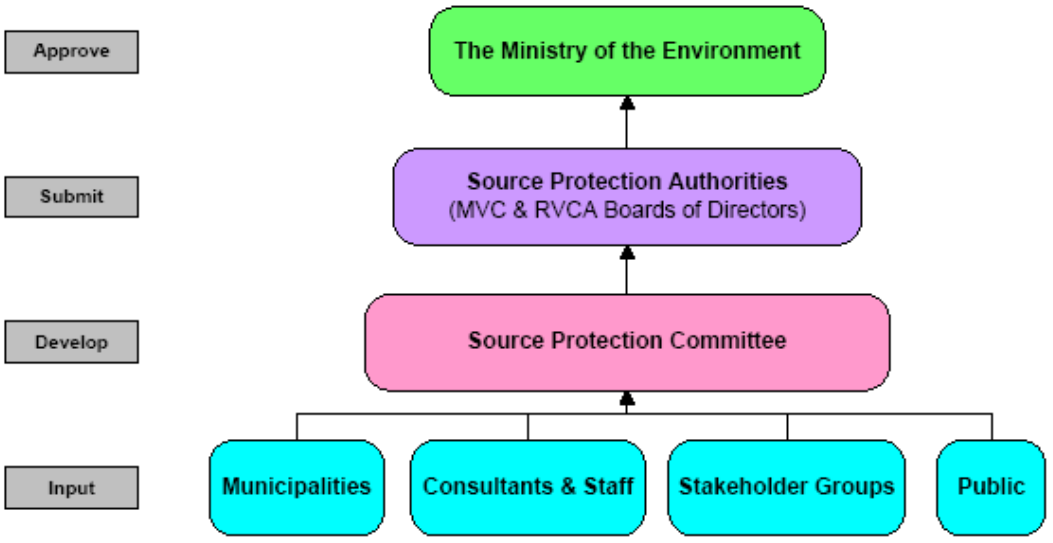
- The inclusion of "other" drinking water systems in the source protection planning process; or
- The implementation of source protection plans.

Implementation costs will depend on the types of policies that will be used to address drinking water threats. The Mississippi-Rideau Source Protection Region has repeatedly told MOE that municipalities are very concerned about potential implementation costs they may incur and our region will continue to raise this issue at the provincial level on behalf of our local municipalities.

1.4. Participants in the Process

We know Source Protection Committees are responsible for developing Terms of Reference, Assessment Reports and Source Protection Plans. We know Source Protection Authorities are then responsible for submitting these documents to the MOE for review and approval. What has not been highlighted are the groups and individuals who provide valuable input into the source protection process, input the Committee reviews and considers when developing their documents and the MOE considers when developing new regulations and rules.

Everyone has an interest in drinking water source protection, from wanting to ensure their source of drinking water is protected to having input into source protection policies that may affect their property. This is the reason source protection in Ontario is being lead locally at the watershed scale. It is also the reason the Mississippi-Rideau Source Protection Committee is committed to ensuring effective municipal and public participation and developing source protection policies in an open and consultative manner.



1.4.1. Municipalities

Municipalities are key partners in source protection planning:

- They own and/or operate the municipal residential drinking water systems which are the focus of this Act;
- They can chose to lead technical studies and/or develop the source protection policies required for their municipality;
- Their councils can include "other" drinking water systems in the source protection process;
- They could be responsible for implementing parts of source protection plans once they are approved; and
- Source Protection Plans could trigger changes to municipal Official Plans and/or Zoning By-laws.

In the Mississippi-Rideau local municipalities have been very involved in the source protection process. Since 2005 they have worked closely with source protection staff on data collection, technical studies and communications initiatives. Most notably, many municipal staff sat on one or more of our technical working groups which oversaw the technical studies that fed into the Assessment Report. Municipalities will play a large role on our upcoming planning working group which will draft preliminary source protection plan policies for Committee consideration.

All or part of 31 municipalities fall within the Mississippi-Rideau Source Protection Region (seven counties and 24 lower and single tier municipalities). A list of these municipalities is below.

Upper Tier Municipalities (Counties)	Lower and Single Tier Municipalities
Frontenac, County of	Central Frontenac Township
	North Frontenac Township
	South Frontenac, Township of
Lanark County	Beckwith Township
	Carleton Place, Town of
	Drummond/North Elmsley, Township of
	Lanark Highlands, Township of
	Mississippi Mills, Town of
	Montague, Township of
	Perth, Town of
	Tay Valley Township
Leeds & Grenville, United Counties of	Athens ,Township of
	Augusta, Township of
	Elizabethtown - Kitley, Township of
	Merrickville - Wolford , Village of
	North Grenville, Municipality of
	Rideau Lakes, Township of
	Westport, Village of
Lennox & Addington, County of	Addington Highlands, Township of
	Ottawa, City of

Prescott & Russell, United Counties of	Clarence - Rockland, City of
	Smiths Falls, Town of
Stormont, Dundas & Glengarry, United Counties of	North Dundas, Township of
Renfrew, County of	Greater Madawaska, Township of

1.4.2. Provincial Government

There are a number of provincial agencies who have been involved with or will play an increasing role in source protection. They include:

- Ontario Ministry of the Environment
- Ontario Ministry of Natural Resources
- Ontario Ministry of Municipal Affairs and Housing
- Ontario Ministry of Agriculture, Food and Rural Affairs
- Public Health Units
- Stewardship Councils

These agencies are important partners because they share their knowledge, and some assist with landowner contact and the delivery of programs to landowners.

1.4.3. Federal Government

The federal government has many interests in the Mississippi-Rideau Source Protection Region, including that of landowner. Parks Canada and the National Capital Commission are federal organizations that have been or will be involved in the source protection planning process.

Algonquins of Ontario are also important federal partners as they have a long-standing interest in protecting water resources along with a land claim over much of the Mississippi-Rideau region.

1.4.4. Adjacent Source Protection Regions

The Mississippi-Rideau Source Protection Committee coordinates their efforts with their three neighbouring source protection areas and regions (Cataraqui, Quinte and Raisin-South Nation). This builds on a long tradition of cooperation between the conservation authorities and the intent is to provide consistent information wherever possible, for the benefit of those municipalities that fall into more than one source protection region.

1.4.5. Interested Groups, Stakeholders and the Public

There are many individuals and groups in the Mississippi-Rideau Source Protection Region who are interested in source protection and engaged in the process. In particular the agricultural community, lake associations, aggregate and golf course industries, community and landowner associations and environmental groups have shown interest in the process and invited staff to speak to their members. Many of these economic and community interests are represented by members on the Source Protection Committee which ensures a broad range of views and perspectives are at the table when decisions are being made.

1.4.6. Ottawa River Watershed

The largest municipal drinking water system in the Mississippi-Rideau Region is in the City of Ottawa. The Britannia Water Purification Plant and the Lemieux Island Water Purification Plant are located along the Ottawa River in the urban area of Ottawa and together they provide drinking water for approximately 700,000 people. Understandably the overall health of the Ottawa River has been an issue of concern to the Mississippi-Rideau Source Protection Committee since they convened in 2008.

The Ottawa River watershed encompasses an area of approximately 146,000 square kilometres with countless rivers, lakes, streams and drainage areas. The Mississippi-Rideau Source Protection Region makes up a mere 6% of this total area. Although the Mississippi-Rideau Region works closely with their neighbouring source protection regions and City of Ottawa staff, the larger issue at play is the overall water quality, water quantity and ecological integrity of the Ottawa River.

Protecting the Ottawa River watershed is beyond the capacity and scope of the Mississippi-Rideau Source Protection Region or its Source Protection Authorities. An inter-jurisdictional committee needs to be formed that is empowered to protect the water quality and quantity, and ecological integrity of the Ottawa River through a watershed approach. The MOE has taken the lead and is working on establishing such a Committee.

1.5. Scope and Purpose of the Assessment Report

1.4.1. Scope of the Report

The scope of this assessment report is defined by the Terms of Reference developed by the Mississippi-Rideau Source Protection Committee. Its focus is on the 13 local municipal residential drinking water systems. Chapter 5 includes information about the general state of groundwater resources across the entire Mississippi-Rideau region. Future versions of the Assessment Report may include technical findings related to other public drinking water systems and/or clusters of private intakes or wells. These systems can only be included if added to the Terms of Reference through a municipal council resolution, or at the direction of the Ontario Minister of the Environment.

1.4.2. Purpose of the Report

The main purpose of the assessment report is to prioritize drinking water issues and threats within the vulnerable areas that are described in Chapters 5 and 6. This information will assist the community, led by the Mississippi-Rideau Source Protection Committee, to prepare the Source Protection Plan. Drinking water issues and threats that are prioritized in this document will be the main focus of discussion during the development of the Plan.

The report also serves as a summary of technical findings. For more detailed findings about a specific topic or location, please refer to the individual technical reports, each of which are listed in Appendix A1 and are held by the Mississippi Valley and Rideau Valley Conservation Authorities at their respective administrative offices (Lanark and Manotick). Copies of these technical reports are also available on CD (please see contact information on inside cover).

The report further serves as a list of topics that require additional research in the future. Chapter 8 identifies data gaps and topics that do not fit into the current scope of drinking water source protection under the Clean Water Act.

The *Clean Water Act* established minimum objectives for Assessment Reports. The following chart lists these objectives and where they are addressed in this report:

	Provincial Assessment Report Objectives	Addressed in Chapter:
1	Identify all the watersheds and subwatersheds in the source protection area	2
2	Characterize the quality and quantity of water in each watershed	2 & 3
3	Set out a water budget for each subwatershed, which describes how water enters and leaves the watershed and describes the groundwater and surface water flows in the watershed and how water is used	3
4	Identify all significant groundwater recharge areas and highly vulnerable *aquifers* that are in the source protection area	5
5	Identify all surface water intake protection zones and wellhead protection areas that are in the source protection area	5 & 6
6	Describe the drinking water issues relating to the quality and quantity of water in each of the vulnerable areas identified under clauses (d) and (e)	5 & 6
7	List *activities* that are or would be drinking water threats, and conditions that result from past *activities* and that are drinking water threats	4, 5 & 6
8	Identify the areas where an *activity* listed under clause (g) is or would be a significant drinking water threat, and the areas where a condition listed under clause (g) is a significant drinking water threat.	5 & 6
9	Review of available climate change information and ho it will affect the Assessment Report conclusions	7

1.4.3. Layout of the Report

This Assessment Report includes detailed local information in support of each of the above objectives. The ensuing chapters provide the details on each of these topics as required by the legislation, regulations and rules.

- Chapter 2 delineates the Mississippi Valley and Rideau Valley Source Protection Areas and provides the overview of the watersheds, the physiography, human geography, and interactions of humans on the landscape.
- Chapter 3 provides a Water Quality Stress assessment which is based on a synopsis of the water budget reports (conceptual and Tier 1).
- Chapter 4 provides an overview of the approach used to evaluate drinking water threats and issues.
- Chapter 5 focuses on groundwater. It defines vulnerable areas, groundwater sources of drinking water in the area, and high risk activities, issues and conditions which could contribute to groundwater contamination.
- Chapter 6 focuses on surface water. It defines vulnerable areas, surface water sources of drinking water in the area, and high risk activities, issues and conditions which could contribute to surface water contamination.
- Chapter 7 provides local thinking on adaptation to Climate Change.
- Chapter 8 identifies data gaps and future research needs.
- Chapter 9 is a summary of key findings that should be taken under consideration when formulating the source protection plan.

The Assessment Report comprises three volumes:

- Volume 1 is the text and tables
- Volume 2 is the book of maps for the Assessment Report
- Volume 3 is the appendices

1.6. Methods of Technical Work

The source protection program in Ontario is intended to be based on the best available science. The scientific methods used to carry out the technical work are laid out in Ontario Regulation 287/07 General, the *Technical Rules: Assessment Report* document, and related guidance materials. These documents were developed by the provincial government in consultation with scientists from various fields and representatives from stakeholder groups such as agriculture and industry. Similar methods are being used across Ontario, so that there is a reasonable degree of consistency. These documents are available on the MOE web site at http://www.ene.gov.on.ca/en/water/cleanwater/index.php

This Assessment Report includes findings from a large number of technical studies, all of which are listed in Appendix A1. The studies were completed under the supervision of technical working groups made up of source water staff, municipal staff, and others. In addition, all of the studies were completed in accordance with the Clean Water Act, its Regulations and the Technical Rules and most have been subject to peer review by a neutral third party who is qualified in the type of technical work. Additional information about specific technical methods is presented in many of the chapters.

Study findings were carefully reviewed by Conservation Authority staff and the Source Protection Committee. The Committee hosted 11 municipal and public open houses to share the draft findings with the community and seek feedback and local knowledge. The Committee then reviewed all public comments and modified or accepted the study findings for inclusion in this document.

1.7. Continuous Improvement

This report has been prepared using the best data and knowledge available at the time the technical studies were completed, and where possible, at the time of publication. Data gaps were identified and are described in Chapter 8 and are outlined in detail in Appendix 'X'. Assessment Reports will be reviewed and updated on a regular basis. The MOE will determine the review timeframe when they approve the report.

We encourage readers to contact staff at the Mississippi Valley or Rideau Valley Conservation Authorities to check for updated information when conducting research about a specific topic or location.

Appendices

Appendix A1 – List of Studies
Appendix A2 – SPC member biographies

Chapter 4 Table of Contents

4 Drinking Water Quality Threats and Issues Approach

This chapter provides an overview of the methodology and associated definitions which have been developed by the Province of Ontario's Ministry of the Environment (MOE) to identify drinking water quality issues and threats in all source protection regions. These processes are important components in the multi-barrier approach to protecting drinking water sources from contamination. The specific approaches or methods used to identify drinking water threats and issues in the MRSPR are also discussed in this chapter.

Sections 4.1 through 4.5 provide general information on methodology and section 4.6 discusses how the methodology has been used in the MRSPR.

The results of the processes are outlined in Chapters 5 and 6, wherein vulnerable areas are mapped and assigned scores, drinking water issues are listed, and counts of significant drinking water threats are provided. By assessing and ranking past, present and future activities that could harm the quality of source water, local communities can make informed decisions about how best to protect their water supplies for the future.

Further information on these processes may be found in technical studies listed in Appendix A1.

4.1 Delineating and Scoring Vulnerable Areas

Source protection technical work is focused on the identification and assessment of drinking water quality threats and issues affecting four different types of vulnerable areas, three of which are associated with groundwater and one with surface water.

The four different types of vulnerable areas are:

- **Wellhead Protection Area (WHPA)**: A WHPA is the area surrounding a municipal well where land use activities have the potential to affect the quality of water flowing into the well. The WHPA is divided into 4 or more zones representing different amounts of time it takes for water to travel to the well.

- **Significant Groundwater Recharge Area (SGRA):** A SGRA is the land area where rain or snow seeps down and recharges an aquifer. Recharge areas often have loose or permeable soil. A recharge area is considered significant when it supplies a large percentage of the water needed to maintain the water level in an aquifer which supplies a municipal, community, or private drinking water system.

- **Highly Vulnerable Aquifer (HVA)**: A HVA is an aquifer that, based on a number of factors, is very susceptible to contamination from the surface. The more easily water or other fluids can flow through the

ground to the aquifer, the more vulnerable the aquifer is to contamination. As specified by the Technical Rules HVAs generally define the first, or shallowest, aquifer. This may or may not represent the aquifer being used as a drinking water source.

- **Intake Protection Zone (IPZ)**: An IPZ is the area of land and water mainly upstream of a drinking water surface intake where land use activities have the potential to affect the quality of water flowing into the surface water intake. The IPZ is divided into 3 zones representing the amount of time it takes for water to travel to the water intake.

Specific descriptions of how each type of vulnerable area is delineated are included in Chapter 5 for groundwater and Chapter 6 for surface water.

4.2 Drinking Water Issues

A drinking water issue is a documented problem with the quality of the source water. The following information must be considered in order to identify issues:

- Issues must be identified at an intake, well, or monitoring well.
- For drinking water systems included in the Terms of Reference, issues can be identified for parameters in Schedules 1, 2 or 3 of the Ontario Drinking Water Quality Standard (ODWQS) or in Table 4 of the Technical Support Document. The parameter must be present at a concentration that may result in the deterioration of the quality of water for use as a source of drinking water or it must be shown that there is a trend of increasing concentrations of the parameter.
- For any other drinking water systems as defined under the Safe Drinking Water Act (SDWA), only chemical drinking water issues may be included (Schedules 2 and 3 of the ODWQS or Table 4 of the Technical Support Document).
- The definition of a drinking water system under the SDWA means any system that takes water for drinking water purposes. This includes any private well or intake.

It is not mandatory that every elevated parameter in the raw water be considered an issue. When identifying issues, it is necessary to consult with the operators of the system, and the municipality if they are not the operator, to determine if the raw water quality presents a problem for them. Elevated parameters are not considered to be an issue when they are known to be naturally occurring and do not present a problem for the water treatment plant operator.

For issues caused by human activities, the Assessment Report must include a plan to delineate the area contributing to an issue at the water treatment plant. Additional information about issue contributing areas is included in Section 4.4.1 below.

4.3 Drinking Water Threats

A drinking water threat is defined in the Ontario Clean Water Act, 2006 to be:

> "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 regulations as a drinking water threat" (Section 2(1)).

Land Use Activities

Section 1.1 of Ontario Regulation 287/07 (made under the Clean Water Act) lists 21 broad land use activities as '*prescribed drinking water threats*'. The 21 prescribed drinking water threats are listed below. Note that 19 of the 21 prescribed drinking water threats relate to water quality threats and 2 of them related to water quantity threats.

Prescribed Drinking Water Threat Category	
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the *Environmental Protection Act*.
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.
3	The application of agricultural source material to land.
4	The storage of agricultural source material.
5	The management of agricultural source material.
6	The application of non-agricultural source material to land.
7	The handling and storage of non-agricultural source material.
8	The application of commercial fertilizer to land.
9	The handling and storage of commercial fertilizer.
10	The application of pesticide to land.
11	The handling and storage of pesticide.
12	The application of road salt.
13	The handling and storage of road salt.
14	The storage of snow.
15	The handling and storage of fuel.
16	The handling and storage of a dense non-aqueous phase liquid (DNAPLs)*.
17	The handling and storage of an organic solvent.
18	The management of runoff that contains chemicals used in the de-icing of aircraft.
19	An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.**
20	An activity that reduces the recharge of an aquifer.**
21	The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard.
	*DNAPLs are chemicals that are heavy and sink in water (e.g. trichloroethylene)
	**Water quantity threats are evaluated as part of Water Budget studies

Conditions

Threats can also be identified if conditions relating to a past activity (e.g. a contaminated site) have resulted in:

- the presence of non-aqueous phase liquid in groundwater (i.e gasoline) in a highly vulnerable aquifer, significant groundwater recharge area or wellhead protection area;
- the presence of a single mass of 100 liters of one of more dense non-aqueous phase liquids in surface water in a surface water intake protection zone;
- the presence of a contaminant in groundwater in a highly vulnerable aquifer, significant groundwater recharge area or a wellhead protection area, if the contaminant is listed in Table 2 of the Soil, Ground Water and Sediment Standards and is present at a concentration that exceeds the potable groundwater standard set out for the contaminant in that Table;
- the presence of a contaminant in surface soil in a surface water intake protection zone if, the contaminant is listed in Table 4 of the Soil, Ground Water and Sediment Standards and is present at a concentration that exceeds the surface soil standard for industrial/commercial/community property use set out for the contaminant in that Table; and
- the presence of a contaminant in sediment, if the contaminant is listed in Table 1 of the Soil, Ground Water and Sediment Standards and is present at a concentration that exceeds the sediment standard set out for the contaminant in that Table.

4.4 Approaches for Identifying Drinking Water Threats

The MOE has ranked drinking water threats as being significant, moderate, low, or negligible. There are three possible approaches to identifying drinking water threats:

- the issues approach
- the event-based approach
- the vulnerability scoring/threats based approach.

4.4.1 The Issues Approach

Once a drinking water issue is identified (see Section 4.2 above), then any activities or conditions that may be causing that issue need to be identified. This is called the issues approach to identifying drinking water threats.

The first step is to delineate an issue-contributing area in the vicinity of the location at which the issue has been observed. The issue contributing area may be different than the vulnerable area (intake protection zone) around the drinking water system. In the second step, specific drinking water threats that could reasonably be expected to contribute to the issue are identified. All such threats are automatically classified as significant. For each issue identified in this Assessment Report, there is a plan through which issue-contributing areas and related drinking water threats will be identified in future editions of this document.

4.4.2 The Event-Based Approach

The event-based approach was designated to address threats to drinking water in systems drawing water from larger surface water bodies where the vulnerability scores are generally low. This approach is only applicable for surface water intakes in Lake Nipissing, Lake Simcoe, Lake St. Clair, and the Ottawa River. The approach allows the use of modelling to identify existing or future activities or existing conditions as significant drinking water threats if the modelling results indicate that there would be a drinking water issue at an intake if chemicals or pathogens were released from the location under an extreme event.

4.4.3 The Vulnerability Scoring/Threats Based Approach

In this approach, activities are compared against thousands of circumstances prescribed by the MOE.

The vulnerability scoring approach relies upon the extensive Tables of Drinking Water Threats (MOE, 2008a) (referred to as Threats Tables) that were created to identify and rank drinking water threats. A variety of circumstances are outlined in the Threats Tables for each of the 21 prescribed drinking water threats. The Threats Tables were created to provide a consistent approach to similar situations across Ontario.

The Threats Tables provide the list of circumstances where provincially prescribed activities are drinking water threats. These Threats Tables can be used to identify circumstances where activities are significant, moderate, or low drinking water threats and to identify areas where activities are significant, moderate, or low drinking water threats. To determine these circumstances and areas, it is necessary to understand how the Threats Tables were set up.

The Threats Tables link the hazard rating of an activity under a specific circumstance and for a specific source of water, and the vulnerability scores needed to make the activity/circumstance a significant, moderate, or low drinking water threat.

The risk score is determined through the use of the following equation;
R = V x HR

Where;
R is the Risk Score
V is Vulnerability of the source water (scale of 1 to 10)
HR is the Hazard Rating of the threat (scale of 1 to 10)

The risk score range is between 1 and 100. MOE has assigned the following ranges and associated drinking water threat classifications.

Risk Score Range	Drinking Water Threat Classification
80-100	Significant
60-<80	Moderate
>40 and <60	Low

*Note: Risk Scores below 40 are considered negligible and do not require further consideration.

The hazard ratings are not provided in the Threats Tables, but are available within the lookup table database that generated the Threats Tables. The chemical hazard ratings are determined by considering factors such as toxicity, environmental fate, quantity and method of release. The lookup table database has been provided to the MRSPR and is available upon request.

The vulnerability scores are calculated by taking the hazard rating for each activity and back calculating the vulnerability scores necessary for the activity to fall into the risk score ranges shown above.

The Threats Tables separate circumstances into chemical- and pathogen-based contaminants, and are outlined for each of the drinking water quality threats. The chemical contaminants have been identified into activities that could produce specific chemicals (such as arsenic or zinc), and have over 1,900 unique combinations of circumstances. The pathogen-based circumstances include the presence of any pathogen; and have approximately 30 unique combinations of circumstances.

The Threats Tables have been modified into summary tables for each type of vulnerable area and possible vulnerability score. The summary tables are provided via the following web link WEB LINK TO BE INSERTED HERE. The summary tables provide the required documentation of lists of potential circumstances that address the terminology "is or would be a significant, moderate or low drinking water threat". The summary tables have been organized by the MOE into 74 different tables, as presented in Table 4-1.

A drinking water threat can also be identified by the Source Protection Committee even if the activity is not included in the provincial list of 19 prescribed drinking water quality threats. This can only occur if a hazard assessment confirms that the activity is a threat, and this assessment is approved by the MOE.

4.5 Enumerating Drinking Water Threats

In preparing a source protection plan, it is useful to know the approximate number, location and specific details about drinking water threats. The minimum requirement for the preparation of this Assessment Report is the counting of the potential significant drinking water threats within intake protection zones and wellhead protection areas.

Table 4-2 indicates which of the 21 prescribed drinking water threats has one or more circumstances that pose a significant threat within a wellhead protection area for each vulnerability score. The table shows that the majority of threats must occur in areas with a vulnerability score of 10 to be classed as significant, only three can be significant in areas with a vulnerability score of 8.

Table 4-3 shows which of the 21 prescribed drinking water threats have circumstances that pose a significant threat within an intake protection zone for each vulnerability score. The table shows that the majority of threats must occur in areas with a vulnerability score of 9 or 10 to be classed as significant. Only two can be significant in areas with a vulnerability score of 8.

According to the Technical Rules, all highly vulnerable aquifers (HVA) and significant groundwater recharge areas (SGRA), outside of a WHPA and IPZ, have a vulnerability score of 6 or lower. Land use activities in these areas are categorized as low or moderate threats in the provincial threats tables. No activities can scored (or labeled) as significant threats within an HVA or SGRA.

4.6 Application of Provincial Threats and Issues Methodology in the Mississippi-Rideau Source Protection Region

This section provides information on how issues and potential threats have been identified in the MRSPR.

4.6.1 Issues

In the MRSPR, issues have been evaluated for the source water in each of the four vulnerable areas. The issues for each drinking water system were compiled based on the Mississippi-Rideau Watershed Characterization Report, the Annual Reports for each water-distribution system, the Engineer's Reports, raw water quality analyses and interviews with operators and managers. All data is compared against ODWS. Where there is sufficient data, the data is plotted, analyzed for trends and compared against ODWS as required in the Technical Rules.

The issues assessment was done for non-municipal drinking water sources as well as municipal drinking water sources. Non-municipal drinking water issues refer to issues that are associated with a private drinking water system (e.g., a private well) and the results are presented in Section 5.1.5 under Highly Vulnerable Aquifers.

4.6.2 Threats

Land Use Activity Inventory

An inventory of conditions and land use activities was completed within the vulnerable areas in the MRSPR. The inventory was only required within wellhead protection areas and intake protection zones where vulnerability scores are high enough to pose significant threats, not significant groundwater recharge areas or highly vulnerable aquifers. The inventory was completed via existing data review, windshield survey, general research, and agricultural assessment.

The land use inventory is based entirely on a review of publicly available information and field reconnaissance work completed from public right-of-ways. The limitations to this approach are that some activities may be taking place that were not inventoried, or an activity may be categorized as a threat because the specific circumstance (volume of a contaminant, method of storage, etc) is currently unknown. Since no specific site verification has been conducted, it is important to note that the current inventory identifies locations where potential significant threats to water quality exist.

The land use inventory included:

- Use of provincial database containing a list of standard land use activity names for categorizing activities.

- Collection and review of existing data (e.g., municipal and provincial records, air photographs)
- Windshield survey or visual inventory, taken from public right-of-ways.
- Agricultural assessment to identify potential agricultural land uses that may involve the handling and/or storage of chemicals of concern. This was done primarily by air photo interpretation and windshield survey.

During the land use inventory point locations of activities such as gasoline storage are identified and coordinates mapped as a point. Other activities such as sanitary sewer lines are identified as a line. Where a line crosses from one WHPA to another (i.e. from a Zone A to a Zone B) the line is considered to be two threats, one in each zone.

Activities which cover a larger area such as the application of agricultural materials on a field are identified as a polygon. A polygon is also used to group areas such as dense residential areas where there are likely a large number of septic systems. Therefore, it should be noted that under certain circumstances polygons may actually represent numerous potential threats but have been enumerated as one due to the lack of availability of specific data.

Threats Assessment

At this stage, each inventoried land use activity in the wellhead protection areas and intake protection zones was compared against the Threats Tables. Not all inventoried activities appear in the tables. Activities which matched were assigned their associated threat risk level.

In order to complete the threats assessment, some general assumptions were made to complete the enumeration of certain prescribed activities and circumstances. These assumptions were made according to local knowledge and professional judgement. In some cases, the assumptions will be refined at a later date, when site visits and contact with property owners occurs.

Conditions

In the MRSPR, the review of the MOE data provided indicated very few activities or conditions that had not already been identified through other exercises. The reporting requirements for spills and other contamination is relatively well legislated and regulated and as a result there are many sources for identifying even minor spills and leaks. However, the ensuing clean-up activities are not required to be as equally well documented. Therefore, the information on the current status of these potential conditions is not available.

It is important to note that it is possible that other circumstances exist in the vulnerable areas that cannot be identified through this exercise based on the limitations of the data available. If a spill or other contamination has not been reported through proper channels there is no way for this process to identify the condition.

4.7 Summary

Source protection technical work is focused on the identification and assessment of drinking water quality threats and issues affecting four different

types of vulnerable areas, three of which are associated with groundwater and one with surface water. The four types of vulnerable areas are WHPAs, HVAs, SGRAs, and IPZs.

A number of terms are defined.

1. Drinking water threats are land use activities which may adversely affect the quality or quantity of a source of drinking water and relate to the past, present and future.
2. Issues are defined as documented water quality problems.
3. Conditions are past land use activities which may pose a problem to water quality due to their nature.

The three possible approaches to identifying drinking water threats are;

- the issues approach
- the event-based approach
- the vulnerability scoring/threats based approach.

A combination of the three approaches has been used in the MRSPR.

Land use activities have been inventoried in vulnerable areas of the MRSPR and potential significant threats have been identified.

The provincial Technical Rules provide defined parameters for identifying threats and issues. In the MRSPR these rules have been applied utilizing the information available. Limitations and data gaps have been identified.

4.8 References

MOE. February 2010. Technical Bulletin: Threats Assessment and Issues Evaluation,

MOE. November 2009. Table of Drinking Water Threats, *Clean Water Act, 2006*, amended November 16, 2009

Conservation Ontario. November 2007. Wellhead Protection Areas.

Conservation Ontario. November 2007. Intake Protection Zones.

Table 4-1 Provincial Summary Tables

Provincial Table Number	Table Name	Table Title
1	CW10S	Chemicals in a WHPA with a vulnerability score of 10 where threats are significant
2	CW8S	Chemicals in a WHPA with a vulnerability score of 8 where threats are significant
3	CW10M	Chemicals in a WHPA with a vulnerability score of 10 where threats are moderate
4	CW8M	Chemicals in a WHPA with a vulnerability score of 8 where threats are moderate
5	CW6M	Chemicals in a WHPA with a vulnerability score of 6 where threats are moderate
6	CW10L	Chemicals in a WHPA with a vulnerability score of 10 where threats are low
7	CW8L	Chemicals in a WHPA with a vulnerability score of 8 where threats are low
8	CW6L	Chemicals in a WHPA with a vulnerability score of 6 where threats are low
9	DWAS	DNAPLS in WHPA A, B, C, C1, with any vulnerability where threats are significant
10	DW6M	DNAPLS in WHPA D with a vulnerability of 6 where threats are moderate
11	DW6L	DNAPLS in WHPA D with a vulnerability of 6 where threats are low
12	PW10S	Pathogens in WHPA A, B with a vulnerability of 10 where threats are significant
13	PW10M	Pathogens in WHPA A, B with a vulnerability of 10 where threats are moderate
14	PW8M	Pathogens in WHPA A, B with a vulnerability of 8 where threats are moderate
15	PW8L	Pathogens in WHPA A, B with a vulnerability of 8 where threats are low
16	PW6L	Pathogens in WHPA A, B with a vulnerability of 6 where threats are low
17	CSGRAHVA6M	Chemicals in an SGRA or HVA with a vulnerability score of 6 where threats are moderate
18	CSGRAHVA6L	Chemicals in an SGRA or HVA with a vulnerability score of 6 where threats are low
19	CIPZ10S	Chemicals in an IPZ with a vulnerability of 10 where threats are significant
20	CIPZWE9S	Chemicals in an IPZ or WHPA E where the vulnerability score is 9 where threats are significant
21	CIPZWE8.1S	Chemicals in an IPZ or WHPA E where the vulnerability score is 8.1 where threats are significant
22	CIPZWE8S	Chemicals in an IPZ or WHPA E where the vulnerability score is 8 where threats are significant
23	CIPZ10M	Chemicals in an IPZ with a vulnerability of 10 where threats are moderate
24	CIPZWE9M	Chemicals in an IPZ or WHPA E where the vulnerability score is 9 where threats are moderate
25	CIPZWE8.1M	Chemicals in an IPZ or WHPA E where the vulnerability score is 8.1 where threats are moderate
26	CIPZWE8M	Chemicals in an IPZ or WHPA E where the vulnerability score is 8 where threats are moderate
27	CIPZWE7.2M	Chemicals in an IPZ or WHPA E where the vulnerability score is 7.2 where threats are moderate
28	CIPZWE7M	Chemicals in an IPZ or WHPA E where the vulnerability score is 7 where threats are moderate
29	CIPZWE6.4M	Chemicals in an IPZ or WHPA E where the vulnerability score is 6.4 where threats are moderate
30	CIPZWE6.3M	Chemicals in an IPZ or WHPA E where the vulnerability score is 6.3 where threats are moderate
31	CIPZWE10L	Chemicals in an IPZ with a vulnerability of 10 where threats are low
32	CIPZWE9L	Chemicals in an IPZ or WHPA E where the vulnerability score is 9 where threats are low
33	CIPZWE8.1L	Chemicals in an IPZ or WHPA E where the vulnerability score is 8.1 where threats are low
34	CIPZWE8L	Chemicals in an IPZ or WHPA E where the vulnerability score is 8 where threats are low
35	CIPZWE7.2L	Chemicals in an IPZ or WHPA E where the vulnerability score is 7.2 where threats are low
36	CIPZWE7L	Chemicals in an IPZ or WHPA E where the vulnerability score is 7 where threats are low
37	CIPZWE6.4L	Chemicals in an IPZ or WHPA E where the vulnerability score is 6.4 where threats are low
38	CIPZWE6.3L	Chemicals in an IPZ or WHPA E where the vulnerability score is 6.3 where threats are low
39	CIPZWE5.6L	Chemicals in an IPZ or WHPA E where the vulnerability score is 5.6 where threats are low
40	CIPZWE5.4L	Chemicals in an IPZ or WHPA E where the vulnerability score is 5.4 where threats are low
41	CIPZWE4.9L	Chemicals in an IPZ or WHPA E where the vulnerability score is 4.9 where threats are low
42	CIPZWE4.8L	Chemicals in an IPZ or WHPA E where the vulnerability score is 4.8 where threats are low
43	CIPZWE4.5L	Chemicals in an IPZ or WHPA E where the vulnerability score is 4.5 where threats are low
44	CIPZWE4.2L	Chemicals in an IPZ or WHPA E where the vulnerability score is 4.2 where threats are low
45	PIPZ10S	Pathogens in an IPZ with a vulnerability of 10 where threats are significant
46	PIPZWE9S	Pathogens in an IPZ or WHPA E with a vulnerability of 9 where threats are significant
47	PIPZWE8.1S	Pathogens in an IPZ or WHPA E with a vulnerability of 8.1 where threats are significant
48	PIPZWE8S	Pathogens in an IPZ or WHPA E with a vulnerability of 8 where threats are significant

Provincial Table Number	Table Name	Table Title
49	PIPZWE10M	Pathogens in an IPZ with a vulnerability of 10 where threats are moderate
50	PIPZWE9M	Pathogens in an IPZ or WHPA E with a vulnerability of 9 where threats are moderate
51	PIPZWE8.1M	Pathogens in an IPZ or WHPA E with a vulnerability of 8.1 where threats are moderate
52	PIPZWE8M	Pathogens in an IPZ or WHPA E with a vulnerability of 8 where threats are moderate
53	PIPZWE7.2M	Pathogens in an IPZ or WHPA E with a vulnerability of 7.2 where threats are moderate
54	PIPZWE7M	Pathogens in an IPZ or WHPA E with a vulnerability of 7 where threats are moderate
55	PIPZWE6.4M	Pathogens in an IPZ or WHPA E with a vulnerability of 6.4 where threats are moderate
56	PIPZWE6.3M	Pathogens in an IPZ or WHPA E with a vulnerability of 6.3 where threats are moderate
57	PIPZ6M	Pathogens in an IPZ with a vulnerability of 6 where threats are moderate
58	PIPZ10L	Pathogens in an IPZ with a vulnerability of 10 where threats are low
59	PIPZWE9L	Pathogens in an IPZ or WHPA E with a vulnerability of 9 where threats are low
60	PIPZWE8.1L	Pathogens in an IPZ or WHPA E with a vulnerability of 8.1 where threats are low
61	PIPZWE8L	Pathogens in an IPZ or WHPA E with a vulnerability of 8 where threats are low
62	PIPZWE7.2L	Pathogens in an IPZ or WHPA E with a vulnerability of 7.2 where threats are low
63	PIPZWE7L	Pathogens in an IPZ or WHPA E with a vulnerability of 7 where threats are low
64	PIPZWE6.4L	Pathogens in an IPZ or WHPA E with a vulnerability of 6.4 where threats are low
65	PIPZWE6.3L	Pathogens in an IPZ or WHPA E with a vulnerability of 6.3 where threats are low
66	PIPZ6L	Pathogens in an IPZ with a vulnerability of 6 where threats are low
67	PIPZWE5.6L	Pathogens in an IPZ or WHPA E with a vulnerability of 5.6 where threats are low
68	PIPZWE5.4L	Pathogens in an IPZ or WHPA E with a vulnerability of 5.4 where threats are low
69	PIPZ5L	Pathogens in an IPZ with a vulnerability of 5 where threats are low
70	PIPZWE4.9L	Pathogens in an IPZ or WHPA E with a vulnerability of 4.9 where threats are low
71	PIPZWE4.8L	Pathogens in an IPZ or WHPA E with a vulnerability of 4.8 where threats are low
72	PIPZWE4.5L	Pathogens in an IPZ or WHPA E with a vulnerability of 4.5 where threats are low
73	PIPZWE4.2L	Pathogens in an IPZ or WHPA E with a vulnerability of 4.2 where threats are low
74	CIPZWE5L	Chemicals in an IPZ or WHPA E where the vulnerability score is 5 where threats are low

Table 4-2 Provincial Threat Categories with Circumstances That Could Pose a Significant Risk in an IPZ

		Intake Protection Zone (IPZ) Vulnerability Scoring							
	Contaminant released:	Chemical				Pathogen			
	Prescribed drinking water threat category	10	9	8+	7 to 1	10	9	8+	7 to 1
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the *Environmental Protection Act*.	✓	✓			✓	✓	✓	
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	✓	✓	✓		✓	✓	✓	
3	The application of agricultural source material to land.	✓	✓			✓	✓	✓	
4	The storage of agricultural source material.	✓	✓			✓	✓	✓	
5	The management of agricultural source material.								
6	The application of non-agricultural source material to land.	✓	✓			✓	✓	✓	
7	The handling and storage of non-agricultural source material.	✓	✓			✓	✓	✓	
8	The application of commercial fertilizer to land.	✓	✓						
9	The handling and storage of commercial fertilizer.	✓							
10	The application of pesticide to land.	✓	✓	✓					
11	The handling and storage of pesticide.	✓	✓						
12	The application of road salt.	✓	✓						
13	The handling and storage of road salt.	✓	✓						
14	The storage of snow.	✓	✓						
15	The handling and storage of fuel.	✓							
16	The handling and storage of a dense non-aqueous phase liquid (DNAPLS)*.	✓							
17	The handling and storage of an organic solvent.	✓							
18	The management of runoff that contains chemicals used in the de-icing of aircraft.	✓	✓						
19	An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.**								
20	An activity that reduces the recharge of an aquifer.**								
21	The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard.	✓	✓			✓	✓	✓	

*DNAPLs are chemicals that are heavy and sink in water (e.g. trichloroethylene)

**Water quantity threats will be evaluated as a part of the Water Budget studies

Table 4-3 Provincial Threat Categories with Circumstances That Could Pose a Significant Threat in a WHPA

		Wellhead Protection Area (WHPA) Vulnerability Scoring									
	Contaminant released:	Chemical					Pathogen				
	Prescribed Drinking Water Threats (Ontario Regulation 287/07)	10	8	6	4	2	10	8	6	4	2
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the *Environmental Protection Act*.	✓	✓				✓				
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	✓	✓				✓				
3	The application of agricultural source material to land.	✓					✓				
4	The storage of agricultural source material.	✓					✓				
5	The management of agricultural source material.										
6	The application of non-agricultural source material to land.	✓					✓				
7	The handling and storage of non-agricultural source material.	✓					✓				
8	The application of commercial fertilizer to land.	✓									
9	The handling and storage of commercial fertilizer.	✓									
10	The application of pesticide to land.	✓									
11	The handling and storage of pesticide.	✓									
12	The application of road salt.	✓									
13	The handling and storage of road salt.	✓									
14	The storage of snow.	✓									
15	The handling and storage of fuel.	✓									
16	The handling and storage of a dense non-aqueous phase liquid (DNAPLs)*.	Anywhere in 5 year time of travel									
17	The handling and storage of an organic solvent.	✓									
18	The management of runoff that contains chemicals used in the de-icing of aircraft.	✓									
19	An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.**										
20	An activity that reduces the recharge of an aquifer.**										
21	The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard.	✓					✓				

*DNAPLs are chemicals that are heavy and sink in water (e.g. trichloroethylene)

**Water quantity threats will be evaluated as a part of the Water Budget studies

Chapter 5 Table of Contents

5 Groundwater Sources

Following a brief review of MRSPR aquifers, this section provides information on methodologies used to identify areas where groundwater may be more susceptible to contamination. Groundwater issues and potential threats within the Mississippi-Rideau Source Protection Region (MRSPR) are identified as well as specific information on each of the municipal groundwater sources found in the region.

Further general information on aquifers is provided in Chapter 2 and further background information on threats and issues may be found in Chapter 4. Information on municipal surface water intakes in the region can be found in Chapter 6. A full list of supporting technical reports may be found in Appendix A1. More detailed information may be found in these reports.

5.1 Highly Vulnerable Aquifers

This section provides information on aquifers, including the delineation process used to determine vulnerability, and the process used to determine vulnerability scoring.

An aquifer is an underground layer of sand, gravel, or rock that contains enough water to supply a well. The amount of water available from various aquifers is dependent on size, depth, recharge rate, and a number of other factors. Regional-scale aquifers are very large aquifers with a span covering a large part (or all) of the region and potentially beyond. The following regional-scale aquifers have been identified in the MRSPR:

- An Upper Precambrian bedrock aquifer is located in the western portion of the region.
- Nepean Sandstone and Oxford-March bedrock aquifers are located in the central portion of the region.
- Sand and gravel aquifers are located along the eastern and northern portions of the region.

Different aquifers are used by different types of wells. For example, shallow aquifers (the 1st aquifer below the ground surface) are often used for private wells that do not require high volumes of water. Deeper aquifers may transmit more water, and are often used to supply municipal drinking water systems.

The shallow aquifers in the MRSPR are sand and gravel deposits, the Oxford and March Formations, and in the western part of the region, the upper Precambrian rock. The primary deep aquifer in the region is the Nepean Formation, although this is also a shallow aquifer in some areas.

5.1.1. What is a Highly Vulnerable Aquifer?

A highly vulnerable aquifer, or HVA, is an aquifer that is susceptible to contamination from sources at the surface. Factors that can affect an aquifer's vulnerability are:

- the depth from the ground surface to top of the aquifer
- the water table depth, if the aquifer is exposed at ground surface
- the type of soil and rock between the aquifer and the ground surface

The delineation of vulnerable aquifers in the MRSPR focused on the shallow aquifers, which is important for private well water supplies.

5.1.2. Methodology for Delineation

There are numerous methods available for assessing aquifer vulnerability. All of these methods use the geological properties of the aquifer and some also require estimations of the hydraulic properties of the aquifers.

HVAs in the MRSPR were delineated using the Ontario Ministry of the Environment (MOE) Intrinsic Susceptibility Index (ISI) protocol. This method was modified to address local conditions and is approved by MOE. The ISI approach assesses the vulnerability of the '1st aquifer', or the aquifer closest to the surface.

Areas with soils and rock which easily allow water to travel through them to the aquifer are considered to be highly vulnerable. Areas where soils such as clay or unfractured rock are present which do not allow easy movement of water are considered to be less vulnerable to contamination.

MOE ISI Process

Prepare Data

Water well records from the MOE water well database were analyzed to determine the aquifer depths and the thickness of each geologic unit (e.g. sand, gravel, and bedrock formations) It is recognized that some records may contain incorrect or incomplete coordinates for well locations, or vary in how the types of rock and soil are described. The reliability of the study results was improved by correcting obvious errors in the database, correcting well location coordinates, or screening out incorrect records altogether.

Map the Water Table

The water well record data was used to determine the 'depth to water', or water table level, at each well location. Using this information, the overall depth to water for the aquifer is modeled for the region.

Calculate Intrinsic Vulnerability Index

The properties of the soil and/or bedrock overlying the first aquifer were evaluated and assigned an ISI value to each well. Specifically, each soil or rock layer is evaluated in terms of its 'hydraulic conductivity' and associated 'K-factor' – that is, how easily water can travel vertically through it. The K-factor is assigned for each soil or rock layer from the ground surface down to where water is found in the well, and a resulting ISI value is calculated.

This process also allows the location and type of aquifers (confined, unconfined, or semi-confined) in the region to be mapped by comparing ISI and water depth information among wells. This information can provide a picture of the depth and extent of an aquifer.

Categorize Well Vulnerability

ISI results indicate the level of protection that an aquifer has from surface contamination. For example, low ISI results numbers indicate that the geologic materials which are above the aquifer provide little protection as they allow water to flow freely through them, as noted above, meaning the aquifer is very vulnerable. A high ISI number indicates that the aquifer has a large amount of protection and so is not very vulnerable as surface water cannot readily reach it.

Each area is categorized as 'High', 'Medium', or 'Low' vulnerability, based on the ISI value that was calculated in the previous step. ISI values less than 30 are high, values between 30 and 80 are medium, and values above 80 are low vulnerability.

Map Intrinsic Vulnerability Index Values

The calculated ISI values were mapped and regions of similar vulnerability were identified. Mathematical methods were used to find the best way to group the different ISI values from each well together. The end result is a map that shows the vulnerability of the aquifer across the entire region.

The ISI approach to determining aquifer vulnerability was originally intended by the MOE for use in assessing the vulnerability of unconfined aquifers, which are aquifers that are connected to the surface. However, many of the upper aquifers in the MRSPR are confined aquifers, which are aquifers that have an overlying layer that has low permeability such as a clay, a clay-till or a shaley bedrock.

The ISI approach was modified with permission from MOE to better suit the unique characteristics of the region. This modification was developed in consultation with MOE staff, and the study's technical advisory group. Documentation of the Provincial acceptance of this methodology is in Appendix E1.

The modification uses information about the types of rocks and soils found at the ground surface (called 'surficial geology') as an indicator of vulnerability. The geology of the MRSPR study area is unique in several ways:

- the bedrock of the Canadian Shield is at or very close to the ground surface for a significant part of the study area
- this rock is very fractured near surface, comprising a shallow aquifer
- significant deposits of sand and gravel are also present in the MRSPR

As a result, the modified the ISI approach mapped bare rock, rock covered with less than 1.5m of material (soil, glacial till, etc), or bedrock covered by sand or gravel and these were automatically classed as highly vulnerable. All other areas were assessed according to the described MOE ISI protocol.

The final step was to combine the results from the original ISI method with the modified ISI method to delineate the HVAs across the MRSPR. The ISI results were separated into three vulnerability categories, as required by the Technical Rules and are shown in Figure 5-1, MRSPR Aquifer Vulnerability.

Figure 5-2 shows a map of the final High Vulnerability Aquifers areas. All of the areas mapped as highly vulnerable were assigned a vulnerability score of 6 as shown in Figure 5-3. Approximately 90% of the region has been determined to fall under the HVA designation. Areas of low to moderate vulnerability are predominantly in flat lying areas which have clay or silt deposits as the surficial geology.

Uncertainty

HVA delineation relies on water well records from the MOE water well database. The reliability of the study results was improved by correcting obvious errors in the database; however, the accuracy of the remaining data still has uncertainty associated with it. Therefore, there is high uncertainty associated with HVA delineation at a local scale.

5.1.3. Managed Lands and Livestock Density

The percentage of managed lands and nutrient units are indicators of the degree of agricultural activity and other land management activities. In some cases the storage and application of pesticides, fertilizers, and other agricultural materials associated with agricultural activities may result in pathogen and chemical contamination of drinking water sources.

MRSPR studies on managed lands and livestock density have been completed in accordance with the MOE Technical Guidance Bulletin entitled "Proposed Methodology for Calculating Percentage of Managed Land and Livestock Density for Land Application of Agricultural Source of Material, Non-Agricultural Source of Material and Commercial Fertilizers" issued December 2009.

MOE lists a number of definitions for agricultural operations which fall under the Farm Unit. Below are a summary of definitions; more information may be found at http://www.ene.gov.on.ca/en/water/cleanwater/cwdocs/tbmanagedLandsAndLivestock.pdf.

Key Definitions

Managed lands are lands to which fertilizers and/or nutrient units are or may be applied. Managed lands can be broken into two subsets: agricultural managed land and non-agricultural managed land. A managed land includes, but is not limited to, cropland, fallow land, improved pasture, golf courses, sports fields, and lawns.

Livestock density is defined as the number of nutrient units over a given area.

A farm unit is the area where nutrients generated must be at least the size of the property deed, the generating facility, or all land receiving nutrients. It should include all facilities on other deeds owned by the same person if the nutrients generated there are used on the land of the first deed, and can consist of separate farm units if nutrients are applied to different land bases. The size of a farm unit depends on whether or not the unit generates nutrients. If the farm unit does not generate nutrients, it must be at least the size a single field where nutrients are applied.

Method for Calculating the Percentage of Managed Lands

Agricultural managed land includes areas of cropland, fallow, and improved pasture that may receive nutrients. Non-agricultural managed lands includes golf courses (turf), sports fields, lawns (turf) and other built-up grassed areas that may receive nutrients (primarily commercial fertilizer). The following method describes the calculation of each of these values.

The areas of agricultural and non-agricultural lands were determined using land assessment and Municipal Property Assessment Corporation property classifications. The areas were confirmed through analysis of satellite imagery.

The percentage of managed lands within groundwater vulnerable areas (HVA, SGRA or WHPA) was calculated by summing the total area of managed lands (both agricultural and non-agricultural) and dividing the result by the total land area (HVAs, SGRAs or WHPA).

The Province defined thresholds based on the area of managed lands in a vulnerable area to determine the risk of over-application of nutrients causing contamination of drinking water sources.

Table 5-1 lists the percentage of total managed lands for HVAs and SGRAs and the risk threshold associates with the over application of nutrients.

Risk Thresholds

Land Use	Risk
<40% of vulnerable area is managed lands	Low potential
40-80% of vulnerable area is managed lands	Moderate potential
>80% of vulnerable area is managed lands	High potential

Method for Calculating Livestock Density

Livestock Density is measured in Nutrient Units per acre (NU/ac) to estimate the generation, storage and application of nutrients from agricultural source material (ASM) in an area. The NU represents amount of manure and biosolids used to fertilize a Farm Unit either produced by animals on the farm or brought from the outside. A farm unit is a single field, the land base that generates nutrients or the land base that receives nutrients.

The calculation of livestock density within groundwater vulnerable areas (WHPA, HVA, SGRA) was based on the calculation of Nutrient Units per acre (NU/ac) of agricultural managed lands. Two values for livestock density were calculated. The first value is the Land Application of Nutrients, which represents the nutrient units applied to crops or turf. The second value reported is for livestock density associated with grazing or pasturing. This value was calculated using the estimated number of livestock in each farm unit or pasture area. The following method describes the calculation of each of these values.

Determine the number of animals on a farm unit and estimate how many of each type of animals (e.g. poultry – broiler, cattle - cow, or swine - sows) are present. Estimates of the number of animals on a farm were carried out based on building design and size.

Convert the number of each type of animals to nutrient units using nutrient unit conversion tables supplied by the Province.

Determine the area of managed lands that are within a vulnerable area (HVA, SGRA or WHPA – see below). For the purposes of estimating the NUs required for the estimation of livestock density in a farm unit, where a portion of a farm unit falls within a vulnerable area, the NUs generated on the entire parcel of land should be factored into the calculations rather than the NUs generated within the portion of land that falls within a vulnerable area.

Determine the area of land used for pasturing or grazing associated with each farm unit.

Calculate the livestock density for the application of nutrients to land by dividing the total number of nutrient units by the area of managed lands that are within a vulnerable area.

Calculate the livestock density for pasturing/grazing by dividing the total number of nutrient units by the area available for pasturing/grazing for each farm unit.

MOE defines thresholds in order to evaluate the risk of over-application of agriculturally sourced materials:

- If livestock density in the vulnerable area is less than 0.5 NU/acre, the area is considered to have a low potential for nutrient application exceeding crop requirements,
- If livestock density in the vulnerable areas is over 0.5 and less than 1.0 NU/acre, the area is considered to have a moderate potential for nutrient application exceeding crop requirements, and
- If livestock density in the vulnerable areas is over 1.0 NU/acre, the area is considered to have a high potential for nutrient application exceeding crop requirements.

Table 5-1 lists the livestock densities for HVAs and SGRAs and the risk threshold associates with the over-application of ASM. More information may be found in the MOE Technical Bulletin sited at the beginning of this Section.

Uncertainty

The uncertainty associated with regional mapping of managed lands and livestock density is high. The accuracy of regional data sets, including the estimation of livestock numbers, is unknown. Other factors including estimation of nutrient units produced from the livestock and regional land use data further increase the uncertainty of the estimation of percent managed lands and livestock density.

5.1.4. Impervious Surfaces

Impervious surfaces are primarily constructed surfaces such as roads and parking lots that are covered by impenetrable materials such as asphalt, concrete and stone. These materials are a barrier to groundwater infiltration. Impervious surfaces also generate more runoff during melt or storm events.

Road salt applied to roads and walkways for winter maintenance is regarded as a threat. Impervious surface area calculations are required to determine if road salt application in the vulnerable areas could be a drinking water threat.

Method for Calculating the Percentage of Impervious Surfaces

The Southern Ontario Land Resource Information System (SOLRIS) was the primary data source used to identify impervious surfaces. SOLRIS is a landscape-level inventory of natural, rural, and urban areas. For the areas without SOLRIS coverage, a combination of the Ontario Road Network (ORN), Ministry of Natural Resources (MNR) built-up areas and some digitized areas were used (e.g., Village boundaries).

Using GIS software, a 1000m x 1000m grid was created to cover the MRSPR. With permission from the MOE, the grid was then shifted so that one of the grid cell intersections overlapped the centroid (centre of mass) of the MRSPR. Appendix E1 provides information on the modifications. The use of one grid over the entire MRSPR was to eliminate grid overlap between the Mississippi and Rideau Source Protection Areas. The data sources listed above were then combined into one layer, impervious surfaces. For each grid cell, the amount of impervious surface areas is divided by the area of the cell to determine the percentage of impervious surfaces.

The percent impervious surfaces results for each grid within the HVA areas is shown on Figure 5-4. The results range from 0 to 99%. The application of road salt cannot be considered a significant threat in HVAs as they are assigned a vulnerability score of 6.

5.1.5. Drinking Water Threats and Issues

Since HVAs are assigned a vulnerability score of 6 in accordance with the Technical Rules, land use activities are categorized as low or moderate threats in the provincial threats tables. No activities can be scored (or labeled) as significant threats within an HVA.

Issues and Conditions

Possible drinking water issues were identified for non-municipal drinking water systems in the MRSPR. The location of each of the communities is shown in Figure 5-5, with insets providing more information on where issues have been identified within the community. The following non-municipal groundwater drinking water issues may affect some domestic and private wells in those communities. Each of these issues is discussed in more detail below and summarized in Table 5-2.

Beckwith (Former Landfill)

Documented presence of contaminant parameters associated with chlorinated solvents in groundwater in the Township of Beckwith has been attributed to a former private landfill (also referred to as the Levine property) located near Black's Corners. Groundwater investigations in the area have been conducted since 1999 and have identified compounds including benzene and chlorinated solvent parameters (trichloroethylene and its associated degradation products, 1,1-dichloroethene, cis- and trans-1,2-dichloroethene and vinyl chloride).

The studies indicated the presence of chlorinated solvent parameters in some private wells, with some concentrations in excess of ODWS criteria. Of the 76 wells sampled 7 exceeded the ODWS for trichloroethylene (50 µg/L), 11 exceeded for vinyl chloride (2.0 µg/L) and 2 exceeded for 1,1 dichloroethene (14 µg/L).

As a result of the water quality sampling program residences with impacted wells have been provided with bottled water and/or granular activated carbon (GAC) treatment systems. The elevated concentrations of chlorinated solvent

parameters in drinking water are considered to represent an anthropogenic (human-caused) drinking water issue for the purposes of this evaluation.

Cranberry Estates
Since 1984, multiple studies have been performed in the subdivision located immediately west of Kemptville. These studies showed between 32 and 83% of private wells contained coliform bacteria (including 10% of wells with E. *coli*) and between 10 and 20% of homes had nitrate concentrations above the ODWS (10 mg/L as N). The elevated concentrations of nitrate and bacteria are likely attributed to septic loading, and are considered to represent anthropogenic drinking water issues for the purposes of this evaluation.

Crotch Lake Area
Crotch Lake is located in North Frontenac County, north of Coxvale and south of Ompah. Mississippi Valley Conservation sampled 98 wells in the Crotch Lake area in order to measure the concentration of uranium in groundwater for the region. The mean concentration was 11 µg/L, with a maximum of 170 µg/L. Of the samples collected, 12 samples exceeded the ODWS for uranium (0.2 µg/L). Of these samples, 2 exceeded the ODWS by 500% and 6 wells exceeded the ODWS by 50%.

The elevated uranium are interpreted to be naturally occurring, a result of the aquifer geology. Elevated concentrations of uranium in drinking water may present a health-related risk, and are considered to occur relatively infrequently. Thus, the elevated concentrations of uranium are considered to represent a naturally occurring drinking water issue for the purposes of this evaluation.

Village of Constance Bay
The Village of Constance Bay is located in the north-western portion of the City of Ottawa, adjacent to the Ottawa River. Land use in the Village is predominantly residential, with most residences located along Bayview Drive and within a central residential area. A groundwater study for the Village of Constance Bay was completed during the summer of 2005. The study involved the sampling of 69 water wells at selected residential properties, with an attempt to obtain a valid cross section of data.

Significant nitrate concentrations were detected at an average concentration of 5.2 mg/L with 19% of the samples exceeding the Ontario Drinking Water Standards (ODWS) of 10 mg/L as N. These nitrate concentrations appear to be a result of the septic loading within the Village of Constance Bay, and are considered to represent an anthropogenic drinking water issue for the purposes of this evaluation.

Village of Lanark
The Village of Lanark (now part of the Township of Lanark Highlands) is located along the Clyde River. All properties in the community are serviced by private wells and septic systems. Multiple well sampling programs have shown that between 17 and 51% of residential wells contained coliform bacteria and approximately 17% of the wells contained nitrate concentrations above the ODWS upper level of 10 mg/L.

The elevated concentrations of nitrate and bacteriological parameters are considered to represent anthropogenic drinking water issues for the purposes of this evaluation. These issues are, at least in part, likely attributed to the relatively high density of septic systems in the area.

Uncertainty

Information regarding contaminated sites in Ontario is not always available to the public until after the filing of a Record of Site Condition, which occurs following the completion of assessment and clean-up work. In other cases, historic groundwater contaminant plumes may exist, but have not been identified by any testing/assessment activities. Therefore, it is expected that there are additional areas of groundwater contamination within the region that have not been identified by this evaluation.

Review of other known current or former landfill sites within the region (for which information was available) did not indicate the presence of conditions that qualify as drinking water issues within the context of this evaluation (including the Trail Road Landfill, Nepean Landfill, Carp Landfill and former March Landfill).

Communications with Ottawa MOE staff indicated that trichloroethylene has been detected in wells in the Carleton Place area within an industrial park. Documentation regarding the site was not available for review, but it is understood that elevated trichloroethylene concentrations (above ODWS) affect only a very limited number of wells. Thus, the Carleton Place Industrial Park likely does not represent a widespread drinking water issue for the purposes of this evaluation.

5.2 Significant Groundwater Recharge Areas

Groundwater recharge is the process by which water moves from the ground surface to the water table, or aquifer. This section provides information on areas which have been determined to be Significant Groundwater Recharge Areas.

5.2.1. What are Significant Groundwater Recharge Areas?

A significant groundwater recharge area, or SGRA, is an area where a relatively significant amount of water recharges from the ground surface to an aquifer. SGRAs represent important areas for groundwater to recharge the water table. These areas are not necessarily associated with individual aquifers, but are thought to be areas where groundwater recharge is important at a regional scale.

5.2.2. Methodology for Delineation

The Technical Rules outline two acceptable methods for delineating SGRAs.

Method 1 identifies SGRAs as areas where annual groundwater recharge is 1.15 times greater than average annual groundwater recharge.

Method 2 identifies SGRAs as areas where annual groundwater recharge is greater than 55% of the average regional water surplus.

Method 1 is typically applied in areas where the ground cover (geology, vegetation, etc.) are similar throughout the Source Protection Area/Region. Method 2 is more applicable to areas with a wide range of ground cover, which is the case for the MRSPR. Therefore, Method 2 was used to delineate SGRAs in MRSPR. The data used to carry out these calculations was obtained from the Tier 1 Water Budget and Stress Assessment (Chapter 3). The methodology to delineate SGRAs is listed below.

Determine Annual Water Surplus

Annual water surplus is an estimate of how much water is available for runoff and recharge to underlying aquifers. It is based on precipitation (rain or snow) and evapotranspiration values. Evapotranspiration is the water lost from the ground surface to the air by evaporation and transpiration (water used by plants). Evapotranspiration and precipitation are outputs from the water budget study.

Using these datasets, experts calculated water surplus, where:

Water Surplus = (Precipitation – Evapotranspiration)

Determine Groundwater Recharge

Groundwater recharge is an estimate of how much water travels from the ground surface to become groundwater. This calculation uses the water surplus and considers soil type, surface slope and vegetation cover to calculate the annual groundwater recharge. Calculations were performed on 25 m × 25 m area (or cell) to reflect the variability of groundwater recharge in the region.

Groundwater recharge was determined as part of the water budget study.

Identify Preliminary SGRAs

At this stage, Method 2 was used to identify areas that may be SGRAs. Method 2 compares water surplus values to groundwater infiltration values on a cell-by-cell basis. A cell where groundwater infiltration is greater than 55% of the average regional water surplus could be a SGRA. The average water surplus value for the MRSPR was calculated (as part of the water budget) as 346 mm/yr. So, any cell where infiltration is greater than 190 mm/yr (346 x 0.55 = 190) is identified by Method 2 as a preliminary SGRA (Figure 5-6).

Refine Preliminary SGRAs

The next step is to refine the preliminary SGRA areas that were identified by the MOE Method 2 according to local conditions and professional judgment related to the following items.

Size

The initial output from the Method 2 approach shows a ‘paint splatter’ effect, because all cells that meet the criteria are selected.

The first refinement was to filter out single cells from consideration - any cell not adjacent to another SGRA cell was excluded.

The second set of refinements is based on the total size of adjacent SGRAs. Five different threshold values were examined: areas > 1, 10, 25, 50, and 100 hectares.

Sand and Gravel deposits

Experts compared surface deposits of sand and gravel (as mapped in regional geology data) against the areas identified as preliminary SGRAs. Since sand and gravel deposits on the surface can transmit surface water quickly to the groundwater, they are generally accepted to be important recharge areas.

The comparison revealed that the preliminary SGRAs greater than 25 ha correlate with the location of the sand and gravel deposits. As a result, the SGRAs with an area greater than 25 ha were used as a basis for further refinements shown in Figure 5-7.

Eskers

Eskers in the region are composed of sand and gravel. Eskers have been identified as important groundwater features. Some of the esker areas have steep slopes and were not identified by Method 2 as a SGRA. Given the importance of eskers in the region, all above ground eskers as mapped by the Ontario Geologic Survey were identified as SGRAs, and included in Figure 5-8.

Nepean Formation

In the MRSPR, the Nepean Formation sandstone aquifer is the primary aquifer for municipal water supply. The Nepean Formation was the only aquifer considered to be an SGRA because of the regional importance of the aquifer. In several locations in the MRSPR (and specifically along the edge of the Canadian Shield), the Nepean Formation comes to the ground surface (called 'outcropping'). Since these outcrop areas provide a direct pathway to the aquifer they were identified as SGRAs, and included in Figure 5-8.

Determine Connectivity to Groundwater or Surface Water Supplies

The geology in the region is complicated by numerous soil types, discontinuous bedrock units, and large bedrock faults. Because of the numerous private bedrock wells and abundance of lakes and wetlands in the region, all of the SGRAs which were reviewed were assumed to be connected to a groundwater or surface water supply.

5.2.3. Delineation of Significant Groundwater Recharge Areas

The next step was to determine a vulnerability score for the SGRAs in accordance with the technical rules. For SGRAs, the scoring process depends on the vulnerability of the aquifer. Aquifer vulnerability for the MRSPR was completed following the methods outlined in Section 5.1.2 and the vulnerability scoring was carried out using the values listed below as outlined by the Technical Rules.

Vulnerability Category	Vulnerability Score
LOW	2
MEDIUM	4
HIGH	6

For SGRAs, the scoring process depends on the vulnerability of the aquifer that was shown in Figure 5-1. The vulnerability scores from the HVA mapping were overlaid by the final SGRA map, Figure 5-8 in order to produce the final SGRA vulnerability map, shown in Figure 5-9. SGRAs account for 13.2% of the MRSPR.

Uncertainty

The calculations used to develop the final SGRA map were carried out at a regional scale using hydrologic, geologic, and land cover data sets that contain uncertainty, therefore there is uncertainty in the hydrologic data, geologic mapping and the final delineation of the SGRAs. The final SGRA map should be used with caution as there is high uncertainty at a local scale.

5.2.4. Managed Lands and Livestock Density

Section 5.1.3 describes the analyses used to delineate managed lands and calculate livestock densities. Percent managed land and livestock density calculations are only carried out for areas where the vulnerability score is greater than or equal to 6. Vulnerability scores were calculated for the MRSPR following the method outlined in Section 5.1.2. SGRAs were overlaid on the regional vulnerability score map to determine the SGRAs that had a vulnerability score of 6.

Table 5-1 lists the percentage of total managed lands for SGRAs and the livestock density and the risk threshold associated with the over application of nutrients and agricultural source material (ASM).

Uncertainty

The uncertainty associated with regional mapping of managed lands and livestock density is high. The accuracy of regional data sets, including the estimation of livestock numbers, is unknown. Other factors including estimation of nutrient units produced from the livestock and regional land use data further increase the uncertainty of the estimation of percent managed lands and livestock density.

5.2.5. Impervious Surfaces

Impervious surfaces are primarily constructed surfaces such as roads and parking lots that are covered by impenetrable materials such as asphalt, concrete and stone. These materials are a barrier to groundwater infiltration. Impervious surfaces also generate more runoff during melt or storm events.

Road salt applied to roads and walkways for winter maintenance is regarded as a threat. Impervious surface area calculations are required to determine if road salt application in the SGRAs could be a drinking water threat.

For information on methodology for determining percentage of impervious surfaces please see section 5.1.4 Impervious Surfaces.

The percent impervious surfaces results for each grid within the SGRAs are shown on Figure 5-10. The results range from 0 to 97%. The application of road salt cannot be a significant threat in SGRAs as under the Technical Rules they are assigned a maximum vulnerability score of 6.

5.2.6. Drinking Water Threats

Since the vulnerability scores for SGRAs range from 2 to 6, land use activities are categorized as low or moderate threats in the provincial threats tables. No activities can be scored (or labeled) as significant threats within an SGRA.

5.2.7. Issues and Conditions

There are no issues and conditions identified specifically for SGRAs. Possible drinking water issues are discussed for non-municipal groundwater drinking water systems in highly vulnerable aquifers in Section 5.1.6.

5.3 Wellhead Protection Areas

This section provides information on Wellhead Protection Areas, called WHPAs, and how they are delineated. Sections 5.5 – 5.12 discuss specific results for each of the MRSPR municipalities that depend on groundwater.

5.3.1. What is a Wellhead Protection Area?

A WHPA is the surface projection of the area of an aquifer that contributes water to an aquifer, and within this area it is desirable to monitor or regulate drinking water threats. WHPA studies aim to provide an understanding of local groundwater conditions and potential sources of contamination surrounding a well or well field that supplies a public water system.

The WHPA zones are outlined in the Technical Rules. Zones B, C and D are delineated by time of travel. Time of travel is the distance groundwater travels to the wellhead for a 2, 5 or 25-year time period. These distances are determined using numerical groundwater models. The delineation of a capture zone does not automatically imply that a contaminant, spilled or released at surface, would reach the water supply well within the specified time of travel. Depending on the characteristics of the aquifer, on the nature of the contaminant and on various transport processes, travel times from the point of contaminant release within the capture zones may be considerably shorter or longer, or the contaminant may never reach the pumping well.

The term GUDI is used for wells where the groundwater that is entering the well is under direct influence of surface water. A review of available records from municipalities and engineers' reports show that no municipal groundwater systems in the MRSPR were GUDI wells. Therefore, WHPA Zones E and F were not considered in the WHPA analyses.

WHPA Descriptions

WHPA Zone	Description
Zone A	100 m radius from the wellhead
Zone B	2-year time of travel to the wellhead
Zone C	5-year time of travel to the wellhead
Zone D	25-year time of travel to the wellhead
Zones E & F	Protection areas for the wellhead of a GUDI well

Collection of data and information

Geological and hydrological data was collected from groundwater technical studies, and from Federal, Provincial, and Municipal sources. One of the most important data sources was the Water Well Information System, a database of current and historic well records for Ontario, maintained by MOE. Another key data set was "golden spikes". Golden spikes are single high quality borehole

logs and water level data, which may be associated with a Provincial or Federal database.

Development of a conceptual (theoretical) model

Once data was collected, it was used to develop a general understanding of the local groundwater system, known as a conceptual model. The conceptual model is a representation of the local physical environment showing how water behaves above and below ground. It requires knowledge of geology, how rainfall makes its way beneath the surface (infiltration), and an understanding of the location, depth, and flow direction of water in the aquifer. Figure 5-11 shows a generic conceptual cross-section; specific conceptual cross-sections were created for each WHPA using site specific data. These cross-sections are useful in creating an understanding of the conceptual mode. An independent third party peer review occurred at this stage to ensure the conceptual model for each WHPA was accepted by other groundwater experts.

Selection, development, and calibration of a numerical model

A numerical model is a set of mathematical equations, usually held within a computer program, that represent how water behaves in the physical environment (or hydrogeological system). Using the conceptual model for each WHPA, a numerical model was developed to best represent the hydrogeological system associated with each wellhead. The model was calibrated by adjusting model parameters so that results were consistent with observations (e.g. known well water levels). Often it is impossible to identify a single value for an input parameter, so a range of reasonable values are identified. Using a range of values means a calibrated model run can result in different but equally valid results. This is often called a 'sensitivity analysis'.

5.3.2. Delineation of the Wellhead Protection Areas

For each WHPA, the numerical model determined the speed water travels in the aquifer towards the wells by using a variety of inputs, including municipal water demand values. This information was used to determine WHPA time of travel intervals as discussed above. Since each model had more than one reasonable output (resulting from a range of values for some parameters), the final WHPAs for the shallow and deep aquifers are the combinations, or outer boundaries, of all valid model runs.

Uncertainty

The sensitivity analysis for the numerical model made reasonable adjustments to the aquifer parameters and model assumptions to determine what the WHPA zones would look like if the model parameters were slightly different. The results of each of the additional computer simulations were plotted on a map. The area where the results from the these additional computer simulations over-lapped for the 2 years, 5 years, and 25 years time of travel was used to delineate the final WHPA-B, WHPA-C, and WHPA-D, zones respectively. The approach to determine uncertainly was to give low uncertainty to all areas within the 5 year time of travel line (including WHPA-A, WHPA-B and WHPA-C) and to give high uncertainty to all areas beyond this area (WHPA-D).

The final (composite) capture zones are considered to provide a greater degree of protection around the supply wells than would be achieved by using the results from a single model simulation.

5.4 Wellhead Protection Areas in the Mississippi-Rideau Source Protection Region

As discussed in Chapter 2, there are 7 municipal drinking water protection systems in the MRSPR;

- Almonte (Mississippi Mills)
- Carp
- Carleton Place
- Merrickville
- Munster
- Richmond (King's Park)
- Westport

Each of the systems and the surrounding areas is discussed below. There is an explanation of the approach for each in determining the proposed wellhead protection areas and maps of each may be found in the associated figures. Vulnerability scores are discussed and threats for each wellhead are identified.

The Township of Lanark Highlands is currently seeking construction funding and working on the design of a new municipal groundwater-based drinking water system for the Village of Lanark in Lanark County. This planned system has been studied in accordance with the environmental assessment process and is included in the Approved Terms of Reference for the Mississippi Valley Source Protection Area. It is expected that this system, along with associated vulnerability studies and WHPAs, will be included in updated versions of the assessment report.

5.5 Almonte Water Supply

Almonte, in the Town of Mississippi Mills, obtains water from five drilled wells (Wells 3, 5, 6, 7 and 8). The wells are drilled to depths between 39 and 79 m below ground surface. The wells obtain water from the following bedrock formations: Oxford, March and Nepean. Additionally, Well 6 is completed 2 m into the Precambrian bedrock. The groundwater system supplies approximately 4,700 people.

The local geology in the Almonte area consists primarily of silt to clay till and marine deposits and ranges in thickness from 0 to 25 m. The sequence of sedimentary rocks underlying Almonte (from oldest/deepest to youngest/shallowest) is Nepean Formation (sandstone), March Formation (sandstone/dolostone), and the Oxford Formation (limestone/dolostone). There are numerous bedrock faults in the Almonte area, which complicate the regional hydrogeology.

The municipal drinking water system in Almonte is operated by the Ontario Clean Water Agency (OCWA). The Almonte source water quality, on isolated occasions, exceeded guidelines in hardness, organic nitrogen, TDS, turbidity, aluminum and sodium. Elevated turbidity at Well 6 has been documented during pumping, especially during high demand. Sodium concentrations are consistently above 20 mg/L, which is the advisory limit set by the MOE above which the operator must notify the MOE and the Health Unit to protect patients on sodium-reduced diets. Sodium does not exceed a benchmark, nor does it

have human health effects except in a smaller number of cases that are considered in the advisory limit.

5.5.1 Almonte Wellhead Protection Area Delineation

A cross-section for the WHPA conceptual model is shown in Figure 5-12. On the east side of the Mississippi River, wells 3, 7 and 8 pass through the shallow aquifer rock formations before reaching the deep Nepean sandstone aquifer. On the west side of the Mississippi River, Well 5 passes through a thin layer of soil before reaching the Nepean aquifer. Well 6 travels through soil and the Oxford/March formation before reaching the Nepean aquifer. Groundwater studies show the upper bedrock and overburden units do not contribute a significant amount of water to the Almonte wells. The underlying Nepean Formation aquifer is the primary aquifer for the wells. Therefore, only the deep groundwater system (Nepean Formation aquifer) is considered for this WHPA. An independent third party peer review ensured the approach was accepted by other groundwater experts.

Regional groundwater flow direction in the Nepean aquifer is typically from west to east. In Almonte, however, the Mississippi River affects the local groundwater flow direction. On the east side of the river, the Nepean aquifer flows from east to west, so groundwater flow is towards the river from both the east and west sides.

The numerical model calculated WHPA zones A through D for the Almonte system. Figure 5-13 shows the Almonte aquifer wellhead protection area zones around the municipal wellheads. They are made up of a 100m buffer around the wellheads and the 2, 5, and 25 year times of travel.

Due to geographic location and groundwater flow regimes for the five separate wells, two distinct WHPA have been established for Almonte (as shown in Figure 5-13). The WHPAs are located on either side of the Mississippi River. Wells 3, 7, and 8 are located in the northeast WHPA and Wells 5 and 6 are located in the southwest WHPA.

Section 5.3.9 discusses sensitivity analysis in WHPAs. The zones of high and low uncertainty are shown in Figure 5-14.

5.5.2 Aquifer Vulnerability in the Almonte Wellhead Protection Area

Once the WHPA is delineated, the aquifer vulnerability is determined using the Intrinsic Susceptibility Index or ISI as shown in Section 5.1.2. Briefly, the ISI looks at the thickness and types of soil and rock layers above the aquifer, and how easily water can pass through these layers. The Technical Rules outline the process for categorizing the ISI results into aquifer vulnerability (Low, Medium or High) for the areas within the WHPA zones. Figure 5-15 shows the results of the aquifer vulnerability determination.

Under the Technical Rules, the presence of transport pathways within a WHPA can increase the intrinsic vulnerability. An area with low vulnerability can increase to medium, and an area with medium vulnerability can increase to high. Areas that are already high cannot be increased. The presence of water wells, pits and quarries, mines, construction activities, sewer services, septic systems and stormwater infiltration was examined in the WHPA.

As shown in Figure 5-15, four areas were identified where transport pathways increase the risk to the Nepean aquifer. Two of the areas are bedrock quarries located on the east side of the Mississippi River, close to the limit of the 25

year time of travel zone. In both areas, the aquifer vulnerability was increased from low to medium.

The other two areas (sewage lagoons and a sand/gravel pit) where transport pathways increase the risk to the Nepean aquifer are located on the west side of the Mississippi River. The sewage lagoons are located just west of Wolf Grove Road and the sand/gravel pit is located north of the intersection of Old Perth Road and Concession 8. For the sewage lagoons, the vulnerability was increased from low to medium for those portions of the lagoons which are currently classified as low.

5.5.3 Vulnerability Scoring in the Almonte Wellhead Protection Area

The Technical Rules set out a process for scoring vulnerability within a WHPA. It is based on the combination of aquifer vulnerability and overlapping WHPA zones. The more vulnerable the aquifer and the closer you are to the well, the higher the vulnerability score.

Table 5-3 shows the scoring system laid out in the provincial Technical Rules. Possible vulnerability scores are 2, 4, 6, 8, and 10. A score of 10 is highest, indicating an area where drinking water is most vulnerable to contamination. These categories were used to assign vulnerability scores to the areas within the WHPA in Figure 5-16. Figure 5-17 shows a close-up of the vulnerability scoring.

On the east side of the Mississippi River, the aquifer vulnerability is all low, except for two small areas which have been increased to medium due to transport pathways. On this side of the river, the Nepean aquifer is well protected by a relatively thick bedrock layer consisting of shale/limestone/sandstone. On the west side of the Mississippi River, the aquifer vulnerability varies from low to high due the fact that the Nepean aquifer is protected by a relatively thin bedrock or soil layer.

5.5.4 Managed Lands and Livestock Density

Percent managed land and livestock density calculations were carried out according to the methods outlined in Section 5.1.3. Figure 5-18 shows the managed lands and the livestock density in the WHPA zones. The percent managed lands and average livestock densities for each zone are listed in Table 5-4. Note some zones in these tables have two results because the calculation was carried out for each vulnerability score in each WHPA Zone. Also shown in the table is the risk threshold for the over application of nutrients to land and the risk threshold for the over application of ASM to land.

The data for the managed lands evaluation was based on property assessment data and refined using satellite imagery. Site activity, including the level of nutrient application, was not known. Livestock numbers were based on building size from satellite imagery and the number of nutrient units produced by barns was estimated on barn size and estimated livestock type. Overall, the uncertainty associated with the estimation of percent managed lands and livestock density is high.

5.5.5 Impervious Surfaces

Impervious surfaces are primarily constructed surfaces such as roads and parking lots that are covered by impenetrable materials such as asphalt, concrete and stone. These materials are a barrier to groundwater infiltration. Impervious surfaces also generate more runoff during melt or storm events.

Road salt applied to roads and walkways for winter maintenance is regarded as a potential threat. Impervious surface area calculations are required to determine if road salt application in the vulnerable areas could be a drinking water threat.

For information on methodology for determining percentage of impervious surfaces please see section 5.1.4 Impervious Surfaces.

The percent impervious surfaces results for each grid within the Almonte vulnerable aquifer areas is shown on Figure 5-19. The results range from 0 to 77%.

5.5.6 Potential Water Quality Threats in the Almonte Wellhead Protection Area

Water quality threats are existing conditions (e.g. contaminated sediment, soil or groundwater) or existing or future land use activities that could contaminate a drinking water supply. A land use inventory of the Almonte WHPA was completed in 2008.

It should be noted that a single land use activity could fall into multiple threat categories. For example, a crop farm could be practicing storage of fuel, application of commercial fertilizer to land, and application of agricultural source material to land. Each of these activities is a separate threat category in the provincial table, and so each is therefore a separate threat.

Land use activities and associated threats that occur where the vulnerability score is high may result in determining it to be a significant threat. In many cases, the specific circumstances that apply to a threat category are unknown. Using the same example, a crop farm may practice fuel storage, but the volume of fuel stored is unknown. Unless additional information was available, it was assumed that enough material was stored for that activity to be a significant threat.

A total of 29 potentially significant drinking water threats were identified in the Almonte WHPA. For WHPAs, significant threats are where the vulnerability score is 8 or 10, or if the activity pertains to dense non-aqueous phase liquids (DNAPLs), anywhere within the 5-year WHPA Zone C. The areas with potential significant drinking water threats are summarized in Table 5-5. The term “Poly” in the table refers to a polygon, or an area that may contain multiple threats. The term “Point” in the table refers to a point source. Figure 5-20 shows the areas containing potential significant threats in purple and outlines the areas containing potential DNAPL threats in blue. Please see section 4.3.3 for information on the full list of significant, moderate, and low threats.

Transportation Corridors

A number of transportation corridors exist within the Almonte WHPA where there may be the transportation of dangerous and/or hazardous goods and the potential for a spill exists. Spills within the WHPA have the potential to impair the groundwater quality however they are not included as threats as per the prescribed drinking water threats categories (see Section 4-3).

This Assessment Report provides this key information for municipalities and other agencies to assist in ensuring all available information is accessible for

emergency response planning purposes. Transportation corridors can be found on all WHPA maps including the Almonte WHPA map in Figure 5-13.

5.5.7 Issues and Conditions

Issues are documented cases of water quality contamination approaching or exceeding acceptable provincial levels. No issues were identified in the Almonte WHPA.

As discussed in Chapter 4 a condition is a situation where past activities resulted in a drinking water threat. Potential conditions in the Almonte WHPA are the sewage lagoons located 200 m from Well 5. Groundwater samples from monitoring wells in the immediate vicinity of the sewage lagoons showed groundwater from one monitoring well exceeded the Ontario Drinking Water Standards for chloride, E.*coli* and total coliforms. Although there is no impact to Well 5, groundwater chloride and bacteria concentrations represent possible migration of the contents of the sewage lagoon.

5.6 Carp Water Supply

The Village of Carp obtains its drinking water from two municipal wells that draw water from a sand and gravel aquifer. The wells are drilled to depths of 27 and 24 m below ground surface. The groundwater system supplies water for 1500 people in the Village of Carp.

The Village is located in a complex geological setting. The Hazeldean bedrock fault, a significant structural geological feature, is located just northeast of the Village and marks the contact between the near surface Precambrian bedrock to the northeast, and the thick deposits of unconsolidated sediment to the west/southwest. The unconsolidated sediments make up the Carp River Valley and consist of clay soils overlying variable granular deposits and glacial till. Previous studies identified that the aquifer is primarily recharged via infiltration through the extensive sand deposits that come to surface in the higher land adjacent to the Carp Ridge, as well as to the north end of the Village.

The groundwater has been consistently clear of bacteriological and chemical contaminants. Well 2 is the primary well because of identified ammonia issues at Well 1. Well 1 is used as a back-up during periods of high demand. The Carp aquifer consistently had hardness concentrations greater than the 80 - 100 mg/L Ontario Drinking Water Standards – Operational Guideline. Hydrogen sulphide has also been found to be consistently over the aesthetic objective, and is considered to be naturally occurring and not due to anthropogenic sources.

Naturally elevated sodium levels were found in the water during the testing of the aquifer prior to the construction of the communal well system. Concentrations are consistently above 20 mg/L, which is the advisory limit set by the MOE above which the operator must notify the MOE and the Health Unit to protect individuals on sodium-reduced diets. Sodium concentrations do not exceed the Ontario Drinking Water Standards – Operational Guideline Aesthetic Objective of 200 mg/L, nor does sodium have human health effects except in a small number of cases that are considered in the advisory limit.

5.6.1 Carp Wellhead Protection Area Delineation

The conceptual hydrogeological model for the Carp wellhead was created from the MOE Water Well Information System, as well as geologic and hydrologic data which was obtained from previous studies carried out in the Carp area. Geologic and hydrologic data was also obtained from Provincial and Federal studies. Observation wells were also drilled as part of a field campaign to improve the understanding of the geology and hydrogeology of the groundwater system.

A cross-section for the conceptual model is shown in Figure 5-21. The sand and gravel aquifer that supplies the wells is made up of the fine, medium, and coarse sand and gravel formations. A layer of clay, of varying thickness, covers the aquifer, however, the continuity of this layer is not well known. A layer of limestone bedrock is below the aquifer. The groundwater system for the Carp wells is confined to the shallow overburden. The bedrock does not play a significant role in the groundwater system. Therefore, only the shallow overburden system was considered. An independent third party peer review ensured the approach was accepted by other groundwater experts.

The WHPA is made up of a 100m buffer around the wellheads and the 2, 5, and 25 year times of travel. Results from the numerical model calculated WHPA zones A through D for Carp are shown in Figure 5-22, Carp Wellhead Protection Area.

Please see section 5.3.1 for information on the uncertainty associated with delineation of the WHPAs. Levels of uncertainty are shown in Figure 5-23 Carp Wellhead Protection Area - Uncertainty.

5.6.2 Aquifer Vulnerability in the Carp Wellhead Protection Area

Once the WHPA was delineated, the aquifer vulnerability was determined using the Intrinsic Susceptibility Index or ISI (see Section 5.1.2). Briefly, the ISI looks at the thickness and types of soil and rock layers above the aquifer, and how easily water can pass through these layers. The Technical Rules outline the process for categorizing aquifer vulnerability (Low, Medium or High) for the areas within the WHPA zones. Figure 5-24 shows the results of the aquifer vulnerability assignment for Carp.

In Carp, high aquifer vulnerability exists where there is a thin layer of fine sands above the aquifer (close to the municipal wells). Medium aquifer vulnerability exists where there is a thick layer of fine sands above the aquifer (the topographically high area to the southwest of the Carp Ridge). Medium vulnerability also exists where thin weathered clay overlies the fine sands. Low aquifer vulnerability exists where three metres of weathered clay and a significant thickness of un-weathered clay is above the aquifer, in the lower lying Carp River valley area. This is shown in Figure 5-24.

Under the Technical Rules, the presence of transport pathways within a WHPA can increase the intrinsic vulnerability. An area with low vulnerability can increase to medium, and an area with medium vulnerability can increase to high. Areas that are already high cannot be increased. The presence of water wells, pits and quarries, mines, construction activities, sewer services, septic systems and stormwater infiltration was examined in the WHPA. The review showed transport pathways in the Carp WHPA did not warrant an increase in intrinsic vulnerability.

5.6.3 Vulnerability Scoring in the Carp Wellhead Protection Area

The Technical Rules set out a process for scoring vulnerability within a WHPA. It is based on the combination of aquifer vulnerability and overlapping WHPA zones. The more vulnerable the aquifer and the closer you are to the well, the higher the vulnerability score.

Table 5-3 shows the scoring system laid out in the Technical Rules. Possible vulnerability scores are 2, 4, 6, 8, and 10. A score of 10 is highest, indicating an area where drinking water is most vulnerable to contamination. The categories in Table 5-3 were used to assign vulnerability scores to the areas within the WHPA, shown in Figure 5-25 Carp Wellhead Vulnerability Scoring and Figure 5-26 shows the area in more detail.

5.6.4 Managed Lands and Livestock Density

Percent managed land and livestock density calculations were carried out according to the methods outlined in Section 5.1.3. Figure 5-27 shows the managed lands and the livestock density in the WHPA zones. The percent managed lands and average livestock densities for each zone are listed in Table 5-6. Note some zones in these tables have two results because the calculation was carried out for each vulnerability score in each WHPA Zone. Also shown in the table is the risk threshold for the over application of nutrients to land and the risk threshold for the over application of Agricultural Source Material to land as described in Section 5.1.3.

The managed lands evaluation was based on property assessment data and refined using satellite imagery. Site activity, including the level of nutrient application, was not known. Livestock numbers were based on building size from satellite imagery and the number of nutrient units produced by barns was estimated on barn size and estimated livestock type. Overall, the uncertainty associated with the estimation of percent managed lands and livestock density is high.

5.6.5 Impervious Surfaces

Impervious surfaces are primarily constructed surfaces such as roads and parking lots that are covered by impenetrable materials such as asphalt, concrete and stone. These materials are a barrier to groundwater infiltration. Impervious surfaces also generate more runoff during melt or storm events.

Road salt applied to roads and walkways for winter maintenance is regarded as a potential threat. Impervious surface area calculations are required to determine if road salt application in the vulnerable areas could be a drinking water threat.

For information on methodology for determining percentage of impervious surfaces please see section 5.1.4 Impervious Surfaces.

The percent impervious surfaces results for each grid within the Carp vulnerable aquifer areas is shown on Figure 5-28. The results range from 0.5 to 52%.

5.6.6 Water Quality Threat Assessment in the Carp Wellhead Protection Area

Water quality threats are existing conditions (e.g. contaminated sediment, soil or groundwater) or existing or future land use activities that could contaminate

a drinking water supply. A land use inventory of the Carp WHPA was completed in 2008.

It should be noted that a single land use activity could fall into multiple threat categories. For example, a crop farm could be practicing storage of fuel, application of commercial fertilizer to land, and application of agricultural source material to land. Each of these activities is a separate threat category in the provincial table, and so is therefore a separate threat.

The next step was to determine which land use activities and associated threats are occurring where the vulnerability score is high enough to result in a significant threat. In many cases, the specific circumstances that apply to a threat category are unknown. Using the same example, a crop farm may practice fuel storage, but the volume of fuel stored is unknown. Unless additional information was available, it was assumed that enough material was stored for that activity to be a significant threat.

A total of 15 potentially significant drinking water threats were identified in the Carp WHPA. For WHPAs, significant threats are where the vulnerability score is 8 or 10, or if the activity pertains to dense non-aqueous phase liquids (DNAPLs), anywhere within the 5-year WHPA Zone C. The areas with potential significant drinking water threats are summarized in Table 5-7. Figure 5-29 shows the areas containing potential significant threats in purple and outlines the areas containing potential DNAPL threats in blue. Please see section 4.3.3 for information on the full list of significant, moderate, and low threats.

Transportation Corridors

A number of transportation corridors exist including a CPR rail line within the Carp WHPA where there may be the transportation of dangerous and/or hazardous goods and the potential for a spill exists. Spills within the WHPA have the potential to impair the groundwater quality however they are not included as threats as per the prescribed drinking water threats categories (see Section 4-3).

This Assessment Report provides this key information for municipalities and other agencies to assist in ensuring all available information is accessible for emergency response planning purposes. Transportation corridors can be found on all WHPA maps including the Carp WHPA map in Figure 5-22.

Issues and Conditions

As discussed in Chapter 4 issues are documented cases of water quality contamination approaching or exceeding acceptable provincial levels. A condition is a situation where past activities resulted in a drinking water threat. No issues or conditions were identified in the Carp WHPA.

5.7 Kemptville Water Supply

The Town of Kemptville obtains its drinking water from three municipal wells, which obtain water from the Nepean Formation sandstone. The three wells are drilled to depths between 62 and 110 m below ground surface. The wells have casing down to the Oxford Formation (above the Nepean Formation), and are open holes in the Oxford and Nepean Formations. The groundwater system supplies approximately 3,400 people.

The local geology in the Kemptville area consists of a thin (i.e., less than two metres) in the western half of the area around Kemptville, while in the eastern half, local areas of increased overburden thickness are present (i.e., up to approximately 20 metres). The overburden material consists primarily of glacial till deposits, offshore marine clay deposits and near shore fine to medium sand deposits.

The overburden material is underlain by sedimentary rocks of Paleozoic age. The sequence of sedimentary rocks underlying the area is (from oldest/deepest to youngest/shallowest) is Nepean Formation (sandstone), March Formation (sandstone/dolostone) and Oxford Formation (limestone/dolostone).

The Kemptville water system produces high-quality groundwater. Total coliform bacteria are detected in Well 1 a few times per year. However, E. coli has not been detected in the groundwater, and total coliforms are removed during water treatment. Colour and hardness exceed the Ontario Drinking Water Standards – Operational Guideline Aesthetic Objective; however, these parameters do not affect health.

Hardness and sodium concentrations are typical of the Nepean formation. Typical sodium concentrations range between 30 – 40 mg/L at all three wells. 20 mg/L is the advisory limit set by the MOE above which the operator must notify the MOE and the Health Department to protect individuals on sodium reduced diets. Sodium does not exceed any other benchmark, nor does it have human health effects except in a small number of cases that are considered in the advisory limit.

5.7.1 Kemptville Wellhead Protection Area Delineation

In addition to the Water Well Information System, geologic and hydrologic data were also obtained from previous studies carried out in the Kemptville area. Also, geologic and hydrologic data was obtained from Provincial and Federal studies. These data were used to create the conceptual hydrogeological model for Kemptville. Furthermore, observation wells were drilled as part of a field campaign to improve the understanding of the geology and hydrogeology of the groundwater system.

A cross-section for Kemptville's conceptual model is shown in Figure 5-30. The well descend through surface layers of clay and glacial till, then through the upper aquifer (the Oxford/March formations), before arriving at the deep Nepean aquifer. Precambrian bedrock lies below the Nepean aquifer. Groundwater from the Oxford/March formation and the Nepean Formation enters the Kemptville wells. Therefore, WHPA analyses were carried out for shallow (Oxford/March) and deep (Nepean) groundwater systems. An independent third party peer review ensured the approach was accepted by other groundwater experts.

The numerical model calculated WHPA zones A through D for the Kemptville system for the shallow and deep aquifer systems. Figure 5-31 shows the Kemptville shallow aquifer wellhead protection area zones around the municipal wellheads. It is made up of a 100m buffer around the wellheads and the 2, 5, and 25 year times of travel. Figure 5-32 shows the Kemptville deep aquifer wellhead protection area zones around the municipal wellheads. It is made up of a 100m buffer around the wellheads and the 2, 5, and 25 year times of travel. As indicated on Figure 5-32, a small area of the deep WHPA-D is located within the Raisin-South Nation Source Protection Region.

The approach to determine uncertainly was to give low uncertainty to all areas within the 5 year time of travel line (including WHPA-A, WHPA-B and WHPA-C) and to give high uncertainty to all areas beyond this area (WHPA-D) as shown in Figures 5-33 and 5-34 which show Kemptville's Shallow and Deep Wellhead Protection Area Uncertainty.

5.7.2 Aquifer Vulnerability in the Kemptville Wellhead Protection Area

Once the WHPA was delineated, the aquifer vulnerability was determined using the Intrinsic Susceptibility Index or ISI (see Section 5.1.2). Briefly, the ISI looks at the thickness and types of soil and rock layers above the aquifer, and how easily water can pass through these layers. The Technical Rules outline the process for categorizing the ISI results into aquifer vulnerability (Low, Medium or High) for the areas within the WHPA zones. Figures 5-35 and 5-36 show the results of the aquifer vulnerability assignment for Kemptville's shallow and deep aquifers, respectively.

Under the Technical Rules, the presence of transport pathways within a WHPA can increase the intrinsic vulnerability. An area with low vulnerability can increase to medium, and an area with medium vulnerability can increase to high. Areas that are already high cannot be increased. The presence of water wells, pits and quarries, mines, construction activities, sewer services, septic systems and stormwater infiltration was examined in the WHPA.

Three areas were identified where transport pathways pose a risk to the deep aquifer in Figures 5-35 and 5-36. The vulnerability of all three areas was increased from medium to high vulnerability because of the presence of bedrock quarries. No changes were made to the shallow aquifer because the vulnerability of the shallow aquifer was already high.

5.7.3 Vulnerability Scoring in the Kemptville Wellhead Protection Area

The Technical Rules set out a process for scoring vulnerability within a WHPA. It is based on the combination of aquifer vulnerability and overlapping WHPA zones. The more vulnerable the aquifer and the closer you are to the well, the higher the vulnerability score.

Table 5-3 shows the scoring system laid out in the provincial Technical Rules. Possible vulnerability scores are 2, 4, 6, 8, and 10. A score of 10 is highest, indicating an area where drinking water is most vulnerable to contamination. The categories in Table 5-3 were used to assign vulnerability scores to the areas within the WHPA for the shallow (Figure 5-37) and deep (Figure 5-38) groundwater systems. The final vulnerability scoring is based on the highest of the combined scores for the deep and shallow aquifers and is shown in Figures 5-39 and 5-40.

5.7.4 Managed Lands and Livestock Density

The percent of managed land and livestock density calculations were carried out according to the methods outlined in Section 5.1.3. Figures 5-41 and 5-42 show the managed lands and the livestock density in the WHPA zones. The percent managed lands and average livestock densities for each zone are listed in Table 5-8 and Table 5-9. Note some zones in these tables have two results because the calculation was carried out for each vulnerability score in each WHPA Zone. Also shown in the table is the risk threshold for the over

application of nutrients to land and the risk threshold for the over application of ASM to land as described in Section 5.1.3.

The data for the managed lands evaluation was based on property assessment data and refined using satellite imagery. Site activity, including the level of nutrient application, was not known. Livestock numbers were based on building size from satellite imagery and the number of nutrient units produced by barns was estimated on barn size and estimated livestock type. Overall, the uncertainty associated with the estimation of percent managed lands and livestock density is high.

5.7.5 Impervious Surfaces

Impervious surfaces are primarily constructed surfaces such as roads and parking lots that are covered by impenetrable materials such as asphalt, concrete and stone. These materials are a barrier to groundwater infiltration. Impervious surfaces also generate more runoff during melt or storm events.

Road salt applied to roads and walkways for winter maintenance is regarded as a threat. Impervious surface area calculations are required to determine if road salt application in the vulnerable areas could be a drinking water threat.

For information on methodology for determining percentage of impervious surfaces please see section 5.1.4 Impervious Surfaces.

The percent impervious surfaces results for each grid within the Kemptville vulnerable aquifer areas is shown on Figure 5-43. The results range from 0 to 89%.

5.7.6 Water Quality Threat Assessment in the Kemptville Wellhead Protection Area

Water quality threats are existing conditions (i.e. contaminated sediment, soil or groundwater) or existing or future land use activities that could contaminate a drinking water supply. A land use inventory of the Kemptville WHPA was completed in 2009.

It should be noted that a single land use activity could fall into multiple threat categories. For example, a crop farm could be practicing storage of fuel, application of commercial fertilizer to land, and application of agricultural source material to land. Each of these activities is a separate threat category in the provincial table, and so is therefore a separate threat.

The next step was to determine which land use activities and associated threats are occurring where the vulnerability score is high enough to result in a significant threat. In many cases, the specific circumstances that apply to a threat category are unknown. Using the same example, a crop farm may practice fuel storage, but the volume of fuel stored is unknown. Unless additional information was available, it was assumed that enough material was stored for that activity to be a significant threat.

A total of 61 potentially significant drinking water threats were identified in the Kemptville WHPA. For WHPAs, significant threats are where the vulnerability score is 8 or 10, or if the activity pertains to dense non-aqueous phase liquids (DNAPLs), anywhere within the 5-year WHPA Zone C. The areas with potential significant drinking water threats are summarized in Table 5-10. Figure 5-44 shows the areas containing potential significant threats in purple and outlines

the areas containing potential DNAPL threats in blue. Please see section 4.3.3 for information on the full list of significant, moderate, and low threats.

Transportation Corridors

A number of transportation corridors, including Highway 416 and a CPR rail line exist within the Kemptville WHPA where there may be the transportation of dangerous and/or hazardous goods and the potential for a spill exists. Spills within the WHPA have the potential to impair the groundwater quality however they are not included as threats as per the prescribed drinking water threats categories (see Section 4-3).

This Assessment Report provides this key information for municipalities and other agencies to assist in ensuring all available information is accessible for emergency response planning purposes. Transportation corridors can be found on all WHPA maps including the Kemptville WHPA maps in Figures 5-31 and 5-32.

5.7.7 Issues and Conditions

As discussed in Chapter 4 issues are documented cases of water quality contamination approaching or exceeding acceptable provincial levels. A condition is a situation where past activities resulted in a drinking water threat. No issues or conditions were identified in the Kemptville WHPA.

5.8 Merrickville Water Supply

The Village of Merrickville obtains its drinking water from three municipal wells. Well 1, Well 2 and Well 4 are completed at 35, 49 and 50 m below ground surface, respectively. Well 3 was decommissioned in 2002. All three wells are completed in the Nepean Formation sandstone. The groundwater system supplies water for 1000 people in Merrickville.

The local geology in the Merrickville area consists of a thin overburden layer (i.e., less than two metres) in the western half of the area around Merrickville, while in the eastern half, local areas of increased overburden thickness are present (i.e., up to approximately 20 metres. The overburden material consists primarily of glacial till deposits, offshore marine clay deposits and near shore fine to medium sand deposits.

The overburden material is underlain by sedimentary rocks of Paleozoic age. The sequence of sedimentary rocks underlying the area is (from oldest/deepest to youngest/shallowest) is Nepean Formation (sandstone), March Formation (sandstone/dolostone) and Oxford Formation (limestone/dolostone).

The groundwater has been characterized as having elevated hardness and iron, which do not pose health risks. Elevated turbidity and colour have also been detected in the water, but these are not health risks. The source water is clear of chemical contaminants. Total coliform bacteria were found periodically between 2003 and 2006. However, E. coli has not been detected in the groundwater, and total coliforms are removed during water treatment.

5.8.1 Merrickville Wellhead Protection Area Delineation

In addition to the Water Well Information System, geologic and hydrologic data were also obtained from previous studies carried out in the Merrickville area. Also, geologic and hydrologic data was obtained from Provincial and Federal studies. These data were used to create the conceptual hydrogeological model for Merrickville. Furthermore, observation wells were drilled as part of a field campaign to improve the understanding of the geology and hydrogeology of the groundwater system.

A cross-section for the conceptual model is shown in Figure 5-45. The wells descend through surface layers of clay and glacial till, then through the upper aquifer (the Oxford/March formations), before arriving at the deep Nepean aquifer. Precambrian bedrock lies below the Nepean aquifer. Groundwater from the Oxford/March formation and the Nepean Formation enters the Merrickville wells. Therefore, WHPA analyses were carried out for shallow (Oxford/March) and deep (Nepean) groundwater systems. An independent third party peer review ensured the approach was accepted by other groundwater experts.

The numerical model calculated WHPA zones A through D for the Merrickville system for the shallow and deep aquifer systems (Figures 5-46 and 5-47). Figure 5-46 shows the Merrickville shallow aquifer wellhead protection area zones around the municipal wellheads. It is made up of a 100m buffer around the wellheads and the 2, 5, and 25 year times of travel. Figure 5-47 shows the Merrickville deep aquifer wellhead protection area zones around the municipal wellheads. It is made up of a 100m buffer around the wellheads and the 2, 5, and 25 year times of travel.

See section 5.3.9 for information on uncertainty. The Merrickville WHPA uncertainty maps are shown in Figures 5-48 and 5-49.

5.8.2 Aquifer Vulnerability in the Merrickville Wellhead Protection Area

Once the WHPA was delineated, the aquifer vulnerability was determined using the Intrinsic Susceptibility Index or ISI (see Section 5.1.2). Briefly, the ISI looks at the thickness and types of soil and rock layers above the aquifer, and how easily water can pass through these layers. The Technical Rules outline the process for categorizing aquifer vulnerability (Low, Medium or High) for the areas within the WHPA zones. Figures 5-50 and 5-51 show the results of the aquifer vulnerability assignment.

For the shallow aquifer, the aquifer vulnerability is mostly high with some medium areas (Figures 5-50 and 5-51). The relatively patchy nature of the aquifer vulnerability results from a complex layering of soil in Kemptville. For example, the soil thicknesses varies from zero metres to over twenty metres with several different soil types present (i.e., sand and gravel, silt and clay, till). For the deep aquifer, the aquifer vulnerability is generally low because the Nepean aquifer is well protected from the overlying Oxford aquifer, except for some small areas near the north boundary of the WHPA which is medium as the Nepean aquifer gets closer to the ground surface. The three areas adjusted for transport pathways have medium vulnerability.

Under the Technical Rules, the presence of transport pathways within a WHPA can increase the intrinsic vulnerability. An area with low vulnerability can increase to medium, and an area with medium vulnerability can increase to

high. Areas that are already high cannot be increased. The presence of water wells, pits and quarries, mines, construction activities, sewer services, septic systems and stormwater infiltration was examined in the WHPA.

Three areas were identified for the deep aquifer. Vulnerabilities were increased from low to medium because of the presence of bedrock quarries. For the shallow aquifer, no adjustments were made because the vulnerability rankings were already ranked high.

5.8.3 Vulnerability Scoring in the Merrickville Wellhead Protection Zone

The Technical Rules set out a process for scoring vulnerability within a WHPA. It is based on the combination of aquifer vulnerability and overlapping WHPA zones. The more vulnerable the aquifer and the closer you are to the well, the higher the vulnerability score.

Table 5-3 shows the scoring system laid out in the provincial Technical Rules. Possible vulnerability scores are 2, 4, 6, 8, and 10. A score of 10 is highest, indicating an area where drinking water is most vulnerable to contamination. The categories in Table 5-2 were used to assign vulnerability scores to the areas within the WHPA for the shallow (Figure 5-52) and deep (Figure 5-53) groundwater systems. The final vulnerability scoring is based on the highest of the combined scores for the deep and shallow aquifers and is shown in Figures 5-54 and 5-55.

5.8.4 Managed Lands and Livestock Density

Percent managed land and livestock density calculations were carried out according to the methods outlined in Section 5.1.3. Figures 5-56 and 5-57 show the managed lands and the livestock density in the WHPA zones. The percent managed lands and average livestock densities for each zone are listed in Table 5-11 and Table 5-12. Note some zones in these tables have two results because the calculation was carried out for each vulnerability score in each WHPA Zone. Also shown in the table is the risk threshold for the over application of nutrients to land and the risk threshold for the over application of ASM to land as described in Section 5.1.3.

The data for the managed lands evaluation was based on property assessment data and refined using satellite imagery. Site activity, including the level of nutrient application, was not known. Livestock numbers were based on building size from satellite imagery and the number of nutrient units produced by barns was estimated on barn size and estimated livestock type. Overall, the uncertainty associated with the estimation of percent managed lands and livestock density is high.

5.8.5 Impervious Surfaces

Impervious surfaces are primarily constructed surfaces such as roads and parking lots that are covered by impenetrable materials such as asphalt, concrete and stone. These materials are a barrier to groundwater infiltration. Impervious surfaces also generate more runoff during melt or storm events.

Road salt applied to roads and walkways for winter maintenance is regarded as a threat. Impervious surface area calculations are required to determine if road salt application in the vulnerable areas could be a drinking water threat.

For information on methodology for determining percentage of impervious surfaces please see section 5.1.4 Impervious Surfaces.

The percent impervious surfaces results for each grid within the Merrickville vulnerable aquifer areas are shown on Figure 5-58. The results range from 0 to 88%. The higher values found in this area are attributed to the Town of Smith's Falls.

5.8.6 Water Quality Threat Assessment in the Merrickville Wellhead Protection Area

Water quality threats are existing conditions (i.e., contaminated sediment, soil or groundwater) or existing or future land use activities that could contaminate a drinking water supply. A land use inventory of the Merrickville WHPA was completed in 2009.

It should be noted that a single land use activity could fall into multiple threat categories. For example, a crop farm could be practicing storage of fuel, application of commercial fertilizer to land, and application of agricultural source material to land. Each of these activities is a separate threat category in the provincial table, and so is therefore a separate threat.

The next step was to determine which land use activities and associated threats are occurring where the vulnerability score is high enough to result in a significant threat. In many cases, the specific circumstances that apply to a threat category are unknown. Using the same example, a crop farm may practice fuel storage, but the volume of fuel stored is unknown. Unless additional information was available, it was assumed that enough material was stored for that activity to be a significant threat.

A total of 30 potentially significant drinking water threats were identified in the Merrickville WHPA. For WHPAs, significant threats are where the vulnerability score is 8 or 10, or if the activity pertains to dense non-aqueous phase liquids (DNAPLs), anywhere within the 5-year WHPA Zone C. The areas with potential significant drinking water threats are summarized in Table 5-13. Figure 5-59 shows the areas containing potential significant threats in purple and outlines the areas containing potential DNAPL threats in blue. Please see section 4.3.3 for information on the full list of significant, moderate, and low threats.

Transportation Corridors

A number of transportation corridors, including roads and a CPR rail line exist within the Merrickville WHPA where there may be the transportation of dangerous and/or hazardous goods and the potential for a spill exists. Spills within the WHPA have the potential to impair the groundwater quality however they are not included as threats as per the prescribed drinking water threats categories (see Section 4-3).

This Assessment Report provides this key information for municipalities and other agencies to assist in ensuring all available information is accessible for emergency response planning purposes. Transportation corridors can be found on all WHPA maps including the Merrickville WHPA maps in Figures 5-46 and 5-47.

Issues and Conditions

As discussed in Chapter 4 issues are documented cases of water quality contamination approaching or exceeding acceptable provincial levels. A condition is a situation where past activities resulted in a drinking water threat. No issues or conditions were identified in the Merrickville WHPA.

5.9 Munster Water Supply

Munster Hamlet obtains its drinking water from two municipal wells. The Munster water supply system currently serves the entire Hamlet and obtains its water supply from two bedrock aquifer wells: Munster Well No. 1 (MW1) and Munster Well No. 2 (MW2). MW1 and MW2 are completed to a depth of 116 m and 122 m, respectively. Both wells are completed in the Nepean Formation sandstone. The groundwater system supplies approximately 1,300 people.

The local geology in the Munster area consists of limited overburden material (less than 5 m) made up of clay material in the Richmond area and a sandy till in the Munster area. The overburden material is underlain by sedimentary rocks of Paleozoic age. The sequence of sedimentary rocks underlying Richmond (from oldest/deepest to youngest/shallowest) is Nepean Formation (sandstone), March Formation (sandstone/dolostone) and Oxford Formation (limestone/dolostone).

The source water has consistently been clear of bacteriological and chemical contaminants. Well 1 is used almost exclusively as Well 2 has exhibited turbidity problems since 2001. Historically, conductivity, iron, pH and turbidity have periodically and marginally exceeded drinking water guidelines. The Munster raw water quality has exceeded guidelines for hardness and iron and also identified turbidity issues at Well 2. These parameters do not pose a health risk.

5.9.1 Munster Wellhead Protection Area Delineation

In addition to the Water Well Information System, geologic and hydrologic data were also obtained from previous studies carried out in the Munster area. Also, geologic and hydrologic data was obtained from Provincial and Federal studies. These data were used to create the conceptual hydrogeological model for Munster.

A cross-section for the conceptual model is shown in Figure 5-60. The wells descend through surface layers of clay and glacial till, then through the upper aquifer (the Oxford/March formations), before arriving at the deep Nepean aquifer. Precambrian bedrock lies below the Nepean aquifer. Groundwater from the Oxford/March formation and the Nepean Formation enters the Munster wells. Therefore, WHPA analyses were carried out for shallow (Oxford/March) and deep (Nepean) groundwater systems. An independent third party peer review ensured the approach was accepted by other groundwater experts.

The numerical model calculated WHPA zones A through D for the Munster system for the shallow and deep aquifer systems (Figures 5-61 and 5-62). Figure 5-61 shows the Munster shallow aquifer wellhead protection area zones around the municipal wellheads. It is made up of a 100m buffer around the wellheads and the 2, 5, and 25 year times of travel. Figure 5-61 shows the Munster deep aquifer wellhead protection area zones around the municipal

wellheads. It is made up of a 100m buffer around the wellheads and the 2, 5, and 25 year times of travel.

See Section 5.3.9 for information on uncertainty. The Merrickville WHPAs for the shallow and deep aquifers are shown in Figures 5-63 and 5-64.

5.9.2 Aquifer Vulnerability in the Munster Wellhead Protection Area

Once the WHPA was delineated, the aquifer vulnerability was determined using the Intrinsic Susceptibility Index or ISI (see Section 5.1.2). Briefly, the ISI looks at the thickness and types of soil and rock layers above the aquifer, and how easily water can pass through these layers. The Technical Rules outline the process for categorizing aquifer vulnerability (Low, Medium or High) for the areas within the WHPA zones. Figures 5-65 and 5-66 show the results of the aquifer vulnerability assignment.

Under the Technical Rules, the presence of transport pathways within a WHPA can increase the intrinsic vulnerability. An area with low vulnerability can increase to medium, and an area with medium vulnerability can increase to high. Areas that are already high cannot be increased. The presence of water wells, pits and quarries, mines, construction activities, sewer services, septic systems and stormwater infiltration was examined in the WHPA.

Two areas were identified where transport pathways pose a risk to the shallow aquifer (Figures 5-65 and 5-66). One area, located in the centre of Munster, was raised from medium to high vulnerability because of the presence of high groundwater well density and sewer services. In another area, just west of the centre, the vulnerability was increased from medium to high because of the presence of surface water ponds. Two areas were also identified for the deep aquifer. Vulnerabilities were increased from low to medium because of the presence of bedrock quarries (one active and one abandoned). Both areas are located several kilometres north-west of Munster.

5.9.3 Vulnerability Scoring in the Munster Wellhead Protection Area

The Technical Rules set out a process for scoring vulnerability within a WHPA. It is based on the combination of aquifer vulnerability and overlapping WHPA zones. The more vulnerable the aquifer and the closer you are to the well, the higher the vulnerability score.

Table 5-3 shows the scoring system laid out in the provincial Technical Rules. Possible vulnerability scores are 2, 4, 6, 8, and 10. A score of 10 is highest, indicating an area where drinking water is most vulnerable to contamination. The categories in Table 5-3 were used to assign vulnerability scores to the areas within the WHPA for the shallow (Figure 5-67) and deep (Figure 5-68) groundwater systems. The final vulnerability scoring is based on the highest of the combined scores for the deep and shallow aquifers and is shown in Figures 5-69 and 5-70.

5.9.4 Managed Lands and Livestock Density

Percent managed land and livestock density calculations were carried out according to the methods outlined in Section 5.1.3. Figure 5-71 and 5-72 show the managed lands and the livestock density in the WHPA zones. The percent managed lands and average livestock densities for each zone are listed in Table 5-14 and Table 5-15. Note some zones in these tables have two results because the calculation was carried out for each vulnerability score in each WHPA Zone. Also shown in the table is the risk threshold for the over

application of nutrients to land and the risk threshold for the over application of ASM to land as described in Section 5.1.3.

The data for the managed lands evaluation was based on property assessment data and refined using satellite imagery. Site activity, including the level of nutrient application, was not known. Livestock numbers were based on building size from satellite imagery and the number of nutrient units produced by barns was estimated on barn size and estimated livestock type. Overall, the uncertainty associated with the estimation of percent managed lands and livestock density is high.

5.9.5 Impervious Surfaces

Impervious surfaces are primarily constructed surfaces such as roads and parking lots that are covered by impenetrable materials such as asphalt, concrete and stone. These materials are a barrier to groundwater infiltration. Impervious surfaces also generate more runoff during melt or storm events.

Road salt applied to roads and walkways for winter maintenance is regarded as a threat. Impervious surface area calculations are required to determine if road salt application in the vulnerable areas could be a drinking water threat.

For information on methodology for determining percentage of impervious surfaces please see section 5.1.4 Impervious Surfaces.

The percent impervious surfaces results for each grid within the Munster vulnerable aquifer areas is shown on Figure 5-73. The results range from 0 to 25%.

5.9.6 Water Quality Threat Assessment in the Munster Wellhead Protection Area

Water quality threats are existing conditions (i.e., contaminated sediment, soil or groundwater) or existing or future land use activities that could contaminate a drinking water supply. A land use inventory of the Munster WHPA was completed in 2008.

It should be noted that a single land use activity could fall into multiple threat categories. For example, a crop farm could be practicing storage of fuel, application of commercial fertilizer to land, and application of agricultural source material to land. Each of these activities is a separate threat category in the provincial table, and so is therefore a separate threat.

The next step was to determine which land use activities and associated threats are occurring where the vulnerability score is high enough to result in a significant threat. In many cases, the specific circumstances that apply to a threat category are unknown. Using the same example, a crop farm may practice fuel storage, but the volume of fuel stored is unknown. Unless additional information was available, it was assumed that enough material was stored for that activity to be a significant threat.

A total of 7 potentially significant drinking water threats were identified in the Munster WHPA. For WHPAs, this is where the vulnerability score is 8 or 10, or if the activity pertains to dense non-aqueous phase liquids (DNAPLs), anywhere within the 5-year WHPA Zone C. The areas with potential significant drinking water threats are summarized in Table 5-16. Figure 5-74 shows the areas containing potential significant threats in purple and outlines the areas

containing potential DNAPL threats in blue. Please see Section 4.3.3 for information on the full list of significant, moderate, and low threats.

Transportation Corridors

A number of transportation corridors, primarily roadways, exist within the Munster WHPA where there may be the transportation of dangerous and/or hazardous goods and the potential for a spill exists. Spills within the WHPA have the potential to impair the groundwater quality however they are not included as threats as per the prescribed drinking water threats categories (see Section 4-3).

This Assessment Report provides this key information for municipalities and other agencies to assist in ensuring all available information is accessible for emergency response planning purposes. Transportation corridors can be found on all WHPA maps including the Munster WHPA maps in Figures 5-61 and 5-62.

5.9.7 Issues and Conditions

As discussed in Chapter 4 issues are documented cases of water quality contamination approaching or exceeding acceptable provincial levels. A condition is a situation where past activities resulted in a drinking water threat. No issues or conditions were identified in the Munster WHPA.

5.10 Richmond - King's Park Water Supply

The King's Park community in the Village of Richmond obtains its drinking water from two municipal wells. The Kings Park Water Supply System consists of two bedrock wells, Well No. 1 (RW1) and Well No. 2 (RW2), which are both approximately 30 years old. RW1 and RW2 are completed to a depth of 66 and 61 m, respectively. The wells penetrate the Oxford and March formations and are completed as open holes in the underlying Nepean Formation sandstone. The groundwater system supplies approximately 450 people.

The local geology in the Richmond area consists of limited overburden material (less than 5 m) made up of clay material in the Richmond area and a sandy till in the Munster area. The overburden material is underlain by sedimentary rocks of Paleozoic age. The sequence of sedimentary rocks underlying Richmond (from oldest/deepest to youngest/shallowest) is Nepean Formation (sandstone), March Formation (sandstone/dolostone) and Oxford Formation (limestone/dolostone).

Raw water quality data collected at the two wells from 2000 to 2005 indicates that the aquifer water quality is very consistent. The source water has consistently been clear of bacteriological and chemical contaminants. Sodium was identified during the testing of the aquifer prior to the construction of the communal well system as being naturally elevated. Concentrations were consistently above 20 mg/L, which is the advisory limit set by the MOE above which the operator must notify the MOE and the Health Department to protect individuals on sodium-reduced diets. Sodium does not exceed the Ontario Drinking Water Standards – Operational Guideline Aesthetic Objective of 200 mg/L, nor does it have human health effects except in a smaller number of cases that are considered in the advisory limit.

5.10.1 Richmond - King's Park Wellhead Protection Area Delineation

A cross-section for the WHPA conceptual model is shown in Figure 5-75. The wells descend through surface layers of clay and glacial till, then through the upper aquifer (the Oxford/March formations), before arriving at the deep Nepean aquifer. Precambrian bedrock lies below the Nepean aquifer. Groundwater from the Oxford/March formation and the Nepean Formation enters the King's Park wells. Therefore, WHPA analyses were carried out for shallow (Oxford/March) and deep (Nepean) groundwater systems. An independent third party peer review occurred at this stage to ensure the approach was accepted by other groundwater experts.

The numerical model calculated WHPA zones A through D for the King's Park system for the shallow and deep aquifer systems. Figure 5-76 shows the King's Park shallow aquifer wellhead protection area zones around the municipal wellheads. It is made up of a 100m buffer around the wellheads and the 2, 5, and 25 year times of travel. Figure 5-77 shows the King's Park deep aquifer wellhead protection area zones around the municipal wellheads. It is made up of a 100m buffer around the wellheads and the 2, 5, and 25 year times of travel.

Please see Section 5.3.9 for information on uncertainty. Uncertainty related to the shallow and deep aquifer delineation is shown in Figures 5-78 and 5-79.

5.10.2 Aquifer Vulnerability in the Richmond - King's Park Wellhead Protection Area

Once the WHPA was delineated, the aquifer vulnerability was determined using the Intrinsic Susceptibility Index or ISI, as shown in Section 5.1.2. Briefly, the ISI looks at the thickness and types of soil and rock layers above the aquifer, and how easily water can pass through these layers. The Technical Rules outline the process for categorizing aquifer vulnerability (Low, Medium or High) for the areas within the WHPA zones. Figures 5-80 and 5-81 show the results of the aquifer vulnerability assignment.

Under the Technical Rules, the presence of transport pathways within a WHPA can increase the intrinsic vulnerability. An area with low vulnerability can increase to medium, and an area with medium vulnerability can increase to high. Areas that are already high cannot be increased. The presence of water wells, pits and quarries, mines, construction activities, sewer services, septic systems and stormwater infiltration was examined in the WHPA. Three areas where transport pathways pose a risk to the deep aquifer were identified. The vulnerability was raised in these areas from low to medium. In all three cases, these transport pathways are bedrock quarries (two active and one abandoned). The bedrock quarries are located near Fernbank Road. For the shallow aquifer, no transport pathways that warranted an increase in intrinsic vulnerability were identified.

5.10.3 Vulnerability Scoring in the Richmond - King's Park Wellhead Protection Area

The Technical Rules set out a process for scoring vulnerability within a WHPA. It is based on the combination of aquifer vulnerability and overlapping WHPA zones. The more vulnerable the aquifer, and the closer you are to the well, the higher the vulnerability score.

Table 5-3 shows the scoring system laid out in the provincial Technical Rules. Possible vulnerability scores are 2, 4, 6, 8, and 10. A score of 10 is highest, indicating an area where drinking water is most vulnerable to contamination. The categories in Table 5-3 were used to assign vulnerability scores to the areas within the WHPA for the shallow/deep (Figure 5-82) and deep (Figure 5-83 groundwater systems. The final vulnerability scoring is based on the highest of the combined scores for the deep and shallow aquifers and is shown in Figures 5-84 and 5-85.

5.10.4 Managed Lands and Livestock Density

Percent managed land and livestock density calculations were carried out according to the methods outlined in Section 5.1.3. Figure 5-86 and Figure 5-87 show the managed lands and the livestock density in the WHPA zones. The percent managed lands and average livestock densities for each zone are listed in Table 5-17 and Table 5-18. Note some zones in these tables have two results because the calculation was carried out for each vulnerability score in each WHPA Zone. Also shown in the table is the risk threshold for the over application of nutrients to land and the risk threshold for the over application of ASM to land as described in Section 5.1.3.

The data for the managed lands evaluation was based on property assessment data and refined using satellite imagery. Site activity, including the level of nutrient application, was not known. Livestock numbers were based on building size from satellite imagery and the number of nutrient units produced by barns was estimated on barn size and estimated livestock type. Overall, the uncertainty associated with the estimation of percent managed lands and livestock density is high.

5.10.5 Impervious Surfaces

Impervious surfaces are primarily constructed surfaces such as roads and parking lots that are covered by impenetrable materials such as asphalt, concrete and stone. These materials are a barrier to groundwater infiltration. Impervious surfaces also generate more runoff during melt or storm events.

Road salt applied to roads and walkways for winter maintenance is regarded as a threat. Impervious surface area calculations are required to determine if road salt application in the vulnerable areas could be a drinking water threat.

For information on methodology for determining percentage of impervious surfaces please see section 5.1.4 Impervious Surfaces.

The percent impervious surfaces results for each grid within the King's Park vulnerable aquifer areas is shown on Figure 5-88. The results range from 0 to 64%.

5.10.6 Water Quality Threat Assessment in the Richmond - King's Park Wellhead Protection Area

Water quality threats are existing conditions (i.e., contaminated sediment, soil or groundwater) or existing or future land use activities that could contaminate a drinking water supply. A land use inventory of the King's Park WHPA was completed in 2008.

It should be noted that a single land use activity could fall into multiple threat categories. For example, a crop farm could be practicing storage of fuel, application of commercial fertilizer to land, and application of agricultural

source material to land. Each of these activities is a separate threat category in the provincial table, and so is therefore a separate threat.

The next step was to determine which land use activities and associated threats are occurring where the vulnerability score is high enough to result in a significant threat. In many cases, the specific circumstances that apply to a threat category are unknown. Using the same example, a crop farm may practice fuel storage, but the volume of fuel stored is unknown. Unless additional information was available, it was assumed that enough material was stored for that activity to be a significant threat.

A total of 10 potentially significant drinking water threats were identified in the King's Park WHPA. For WHPAs, this is where the vulnerability score is 8 or 10, or if the activity pertains to dense non-aqueous phase liquids (DNAPLs), anywhere within the 5-year WHPA Zone C. The areas with potential significant drinking water threats are summarized in Table 5-19. Figure 5-89 shows the areas containing potential significant threats in purple and outlines the areas containing potential DNAPL threats in blue. Please see Section 4.3.3 for information on the full list of significant, moderate, and low threats.

Transportation Corridors

A number of transportation corridors, primarily roadways, exist within the King's Park WHPA where there may be the transportation of dangerous and/or hazardous goods and the potential for a spill exists. Spills within the WHPA have the potential to impair the groundwater quality however they are not included as threats as per the prescribed drinking water threats categories (see Section 4-3).

This Assessment Report provides this key information for municipalities and other agencies to assist in ensuring all available information is accessible for emergency response planning purposes. Transportation corridors can be found on all WHPA maps including the King's Park WHPA maps in Figures 5-76 and 5-77.

5.10.7 Issues and Conditions

As discussed in Chapter 4 issues are documented cases of water quality contamination approaching or exceeding acceptable provincial levels. A condition is a situation where past activities resulted in a drinking water threat. No issues or conditions were identified in the King's Park WHPA.

5.11 Westport Water Supply

Westport obtains its drinking water from two municipal wells, Well 2 and Well 3, which draw groundwater from the March/Nepean aquifers. The wells are 34 and 40 m deep respectively and were constructed in 1969 and 2003, respectively. The groundwater supplies approximately 650 people in the village.

The Westport area has rugged terrain with an elevation change of about 75 metres. The Village is situated between Big Rideau Lake to the east, Westport Pond to the north and Westport Sand Lake to the west. Within the Village itself, clay soils lie over the March/Nepean aquifer, with sand and/or exposed bedrock over the highlands to the west. Although the March/Nepean aquifer provides

the source water for the Village of Westport, it is localized and is not present just to the north, south and west. Precambrian (Canadian Shield) bedrock is present north, south and west of Westport. Private wells in the greater Westport area may draw water from a variety of different aquifers, such as the March/Nepean or Precambrian aquifer.

Prior to the abandonment of Well 1, both Well 1 and Well 2 raw water detections of E.*coli* bacteria were common. Following abandonment of Well 1, detection of E.*coli* in Well 2 was infrequent and at lower levels. Treated water has not identified the presence of E. coli or total coliform bacteria. Treatment system upgrades are currently being implemented.

Sodium concentrations were consistently above 20 mg/L, which is the advisory limit set by the MOE above which the operator must notify the MOE and the Health Department to protect individuals on sodium-reduced diets. Sodium does not exceed the Ontario Drinking Water Standards – Operational Guideline Aesthetic Objective of 200 mg/L, nor does it have human health effects except in a smaller number of cases that are considered in the advisory limit. The water has high hardness and alkalinity, which do not pose health risks.

5.11.1 Westport Wellhead Protection Area Delineation

A cross-section for the conceptual model is shown in Figure 5-90. The cross-section shows the clay till layer that lies near the ground surface at the location of municipal well MW 3 (in the Village itself). Note the thick clay till layer does not extend throughout the entire Village. Continuing to the southwest, the March/Nepean aquifer is much closer to surface with limited sand cover and/or exposed bedrock. The amount groundwater supplied from the clay/till to the Westport well is considered to be small. Therefore, only the deep groundwater system (March/Nepean aquifer) is considered for this WHPA. An independent third party peer review ensured the approach was accepted by other groundwater experts. The numerical model calculated WHPA zones A through D for the Westport system (Figure 5-91). As indicated on Figure 5-91, a small area of the WHPA-D is located within the Cataraqui Source Protection Area.

For information on uncertainly please see Section 5.3.9. Uncertainty for the Westport wellhead area is shown in Figure 5-92.

5.11.2 Aquifer Vulnerability in the Westport Wellhead Protection Area

Once the WHPA was delineated, the aquifer vulnerability was determined using the Intrinsic Susceptibility Index or ISI (see Section 5.1.2). Briefly, the ISI looks at the thickness and types of soil and rock layers above the aquifer, and how easily water can pass through these layers. The Technical Rules outline the process for categorizing aquifer vulnerability (Low, Medium or High) for the areas within the WHPA zones. Figure 5-93 shows the results of the aquifer vulnerability assignment.

Under the Technical Rules, the presence of transport pathways within a WHPA can increase the intrinsic vulnerability. An area with low vulnerability can increase to medium, and an area with medium vulnerability can increase to high. Areas that are already high cannot be increased. A bedrock quarry located southeast of the intersection of Concession 8 and Salem Road in the Westport WHPA was identified as a potential transport pathway to the March/Nepean aquifer (Figure 5-93). The aquifer vulnerability was increased from low and medium to medium and high for the area near the quarry.

5.11.3 Vulnerability Scoring in the Westport Wellhead Protection Area

The Technical Rules under the *Clean Water Act* set out a process for scoring vulnerability within a WHPA. It is based on the combination of aquifer vulnerability and overlapping WHPA zones. The more vulnerable the aquifer and the closer you are to the well, the higher the vulnerability score.

Table 5-2 shows the scoring system laid out in the provincial Technical Rules. Possible vulnerability scores are 2, 4, 6, 8, and 10. A score of 10 is highest, indicating an area where drinking water is most vulnerable to contamination. The categories in Table 5-3 were used to assign vulnerability scores to the areas within the WHPA (Figures 5-94 and 5-95).

5.11.4 Managed Lands and Livestock Density

Percent managed land and livestock density calculations were carried out according to the methods outlined in Section 5.1.3. Figure 5-96 show the managed lands and the livestock density in the WHPA zones. The percent managed lands and average livestock densities for each zone are listed in Table 5-20. Note some zones in these tables have two results because the calculation was carried out for each vulnerability score in each WHPA Zone. Also shown in the table is the risk threshold for the over application of nutrients to land and the risk threshold for the over application of ASM to land as described in Section 5.1.3.

The data for the managed lands evaluation was based on property assessment data and refined using satellite imagery. Site activity, including the level of nutrient application, was not known. Livestock numbers were based on building size from satellite imagery and the number of nutrient units produced by barns was estimated on barn size and estimated livestock type. Overall, the uncertainty associated with the estimation of percent managed lands and livestock density is high.

5.11.5 Impervious Surfaces

Impervious surfaces are primarily constructed surfaces such as roads and parking lots that are covered by impenetrable materials such as asphalt, concrete and stone. These materials are a barrier to groundwater infiltration. Impervious surfaces also generate more runoff during melt or storm events.

Road salt applied to roads and walkways for winter maintenance is regarded as a threat. Impervious surface area calculations are required to determine if road salt application in the vulnerable areas could be a drinking water threat.

For information on methodology for determining percentage of impervious surfaces please see Section 5.1.4 Impervious Surfaces.

The percent impervious surfaces results for each grid within the Westport vulnerable aquifer areas is shown on Figure 5-97. The results range from 0 to 37%.

5.11.6 Water Quality Threat Assessment in Westport Wellhead Protection Area

Water quality threats are existing conditions (i.e., contaminated sediment, soil or groundwater) or existing or future land use activities that could contaminate a drinking water supply. A land use inventory of the Westport WHPA was completed in 2009.

It should be noted that a single land use activity could fall into multiple threat categories. For example, a crop farm could be practicing storage of fuel, application of commercial fertilizer to land, and application of agricultural source material to land. Each of these activities is a separate threat category in the provincial table, and so is therefore a separate threat.

The next step was to determine which land use activities and associated threats are occurring where the vulnerability score is high enough to result in a significant threat. In many cases, the specific circumstances that apply to a threat category are unknown. Using the same example, a crop farm may practice fuel storage, but the volume of fuel stored is unknown. Unless additional information was available, it was assumed that enough material was stored for that activity to be a significant threat.

A total of 8 potentially significant drinking water threats were identified in the Westport WHPA. For WHPAs, this is where the vulnerability score is 8 or 10, or if the activity pertains to dense non-aqueous phase liquids (DNAPLs), anywhere within the 5-year WHPA Zone C. The areas with potential significant drinking water threats are summarized in Table 5-21. Figure 5-98 shows the areas containing potential significant threats in purple and outlines the areas containing potential DNAPL threats in blue. Please see Section 4.3.3 for information on the full list of significant, moderate, and low threats.

Transportation Corridors

A number of transportation corridors, primarily roadways, exist within the Westport WHPA where there may be the transportation of dangerous and/or hazardous goods and the potential for a spill exists. Spills within the WHPA have the potential to impair the groundwater quality however they are not included as threats as per the prescribed drinking water threats categories (see Section 4-3).

This Assessment Report provides this key information for municipalities and other agencies to assist in ensuring all available information is accessible for emergency response planning purposes. Transportation corridors can be found on all WHPA maps including the Westport WHPA map in Figure 5-91.

5.11.7 Issues and Conditions in Westport Wellhead Protection Area

As discussed in Chapter 4 issues are documented cases of water quality contamination approaching or exceeding acceptable provincial levels. Both Total coliforms and E. *coli* have been detected in the Westport wells. Neither E. *coli* nor total coliforms have been detected in treated water. Scott Bryce (Clerk Treasurer, Village of Westport) has indicated that drinking water treatment upgrades are currently being implemented. More specifically, Mr. Bryce indicated that ultra violet disinfection units will be in place before the end of March 2010. As such, the documented presence of Total Coliforms and E. *coli* is not considered to be an issue for the Westport drinking water system because of the new drinking water treatment upgrades.

A condition is a situation where past activities resulted in a drinking water threat. No conditions were identified in the Westport WHPA.

5.12 Summary of Threats to Wellhead Protection Areas

Drinking water systems in the MRSPR have a total of 157 potentially significant threats. Kemptville has the greatest number of potential threats (58), followed by Merrickville (30) and Almonte (29). The Munster Hamlet drinking water system has the fewest threats, with only 7. The results are summarized in Table 5-22.

Septic loading also constitutes an important potential source of drinking water contamination in certain areas, as a high density of septic systems can lead to elevated levels of nitrate and bacteria in drinking water. In some instances, these areas may have been identified as polygons and counted as one threat, where in reality there are multiple septic systems involved. Table 5-23 lists the number of septic systems in each drinking water system in the MRSPR.

5.13 Summary

Seven wellhead protection areas have been delineated in the MRSPR. An eighth well for the Town of Lanark has not been completed and it is anticipated that information on the well and associated WHPAs will be included in assessment review updates. All municipal wells in the MRSPR, with the exception of the Almonte, Carp, and Westport wells, draw from a combination of the shallow and deep aquifers found at each site. All wellhead protection areas in the MRSPR which are currently delineated are shown in Figure 5-99.

Groundwater is more susceptible to contamination in some areas and these areas have been identified regionally as Highly Vulnerable Areas and Significant Groundwater Recharge Areas. Approximately 90% of the MRSPR has been identified as HVA. SGRAs account for 13.2% of the MRSPR.

Issues have been identified in non-municipal drinking water. As noted in Section 5.12, one hundred fifty-seven potentially significant threats have been identified in the region. Information on threats tables, which determine whether an activity is a significant threat, is provided.

Appendices

Appendix E1 - ISI Protocols, modifications, provincial permission

References

Dillon.

Ministry of the Environment. 2009. Proposed Methodology for Calculating Percentage of Managed Land and Livestock Density for Land Application of Agricultural Source of Material, Non-Agricultural Source of Material and Commercial Fertilizers, December 2009.

Chapter 5 - List of Tables

Mississippi-Rideau Source Protection Region Assessment Report

Table 5-1

Total managed lands and risk thresholds for HVAs and SGRAs in MRSPR.

Area	Percent Total Managed Lands	Risk Threshold	Livestock Density (NU/acre)	Risk Threshold
HVA	0.143	LOW	15.0%	LOW
SGRA	0.248	LOW	15.0%	LOW

Table 5-2

Potential Non--Municipal Drinking Water Issues

Mississippi - Rideau Source Protection Region

Potential NON-MUNICIPAL Drinking Water Issue	Brief Description	Associated Threat
Beckwith Landfill (Former) (Mississippi Valley watershed)	Detected contaminants in groundwater, including benzene, trichloroethylene, dichloroethylene and vinyl chloride.	Former private landfill just west of Blacks Corners.
Cranberry Estates Subdivisions (Rideau Valley watershed)	Detected coliform and elevated nitrate in private wells.	Numerous septic bed fields in subdivisions
Crotch Lake Area (Mississippi Valley watershed)	Elevated uranium in private wells.	n/a (naturally occurring)
Village of Constance Bay (Mississippi Valley watershed)	Elevated nitrate concentrations in private wells.	Likely due to cumulative effect of numerous septic systems in village
Village of Lanark (Mississippi Valley watershed)	Detected fecal coliform bacteria, and elevated nitrate in private wells.	Likely due to numerous septic systems in village

Table 5-3

Wellhead Protection Area Vulnerability Scores

Mississippi - Rideau Source Protection Region

Vulnerability Category (ISI)	WHPA-A	WHPA-B	WHPA-C	WHPA-D
High	10	10	10	6
Medium	10	8	8	4
Low	10	6	6	2

Table 5-4

Risk to Almonte WHPAs based on managed lands and livestock density.

Mississippi - Rideau Source Protection Region

WHPA Zone and Vul. Score	Percent Total Managed Lands	Risk for Over Application of Nutrients	Livestock Density		Risk for Over-Application of ASM
			Application of Nutrients (NU/acre)	Pasture/Grazing (NU/acre)	
NE Zone A #1 (10)	0.565	MODERATE	11.0%	0.17	LOW
NE Zone A #2 (10)	0.541	MODERATE	0	0	LOW
NE Zone B (6)	0.561	MODERATE	22.0%	0.41	LOW
NE Zone C (4)	0	LOW	0	0	LOW
NE Zone D (2)	0	LOW	0.0%	0	LOW
SW Zone A #1 (10)	0.282	LOW	0	0	LOW
SW Zone A #2 (10)	0.384	LOW	0.0%	0	LOW
SW Zone B (6)	0.071	LOW	0	0	LOW
SW Zone B (8)	0.503	MODERATE	0.0%	0.26	LOW
SW Zone B (10)	0.061	LOW	0.04%	0.26	LOW
SW Zone C (6)	0.252	LOW	3.0%	0.26	LOW
SW Zone C (8)	0.092	LOW	0	0.26	LOW
SW Zone D (6)	0.912	HIGH	0.0%	0	LOW

Table 5-5

Summary of Potentially Significant Threats to Almonte Source Water and Prescribed Activities Considered

Mississippi - Rideau Source Protection Region

Land Use Activity	Prescribed Drinking Water Quality Threat Category											TOTAL
	The application of agricultural source material to land.	The application of pesticide to land.	The handling and storage of a dense non-aqueous phase liquid.	The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.			The handling and storage of pesticide.	The handling and storage of commercial fertilizer.	The handling and storage of fuel.		
	Poly	Poly	Point	Poly	Line	Poly	Point	Poly	Poly	Point	Poly	
Municipal Fire-Fighting Services										1		**1**
Electric Power Generation, Transmission and Distribution										1		**1**
Sewage Treatment Facilities							1					**1**
Dry Cleaning and Laundry Services			1									**1**
Sewer Mainlines and Connections					3							**3**
Cattle Ranching and Farming				1								**1**
Other Animal Production				2							2	**4**
Other Crop Farming	2	2						2	2		3	**11**
Oilseed and Grain Farming	1	1						1	1		1	**5**
On-Site Septic Systems - Recreational/Residential						1						**1**
TOTAL	**3**	**3**	**1**	**3**	**3**	**1**	**1**	**3**	**3**	**2**	**6**	**29**

Note:

Clusters of residential septic systems in the significant threats inventory are grouped together and represented as polygons. Each polygon is counted once in the inventory, but represents multiple potentially significant threats. Based on a review of the sanitary sewer information, there are approximately 5 septic systems in the 1 polygon.

Table 5-6

Risk to Carp WHPAs based on managed lands and livestock density.

Mississippi - Rideau Source Protection Region

WHPA Zone and Vul. Score	Percent Total Managed Lands	Risk for Over Application of Nutrients	Livestock Density		Risk for Over Application of ASM
			Application of Nutrients (NU/acre)	Pasture/ Grazing (NU/acre)	
Zone A (10)	55.60%	MODERATE	0.00	0	LOW
Zone B (8)	9.10%	LOW	0.00	0	LOW
Zone B (10)	57.60%	MODERATE	0.00	0	LOW
Zone C (6)	26.70%	LOW	0.40	0.63	LOW
Zone C (8)	45.40%	MODERATE	0.07	0.36	LOW

Table 5-7

Summary of Potentially Significant Threats to Carp Source Water and Prescribed Activities Considered

Mississippi - Rideau Source Protection Region

Land Use Activity	Prescribed Drinking Water Quality Threat Category									TOTAL
	The application of pesticide to land.	The handling and storage of a dense non-aqueous phase liquid.	The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.		The handling and storage of pesticide.	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.	The handling and storage of fuel.		
	Poly	Point	Poly	Line	Poly	Poly	Poly	Point	Poly	
Dry Cleaning and Laundry Services		2								**2**
Automotive Parts, Accessories and Tire Stores		1								**1**
Elementary and Secondary Schools								1		**1**
Municipal Fire-Fighting Services								1		**1**
Agricultural Supplies Wholesaler-Distributors						1				**1**
Pesticide storage						1				**1**
Sewer Mainlines and Connections				2						**2**
Oilseed and Grain Farming	2								1	**3**
Cattle Ranching and Farming			2							**2**
Waste Treatment and Disposal							1			**1**
TOTAL	**2**	**3**	**2**	**2**	**0**	**2**	**1**	**2**	**1**	**15**

Table 5-8

Risk to Kemptville WHPAs (shallow aquifer) based on managed lands and livestock density

Mississippi - Rideau Source Protection Region

WHPA Zone and Vul. Score	Percent Total Managed Lands	Risk for Over Application of Nutrients	Livestock Density		Risk for Over Application of ASM
			Application of Nutrients (NU/acre)	Pasture/ Grazing (NU/acre)	
Zone A #1	27.50%	LOW	0.00	0	LOW
Zone A #2	37.60%	LOW	0.00	0	LOW
Zone A #3	30.10%	LOW	0.00	0	LOW
Zone B (8)	6.20%	LOW	0.09	4.1	LOW
Zone B (10)	38.60%	LOW	1.16	4.1	HIGH
Zone C (6)	9.90%	LOW	2.59	4.1	HIGH
Zone C (8)	33.90%	LOW	0.66	4.05	MODERATE
Zone D (6)	37.30%	LOW	0.34	0.5	LOW

Table 5-9

Risk to Kemptville WHPAs (deep aquifer) based on managed lands and livestock density

Mississippi - Rideau Source Protection Region

WHPA Zone and Vul. Score	Percent Total Managed Lands	Risk for Over Application of Nutrients	Livestock Density		Risk for Over Application of ASM
			Application of Nutrients (NU/acre)	Pasture/ Grazing (NU/acre)	
Zone A #1 (10)	27.50%	LOW	0.00	0	LOW
Zone A #2 (10)	37.60%	LOW	0.00	0	LOW
Zone A #3 (10)	30.10%	LOW	0.00	0	LOW
Zone B (6)	40.10%	MODERATE	0.67	1.41	MODERATE
Zone C (4)	0.00%	LOW	0.00	0	LOW
Zone D (2,4)	0.00%	LOW	0.00	0	LOW

Table 5-10

Summary of Potentially Significant Threats to Kemptville Source Water and Prescribed Activities Considered

Mississippi - Rideau Source Protection Region

Land Use Activity	Prescribed Drinking Water Quality Threat Category													TOTAL
	The application of agricultural source material to land.	The application of commercial fertilizer to land.	The application of pesticide to land.	The handling and storage of a dense non-aqueous phase liquid.	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	The handling and storage of pesticide.		The handling and storage of commercial fertilizer.	The handling and storage of fuel.		The handling and storage of fuel.	The application of road salt.	
	Poly	Poly	Poly	Point	Line	Poly	Point	Poly	Poly	Point	Poly	Point	Poly	
Animal Food Manufacturing							1	1						**2**
Automobile Dealers										2				**2**
Automotive Repair and Maintenance										1				**1**
Dry Cleaning and Laundry Services				3										**3**
Electric Power Generation, Transmission and Distribution				1						1				**2**
Electronic and Precision Equipment Repair and Maintenance				1										**1**
Elementary and Secondary Schools				1						3				**4**
Forest Nurseries and Gathering of Forest Products		1	1					1	1		1			**5**
Gasoline Stations										2				**2**
Glass Product Manufacturing from Purchased Glass										1				**1**
Meat Product Manufacturing												1		**1**
On-Site Septic Systems - Recreational/Residential						1								**1**
Other Ambulatory Health Care Services										1				**1**
Other Crop Farming	6	6	6					1	1		1			**21**
Other Schools and Instruction										1				**1**
Other Wood Product Manufacturing				1										**1**
Provincial Fire-Fighting Services										1				**1**
Residential Fuel / Hydrocarbon Storage										2				**2**
Road Salt Application														
Sewer Mainlines and Connections					4									**4**
Ship and Boat Building				1										**1**
Support Activities for Forestry											1			**1**
Taxi and Limousine Service										1				**1**
TOTAL	**6**	**7**	**7**	**8**	**4**	**1**	**1**	**2**	**2**	**16**	**3**	**1**	**3**	**61**

Note:

Clusters of residential septic systems in the significant threats inventory are grouped together and represented as polygons. Each polygon is counted once in the inventory, but represents multiple potentially significant threats. Based on a review of the sanitary sewer information, there are approximately 115 septic systems in the 1 polygon.

Table 5-11

Risk to Merricktville WHPAs (shallow aquifer) based on managed lands and livestock density

Mississippi - Rideau Source Protection Region

WHPA Zone and Vul. Score	Percent Total Managed Lands	Risk for Over Application of Nutrients	Livestock Density		Risk for Over Application of ASM
			Application of Nutrients (NU/acre)	Pasture/ Grazing (NU/acre)	
Zone A (10)	21.60%	LOW	0.00	0	LOW
Zone B (10)	55.20%	MODERATE	0.00	0	LOW
Zone C (8)	55.20%	MODERATE	0.01	0.48	LOW
Zone D (6)	32.60%	LOW	0.19	0.91	LOW

Table 5-12

Risk to Merricktville WHPAs (deep aquifer) based on managed lands and livestock density

Mississippi - Rideau Source Protection Region

WHPA Zone and Vul. Score	Percent Total Managed Lands	Risk for Over Application of Nutrients	Livestock Density		Risk for Over Application of ASM
			Application of Nutrients (NU/acre)	Pasture/ Grazing (NU/acre)	
Zone A (10)	21.60%	LOW	0.00	0.0	LOW
Zone B (6)	35.90%	LOW	0.34	0.9	LOW
Zone C (6)	1.20%	LOW	0.00	0.0	LOW
Zone D (6)	14.60%	LOW	0.00	0.0	LOW

Table 5-13

Summary of Potentially Significant Threats to Merrickville Source Water and Prescribed Activities Considered
Mississippi - Rideau Source Protection Region

Land Use Activity	Prescribed Drinking Water Quality Threat Category									
	The application of commercial fertilizer to land.	The application of pesticide to land.	The handling and storage of a dense non-aqueous phase liquid.	The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.		The handling and storage of fuel.	The handling and storage of non-agricultural source material.	TOTAL
	Poly	Poly	Point	Poly	Line	Point	Poly	Point	Point	
Automotive Repair and Maintenance			1							**1**
Cattle Ranching and Farming				3						**3**
Coating, Engraving, Heat Treating and Allied Activities			1							**1**
Dry Cleaning and Laundry Services (historical)			1							**1**
Electric Power Generation, Transmission and Distribution			1					1		**2**
Elementary and Secondary Schools								2		**2**
Gasoline Stations								1		**1**
Machine Shops, Turned Product, and Screw, Nut and Bolt Manufacturing			4							**4**
Marinas								1		**1**
Municipal Fire-Fighting Services								1		**1**
Navigational, Measuring, Medical and Control Instruments Manufacturing			1							**1**
Oilseed and Grain Farming	1	1								**2**
On-Site Septic Systems and Holding Tanks							2			**2**
Other Miscellaneous Manufacturing (historical)			1							**1**
RV (Recreational Vehicle) Parks and Recreational Camps							1	1		**2**
Sewage Treatment Facilities						1			1	**2**
Sewer Mainlines and Connections					2					**2**
Ship and Boat Building			1							**1**
TOTAL	**1**	**1**	**11**	**3**	**2**	**1**	**3**	**7**	**1**	**30**

Note:

Clusters of residential septic systems in the significant threats inventory are grouped together and represented as polygons. Each polygon is counted once in the inventory, but represents multiple potentially significant threats. Based on a review of the sanitary sewer information, there are approximately 140 septic systems in the 2 polygons.

Table 5-14

Risk to Munster WHPAs (shallow aquifer) based on managed lands and livestock density

Mississippi - Rideau Source Protection Region

WHPA Zone and Vul. Score	Percent Total Managed Lands	Risk for Over Application of Nutrients	Livestock Density		Risk for Over Application of ASM
			Application of Nutrients (NU/acre)	Pasture/ Grazing (NU/acre)	
Zone A #1 (10)	61.80%	MODERATE	0.00	0.00	LOW
Zone A #2 (10)	90.00%	HIGH	0.00	0.00	LOW
Zone B (8)	67.10%	MODERATE	0.50	0.67	MODERATE
Zone B (10)	47.60%	MODERATE	0.00	0.00	LOW
Zone C (6)	78.50%	MODERATE	0.20	0.69	LOW
Zone C (8)	64.50%	MODERATE	0.08	0.72	LOW
Zone D (6)	67.20%	MODERATE	0.00	0.00	LOW

Table 5-15

Risk to Munster WHPAs (deep aquifer) based on managed lands and livestock density

Mississippi - Rideau Source Protection Region

WHPA Zone and Vul. Score	Percent Total Managed Lands	Risk for Over Application of Nutrients	Livestock Density		Risk for Over Application of ASM
			Application of Nutrients (NU/acre)	Pasture/ Grazing (NU/acre)	
Zone A #1 (10)	61.80%	MODERATE	0.00	0.00	LOW
Zone A #2 (10)	90.00%	HIGH	0.00	0.00	LOW
Zone B (6)	62.80%	MODERATE	0.41	0.70	LOW
Zone B (8)	0.00%	LOW	0.00	0.00	LOW
Zone C (4)	0.00%	LOW	0.00	0.00	LOW
Zone C (6)	11.00%	LOW	0.00	0.00	LOW
Zone D (2)	0.00%	LOW	0.00	0.00	LOW

Table 5-16

Summary of Potentially Significant Threats to Munster Source Water and Prescribed Activities Considered
Mississippi - Rideau Source Protection Region

Land Use Activity	Prescribed Drinking Water Quality Threat					
	The application of agricultural source material to land.	The application of agricultural source material to land.	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.		The handling and storage of non-agricultural source material.	TOTAL
	Poly	Poly	Line	Poly	Poly	
Oilseed and Grain Farming	1	1				2
Sewage Treatment Facilities				1	1	**2**
Sewer Mainlines and Connections			3			**3**
TOTAL	**1**	**1**	**3**	**1**	**1**	**7**

Table 5-17

Risk to King's Park WHPAs (shallow aquifer) based on managed lands and livestock density

Mississippi - Rideau Source Protection Region

WHPA Zone and Vul. Score	Percent Total Managed Lands	Risk for Over Application of Nutrients	Livestock Density		Risk for Over Application of ASM
			Application of Nutrients (NU/acre)	Pasture/ Grazing (NU/acre)	
Zone A #1 (10)	43.80%	MODERATE	0.00	0.00	LOW
Zone A #2 (10)	27.70%	LOW	0.00	0.00	LOW
Zone B (8)	34.80%	MODERATE	0.00	0.00	LOW
Zone B (10)	12.50%	LOW	0.00	0.00	LOW
Zone C (6)	56.90%	MODERATE	0.00	0.00	LOW
Zone D (6)	77.90%	MODERATE	0.00	0.00	LOW

Table 5-18

Risk to King's Park WHPAs (deep aquifer) based on managed lands and livestock density

Mississippi - Rideau Source Protection Region

WHPA Zone and Vul. Score	Percent Total Managed Lands	Risk for Over Application of Nutrients	Livestock Density		Risk for Over Application of ASM
			Application of Nutrients (NU/acre)	Pasture/ Grazing (NU/acre)	
Zone A #1 (10)	43.80%	MODERATE	0.00	0.00	LOW
Zone A #2 (10)	27.70%	LOW	0.00	0.00	LOW
Zone B (6)	64.00%	MODERATE	0.10	0.45	LOW
Zone C (4)	0.00%	LOW	0.00	0.00	LOW
Zone D (2,4)	0.00%	LOW	0.00	0.00	LOW

Table 5-19

Summary of Potentially Significant Threats to King's Park Source Water and Prescribed Activities Considered.

Mississippi - Rideau Source Protection Region

Land Use Activity	Prescribed Drinking Water Quality Threat				
	The application of agricultural source material to land.	The application of pesticide to land.	The handling and storage of a dense non-aqueous phase liquid.	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	TOTAL
	Poly	Poly	Point	Line	
Dry Cleaning and Laundry Services			4		4
Manufacturing and Reproducing Magnetic and Optical Media			1		1
Other Crop Production	1	1			2
Other Wood Product Manufacturing			1		1
Sewer Mainlines and Connections				2	2
TOTAL	1	1	6	2	10

Table 5-20

Risk to Westport WHPAs based on Managed Lands and Livestock Density

Mississippi - Rideau Source Protection Region

WHPA Zone and Vul. Score	Percent Total Managed Lands	Risk for Over Application of Nutrients	Livestock Density		Risk for Over Application of ASM
			Application of Nutrients (NU/acre)	Pasture/ Grazing (NU/acre)	
Zone A (10)	47.60%	MODERATE	0.00	0.00	LOW
Zone B (8)	33.60%	LOW	0.37	0.80	LOW
Zone B (10)	23.60%	LOW	0.61	0.62	MODERATE
Zone C (6)	22.70%	LOW	0.66	0.71	MODERATE
Zone C (8)	19.80%	LOW	0.38	0.43	LOW
Zone D (6)	33.10%	LOW	0.15	0.29	LOW

Table 5-21

Summary of Potentially Significant Threats to Westport Source Water and Prescribed Activities Considered.
Mississippi - Rideau Source Protection Region

Land Use Activity	Prescribed Drinking Water Quality Threat Category								
	The handling and storage of a denseid.	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.		The handling and storage of pesticide.	The handling and storage of an organic solvent.	The handling and storage of commercial fertilizer.	The handling and storage of fuel.		TOTAL
	Point	Line	Poly	Poly	Point	Poly	Point	Poly	
Other Crop Farming				1		1		1	3
Rail Transportation	1				1		1		3
Sewer Mainlines and Connections		2							2
TOTAL	1	2	0	1	1	1	1	1	8

Table 5-22

Summary of Potential Significant Threats to Groundwater Based Municipal Drinking Water Systems.
Mississippi - Rideau Source Protection Region

System Name	Number of Potential Significant Threats	Line	Point	Poly	Total
Almonte (Mississippi Mills)	29	3	4	22	29
Carp (City of Ottawa)	15	2	7	6	15
Kemptville (North Grenville)	61	4	26	31	61
Merrickville (Merrickville-Wolford)	30	2	20	8	30
Munster (City of Ottawa)	7	3	0	4	7
Richmond – King's Park (City of Ottawa)	10	2	6	2	10
Westport (Westport)	8	2	3	3	8
TOTAL	160	18	66	73	160

Table 5-23

Approximate number of septic systems, based on review of sanitary servicing data.

Mississippi - Rideau Source Protection Region

System Name	Number of Septic Systems
Almonte (Mississippi Mills)	5
Carp (City of Ottawa)	0
Kemptville (North Grenville)	115
Merrickville (Merrickville-Wolford)	140
Munster (City of Ottawa)	0
Richmond – King's Park (City of Ottawa)	0
Westport (Westport)	0

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

Mississippi Valley Conservation

RIDEAU VALLEY CONSERVATION AUTHORITY

Drinking Water in the Town of Carleton Place

Draft Surface Water Study Findings – February 2010

Why Read This?

Property owners in the Carleton Place area, both on and off of town water, should review the following study results, currently under public review to:

- See maps of where Carleton Place's town water is taken from the Mississippi River;
- Understand if this section of the river is at risk of contamination; and
- Learn how land use policies in the Carleton Place area will help protect this part of the river.

The Clean Water Act

This study was done under Ontario's *Clean Water Act* which requires municipalities and the local community to work together to protect local drinking water sources from becoming contaminated or depleted. The Act is proactive, and is primarily focused on reducing risks to municipal drinking water sources (lakes, rivers and underground aquifers that supply "town water" to residents). Where drinking water sources face significant risks, mandatory action could be required.

2007 – Source Protection Committee Created

The Mississippi-Rideau Source Protection Committee is made up of 16 people representing a wide variety of local interests and sectors. This Committee is overseeing the development of science-based Source Protection Plans for the Mississippi River and Rideau River watersheds.

2009/2010 – Complete Scientific Studies

Technical studies are mapping local sources of drinking water, determining how vulnerable they are to contamination or overuse, and identifying potential risks. This science will show us where source protection policies are needed, and what risks they need to address.

2012 – Develop Policies to Protect Source Water

Source Protection Plans will contain a combination of voluntary and mandatory land use policies to protect drinking water sources. Under the Act, policies must moderate significant risks and prevent others from becoming significant.

Your Role

Broad public consultation will occur at each stage to ensure all local interests, concerns and knowledge are considered – please participate! The process of developing Source Protection Plans has been designed so that municipalities, conservation authorities, farmers, property owners, industry, business, community groups, environmental interests, public health officials, First Nations and the public work together to create effective, locally-workable, source protection policies.

Facts about the Carleton Place Municipal Drinking Water System:

- It is operated by the Town of Carleton Place
- It supplies 9,400 people in the Town of Carleton Place with drinking water
- Its water quality is consistently in compliance with the Ontario Drinking Water Standards
- It is made up of 1 intake that draws water from the Mississippi River
- The water treatment plant was constructed 1914

The Mississippi River - Carleton Place's Source of Drinking Water

The Town of Carleton Place draws its drinking water from the Mississippi River, which flows through a series of lakes (Crotch, Dalhousie, Mississippi Lake) before flowing past Carleton Place, Almonte, then north to the Ottawa River. The Mississippi River is 170 km in length and drains an area of approximately 3750 km^2. This surface water network is Carleton Place's 'source' water.

Water from the Mississippi River is treated at the water treatment plant before it is piped to homes and businesses in the Town of Carleton Place. Water is pretreated and screened to remove solids. It is then mixed with a coagulant which binds with remaining solids. The coagulant forms into sticky particles (called 'floc'), which attract and trap suspended particles before settling out of the water in large settling tanks. The 'floc' is collected at the bottom of each settling tank, while the clear water flows into collection troughs at the top. The clear water is filtered through layers of sand and anthracite. The filtered water is then disinfected, and fluoride is added before the water is ready for consumption.

Carleton Place Surface Water Study

In February 2010 a draft surface water study was completed to identify where extra measures should be taken to protect the Mississippi River upstream of Carleton Place's intake.

Step 1 – Delineate an Intake Protection Zone

Experts determined the direction and speed of the water in the Mississippi River, and its connecting streams and water courses, upstream of the intake. The map, showing the size and shape of the area that Carleton Place's municipal intake draws water from, is called an 'Intake Protection Zone'.

Step 2 – Assess Vulnerability

Next, experts assessed how vulnerable the Mississippi River and its tributaries are to contamination within the Intake Protection Zone. This was based on the physical characteristics and setting of intake, the historic incidence of water quality issues, the slope of the land surface, the type of land cover in the Intake Protection Zone, the built environment around the intake and other such factors.

Step 3 – Identify Threats and Issues

The province created a list of land uses and activities that could pose a low, moderate or significant risk in areas where the Mississippi River is vulnerable to contamination. Experts will inventory how many significant risks currently exist and identify any existing documented water quality problems. Water quantity threats will be evaluated as part of a water budget study currently underway.

Note: The following study findings provide information about water supplying Carleton Place's municipal intake. These findings may not apply to water supplying private intakes in the area. Individuals on private intakes should contact staff for more information.

Carleton Place Surface Water Study Findings

The Experts

For the Carleton Place surface water study, step 1 was completed by engineers at Mississippi Valley Conservation (MVC) in 2006. J.F. Sabourin and Associates Inc. (JFSA) and Water and Earth Science Associates Ltd. (WESA) revised and updated the results from step 1, and completed the work for step 2 in February 2010. Step 3 is currently being completed by Dillon Consulting Ltd. (Dillon). Steps 1 and 2 of the Carleton Place surface water study were subject to peer review (independent third party review) and conform to the Assessment Report Technical Rules (dated November 2009) issued under the *Clean Water Act*. The Technical Rules can be found at http://www.ene.gov.on.ca/en/water/cleanwater/cwa-technical-rules.php.

Climate Change Review

Climate change may impact the amount of water available to us in the future. The impact that climate change will have on the quantity of water supplies in the Mississippi Valley and Rideau Valley watersheds is generally unknown at this time. The Province therefore requires the use of historical stream flow data for the intake protection zones studies. The Province also requires a summary of the existing climate change knowledge and climate data, and an interpretation of how climate change can impact the conclusions in the Assessment Report. Please refer to the Mississippi-Rideau 'Climate Change Review' study and summary for this information. Future updates of intake protection zone studies may incorporate historical stream flow data as well as climate change information.

Step 1 – Delineate Intake Protection Zones

Methodology

An Intake Protection Zone is made up of three separate zones: IPZ-1, IPZ-2, and IPZ-3. These areas are adjacent to one another, but do not overlap. JFSA undertook six steps to delineate an Intake Protection Zone for Carleton Place:

1. Collection and assembly of data and information:

   JFSA collected relevant data and information from Federal, Provincial, Municipal, and other sources, relating to Carleton Place's local hydrology and climate. This included the generic regulation limit lines from MVC (for more information, visit http://www.mvc.on.ca/planning/regs.html). In addition, they looked at the characteristics of the surface water intake and surrounding land use. An integral part of this analysis was current and high-quality digital aerial photography and elevation data of the Town of Carleton Place, acquired by the Mississippi-Rideau Source Protection Region in 2006.

2. Delineation of IPZ-1:

   The first intake protection zone (IPZ-1), is directly adjacent to the surface water intake. The provincial Technical Rules outline how to create IPZ-1. First, a semi-circle with a radius of 200 metres was extended upstream from the centre of the intake. Then, to accommodate for overland flow or backflow, the semi-circle was extended 10 metres downstream of the intake (see figure 1 for an example of this default zone). Where IPZ-1 intersected the shore, it was expanded to a setback of 120 metres from the high water mark, or the Conservation Authority generic regulation limit, whichever is greater.

3. Development of a computer model:

   The second intake protection zone (IPZ-2), was based in part on the distance upstream from the intake that represents how long a contaminant in the water takes to travel a minimum of two hours. To calculate this, experts used a computer model to determine how fast water flows towards the intake.

   Specifically, the collected data is used to develop a general understanding of the local surface water system. Then, an appropriate surface water computer model was chosen from existing, established numerical models. A numerical model is a set of mathematical equations, usually held within a computer program, which is used to represent how surface water behaves in the physical environment (or 'hydraulic setting').

   For Carleton Place, the modeling was initially completed by MVC using *HEC-RAS*, and then revised by JFSA. HEC-RAS is a computer program that models how water flows through natural rivers and channels. This modeling software is publicly available and has been peer reviewed.

   Using the geometry from cross-sections at various points along the river, along with water flow data from a stream flow gauge, the model was used to determine the velocity with which water (at the various points) travels towards the intake in

the river. This information was used to determine the IPZ-2 time of travel. Under the provincial Technical Rules, the required time of travel must be equal to or less than the time that is sufficient to allow operators to shut down the water treatment plant in the event of a spill. For Carleton Place, the plant takes less than 5 minutes to shut down, so the time of travel was set to the minimum 2 hour limit.

4. Delineation of IPZ-2:

   The model used in step (3) provided the upper limits of the IPZ-2. To complete the delineation, the outer boundaries of the zone, along the edges of the river, needed to be set. According to the Technical Rules, the outer boundary of IPZ-2 is a setback of 120 metres from the high water mark, or the generic regulation limits line (as developed and maintained by MVC), whichever is greater.

   Also included in IPZ-2 were any storm sewer areas that discharge into the river within the 2 hour time. These areas were determined using the same approach as described in step 3 (i.e. using a 2 hour time of travel to establish what distance should be included up the storm sewer).

   So, to complete IPZ-2, the upper limits from the model were combined with the 120 metre setback and regulation limit lines from MVC, along with any nearby storm sewer areas.

5. Delineation of IPZ-3:

   The third intake protection zone (IPZ-3), was created by buffering all rivers, streams, and lakes upstream of IPZ-2 to include a setback of not more than 120 metres inland from the high water shoreline, and the area of the generic regulation limits line. Because the area upstream of Carleton Place's IPZ-2 is large with many streams, the total area of IPZ-3 is about 1,525 km^2.

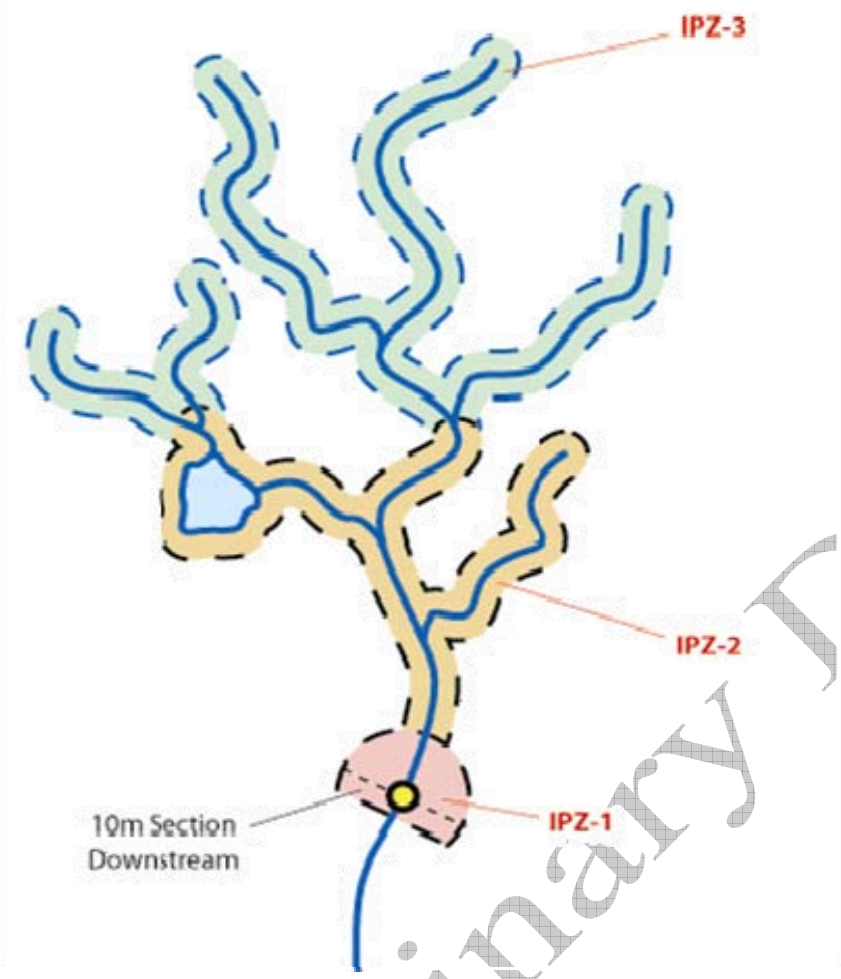
6. Assessment of Transport Pathways:

   A 'transport pathway' is anything that provides a direct way for contaminants to enter surface water. These are human-made or natural features, like water courses, drainage ditches, tile drains and roadways, which drain directly into the source water. Since these structures can drain water from a larger area than the river's main channel alone, the Intake Protection Zones were expanded to include them.

   So, the final step in the IPZ delineation process was to expand the default IPZ-2 and IPZ-3 zones if transport pathways were present. Using available information, JFSA completed this work for Carleton Place's IPZ-2 zone. There was not enough data available to complete this assessment for IPZ-3. Mapped wetlands that are contiguous to the IPZ-3 water courses were identified as potential transport pathways and included in the IPZ-3.

Figure 1, below, is a generic illustration of an Intake Protection Zone.

Figure 1. Theoretical Intake Protection Zone – IPZ-1, IPZ-2, IPZ-3



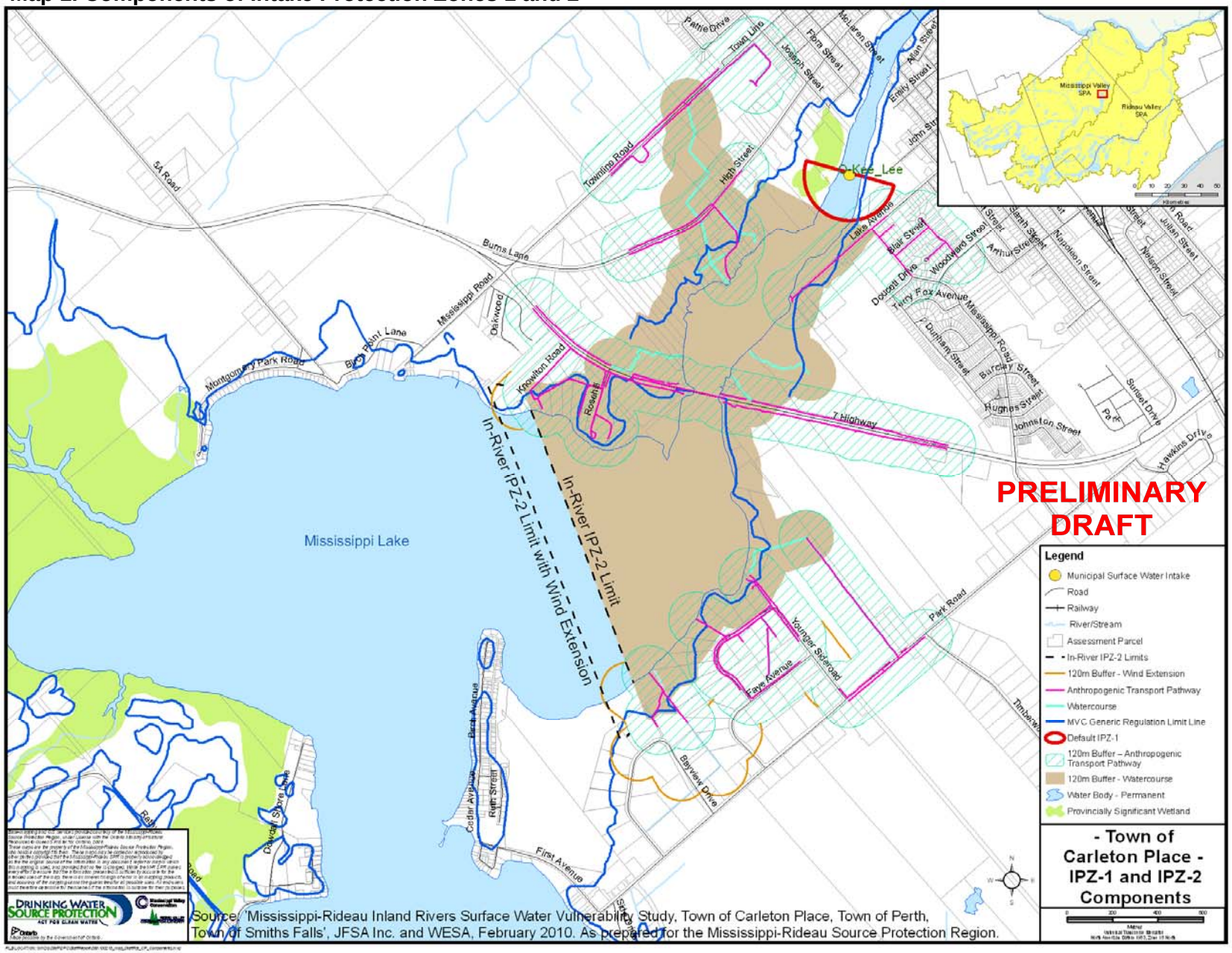
Results – Carleton Place Intake Protection Zones

Map 1 shows the various pieces that make up Carleton Place's IPZ-1 and IPZ-2. The map displays the generic regulation limit line, the default delineations based on the Technical Rules, and the modifications made to accommodate transport pathways.

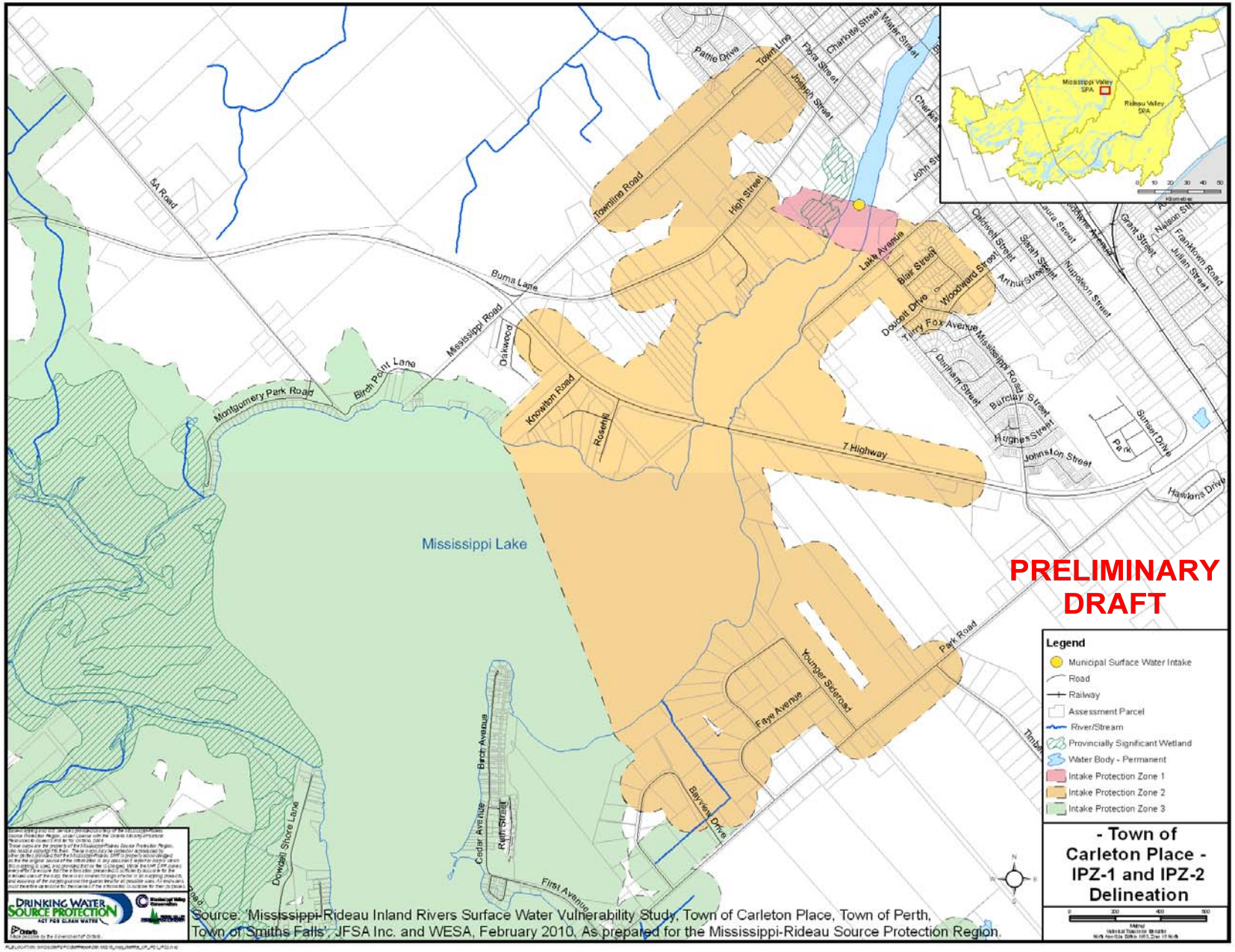
Map 2 shows the final IPZ-1 and IPZ-2 zones around Carleton Place's surface water intake. IPZ-1 covers approximately 0.09 km^2, and IPZ-2 approximately 3.9 km^2.

Map 3 shows Carleton Place's IPZ-3. The total area of this zone is approximately 1,525 km^2.

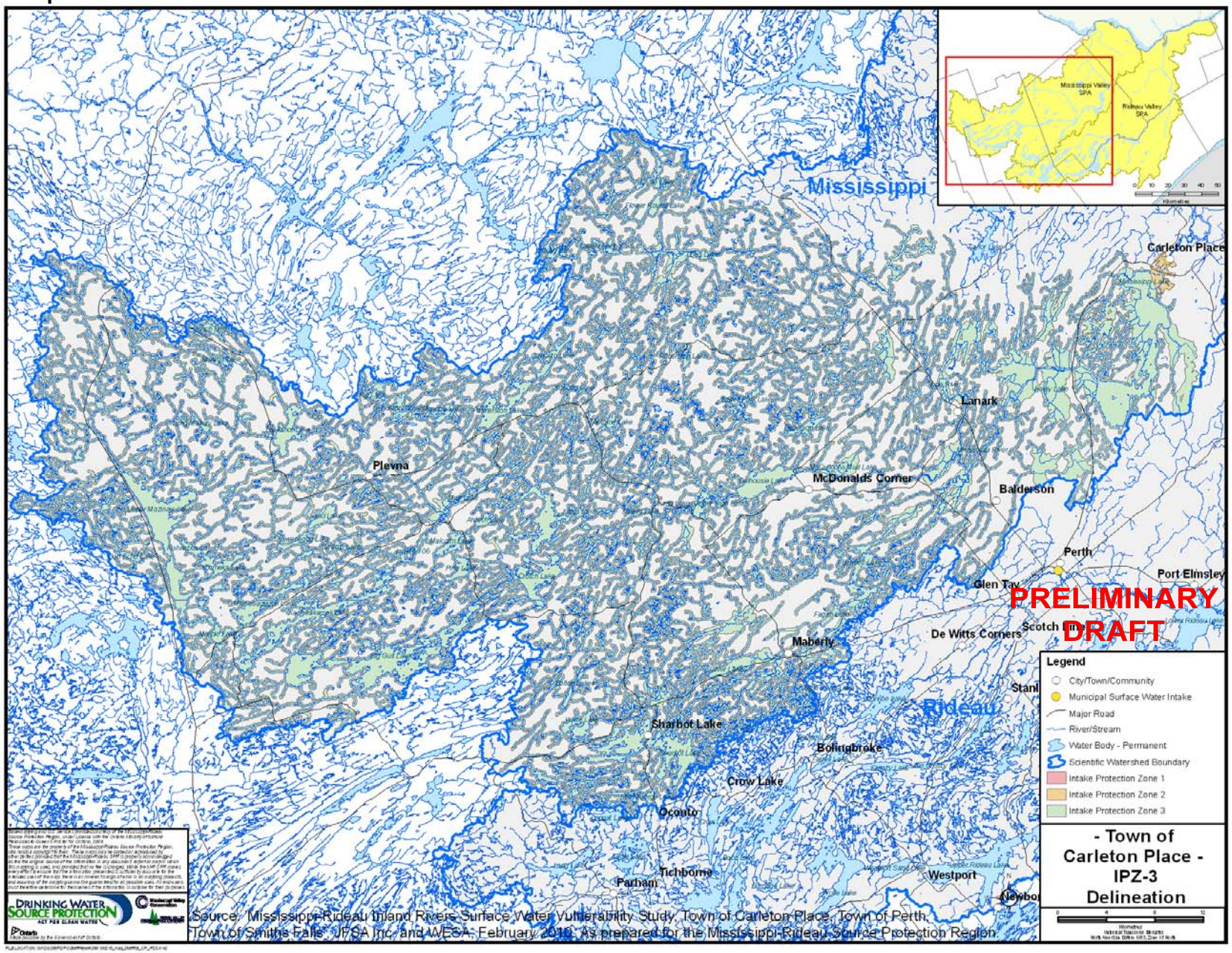
Map 1. Components of Intake Protection Zones 1 and 2



Map 2. Intake Protection Zones 1 and 2



Map 3. Intake Protection Zone 3



Step 2 – Assess Vulnerability

Once the intake protection zones were delineated, JFSA assessed how susceptible the surface water in these zones was to contamination. Identifying the surface water vulnerability of the mapped IPZ can reveal areas where extra care is needed to protect the water supply.

The provincial Technical Rules under the *Clean Water Act* set out a means for assessing the vulnerability for each intake protection zone. The final score is based on the following equation:

V = B x C

Where:

B is the area vulnerability factor

C is the source vulnerability factor

V is the vulnerability score

Table 1, below, shows the range of possible values for B, C and V for IPZ-1, IPZ-2 and IPZ-3. These components and how they are assigned are described below Table 1.

Table 1. IPZ Vulnerability Scores and Modifiers – Type C Intake

	Area Vulnerability Factor (B) *Expressed as a whole number*			**Source Vulnerability Factor (C)**	**Vulnerability Score (V)** *Expressed to one decimal point or as whole number depending on the value of C*		
Zone:	**IPZ-1**	**IPZ-2**	**IPZ-3**		**IPZ-1**	**IPZ-2**	**IPZ-3**
Possible Values:	*10*	*7 to 9*	*1 to 9*	*0.9 or 1*	*9 or 10*	*6.3 to 9*	*0.9 to 9*

Methodology and Results

1. Assigning the Area Vulnerability Factor:

   The first step in the evaluation of surface water vulnerability is to assign an 'area vulnerability factor', or **B**, for each intake protection zone. As shown in Table 1, B must be a whole number (no decimal points), and ranges from 1 to 10, with 10 being most vulnerable.

   - **IPZ-1**: This zone is closest to the intake and encompasses the area of water and land to which the intake is most vulnerable. It is assumed that if contaminants were released within IPZ-1 they would not diluted or filtered before reaching the intake, therefore, the area vulnerability factor for IPZ-1 is always **10**.

- **IPZ-2**: Under the provincial Technical Rules, the area vulnerability factor for IPZ-2 can be either 7, 8, or 9. One score must be assigned to the whole zone and the following factors must be taken into consideration:

  1) *Percentage of area of IPZ-2 that is land.* This factor reflects the potential for a spill to occur that may impact the intake.

  2) *The land cover, soil type, permeability of the land and the slope of the land.*

  3) *The hydrological and hydrogeological conditions.* This factor reflects the extent of the transport pathways that may exist in the zone.

  JFSA weighted each of these three criteria, and assigned a final area vulnerability score (B) for the Carleton Place IPZ-2 as 9. Further information is provided below.

- **IPZ-3**: For intake protection zone 3, more than one area vulnerability factor can be assigned, based on the above critieria and the distance from the intake. Land use and distance from the intake were used to determine the area vulnerability factors in this zone. According to the provincial Technical Rules, no factor can be higher than the one assigned to IPZ-2. Since B for IPZ-2 was set equal to 9, B for IPZ-3 ranges from **1** to **9**.

Determination of Area Vulnerability Factor for IPZ-2

Due to concerns raised by the Mississippi-Rideau Source Protection Committee in the Spring of 2009 about the 'numerical' surface water vulnerability scoring approach used by JFSA, further discussions were held in 2009 to explore other approaches and to hear various perspectives. As a result of the numerous discussions held in 2009, JFSA used a 'modified numerical approach' which addressed several of the concerns raised by the Committee.

The area vulnerability factor (B) for the Carleton Place IPZ-2 was established based on a numerical approach involving a weighted combination of the three factors presented above. The relationships and scoring categories that were developed for each factor that was considered in the analysis required some assumptions to be made in order to quantify a range in the vulnerability experienced locally in the study region. Table 2 below summarizes the specific information, including assumed minimum and maximum values for area vulnerability factor (B) that were used in the analysis to quantify each criteria.

Table 2, Summary of Specific Information used to determine the IPZ-2 Area Vulnerability Factor (B)

Parameter	Assumed Minimum Value (B = 7)	Assumed Maximum Value (B = 9)	Calculated value for Carleton Place IPZ 2 (based on local data)
Percentage of Area Composed of Land	10 %	90%	72%
Runoff Potential based on land cover/soil type/permeability (CN) and slope	CN =36, Slope = 0.25%	CN =95, Slope = 2%	CN =83, Slope = 1.42%
Transport Pathways (total length / main channel length)	0	9	14.86 km/2.12 km = 7.0

Table 3 below summarizes the derivation of the IPZ-2 area vulnerability factor (B) for the Carleton Place IPZ-2. Table 3 includes the converted area vulnerability values between assumed minimum value (B=7) and assumed maximum value (B=9) for each of the three parameters, as well as the assumed weighting.

Table 3, Summary of Scoring for the IPZ-2 Area Vulnerability Factor (B)

Parameter	Calculated value for Carleton Place IPZ 2 (based on local data	Converted B values for Carleton Place IPZ 2 between assumed minimum value (B=7) and assumed maximum value (B=9)		
		$B_{\%LA}$	$B_{CN, Slope}$	B_{TP}
Percentage of Area Composed of Land	72%	8.55		
Runoff Potential based on land cover/soil type/permeability (CN) and slope	CN =83, Slope = 1.42%		8.88	
Transport Pathways (total length / main channel length)	14.86 km/2.12 km = 7.0			8.56
Assumed Weighting		30 %	30%	40%
Weighted Area Vulnerability Factor (B)	8.65			
Assigned Area Vulnerability Factor (B)	9			

2. Assigning the Source Vulnerability Factor Modifier:

   The second step is to assess the 'source vulnerability factor', or **C**. This is an assessment of the location of the surface water intake and how vulnerable it is to the impact of contaminants. For a Type C intake (an intake on an inland river such as the Mississippi), C must be either **0.9** or **1.0**. The selected value was based on:

   - the depth of the intake below the water surface (the deeper the intake, the lower the vulnerability);
   - the distance of the intake from land (the further away from shore, the lower the vulnerability);
   - the number of recorded drinking water quality issues at the intake, if any;
   - the presence of hydraulic structures upstream.

   Although there have been no reported water quality incidences and there are no hydraulic structures near the intake, JFSA assessed C as **1.0** for Carleton Place because of the following:

   - shallow depth of intake (2.2 metres);
   - moderate distance of the intake from shore (48 metres);

3. Calculating IPZ Vulnerability Scores:

   Once the source and area vulnerability factors have been finalized, the final step is to complete the calculation of the final vulnerability scores, according to the prescribed equation.

   For Carleton Place, since the source vulnerability modifying factor (C) was set to **1**, the final vulnerability scores (v) for each of the zones were determined to be the same as the area vulnerability factors (B). Carleton Place's IPZ-1 has a final vulnerability score of 10, IPZ-2 a score of 9, and IPZ-3 a range of scores from 1 to 9. Table 4, below, displays these final values.

Table 4, IPZ Vulnerability Scores and Modifiers – Type C Intake

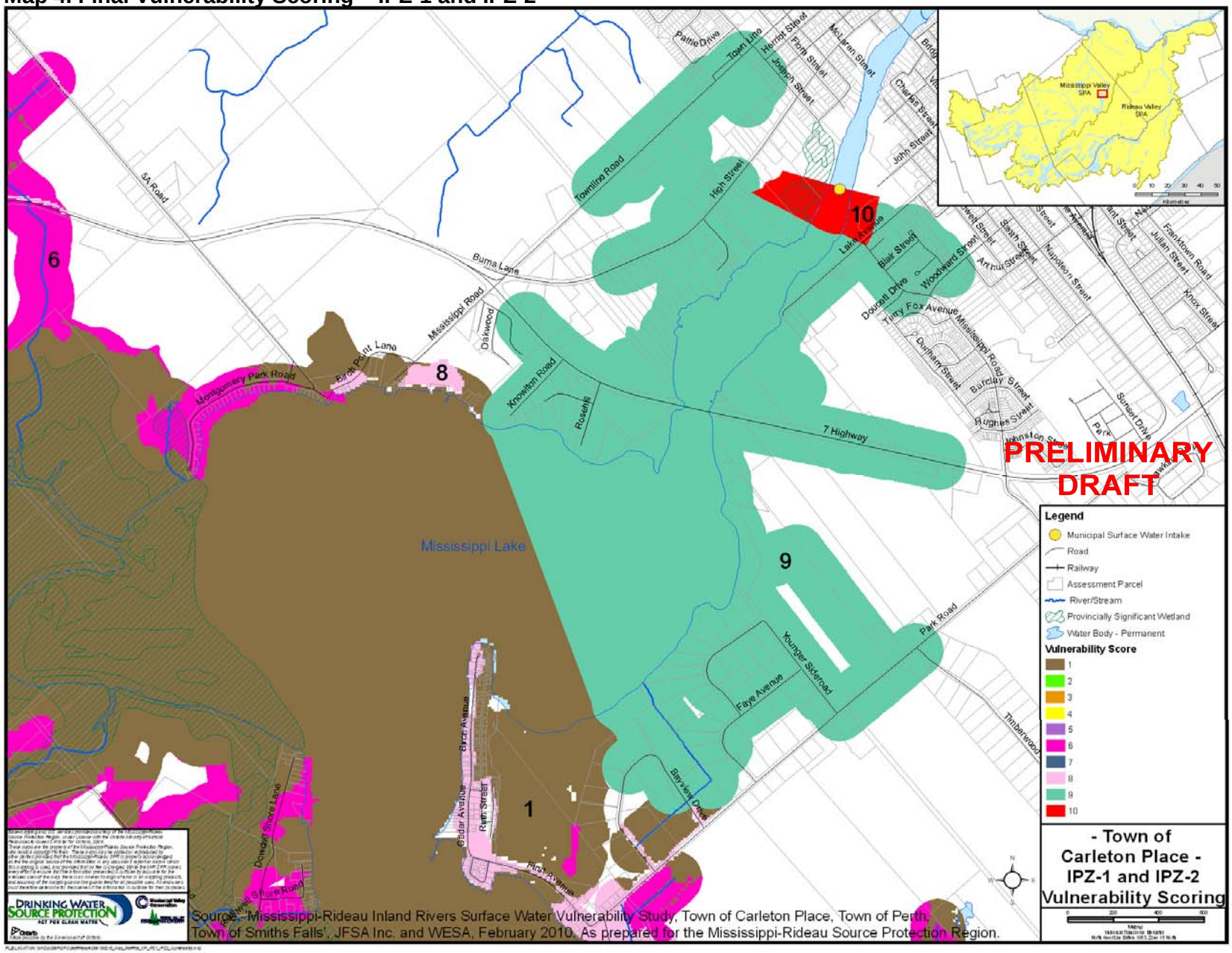
	Area Vulnerability Factor (B) *Expressed as a whole number*			Source Vulnerability Factor (C)	Vulnerability Score (V) *Expressed to one decimal point or as whole number depending on the value of C*		
Zone:	**IPZ-1**	**IPZ-2**	**IPZ-3**		**IPZ-1**	**IPZ-2**	**IPZ-3**
Possible Values:	*10*	*7 to 9*	*1 to 9*	*0.9 or 1*	*9 or 10*	*6.3 to 9*	*0.9 to 9*
Carleton Place Scores:	**10**	**9**	**1 to 9**	**1**	**10**	**9**	**1 to 9**

Results – Carleton Place Vulnerability Scores

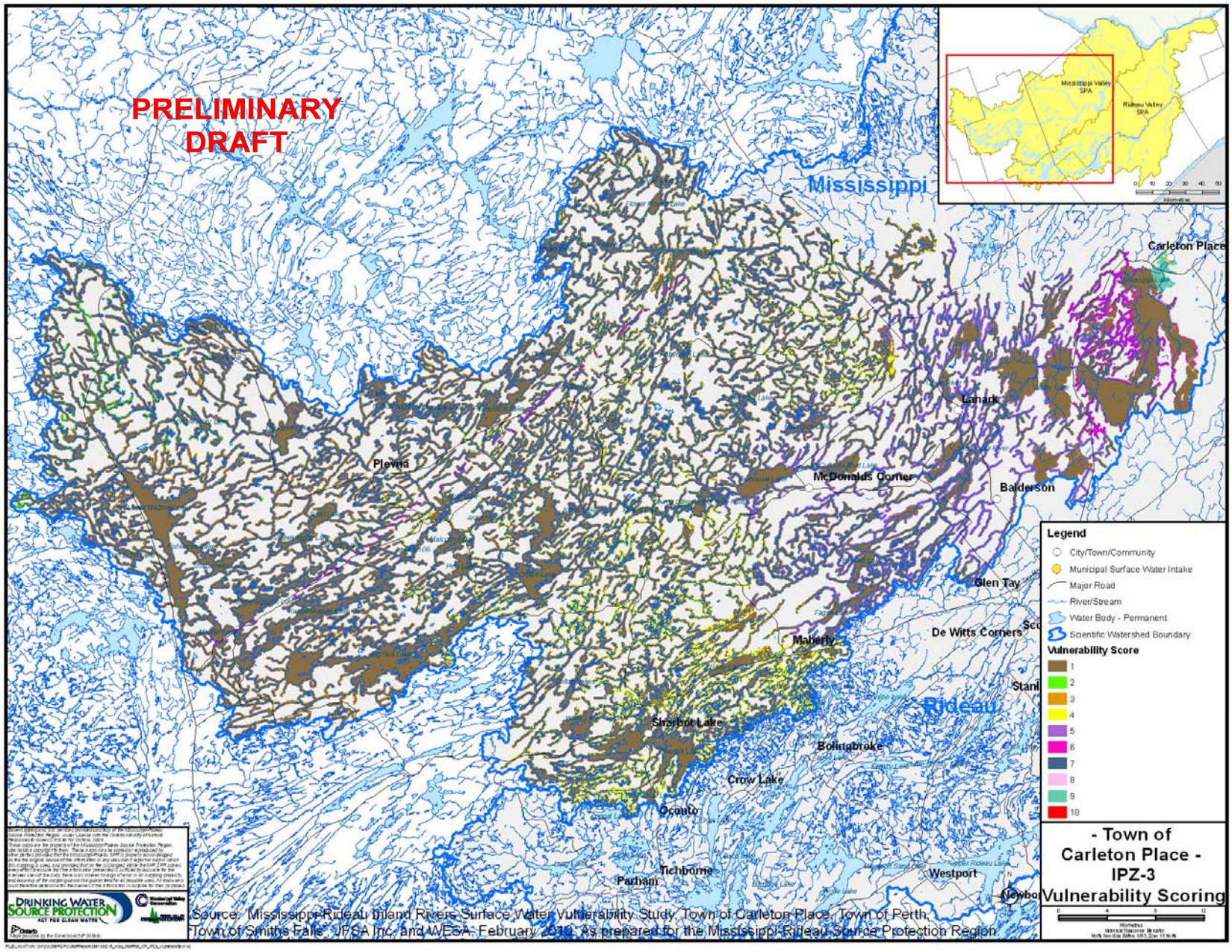
Map 4 shows the final vulnerability scoring for Carleton Place's IPZ-1 and IPZ-2.

Map 5 shows the final vulnerability scoring for Carleton Place's IPZ-3.

Map 4. Final Vulnerability Scoring – IPZ-1 and IPZ-2



Map 5. Final Vulnerability Scoring – IPZ-3



Step 3 – Identify Threats and Issues for Water Quality

Once experts determine where a drinking water supply is vulnerable to contamination, they need to identify what land use activities could pose a contamination risk in those areas (threats). Experts also need to identify any existing water quality problems (issues) and link them back to the land use(s) causing the contamination.

(1) **Threats** are existing conditions (i.e., contaminated sediment, soil or groundwater) or existing or future land use activities that could contaminate a drinking water supply;

(2) **Issues** are documented cases of water quality contamination approaching or exceeding acceptable provincial levels. While some issues are naturally occurring, many are caused by an existing or historic land use activity.

For the Carleton Place intake, there are three possible approaches for identifying drinking water threats:

3a) Threats

The Assessment Report Technical Rules identify the three ways that a water quality threat can be identified:

I. Through an activity prescribed by the Clean Water Act;

II. Through an activity identified by the Source Protection Committee; and

III. Through a condition resulting from past activities.

I. Activities Prescribed by the Clean Water Act

Before threats could be identified, the province had to decide what activities pose a threat, and to what extent. Section 1.1 of Ontario Regulation 287/07 (made under the Clean Water Act) lists 21 broad land use activities as '*prescribed drinking water threats*'. These 21 activities are listed in Table 2 below, and they cover both chemical contaminants and pathogenic bacteria.

The province then broke each of the 21 broad activities into various scenarios called *circumstances* (e.g. activity A involving the storage of chemical X in an above ground storage tank greater than 50,000 litres). There are 500 pages of specific circumstances in the provincial Technical Rules and they are divided into two tables – chemical threats and pathogenic threats. The tables of drinking water threats can be found at:

http://www.ene.gov.on.ca/en/water/cleanwater/cwa-technical-rules.php

These tables identify if a circumstance is a 'significant', 'moderate', or 'low' risk in each vulnerability score (2, 4, 6, 8 and 10). For example, a circumstance may be a *significant* risk in an area with a vulnerability score of 10, and a *moderate* risk in an area with a vulnerability score of 8.

Note: There are two prescribed drinking water threats (numbers 19 and 20) that pertain to water *quantity* threats. These will be evaluated as part of a water budget study currently underway.

Methodology

1. List low, moderate, and significant risks:

   Using the threats tables, the first step is to list all land use activities (circumstances) that pose a low, moderate, and significant risk to the surface water supplying Carleton Place's municipal intake (based on the vulnerability scores in the IPZ). This is simply a summary of the provincial drinking water threats tables, it does not reflect what activities are actually taking place in the IPZ (see step 2).

   Under the province's threats tables, a land use activity can only be a *significant risk* if it is in an area that has a vulnerability score of **8, 9** or **10**. Table 2, below, shows for each vulnerability score, which of the 21 prescribed drinking water threats have circumstances that pose a significant risk. The table shows that the majority of threats must occur in areas with a vulnerability score of **9 or 10** to be classed as significant, and only two can be significant in areas with a vulnerability score of **8**.

   Attached to this document is a complete list of the threats circumstances that can be classed as significant in an IPZ. This table is a *subset* of the full provincial drinking water threats tables.

2. Inventory existing significant risks:

   Under the Technical Rules, Dillon must use the list of potential significant risks and count how many of those land uses are taking place on the ground.

   Dillon is using air photos, commercial databases, and roadside observations, to develop an inventory of locations that may have significant risks within the Carleton Place IPZ.

3. Confirm inventory of significant risks:

   It is impossible to know the details of a particular land use activity without seeking additional information from the property owner. This information would include details about specific practices and contaminants in use. This detailed information is required to confirm if a land use activity is a significant risk or not.

   Dillon will not be approaching property owners for additional information in the Mississippi-Rideau region. The inventory of existing significant risks will be compiled based on the information available about local land use activities. Property owners wishing to confirm whether or not they are a significant risk are encouraged to contact staff who will work with them to collect the necessary information to make such a determination.

II. Activity identified by the Source Protection Committee

A drinking water threat can be identified by the Source Protection Committee if the activity is not included in the provincial list of 21 prescribed drinking water threats. This can only occur if a hazard assessment confirms that the activity is a threat, and this assessment is approved by the MOE.

III. Through a condition resulting from past activities.

Threats can also be identified if conditions relating to a past activity (i.e. a contaminated site) have resulted in:

- the presence of contamination in sediment;
- the presence of non-aqueous phase liquid (i.e., gasoline) in groundwater;
- the presence of a single mass of 100 litres of dense non-aqueous phase liquids in surface water.

Table 2: Provincial Threat Categories with Circumstances That Could Pose a Significant Risk in an IPZ

		Intake Protection Zone (IPZ) Vulnerability Scoring							
	Contaminant released:	Chemical				Pathogen			
	Prescribed drinking water threat category	10	9	8	1-7	10	9	8	1-7
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the *Environmental Protection Act*.	✓	✓			✓	✓	✓	
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	✓	✓	✓		✓	✓	✓	
3	The application of agricultural source material to land.	✓	✓			✓	✓	✓	
4	The storage of agricultural source material.	✓	✓			✓	✓	✓	
5	The management of agricultural source material.								
6	The application of non-agricultural source material to land.	✓	✓			✓	✓	✓	
7	The handling and storage of non-agricultural source material.	✓	✓			✓	✓	✓	
8	The application of commercial fertilizer to land.	✓	✓						
9	The handling and storage of commercial fertilizer.	✓							
10	The application of pesticide to land.	✓	✓	✓					
11	The handling and storage of pesticide.	✓	✓						
12	The application of road salt.	✓	✓						
13	The handling and storage of road salt.	✓	✓						
14	The storage of snow.	✓	✓						
15	The handling and storage of fuel.	✓							
16	The handling and storage of a dense non-aqueous phase liquid (DNAPLS)*.	✓							
17	The handling and storage of an organic solvent.	✓							
18	The management of runoff that contains chemicals used in the de-icing of aircraft.	✓	✓						
19	An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.**								
20	An activity that reduces the recharge of an aquifer.**								
21	The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard.	✓	✓			✓	✓	✓	

*DNAPLs are chemicals that are heavy and sink in water (e.g. trichloroethylene)

**Water quantity threats will be evaluated as a part of the Water Budget studies

3b) Issues

A drinking water issue is a documented problem with the quality of drinking water. This can be a chemical or pathogenic bacteria problem documented in the source of a surface water system that exceeds Ontario's established drinking water standards, or shows the potential to exceed these standards in the future.

Under the Technical Rules, for municipal drinking water systems issues can refer to chemical, nuclear, or bacterial contaminants. For non-municipal intakes, issues are limited to chemical or nuclear contaminants. The specific parameters can be found in Schedules 1, 2, or 3 of the Ontario Drinking Water Quality Standards, and in Table 4 of the Technical Support Document for the Ontario Drinking Water Quality Standards, Objectives and Guidelines. The Ontario Drinking Water Quality Standards can be found here: http://www.search.e-laws.gov.on.ca/en/isysquery/4911a9de-3fbb-4359-ad9f-4bb28526e99e/5/frame/?search=browseStatutes&context.

The Technical Support Document for the Ontario Drinking water Standards can be found here: http://www.ontario.ca/drinkingwater/stel01_046947.pdf

The identification of known issues is a way to include historic or cumulative activities in the source protection planning process. For example, an old industrial site could be leaching a contaminant into the aquifer, resulting in poor water quality.

If a contaminant or pathogen has been identified in the source water of a well, the following information is required:

- the area or location that is causing the contaminant or pathogen, and
- the land use activities, conditions (including naturally occurring conditions), or past activities at that location that are associated with the contaminant or pathogen.

If the above information cannot be readily determined, a plan must be developed to collect it for inclusion in a future Assessment Report.

While all reports to date indicate that Carleton Place's municipal drinking water quality is in compliance with the Ontario Drinking Water Standards, Dillon will be reviewing all available information, as required by the province, to ensure there are no drinking water issues.

For More Information Contact:

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www.mrsourcewater.ca

Drinking Water in the Town of Perth

Draft Surface Water Study Findings – February 2010

Why Read This?

Property owners in the Perth area, both on and off of town water, should review the following study results, currently under public review, to:

- See maps of where Perth's town water is taken from the Tay River;
- Understand if this section of the river is at risk of contamination; and
- Learn how land use policies in the Perth area will help protect this part of the river.

The Clean Water Act

This study was done under Ontario's *Clean Water Act* which requires municipalities and the local community to work together to protect local drinking water sources from becoming contaminated or depleted. The Act is proactive, and is primarily focused on reducing risks to municipal drinking water sources (lakes, rivers and underground aquifers that supply "town water" to residents). Where drinking water sources face significant risks, mandatory action could be required.

2007 – Source Protection Committee Created

The Mississippi-Rideau Source Protection Committee is made up of 16 people representing a wide variety of local interests and sectors. This Committee is overseeing the development of science-based Source Protection Plans for the Mississippi River and Rideau River watersheds.

2009 – Complete Scientific Studies

Technical studies are mapping local sources of drinking water, determining if they are vulnerable to contamination or overuse, and identifying potential risks. This science will show us where source protection policies are needed, and what risks they need to address.

2012 – Develop Policies to Protect Source Water

Source Protection Plans will contain a combination of voluntary and mandatory land use policies to protect drinking water sources. Under the Act, policies must moderate significant risks and prevent others from becoming significant.

Your Role

Broad public consultation will occur at each stage to ensure all local interests, concerns and knowledge are considered – please participate! The process of developing Source Protection Plans has been designed so that municipalities,

conservation authorities, farmers, property owners, industry, business, community groups, environmental interests, public health officials, First Nations and the public work together to create effective, locally-workable, source protection policies.

Facts about the Perth Municipal Drinking Water System:

- It is operated by the Town of Perth
- It supplies 6,000 people in the Town of Perth with drinking water
- Its water quality is consistently in compliance with the Ontario Drinking Water Standards
- It is made up of 1 intake that draws water from the Tay River
- The water treatment plant was constructed 1964

The Tay River – Perth's Source of Drinking Water

The Town of Perth draws its drinking water from the Tay River, which flows through downtown and is a tributary of the Rideau River. The Tay River is 95 km in length and drains an area of approximately 800 km^2. There are many lakes upstream of Perth (e.g. Long, Eagle, Elbow, Crow, Bobs, Christie). Control structures at Eagle Lake and at Bobs Lake are used for flood control and for maintaining summer water flow within the Rideau Canal system. This surface water network is Perth's 'source' water.

Water from the Tay River is treated at the water treatment plant before it is piped to homes and businesses in the Town of Perth. Water is screened to remove solids, pre-treated, and then mixed with a coagulant which binds with remaining solids. The coagulant forms into sticky particles (called 'floc'), which attract and trap suspended particles before settling out of the water in large settling tanks. The clear water is pumped from the top of the tank, and filtered through layers of activated carbon, sand, and gravel. The filtered water is then disinfected, lime is added to adjust for pH (as well as to help reduce pipe corrosion), and fluoride is added before the water is ready for consumption.

Perth Surface Water Study

In February 2010 a draft surface water study was completed to identify where extra measures should be taken to protect the Tay River upstream of Perth's intake.

Step 1 – Delineate an Intake Protection Zone

Experts determined the direction and speed of the water in the Tay River, and its connecting streams and water courses, upstream of the intake. The map, showing the size and shape of the area that Perth's municipal intake draws water from, is called an Intake Protection Zone.

Step 2 – Assess Vulnerability

Next, experts assessed how vulnerable the Tay River and its tributaries are to contamination within the Intake Protection Zone. This was based on the physical characteristics and setting of the intake, the historic incidence of water quality issues, the slope of the land surface, the type of land cover in the Intake Protection Zone, the built environment around the intake and other such factors.

Step 3 – Identify Threats and Issues

The province created a list of land uses and activities that could pose a low, moderate or significant risk in areas where the Tay River is vulnerable to contamination. Experts will inventory how many significant risks currently exist and identify any existing documented water quality problems. Water quantity threats will be evaluated as part of a water budget study currently underway.

Note: The following study findings provide information about water supplying Perth's municipal intake. These findings may not apply to water supplying private intakes in the area. Individuals on private intakes should contact staff for more information.

Perth Surface Water Study Findings

The Experts

For the Perth surface water study, step 1 was completed by engineers at the Rideau Valley Conservation Authority (RVCA) in 2006. J.F. Sabourin and Associates Inc. (JFSA) and Water and Earth Science Associates Ltd. (WESA) revised and updated the results from step 1, and completed the work for step 2 in February 2010. Step 3 is currently being completed by Dillon Consulting Ltd. (Dillon). Steps 1 and 2 of the study were subject to peer review (independent third party review) and conform to the Assessment Report Technical Rules (dated November 2009) issued under the *Clean Water Act*. The Technical Rules can be found at http://www.ene.gov.on.ca/en/water/cleanwater/cwa-technical-rules.php.

Climate Change Review

Climate change may impact the amount of water available to us in the future. The impact that climate change will have on the quantity of water supplies in the Mississippi Valley and Rideau Valley watersheds is generally unknown at this time. The Province therefore requires the use of historical stream flow data for the intake protection zones studies. The Province also requires a summary of the existing climate change knowledge and climate data, and an interpretation of how climate change can impact the conclusions in the Assessment Report. Please refer to the Mississippi-Rideau 'Climate Change Review' study and summary for this information. Future updates of intake protection zone studies may incorporate historical stream flow data as well as climate change information.

Step 1 – Delineate Intake Protection Zones

Methodology

An Intake Protection Zone is made up of three separate zones: IPZ-1, IPZ-2, and IPZ-3. These areas are adjacent to one another, but do not overlap. JFSA undertook six steps to delineate an Intake Protection Zone for Perth:

1. Collection and assembly of data and information:

   JFSA collected relevant data and information from Federal, Provincial, Municipal, and other sources, relating to Perth's local hydrology and climate. This included the generic regulation limit lines from RVCA (for more information visit www.rvca.ca/plan-reg/maps_regulations.html). In addition, they looked at the characteristics of the surface water intake and surrounding land use. An integral part of this analysis was current and high-quality digital aerial photography and

elevation data of the Town of Perth, acquired by the Mississippi-Rideau Source Protection Region in 2006.

2. Delineation of IPZ-1:

   The first intake protection zone (IPZ-1) is directly adjacent to the surface water intake. The provincial Technical Rules outline how to create IPZ-1. First, a semi-circle with a radius of 200 metres was extended upstream from the centre of the intake. Then, to accommodate for overland flow or backflow, the semi-circle was extended 10 metres downstream of the intake (see figure 1 for an example of this default zone). Where IPZ-1 intersected the shore, it was expanded to a setback of 120 metres from the high water mark or the Conservation Authority generic regulation limit, whichever was greater.

3. Development of a computer model:

   The second intake protection zone (IPZ-2), was based in part on the distance upstream from the intake that represents how long a contaminant in the water takes to travel a minimum of two hours. To calculate this, experts used a computer model to determine how fast water flows towards the intake.

   Specifically, the collected data was used to develop a general understanding of the local surface water system. Then, an appropriate surface water computer model was chosen from existing, established numerical models. A numerical model is a set of mathematical equations, usually held within a computer program, which is used to represent how surface water behaves in the physical environment (or 'hydraulic setting').-

   For Perth, the modeling was initially completed by the RVCA using *HEC-2*l, and then revised by JFSA using *HEC-RAS*. HEC-RAS is a computer program that models how water flows through natural rivers and channels. This modeling software is publicly available and has been peer reviewed.

   Using the geometry from cross-sections at various points along the river, along with water flow data from a stream flow gauge, the model was used to determine the velocity with which water (at the various points) travels towards the intake in the river. This information was used to determine the IPZ-2 time of travel. Under the provincial Technical Rules, the required time of travel must be equal to or less than the time that is sufficient to allow operators to shut down the water treatment plant in the event of a spill. For Perth, the plant takes less than 5 minutes to shut down, so the time of travel was set to the minimum 2 hour limit.

4. Delineation of IPZ-2:

   The model used in step (3) provided the upper limits of IPZ-2. To complete the delineation, the outer boundaries of the zone, along the edges of the river, needed to be set. According to the Technical Rules, the outer boundary of IPZ-2 is a setback of 120 metres from the high water mark, or the generic regulation limits line (as developed and maintained by the RVCA), whichever is greater.

   Also included in IPZ-2 were any storm sewer areas that discharge into the river within the 2 hour time. These areas were determined using the same approach as described in step 3 (i.e. using a 2 hour time of travel to establish what distance should be included up the storm sewer).

   So, to complete IPZ-2, the upper limits from the model were combined with the 120 metre setback and regulation limit lines from the RVCA, along with any nearby storm sewer areas.

5. Delineation of IPZ-3:

   The third intake protection zone (IPZ-3), was created by buffering all rivers, streams, and lakes upstream of IPZ-2 to include a setback of 120 metres from the high water mark, or the generic regulation limits line, whichever is greater. Because the area upstream of Perth's IPZ-2 is large with many streams, the total area of IPZ-3 is about 364 km^2.

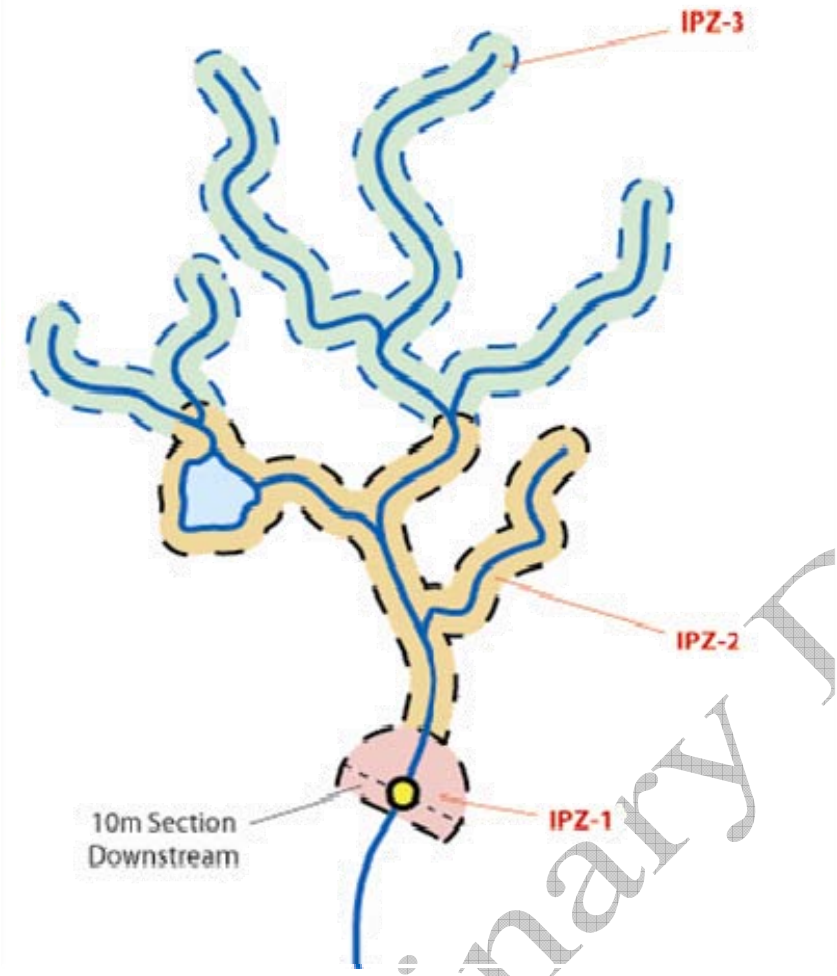
6. Assessment of Transport Pathways:

   A 'transport pathway' is anything that provides a direct way for contaminants to enter surface water. These are human-made or natural features, like drainage ditches, tile drains and roadways, which drain directly into the source water. Since these structures can drain water from a larger area than the river's main channel alone, the Intake Protection Zones were expanded to include them.

   So, the final step in the IPZ delineation process was to expand the default IPZ-2 and IPZ-3 zones if transport pathways were present. Using available information, JFSA completed this work for Perth's IPZ-2 zone. There was not enough data available to complete this assessment for IPZ-3. Mapped wetlands that are contiguous to the IPZ-3 water courses were identified as potential transport pathways and included in the IPZ-3.

Figure 1, below, is a generic illustration of an Intake Protection Zone.

Figure 1. Theoretical Intake Protection Zone – IPZ-1, IPZ-2, and IPZ-3



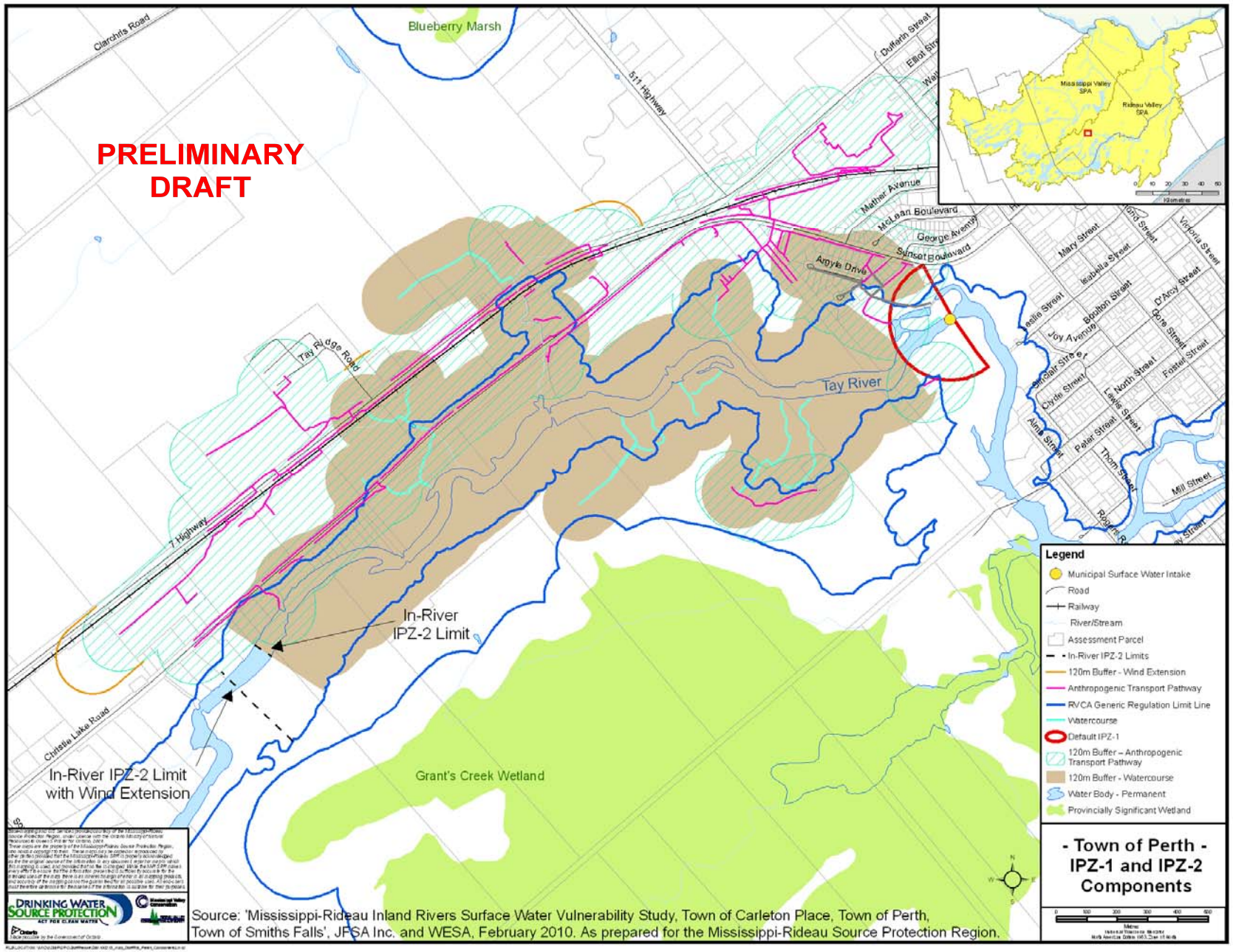
Results – Perth Intake Protection Zones

Map 1 shows the various pieces that make up Perth's IPZ-1 and IPZ-2. The map displays the generic regulation limit line, the default delineations based on the Technical Rules, and the modifications made to accommodate transport pathways.

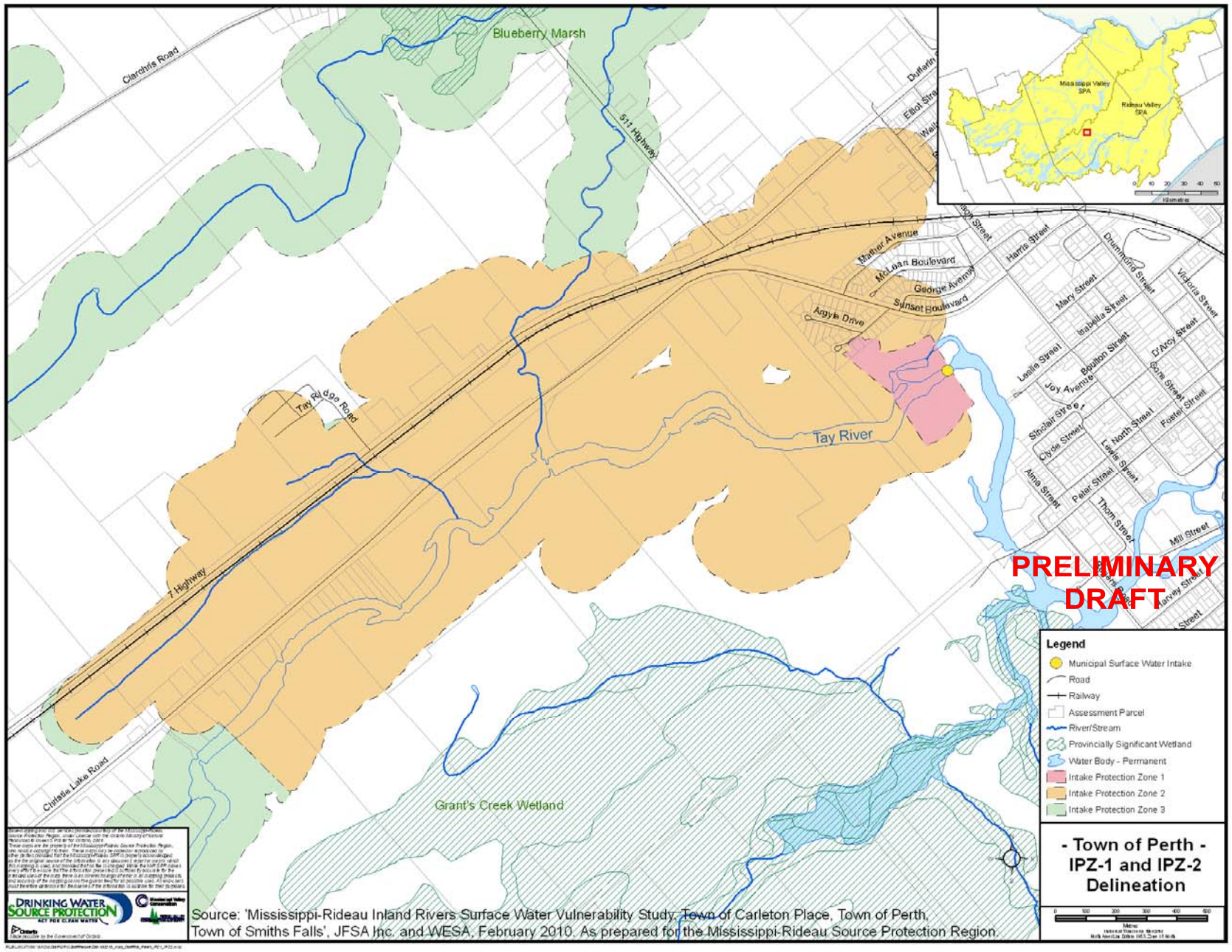
Map 2 shows the final IPZ-1 and IPZ-2 zones around Perth's surface water intake. IPZ-1 covers approximately 0.06km^2, and IPZ-2 approximately 2.9 km^2.

Map 3 shows Perth's IPZ-3. The total area of this zone is approximately 364 km^2.

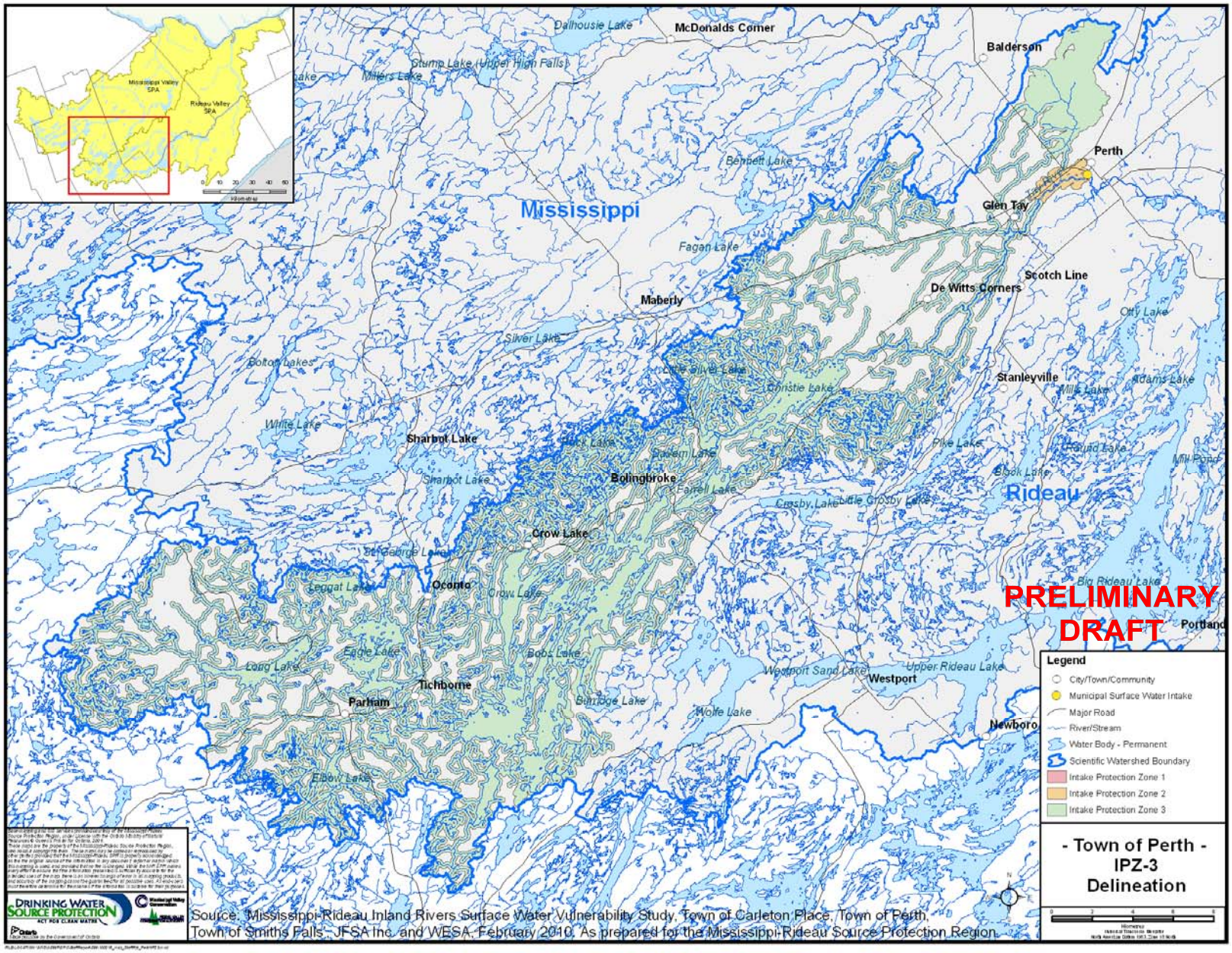
Map 1. Components of Intake Protection Zones 1 and 2



Map 2. Intake Protection Zones 1 and 2



Map 3. Intake Protection Zone 3



Step 2 – Assess Vulnerability

Once the intake protection zones were delineated, JFSA assessed how susceptible the surface water in these zones was to contamination. Identifying the surface water vulnerability of the mapped IPZ can reveal areas where extra care is needed to protect the water supply.

The provincial Technical Rules under the *Clean Water Act* set out a means for assessing the vulnerability for each intake protection zone. The final score is based on the following equation:

V = B x C

Where:

B is the area vulnerability factor

C is the source vulnerability factor

V is the vulnerability score

Table 1, below, shows the range of possible values for B, C and V for IPZ-1, IPZ-2 and IPZ-3. These components and how they are assigned are described below Table 1.

Table 1. IPZ Vulnerability Scores and Modifiers – Type C Intake

	Area Vulnerability Factor (B) *Expressed as a whole number*			**Source Vulnerability Factor (C)**	**Vulnerability Score (V)** *Expressed to one decimal point or as whole number depending on the value of C*		
Zone:	**IPZ-1**	**IPZ-2**	**IPZ-3**		**IPZ-1**	**IPZ-2**	**IPZ-3**
Possible Values:	*10*	*7 to 9*	*1 to 9*	*0.9 or 1*	*9 or 10*	*6.3 to 9*	*0.9 to 9*

Methodology and Results

1. Assigning the Area Vulnerability Factor:

   The first step in the evaluation of surface water vulnerability is to assign an 'area vulnerability factor', or **B**, for each intake protection zone. As shown in Table 1, B must be a whole number (no decimal points), and ranges from 1 to 10, with 10 being most vulnerable.

   - **IPZ-1**: This zone is closest to the intake and encompasses the area of water and land to which the intake is most vulnerable. It is assumed that if contaminants were released within IPZ-1 they would not diluted or filtered before reaching the intake, therefore, the area vulnerability factor for IPZ-1 is always **10**.
   - **IPZ-2**: Under the provincial Technical Rules, the area vulnerability factor for IPZ-2 can be either 7, 8, or 9. One score must be assigned to

the whole zone and the following factors must be taken into consideration:

1) *Percentage of area of IPZ-2 that is land.* This factor reflects the potential for a spill to occur that may impact the intake.
2) *The land cover, soil type, permeability of the land and the slope of the land.*
3) *The hydrological and hydrogeological conditions.* This factor reflects the extent of the transport pathways that may exist in the zone.

JFSA weighted each of these three criteria, and assigned a final area vulnerability score (B) for the Perth IPZ-2 as 9. Further information is provided below.

- **IPZ-3**: For intake protection zone 3, more than one area vulnerability factor can be assigned, based on the above critieria and the distance from the intake. Land use and distance from the intake were used to determine the area vulnerability factors in this zone. According to the provincial Technical Rules, no factor can be higher than the one assigned to IPZ-2. Since B for IPZ-2 was set equal to 9, B for IPZ-3 ranges from **1** to **9**.

Determination of Area Vulnerability Factor for IPZ-2

Due to concerns raised by the Mississippi-Rideau Source Protection Committee in the Spring of 2009 about the 'numerical' surface water vulnerability scoring approach used by JFSA, further discussions were held in 2009 to explore other approaches and to hear various perspectives. As a result of the numerous discussions held in 2009, JFSA used a 'modified numerical approach' which addressed several of the concerns raised by the initial approach.

The area vulnerability factor (B) for the Perth IPZ-2 was established based on a numerical approach involving a weighted combination of the three factors presented above. The relationships and scoring categories that were developed for each factor that was considered in the analysis required some assumptions to be made in order to quantify a range in the vulnerability experienced locally in the study region. Table 2 below summarizes the specific information, including assumed minimum and maximum values for area vulnerability factor (B) that were used in the analysis to quantify each criteria.

Table 2, Summary of Specific Information used to determine the IPZ-2 Area Vulnerability Factor (B)

Parameter	Assumed Minimum Value (B = 7)	Assumed Maximum Value (B = 9)	Calculated value for Perth IPZ 2 (based on local data)
Percentage of Area Composed of Land	10 %	90%	87%
Runoff Potential based on land cover/soil type/permeability (CN) and slope	CN =36, Slope = 0.25%	CN =95, Slope = 2%	CN =85, Slope = 1.26%
Transport Pathways (total length / main channel length)	0	9	13.84 km/2.95 km = 4.7

Table 3 below summarizes the derivation of the IPZ-2 area vulnerability factor (B) for the Perth IPZ-2. Table 3 includes the converted area vulnerability values between assumed minimum value (B=7) and assumed maximum value (B=9) for each of the three parameters, as well as the assumed weighting.

Table 3, Summary of Scoring for the IPZ-2 Area Vulnerability Factor (B)

Parameter	Calculated value for Perth IPZ 2 (based on local data	Converted B values for Perth IPZ 2 between assumed minimum value (B=7) and assumed maximum value (B=9)		
		$B_{\%LA}$	$B_{CN, Slope}$	B_{TP}
Percentage of Area Composed of Land	87%	8.92		
Runoff Potential based on land cover/soil type/permeability (CN) and slope	CN =85, Slope = 1.26%		8.88	
Transport Pathways (total length / main channel length)	13.84 km/2.95 km = 4.7			8.04
Assumed Weighting		30 %	30%	40%
Weighted Area Vulnerability Factor (B)	8.56			
Assigned Area Vulnerability Factor (B)	9			

2. Assigning the Source Vulnerability Factor Modifier:

The second step is to assess the 'source vulnerability factor', or **C**. This is an assessment of the location of the surface water intake and how vulnerable it is to the impact of contaminants. For a Type C intake (an intake on an inland river such as the Tay), C must be either **0.9** or **1.0**. The selected value was based on:

- the depth of the intake below the water surface (the deeper the intake, the lower the vulnerability);
- the distance of the intake from land (the further away from shore, the lower the vulnerability);
- the number of recorded drinking water quality issues at the intake, if any;
- the presence of hydraulic structures upstream.

Although there have been no reported water quality incidences and there are no hydraulic structures near the intake, JFSA assessed C as **1.0** for Perth because of the following:

- shallow depth of intake (1.98 metres);
- close distance of the intake from shore (4 metres);

3. Calculating IPZ Vulnerability Scores:

Once the source and area vulnerability factors have been finalized, the final step is to complete the calculation of the final vulnerability scores, according to the prescribed equation.

For Perth, since the source vulnerability modifying factor (C) was set to **1**, the final vulnerability scores (v) for each of the zones were determined to be the same as the area vulnerability factors (B). Perth's IPZ-1 has a final vulnerability score of 10, IPZ-2 a score of 9, and IPZ-3 a range of scores from 1 to 9. Table 4, below, displays these final values.

Table 4, IPZ Vulnerability Scores and Modifiers – Type C Intake

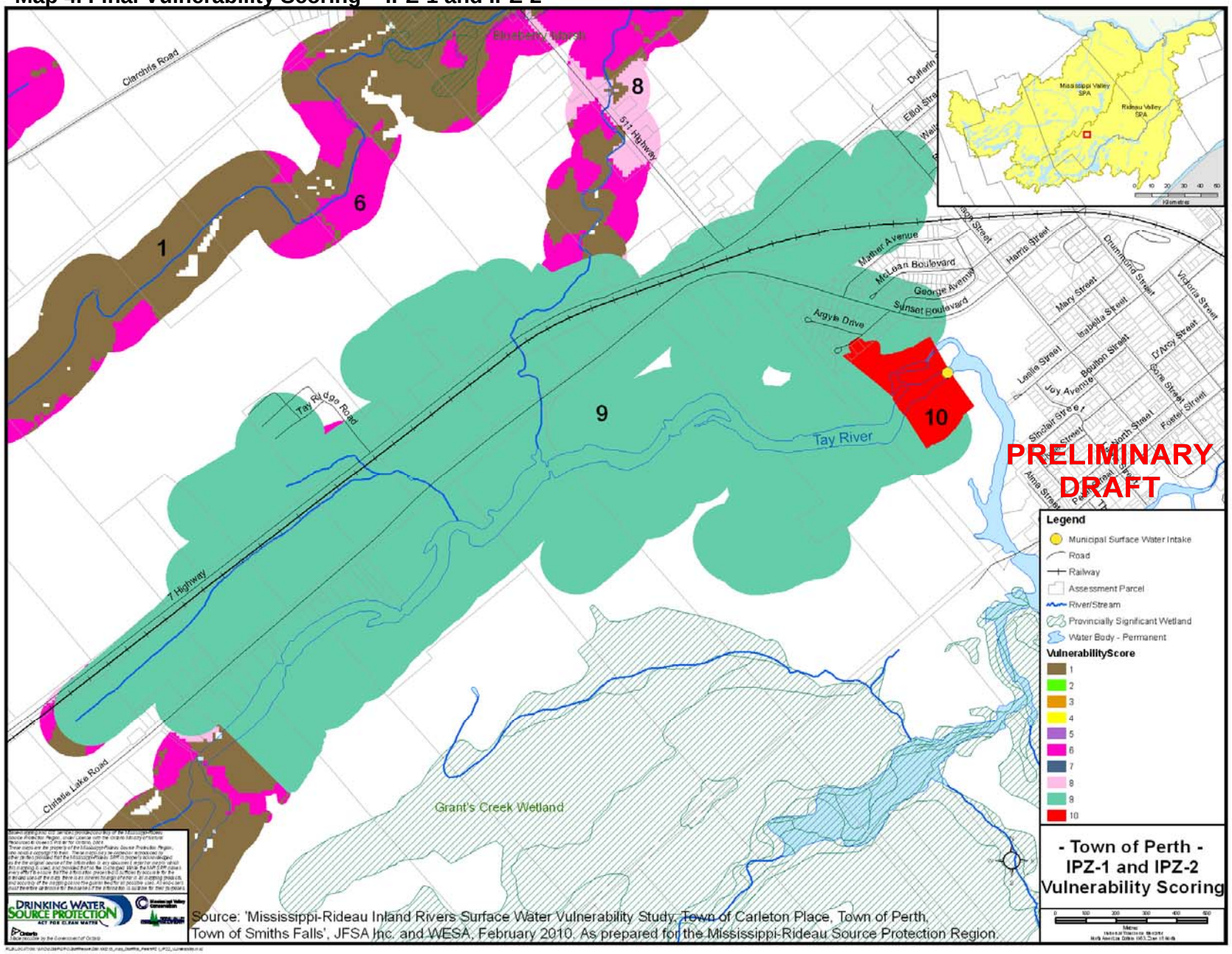
	Area Vulnerability Factor (B) *Expressed as a whole number*			**Source Vulnerability Factor (C)**	**Vulnerability Score (V)** *Expressed to one decimal point or as whole number depending on the value of C*		
Zone:	**IPZ-1**	**IPZ-2**	**IPZ-3**		**IPZ-1**	**IPZ-2**	**IPZ-3**
Possible Values:	*10*	*7 to 9*	*1 to 9*	*0.9 or 1*	*9 or 10*	*6.3 to 9*	*0.9 to 9*
Perth Scores:	**10**	**9**	**1 to 9**	**1**	**10**	**9**	**1 to 9**

Results – Perth Vulnerability Scores

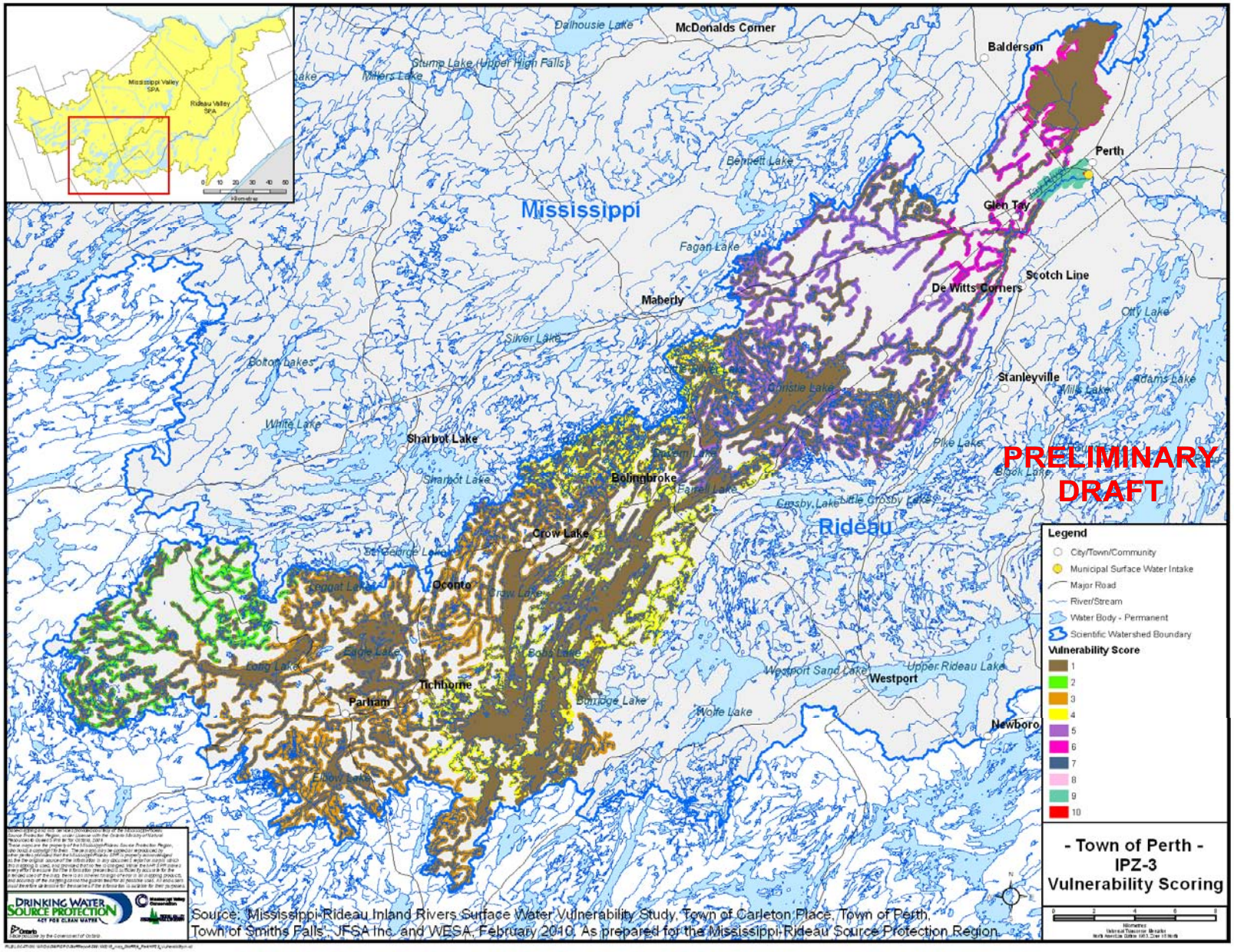
Map 4 shows the final vulnerability scoring for Perth's IPZ-1 and IPZ-2.

Map 5 shows the final vulnerability scoring for Perth's IPZ-3.

Map 4. Final Vulnerability Scoring – IPZ-1 and IPZ-2



Map 5. Final Vulnerability Scoring – IPZ-3



Step 3 – Identify Threats and Issues for Water Quality

Once experts determine where a drinking water supply is vulnerable to contamination, they need to identify what land use activities could pose a contamination risk in those areas (threats). Experts also need to identify any existing water quality problems (issues) and link them back to the land use(s) causing the contamination.

(1) **Threats** are existing conditions (i.e., contaminated sediment, soil or groundwater) or existing or future land use activities that could contaminate a drinking water supply;

(2) **Issues** are documented cases of water quality contamination approaching or exceeding acceptable provincial levels. While some issues are naturally occurring, many are caused by an existing or historic land use activity.

For the Perth intake, there are three possible approaches for identifying drinking water threats:

3a) Threats

The Assessment Report Technical Rules identify the three ways that a water quality threat can be identified:

I. Through an activity prescribed by the Clean Water Act;

II. Through an activity identified by the Source Protection Committee; and

III. Through a condition resulting from past activities.

I. Activities Prescribed by the Clean Water Act

Before threats could be identified, the province had to decide what activities pose a threat, and to what extent. Section 1.1 of Ontario Regulation 287/07 (made under the Clean Water Act) lists 21 broad land use activities as '*prescribed drinking water threats*'. These 21 activities are listed in Table 2 below, and they cover both chemical contaminants and pathogenic bacteria.

The province then broke each of the 21 broad activities into various scenarios called *circumstances* (e.g. activity A involving the storage of chemical X in an above ground storage tank greater than 50,000 litres). There are 500 pages of specific circumstances in the provincial Technical Rules and they are divided into two tables – chemical threats and pathogenic threats. The tables of drinking water threats can be found at:
http://www.ene.gov.on.ca/en/water/cleanwater/cwa-technicalstudies.php

These tables identify if a circumstance is a 'significant', 'moderate', or 'low' risk in each vulnerability score (2, 4, 6, 8 and 10). For example, a circumstance may be a *significant* risk in an area with a vulnerability score of 10, and a *moderate* risk in an area with a vulnerability score of 8.

Note: There are two prescribed drinking water threats (numbers 19 and 20) that pertain to water *quantity* threats. These will be evaluated as part of a water budget study currently underway.

Methodology

1. List low, moderate, and significant risks:

   Using the threats tables, the first step is to list all land use activities (circumstances) that pose a low, moderate, and significant risk to the surface water supplying Perth's municipal intake (based on the vulnerability scores in the IPZ). This is simply a summary of the provincial drinking water threats tables, it does not reflect what activities are actually taking place in the IPZ (see step 2).

   Under the province's threats tables, a land use activity can only be a *significant risk* if it is in an area that has a vulnerability score of **8, 9** or **10**. Table 2, below, shows for each vulnerability score, which of the 21 prescribed drinking water threats have circumstances that pose a significant risk. The table shows that the majority of threats must occur in areas with a vulnerability score of **9 or 10** to be classed as significant, and only two can be significant in areas with a vulnerability score of **8**.

   Attached to this document is a complete list of the threats circumstances that can be classed as significant in an IPZ. This table is a *subset* of the full provincial drinking water threats tables.

2. Inventory existing significant risks:

   Under the Technical Rules, Dillon must use the list of potential significant risks and count how many of those land uses are taking place on the ground.

   Dillon is using air photos, commercial databases, and roadside observations, to develop an inventory of locations that may have significant risks within the Perth IPZ.

3. Confirm inventory of significant risks:

   It is impossible to know the details of a particular land use activity without seeking additional information from the property owner. This information would include details about specific practices and contaminants in use. This detailed information is required to confirm if a land use activity is a significant risk or not.

   Dillon will not be approaching property owners for additional information in the Mississippi-Rideau region. The inventory of existing significant risks will be compiled based on the information available about local land use activities. Property owners wishing to confirm whether or not they are a significant risk are encouraged to contact staff who will work with them to collect the necessary information to make such a determination.

II. Activity identified by the Source Protection Committee

A drinking water threat can be identified by the Source Protection Committee if the activity is not included in the provincial list of 21 prescribed drinking water threats. This can only occur if a hazard assessment confirms that the activity is a threat, and this assessment is approved by the MOE.

III. Through a condition resulting from past activities.

Threats can also be identified if conditions relating to a past activity (i.e. a contaminated site) have resulted in:

- the presence of contamination in sediment;
- the presence of non-aqueous phase liquid (i.e., gasoline) in groundwater;
- the presence of a single mass of 100 litres of dense non-aqueous phase liquids in surface water.

Table 2: Provincial Threat Categories with Circumstances That Could Pose a Significant Risk in an IPZ

		Intake Protection Zone (IPZ) Vulnerability Scoring							
	Contaminant released:	Chemical				Pathogen			
	Prescribed drinking water threat category	10	9	8	1-7	10	9	8	1-7
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the *Environmental Protection Act*.	✓	✓			✓	✓	✓	
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	✓	✓	✓		✓	✓	✓	
3	The application of agricultural source material to land.	✓	✓			✓	✓	✓	
4	The storage of agricultural source material.	✓	✓			✓	✓	✓	
5	The management of agricultural source material.								
6	The application of non-agricultural source material to land.	✓	✓			✓	✓	✓	
7	The handling and storage of non-agricultural source material.	✓	✓			✓	✓	✓	
8	The application of commercial fertilizer to land.	✓	✓						
9	The handling and storage of commercial fertilizer.	✓							
10	The application of pesticide to land.	✓	✓	✓					
11	The handling and storage of pesticide.	✓	✓						
12	The application of road salt.	✓	✓						
13	The handling and storage of road salt.	✓	✓						
14	The storage of snow.	✓	✓						
15	The handling and storage of fuel.	✓							
16	The handling and storage of a dense non-aqueous phase liquid (DNAPLS)*.	✓							
17	The handling and storage of an organic solvent.	✓							
18	The management of runoff that contains chemicals used in the de-icing of aircraft.	✓	✓						
19	An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.**								
20	An activity that reduces the recharge of an aquifer.**								
21	The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard.	✓	✓			✓	✓	✓	

*DNAPLs are chemicals that are heavy and sink in water (e.g. trichloroethylene)

**Water quantity threats will be evaluated as a part of the Water Budget studies

3b) Issues

A drinking water issue is a documented problem with the quality of drinking water. This can be a chemical or pathogenic bacteria problem documented in the source of a surface water system that exceeds Ontario's established drinking water standards, or shows the potential to exceed these standards in the future.

Under the Technical Rules, for municipal drinking water systems issues can refer to chemical, nuclear, or bacterial contaminants. For non-municipal intakes, issues are limited to chemical or nuclear contaminants. The specific parameters can be found in Schedules 1, 2, or 3 of the Ontario Drinking Water Quality Standards, and in Table 4 of the Technical Support Document for the Ontario Drinking Water Quality Standards, Objectives and Guidelines. The Ontario Drinking Water Quality Standards can be found here: http://www.search.e-laws.gov.on.ca/en/isysquery/4911a9de-3fbb-4359-ad9f-4bb28526e99e/5/frame/?search=browseStatutes&context.

The Technical Support Document for the Ontario Drinking water Standards can be found here: http://www.ontario.ca/drinkingwater/stel01_046947.pdf

The identification of known issues is a way to include historic or cumulative activities in the source protection planning process. For example, an old industrial site could be leaching a contaminant into the aquifer, resulting in poor water quality.

If a contaminant or pathogen has been identified in the source water of a well, the following information is required:

- the area or location that is causing the contaminant or pathogen, and
- the land use activities, conditions (including naturally occurring conditions), or past activities at that location that are associated with the contaminant or pathogen.

If the above information cannot be readily determined, a plan must be developed to collect it for inclusion in a future Assessment Report.

While all reports to date indicate that Perth's municipal drinking water quality is in compliance with the Ontario Drinking Water Standards, Dillon will be reviewing all available information, as required by the province, to ensure there are no drinking water issues.

For More Information Contact:

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www.mrsourcewater.ca

Drinking Water in the Town of Smiths Falls

Draft Surface Water Study Findings – February 2010

Why Read This?

Property owners in the Smiths Falls area, both on and off of town water, should review the following study results, currently under public review, to:

- See maps of where Smiths Falls's town water is taken from the Rideau River;
- Understand if this section of the river is at risk of contamination; and
- Learn how land use policies in the Smiths Falls area will help protect this part of the river.

The Clean Water Act

This study was done under Ontario's *Clean Water Act* which requires municipalities and the local community to work together to protect local drinking water sources from becoming contaminated or depleted. The Act is proactive, and is primarily focused on reducing risks to municipal drinking water sources (lakes, rivers and underground aquifers that supply "town water" to residents). Where drinking water sources face significant risks, mandatory action could be required.

2007 – Source Protection Committee Created

The Mississippi-Rideau Source Protection Committee is made up of 16 people representing a wide variety of local interests and sectors. This Committee is overseeing the development of science-based Source Protection Plans for the Mississippi River and Rideau River watersheds.

2009 – Complete Scientific Studies

Technical studies are mapping local sources of drinking water, determining if they are vulnerable they are to contamination or overuse, and identifying potential risks. This science will show us where source protection policies are needed, and what risks they need to address.

2012 – Develop Policies to Protect Source Water

Source Protection Plans will contain a combination of voluntary and mandatory land use policies to protect drinking water sources. Under the Act, policies must moderate significant risks and prevent others from becoming significant.

Your Role

Broad public consultation will occur at each stage to ensure all local interests, concerns and knowledge are considered – please participate! The process of developing Source Protection Plans has been designed so that municipalities,

conservation authorities, farmers, property owners, industry, business, community groups, environmental interests, public health officials, First Nations and the public work together to create effective, locally-workable, source protection policies.

Facts about the Smiths Falls Municipal Drinking Water System:

- It is operated by the Town of Smiths Falls
- It supplies 10,000 people in the Town of Smiths Falls with drinking water
- Its water quality is consistently in compliance with the Ontario Drinking Water Standards
- It is made up of 2 intakes (one of which is a backup) that draw water from the Rideau River
- A new water treatment plant has just been constructed and is currently being commissioned

The Rideau River - Smiths Falls' Source of Drinking Water

The Town of Smiths Falls' draws its drinking water from the Rideau River, which flows north from Upper Rideau Lake and empties into the Ottawa River. The Rideau River is 146 km in length and drains an area of approximately 4,100 km^2. It is a regulated waterway. The Rideau Canal system includes several locks in the section flowing through Smiths Falls. The water treatment plant has established communication procedures with Parks Canada regarding the operation of the locks and dam flow control in the Rideau Canal system. This communication is important, in order to reduce potential problems with turbidity that could occur with the opening of Rideau Canal system gates upstream of the Smiths Falls water treatment plant.

Water from the Rideau River is treated at the water treatment plant before it is piped to homes and businesses in the Town of Smiths Falls. Water enters the intake structure, which has trash racks to remove large solids. The water flows by gravity to the plant, where it enters a mixing chamber. The water is then mixed with a coagulant and chlorine. The coagulant binds with the remaining solids to form sticky particles (called 'floc'), which attract and trap suspended particles before settling out of the water in large settling tanks. The settled water flows to the filters, where it is filtered through layers of activated carbon, sand, and gravel. The filtered water is then disinfected, and fluoride is added before it is ready for consumption.

A new water treatment plant has just been constructed. The new treatment plant consists of an AquaDAF system, dual media filtration, UV disinfection, chlorination with chlorine gas, corrosion control, fluoridation, residue management and dechlorination.

Smiths Falls Surface Water Study

In February 2010 a draft surface water study was completed to identify where extra measures should be taken to protect the Rideau River upstream of Smiths Falls' intake.

Step 1 – Delineate an Intake Protection Zone

Experts determined the direction and speed of the water in the Rideau River, and its connecting streams and water courses, upstream of the intake. The

map, showing the size and shape of the area that Smiths Falls' municipal intake draws water from, is called an 'Intake Protection Zone'.

Step 2 – Assess Vulnerability

Next, experts assessed how vulnerable the Rideau River and its tributaries are to contamination within the Intake Protection Zone. This was based on the physical characteristics and setting of intake, the historic incidence of water quality issues, the slope of the land surface, the type of land cover in the Intake Protection Zone, the built environment around the intake and other such factors.

Step 3 – Identify Threats and Issues

The province created a list of land uses and activities that could pose a low, moderate or significant risk in areas where the Rideau River is vulnerable to contamination. Experts will inventory how many significant risks currently exist and identify any existing documented water quality problems. Water quantity threats will be evaluated as part of a water budget study currently underway.

Note: The following study findings provide information about water supplying Smiths Falls' municipal intake. These findings may not apply to water supplying private intakes in the area. Individuals on private intakes should contact staff for more information.

Smiths Falls Surface Water Study Findings

The Experts

For the Smiths Falls surface water study, step 1 was completed by engineers at the Rideau Valley Conservation Authority (RVCA) in 2006. J.F. Sabourin and Associates Inc. (JFSA) and Water and Earth Science Associates Ltd. (WESA) revised and updated the results from step 1, and completed the work for step 2 in February 2010. Step 3 is currently being completed by Dillon Consulting Ltd. (Dillon). Steps 1 and 2 of the Smiths Falls surface water study were subject to peer review (independent third party review) and conform to the Assessment Report Technical Rules (dated November 2009) issued under the *Clean Water Act*. The Technical Rules can be found at http://www.ene.gov.on.ca/en/water/cleanwater/cwa-technical-rules.php.

Climate Change Review

Climate change may impact the amount of water available to us in the future. The impact that climate change will have on the quantity of water supplies in the Mississippi Valley and Rideau Valley watersheds is generally unknown at this time. The Province therefore requires the use of historical stream flow data for the intake protection zones studies. The Province also requires a summary of the existing climate change knowledge and climate data, and an interpretation of how climate change can impact the conclusions in the Assessment Report. Please refer to the Mississippi-Rideau 'Climate Change Review' study and summary for this information. Future updates of intake protection zone studies may incorporate historical stream flow data as well as climate change information.

Step 1 – Delineate Intake Protection Zones

Methodology

An Intake Protection Zone is made up of three separate zones: IPZ-1, IPZ-2, and IPZ-3. These areas are adjacent to one another, but do not overlap. JFSA undertook six steps to delineate an Intake Protection Zone for Smiths Falls:

1. Collection and assembly of data and information:

   JFSA collected relevant data and information from Federal, Provincial, Municipal, and other sources, relating to Smiths Falls's local hydrology and climate. This included the generic regulation limit lines from RVCA (for more information visit www.rvca.ca/plan-reg/maps_regulations.html). In addition, they looked at the characteristics of the surface water intake and surrounding land use. An integral part of this analysis was current and high-quality digital aerial photography and elevation data for the Town of Smiths Falls, acquired by the Mississippi-Rideau Source Protection Region in 2006.

2. Delineation of IPZ-1:

   The first intake protection zone (IPZ-1), is directly adjacent to the surface water intake. The provincial Technical Rules outline how to create IPZ-1. First, a semi-circle with a radius of 200 metres was extended upstream from the centre of the intake. Then, to accommodate for overland flow or backflow, the semi-circle was extended 10 metres downstream of the intake (see figure 1 for an example of this default zone). Where IPZ-1 intersected the shore, it was expanded to a setback of 120 metres from the high water mark, or the Conservation Authority generic regulation limit, whichever was greater.

3. Development of a computer model:

   The second intake protection zone (IPZ-2), was based in part on the distance upstream from the intake that represents how long a contaminant in the water takes to travel a minimum of two hours. To calculate this, experts used a computer model to determine how fast water flows towards the intake.

   Specifically, the collected data was used to develop a general understanding of the local surface water system. Then, an appropriate surface water computer model was chosen from existing, established numerical models. A numerical model is a set of mathematical equations, usually held within a computer program, which is used to represent how surface water behaves in the physical environment (or 'hydraulic setting').

   For Smiths Falls, the modeling was initially completed by the RVCA using *HEC-RAS*, and then revised by JFSA. HEC-RAS is a computer program that models how water flows through natural rivers and channels. This modeling software is publicly available and has been peer reviewed.

   Using the geometry from cross-sections at various points along the river, along with water flow data from a stream flow gauge, the model was used to determine the velocity with which water (at the various points) travels towards the intake in the river. This information was used to determine the IPZ-2 time of travel. Under the provincial Technical Rules, the required time of travel must be equal to or less than the time that is sufficient to allow operators to shut down the water treatment

plant in the event of a spill. For Smiths Falls, the plant takes approximately 15 minutes to shut down, so the time of travel was set to the minimum 2 hour limit.

4. Delineation IPZ-2

   The model used in step (3) provided the upper limits of the IPZ-2. To complete the delineation, the outer boundaries of the zone, along the edges of the river, needed to be set. According to the Technical Rules, the outer boundary of IPZ-2 is a setback of 120 metres from the high water mark, or the generic regulation limits line (as developed and maintained by the RVCA), whichever is greater.

   Also included in IPZ-2 were any storm sewer areas that discharge into the river within the 2 hour time. These areas were determined using the same approach as described in step 3 (i.e. using a 2 hour time of travel to establish what distance should be included up the storm sewer).

   So, to complete IPZ-2, the upper limits from the model were combined with the 120 metre setback and regulation limit lines from the RVCA, along with any nearby storm sewer areas.

5. Delineation of IPZ-3:

   The third intake protection zone (IPZ-3), was created by buffering all rivers, streams, and lakes upstream of IPZ-2 to include a setback of not more than 120 metres inland from the high water shoreline, and the area of the generic regulation limits line. Because the area upstream of Smiths Falls' IPZ-2 is large with many streams, the total area of IPZ-3 is about 864 km^2.

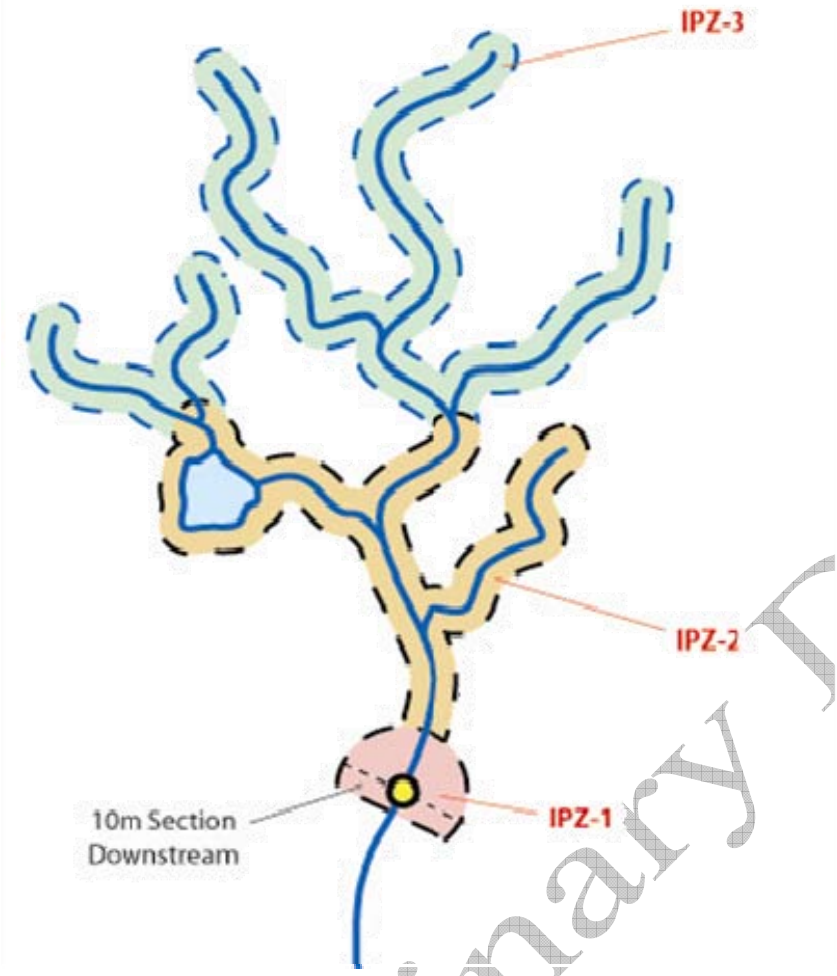
6. Assessment of Transport Pathways:

   A 'transport pathway' is anything that provides a direct way for contaminants to enter surface water. These are human-made or natural features, like drainage ditches, tile drains and roadways, which drain directly into the source water. Since these structures can drain water from a larger area than the river's main channel alone, the Intake Protection Zones were expanded to include them.

   So, the final step in the IPZ delineation process was to expand the default IPZ-2 and IPZ-3 zones if transport pathways were present. Using available information, JFSA completed this work for Smiths Falls' IPZ-2 zone. There was not enough data available to complete this assessment for IPZ-3. Mapped wetlands that are contiguous to the IPZ-3 water courses were identified as potential transport pathways and included in the IPZ-3.

Figure 1, below, is a generic illustration of an Intake Protection Zone.

Figure 1. Theoretical Intake Protection Zone – IPZ-1, IPZ-2, IPZ-3



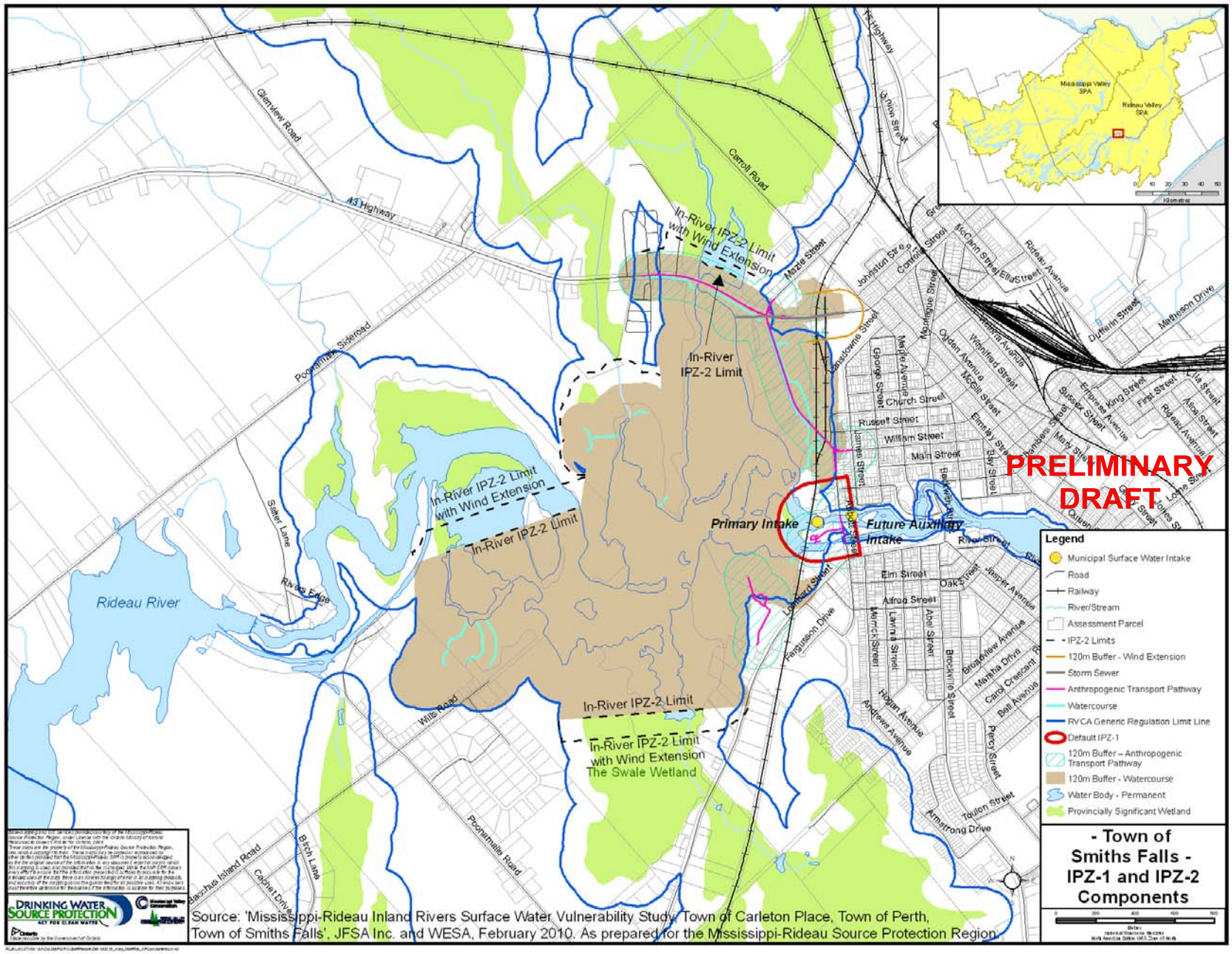
Results – Smiths Falls Intake Protection Zones

Map 1 shows the various pieces that make up Smiths Falls' IPZ-1 and IPZ-2. The map displays the generic regulation limit line, the default delineations based on the Technical Rules, and the modifications made to accommodate transport pathways.

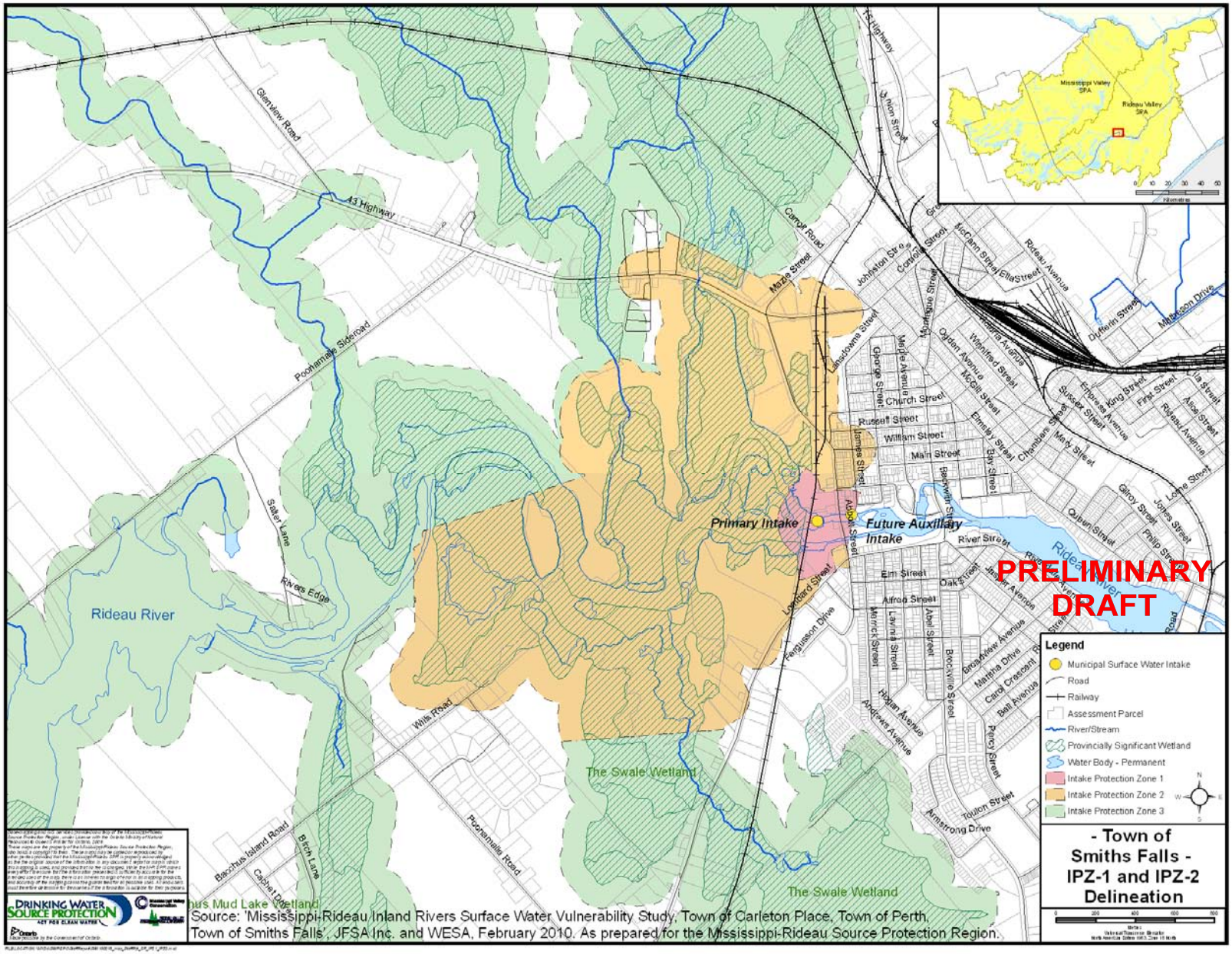
Map 2 shows the final IPZ-1 and IPZ-2 zones around Smiths Falls' surface water intake. IPZ-1 covers approximately 0.14 km^2, and IPZ-2 approximately 3.5 km^2.

Map 3 shows Smiths Falls' IPZ-3. The total area of this zone is approximately 864 km^2.

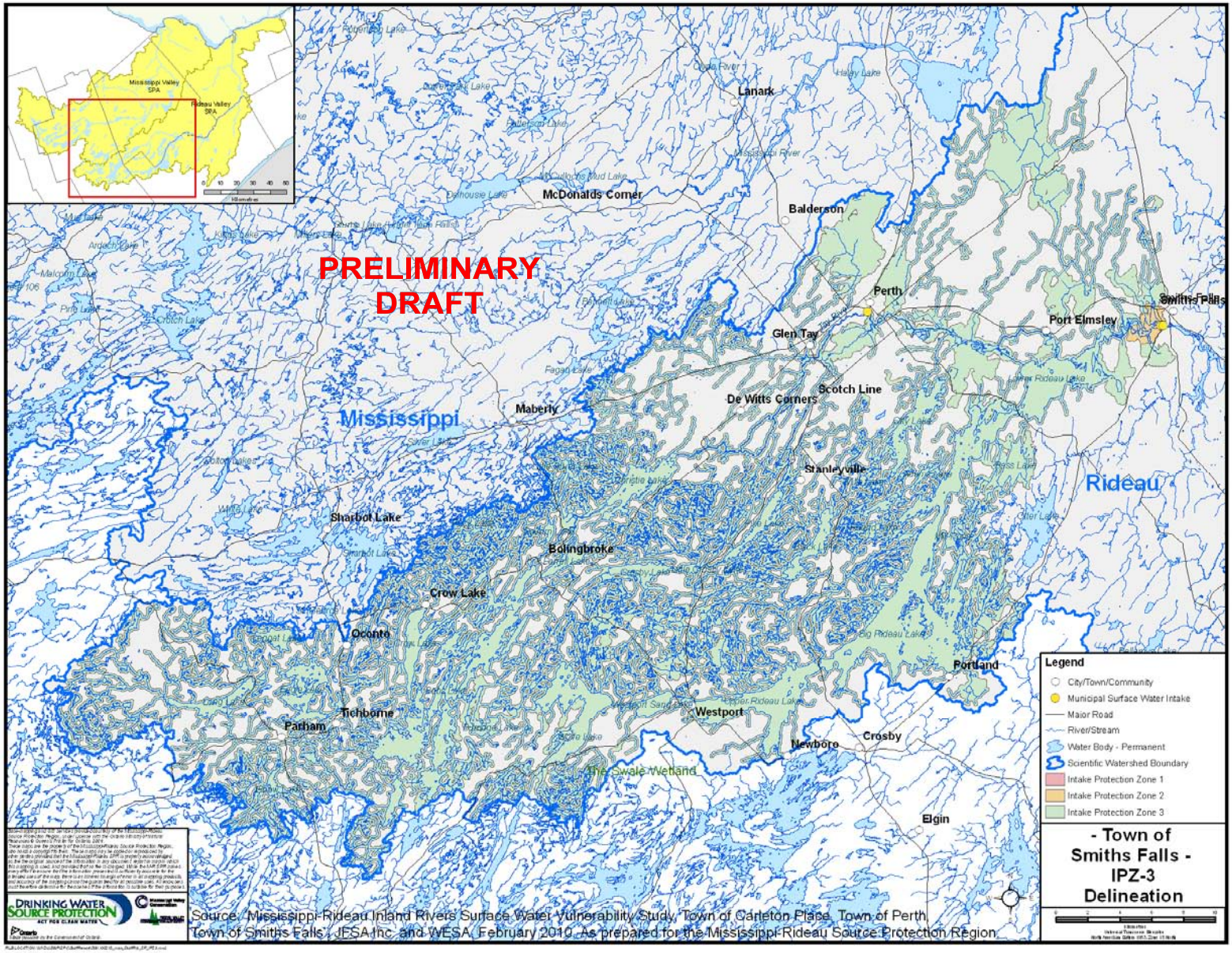
Map 1. Components of Intake Protection Zones 1 and 2



Map 2. Intake Protection Zones 1 and 2



Map 3. Intake Protection Zone 3



Step 2 – Assess Vulnerability

Once the intake protection zones were delineated, JFSA assessed how susceptible the surface water in these zones was to contamination. Identifying the surface water vulnerability of the mapped IPZ can reveal areas where extra care is needed to protect the water supply.

The provincial Technical Rules under the *Clean Water Act* set out a means for assessing the vulnerability for each intake protection zone. The final score is based on the following equation:

V = B x C

Where:

B is the area vulnerability factor

C is the source vulnerability factor

V is the vulnerability score

Table 1, below, shows the range of possible values for B, C and V for IPZ-1, IPZ-2 and IPZ-3. These components and how they are assigned are described below Table 1.

Table 1. IPZ Vulnerability Scores and Modifiers – Type C Intake

	Area Vulnerability Factor (B) *Expressed as a whole number*			**Source Vulnerability Factor (C)**	**Vulnerability Score (V)** *Expressed to one decimal point or as whole number depending on the value of C*		
Zone:	**IPZ-1**	**IPZ-2**	**IPZ-3**		**IPZ-1**	**IPZ-2**	**IPZ-3**
Possible Values:	*10*	*7 to 9*	*1 to 9*	*0.9 or 1*	*9 or 10*	*6.3 to 9*	*0.9 to 9*

Methodology and Results

1. Assigning the Area Vulnerability Factor:

   The first step in the evaluation of surface water vulnerability is to assign an 'area vulnerability factor', or **B**, for each intake protection zone. As shown in Table 1, B must be a whole number (no decimal points), and ranges from 1 to 10, with 10 being most vulnerable.

   - **IPZ-1**: This zone is closest to the intake and encompasses the area of water and land to which the intake is most vulnerable. It is assumed that if contaminants were released within IPZ-1 they would not diluted or filtered before reaching the intake, therefore, the area vulnerability factor for IPZ-1 is always **10**.

- **IPZ-2**: Under the provincial Technical Rules, the area vulnerability factor for IPZ-2 can be either 7, 8, or 9. One score must be assigned to the whole zone and the following factors must be taken into consideration:

  1) *Percentage of area of IPZ-2 that is land.* This factor reflects the potential for a spill to occur that may impact the intake.

  2) *The land cover, soil type, permeability of the land and the slope of the land.*

  3) *The hydrological and hydrogeological conditions.* This factor reflects the extent of the transport pathways that may exist in the zone.

  JFSA weighted each of these three criteria, and assigned a final area vulnerability score (B) for the Smiths Falls IPZ-2 as 9. Further information is provided below.

- **IPZ-3**: For intake protection zone 3, more than one area vulnerability factor can be assigned, based on the above critieria and the distance from the intake. Land use and distance from the intake were used to determine the area vulnerability factors in this zone. According to the provincial Technical Rules, no factor can be higher than the one assigned to IPZ-2. Since B for IPZ-2 was set equal to 9, B for IPZ-3 ranges from **1** to **9**.

Determination of Area Vulnerability Factor for IPZ-2

Due to concerns raised by the Mississippi-Rideau Source Protection Committee in the Spring of 2009 about the 'numerical' surface water vulnerability scoring approach used by JFSA, further discussions were held in 2009 to explore other approaches and to hear various perspectives. As a result of the numerous discussions held in 2009, JFSA used a 'modified numerical approach' which addressed several of the concerns raised by the Committee.

The area vulnerability factor (B) for the Smiths Falls IPZ-2 was established based on a numerical approach involving a weighted combination of the three factors presented above. The relationships and scoring categories that were developed for each factor that was considered in the analysis required some assumptions to be made in order to quantify a range in the vulnerability experienced locally in the study region. Table 2 below summarizes the specific information, including assumed minimum and maximum values for area vulnerability factor (B) that were used in the analysis to quantify each criteria.

Table 2, Summary of Specific Information used to determine the IPZ-2 Area Vulnerability Factor (B)

Parameter	Assumed Minimum Value (B = 7)	Assumed Maximum Value (B = 9)	Calculated value for Smiths Falls IPZ 2 (based on local data)
Percentage of Area Composed of Land	10 %	90%	47%
Runoff Potential based on land cover/soil type/permeability (CN) and slope	CN =36, Slope = 0.25%	CN =95, Slope = 2%	CN =91, Slope = 0.45%
Transport Pathways (total length / main channel length)	0	9	3.57 km/1.90 km = 1.9

Table 3 below summarizes the derivation of the IPZ-2 area vulnerability factor (B) for the Smiths Falls IPZ-2. Table 3 includes the converted area vulnerability values between assumed minimum value (B=7) and assumed maximum value (B=9) for each of the three parameters, as well as the assumed weighting.

Table 3, Summary of Scoring for the IPZ-2 Area Vulnerability Factor (B)

Parameter	Calculated value for Smiths Falls IPZ 2 (based on local data	Converted B values for Smiths Falls IPZ 2 between assumed minimum value (B=7) and assumed maximum value (B=9)		
		$B_{\%LA}$	$B_{CN, Slope}$	B_{TP}
Percentage of Area Composed of Land	47%	7.93		
Runoff Potential based on land cover/soil type/permeability (CN) and slope	CN =91, Slope = 0.45%		8.80	
Transport Pathways (total length / main channel length)	3.57 km/1.90 km = 1.9			7.42
Assumed Weighting		30 %	30%	40%
Weighted Area Vulnerability Factor (B)	7.98			
Assigned Area Vulnerability Factor (B)	8			

2. Assigning the Source Vulnerability Factor Modifier:

   The second step is to assess the 'source vulnerability factor', or **C**. This is an assessment of the location of the surface water intake and how vulnerable it is to the impact of contaminants. For a Type C intake (an intake on an inland river such as the Mississippi), C must be either **0.9** or **1.0**. The selected value was based on:

   - the depth of the intake below the water surface (the deeper the intake, the lower the vulnerability);
   - the distance of the intake from land (the further away from shore, the lower the vulnerability);
   - the number of recorded drinking water quality issues at the intake, if any;
   - the presence of hydraulic structures upstream.

   There have been no reported water quality incidences. However, JFSA assessed C as **1.0** for Smiths Falls because of the following:

   - shallow depth of intake (1.82 metres);
   - close distance of the intake from shore (5 metres);
   - the presence of a hydraulic structure

3. Calculating IPZ Vulnerability Scores:

   Once the source and area vulnerability factors have been finalized, the final step is to complete the calculation of the final vulnerability scores, according to the prescribed equation.

   For Smiths Falls, since the source vulnerability modifying factor (C) was set to **1**, the final vulnerability scores (v) for each of the zones were determined to be the same as the area vulnerability factors (B). Smiths Falls's IPZ-1 has a final vulnerability score of 10, IPZ-2 a score of 9, and IPZ-3 a range of scores from 1 to 9. Table 4, below, displays these final values.

Table 4, IPZ Vulnerability Scores and Modifiers – Type C Intake

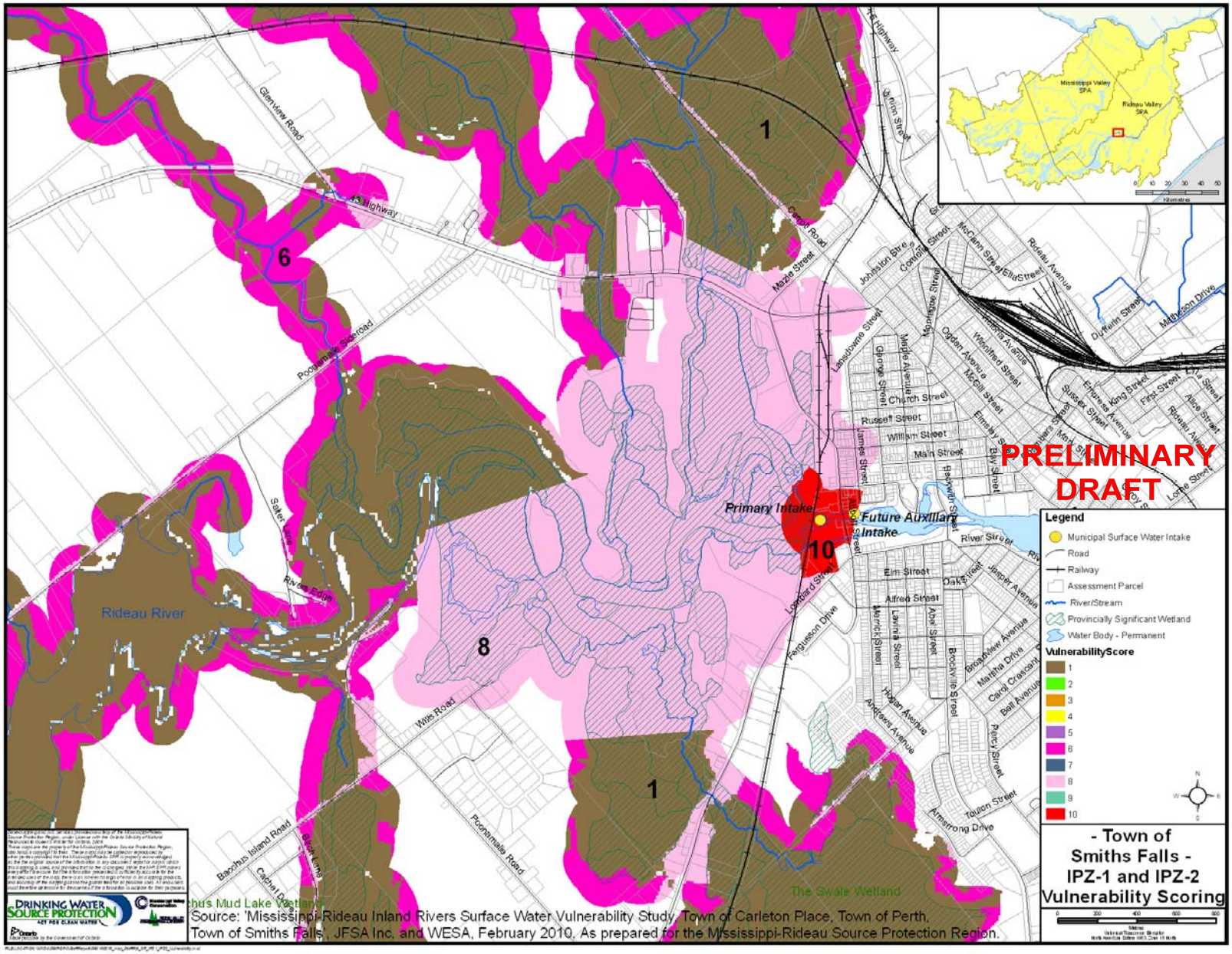
	Area Vulnerability Factor (B) *Expressed as a whole number*			Source Vulnerability Factor (C)	Vulnerability Score (V) *Expressed to one decimal point or as whole number depending on the value of C*		
Zone:	**IPZ-1**	**IPZ-2**	**IPZ-3**		**IPZ-1**	**IPZ-2**	**IPZ-3**
Possible Values:	*10*	*7 to 9*	*1 to 9*	*0.9 or 1*	*9 or 10*	*6.3 to 9*	*0.9 to 9*
Smiths Falls Scores:	**10**	**8**	**1 to 8**	**1**	**10**	**8**	**1 to 8**

Results – Smiths Falls Vulnerability Scores

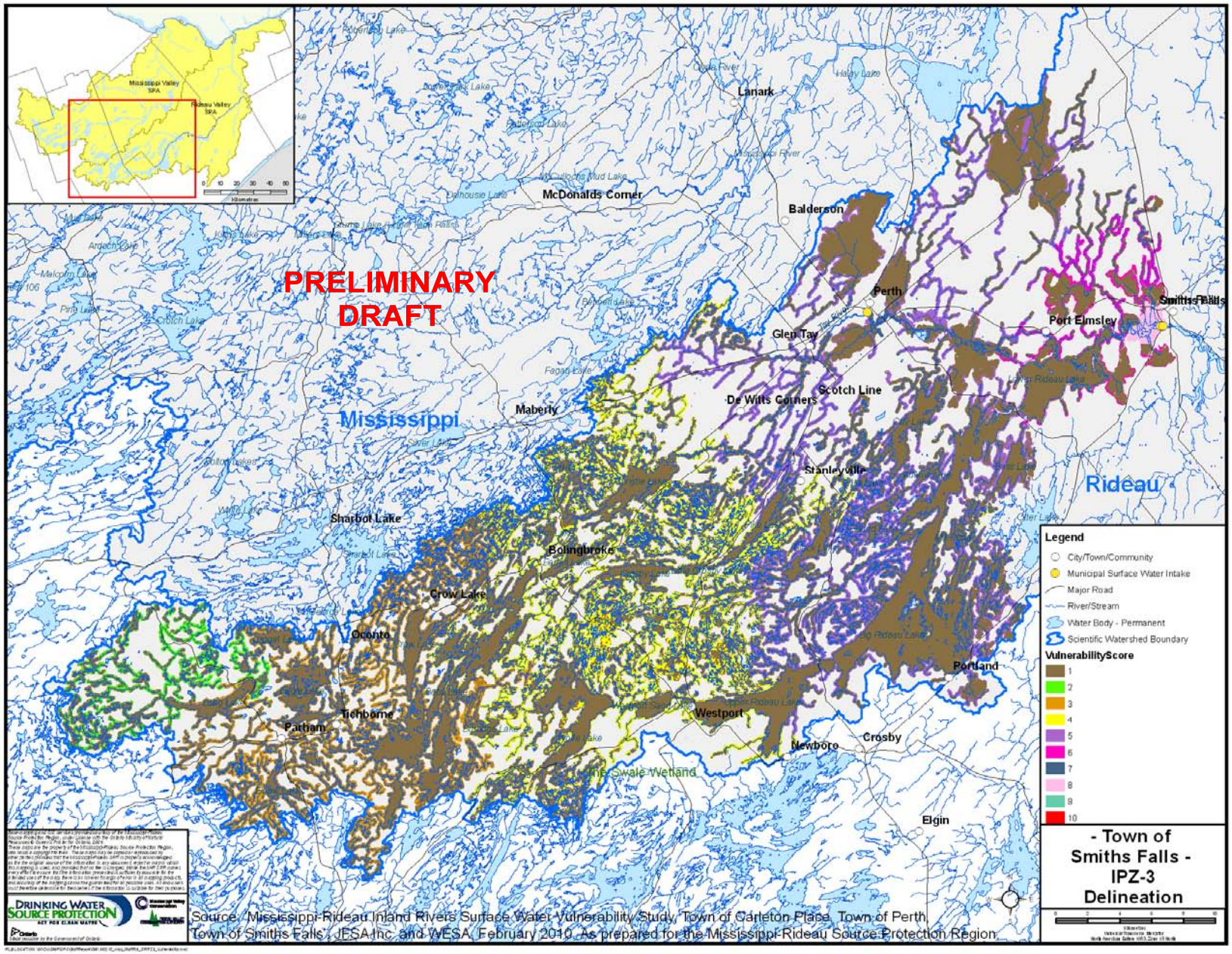
Map 4 shows the final vulnerability scoring for Smiths Falls' IPZ-1 and IPZ-2.

Map 5 shows the final vulnerability scoring for Smiths Falls' IPZ-3.

Map 4. Final Vulnerability Scoring – IPZ-1 and IPZ-2



Map 5. Final Vulnerability Scoring – IPZ-3



Step 3 – Identify Threats and Issues for Water Quality

Once experts determine where a drinking water supply is vulnerable to contamination, they need to identify what land use activities could pose a contamination risk in those areas (threats). Experts also need to identify any existing water quality problems (issues) and link them back to the land use(s) causing the contamination.

(1) **Threats** are existing conditions (i.e., contaminated sediment, soil or groundwater) or existing or future land use activities that could contaminate a drinking water supply;

(2) **Issues** are documented cases of water quality contamination approaching or exceeding acceptable provincial levels. While some issues are naturally occurring, many are caused by an existing or historic land use activity.

For the Smiths Falls intake, there are three possible approaches for identifying drinking water threats:

3a) Threats

The Assessment Report Technical Rules identify the three ways that a water quality threat can be identified:

I. Through an activity prescribed by the Clean Water Act;

II. Through an activity identified by the Source Protection Committee; and

III. Through a condition resulting from past activities.

I. Activities Prescribed by the Clean Water Act

Before threats could be identified, the province had to decide what activities pose a threat, and to what extent. Section 1.1 of Ontario Regulation 287/07 (made under the Clean Water Act) lists 21 broad land use activities as '*prescribed drinking water threats*'. These 21 activities are listed in Table 2 below, and they cover both chemical contaminants and pathogenic bacteria.

The province then broke each of the 21 broad activities into various scenarios called *circumstances* (e.g. activity A involving the storage of chemical X in an above ground storage tank greater than 50,000 litres). There are 500 pages of specific circumstances in the provincial Technical Rules and they are divided into two tables – chemical threats and pathogenic threats. The tables of drinking water threats can be found at:
http://www.ene.gov.on.ca/en/water/cleanwater/cwa-technicalstudies.php

These tables identify if a circumstance is a 'significant', 'moderate', or 'low' risk in each vulnerability score (2, 4, 6, 8 and 10). For example, a circumstance may be a *significant* risk in an area with a vulnerability score of 10, and a *moderate* risk in an area with a vulnerability score of 8.

Note: There are two prescribed drinking water threats (numbers 19 and 20) that pertain to water *quantity* threats. These will be evaluated as part of a water budget study currently underway.

Methodology

1. List low, moderate, and significant risks:

   Using the threats tables, the first step is to list all land use activities (circumstances) that pose a low, moderate, and significant risk to the surface water supplying Smiths Falls' municipal intake (based on the vulnerability scores in the IPZ). This is simply a summary of the provincial drinking water threats tables, it does not reflect what activities are actually taking place in the IPZ (see step 2).

   Under the province's threats tables, a land use activity can only be a *significant risk* if it is in an area that has a vulnerability score of **8, 9** or **10**. Table 2, below, shows for each vulnerability score, which of the 21 prescribed drinking water threats have circumstances that pose a significant risk. The table shows that the majority of threats must occur in areas with a vulnerability score of **9 or 10** to be classed as significant, and only two can be significant in areas with a vulnerability score of **8**.

   Attached to this document is a complete list of the threats circumstances that can be classed as significant in an IPZ. This table is a *subset* of the full provincial drinking water threats tables.

2. Inventory existing significant risks:

   Under the Technical Rules, Dillon must use the list of potential significant risks and count how many of those land uses are taking place on the ground.

   Dillon is using air photos, commercial databases, and roadside observations, to develop an inventory of locations that may have significant risks within the Smiths Falls IPZ.

3. Confirm inventory of significant risks:

   It is impossible to know the details of a particular land use activity without seeking additional information from the property owner. This information would include details about specific practices and contaminants in use. This detailed information is required to confirm if a land use activity is a significant risk or not.

   Dillon will not be approaching property owners for additional information in the Mississippi-Rideau region. The inventory of existing significant risks will be compiled based on the information available about local land use activities. Property owners wishing to confirm whether or not they are a significant risk are encouraged to contact staff who will work with them to collect the necessary information to make such a determination.

II. Activity identified by the Source Protection Committee

A drinking water threat can be identified by the Source Protection Committee if the activity is not included in the provincial list of 21 prescribed drinking water threats. This can only occur if a hazard assessment confirms that the activity is a threat, and this assessment is approved by the MOE.

III. Through a condition resulting from past activities.

Threats can also be identified if conditions relating to a past activity (i.e. a contaminated site) have resulted in:

- the presence of contamination in sediment;
- the presence of non-aqueous phase liquid (i.e., gasoline) in groundwater;
- the presence of a single mass of 100 litres of dense non-aqueous phase liquids in surface water.

Table 2: Provincial Threat Categories with Circumstances That Could Pose a Significant Risk in an IPZ

		Intake Protection Zone (IPZ) Vulnerability Scoring							
	Contaminant released:	Chemical				Pathogen			
	Prescribed drinking water threat category	10	9	8	1-7	10	9	8	1-7
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the *Environmental Protection Act*.	✓	✓			✓	✓	✓	
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	✓	✓	✓		✓	✓	✓	
3	The application of agricultural source material to land.	✓	✓			✓	✓	✓	
4	The storage of agricultural source material.	✓	✓			✓	✓	✓	
5	The management of agricultural source material.								
6	The application of non-agricultural source material to land.	✓	✓			✓	✓	✓	
7	The handling and storage of non-agricultural source material.	✓	✓			✓	✓	✓	
8	The application of commercial fertilizer to land.	✓	✓						
9	The handling and storage of commercial fertilizer.	✓							
10	The application of pesticide to land.	✓	✓	✓					
11	The handling and storage of pesticide.	✓	✓						
12	The application of road salt.	✓	✓						
13	The handling and storage of road salt.	✓	✓						
14	The storage of snow.	✓	✓						
15	The handling and storage of fuel.	✓							
16	The handling and storage of a dense non-aqueous phase liquid (DNAPLS)*.	✓							
17	The handling and storage of an organic solvent.	✓							
18	The management of runoff that contains chemicals used in the de-icing of aircraft.	✓	✓						
19	An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.**								
20	An activity that reduces the recharge of an aquifer.**								
21	The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard.	✓	✓			✓	✓	✓	

*DNAPLs are chemicals that are heavy and sink in water (e.g. trichloroethylene)

**Water quantity threats will be evaluated as a part of the Water Budget studies

3b) Issues

A drinking water issue is a documented problem with the quality of drinking water. This can be a chemical or pathogenic bacteria problem documented in the source of a surface water system that exceeds Ontario's established drinking water standards, or shows the potential to exceed these standards in the future.

Under the Technical Rules, for municipal drinking water systems issues can refer to chemical, nuclear, or bacterial contaminants. For non-municipal intakes, issues are limited to chemical or nuclear contaminants. The specific parameters can be found in Schedules 1, 2, or 3 of the Ontario Drinking Water Quality Standards, and in Table 4 of the Technical Support Document for the Ontario Drinking Water Quality Standards, Objectives and Guidelines. The Ontario Drinking Water Quality Standards can be found here: http://www.search.e-laws.gov.on.ca/en/isysquery/4911a9de-3fbb-4359-ad9f-4bb28526e99e/5/frame/?search=browseStatutes&context.

The Technical Support Document for the Ontario Drinking water Standards can be found here: http://www.ontario.ca/drinkingwater/stel01_046947.pdf

The identification of known issues is a way to include historic or cumulative activities in the source protection planning process. For example, an old industrial site could be leaching a contaminant into the aquifer, resulting in poor water quality.

If a contaminant or pathogen has been identified in the source water of a well, the following information is required:

- the area or location that is causing the contaminant or pathogen, and
- the land use activities, conditions (including naturally occurring conditions), or past activities at that location that are associated with the contaminant or pathogen.

If the above information cannot be readily determined, a plan must be developed to collect it for inclusion in a future Assessment Report.

While all reports to date indicate that Smiths Falls' municipal drinking water quality is in compliance with the Ontario Drinking Water Standards, Dillon will be reviewing all available information, as required by the province, to ensure there are no drinking water issues..

For More Information Contact:

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4.0 Community Outreach

Date: February 23, 2010
To: Mississippi-Rideau Source Protection Committee
From: Sommer Casgrain-Robertson, Co-Project Manager
Mississippi – Rideau Source Protection Region

Recommendation:

1. That the Mississippi-Rideau Source Protection Committee receive the following report for information.

Background
Staff and MRSPC members participate in many different community outreach activities that raise awareness and promote the source protection planning process. These activities include information booths at events, presentations at meetings and articles in newsletters and local papers. It is important that staff and members keep each other informed about the activities they are involved in so that we can coordinate our participation and prepare appropriate materials in advance. This includes coordinating with our neighbouring regions for meetings and events that cover Eastern Ontario.

Past Activities
Members & staff are asked to give a verbal update on any other activities that took place in the past month related to source protection.

1. *South Frontenac Council Meeting – Source Protection Update*
    - February 16 (Cataraqui staff presenting)
2. *OMYA Public Meeting*
    - February 16, Perth (Drew Lampman participated)
3. *MOE Consultation Session on Draft Source Protection Plan Regulation*
    - February 19, Kingston (Members and staff attended)

Upcoming Activities
Members & staff are asked to give a verbal update about any other activities they know about in the coming months related to source protection.

1. *Rideau Lakes Council Meeting – Source Protection Update*
    - March 1 (Cataraqui staff presenting)
2. *Mississippi Valley Source Protection Authority Meeting*
    - March 24, Almonte (Sommer presenting)
3. *Rideau Valley Source Protection Authority Meeting*
    - March 25, Manotick (Sommer presenting)
4. *Envirothon Presentation – "Protecting Our Groundwater"*
    - March 23, Carleton Place High School (Sommer presenting)
    - March 25, Perth High School (Sommer presenting)