A Look at Private Drinking Water Systems in the Upper-Middle Rideau Valley Watershed

Photo of Wolfe Lake taken by RVCA

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

Mississippi Valley Conservation Authority

Rideau Valley Conservation Authority

June 2023

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Acronyms and Terms

MECP	Ministry of Environment, Conservation, and Parks
SPP	Source Protection Plan
MRSPR	Mississippi-Rideau Source Protection region
Imported Drinking Water	Water sourced from a location other than where it is utilized (bottled water, etc.)
HVA	Highly Vulnerable Aquifer
DTR	Director's Technical Rules
WHPA	Wellhead Protection Area
IPZ	Intake Protection Zone
RVCA	Rideau Valley Conservation Authority
PWQMN	Provincial Water Quality Monitoring Network
WQI	Water Quality Index. This is a score calculated through comparing collected data to established guidelines from the Canadian Council for the Ministry of Environment. The scores range from 1-100, with higher scores indicating better water quality
PWQO	Provincial Water Quality Objectives. These standards are used to protect aquatic life and recreation uses
GIS	Geographic Information System
Residency Time/Flow Rate	The average length of time during which a substance, a portion of material, or an object is in a given location or condition
Time of Travel	In respect to groundwater, the length of time that is required for groundwater to travel a specified horizontal distance in the saturated zone
Significant Drinking Water Threat	A threat located in a vulnerable area and/or involves materials that have a high hazard rating
HAB	Harmful Algae Bloom
POU	Point-of-Use
POE	Point-of-Entry

Executive Summary

The Ministry of the Environment, Conservation and Parks (MECP) released the *Best Practices for Source Water Protection* to help individuals with private drinking water systems assess the risk/vulnerability of their drinking water source and inform them on how to properly protect their drinking water. Alongside the *Best Practices,* MECP committed new funding for Conservation Authorities to conduct pilot programs to provide advice and support to people with non-municipal drinking water systems not included in a *Source Protection Plan* (SPP).

In 2022, the Mississippi-Rideau Source Protection Region (MRSPR) initiated a project to address concerns raised by local lake associations. These concerns were focused on waterfront property owners sourcing their drinking water from the lake through surface water intakes and the drinking water risks associated with blue-green algae or harmful algae blooms.

Number of Surface Water Intakes

The project was divided into two phases. The goal of phase 1 was to estimate the number of homes with surface water intakes within the study area, assess the vulnerability of the area and determine possible risks to the drinking water source. Seven lakes were selected for the project: Bass Lake, Christie Lake, Eagle Lake, Otter Lake, Otty Lake, Upper Rideau Lake, and Wolfe Lake.

A preliminary analysis of the lakes was conducted using GIS analytical tools to estimate the number of homes sourcing their drinking water from a surface water intake in the lake. A survey was then distributed to waterfront property owners to aid in refining these estimates.

The preliminary analysis estimated there to be 2,011 total residential parcels/lots around all seven lakes, with approximately 50% of all residents using a surface water intake and 50% using a private well. Survey results demonstrated a similar distribution between residential parcels/lots with surface water intakes and private wells. Utilizing the survey results and estimated number of residential parcels/lots, there was estimated to be 976 residential parcels/lots with surface water intakes. Of these parcels/lots, about one-third are sourcing their drinking water from the intake and the remaining two-thirds are importing their drinking water. All individuals drinking surface water reported they have a treatment system and are not drinking raw surface water.

Determining Vulnerability

A vulnerability analysis was conducted for all seven lakes. **The analysis was to demonstrate the need for caution in areas with higher vulnerability. The results of this analysis do not indicate poor lake quality or that the area/lake is not a safe place to live.** The vulnerability analysis was

done through a multi-stage approach. The first stage of the vulnerability analysis demonstrated that all lakes are located in a highly vulnerable aquifer (HVA) area meaning that, without proper precautions, activities in these areas may contaminate the groundwater. In an HVA area, the size of the parcel/lot can affect the risk of groundwater contamination from activities, such as septic systems. Parcels/lots that are smaller than 1 hectare have a higher risk of groundwater contamination if proper precautions are not taken. Across all seven lakes, more than 75% of all parcels/lots are less than 1 hectare. Wolfe Lake is the exception with 55% of lots being less than 1 hectare.

The vulnerability of the surface water and surface water intakes from the survey were analyzed. The surface water vulnerability was determined by the residency time of the lake and demonstrated a range of moderate to very high vulnerability. Using the survey responses for intake depth and distance from shore, a general intake vulnerability of moderate was estimated.

The final stage of the vulnerability analysis was to apply the municipal approach to well and intake vulnerability to each of the seven lakes. The municipal approach utilizes the *Directors Technical Rules (DTR)* which divide Wellhead Protection Areas (WHPA) and Intake Protection Zones (IPZ) into multiple sections based on either the distance from the well or intake, or the time for the water source to reach the well or intake. For this project the score for the first WHPA and IPZ of residential properties were delineated. Typically, the first WHPA and IPZ are both assigned the highest vulnerability score of 10, therefore the scores for all WHPAs and IPZs for these seven lakes were 10. These scores were then used alongside the *22 Provincial Threats to Drinking Water* to determine possible significant drinking water threats. Of the possible threats identified, septic systems and fuel storage were determined to be significant threats. Many of the presumed threat activities are eligible for programs and funding that can help property owners mitigate impact, while some threats may require assistance from experienced risk management staff to help determine a plan of action.

Harmful Algae Blooms

Blue-green algae or harmful algae blooms (HAB) have become more prevalent in many lakes throughout Ontario and are a threat to people sourcing their drinking water from a surface water intake. Many of the seven lakes are either prone to HABs or have potential to experience more frequent HABs. The investigation into water treatment systems and HABs provided insight into systems that aid in treating water during HABs. Coming into contact with a HAB can cause skin and eye irritation and ingesting a HAB can cause flu-like symptoms or severe illness if ingested in high quantities. **If a HAB is suspected, individuals are advised not to boil water as boiling the water will increase the levels of toxins.** Micron filters can remove intact algal cells

while reverse osmosis, ozonation and chlorination can reduce the amount of toxins present in the water. **UV lights are not effective at removing cyanobacteria or cyanotoxins.**

MRSPR staff are concerned that private drinking water system owners may not have the knowledge on the proper systems to treat their water and how to properly maintain these systems. As well, there are concerns about the frequency in which individuals test their drinking water to ensure its safety for consumption.

The results of Phase 1 demonstrate that an emphasis on researching and protecting private drinking water sources, surface water and groundwater, is required. The Mississippi-Rideau Source Protection Region plans to address this gap in knowledge and programs through our efforts in Phase 2.

Next Steps

Phase 2 of the project will focus on the implementation of a non-legally binding policy for a multidisciplinary working group to address the gaps in protecting private drinking water systems. As well, it will include researching the extent to which blue-green algae will affect our Region going forward and the MRSPR will develop an educational video series on surface water issues, among other opportunities to increase awareness to these important matters.

Table 1. Summary of key characteristics

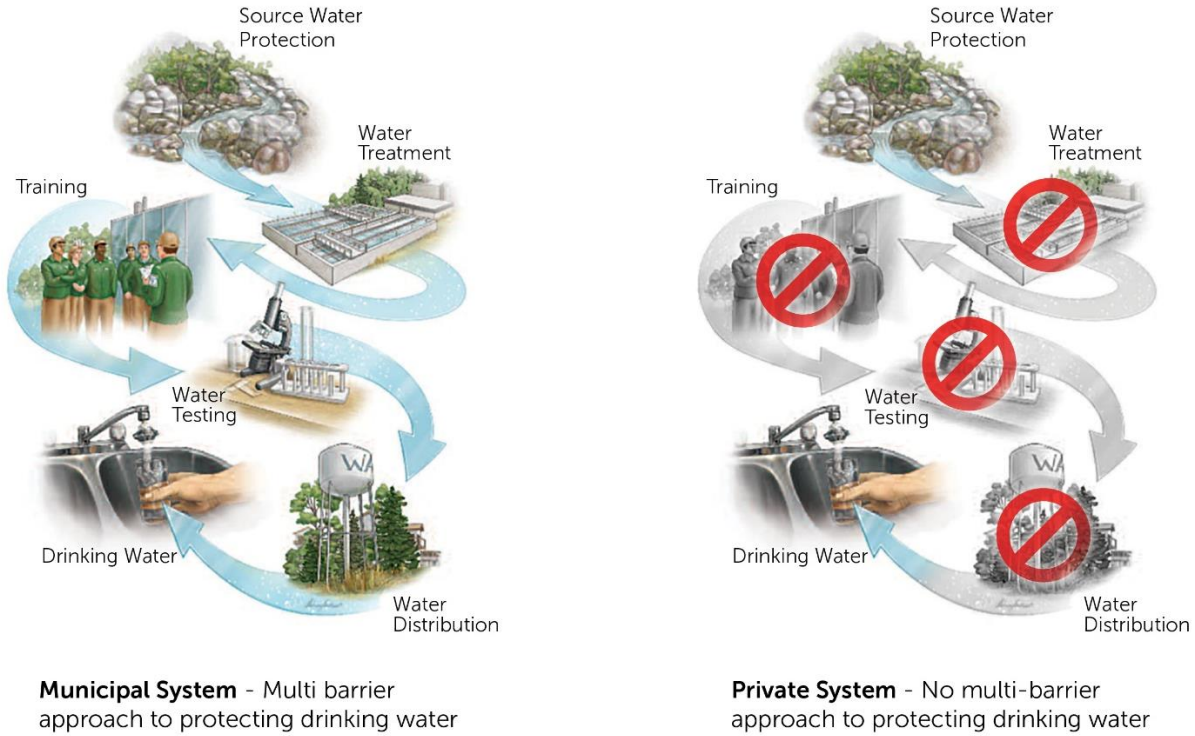
Lake	Surface Area (ha)	Number of RL	Number of RL with a SW Intake	Prone to BG Algae	Notable Catchment Landcover	Mean Water Quality Index Score	GW Vulnerability	Lots Size Vulnerability	SW Vulnerability: Residency Time	General Intake Vulnerability
Bass	290	233	121	Yes	24% wetlands, 22% wooded area, and 21% water	Fair	Highly Vulnerable Aquifer	High	Very High	Moderate
Christie	655	237	145	No	58% wooded area, 17% water, and 14% wetlands	Good			Low	**Insufficient Data**
Eagle	650	236	163	Potential	53% wooded area, 26% water, and 13% wetlands	Very Good			Very High	Moderate
Otter	572	295	178	Potential	30% wooded area, 24% crop and pasture, 21% water	Good			High	Moderate
Otty	655	424	181	Potential	42% wooded area, 20% wetlands, and 14% water	Good			Moderate	Moderate
Upper Rideau	1408	406	143	Yes	37% wooded area, 27% water, and 13% crop and pasture	Poor			Moderate	**Insufficient Data**
Wolfe	1005	180	74	Potential	53% wooded area, 18% water, and 13% wetlands	Good		Moderate	High	Moderate

GW = Groundwater
SW = Surface Water
RL = Residential Lots

1. Background and Objective

Ontario's *Clean Water Act* was created to ensure all drinking water systems are protected from current and future contamination. However, Source Protection Regions/Areas only have mandates under the *Clean Water Act* for the source protection of municipal drinking water systems, which complements the work of water treatment plant operators who ensure municipal drinking water is properly treated, tested, and safely delivered to your tap. While the *Clean Water Act* applies a multibarrier approach for the protection of municipal drinking water systems, non-municipal drinking water systems do not have a similar level of protection measures (see Figure 1).

In late 2021, representatives from local lake associations in the Rideau Valley watershed raised concern for individuals sourcing their drinking water from private surface water intakes. These representatives believed many residents of their respective lakes sourced their drinking water from the lake. As the number of blue green algae or harmful algae blooms (HAB) have increased, they were concerned these residents may be drinking contaminated water. Without adequate protection measures in place, homeowners surrounding the lakes could be getting their drinking water from an unsafe source.



Municipal System - Multi barrier approach to protecting drinking water

Private System - No multi-barrier approach to protecting drinking water

Figure 1. Comparison of municipal and non-municipal systems

In February of 2022, the Ministry of the Environment, Conservation and Parks (MECP) released the *Best Practices for Source Water Protection*. The *Best Practices* is an informational guide to help individuals with non-municipal water systems assess the risk/vulnerability of their drinking water source and advise how to properly protect this source.

With the release of the *Best Practices,* the MECP provided funding for Conservation Authorities to conduct pilot programs to provide advice and support to people with drinking water systems not included in a *Source Protection Plan* (SPP). This funding enabled the Mississippi-Rideau Source Protection Region (MRSPR) to initiate a project to address concerns raised by local lake associations. These concerns were focused on waterfront property owners sourcing their drinking water from the lake through surface water intakes and how blue-green algae or harmful algae blooms will affect the safety of this water source.

The project was divided into two phases. In Phase 1, Mississippi-Rideau Source Protection staff characterized the selected lakes and estimated the number of residential properties surrounding these lakes that source their drinking water from private wells and private surface water intakes. This phase included:

- Outreach to lake residents with assistance from the lake associations
- Threats and vulnerability analysis
- Research about blue green algae and quality treatment systems.

It is expected that Phase 2 will include the development of educational materials to advise individuals with private drinking water systems on how to protect their drinking water source and properly treat their drinking water. As well, these materials will provide details on local measures that address specific drinking water threats (i.e., septic re-inspection program).

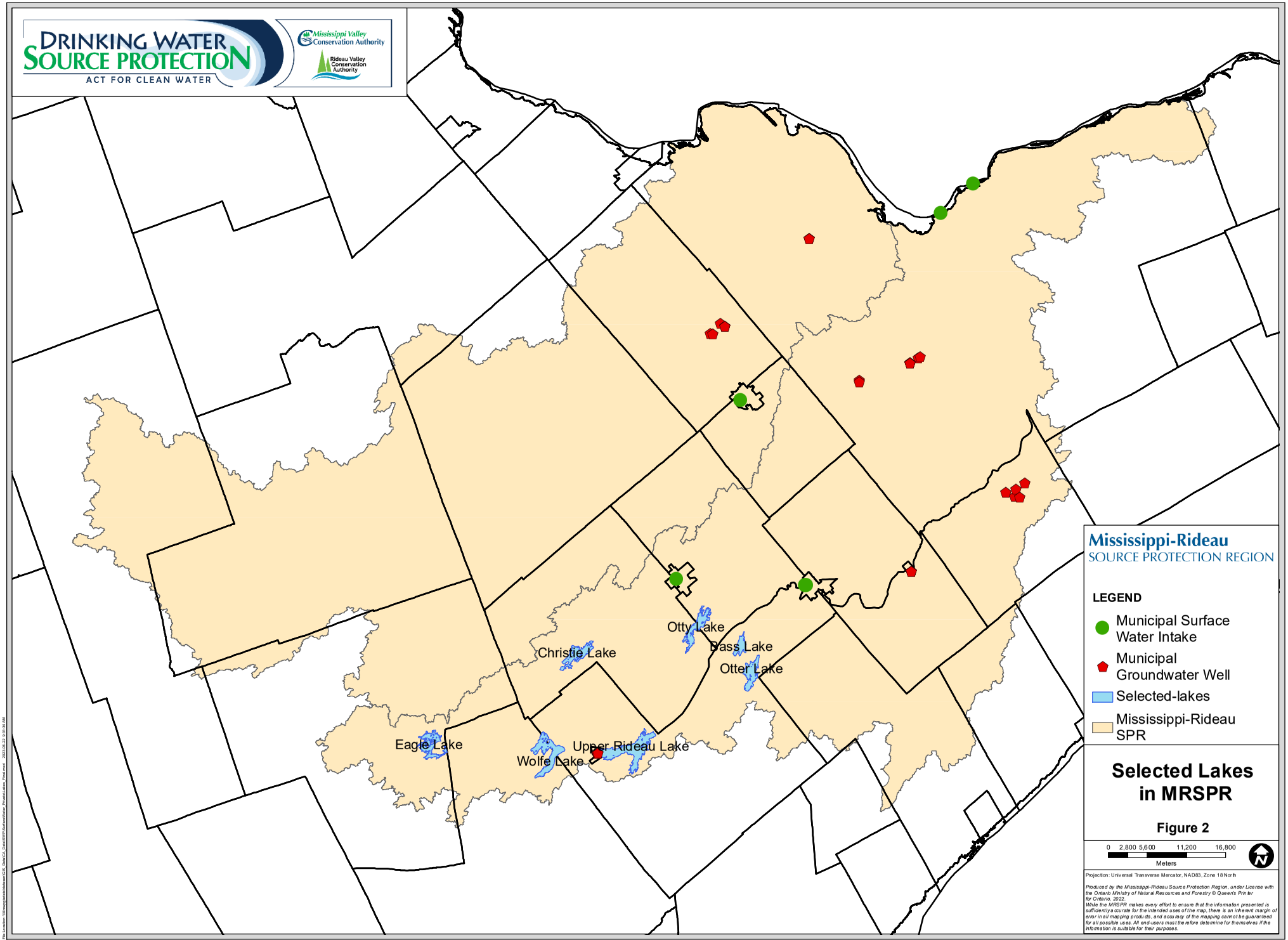
2. Project Area

The project was initiated for the MRSPR exclusively. In the MRSPR, approximately one-quarter of the population are on non-municipal private systems. If the City of Ottawa population is excluded from the MRSPR, two-thirds of the remaining population are on non-municipal systems.

Due to time and budget constraints, the project area was scaled down to focus on a select few lakes within the Rideau Valley watershed, see Table 2. After consultations with RVCA staff, seven lakes were selected for this project (**Error! Reference source not found.**). These lakes were selected to represent a range of characteristics such as water quality, vulnerability of the drinking water source, and development of the area. Once completed, the two-phase study is expected to be useful for the protection of private water supplies for all lakes within the Mississippi-Rideau Source Protection Region.

Table 2. Seven selected lakes

Lake	Township of	Lake Association
Bass Lake	Rideau Lakes	Bass Lake (Rideau) Property Owners Association
Christie Lake	Tay Valley	Christie Lake Association
Eagle Lake	Central Frontenac	Eagle Lake Property Owners' Association
Otter Lake	Rideau Lakes	Otter Lake Landowners Association
Otty Lake	Tay Valley and Drummond/North Elmsley	Otty Lake Association
Upper Rideau Lake	Rideau Lakes	Upper Rideau Lake Association
Wolfe Lake	South Frontenac and Rideau Lakes	Wolfe Lake Association


DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority
Otty Lake
Bass Lake
Otter Lake
Christie Lake
Eagle Lake
Wolfe Lake
Upper Rideau Lake
Mississippi-Rideau
SOURCE PROTECTION REGION
LEGEND
Municipal Surface Water Intake
Municipal Groundwater Well
Selected-lakes
Mississippi-Rideau SPR
Selected Lakes in MRSPR
Figure 2
0 2,800 5,600 11,200 16,800
Meters
Projection: Universal Transverse Mercator, NAD83, Zone 18 North
Produced by the Mississippi-Rideau Source Protection Region, under License with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2022.
While the MRSPR makes every effort to ensure that the information presented is sufficiently accurate for the intended uses of the map, there is an inherent margin of error in all mapping products, and accuracy of the mapping cannot be guaranteed for all possible uses. All end-users must therefore determine for themselves if the information is suitable for their purposes.

3. Project Consultations

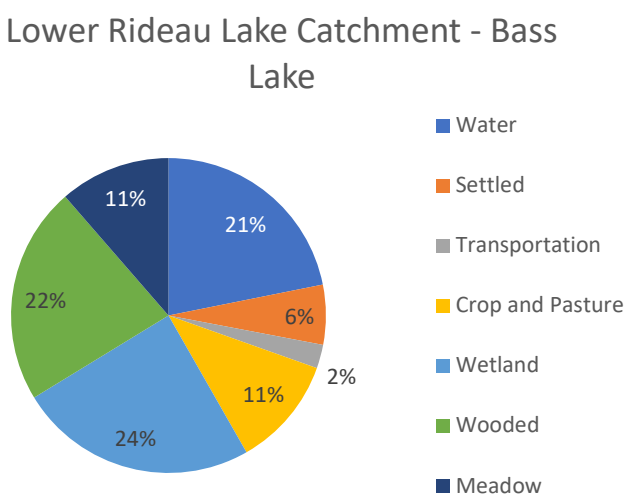
Table 3. List of consultations

Meeting Date	Name	Association
May 5th	Karl Fiander	Otter Lake Landowners Association
	John McDowell	Upper Rideau Lake Association
May 16th	Deb Balika	Conservation Ontario
June 1st	Terry Rees	Federation of Ontario Cottagers' Associations
June 7th	Jennifer Lamoureux	RVCA
	Sarah MacLeod-Neilson	
June 10th	Teresa Clow	Leeds, Grenville, and Lanark Health Unit
	Kim McCann	
June 15th	Dave Counter	Upper Rideau Lake Association
June 20th	Noelle Reeve	Tay Valley Township
	Brittany Mulhern	Rideau Lakes Township
	Claire Dodds	South Frontenac Township
	Jennie Kapusta	Central Frontenac
June 27th	Glenn Tunnock	Friends of the Tay
	Linda Cuthbertson	Otty Lake Association
June 28th	Krystyna Williamson	Christie Lake Association
	Bill St. Jean	Bass lake (Rideau) Property Owners Association
June 30th	Gordan Moore	Wolfe Lake Association
	Doug Cummings	Eagle Lake Property Owners' Association
	Steve Burgess	
July 5th	Jeff Neal	Otter Lake Landowners Association
July 7th	Committee Meeting	Rideau Lakes Lake Association
July 9th	AGM	Upper Rideau Lake Association
July 11th	Gordon Moore	Wolfe Lake Association
July 13th	Bill St. Jean	Bass Lake (Rideau) Property Owners Association
July 16th	Otty Lake Flotilla	Otty Lake Association
July 19th	Brooke Briggs	Christie Lake Association
August 9th	Reid and Christine Kilburn	Otty Lake Association
August 15th	Karl Fiander	Otter Lake Landowners Association
September 6th	PWQMN sampling of Eagle Lake with RVCA staff	

4. Lake Characterization

4.1 Bass Lake

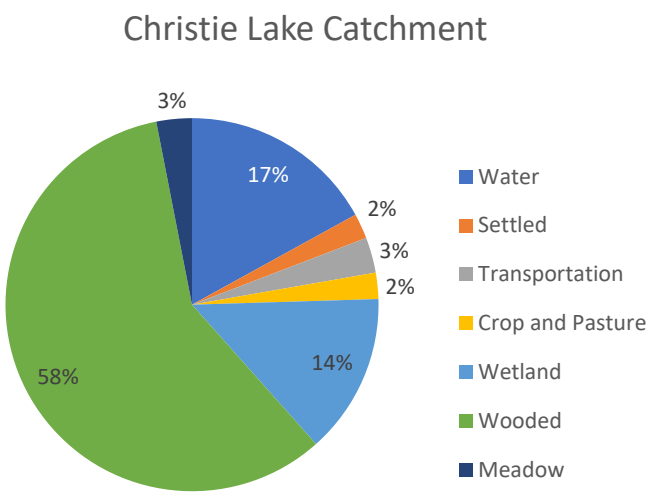
Township	Rideau Lakes
Catchment	Lower Rideau
Surface Area (ha)	290
Shoreline Length (km)	11
Elevation (mASL)	134.5
Maximum Depth (m)	22.5
Flushing Rate (times/year)	0.08
Public Sites	None
Recreational Businesses	• Bass Lake Lodge • Bass Lake Campground



Water Quality	Has a WQI score range of poor to good with a mean of fair. There are no concerns about the pH of the lake. No overall concern for E. coli concentrations. Exceedances of PWQO standards for phosphorus and nitrogen have been present in the past years.
Geology	Quartz sandstone, dolostone, and some conglomerate. Physiographic area of limestone plains.
Other Information	Bass Lake has 14 private roads that give access to all waterfront properties. The lake is located 16km southwest of Smith Falls and 14km southeast of Perth. Bass lake is land locked and much of the shoreline is overdeveloped and very few properties on the shoreline have a vegetative buffer. A berm was constructed in 2021 at the outlet of the lake. Blue-green algae is a concern for the lake. Over the past 5 years there have been reports of algae blooms. In 2018, a blue-green algae bloom spanned much of the lake and tests indicated the toxin levels were low. In 2021, two blooms were reported; one of which had high levels of toxins. Have completed a mandatory septic reinspection.

4.2 Christie Lake

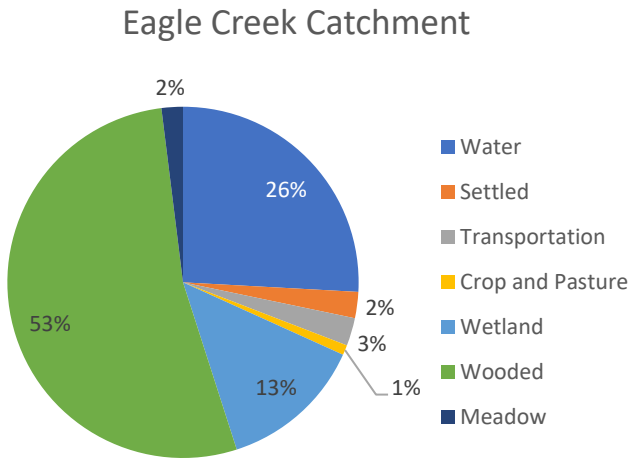
Township	Tay Valley
Catchment	Christie Lake
Surface Area (ha)	655
Shoreline Length (km)	33
Elevation (mASL)	155
Maximum Depth (m)	18.3
Flushing Rate (times/year)	2.64
Public Sites	Unknown
Recreational Businesses	• Christie Lake Kids Camp • Jordans Cottages • Camp Opemikon



Water Quality	WQI score range of good to very good. There are no concerns about the pH of the lake. There are no concerns about E. coli concentrations. Nitrogen levels are good with minimal exceedance values in the past 3 years. Few exceedances of phosphorus values in the past 3 years but the level is typically good.
Geology	Late felsic plutonic and carbonate metasedimentary rocks. Physiographic area of clay plains, shallow till and rock ridges.
Other Information	This lake is located 16km southwest of Perth and 13km northwest of Westport. Christie Lake has 31 islands ranging in size from 0.04ha to 6ha. Many properties on the shoreline have some kind of vegetative buffer. Blue-green algae is not a concern for the lake. Have a voluntary septic reinspection program.

4.3 Eagle Lake

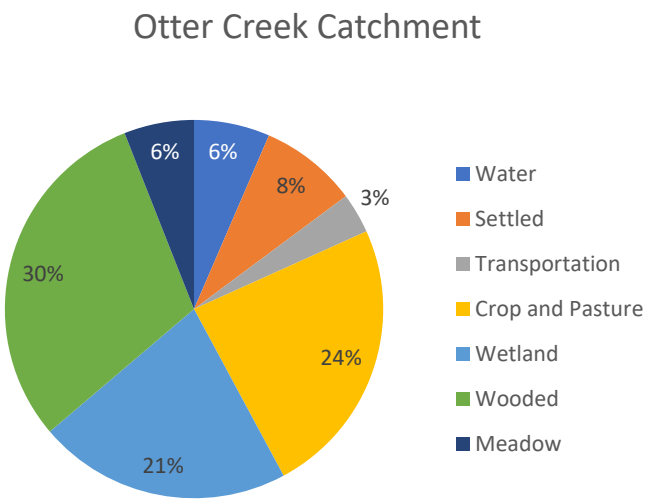
Township	Central Frontenac
Catchment	Eagle Lake
Surface Area (ha)	650
Shoreline Length (km)	50
Elevation (mASL)	191
Maximum Depth (m)	31
Flushing Rate (times/year)	0.08
Public Sites	Two boat launches
Recreational Businesses	• RKY Camp • Camp Oconto



Water Quality	WQI score of good to very good. There are no concerns about the pH of the lake. There are no concerns about E. coli concentrations. No concern for nitrogen values. Phosphorus is typically good with a few values exceeding the PWQO.
Geology	Felsic plutonic rocks, and carbonate and clastic metasedimentary rocks. Physiographic area of shallow till and rock ridges.
Other Information	The lake is 22km west of Westport and 50km north of Kingston. There is a control dam located in Eagle Creek, an outlet of Eagle Lake, to control the water level on Eagle Lake. Properties are widespread around the lake and much of the shoreline is vegetated. Blue-green algae is of some concern for the lake. In progress of completing a mandatory septic reinspection program.

4.4 Otter Lake

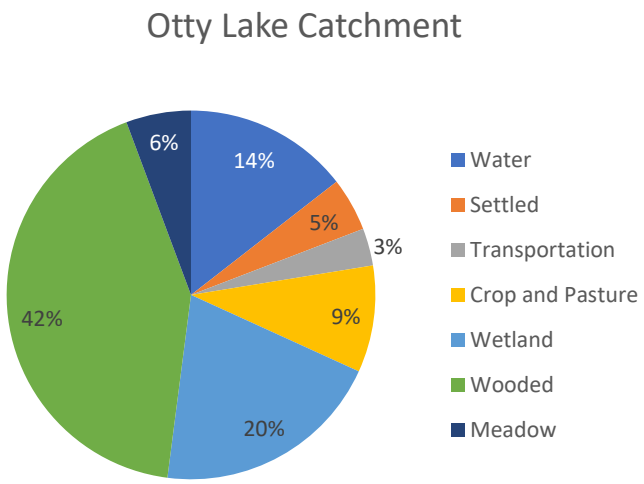
Township	Rideau Lakes
Catchment	Otter Creek
Surface Area (ha)	572
Shoreline Length (km)	23
Elevation (mASL)	124
Maximum Depth (m)	36
Flushing Rate (times/year)	0.12
Public Sites	One boat launch
Recreational Businesses	• Camp Otterdale • Sandy Beach Cabins • Twin Pines Campground • Moonlight Bay Campground



Water Quality	WQI score range of fair to good. There are no concerns about the pH of the lake. There are no concerns about E. coli concentrations. No concern for nutrient values.
Geology	Quartz sandstone, and carbonate metasedimentary rock types. Physiographic area of limestone plains, shallow till, and rock ridges.
Other Information	This lake is situated between the village of Lombardy and Portland. Watershed Canada assessed the shoreline and stated over 50% of it was overdeveloped. There are many outcrops and steep cliffs along the shoreline. Several small inlet creeks and streams, and one primary outlet. Blue-green algae is of slight concern for the lake. There have been a few sightings of small blooms with notable characteristics but no official reporting's. Have completed a mandatory septic reinspection program.

4.5 Otty Lake

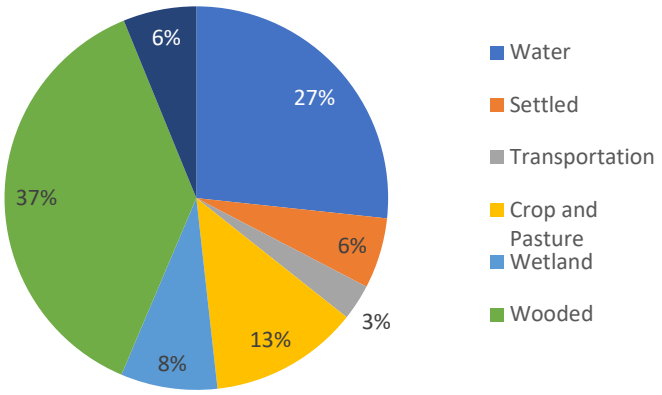
Township	Tay Valley and Drummond/ North Elmsley
Catchment	Otty Lake-Jebbs Creek
Surface Area (ha)	655
Shoreline Length (km)	41
Elevation (mASL)	131
Maximum Depth (m)	27
Flushing Rate (times/year)	0.22
Public Sites	One boat launch
Recreational Businesses	• Camp Shomria • Whispering Pines (Scout Camp)



Water Quality	WQI score range of fair to good. There are no concerns about the pH of the lake. There are no concerns about E. coli concentrations. No concern for phosphorus but nitrogen values average an exceedance of PWQO.
Geology	Carbonate and clastic metasedimentary rocks with quartz sandstone and dolostone present. Physiographic area of shallow till and rock ridges.
Other Information	Otty Lake has 31 islands, 20 of which are provincially owned, and the remaining are privately owned. This lake is 8km south of the town of Perth. Many properties have some kind of vegetative buffer. Densely populated areas have little to no vegetative buffers. Blue-green algae is of slight concern for the lake. Prior to 2021 there were no reported blooms. In 2021, there were two reported blooms; one of which was identified as non-toxic. In progress of completing a mandatory septic reinspection program.

4.6 Upper Rideau Lake

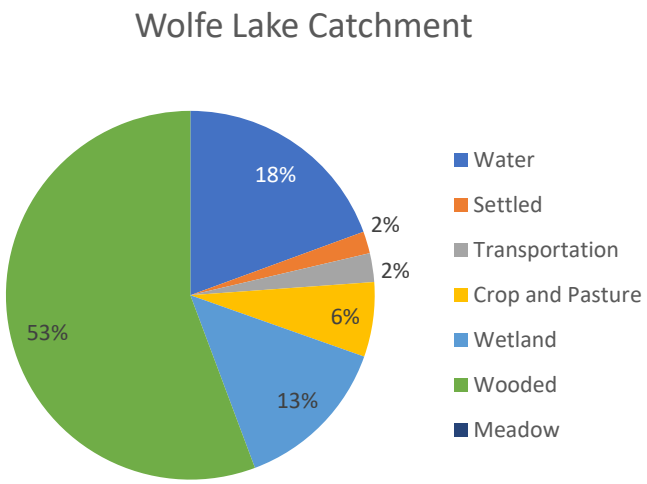
Township	Rideau Lakes
Catchment	Upper Rideau
Surface Area (ha)	1408
Shoreline Length (km)	48
Elevation (mASL)	124.6
Maximum Depth (m)	23
Flushing Rate (times/year)	0.34
Public Sites	Conservation Area and locks
Recreational Businesses	• Rideau Lakes Golf and Country Club • Sunnyside Family Retreat • Narrows Lock Campground • Westport Harbor



Water Quality	WQI score range of poor to fair. There are no concerns about the pH of the lake. There are no concerns about E. coli concentrations. No concern for nitrogen levels but phosphorus averages a value exceeding PWQO.
Geology	Quartz sandstone and dolostone present. Carbonate metasedimentary and felsic plutonic rocks. Physiographic area of limestone plains, shallow till and rock ridges.
Other Information	The town of Westport is located at the southwest end of the lake. Highly populated shoreline with few vegetative buffers. Upper Rideau Lake is geographically the highest lake on the Rideau Canal System. Blue-green algae is a concern for the lake. Algal blooms have been present in Upper Rideau Lake since 2014. In 2021, two blooms were reported. Have completed a mandatory septic reinspection program.

4.7 Wolfe Lake

Township	Rideau Lakes and South Frontenac
Catchment	Wolfe Lake
Surface Area (ha)	1005
Shoreline Length (km)	37.5
Elevation (mASL)	136
Maximum Depth (m)	40
Flushing Rate	0.10
Public Sites	Two boat launches
Recreational Businesses	• Camp Iawah • Evergreen Golf Course • Wolfe Springs Resort



Water Quality	WQI score range of fair to very good. There are no concerns about the pH of the lake. There are no concerns about E. coli concentrations. No concerns with nutrient values.
Geology	Carbonate metasedimentary and felsic plutonic rocks. Some quartz sandstone present. Physiographic area of kame moraines, shallow till and rock ridges.
Other Information	This lake is located 4km west of Westport. There are properties that have vegetative buffers and some properties that do not have a vegetative buffer. There are some steep outcrops along the shoreline. Blue-green algae is not of high concern for the lake. There have been a few small blooms with low toxin levels reported in the past few years. Have a voluntary septic reinspection program.

5. Preliminary Estimates

Using GIS analytical tools, a preliminary estimate of drinking water sources for waterfront properties surrounding the seven lakes were determined. The number of waterfront parcels/lots was determined using RVCA parcel outline data and RVCA imagery. Using the waterfront parcels determined, RVCA imagery and RVCA building footprint data, the number of residential lots were determined. For this study a residential parcel/lot was defined as a parcel/lot containing one or more buildings, excluding known commercial parcels/lots such as campgrounds. To estimate the drinking water source for these residential lots the Provincial Water Well Records Database was utilized. To account for potential discrepancies in reported well locations a 300m buffer was created for each lake. It was assumed that parcels/lots without a well, sourced their water from a surface water intake. These estimates were refined in section **6.2 Survey Results**. The number of residential parcels/lots with a surface water intake was then determined by subtracting the number of wells recorded around a lake from the number of residential parcels/lots for each lake. The results of this analysis are presented in *Table 4*.

Table 4. Preliminary estimates of drinking water sources around the seven lakes

Lake	Number of parcels[1]	Number of RL	Number of wells[2]	Percentage of RL with a private well	Percentage of RL with a SWI
Bass	243	233	101	43%	57%
Christie	289	237	93	39%	61%
Eagle	326	236	54	23%	77%
Otter	352	295	94	32%	68%
Otty	495	424	245	58%	42%
***Upper Rideau**	485	406	310	76%	24%
Wolfe	231	180	101	56%	44%
Total	2421	2011	998	50%	50%

RL = Residential parcel/lot **SWI = Surface Water Intake**

***Upper Rideau is situated near 2 municipal groundwater wells (Westport)

**** Assumption each residence houses 2.5 people

[1]Data sourced from City of Ottawa, OpenStreetMap and RVCA Database

[2] Data sourced from Provincial Water Well Records Database

To aid in the preliminary analysis, records on septic inspections from the Mississippi-Rideau Septic System Office were analyzed. Upon analysis, this data was deemed insufficient and would not be included in the drinking water system analysis. 15% of all data had a water source listed as unknown or null. 27% of available septic inspection data for the selected lakes was not confirmed with the property owner but interpreted by the inspector during the onsite visit. Of the 73% confirmed sources of water, 50% required speculation, as there were multiple sources listed and in some cases one of the sources was listed as unknown.

6. Private Drinking Water Survey

To aid in determining the drinking water sources for waterfront residents a survey was distributed to waterfront property owners of the seven lakes selected for this project. The survey was distributed to residents and promoted through Lake Associations, newsletters, and social media. Responses were collected from July 1st, 2022 to August 31st 2022, blank survey provided in ***Error! Reference source not found.***.

The goal of the survey was to:

1. Determine concerns lake front property owners have about their drinking water source;
2. Refine estimates for drinking water sources surrounding lakes; and,
3. Determine possible threats/risks to drinking water

6.1 Community Concerns

This study was initiated to address concerns raised by Lake Association representatives for the safety of their residents, drinking water sourced from the lake. These representatives believed there to be many residents of their respective lakes that sourced their drinking water from the lake. As the number of blue green algae or harmful algae blooms (HAB) have increased, they were concerned these residents may be drinking contaminated water. They were also concerned by the delays related with HAB reporting and identification through the MECP Spills Action Center. Previous HABs have taken weeks to months for a positive identification once they were reported. Within this time frame residents are at risk of exposure to the bloom and may experience adverse health effects from drinking contaminated waters. Many residents highlighted this as a main concern in their survey responses.

A section of the survey was dedicated to collecting information from homeowners and identifying any additional concerns about their drinking water source or drinking water systems. These concerns were taken into consideration for Phase 1 information collection, and Phase 2 recommendations. Concerns raised in the surveys that required immediate attention were dealt with by MRSPR staff.

There were a variety of concerns raised about both groundwater and surface water sources. Individuals with wells were concerned about the sustainability of their well and if the capacity of the aquifer could sustain new developments in their area.

There were a variety of concerns raised from individuals with surface water intakes. The most common concern raised related to the contamination of the lake water from actions carried out on adjacent properties. Landowners were worried their neighbors may use chemicals on their properties that may contaminate the lake and their source of drinking water. Landowners were also worried that septic systems are not properly maintained and could leach effluent into the lake therefore contaminating their drinking water source. Others were worried about how to treat their surface water to ensure it is safe to drink and where they may get their water tested.

6.2 Survey Results

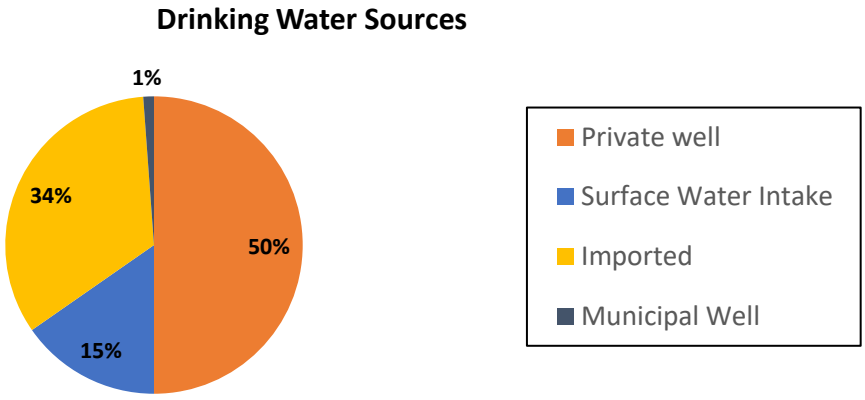
There was a total of 346 responses to the survey, with an estimate of 17% of the population reached. The maximum estimated response rate for one lake was 29%, with a minimum response rate for one lake of 8%. The response rate was calculated by using the number of residential lots surrounding each lake and the number of responses acquired from each lake. Survey responses included 170 permanent homes, 174 seasonal cottages, and 2 vacant lots. The percentage of permanent homes, seasonal cottages and vacant lots varied between lakes.

Table 5. Property type by lake

Lake	Percent Permanent Home	Percent Seasonal Cottage	Percent Vacant Lot
Bass	57%	41%	2%
Christie	28%	72%	0%
Eagle	14%	86%	0%
Otter	49%	51%	0%
Otty	54%	46%	0%
***Upper Rideau**	56%	41%	3%
Wolfe	52%	48%	0%
Total	49%	50%	1%

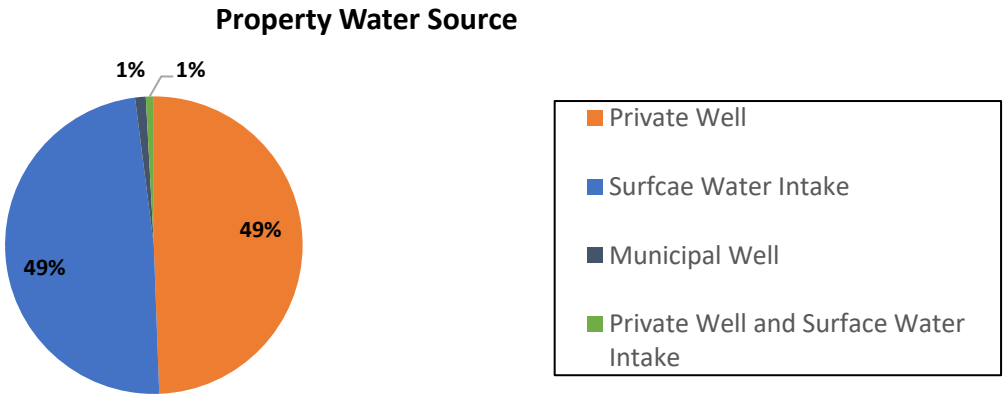
Waterfront properties may have multiple sources of water. A water source may be used to service the property or in the pipes throughout the house, while the drinking water is from a different source. For this study, water was categorized by drinking water source and property water source (i.e., water used not for drinking but for the toilets, laundry, gardening, etc.).

The drinking water source was determined from the survey question “What is your source of potable water?”. Results indicate 50% of lake residences source their drinking water from a private well, 15% from a surface water intake, and 34% are importing their drinking water. The remaining 1% have access to a municipal well.

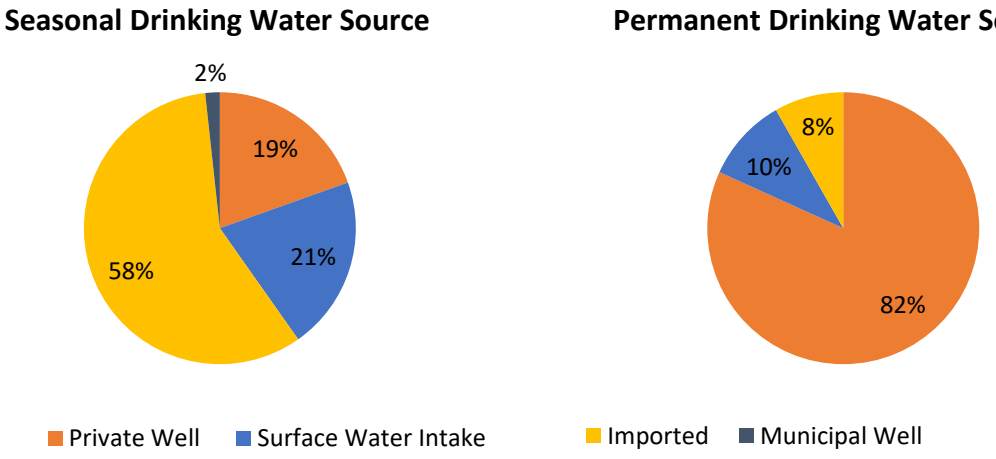


The property water source required some estimation as it was not directly requested in the survey questions. This was not seen as a limitation, as this study was to determine drinking water sources as opposed to property water sources. This work was done to accompany the study but not as a focus.

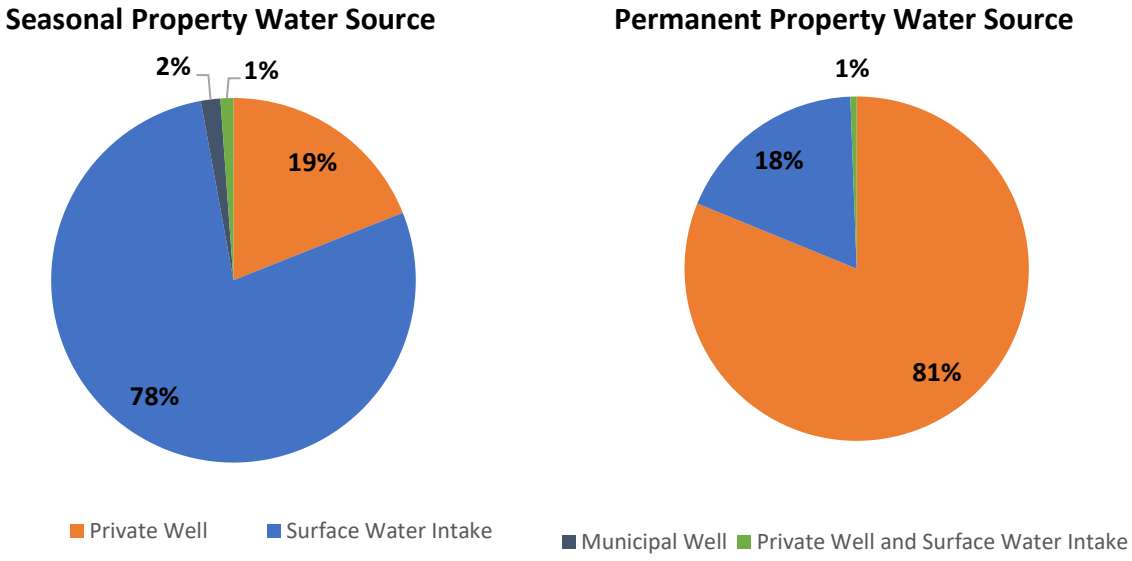
For this study it was inferred that individuals who indicated they import their drinking water, are not importing the water servicing their home but sourcing it from the lake, unless otherwise indicated. A thorough analysis of all survey responses was conducted to best determine the property water source. 18% of all survey results required the assumption that individuals importing their drinking water had a surface water intake, while the remaining 82% of responses indicated their property water source in their responses.



When comparing the drinking and property water sources of permanent homes to that of seasonal cottages, there was a notable difference. For permanent homes drinking water sources, 82% indicated they get their drinking water from a private well, 10% from a surface water intake, and 8% are importing their drinking water. In comparison, 19% of seasonal cottages indicated they get their drinking water from a private well, 21% from a surface water intake, and 58% are importing their drinking water.



The property water sources for permanent homes were 81% have a private well, 18% have a surface water intake, and 1% have both. In comparison, 19% of seasonal cottages have a private well, 78% have a surface water intake, 1% have both and 2% have access to a municipal well.



To aid with the threat/risk and vulnerability analysis conducted, the survey asked residents to indicate whether they had a water treatment system and what treatment they had, how they heated their homes, and if they had a septic system located on their property.

27% of individuals did not respond to the question pertaining to water treatment systems. Of those that did respond, 16% did not have a water treatment system. 21% of individuals who don't treat their water, have a surface water intake but have indicated they are not drinking the untreated surface water. Individuals with a surface water intake and a water treatment system indicated whether they have a UV light, UV light and filter, a reverse osmosis, or a UV light and a reverse osmosis treatment system.

The responses to how individuals heated their homes included wood, electric baseboards, propane and fuel oil. 4% of all responses indicated they heat their homes with fuel oil and have a small fuel storage tank located on the property.

90% of all individuals indicated they have a septic system located on their property.

Individuals with a surface water intake were asked how far their intake was from the shoreline and how deep the intake was positioned below the water surface.

Table 6. Water treatment, fuel storage and septic system results

	Total for all survey responses
Has no Water Treatment Systems	16%
Has a Fuel Oil Tank	4%
Has a Septic System	90%

Table 7. Drinking water source by lake

Lake	Number of Responses	Private Well	Surface Water Intake	Imported	Municipal Well	Private Well	Surface Water Intake	Imported	Municipal Well
Bass	54	26	9	19	0	48%	17%	35%	0%
Christie	18	7	3	8	0	39%	17%	44%	0%
Eagle	29	9	7	13	0	31%	24%	45%	0%
Otter	43	17	9	17	0	40%	21%	40%	0%
Otty	124	68	18	35	3	56%	15%	29%	2%
Upper Rideau	34	20	2	11	1	59%	6%	32%	3%
Wolfe	44	26	5	13	0	59%	11%	30%	0%
Total	346	173	53	116	4	50%	15%	34%	1%

Table 8. Drinking water Source by property type

Lake	Number of Responses	Private Well	Surface Water Intake	Imported	Municipal Well	Private Well	Surface Water Intake	Imported	Municipal Well
Permanent	170	139	17	14	0	82%	10%	8%	0%
Seasonal	174	34	36	101	3	19%	21%	58%	2%
Vacant Lot	2	0	0	1	1	0%	0%	50%	50%
Total	346	173	53	116	4	50%	15%	34%	1%

Table 9. Property water source by lake

Lake	Number of Responses	Private Well	Surface Water Intake	Private Well and Surface Water Intake	Municipal Well	Private Well	Surface Water Intake	Private Well and Surface Water Intake	Municipal Well
Bass	54	26	28	0	0	48%	52%	0%	0%
Christie	18	7	11	0	0	39%	61%	0%	0%
Eagle	29	8	20	1	0	28%	69%	3%	0%
Otter	43	17	26	0	0	40%	60%	0%	0%
Otty	124	67	53	1	3	54%	43%	1%	2%
Upper Rideau	34	20	12	1	1	59%	35%	3%	3%
Wolfe	44	26	18	0	0	59%	41%	0%	0%
Total	346	171	168	3	4	49%	49%	1%	1%

Table 10. Property water source by property type

Lake	Number of Responses	Private Well	Surface Water Intake	Private Well and Surface Water Intake	Municipal Well	Private Well	Surface Water Intake	Private Well and Surface Water Intake	Municipal Well
Permanent	170	138	31	1	0	81%	18%	1%	0%
Seasonal	174	33	136	2	3	19%	78%	1%	2%
Vacant Lot	2	0	1	0	1	0%	50%	0%	50%
Total	346	171	168	3	4	49%	49%	1%	1%

7. Interpretations

Preliminary analysis of the seven lakes estimated there to be 2,421 waterfront parcels with 2,011 residential waterfront properties and suggests that 50% of the residential waterfront properties have a surface water intake.

Survey responses suggest the preliminary analysis was accurate, as 49% of responses indicated they have a surface water intake. Approximately one-third of properties with a surface water intake source their drinking water from this intake while the remaining two thirds of properties with surface water intakes import their drinking water.

Table 61. Comparison of preliminary estimates and survey results

Lake	Preliminary Analysis		Survey Results	
	Number of RL	Percentage RL with SWI	Percentage of RL with a SWI	Percentage of RL Drinking from a SWI
Bass	233	57%	52%	17%
Christie	237	61%	61%	17%
Eagle	236	77%	69%	24%
Otter	295	68%	60%	21%
Otty	424	42%	43%	15%
Upper Rideau	406	24%	35%	6%
Wolfe	180	44%	41%	11%
Total	2011	50%	49%	15%

RL = Residential parcels/lots SWI = Source Water Intake

With the estimated number of residential properties surrounding the seven lakes and the results from the survey, it can be interpreted that there are 976 residential parcels/lots with a surface water intake and 308 residential parcels/lots drinking from a surface water intake.

Table 72. Comparison of preliminary estimates and interpreted results

Lake	Preliminary Analysis		Interpretations	
	Number of RL	Number of RL with a SWI	Number of RL with a SWI	Number of RL Drinking from a SWI
Bass	233	132	121	39
Christie	237	144	145	40
Eagle	236	182	163	57
Otter	295	201	178	62
Otty	424	179	181	62
Upper Rideau	406	96	143	24
Wolfe	180	79	74	20
Total	2011	1013	976	308

RL = Residential parcels/lots SWI = Source Water Intake

8. Vulnerability Analysis

The vulnerability analysis for private drinking water systems around the seven selected lakes was done in a multi-stage approach. Each stage of the assessment focused on a different scale of the area starting with the catchment of each lake and ending with individual intakes and wells. This analysis followed suggested vulnerability assessments from the *Best Practices for Source Water Protection* and the same steps to which threats to municipal drinking water systems are determined. All threats, risks and vulnerabilities have been generalized to each area and scale. One threat may not apply to all lakes or each home on the same lake. Risks and threats to a specific lot must be assessed on a case-by-case basis and a specialist should be consulted.

8.1 Groundwater Vulnerability

The *Clean Water Act* delineates vulnerable areas according to four classifications; Significant Groundwater Recharge Areas, Highly Vulnerable Aquifers, surface water Intake Protection Zones and Wellhead Protection Areas. To begin the vulnerability assessment of this project, aquifer vulnerability was assessed using data from the *MRSPR Assessment Report*.

An aquifer is classified based on its depth underground and the soil type and/or the rock type that holds groundwater. A Highly Vulnerable Aquifer (HVA) is an aquifer that is shallow, has little to no soil cover, or the rock type is highly permeable. The aquifers in the MRSPR were delineated using a modified MECP intrinsic susceptibility index protocol. This protocol studies the 'first aquifer' or the closest to the surface. Approximately 89% of the MRSPR is classified as a HVA and the seven selected lakes are located within a HVA zone, Figure 3.

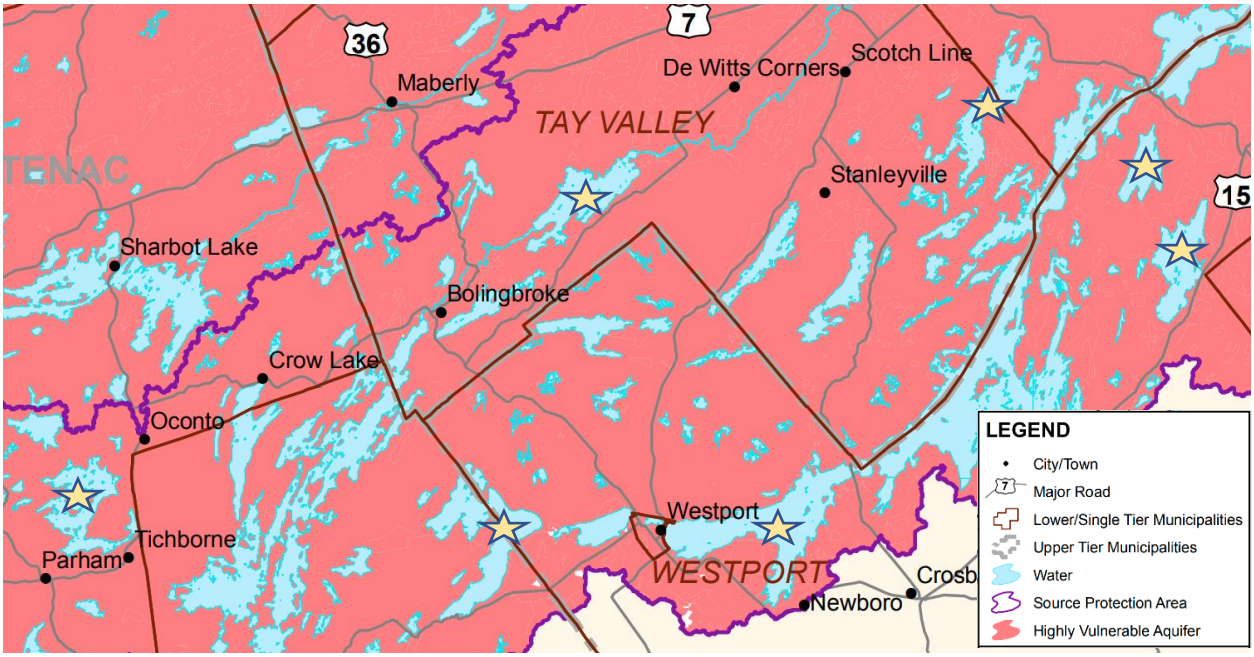


Figure 3. RVCA highly vulnerable aquifer map

8.2 Surface Water Vulnerability: Residency Time

The *Best Practices* classify the vulnerability of surface water sources by the **residency time/flow rate** of the lake water. The *Best Practices* state that slower moving water with less water circulation or mixing has a high vulnerability, while faster moving water with more water circulation or mixing has a low vulnerability. For this analysis the vulnerability of surface water was divided into five categories from 'very low' to 'very high' vulnerability. A classification of 'very low' demonstrates that if a contaminant does get into the lake, it will take less than one season for the contaminant to be completely flushed from the lake. A classification of 'very high' demonstrates that if a contaminant does get into the lake, it will take over 10 years for the contaminant to be completely flushed from the lake. **A surface water vulnerability classification of Highly Vulnerable does not mean the lake is not healthy or safe to drink from currently.**

The seven lakes demonstrated a range of residency times and corresponding vulnerability classifications from low vulnerability to very high vulnerability. The residency times, years to complete one flushing cycle and corresponding vulnerability classification for each of the seven lakes is below in *Table 14.* The residency time was calculated using an estimated volume for each lake and a mean annual outflow derived from the Ontario Flow Assessment Tool.

Table 83. Surface water vulnerability

Lake	Residency Time (times flushed/year)	Years to complete one cycle
Bass	0.08	12.3
Christie	2.65	0.38
Eagle	0.08	11.9
Otter	0.12	8.24
Otty	0.22	4.45
Upper Rideau	0.34	2.98
Wolfe	0.10	9.96

Vulnerability Classification
Very Low = <1 season
Low = 1 season to 1yr
Moderate = 1 to 5yrs
High = 5 to 10yers
Very high = 10+ years

8.3 Groundwater Vulnerability: Parcel/Lot Sizing

The size of a particular parcel/lot and the vulnerability of the groundwater in the area can help determine if the actions carried out on the parcel/lot pose a threat to the groundwater quality. The parcel/lot size can affect the designated uses for the parcel/lot as well as if a septic system and a well can function without affecting one another.

All septic systems dispose of sewage into the ground and if proper precautions and treatment techniques are not followed, they can pose a significant threat to groundwater/drinking water quality. Smaller parcels/lots result in wells and septic systems too close together therefore having a higher risk of sewage contaminating their ground water/drinking water supply. It is understood that parcels/lots smaller than 1 hectare and parcels/lots within HVA areas may have an increased risk in groundwater contamination.

For this study, an analysis of the parcel/lot sizes surrounding all seven lakes was done using available parcel data from the RVCA databases. The table below demonstrates the range of parcel/lot sizes for each of the seven lakes. Many of the parcels/lots around all seven lakes are less than 1 hectare and are therefore at an increased risk to groundwater contamination from parcel/lot activities (i.e., septic systems).

Table 94. Parcel/lot sizing

Lake	> 1 ha	< 1 ha
Bass	5%	95%
Christie	18%	82%
Eagle	19%	81%
Otter	8%	92%
Otty	17%	83%
Upper Rideau	18%	82%
Wolfe	39%	61%

Lake	0.8-1 ha	0.6-0.8 ha	0.2-0.6 ha	< 0.2ha
Bass	1%	3%	48%	43%
Christie	4%	7%	42%	29%
Eagle	6%	5%	44%	25%
Otter	1%	3%	36%	52%
Otty	7%	7%	37%	32%
Upper Rideau	3%	7%	39%	32%
Wolfe	2%	6%	32%	21%

8.4 Intake Vulnerability

The vulnerability of surface water intakes was determined using responses from the survey. The vulnerability classifications were based on arbitrary ranges, seen in *Table 15*, for distance from the shore and depth in the water. These ranges were determined through recommendations from the Ontario Government *Design Guidelines for Drinking-Water Systems.* A classification was given to each intakes distance and depth, and then a general classification was given to the system. The intake distance from the shore had a higher frequency of vulnerability classifications ranging from low to very low vulnerability while the depth classifications had a higher frequency of moderate to very high vulnerability. The average general intake classification for all lakes was moderate.

Table 105. Intake vulnerability based on survey results

Vulnerability Classification (VC)	Distance from Shore (m)	Intake Depth (m)
Very Low	Greater than 10	Greater than 4
Low	8 to 10	3 to 4
Moderate	5 to 8	2 to 3
High	3 to 5	1 to 2
Very high	0 to 3	0 to 1

Lake	Average VC for Intake Distance from Shore	Average VC for Intake Depth	Average VC Overall
Bass	Low	High	Moderate
Christie	**Do not have enough data**		
Eagle	Low	Moderate	Moderate
Otter	Very Low	High	Moderate
Otty	Low	High	Moderate
Upper Rideau	**Do not have enough data**		
Wolfe	Low	High	Moderate

8.5 The Municipal Approach to Vulnerability using Directors Technical Rules

The *Directors Technical Rules* (*DTR*) as per the *Clean Water Act , 2006* stipulate that municipal wells have four designated wellhead protection areas (WHPA) and range from WHPA-A to WHPA-D. WHPAs are used to better understand the local groundwater conditions and identify potential sources of contamination.

WHPA-A is the area immediately surrounding the well and is delineated by a buffer of 100m. WHPA-B, C, and D are delineated by the **time of travel**; 2-years, 5 years, and 25 years respectively. Each WHPA is assigned a vulnerability score ranging from 1-10 based on the aquifer vulnerability and overlapping WHPAs. WHPA-A is assigned a vulnerability score of 10, WHPA-B can be assigned a vulnerability score of 6, 8 or 10, WHPA-C a score of 4, 6 or 8 and WHPA-D a score of 2, 4 or 6.

The *DTRs* classify municipal intakes by the type of waterbody they are located within. For this study all intakes would be classified as a Type D intake; *"anything not classified as a Type A, B or C intake. Type D intakes are typically located in smaller inland lakes."* The vulnerability of the intake is then broken down into three intake protection zones (IPZ-1, 2, and 3). IPZ-1 for a Type D intake is delineated by a radius of 1km and if the area includes land, the setback will be the area of land that drains into the surface water body measured from the high-water mark and the area must not exceed 120 meters. A vulnerability score ranging from 1-10 is then given to each IPZ based on the area vulnerability factor and the source vulnerability factor. The area vulnerability factor is based on the percentage of the area that is land, the landcover, soil type, permeability of the land, slope of the land, and hydrological and hydrogeological conditions where transport pathways are located. The source vulnerability factor is based on the depth of the intake below the water surface, the distance of the intake from the land, and the number of recorded drinking water quality issues at the intake. The vulnerability score for each IPZ is then calculated by multiplying the area vulnerability factor by the source vulnerability factor.

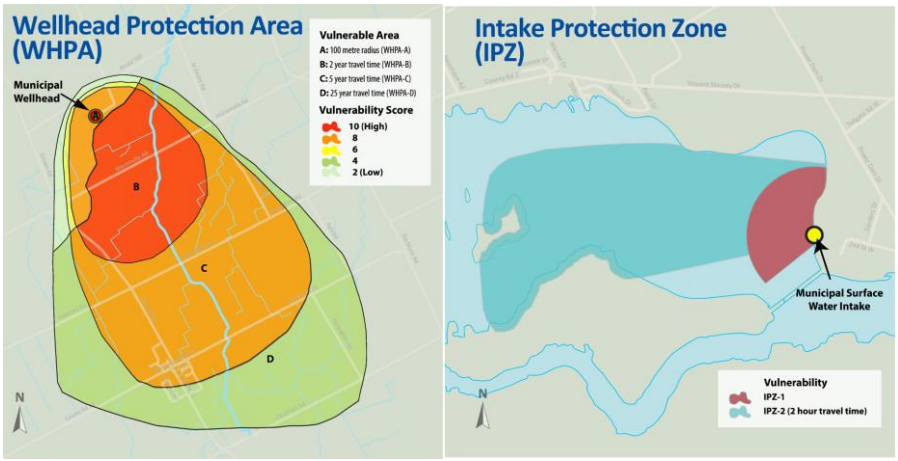


Figure 4. WHPA and IPZ schematics

For this study, WHPA-A for the wells and IPZ-1 for the surface water intakes of the residential lots on the seven lakes were examined. Applying the *DTR* approach, all wells were given a WHPA-A radius of 100m surrounding the wellhead and intakes were given an IPZ-1 radius of 1km in the water and a setback on land of 120 meters. WHPA-As are assigned a vulnerability score of 10. IPZ-1s for a Type D intake are assigned an area vulnerability factor of 10, highly vulnerable, and a source vulnerability factor of 0.8 to 1, 1 being most vulnerable. Vulnerability scores for IPZ-1 of a Type D intake can range from 8 to 10. With more data on the lakes and parcels, a source vulnerability factor can be determined but for this project a worst-case scenario approach was applied and a source vulnerability score of 1 was given to all intakes. Subsequently, all IPZ-1s for the study area will have a vulnerability score of 10.

Figure 5 and 6. WHPA-A and IPZ-1 for a residential waterfront property

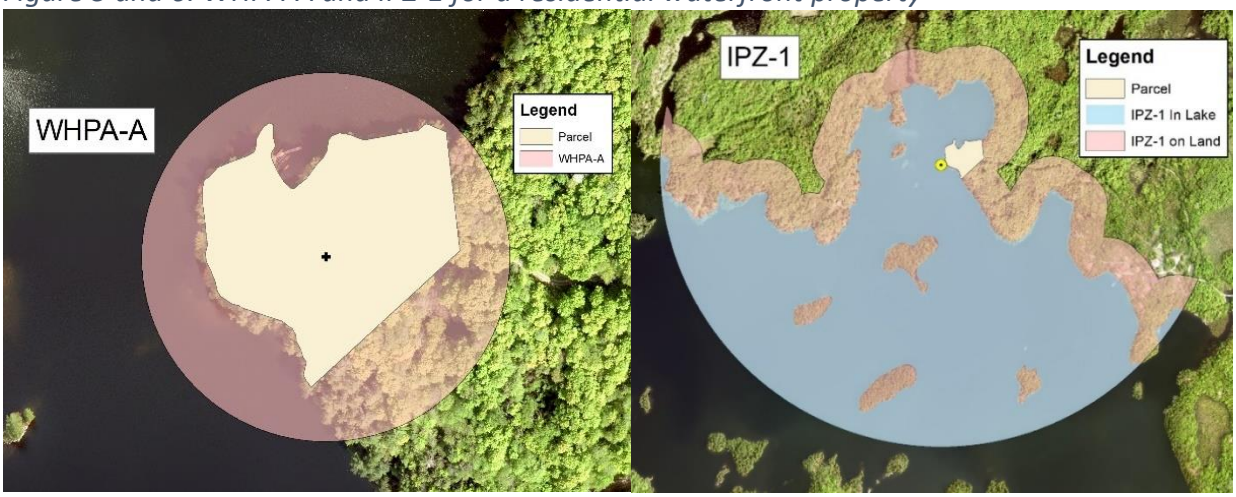
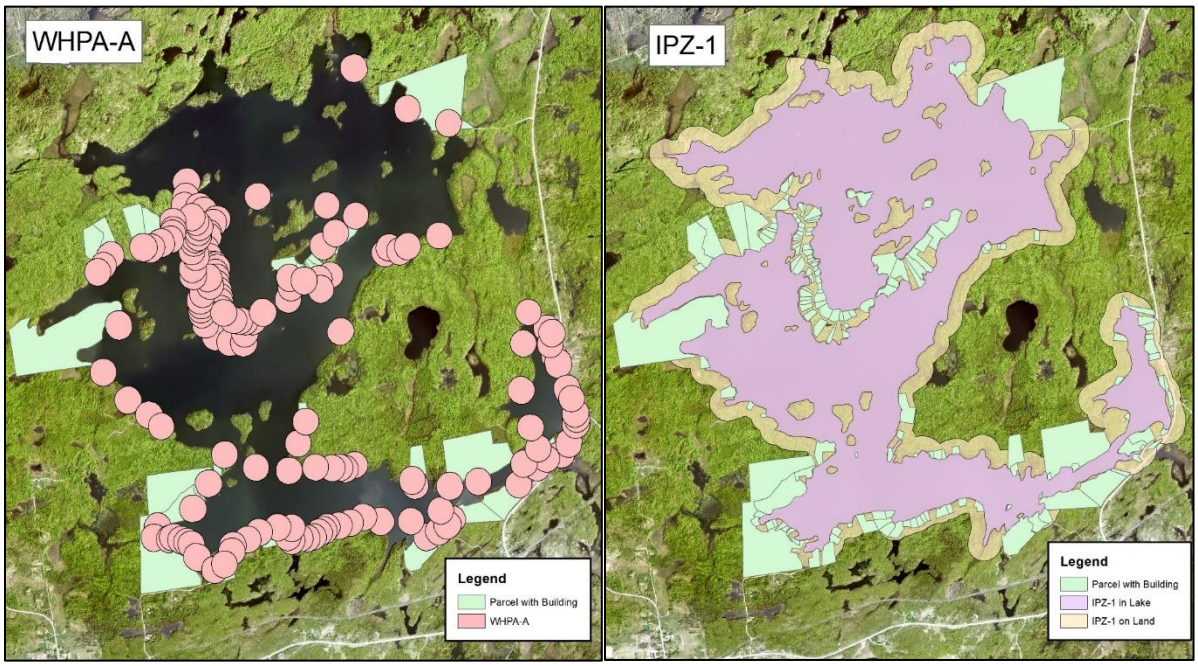


Figure 7 and 8. WHPA-A and IPZ-1 for all residential lots of Eagle Lake



9. Threats Analysis: 22 Provincial Threats for Drinking Water Quality

The *22 Provincial Threats for Drinking Water* were identified through the *Clean Water Act, 2006.* These threats outline activities on the land and in the water that may adversely affect sources of drinking water.

To assess the threats in each lakes catchment, the percentage of landcover categories (i.e., settlements, wooded area, etc.) for each catchment was determined using RVCA databases. These percentages were used to determine which of the *22 Provincial Threats for Drinking Water Quality* may apply to each lake, *Table 116.* Assumed 22 Provincial Threats Of the 22 threats, only a handful were assumed to apply around the lakes—see below.

One of the assumed threats is the application, storage, and management of agricultural source material. On a small-scale, agriculture may not be a direct threat to individual private drinking water systems, but it may have long term effects on lake water quality thus affecting surface water intake water quality.

These assumed threats were then analyzed further to determine which were significant **drinking water threats**, *Table 17.* A threat is considered significant if it meets the specific threat circumstances outlined in the *Clean Water Act, 2006.* A preliminary analysis of the assumed threats was conducted using the landcover type for a setback of 120 meters from the waterline of each lake. A 120m setback was used because IPZ-1s for a Type D intake delineate the area on land, if included, as the area of land that drains into the surface water body measured from the high-water mark and the area must not exceed 120m. Some of the assumed threats were deemed as non-significant as these activities are carried out on landcover types that are not within the 120m setback. The remaining assumed threats were analyzed using the circumstances outlined in the *Clean Water Act,* with the assumption that all WHPA-As and IPZ-1s have a vulnerability score of 10. From this analysis it was determined that the significant threats to drinking water quality surrounding lakes are sewage systems and fuel storage.

Many of the assumed and significant threats determined in this analysis have mitigation programs currently in place. For the mitigation of septic systems, many municipalities have voluntary or mandatory septic reinspection programs. These programs help ensure that septic systems are functioning properly and maintained. Another program that aids in the mitigation of a few assumed threats is the Rural Clean Water Grants Program that helps improve water quality by reducing pollution and the volume of water running off the land. Information on these programs can be found on RVCA Stewardship and Grants website.

Table 116. Assumed 22 Provincial Threats by lake

22 Provincial Threats		Bass	Christie	Eagle	Otter	Otty	Upper Rideau	Wolfe
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	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.				✖		✖	✖
22	The stablishment and operation of a liquid hydrocarbon pipeline.							
*	DNAPLs are chemicals that are heavy and sink in water (e.g., trichloroethylene)							
**	Water quantity threats are evaluated as part of Water Budget studies							

Table 127.Circumstances for the possible 22 Provincial Threats in WHPA-A and IPZ-1

Threat	Vulnerable Area	Circumstance		Is it a threat?
The application, management, and storage of agricultural source material	WHPA-A	Agricultural source material is applied to land in any quantity.	The application may result in the presence of one or more pathogens in the groundwater or surface water.	**No.** It is assumed that within WHPA-A of wells around lakes there is little to no agriculture lands.
Sewage Systems	WHPA-A And IPZ-1	The septic system includes a holding tank for the retention of hauled sewage at the site where it is produced and is subject to Building Code or OWRA		**Yes**. A spill from the tank may result in the presence of pathogens in groundwater or surface water.
		The system is an earth pit privy, privy vault, cesspool, or a leaching bed system and its associated treatment unit.		**Yes**. Discharge from the system may result in the presence of pathogens in groundwater or surface water.
	WHPA-A	Sewage system that is defined in Section 8.1.2.1 of O.Reg. 350, except a holding tank, that may discharge to groundwater or surface water.		**Yes.** Leaching and faulty systems can pose a threat to drinking water quality.
Application, handling, and storage of fertilizer	WHPA-A And IPZ-1	In a vulnerable area where % of Managed Land <40% and Livestock Density >1.0 nutrient units/acre.	Commercial fertilizer is applied to land and may result in a release to groundwater or surface water.	**No.** The percentage of managed land and livestock density were not calculated for this project. It is assumed that <40% is managed lands with a low livestock density if any.
		In a vulnerable area where % of Managed Land 40-80% and Livestock Density >1.0 nutrient units/acre.		
The application, handling, and storage of pesticides	WHPA-A And IPZ-1	Pesticide is applied to land and may result in a release to groundwater or surface water	Total application area of 1 - 10 ha	**No.** It is assumed pesticides will not be applied to and area larger than 1ha.
	IPZ-1	Pesticide is applied to land and may result in a release to groundwater or surface water	Total application area < 1 ha	**No.** The pesticides that are significant threats in either zone such as mecoprop, atrazine, dicamba, etc. These pesticides are assumed to not be used around these lakes.

Threat	Vulnerable Area	Circumstance		Is it a threat?
The application of road salt	WHPA-A	Total impervious area ≥80%	Road salt is applied to roads, highways, or parking lots and may result in a release to groundwater or surface water	**No.** It is assumed that ≥80% of the WHPA is not an impervious area therefore the application of road salt is not a significant threat.
	IPZ-1	Total impervious area in a km^2 > 8 but <80%		**Possible.** It is assumed that the percentage of impervious areas in each IPZ-1 is <8% but may have low significance in total.
The handling and storage of fuel	IPZ-1	The above grade handling of liquid fuel in relation to its storage at a facility as defined in O. Reg 217 except bulk plants, or a facility defined under O Reg 213.	where the quantity handled is >250-2500 L	**Yes.** Spills and leaks can contaminate groundwater and surface water leading to serious environmental and human health issues.
	WHPA-A and IPZ-1	The storage of liquid fuel in a tank partially below grade at a facility defined under O. Reg. 217 excluding a bulk plant, or at a facility defined under O Reg 213.	where the quantity stored is >250 but <= 2500 L	
	IPZ-1	The storage of liquid fuel in a tank at or above grade at a facility defined under O. Reg. 217 excluding a bulk plant, or at a facility defined under O Reg 213.		

10. Research Conducted

10.1 Blue- Green Algae/Harmful Algae Blooms

As a result of climate change, temperatures and the frequency of intense storms are increasing across the province and more waterways are experiencing blue-green algae blooms, also known as harmful algae blooms (HAB). HAB is a form of cyanobacteria that is a microscopic plant-like organism that occurs in waterbodies and can produce toxins harmful to humans and animals. The toxins are released during the death and decay of the organism cells.

Researchers have found that HABs are most prevalent in shallow, slow moving, and warm waters. The blooms are typically detected during the hot summer months and early fall and can form a few times per year in the same waterway. MECP is expecting HABs to increase in frequency and duration. HAB's are known to be caused by high nutrient levels that can come from agricultural and stormwater runoff, industrial and wastewater effluent, lawn fertilizers, and more. Dense blooms can make the water look like a bluish-green pea soup, or a paint slick. Newer blooms can smell like fresh cut grass while older blooms can smell like pig pens.

Coming in contact with a HAB can cause itchy and irritated eyes and skin. Ingesting a HAB can cause flu-like symptoms such as headaches, fever, abdominal pain, nausea, and vomiting. If a large quantity of HABs is ingested, it can cause liver damage and gastrointestinal illness. HAB's can be fatal to animals.

It is recommended that if a HAB is spotted, do not swim, drink, or use the water until the bloom has cleared. As well, do not let your pets/animals go in the water. Never boil the water, as it kills the algae resulting in the release of more toxins. Seek medical attention if feeling unwell after encountering a HAB. Treatment systems based on the following technologies can reduce the level of cyanobacteria and toxins:

- Micron filters – remove intact cells
- Reverse osmosis
- Ozonation, or chlorination (with adequate levels and contact time)
- Point-of-use filters that have been certified to NSF/ANSI 53 f or microcystin reduction

Multiple of the above listed systems should be used to adequately reduce the algae and toxin levels in drinking water. UV lights and water softeners are not effective at removing cyanobacteria or cyanotoxins. **A qualified professional must be consulted to ensure the effectiveness of the treatment system.**

An excess of phosphorus and nitrogen in the water can lead to the growth of HABs. Actions can be taken to help prevent HAB's including using phosphate-free laundry detergents, avoid using fertilizers, reduce surface runoff by maintaining a naturalized shoreline, and ensuring septic systems work properly and are maintained so sewage does not leak.

10.2 Water Treatment Systems

Municipal drinking water systems require extensive water treatment systems, properly trained employees to maintain them, and continued water testing to ensure the safety of the drinking water being distributed. Private drinking water systems rely on individual homeowners to determine the proper treatment systems, maintain these systems, and test their own drinking water.

MRSPR staff are concerned that private drinking water system owners may not have the knowledge on the proper systems to treat their water and how to properly maintain these systems. Without the proper systems and maintenance, individuals may be at risk of drinking contaminated water. As well, there are concerns about the frequency with which individuals are testing their drinking water to ensure its safety for consumption.

There are many types of water treatment systems that can be used for private drinking water. Private drinking water treatment systems are divided into two main categories: point-of-use (POU) or point-of-entry (POE). Point-of-use systems are attached to a single tap or faucet within a home and are typically a filtration system, such as activated carbon filters. Activated carbon filters are a chemical filter used to remove chlorine, pesticides, some bacteria, and bad tastes and odors.

Point-of-entry systems are connected directly to the main incoming water line and may contain multiple treatment systems working in conjunction. These systems may include filters, ultra-violate lights, and reverse osmosis chambers. The type of treatment system required for a home depends on the water supply and what needs to be removed or reduced in the water. **Consult a qualified professional who can assess your water supply to ensure the best treatment system is in place.**

Filters are commonly used in POE systems to remove a variety of contaminants from a home's water source. Physical filters are similar to a sieve and remove sediment and particles from the water. Chemical filters work through ion exchange or absorption, and work to remove harmful chemicals and bacteria.

Ultra-violate systems inactivate bacteria by passing the water through a chamber with a UV light. Reverse osmosis system reverses the flow of water through osmosis, passing the water from a more concentrated solution to a more dilute solution. These two systems do not kill bacteria but remove or inactivate most of the bacteria. Not all bacteria will be removed or inactivated with these systems and should be used in tandem with another treatment system.

Other systems commonly used include chlorinators and ozonators. These systems add chlorine or ozone gas to the water to kill the bacteria present. Both require homeowners to ensure that the proper levels are being added and that there is adequate contact time between the

chlorine or gas and the water. If the levels of chlorine or gas are too low or the contact time is not long enough some bacteria will not be killed and remain in the water.

In areas where the water has high calcium and magnesium levels, many homes have water softeners to remove the hardness. These systems do not remove contaminants or bacteria and they need to regenerate frequently.

Treatment System	What it does	Common issues
Physical Filters (i.e., micron filters, etc.)	- Removes particles such as sediment - Can remove blue-green algae cells	- Need to be replaced frequently - Does not kill bacteria and does not remove toxins
Chemical Filters (i.e., activated carbon, etc.)	- Remove chemicals and bacteria	- Need to be changed frequently
Chlorinators	- Kills bacteria - Can treat blue-green algae/toxins	- Need proper quantities and adequate contact time
Ozonators	- Kills bacteria - Can treat blue-green algae/toxins	- Need proper quantities and adequate contact time
Ultra-Violate	- Inactivates bacteria	- Does not kill bacteria and is not effective at removing blue-green algae or toxins
Reverse Osmosis	- Remove bacteria - Can remove blue-green algae and toxins	- Does not kill bacteria but reduces amount in water
Water Softener	- Removes excess calcium and magnesium	- Regenerate frequently. - Does not kill or remove bacteria.

Table18. Water treatment systems

12. Phase 2 Recommendations and Suggestions for Further Research

The second phase of this project will focus on the development and distribution of resources to key stakeholders. Phase 2 will not include any mandates, all suggestions made will be voluntary, and any policies created will be non-legally binding. Educational materials will be developed and distributed to homeowners with private drinking water systems. These materials will aim to inform individuals on how to protect their drinking water source and how to properly treat their drinking water. These materials will include:

- Educational videos
- Webpage of accumulated resources
- Private well and surface water intake self-assessment tool

RVCA staff suggest all homeowners have their septic systems reinspected every few years to ensure they are maintained and functioning properly. It is also suggested that municipalities implement septic reinspection programs.

It is understood that there is a gap in legislation and policies regarding the protection of private drinking water sources. Many policies are focused on the protection of municipal drinking water sources and private drinking water systems that service major developments. To aid in bridging these gaps, the MRSPR staff aim to develop a non-legally binding policy for the creation of a private drinking water systems working group. The working group would be formed of municipal planners, public health and MECP staff, lake association representatives, and RVCA and MRSPR staff. This group would meet yearly to discuss the protection of drinking water sources for private drinking water systems.

12.1 Blue-Green Algae/ Harmful Algae Bloom Recommendations

Mississippi-Rideau Source Protection Region staff have consulted with the RVCA Surface Water Quality Coordinator about blue-green algae and if it is of high concern in the Mississippi-Rideau watersheds. Based on this discussion, the MRSPR and RVCA staff do not believe blue-green algae is of high concern in the near future. They acknowledge that it is present in some lakes of the Region and that alterations to the reporting system are required.

MRSPR staff are consulting local health units on the systems by which positive bloom identifications are reported to the public and how Conservation Authorities may help in this process. RVCA and MRSPR staff have inquired about historical blue green algae identification records from the MECP and have submitted a request to get copies of these records for the seven lakes.

MRSPR and RVCA staff are exploring institutes by which research projects or programs may be implemented in the MRSPR. This information will be presented to the multidisciplinary working group outlined above in section **12. Phase 2 Recommendations and Suggestions for Further Research.**