2023

Watershed Conditions Report

January 2024

Rideau Valley Conservation Authority

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Request for data

If the data you seek is not contained within this report, we invite you to contact the RVCA to work with staff to find the data you are looking for. You may also find the data you require on our publicly-accessible GeoPortal located at https://gis.rvca.ca.

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Rideau Valley Conservation Authority
Office de protection de la nature de la vallée Rideau

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The Rideau Valley:

An Ever-Changing Watershed

The Rideau River Watershed in Eastern Ontario has existed for millennia, carved away long ago by glacial retreat to create the long, narrow depressions that now hold the region's many lakes and rivers. For several thousand years, this watershed remained a pristine natural landscape, ebbing and flowing with the seasons and providing a safe and bountiful home for the many species who live here – as well as the sovereign Indigenous people who have lived in tandem with this landscape for thousands of years.

But in recent centuries, much has changed in the region. Widespread settlement and industrialization, intensified agriculture and the construction of the Rideau Canal Waterway have permanently altered the watershed's natural systems. Loss of critical green infrastructure such as forest cover, headwaters and wetlands – combined with hardened landscapes in developed areas – has changed the region's hydrological systems, leading to higher flood risks for communities in and around natural floodplains. Increased runoff from urban and agricultural areas, hardened shorelines and increased industrial activity has altered aquatic habitats and water quality, giving rise to more harmful algae blooms and a loss of biodiversity in some areas of the watershed.

These changes are compounded by the increasing threat of climate change and a rapidly growing National Capital Region which continues to place significant pressure on our natural systems, including groundwater and drinking water sources. As we face these challenges, it is critical that we understand the current environmental conditions of our watershed so we can react to issues quickly in the short-term and develop new adaptation strategies for long term sustainability.

What is the RVCA?

The Rideau Valley Conservation Authority (RVCA) is one of 36 conservation authorities in Ontario tasked with protecting people, property and our natural systems through watershed-level resource management.

Operating at the watershed level acknowledges that our dynamic water systems are not contained by municipalities, and that many water-related issues transcend the boundaries of just one or two towns. By taking a watershed-wide approach, we are able to address broad issues with broad solutions.

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The RVCA's jurisdiction includes the approximately 4,000-km^2 Rideau River Watershed from its headwaters in Central Frontenac, north to downtown Ottawa and east to Clarence-Rockland. It also covers two subwatersheds of the Ottawa River Watershed located in Ottawa East and Ottawa West. Across its juridscition, the RVCA is mandated by the provincial *Conservation Authorities Act* to enforce development regulations that restrict the alteration of watercourses or interference with wetlands, and direct development away from hazard areas like floodplains and unstable slopes.

Through our many programs, including flood forecasting and warning, surface water and groundwater monitoring, stewardship, development regulations and planning review, the RVCA aims to conserve and enhance the watershed's natural systems which, in turn, can protect people and property from natural hazards.

▲ Meisel Woods Conservation Area, Tichborne, ON

Surface Water System

The Rideau River Watershed encompasses all the surface water which drains into the Rideau River. It boasts a bountiful interconnected network of surface water features, including hundreds of lakes and wetlands big and small, several major and minor rivers and a multitude of tributary streams.

The RVCA's jurisdiction is further divided into eight subwatersheds or drainage areas focused on regional drainage patterns and major tributaries to the Rideau River and, in two cases, the Ottawa River. The Rideau River subwatersheds are the Tay River Subwatershed, Rideau Lakes Subwatershed, Middle Rideau Subwatershed, Kemptville Creek Subwatershed, Jock River Subwatershed and Lower Rideau Subwatershed. The Ottawa River subwatersheds within the RVCA's jurisdiction are the Ottawa West Subwatershed and Ottawa East Subwatershed.

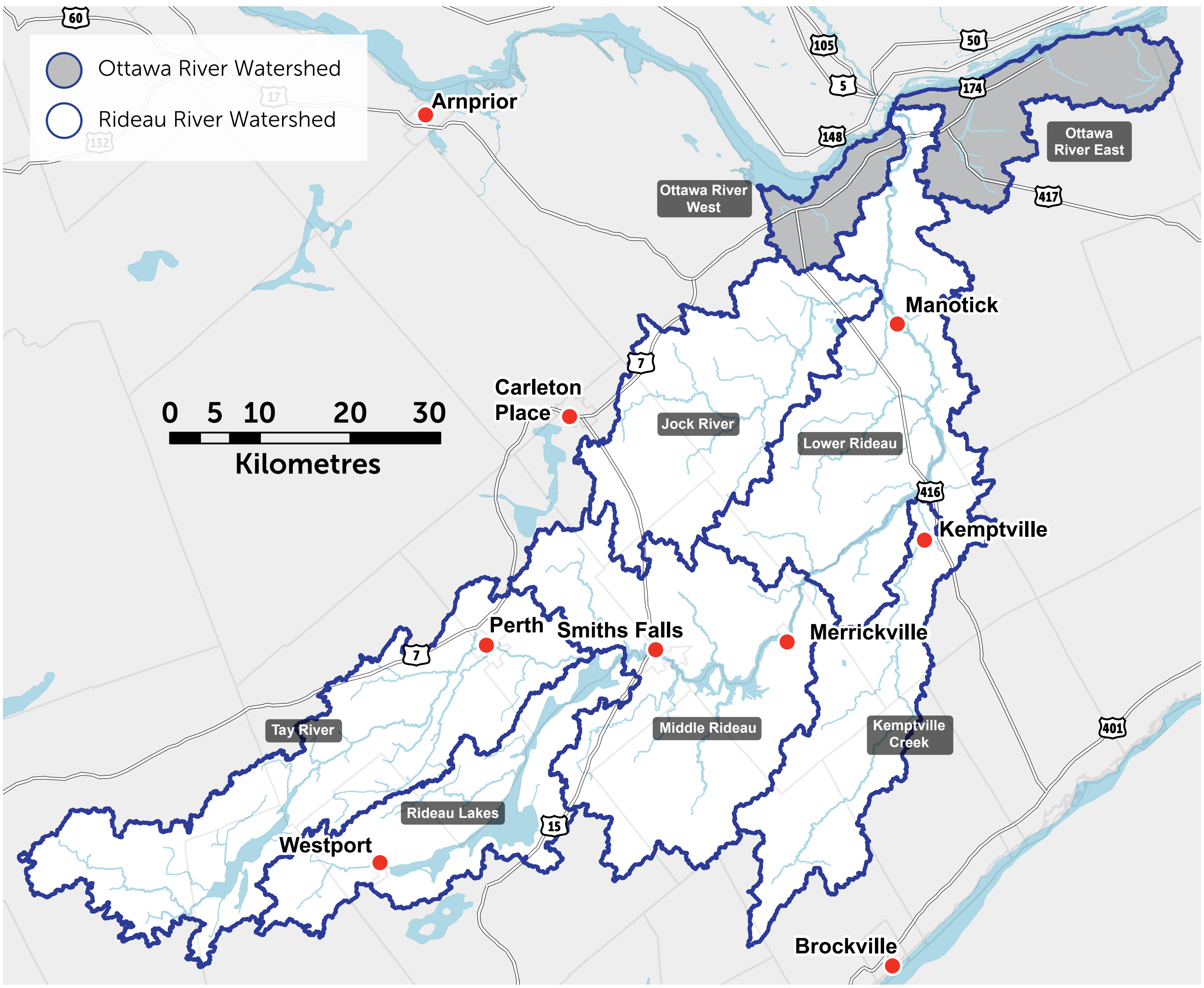


FIGURE 1.1 **Subwatersheds within the RVCA's jurisdictional boundary.**

These eight subwatersheds are further broken down into 89 catchments, which define the drainage areas of specific rivers and other waterways across the watershed. These catchments drain into the watershed's various waterbodies, including the Rideau and Ottawa rivers.

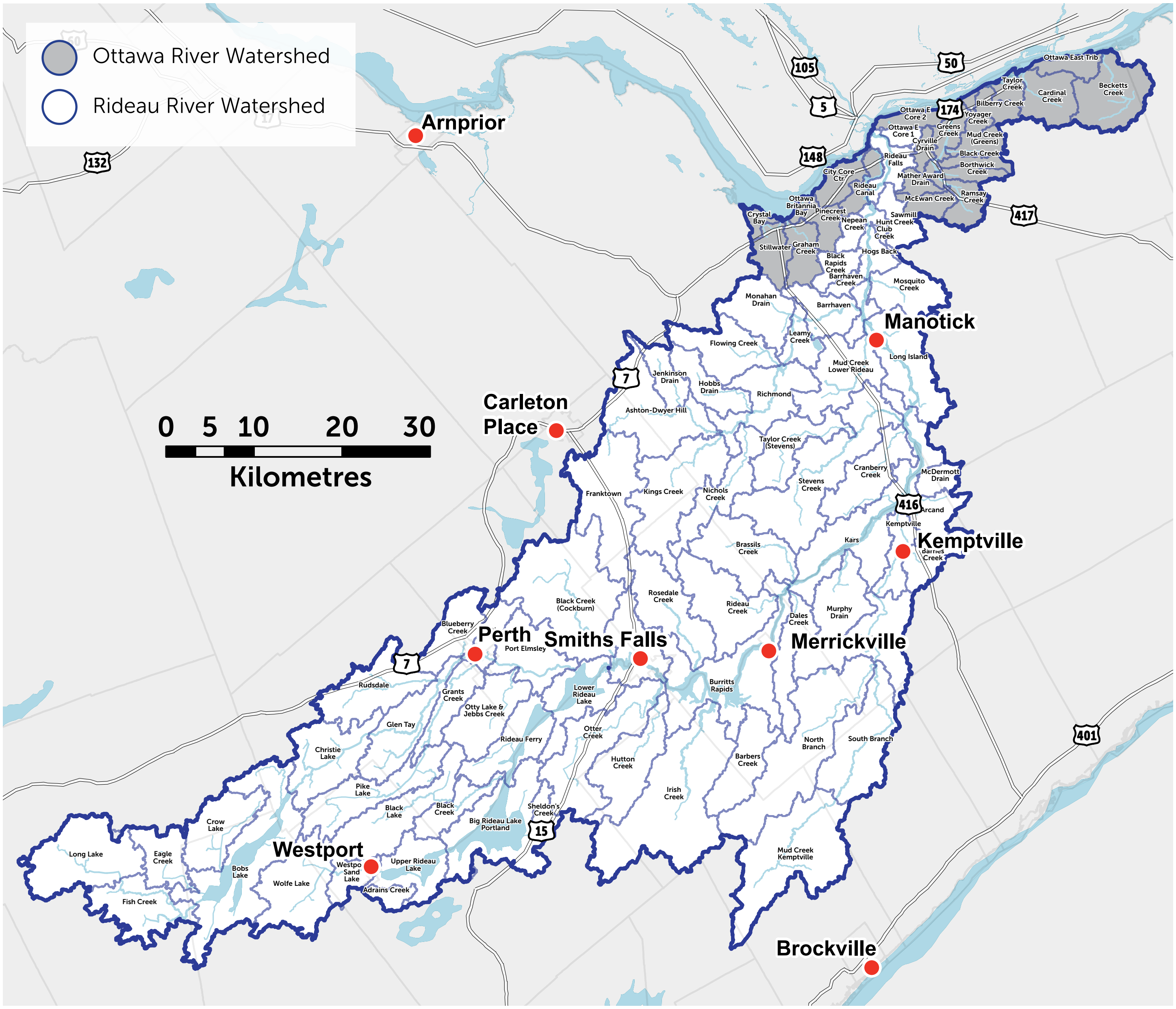


FIGURE 1.2 **Catchments within the RVCA jurisdictional boundary.**

Watershed Conditions

To date, RVCA has reported watershed conditions at the subwatershed and catchment scale. This is RVCA's first comprehensive watershed-wide conditions report in more than 55 years, with the first and only other report of its kind published in 1968. This updated document will help RVCA and stakeholders such as municipalities, government agencies, scientists, private landowners, consultants and residents develop a deeper understanding of the watershed's existing environmental characteristics and conditions. The report summarizes our most recently available monitoring data to assess current land cover and usage, surface water quality, aquatic ecosystem health, groundwater conditions, hydrological functions and significant natural hazards. Each chapter will explore these features in depth and include the RVCA's most recently available data and an analysis of trends, where applicable.

> **The diversity of watershed conditions and issues will require geographic consideration and prioritization, balanced by the priorities of our 18 member municipalities.**

Integrated Watershed Management

Understanding our current conditions is the first step in integrated watershed management, which aims to identify areas of concern and gaps in our conservation efforts, and then create a strategy to address them.

As we begin the next step of developing a Watershed Management Strategy, watershed issues, opportunities and constraints will be identified through this document and other internal and external studies and reports. These sources will form the basis for identifying and assessing various strategies that could help restore balance between human needs and the needs of the natural environment.

Effective strategies will be developed and advanced through discussions with First Nations, municipalities, key stakeholders and the public as well as RVCA's technical teams. The diversity of watershed conditions and issues will require geographic consideration and prioritization, balanced by the priorities of our 18 member municipalities.

Key steps in developing a Watershed Management Strategy include:

Task 1 Complete Watershed Conditions Report

Task 2 Identify Watershed Issues

Task 3 Develop Strategies

Task 4 Prepare Watershed Management Strategy

Task 5 Approve Final Plan

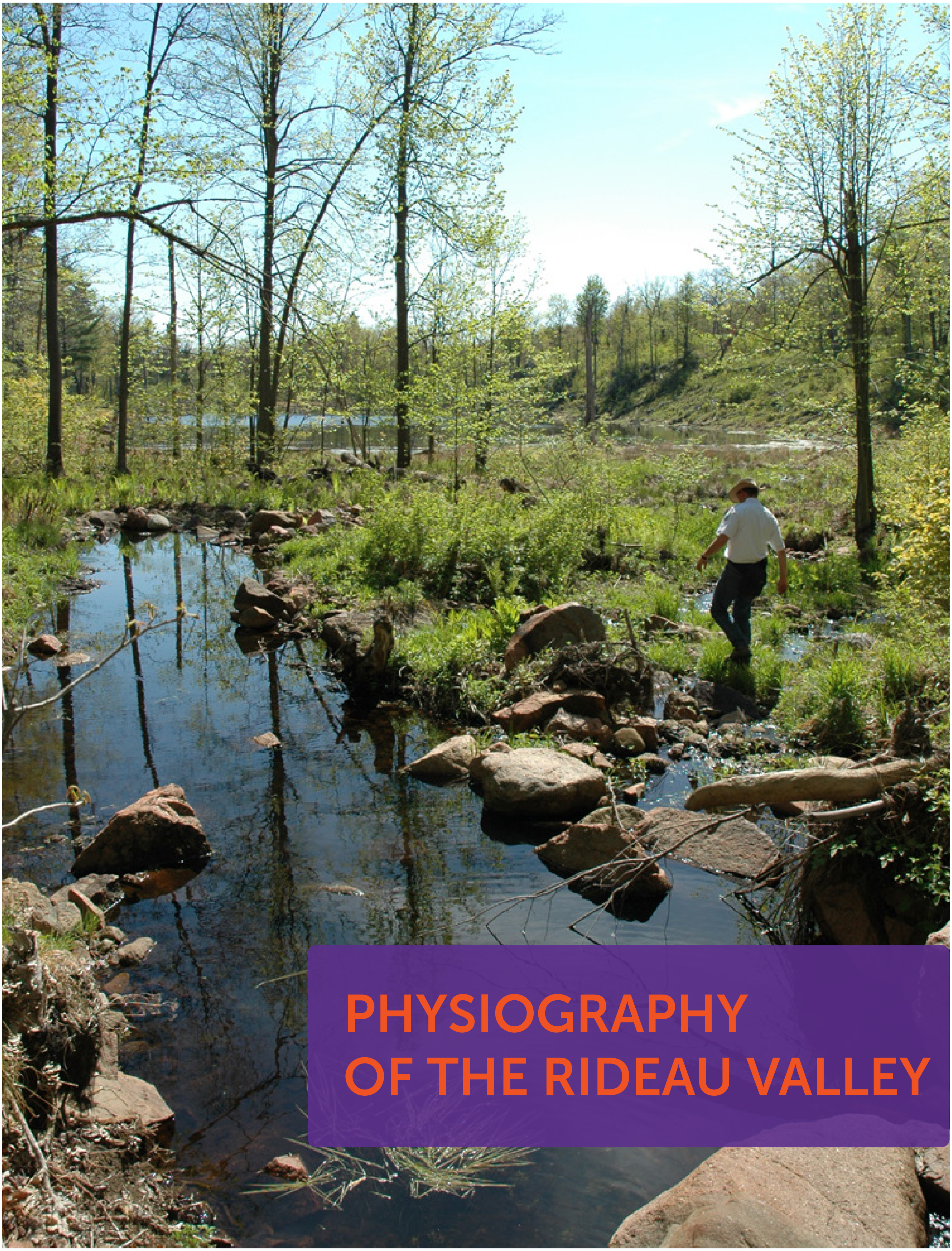
The goals of the Watershed Management Strategy are:

- To create a document that provides direction and assistance to the RVCA, its municipalities and partners for the implementation of policies, programs and actions related to watershed management, including natural heritage and water resource conservation, natural hazard management, climate change, biodiversity and resilience planning;
- To create a document that provides clear recommendations that are supported by policy, can be implemented, and are measurable;
- To create a document and process that thoughtfully considers and incorporates knowledge and input from First Nations, municipalities, partners, stakeholders and the public; and,
- To support an on-going relationship with First Nations, municipalities, partners, stakeholders and the public for the long-term implementation and monitoring of recommendations.

The objectives of the Watershed Management Strategy are:

- To better understand the importance, value and impact of the watershed's natural assets and infrastructure;
- To better understand the potential impact of future pressures on the watershed including climate change and population growth;
- To provide recommendations to enhance:
    - Water quality and quantity
    - Flood and erosion management
    - Resilient biodiversity and habitats
    - Sustainable economic and recreation opportunities
    - Improved quality of life and public safety
    - Ability of the watershed to adapt to stressors
- To engage partners and stakeholders in the process, particularly during the development of strategies and options.

Next Steps:
Following the completion of this conditions report, RVCA staff will embark on the next phase to develop a Watershed Management Strategy to address areas of concern across the watershed.



PHYSIOGRAPHY OF THE RIDEAU VALLEY

The broad, wet, and rocky Rideau Valley is nestled between several ancient mountain ranges and drains its intricate network of lakes, wetlands, streams, and small rivers to the expansiveness of the lower Ottawa River within the crown of the St. Lawrence Lowlands.

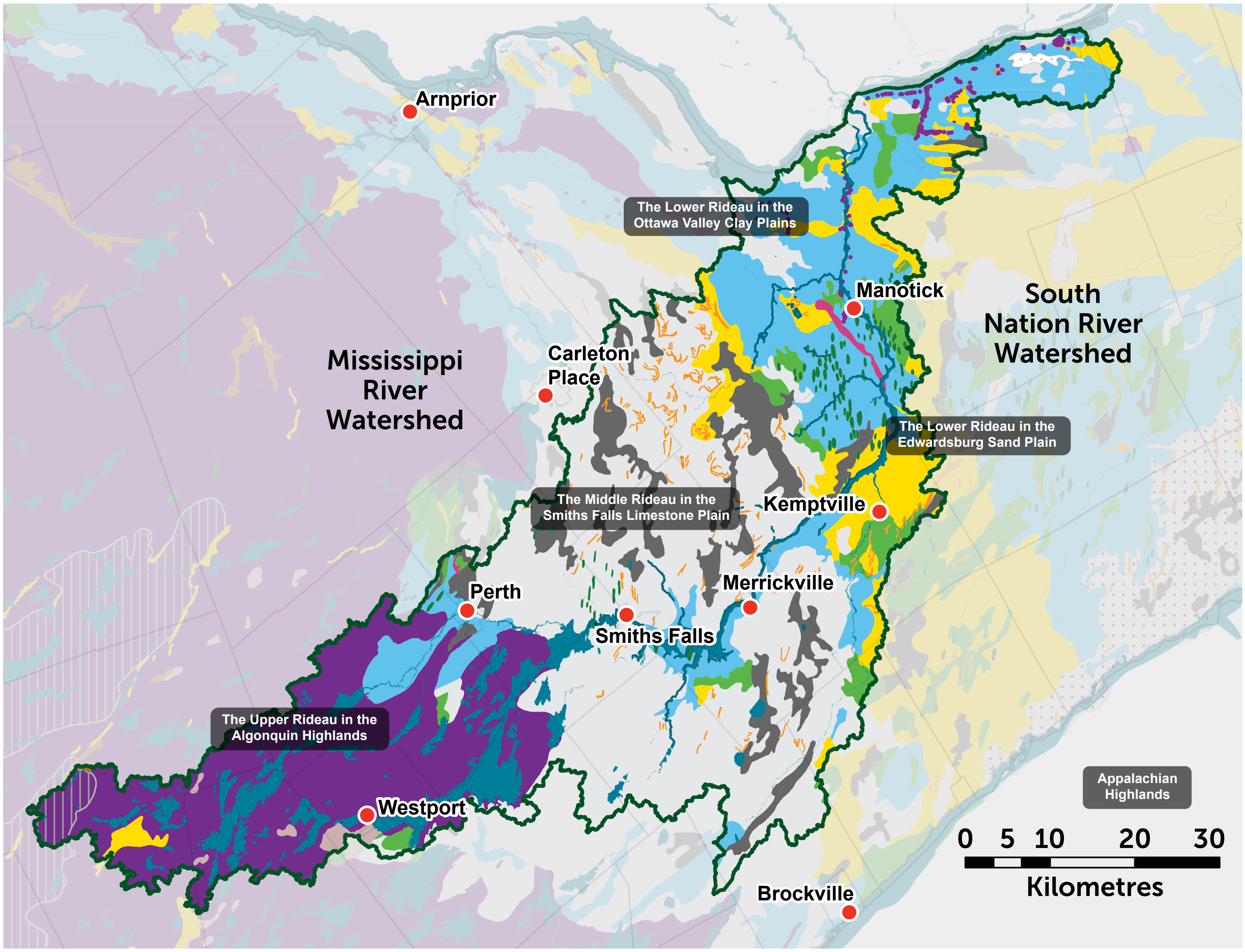


FIGURE 1.3 The physiographic regions of the Rideau River Watershed.

- RVCA boundry
- Sand Plains
- Limestone Plains
- Clay Plains
- Shallow Till and Rock Ridges
- Bare Rock Ridges and Shallow Till
- Beaches
- Eskers
- Drumlins
- Kame Moraines
- Peat And Muck
- Spillways
- Till Plains (Drumlinized)
- Till Plains (Undrumlinized)
- Waterbody

Located in eastern Ontario, the triangular-shaped Rideau River Watershed stretches about 160 kilometers from its highest point in the southwest to its lowest point in the northeast. The valley's headwaters in the Canadian Shield are called the Algonquin Highlands, while its sections of the St. Lawrence Lowlands are known as the Smiths Falls Limestone Plain, the Ottawa Valley Clay Plain, and the Edwardsburg Sand Plain.

The valley falls about 80 metres as it descends from the hilly, lake-dotted, and forested highlands, through the flat, rubbly, and wetland-covered limestone plain, and on to the flat but deeply incised and urbanized agricultural clay plain, where the Rideau River tumbles into the Ottawa River.

The valley's deep geological, glacial, and climatic histories have given us a complex landscape known by the unique characters of the upper, middle, and lower regions, each typified by different patterns in landforms and abundant water bodies.

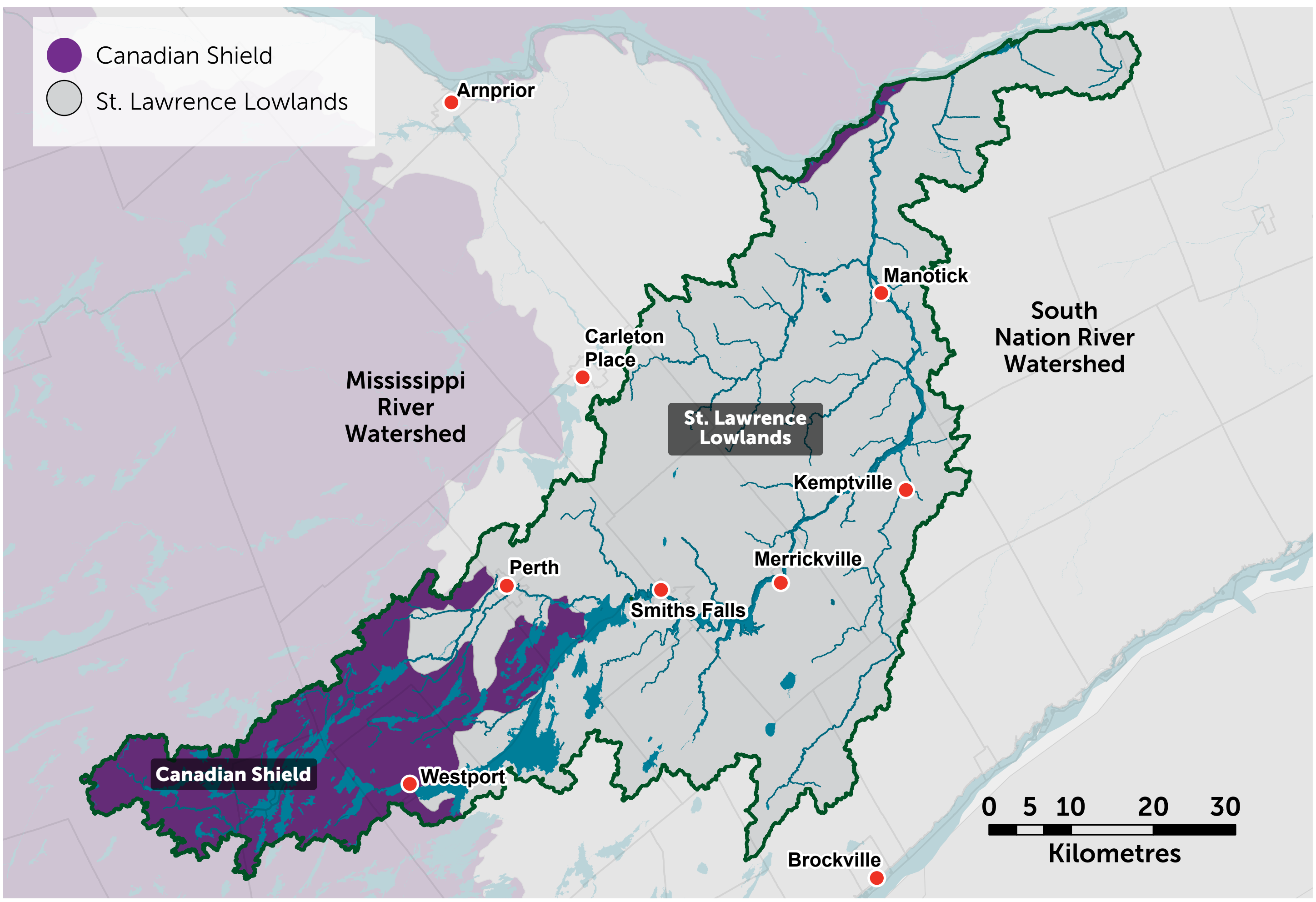


FIGURE 1.4 Map of physiographic regions in the larger Eastern Ontario area.

▲ Precambrian Shield terrain at the Foley Mountain escarpment.

Upper Rideau

The foundation of the Upper Rideau is the ancient metamorphic and igneous rocks of the Precambrian Shield. The broadly undulating rock is deeply ridged. Its moderate relief is made-up mainly of gneiss, other granite-like rocks, and marble. Very little soil overlies the bedrock hills, escarpments and aquifers of the region and below every ridge and within every dip resides a permanent freshwater lake which forms the primary headwater reservoirs of the watershed. These reservoirs are vital to the protection of the watershed from flooding and loss of land, for drinking water reserves, for recreation, and for invaluable aquatic habitat.

▲ Banded gneiss, a pink and grey granite-like metamorphic rock of the Precambrian Shield near Maberly.

Middle Rideau

The Middle Rideau rests atop the flat Smiths Falls Limestone Plain. It is a broad, wet, and scrubby expanse made up of layered sedimentary rock aquifers that include sandstones, limestone-like rocks, and some shale. These thick rock layers rest upon the Precambrian Shield, which forms the basement. Across the plain, soils are of various types and depth but generally thin or, in many places, absent. The region hosts an extensive network of interconnected wetlands, streams, and small rivers that collect, store, and slow the abundance of water that falls on the land and which flows out of the upper lakes. These wetlands and streams are vital to the protection of the watershed from flooding and loss of land, for some recreation, and for priceless habitat.

Lower Rideau

The Lower Rideau is underpinned by sand plains and large, wet clay plains. These overlay the same sedimentary rock aquifers and basement rock aquifers found under the Middle Rideau. The clay plain is often thick and very flat, but also deeply incised by unstable valley lands, wherever a stream or river has cut down through the clay. These valley lands are much broader than would be expected by the size of stream which runs through them, since the valley walls continually move inland, away from the streams, as the clay walls slump and slide away. The clay also forms a terrace inland and parallel to the Ottawa River. This terrace was once the bank of the ancient Ottawa River, which was even mightier than it is now.

▲ **Layered sedimentary rock of the Smiths Falls Limestone Plain found at Henderson Quarry near Stittsville.**

The Ottawa Valley Clay Plain presents an important natural hazard, unique to this part of Ontario but widespread in the developed regions of Quebec and some parts of British Columbia. Marine clay hazards are summarized in the Natural Hazards section.

The clay plains within the Lower Rideau once hosted an extensive network of interconnected wetlands, streams, and small rivers that collected, stored, and slowed-down the abundance of water that falls on the land and which flows out of the Middle Rideau system.

FIGURE 1.5 Artist's interpretation of the faulted sedimentary rock layers that underly the Smiths Falls Limestone Plain above Ottawa.

▲ An active marine clay valley along the Rideau River in Beryl Gaffney Park, City of Ottawa.

During early settlement, the region was transformed and is now primarily riverine. Many of its wetlands were drained and most of its headwaters were eliminated or straightened, steepened, and deepened. However, there is no true way to remove water from one small area without causing wetter areas downhill. So, the region remains very wet and flood plains are broad. The risk of flooding, erosion, and landslides may also be increasing due to development and climate change.

The sand plains are of variable thickness and extent, and form one of the most important areas of focused groundwater storage and interconnection in the watershed, as well as aggregate resources.

◀ Agricultural use of the flat marine clay plain looking southwest from Old Richmond Road, City of Ottawa.

Another sandy geological feature important for groundwater storage, supply and interconnection is the Kars Esker, which is a buried aquifer within the clay plain.

In some areas of the Lower Rideau, both the clay and sand areas are absent. In these locales, as across the Middle Rideau, the limestone has formed karst features to varying degrees. This is further discussed in the Natural Hazards section.

▲ Deep sandy soils, such as those found near Stittsville, Kars, and Perth, keep water out of our floodplains but maintain base flow in our rivers in times of low water, including in winter and late summer. This photo shows the famous and protected Pinhey Sand Dunes, but all sand areas are vital for the health of our drinking water and aquatic habitats – not just special dune habitat.

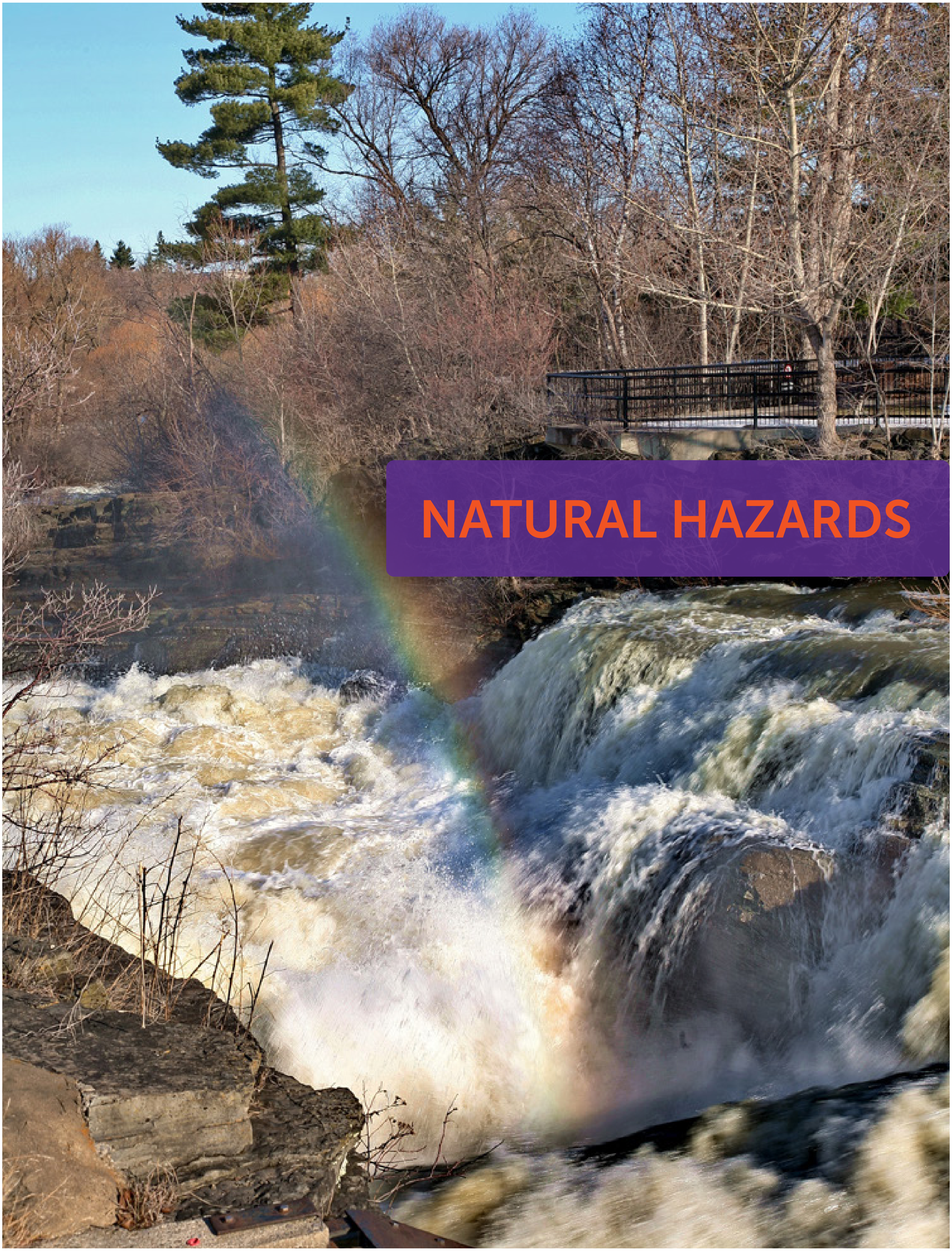
Geological Backdrop

It is important not only to understand a watershed's physiographic setting but also relevant aspects of its distinctively geological setting. This is especially important in eastern Ontario which is located within the active West Quebec Seismic Zone. The risks from marine clay landslides, which are summarized in the Natural Hazards section, are strongly associated with the behaviour of the clay when it is disturbed, such as from an earthquake. We should all take note of this added source of risk for development in the clay plain.

Endnotes

1 "The Renfrew County Landslide," Dave Petley, April 12, 2016. American Geophysical Union Blogosphere: https://blogs.agu.org/landslideblog/2016/04/12/the-renfrew-county-landslide/

2 "Geomorphic Controls on Landslide Activity in Champlain Sea Clays Along Green's Creek, Eastern Ontario, Canada," 2004. Hugenholtz, Chris and Lacelle, Denis. Géographie physique et Quaternaire, 2004, vol. 58, no 1. https://mysite.science.uottawa.ca/idclark/Quat2333/LABS/Greens%20Creek/Hugenholz_and_Lacelle_Geog_phys_et_Quat.pdf



NATURAL HAZARDS

Natural hazards are areas that are naturally dynamic, unstable or potentially treacherous to people or property due to local environmental conditions. Within the RVCA's jurisdiction, significant natural watershed hazards include floodplains, erosion, unstable slopes along valleys and shorelines including across the sensitive marine clay plain, and areas of organic soils. Karst forms another, but lesser, hazard.

Ontario's conservation authorities are mandated to regulate development in and around these natural hazards under the *Conservation Authorities Act*. Development is directed away from areas that are susceptible to natural disasters, or where potential development might increase the likelihood or severity of risks associated with existing natural hazards.

Staff develop hydrologic models and hazard maps along watercourses, lakes and valley lands to better understand how floods, erosion and other hazards could affect existing communities. From there, staff can warn communities of potential problems, and in some cases restrict further development in those areas to keep people and property safe. These products can also inform program decisions such as where to focus stewardship efforts or to acquire conservation lands.

FLOODPLAINS AND FLOODING HAZARDS

In the Rideau River Watershed, riverine flood hazards generally pertain to any area adjacent to a waterbody that is not ordinarily covered by natural waters but that periodically becomes flooded. The limit of the flood hazard for our watershed is defined as the probability of a 100-year flood event occurring in these areas (i.e. a 1% chance of a flood reaching the hazard limit in any given year). Flood hazard limits are used to direct development away from the hazard area. This minimizes potential threats to life as well as the risks of property damage, social disruption and emergency response costs.

Several parameters are considered when determining the 100-year flood limit, including the geometry of the lake, river, or stream; the slope of the land around the waterbody, the amount of precipitation and/or snowmelt needed to produce the flood, and the tendency of any area to accumulate ice-jams. It is important to note that, in Ontario, natural flooding is addressed separately from infrastructure-related flooding like sewer backups or issues with water control structures.

Where are flood hazards located?

Flood hazards are widespread across the Rideau Valley's lakes, rivers, and streams (Figure 1.6), although not all floodplains have been formally mapped. The most up-to-date locations of floodplains can be found in the RVCA's publicly-accessible GeoPortal.

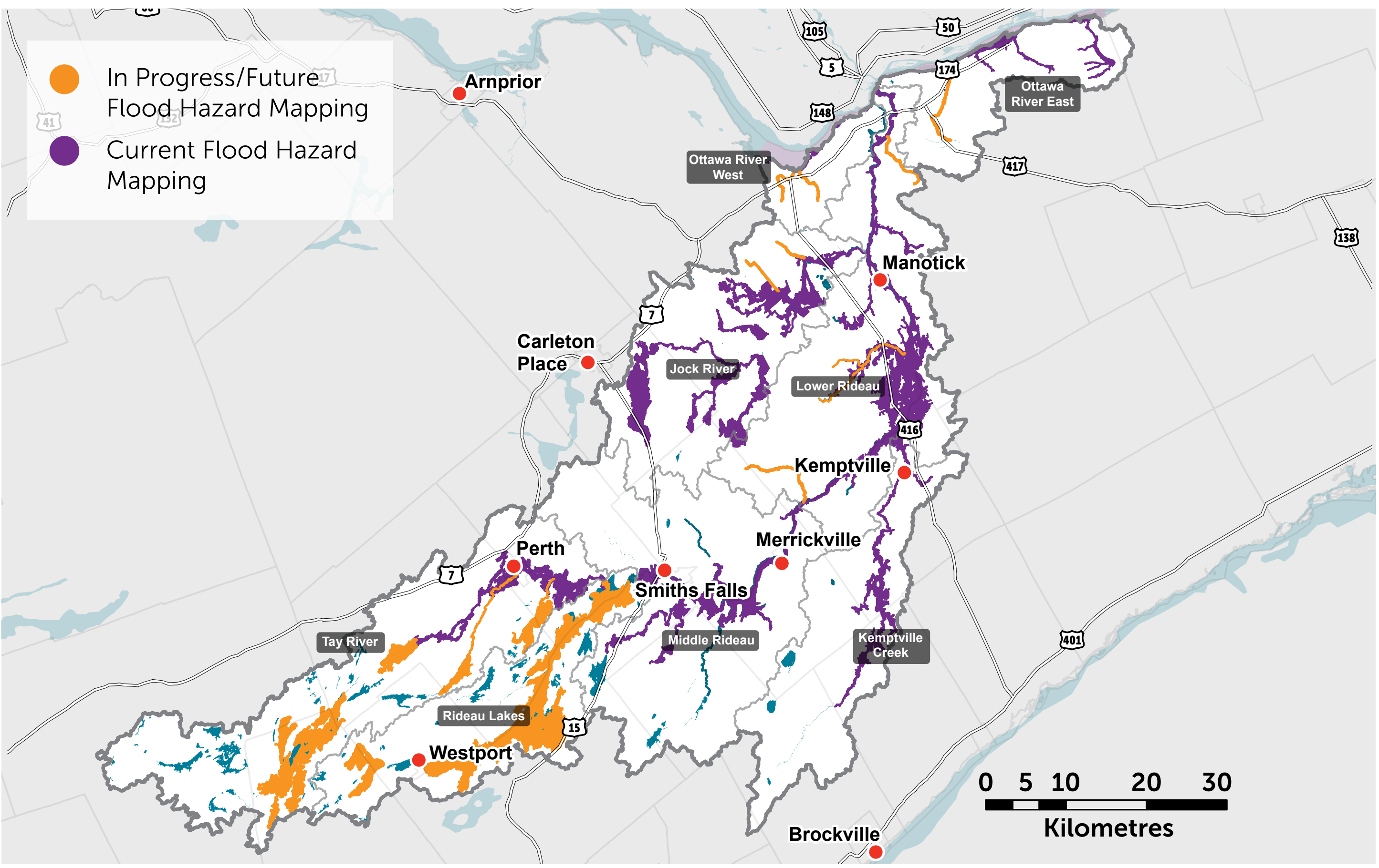


FIGURE 1.6 Current and planned hazard mapping within the RVCA jurisdiction (current to date of publication).

Flooding Occurrences

Major flooding has occurred most recently along the Ottawa River in 2017 and 2019, which saw close to 40-year and 100-year floods respectively; and in North Gower along Stevens Creek in 2017, which experienced a 100-year summertime flood event.

▲ Morin Road near Cumberland floods during a high water event on the Ottawa River.

Other significant high-water events have occurred in the watershed throughout modern history, with records and newspaper references dating back further than Confederation (Table 1.1). It is important to note that while these historic records describe significant local impacts, some of these events may not have actually exceeded flood-level flow rates, as ice jams and other infrastructure issues may have played an outsized role in localized overland flooding.

Flooding impacts during the Stevens Creek 100-year flood in 2017. ▶

Table 1.1 Historic Floods in the National Capital Region

Date	Location	Source	Summary
April 1876	Rideau River in Ottawa	Toronto Globe	Ice jam below St. Patrick Street Bridge breaks and causes damage
1898	Rideau River in Ottawa	Toronto Globe	Ice jam-related flood extends beyond Janesville and New Edinburgh, which normally flood. Water covers all flat areas. 1,000 left homeless
April 1904	Rideau River in Smiths Falls	Toronto Globe	Ice jam on Poonamalie dam causes dam break and 4-foot higher water in Smiths Falls. Extensive industrial damage occurred.
March 1907	Rideau River in Ottawa	Toronto Globe	Ice jams cause 4-foot rise in Rideau River, highest in 7 years and related to flooding in Janesville, Clarkstown, and Rideauville
April 1926	Rideau River in Ottawa	Toronto Globe	Worst spring flood in City's history
April 1947	Eastview in Ottawa	Toronto Globe	Hundreds of people forced out of their homes during one of the worst floods of the previous century in the local area. Flood waters extended to the end of Glen Ave, covering what is now Bronson Ave into the Carleton University property. A cluster of south-side houses were completely flooded. The entrance to the Merkley brick yard, near the present R.A. Centre, was also awash, as was the site of the future Billings Bridge Plaza.
March 1962	Rideau River in Ottawa	Ottawa Journal	High levels caused by ice jams and their release
June 1967	Ottawa River in Upper Valley	Ottawa Journal	Ten days of heavy rain had Ottawa River 5 feet above normal
1970-1982	Rideau River in Ottawa	RVCA	Spring freshet flows exceeded 400 m^3/sec every year consistently between 1970 and 1982, with the highest flow on record observed in 1976 (597 m^3/sec)
Spring 1976	Rideau River	OSCAR	1976 saw the all-time high peak flow rate of the spring runoff, but overall the flooding impacts were possibly less severe than in 1947.
Spring 1993	Rideau River at Ottawa	RVCA	Most recent instance in which spring freshet flows exceeded the 500 m^3/sec threshold. Flows of this magnitude were last observed in the 1970's.
Spring 2017	Tay River	RVCA	The Tay River experienced a peak flow of 69.98 cms, which correlates to about a 1:16 return period. Flows were above the 2-yr return period for more than two weeks, and above the 10-yr for more than three days. It was the highest flow on record since May 2005.
April 2017	Lower Ottawa River	RVCA	Ottawa River flood levels came close to a 1:40 year event at Britannia, and close to the 75-year level in Cumberland based on inferred estimates. An event of this magnitude had not been observed since the 1970's. Evacuations were required on the Ontario and Quebec sides of the river, and more than 2,000 homes were flooded in Gatineau, West Carleton and elsewhere.

Table 1.1 Historic Floods in the National Capital Region

July 2017	Stevens Creek at North Gower	RVCA	Town of North Gower impacted by a significant summer storm, with some sources reporting upwards of 130 mm of rainfall over an 18 hour period. Flows on Stevens Creek are estimated to have hit the 1:100 year event.
Spring 2019	Lower Ottawa River		Significant Ottawa River flooding approaching the 1:100 year event caused significant damage to homes and businesses along the Ontario and Quebec sides of the river. High snow pack and unusual levels of rain combined to create catastrophic conditions. More than 6,000 homes were flooded or at imminent risk, and many roads, bridges, pathways and other amenities also flooded. The flood caused multimillions in damages to private dwellings and public infrastructure, as well as several million in emergency response costs.
Spring 2023	Lower Ottawa River		Significant flood risks were noted along the Ottawa River for the third time in six years. Flow and water levels reached the 1:25 return period in Britannia, with somewhat lower levels downstream of Ottawa still causing some flooding on private property.

EROSION HAZARDS

Erosion is a natural process of land removal and dispersal that occurs along our lake shorelines, watercourse channels, embankments and rock formations. The cycle of erosion and deposition naturally seeks to establish a dynamic equilibrium in these systems, ensuring that water, sediment, nutrients and organic material is moved and deposited in a balanced and efficient manner. However, external forces like climate change, significant flooding or human activities such as vegetation removal, development, stormwater runoff and over-steepening of slopes can throw the erosion cycle out of balance. Erosion can then become a threat to people, property and the environment, and it is considered a hazard.

Erosion hazards in Ontario typically occur along river valleys and lake shorelines, and are limited to the distance a slope may move inland during a 100-year period.

▲ An erosion event along the Rideau River shoreline in Ottawa in 2021. Erosion often looks like undercut banks with the soil exposed. A recent issue of major concern occurred in 2017 along Bilberry Creek, where three homes had to be temporarily evacuated until emergency slope stabilization efforts were completed.

Several phenomena are considered when determining the 100-year erosion limit, including: erosion at the bottom (toe) of a slope, the stability of a slope based on its height, angle, composition, condition etc., the potential meandering of a stream when on a flatter plain, and access to a valley or plain for inspection and rehabilitation. Loss of land may also occur due to landslides on sensitive marine clay. The erosion hazard within marine clay valleys is much different than other valleys in the province and warrants special effort to understand the unique risk. It is discussed in further detail below.

It is important to note that soil erosion from general land management practices is not considered a natural watershed hazard in and of itself, although it often contributes to valley and lake shoreline erosion. In addition, seismic hazards and most soil consolidation issues are managed by other agencies.

Where are erosion hazards located?

Valley and shoreline erosion is variably located across the Rideau River Watershed as seen in Figure 1.7, although not all erosion sites have been formally mapped. Marine clay valley hazards are shown seperately in Figure 1.8.

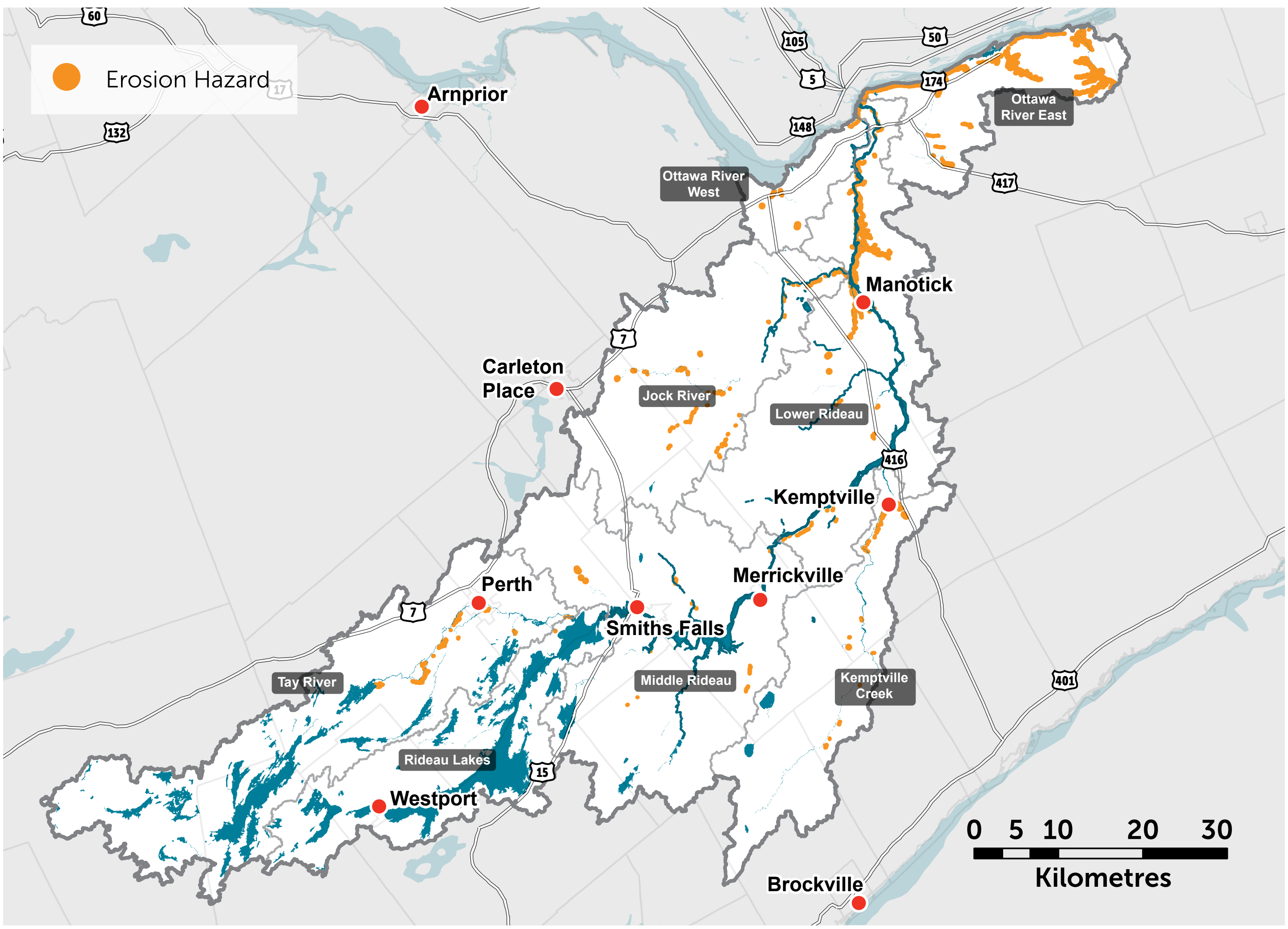


FIGURE 1.7 Known erosion hazard areas within the RVCA's jurisdiction.

SENSITIVE MARINE CLAY HAZARDS

Marine clay is a very small, particle-sized deposit composed of any type of mineral sediment laid down during previous periods of salty sea water coverage over the course of deep geological time (in the Rideau Valley's case, the Champlain Sea). Movements of the earth's crust or changes in sea levels have brought this marine clay to dry ground, upon which modern developments and cities are now built.

However, this clay still naturally contains a large volume of water within its pore spaces. Where this water-logged marine clay rests along valley lands, natural disturbances such as earthquakes, erosion and stormwater infiltration, or human activity such as nearby construction and or landscaping, can affect the soil structure and cause the clay to mobilize and slide downhill – a landslide.

Sensitive marine clay is therefore an important natural hazard since it can catastrophically fail in the form of massive retrogressive landslides, and regularly fail as small landslides. It is important to note that the risk of large retrogressive landslides is very low.

Sensitive marine clay can also pose significant problems when it consolidates. This long-known risk has caused several high-profile problems in the watershed. Most famously, following the construction of the Museum of Nature, its tower had to be removed in 1915 due to extreme settling in the clay underneath the building. More recently, a ground settlement claim in Orleans affected 20 homes built in the 1980s due to similar issues.

Where are marine clays located?

Sensitive marine clays are naturally widespread across the lower, more densely populated part of the Rideau Valley Watershed, as seen in Figure 1.8. These clays range from being virtually absent to many tens of metres deep over very short distances, given the variability in underground geology.

Evidence of a small marine clay landslide along a creek in the eastern suburbs of Ottawa.

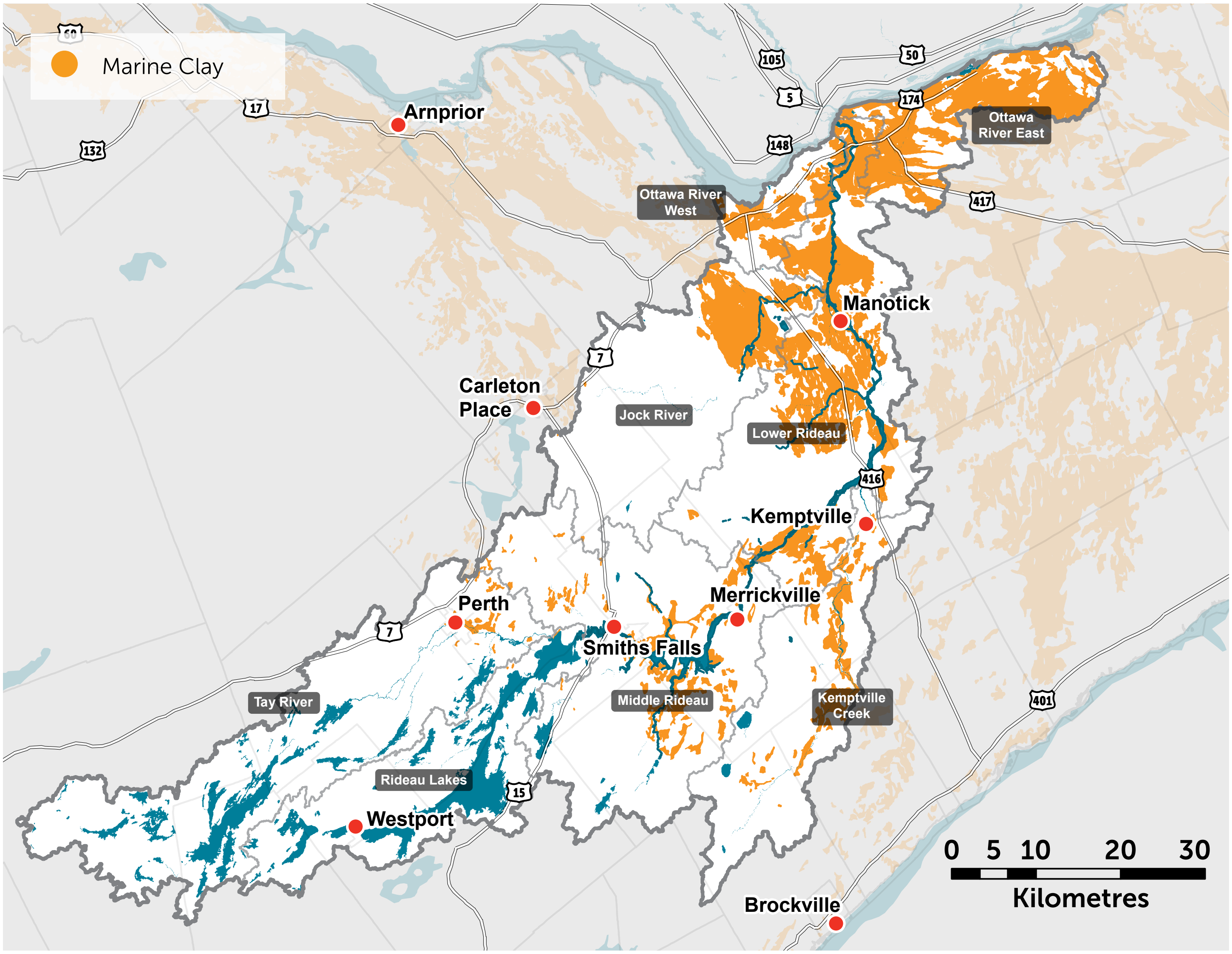


FIGURE 1.8 **Sensitive Marine Clay within the RVCA's jurisdiction.**

Large historic retrogressive landslides have been mapped, most recently in 2019, by the Geological Survey of Canada, as seen in Figure 1.9. The scars of these large landslides range from about half a hectare to 2.5 square kilometres in size. Large failures occur roughly every few thousand years.

Most famously, following the construction of the Museum of Nature, its tower had to be removed in 1915 due to extreme settling in the clay underneath the building.

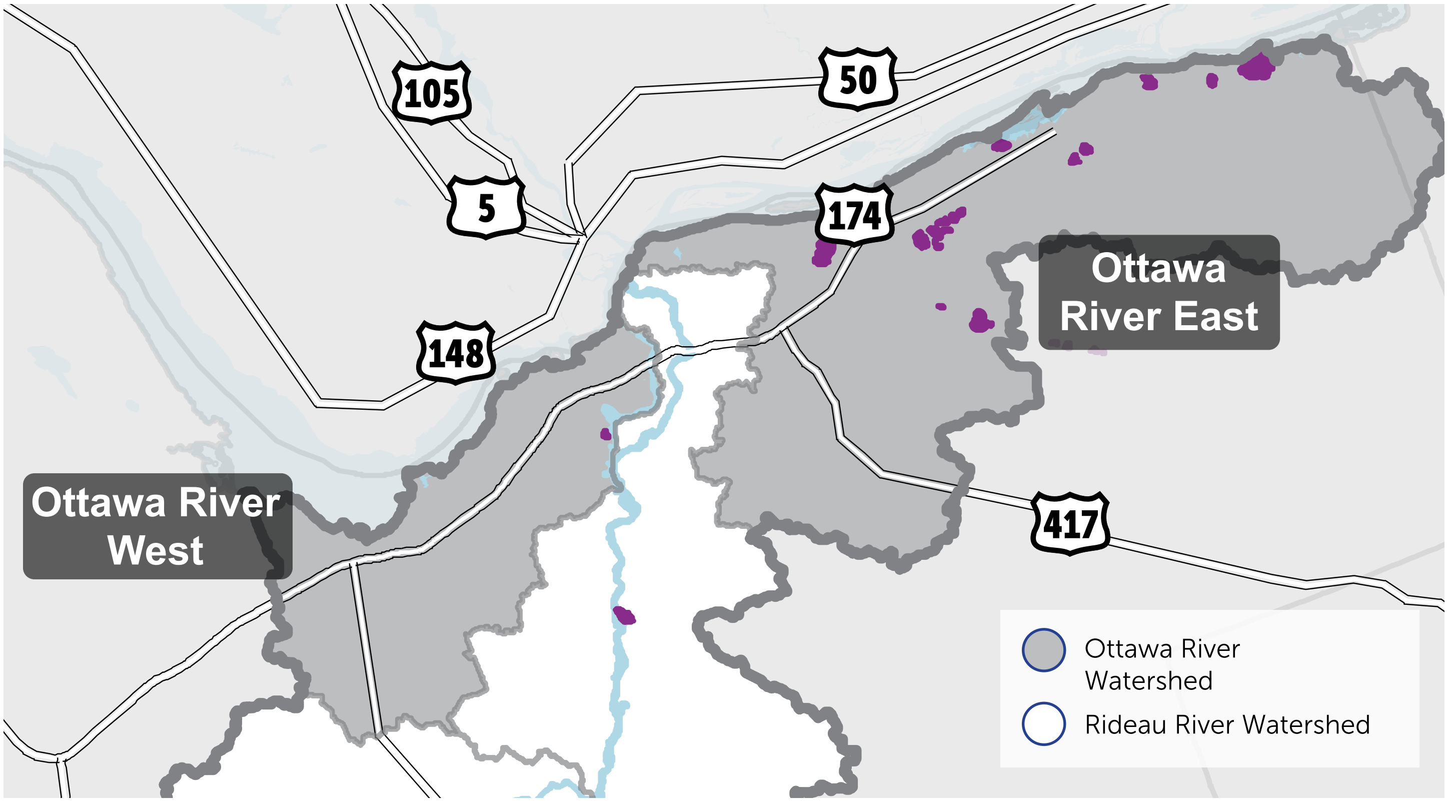


FIGURE 1.9 **Large retrogressive landslide scars in the Rideau River and Ottawa River watersheds within the RVCA jurisdiction.**

▲ A recent landslide scar can be seen along Becketts Creek in Orleans, City of Ottawa.

Recent marine clay landslide occurrences

The most recent large marine clay slide occurred in 2016 about 75 km from our watershed's boundary along the banks of the Bonnechere River in Horton Township. In that case, 10 hectares disappeared overnight[1]. While it occurred outside the Rideau River Watershed, these potentially catastrophic events are possible in select areas within the watershed, including several parts of the City of Ottawa. However, the risk remains very low.

Smaller landslides have also been documented, but only in part, over the past 40 years, as shown below in Figure 1.10. Ottawa University researchers found that these smaller events occur roughly once a decade[2].

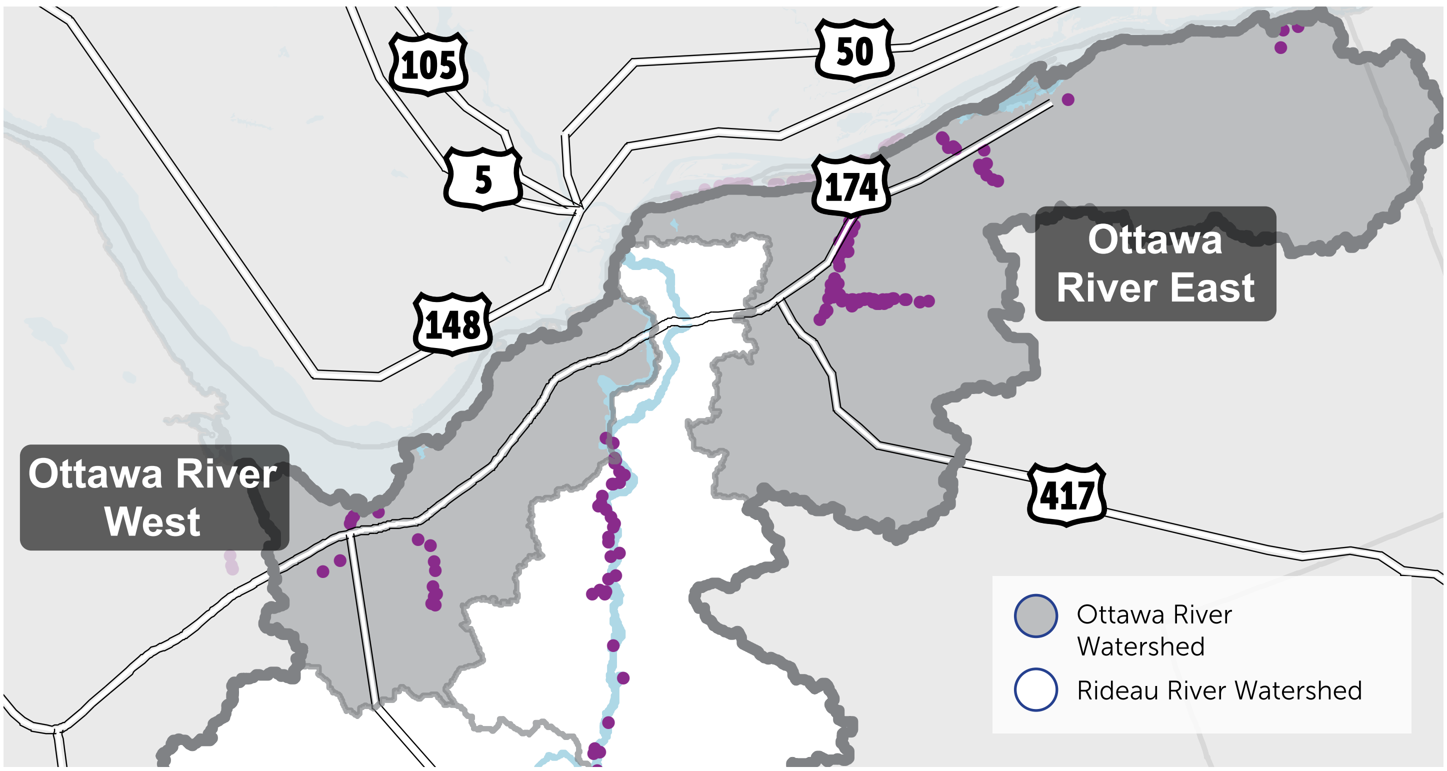


FIGURE 1.10 **Small landslide sites in the Rideau River and Ottawa River watersheds.**

ORGANIC DEPOSIT HAZARDS

An organic deposit or organic soil is any type of natural deposit which is normally wet and in which dead plants, in various stages of slow decay, have built up over very long periods of time. Organic deposits typically lack oxygen and include pure peat (with obvious organic fibres) pure muck (an organic ooze), herbaceous silty sands and more. Generally, if a soil contains more than half its weight in organic material, it is considered an organic deposit.

Organic deposits are typically found in wetlands such as fens, swamps, and marshes, and take many hundreds to thousands of years to form.

Why are organic deposits considered a natural hazard?

Organic deposits are a naturally hazardous type of land since they can:

- create methane gas, which is explosive,
- compress significantly and become unable to support structures, and
- erode easily.

Fortunately, the direct risks from these deposits have been managed since the early 2000s thanks to conservation authorities' mandate to regulate development in and near wetlands. This has also helped prevent other natural hazards from occurring, since deep, undisturbed organic deposits can store large amounts of water that could otherwise contribute to flooding and erosion.

But the historical and widespread loss and damage of organic deposits across the lower watershed prior to wetland protections has likely contributed to the expansion and relocation of flood risk areas, and has likely exacerbated erosion risks.

Any more loss of organic deposits could have a significant impact on the watershed's ability to hold back and slow down flood waters in the future.

▲ Organic soils at the Jebbs Creek wetland in Perth, 2018.

Where are organic deposits located?

Organic deposits are naturally widespread across the Rideau Valley Watershed, as seen in Figure 1.11. The location of organic deposits and wetlands can be explored in more detail in the RVCA's Terrain Atlas.

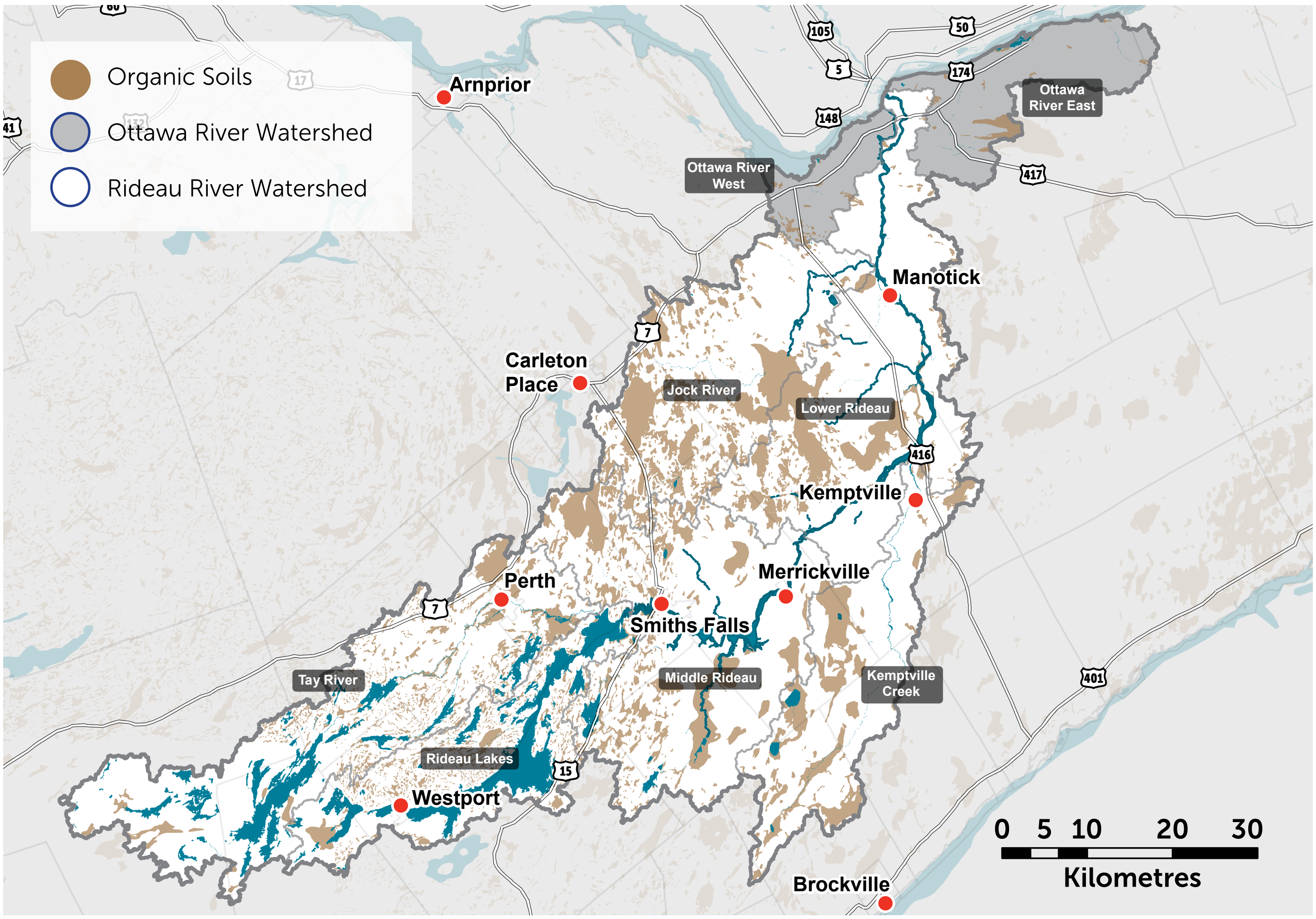


FIGURE 1.11 Organic Soils in the Rideau River Watershed.

KARSTIC LIMESTONE HAZARDS

Karst forms when naturally acidic rain dissolves carbonate rocks as rain infiltrates the subsurface. Natural cracks and depressions in the rock slowly widen, deepen, extend and merge, forming a range of karst features including solution-enhanced bedrock fracture networks, clints and grikes, or caves and sinkholes.

Where is karst located?

Karstic limestone is known to occur only in select parts of the watershed. However, anywhere limestone is exposed at or near the surface there is potential for karst to occur.

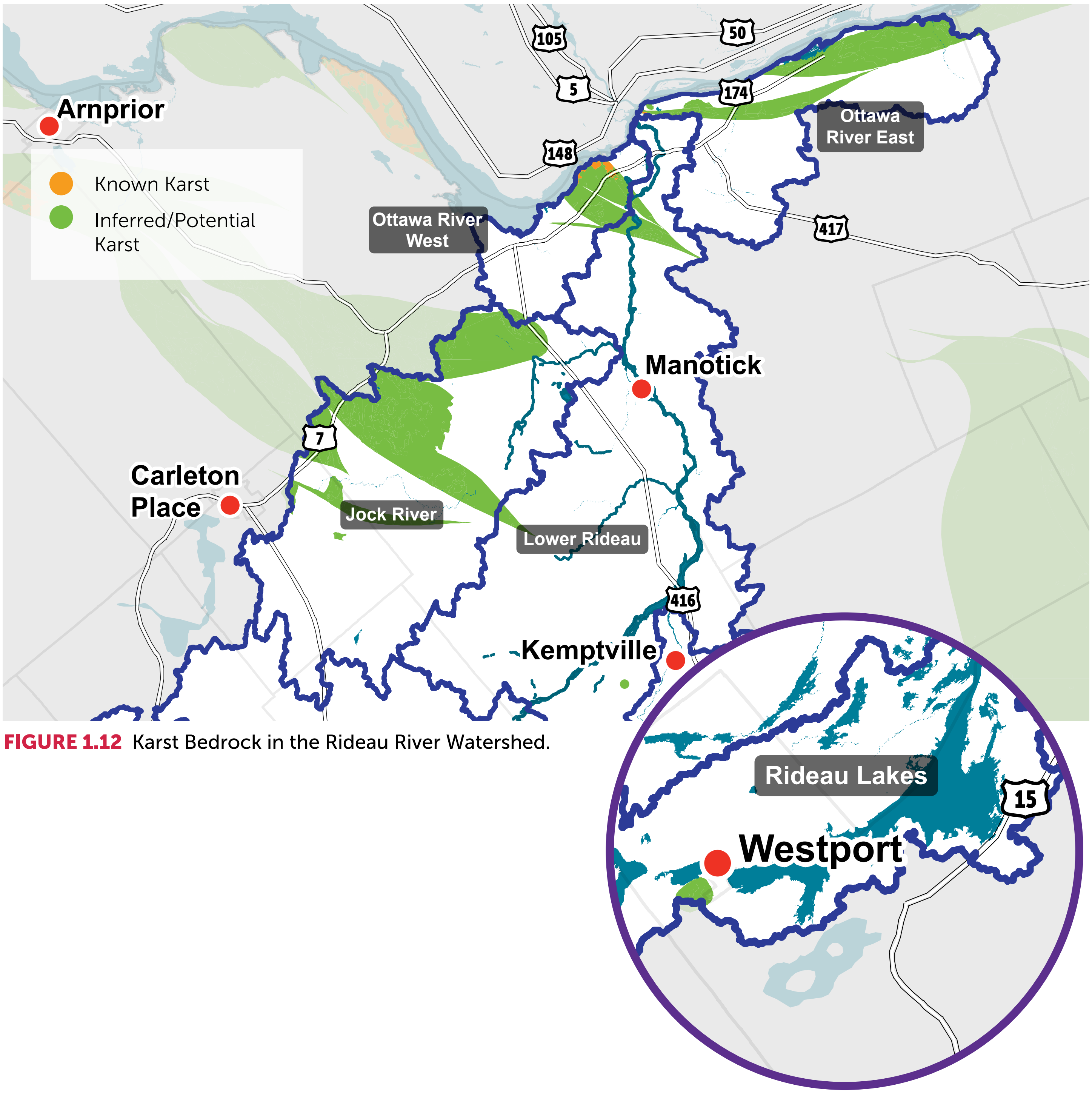


FIGURE 1.12 Karst Bedrock in the Rideau River Watershed.

▲ Karst along the National Capital Commission's Lime Kiln Trail off Moodie Drive in Ottawa.

Karstic limestone has the potential to become hazardous land since well-developed karst can cause the bedrock to fail and therefore be unable to support structures. Fortunately, the direct risk from the collapse of karstic limestone is almost absent across our watershed. The Cardinal Creek watershed has exhibited the most significant issue, where "breakdown collapse" features have formed along Watters Road in Orleans, which is unique in the province.

Karstic limestone likely also plays an important role in preventing flooding and erosion, which are major hazards in our watershed. Karst bedrock can contain many wide and expansive cracks in which a lot of water can be stored. This underground water storage reduces the amount of water available for flooding and erosion on the ground surface.

Karstic limestone also often forms an invaluable and productive aquifer system. Thousands of residents across our watershed rely on limestone aquifers for their drinking water. However, karstic limestone is also highly vulnerable to contamination from land use activities.

IMPACTS AND IMPLICATIONS

Natural hazards play a critical role in our watershed's natural systems, and must be managed in a way that balances the protection of people and property with the protection of our natural infrastructure, ecosystems and hydrological systems.

Properly managing these hazards can be complex and requires the most accurate and up-to-date data, which in some cases is not always readily available. More extensive hazard mapping, particularly for flood- and erosion-prone areas, should be expedited. In the case of marine clays and other unstable soils, better application of existing geotechnical and geomorphological standards is needed to mitigate the potential risks to humans and the environment, particularly in highly developed areas.

As the impacts of climate change, extreme weather and changing land uses intensify, we will benefit greatly from an increased commitment to mapping and monitoring of all natural hazards within the RVCA's jurisdiction – and directing development away from these hazards whenever possible.

References

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Endnotes

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