



## Workshop 2:

# Collaborating to protect and manage groundwater

PACES Gaspésie-Matapédia



May 5, 6, and 7, 2026

This document is licensed under a Creative Commons Attribution - Non-Commercial - Share Alike 4.0 International license. To access a copy of this license, please visit <http://creativecommons.org/licenses/by-nc-sa/4.0/> or send a letter to Creative Commons, 444 Castro Street, Suite 900, Mountain View, California, 94041, USA..





We wish to acknowledge that the land on which this workshop is being held is part of Gespe'gewa'gi, seventh district of Mi'kma'ki, ancestral territory of the Mi'gmaq Nation. Through the recognition of this territory, we declare our collective responsibility for this land and for the history, rights and presence of the Mi'gmaq people.

This knowledge transfer and exchange workshop, held as part of the Projet d'acquisition de connaissances sur les eaux souterraines (PACES) Gaspésie- Matapédia, was made possible thanks to funding from the Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP). It is the result of joint work by the Réseau québécois sur les eaux souterraines (RQES), researchers from the Department of Biology, Chemistry and Geography at the Université du Québec à Rimouski (UQAR), and the Université du Québec à Trois-Rivières (UQTR) Research Chair in Landscape Ecology and Management:

- Miryane Ferlatte, RQES scientific coordinator, workshop preparation and facilitation
- Julie Grenier, RQES project manager, workshop preparation and facilitation
- Julie Ruiz, professor and co-director of UQTR's RIVE research center, workshop design

## References to site

All information on fundamental hydrogeological concepts comes from an outreach effort by an RQES working committee. Any use of these concepts must be cited as follows:

Ferlatte, M., Tremblay, Y., Rouleau, A. et Larouche, U. F. 2014. Notions d'hydrogéologie - Les eaux souterraines pour tous. Première Édition. Réseau québécois sur les eaux souterraines (RQES). 63 p.

This document should be cited as follows: :

Ferlatte, M. , Grenier, J. et Ruiz, J. 2026. Workshop 2 - Collaborating to protect and manage groundwater, participant's workbook. Document prepared by RQES, for water stakeholders, 54 p.

---

# Table of content

06 Introduction

## Activity 1:

11 Groundwater issues in our region

## Activity 2

25 Assessing current actions addressing groundwater protection and management issues

## Activity 3

41 Stakeholders' capacities for groundwater protection and management

## Activity 4

47 Strategies for groundwater protection and management

---

## About Quebec's groundwater network

The RQES is a non-profit organization whose mission is to consolidate and expand collaborations between university research teams and the MELCCFP on one hand, and other governmental and non-governmental organizations, consultants, educational institutions, and other groups interested in groundwater in Quebec, with the goal of mobilizing scientific knowledge on groundwater.

### The RQES has the following specific objectives:

- Ensure that scientific knowledge on groundwater is used by managers, planners, and water professionals in order to support sound management and protection of the resource;
- Support the transfer of scientific knowledge by identifying and disseminating scientific knowledge on groundwater;
- Identify needs in terms of research, practical applications for groundwater resource management, and training;
- Maintain ongoing links between research teams and managers, planners, and water professionals.

Learn more: [rqes.ca](http://rqes.ca)



---

# Training Team

## Your RQES Facilitators



**Miryane Ferlatte**  
Scientific Coordinator  
RQES

[coordination@rqes.ca](mailto:coordination@rqes.ca)



**Julie Grenier**  
Project Manager  
RQES

[julie.grenier@rqes.ca](mailto:julie.grenier@rqes.ca)

## The UQAR Research Team



**Gwendoline Tommi-Morin**  
Research Professional  
UQAR

[paces@uqar.ca](mailto:paces@uqar.ca)



**Yan Boulet**  
Research Professional  
UQAR

[paces@uqar.ca](mailto:paces@uqar.ca)



**Thomas Buffin-Bélanger**  
Professor of Hydrogeomorphology,  
Department of Biology, Chemistry,  
and Geography, UQAR

[thomas\\_buffin-belanger@uqar.ca](mailto:thomas_buffin-belanger@uqar.ca)



**Gwénaëlle Chaillou**  
Professor, Canada Research  
Chair in Coastal Hydrosystem  
Geochemistry, UQAR

[gwenaelle\\_chaillou@uqar.ca](mailto:gwenaelle_chaillou@uqar.ca)

---

# Background



## Groundwater knowledge acquisition projects (GKAP or PACES)

In Quebec, groundwater supplies nearly 90% of the inhabited territory and 20% of the population. It is often the only economically exploitable source of water, due to its generally good quality and proximity to the place of consumption. Despite its importance for the province of Quebec, our knowledge of it was still rather fragmentary in the mid-2000s. In 2008, the Quebec government and the Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP) decided to improve knowledge of this resource by implementing Groundwater Knowledge Acquisition Projects (PACES). The aim of these projects is to draw up a realistic and concrete regional portrait of the groundwater resource in municipalized areas of southern Quebec, with the aim of protecting it and ensuring its sustainability. Between 2009 and 2022, four rounds of PACES projects covered a large part of Quebec's municipalized territory. These projects followed pilot projects (pre-PACES) carried out between 1995 and 2003.

### The Gaspésie–Matapédia PACES

Between 2018 and 2022, the UQAR research team examined possible strategies for adapting PACES deliverables to the territorial realities of Gaspésie in view of a potential PACES project. This pilot project represents Phase 0, which made it possible to define the scope of the PACES Gaspésie–Matapédia project, to be carried out from 2024 to 2028.

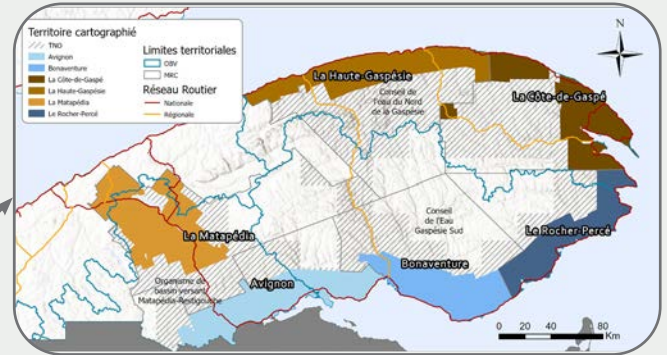
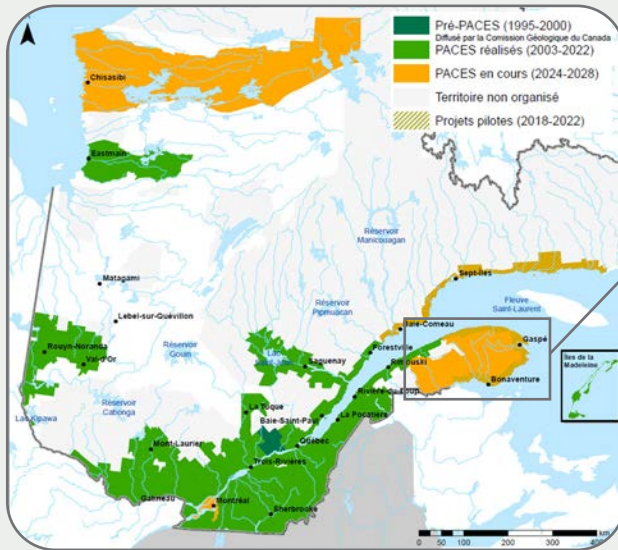
### PACES objectives

A portrait of groundwater must provide a picture of the resource on a regional scale. This portrait must answer the following fundamental questions:

- What is the nature of the geological formations that contain it?
- Where does the water come from (recharge zones) and where does it go (resurgences)?
- Is it drinkable, and what uses can it serve?
- What quantities are exploited and what are the sustainable quantities that can be exploited?
- Is it vulnerable to human activity?
- What are the main threats and issues to be considered to ensure the protection and sustainable management of groundwater in the region?

The results of the PACES projects are presented in the form of thematic maps accompanied by a technical text (scientific report) and a plain-language text (summary report), as well as a geomatics database.

## Covered area



*PACES Gaspésie-Matapédia study area*

## Implementation schedule

RESEARCH TEAM WORK PHASES (UQAR)		KNOWLEDGE TRANSFER AND EXCHANGE WORKSHOPS (RQES)	
<b>YEAR 1</b> 2024-2025	Compiling existing data	<b>1</b>	Discovering our PACES project and connecting it to our territory's issues
<b>YEAR 2</b> 2025-2026	Fieldwork and modeling	<b>2</b>	Collaborating to Protect and Manage Groundwater
<b>YEAR 3</b> 2026-2027	Producing reports and geospatial databases	<b>3</b>	Understanding the hydrogeological dynamics of our territory
<b>YEAR 4</b> 2027-2028		<b>4</b>	Learning to use PACES geomatic databases

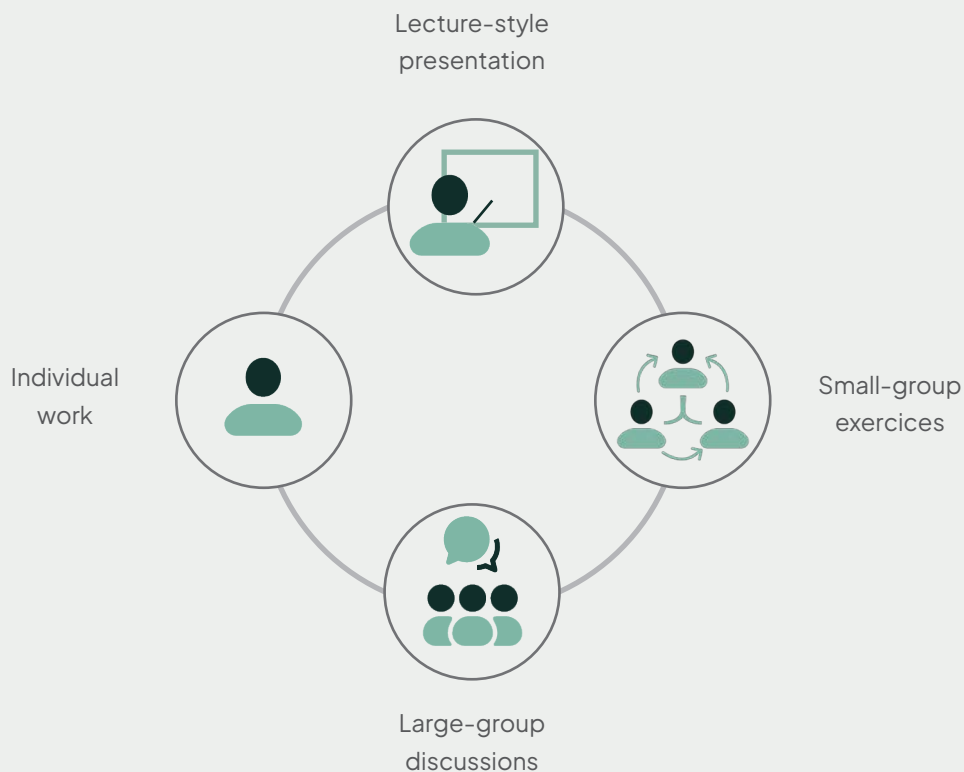
---

# Workshop Objectives



- Assess regional capacities to protect and sustainably manage groundwater.
- Clarify the roles and responsibilities of each stakeholder with respect to groundwater protection and management.
- Understand the diversity of regulatory, planning, incentive, and awareness-raising tools available to land-use and water stakeholders in Québec.
- Develop stakeholders' collaborative capacity to support a regional strategy for groundwater protection and management.

## Our approach



# Workshop Agenda

9:00	► <b>Opening and Welcome</b>
9:30	► <b>Introduction</b> Presentation of the context, objectives, and structure of the day
<b>1 – GROUNDWATER ISSUES IN OUR REGION</b>	
10:00	► <b>Groundwater Dynamics</b> Review of Workshop 1 and a collective discussion focused on the potential causes of the issues present in the region.
<b>2 – ASSESSING CURRENT ACTIONS ADDRESSING GROUNDWATER PROTECTION AND MANAGEMENT ISSUES</b>	
10:30	► <b>The institutional framework and tools for groundwater protection and management</b> RQES presentation
10:50	► <b>Coffee Break</b> ☕
11:05	► <b>Current tools and actions addressing our issues, and their limitations</b> Small-group activity followed by a large-group discussion
12:00	► <b>LUNCH</b> 🍏
<b>3 – STAKEHOLDERS' CAPACITIES FOR GROUNDWATER PROTECTION AND MANAGEMENT</b>	
13:00	► <b>Capacities for Groundwater Protection and Management</b> RQES presentation
13:30	► <b>Assessing one's capacities for groundwater protection and management</b> Individual activity followed by a large-group discussion
14:00	► <b>Coffee Break</b> ☕
<b>4 – STRATEGIES FOR GROUNDWATER PROTECTION AND MANAGEMENT</b>	
14:15	► <b>Developing an action strategy to address our issues</b> Small-group activity followed by a large-group discussion
15:30	► <b>Closing Remarks</b>

---

# Participants



## Round-table discussion



- Name, position, and organization
- Your concerns/interests regarding groundwater protection and management



# Activity 1

Groundwater issues in our region

---

# Review of Workshop 1

## The Identified Issues

During the first workshop, participants gathered around a large map of the territory to identify and locate current or anticipated groundwater protection and management issues. All of the issues mentioned are summarized in Table 1.

Participants then prioritized the issues, that is, they identified those that should be addressed first. In all regions, the issues identified as priorities were related to **water shortages** and **water quality problems**.

The PACES results will provide a knowledge base that will help address regional-scale quantity and quality issues, such as:

- the location of aquifers and their potential for groundwater development;
- priority recharge areas to be protected in order to ensure groundwater supply;
- water use for different purposes (municipal, industrial, commercial, and institutional);
- aquifer vulnerability to contamination;
- risks of salinization of coastal aquifers;
- natural contamination by manganese, arsenic, fluoride, and other metals;
- discharge zones that may contribute to thermal refuges or connectivity with wetlands.

However, they do not make it possible to address local-scale issues, such as the impacts of specific anthropogenic activities, which require a much finer scale of investigation.

Table 1. Issues Identified at Workshop 1 at Each Location

Enjeux	Gaspé	New-Richmond	Amqui
Water shortages*	x	x	x
Low-productivity aquifers	x	x	x
Lack of knowledge of potential aquifers (where they are located) for groundwater development	x	x	x
Lack of knowledge regarding water-quality issues (regional overview vs. problem areas, private wells)	x		x
Thermal refuges (for salmon)	x		x
Major water users (fishing industry, cement plant, ski resorts, golf courses)	x	x	x
Discharges of copper-rich mine dewatering water from the Murdochville mine into the York River	x		
Salinity		x	
Water quality (Mn, As, F, Fe, S, hardness)*		x	x
Water quality (bacteriological contamination)*			x
Coastal flooding		x	
Wastewater and stormwater overflows			x
Agricultural activities		x	x
Herbicide application by Hydro-Québec and along railway corridors		x	
Oil and gas drilling		x	x
Forestry activities	x	x	
Landfills		x	
Water availability for development and pressure from tourism	x	x	
Awareness-raising and training for elected officials, municipal employees, and citizens			x
Connections between wetlands and groundwater			x
Upstream-downstream aquifer connectivity at the watershed scale			x
Integration of knowledge into management tools			x
Management of transboundary aquifers (with New Brunswick)			x

\*Priority Issues Identified by Participants in Workshop 1

# Groundwater dynamics

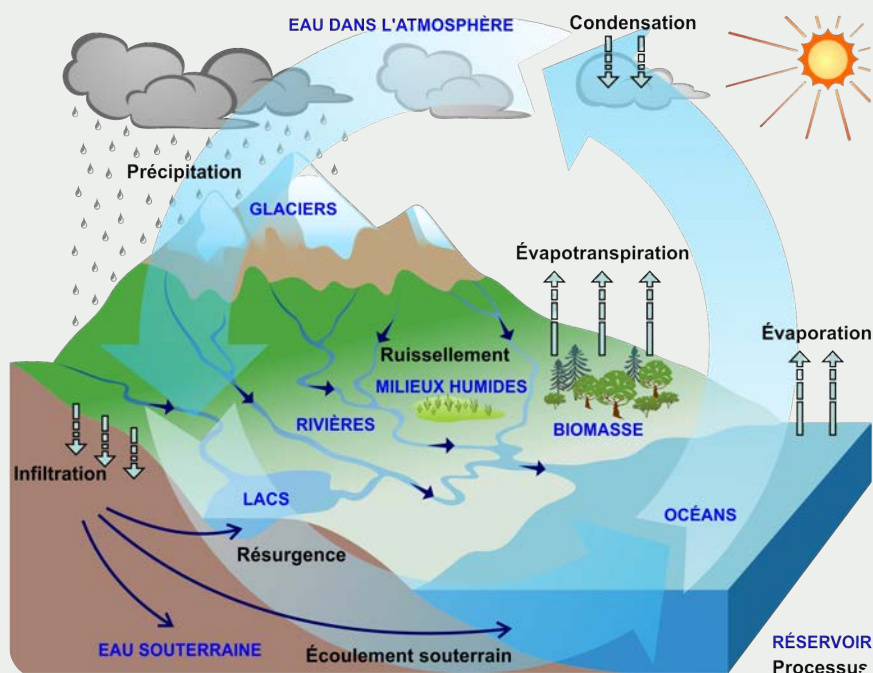


## THE WATER CYCLE

**GROUNDWATER** is the water that lies beneath the surface of the ground, filling the voids in the geological formations.

**GROUNDWATER** is an integral part of the water cycle

- Water evaporates (from oceans) and transpires (from vegetation), then falls back to the ground as precipitation (rain, snow).
- Part of the precipitation runs off into rivers and lakes and eventually reaches the oceans.
- The remainder infiltrates the soil, recharges aquifers, and moves slowly underground as groundwater.
- At the end of their underground flow paths, groundwater resurfaces at the land surface.
- This water then contributes to the supply of rivers, lakes, and wetlands.
- During low-flow periods, most of the water flowing in streams comes from groundwater inputs, thereby contributing to baseflow.
- Groundwater plays a key role in maintaining ecosystems, irrigating crops, and supplying drinking water.





## WATER TABLE, AQUIFER AND AQUITARD

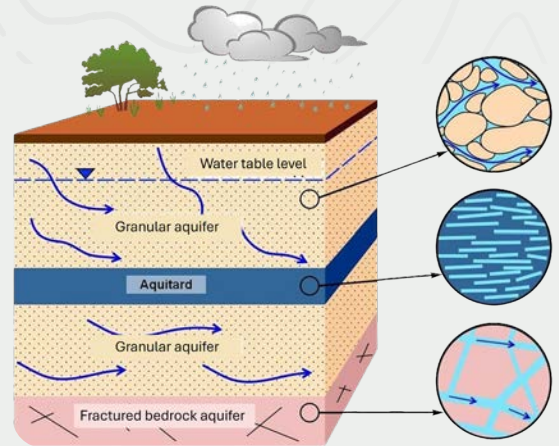
The **WATER TABLE** represents groundwater circulating in an aquifer.

- It's the **content**.

The **AQUIFER** is a permeable geological formation with a saturated zone that allows appreciable quantities of water to be pumped to a well or spring.

- It's the **container**.

The **AQUITARD** is a geological formation of very low permeability, i.e. very low hydraulic conductivity, in which groundwater flows with difficulty. It acts as a natural flow barrier, protecting the underlying aquifer from surface contaminants.



## DIFFERENT TYPES OF AQUIFERS

### GRANULAR AQUIFER

When a unconsolidated deposit is made up of coarse particles (e.g. sand and gravel), it forms an **AQUIFER**.

- The larger the pores, the more interconnected they are, and the more permeable the unconsolidated deposit aquifer is.
- High flow rates can be pumped from these aquifers, provided the saturated thickness is sufficient.

When a unconsolidated deposit is made up of fine particles (e.g. clays and silts), it forms an **AQUITARD**.

- The smaller the pores, the less accessible the water and the less permeable the unconsolidated deposit is.

### FRACTURED BEDROCK AQUIFER

The **pores** in the rock contain groundwater, forming a large reservoir. Their limited interconnection, however, does not allow for efficient water circulation.

**Fractures**, which generally represent only a small percentage by volume compared to pores, still allow for more efficient water flow, sometimes sufficient for groundwater pumping.

When drilling a well in this type of aquifer, the goal is to intersect as many fractures as possible.



gravels



clay



# Groundwater dynamics



## HYDROGEOLOGICAL CONTEXTS

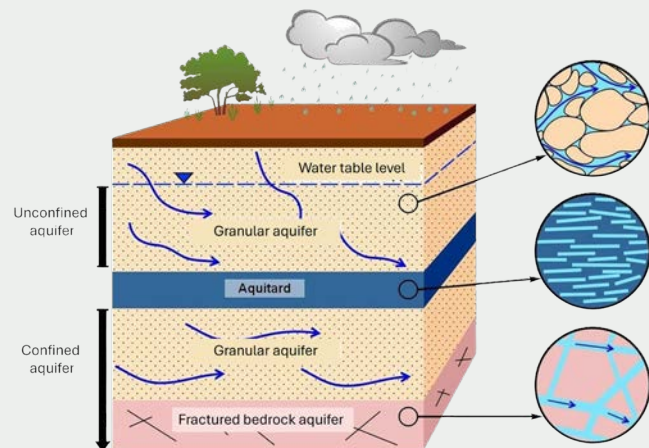
A **HYDROGEOLOGICAL CONTEXT** reflects the superposition of the different geological units.

- Each context influences groundwater flow and quality.
- These sequences determine the confinement conditions of aquifers.

An **UNCONFINED AQUIFER** is not overlain by an aquitard and is in direct contact with the atmosphere. It can be directly recharged by vertical infiltration and is therefore generally more vulnerable to contamination.

A **CONFINED AQUIFER** is “trapped” beneath an aquitard. It is not directly recharged by vertical infiltration and is thus protected from contaminants originating directly at the surface. Its recharge area is located farther upstream, where the impermeable layer is absent. Groundwater in this aquifer is under pressure greater than atmospheric pressure.

A **SEMI-CONFINED AQUIFER** is an intermediate case in which the overlying layers are not completely impermeable or are of limited thickness. It is moderately protected from surface contamination.





## PIEZOMETRY

**PIEZOMETRY** represents the elevation of the water table within an aquifer.

- The **piezometric level** (or hydraulic head) corresponds to the elevation of groundwater measured in a well relative to mean sea level (MSL).
- **Isopiestic lines** (or isopotential lines) connect points with the same groundwater level, similar to topographic contour lines.
  - They indicate the direction of groundwater flow, which moves perpendicular to the isopiestic lines, from higher elevations to lower ones.
  - The closer the lines are to one another, the steeper the hydraulic gradient and, therefore, the higher the groundwater flow velocity.

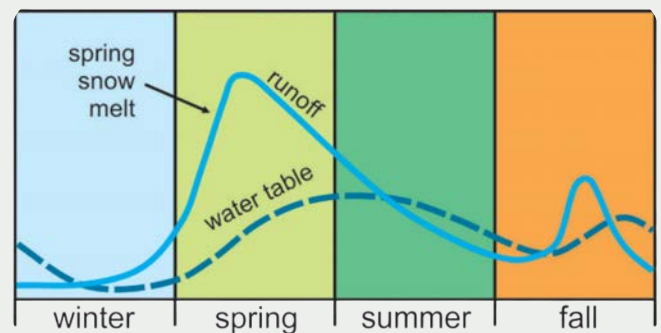
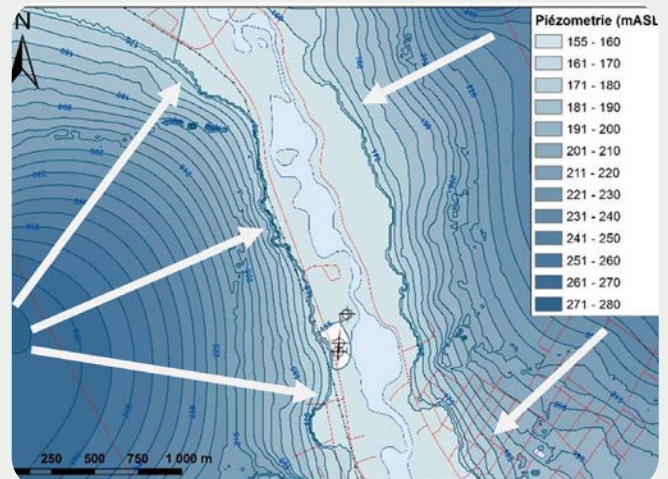
In Québec, piezometry is generally considered to be a smoothed replica of topography (ground surface elevation).

**Piezometric monitoring** consists of continuously recording the water level in a well using a probe in order to track fluctuations of the water table, detect over-extraction, understand groundwater flow, assess the local effects of pumping rates (especially during peak periods), and determine whether nearby wells influence one another.

Groundwater-level monitoring networks make it possible to assess the long-term impacts of water withdrawals and climate change on groundwater resources. In Québec, groundwater levels typically rise in the spring during snowmelt, then gradually decline until late summer. A secondary rise often occurs in the fall, when precipitation remains significant while evapotranspiration is relatively low. During the winter period, groundwater levels decline again until the following spring.

The rise in the water level in a well following a recharge period may be delayed over time, especially in confined aquifer settings.

To learn more about piezometry in Québec: [Réseau du suivi des eaux souterraines du Québec \(MELCCFP\)](#)



Source : <https://publications.gc.ca/site/eng/9.854795/publication.html>

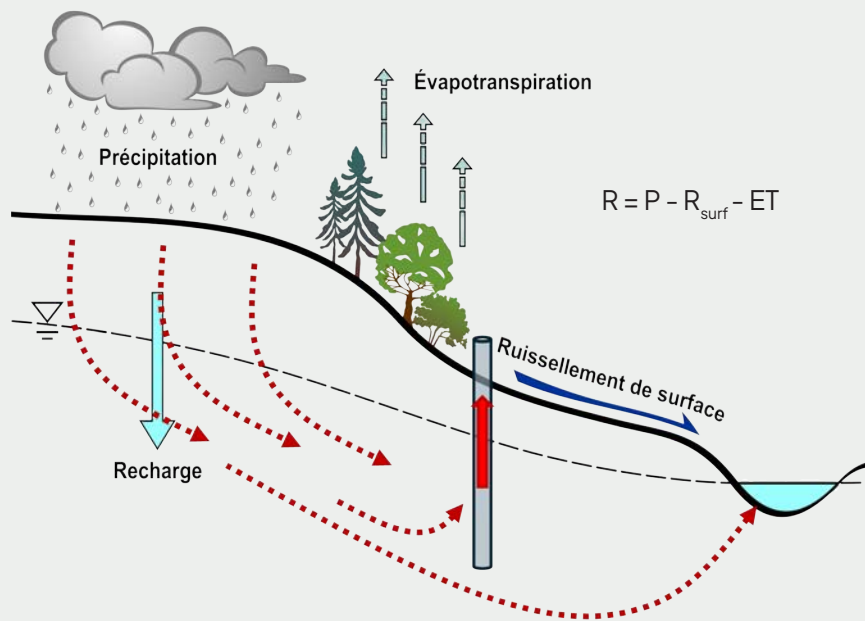
# Groundwater dynamics



## RECHARGE

Recharge is the process that allows groundwater to be renewed. It corresponds to the amount of water that supplies an aquifer through the infiltration of precipitation at the surface. At the regional scale, it is necessary to identify significant recharge areas in order to better protect them. Estimating aquifer recharge over a given unit of time (or recharge rate) is essential to ensure the long-term sustainability of groundwater resources.

Recharge therefore corresponds to the annual renewal rate (mm/year), often estimated using a water balance. It should be noted that the groundwater supplying a well is generally composed of a mixture of water originating from different flow paths connected to recharge areas.



Recharge is influenced by climatic conditions, land use, and the physical properties of the soil, particularly its capacity to allow water to infiltrate. Because these factors vary from place to place, recharge is not uniform across the territory. As a result, areas where bedrock or permeable unconsolidated deposits outcrop and where unconfined aquifers are present constitute preferential recharge zones. Conversely, a thick and continuous clay cover limits recharge. In urban areas, surface sealing caused by road and parking lot paving, soil compaction, and the presence of buildings and other structures has a significant impact on recharge, as it prevents water from infiltrating into the ground.

Recharge occurs seasonally in temperate regions. It is mainly concentrated in the spring, when snowmelt releases large volumes of water that can infiltrate into the soil, and in the fall, when reduced evapotranspiration promotes the infiltration of precipitation. During the rest of the year, recharge is negligible or nonexistent. In summer, high temperatures lead to strong evapotranspiration, and rainfall is largely partitioned between surface runoff and evaporation, limiting infiltration to aquifers. In winter, when temperatures are below 0 °C, precipitation falls as snow and is stored until spring, while frozen ground prevents infiltration. As a result, the amount of recharge accumulated in spring constitutes the main groundwater reserve that supports water uses during the summer period.

---

## What conditions favor effective recharge ?

Effective groundwater recharge depends on a combination of climatic, hydrological, soil-related, and land-use conditions that promote water infiltration into aquifers rather than runoff or evaporation:

### **Favorable climatic conditions**

- Sufficient and regular precipitation, preferably of low to moderate intensity, allowing water to infiltrate rather than run off;
- Moderate temperatures, which limit evapotranspiration;
- A thick snow cover in winter;
- Gradual snowmelt in spring, which slowly releases water and promotes infiltration.

### **Soil- and subsurface-related conditions**

- Sols Permeable soils (sands, gravels, well-structured soils) that facilitate water percolation;
- No or low soil compaction, maintaining good porosity;
- Unfrozen, moist, and unsaturated soil, providing temporary storage capacity for infiltrating water;
- Permeable aquifers well connected to the surface.

### **Biological and land-cover conditions**

- Natural vegetation cover that protects the soil from runoff, improves soil structure, and promotes infiltration;
- Low vegetative activity (early spring, late fall), which reduces evapotranspiration;
- Presence of organic matter in the soil, increasing its water retention and infiltration capacity

### **Geomorphological and land-use conditions**

- Gentle to moderate topography: flat or low-lying surfaces promote infiltration;
- Presence of wetlands, forested areas, and natural recharge zones;
- Low proportion of impervious surfaces or the presence of infrastructure that promotes infiltration (swales, infiltration basins);
- Sustainable land management practices (urban planning, agriculture, forestry) that limit runoff and excessive drainage.

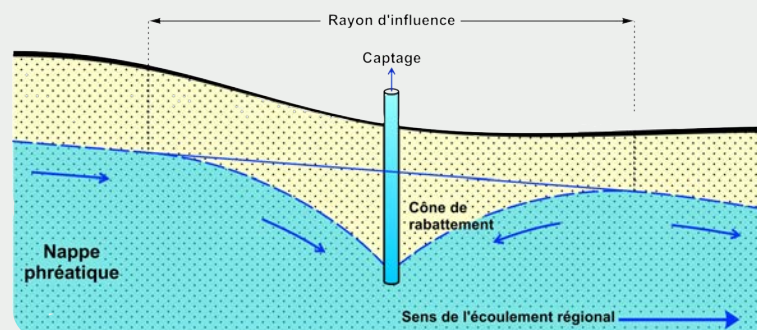
In summary, effective recharge is favored when water is available, the soil can absorb it, and losses through evaporation or runoff are limited. These conditions are most often met in spring and fall. Although summer is generally an unfavorable period for recharge due to high evapotranspiration, recharge can nonetheless be enhanced by improving infiltration and water retention in the soil. This can be achieved by reducing runoff through permeable, uncompacted soils, limiting impervious surfaces, and implementing features that slow down and temporarily store rainwater. Maintaining vegetation cover and organic matter protects the soil from direct evaporation, improves soil structure, and creates conditions conducive to infiltration during rainfall events, thereby locally supporting aquifer recharge during the summer.

---

# Quantity

## Why is my well dry?

The amount of groundwater available for drinking-water supply depends on the interaction between recharge, aquifer properties, and patterns of water use. A well may run dry either because the groundwater level has dropped or because of a loss of capacity of the well itself. Although groundwater is a renewable resource, it renews itself at a limited rate. This requires that the total volume of **water withdrawn** remain within the aquifer's capacity (stored volume) and preferably stay below 20% of the recharge rate in order to ensure sustainable use. Summer is a critical period for water availability, as higher temperatures are generally accompanied by increased demand and declining water levels, while recharge is minimal or even absent. Shallow, surface wells are particularly vulnerable to water shortages because they respond more quickly to meteorological variations and water use than artesian wells in fractured bedrock. In addition, pumping from any well causes a drawdown of the water table, which can affect water levels in neighboring wells and lead to conflicts of use when development density is high.



Availability also depends on the **hydraulic properties** of the aquifer: high permeability allows higher pumping rates and promotes faster recovery of water levels. Conversely, a low-productivity aquifer with low permeability and/or limited thickness and extent restricts the amount of water that can be withdrawn.

A decrease in **recharge** caused by unfavorable conditions—such as low snow accumulation in winter, frozen soil during snowmelt, limited rainfall in the fall, or poor infiltration—can also explain declining groundwater levels. In addition, **climate change** affects recharge and increases the frequency and intensity of summer droughts, resulting in groundwater reserves that are replenished earlier in the year but must sustain water needs over a longer summer period.

Finally, **well design and maintenance** can also influence the amount of water actually available, for example in cases of reduced well capacity. Capacity loss may result from the dewatering of productive fractures, clogging of fractures by iron or fine particles, or fouling of the well and pumping system (corrosion, biofilm buildup). These processes reduce the amount of water that can enter the well. This highlights the importance of proper well maintenance and rehabilitation (mechanical or chemical cleaning, hydrofracturing, deepening), which can partially or fully restore intake capacity. Thus, the amount of groundwater available depends not only on the natural resource itself, but also on how it is used, shared, and maintained over time.

## How can my well water become contaminated ?

Even if the water appears clear, transparent, and odorless, contaminants may still be present and can have adverse health effects on those who consume it. Groundwater quality is influenced by a combination of natural and anthropogenic factors, related both to the aquifer itself and to the way the well is designed.

It first depends on the **nature of the geological setting**: groundwater acquires its chemical composition mainly through the dissolution of minerals contained in rocks and sediments, which explains why many exceedances of standards (iron, manganese, fluoride, arsenic, etc.) are of natural origin.

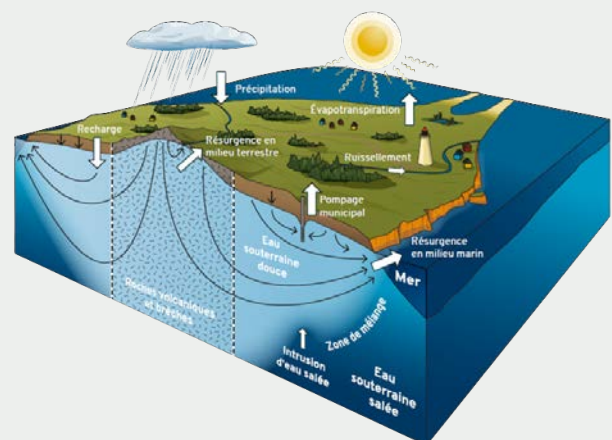
The **residence time** of water in an aquifer is also a determining factor: the longer groundwater circulates and the greater the distance it travels, the more chemically evolved and mineralized it becomes. Conversely, a sufficient residence time promotes the natural removal of bacteria and viruses, which justifies the establishment of setback distances between wells and certain potential sources of contamination.

**Confinement conditions** strongly influence vulnerability: an unconfined aquifer (water-table aquifer), which is directly recharged by vertical infiltration, generally contains less mineralized water but is more exposed to surface-derived contaminants. In contrast, a confined aquifer (artesian aquifer) is better protected, although its water is often more mineralized, as recharge occurs farther upstream, where the confining layer (aquiclude) is absent.

**Human activities** are a major source of groundwater contamination, often diffuse and difficult to detect. Agriculture can contribute to the introduction of nitrates, pesticides, and fertilizers through soil leaching, especially during heavy rainfall or on permeable soils. In residential areas, poorly maintained septic systems or systems located too close to wells can release bacteria, viruses, and nutrients into the groundwater. Industrial and commercial activities are also potential sources of contaminants such as hydrocarbons, solvents, or heavy metals in the event of spills or leaks. Urbanization increases impervious surfaces and can concentrate pollutants that later infiltrate through cracks or recharge areas. Finally, roads and winter maintenance activities (de-icing salts) can lead to increased salinity in groundwater.

Construction and **proper design of a well** in accordance with standards are essential to preserving water quality. A casing that extends at least 30 cm above ground level, a watertight cap, properly sealed joints, a sanitary seal where required, and ground sloping away from the well all help prevent the direct infiltration of surface water, which is often contaminated.

Finally, **climate change** amplifies several risks: rising temperatures promote the survival of certain pathogenic microorganisms and the dissolution of contaminants; more intense precipitation increases the leaching of fecal matter, fertilizers, and pesticides into aquifers; more frequent flooding can affect groundwater where a direct connection exists with contaminated surface waters; and, in coastal areas, sea-level rise leads to increased salinity through saltwater intrusion and the displacement of the freshwater-saltwater interface, a phenomenon often intensified by groundwater pumping.



Source : PACES IDLM

# Discussion : Cause ou consequence ?



In your opinion, is it a cause, or a consequence ?  
How does it affect groundwater protection and management ?

Issues	Causes / Consequences / Problems
Water shortages	
Low-productivity aquifers	
Lack of knowledge of potential aquifers (where they are located) for groundwater development	
Water availability for development and pressure from tourism	
Major water users (fishing industry, cement plant, ski resorts, golf courses)	
Salinity	
Water quality (Mn, As, F, Fe, S, hardness)	
Water quality (bacteriological contamination)	
Coastal flooding	

---

*To address an issue, its causes must first be understood.*

<b>Issues</b>	<b>Causes / Consequences / Problems</b>
Agricultural activities	
Herbicide application by Hydro-Québec and along railway corridors	
Oil and gas drilling	
Forestry activities	
Landfills	
Thermal refuges (for salmon)	
Connections between wetlands and groundwater	
Integration of knowledge into management tools	
Awareness-raising and training for elected officials, municipal employees, and citizens	

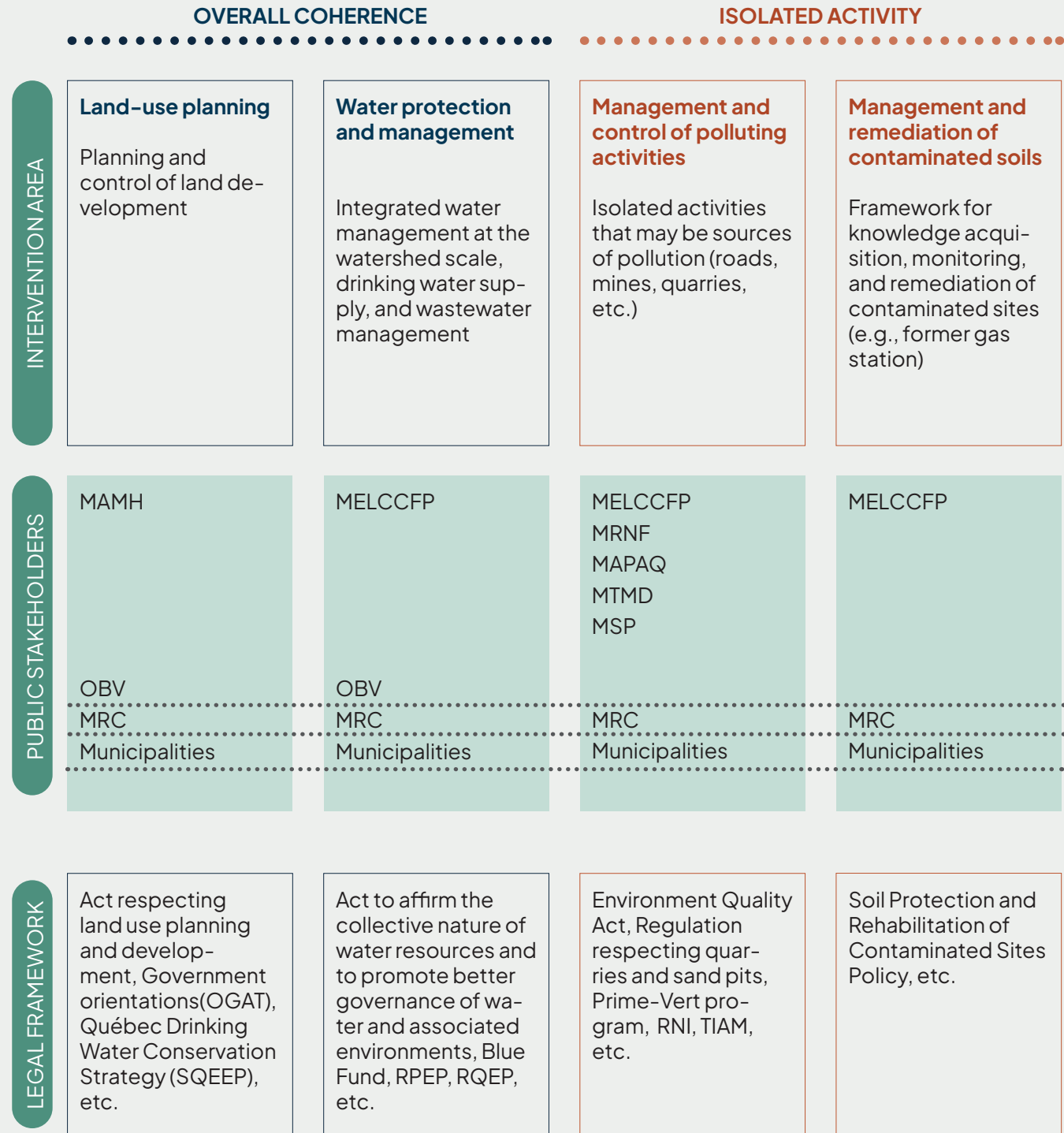




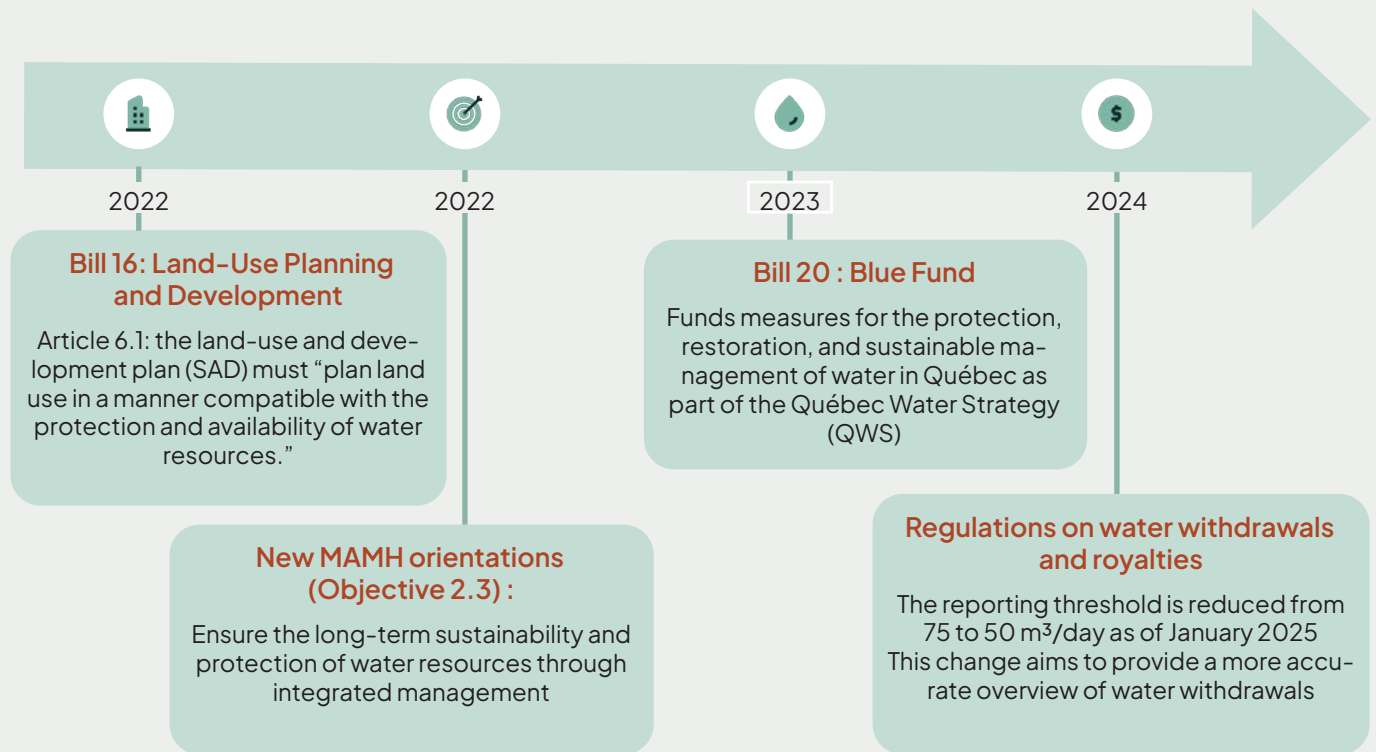
# Activity 2

Assessing current actions addressing groundwater protection and management issues

# A complex institutional framework



# Recent evolution of the legal and regulatory framework in Québec



(From [Mayrand, 2026](#))

---

# Groundwater governance in Québec

## An essential, invisible, and collective resource

Groundwater is a strategic source of drinking water supply in Québec, particularly in rural, peri-urban, and northern areas. It supplies municipal drinking-water systems as well as thousands of private wells. Invisible, slowly renewable, and closely linked to land use, groundwater is sensitive to planning choices, infrastructure, and individual practices. Because it is inherently invisible, groundwater requires proactive governance based on prevention, territorial knowledge, and coordination among multiple stakeholders. In Québec, groundwater management is based on a multi-level governance model: the provincial government establishes the legal framework, regional county municipalities (RCM) structure regional land-use planning, watershed organizations (OBV) contribute knowledge and foster collaboration, and municipalities implement rules on a day-to-day basis. This governance is supported by a coherent set of diverse and complementary policy and regulatory tools.

## The Government of Québec: legal framework, standards, and obligations

The Government of Québec plays a fundamental role as the chief normative coordinator. Through laws and regulations, it establishes the legal framework and minimum rules aimed at protecting the resource, public health, and the environment. The Act respecting Land Use Planning and Development (LAU) governs land-use planning instruments, while the Environment Quality Act (EQA) sets out general obligations related to water protection. Regional branches of government ministries apply this framework on the ground: they review applications for environmental authorizations and intervene in cases of non-compliance.

With regard to groundwater, the Regulation respecting Water Withdrawal and Protection (RPEP) is central. It defines protection areas around drinking-water intakes and prohibits or restricts certain high-risk activities within them. The government also requires the development of key planning instruments—such as Land-Use and Development Plans (SAD), Regional Wetlands and Water Bodies Plans (PRMHH), and climate plans—and provides financial support for their implementation. In addition, it produces guidance documents, hydrogeological data, and technical reference materials.

## Regional County Municipalities (RCM): structuring and protecting at the regional scale

RCMs are responsible for ensuring territorial coherence and occupy a central position in groundwater governance. They are responsible for the Land-Use and Development Plan (SAD), a guiding document that organizes land use at the regional scale and with which municipalities must comply. Through the SAD, the RCM must:

- Define the main land-use designations (conservation, development, constraints) based on water availability;
- Identify areas of hydrological importance (e.g., recharge zones to be protected);
- Integrate drinking-water intake protection areas and require that they be taken into account in local regulations;
- Adopt Interim Control By-laws (ICB) to prevent development from compromising the resource during a planning review process.

The RCM is also responsible for the Regional Wetlands and Water Bodies Plan (PRMHH), which aims to conserve, restore, and create wetlands and aquatic environments that play a key role in groundwater recharge, filtration, and hydrological regulation. In some cases, it may also directly regulate regional issues, such as logging in pri-

---

## Roles and responsibilities: who does what?

vate forests or major hydrological constraints. The RCM serves as the regional arbitration level, which is essential for managing aquifers and drinking-water intake protection areas that extend beyond municipal boundaries. RCM are also responsible for climate plans, which introduce an essential temporal dimension. These plans make it possible to anticipate the effects of climate change on aquifers—such as prolonged droughts, intense rainfall events, more variable recharge, and increased concentrations of contaminants. They serve as a bridge between climate adaptation, land-use planning, and water management.

### **Watershed Organizations (OBV): understanding, fostering collaboration, and setting priorities**

Watershed organizations (OBV) are the cornerstone of integrated water management at the watershed scale. Their role is not to regulate, but to document, analyze, and mobilize stakeholders. Through the Water Master Plan (PDE), developed in collaboration with local and regional actors, they establish an overview of pressures on surface water and groundwater, identify vulnerable areas, and define resource protection objectives. OBVs:

- Document hydrogeological vulnerabilities and pressures on aquifers;
- Identify high-risk areas (water shortages, contamination);
- Mobilize stakeholders (RCM, municipalities, citizens, CISSS, agricultural and forestry producers);
- Lead voluntary actions, such as private well water-quality testing programs, nature-based solution projects, and awareness-raising initiatives.

The PDE is not legally binding, but it can help guide land-use planning decisions, Regional Wetlands and Water Bodies Plans (PRMHH), climate plans, and municipal policies. It must be taken into consideration by RCM when developing their SAD. Without the contribution of OBV, groundwater governance lacks data, coherence, and social acceptability.

### **Municipalities: from planning to permitting**

Local municipalities are the actors that most directly affect groundwater. They translate provincial and regional policy directions into concrete rules, and adopt and enforce the regulations that govern each project—from urban planning documents to building permits. Through their planning and regulatory tools, they can:

- Condition development on proof of groundwater availability;
- Limit soil imperviousness and require on-site water infiltration measures (Low Impact Development – LID);
- Integrate drinking-water intake protection areas into zoning bylaws;
- Use Site Planning and Architectural Integration Programs (PAE) and Site Planning and Architectural Integration Plans (PIIA) to impose tailored criteria in vulnerable areas;
- Require, through permits and certificates bylaws, water quality analyses, hydrogeological studies, and proof of compliance before authorizing construction or development;
- Regulate tree cutting and planting to help maintain groundwater recharge.

Municipalities are also responsible for communication with citizens, inspections, and ongoing monitoring.

---

# Integrating groundwater into planning

The [Good practices guide developed through the Re-Source project](#) is intended to support municipalities and watershed organizations. It presents an overview of groundwater in Montérégie, describes the uses and pressures affecting it, popularizes the scientific results of the Re-Source project, and proposes 29 good-practice fact sheets organized into six thematic areas: water conservation, contamination prevention, land-use planning, infiltration and recharge, monitoring, and knowledge transfer. Below is an excerpt from Theme No. 3: *Municipal land-use planning based on groundwater knowledge*.

## **Make full use of the municipal regulatory authority in land-use planning and environmental protection granted under the Act respecting Land Use Planning and Development (LAU)**

Since 2023, the LAU stipulates that the Urban Planning By-law must “provide measures to ensure the protection and availability of water resources,” while Land-Use and Development Plans (SAD) and Metropolitan Plans must plan land development “in a manner compatible with the protection, availability, and integrated management of water resources.” In addition, the LAU (sections 79.2, 79.3, and 113) authorizes regional county municipalities (RCM) and local municipalities to protect the environment. Furthermore, section 245 of the LAU provides that regulatory amendments aimed at protecting natural environments are no longer necessarily considered disguised expropriation.

## **Leverage the new OGAT to better identify the locations of groundwater withdrawal sites and recharge areas within the territory, as well as areas of high vulnerability.**

The new OGAT must be incorporated, in particular into RCM planning documents. Objective 2.3 of the OGAT is to “ensure the long-term sustainability and protection of water resources through integrated management.” This objective includes, among others, the following two expectations for RCM:

Expectation 2.3.1 is to “identify drinking-water withdrawal sites as well as their protection areas.” More specifically, RCM will be required to identify the following elements:

- Category 1, 2, and 3 groundwater and surface-water withdrawal sites that serve more than 20 people;
- Protection areas for Category 1 withdrawal sites;
- Vulnerability levels of protection areas for groundwater withdrawals;
- Immediate and intermediate protection areas for Category 2 groundwater and surface-water withdrawal sites, as well as for Category 3 sites serving more than 20 people.

Expectation 2.3.3 is to “take measures to preserve water resources.” These measures may include defining land-use designations and permitted uses, adopting provisions in the Land-Use and Development Plan (SAD), developing regional regulations, programs and/or plans, and even creating public awareness campaigns.

To this end, RCM will be required to:

- Develop an overview of water use and assess needs, based on available data, in order to support territorial development over the next 30 years;
- Determine the main issues likely to affect water availability, both in terms of quantity and quality;

---

## What levers are available to local and regional municipalities to integrate groundwater knowledge into municipal land-use planning?

- Identify potential water sources and aquifer recharge areas needed to meet the water requirements of current and future projects, based on available data;
- Provide measures to address the main issues identified, particularly to meet future needs in a climate change context, where applicable;
- Take into account drinking-water source vulnerability assessment reports, aquifer recharge areas, and the elements identified under Expectation 2.3.1 when determining land-use designations and permitted uses.

### **Leverage the RPEP, which, since 2021, requires Category 1 water-withdrawal operators to produce a Drinking Water Source Vulnerability Assessment Report (RAV)**

Category 1 withdrawal sites are those that supply a waterworks system serving more than 500 people and at least one residence. The preparation of Vulnerability Assessment Reports (RAV) is governed by a guide from the MELCCFP (MELCC, 2018). RAVs help highlight weaknesses, issues, and threats affecting drinking-water sources. They guide the prioritization of actions to protect drinking-water sources and serve as a basis for developing source protection plans. However, when it comes to assessing the quantity of water available to plan the establishment of a new industry or a new residential development project, site-specific hydrogeological studies are required.

### **Develop a Drinking Water Source Protection Plan (PPSEP) that addresses the issues identified in the RAV**

The PPSEP applies to municipalities that have Category 1 water-withdrawal sites, as defined in the RPEP, and that have completed their first RAV. Although the PPSEP is not mandatory, the MELCCFP provides funding and an implementation guide to support the development of the Plan.

### **Leverage the climate plans currently being developed by RCM under the Accelerating Local Climate Transition (ATCL) program funded by the Government of Québec**

The ATCL program encourages RCM to develop climate plans, which must include climate change adaptation actions. In this context, climate plans can, for example, incorporate sustainable groundwater management into land-use planning. This integration can take the form of actions that promote the protection of aquifer recharge areas, water infiltration into soils, and even the reduction of contamination risks from runoff or aging infrastructure. Climate plans can also provide opportunities to fund access to reliable scientific data and to encourage the use of monitoring and evaluation tools.

The program includes two components. Component 1 aims to support municipal bodies in developing a climate plan. This component is under the responsibility of the MELCCFP. Component 2 is intended to support the planning and implementation of projects arising from climate plans that have been approved by the MELCCFP. This component is under the responsibility of the MAMH.

# Integrating groundwater into planning

The [Guide for Appropriating Groundwater Knowledge for Integration into the Land-Use and Development Plan](#) (Mayrand, 2022) presents a range of regulatory and planning tools that can be applied to groundwater protection and management (GPM). Below is an adapted summary, accompanied by examples of application for GPM.

## Land-use planning regulatory tools

Tool	Description (what is it used for?)	Relevance for GPM
<b>Planting and removal of trees</b>	By-law promoting sustainable management of private forests	Maintaining forest cover in strategic areas (e.g., recharge zones); reducing runoff; forested buffer strips around water intakes.
<b>By-law on natural constraints</b>	Cartography and regulatory management of physical features of the territory that pose a risk	Regulation of urban development in sensitive areas; limitation or stricter control of land sealing (impervious surfaces); preservation of the aquifer's natural functions (recharge, filtration); reduction of contamination risks.
<b>By-law on anthropogenic constraints and risk management</b>	Cartography and regulatory management of infrastructure or human activities that are disruptive or pose risks	Identification of high-risk activities; separation of incompatible land uses; protection of water intakes and vulnerable areas; preventive risk management for aquifers.
<b>Interim Control By-law (ICB)</b>	Temporary regulatory controls during planning	Freeze or restriction of projects that threaten groundwater recharge or water availability.
<b>Zoning by-law</b>	Normative, zone-based instrument (permitted uses, density, and built form)	Maximum impervious surface ratios; on-site stormwater infiltration; proof that the aquifer can sustain the proposed withdrawals; integration of water-intake protection areas and weighting of land uses; standards for the installation of wells and septic systems.
<b>Comprehensive Development Plan (CDP)</b>	Detailed planning prior to regulatory amendments	Required proportion of permeable area; development phasing; setback distances from wells; initial water-quality testing; establishment of system-equity fees and water-use resource charges.
<b>Site Planning and Architectural Integration Plan (SPAIP)</b>	Qualitative evaluation of projects based on defined criteria	Source control (rain gardens, infiltration trenches, revegetation); construction criteria adapted to vulnerable areas; conservation, during the development of new neighbourhoods, of woodlands, fallow land, or wetlands.

## Territorial planning tools

Tool	Description (what is it used for?)	Relevance for GPM
<b>Land-Use and Development Plan (SAD)</b>	Regional guiding document that sets out the vision, policy directions, and actions for the regional territory	Conditions urban development on water availability, protects recharge areas, and integrates water-intake protection areas (in accordance with OGAT Orientation 2.3); enables the use of interim control by-laws (ICB).
<b>Major land-use designations</b>	Definition of current and future land-use designations (residential, agricultural, etc.)	Conservation designation for recharge areas and aquatic environments; siting of development based on the aquifer's capacity.
<b>Areas of interest</b>	Identification and protection of ecological, water-related, or heritage areas	Protection of peatlands and recharge areas; buffer zones and restrictions on polluting activities around drinking-water withdrawal sites.
<b>Urban Plan</b>	Municipal vision and guiding principles; foundation for regulatory frameworks	Requirement to demonstrate the aquifer's carrying capacity; infiltration and Low Impact Development (LID) objectives at the lot scale; standards for wells and septic systems; SPAIP requirements around water intakes; alignment with the RPEP.
<b>Water Master Plan (PDE)</b>	Strategic watershed-based tool (overview, assessment, action plan)	Identification of issues, objectives, and priority actions; private well sampling programs; coordination of a groundwater stakeholder roundtable.
<b>Regional Wetlands and Water Bodies Plans (PRMHH)</b>	Legal tool to integrate wetland and water body conservation into planning	Conservation and restoration of environments that support recharge; protection of purifying functions, buffer zones, and compatible land uses.
<b>Climate plan</b>	Climate change adaptation and mitigation tools	Anticipates water shortages; strengthens the protection of recharge areas; promotes water conservation; reduces risks following heavy rainfall or drought; enhances monitoring of water intakes; builds internal capacity; trains elected officials and professionals.
<b>Drinking Water Source Protection Plan</b>	Preventive tools to protect drinking-water intakes and reduce contamination risks	Control of high-risk uses and activities; prioritization of risk-reduction actions; regulation of agricultural, industrial, and municipal practices; monitoring and tracking of water quality and water levels.
<b>Communication (strategy / mechanisms)</b>	Provides a framework for information sharing, public consultation, and public engagement	Gradual messaging during drought periods; inter-municipal consistency; private well sampling campaigns; harmonized public health advisories.
<b>Public participation</b>	Consultation and co-creation mechanisms	social acceptability of water-related constraints (proof of water availability, infiltration requirements) and protection measures; involvement of the population in groundwater data collection.

---

# Multiple and complementary tools

## Complementary tools in support of integrated governance

Groundwater governance in Québec is based on shared and complementary responsibility. The strength of the Québec model lies in the complementarity of its tools: while the tools are numerous, their effectiveness depends on their coherence and on their appropriation by local stakeholders. When used effectively, they make it possible to move from strategy to action and to sustainably protect this essential, invisible, yet vital resource. They also leave room for creativity and collective intelligence in the development of strategies tailored to local realities, fostering innovative, collaborative, and adaptive solutions for the sustainable management of groundwater.

## Sustainable management principle

Sustainable water resource management is based on the principle of sustainable development, according to which resources must be used in a way that meets society's needs while preserving their long-term viability. As with all types of resources, sustainable water management results from a set of trade-offs accepted by society.

Sustainable groundwater management must be grounded in adequate knowledge of available resources. The PACES program plays a major role in developing this knowledge. It makes it possible to build a reliable and comprehensive database of current groundwater knowledge for the regions studied, where very little data had previously been available. The maps produced, together with all complementary work carried out as part of the PACES projects, provide an understanding of groundwater that forms a solid foundation for the sustainable management of water resources, whose objectives generally include:

- Protect the quantity of groundwater
- Protect groundwater quality
- Preserve ecosystem health
- Ensure socio-economic well-being
- Apply the principles of good governance



## REGULATORY TOOLS

DEFINITION

Establishment of legally binding standards applicable to citizens or businesses to regulate anthropogenic activities

EXAMPLES

- Regulation respecting Water Withdrawal and Protection (RPEP)
- Regulation respecting quarries and sand pits
- Complementary document to the Land-Use and Development Plans (SAD)
- Urban planning by-laws that provide tighter control over development in already high-risk area
- Use restrictions



## NON-REGULATORY TOOLS



### Planning and collaboration tools

DEFINITION

Strategies, management plans, and action plans that define policy directions through stakeholder collaboration

EXAMPLES

- Land-Use and Development Plan
- Water Source Protection Plan
- Emergency measures



### Voluntary tools

Encourage changes in practices on a voluntary basis

- Awareness-raising campaign
- Drinking water conservation program
- Education on best practices



### Incentive tools

Economic measures that drive changes in practices and promote alternative approaches to land development

- Water royalties / water fees
- Property tax rebates
- Fines



### Knowledge acquisition and management

DEFINITION

Aims to understand the processes that affect groundwater

EXAMPLES

- Characterization study
- Automated groundwater-level monitoring
- Data management protocols



### Technologies and engineering

Operational measures: concrete, practical actions that can be implemented on the field

- Drinking water storage reservoirs
- Installation of water level-loggers
- Well maintenance and rehabilitation



### Nature-based solutions

Actions aimed at protecting, sustainably managing, and restoring natural or human-modified ecosystems, thereby benefiting from their ecosystem services

- Land acquisition and conservation to protect recharge areas
- Vegetation planting, reforestation, and removal of impervious surfaces

---

# Examples of inspiring case studies



## Example 1 – Assessment of sustainable groundwater management indicators (Montréal)

Pilot project aimed at developing and evaluating sustainable groundwater management indicators based on data from the PACES Montréal-Est project. <https://espace.inrs.ca/id/eprint/2408/1/R001533.pdf>



## Example 2 – Land-Use and Development Plan of the Val-Saint-François RCM (Estrie)

Thanks to a collaboration with INRS-ETE and the RQES, the Val-Saint-François RCM was able to use data from the Estrie PACES project to meet the requirements of Objective 2.3 of the new OGATs, notably to prioritize aquifer recharge areas to be protected for drinking-water supply within its territory (Chapter 7). <https://val-saint-francois.qc.ca/wp-content/uploads/2025/09/Chapitre-07-Protection-de-leau-sur-le-territoire.pdf>



## Example 3 – Exclude Category 1 groundwater withdrawal sites from mining activities (Société de l'eau souterraine Abitibi-Témiscamingue – SESAT)

SESAT identified the active mining titles within the entire recharge areas of the region's twenty-two (22) Category 1 groundwater withdrawal sites in order to encourage RCMs to designate these areas as territories incompatible with mining activities (TIAM). [https://b01fae16-75b1-4772-a017-29954f448739.usrfiles.com/ugd/b01fae\\_3f90aa8b7eb54f46a59bce17a13ce280.pdf](https://b01fae16-75b1-4772-a017-29954f448739.usrfiles.com/ugd/b01fae_3f90aa8b7eb54f46a59bce17a13ce280.pdf)



## Example 4 – My water, my well, my health (Chaudière-Appalaches)

This project proposes a series of strategies to increase the practice of water testing among private well owners. <https://moneaumonpuits.ca/>



## Example 5 – By-law requiring real estate developers to produce hydrogeological studies (Saint-Hippolyte, Laurentides)

Bill no 993-09 (sections 9.3 and 9.4): The objectives are to assess the quantity of water that the aquifer must supply (i.e., 250 litres per person per day) and to estimate the aquifer's capacity to provide water, including groundwater flow velocity, recharge rate, and the water balance. <https://saint-hippolyte.ca/wp-content/uploads/2022/06/COD-ADM-993-09-1.pdf>

*Discover more inspiring case studies on our [website](#) >>*



#### **Example 6 – Piezometric monitoring program (Saint-Paul-de-l'Île-aux-Noix, Montérégie).**

The municipality has launched a program to measure groundwater levels in order to better anticipate the risk of drinking-water shortages. These groundwater level measurements will enable the municipality to gain a better understanding of the dynamics of its water table. <https://www.coupdoeil.info/archives/22-octobre-2025/>



#### **Example 7 – Agglomeration by-law on the protection of water intakes (Québec City, Capitale-Nationale)**

The by-law prohibits certain activities around wells that supply a drinking-water system in order to protect water quality. Within a 300-metre radius, it is prohibited to: 1) Bury residual waste; 2) Dispose of snow waste; 3) Store hazardous materials outdoors. <https://reglements.ville.quebec.qc.ca/fr/document/rc/R.A.V.Q.266/>



#### **Example 8 – Capturing snow to better withstand droughts (Sainte-Luce, Bas-Saint-Laurent)**

En favorisant l'accumulation de neige sur les terres agricoles situées dans la zone de captage, grâce à des brise-vent amovibles et à des aménagements agroécologiques, la municipalité agit directement sur la recharge de son aquifère, qui assure l'alimentation en eau potable de la population. Bien que modestes en apparence, ces aménagements ont permis de capter l'équivalent de un million de litres d'eau, soit l'équivalent de 13 heures de consommation municipale, ou d'une trentaine de camions citernes. <https://www.rqes.ca/post/capter-la-neige-pour-mieux-r%C3%A9sister-aux-s%C3%A9cheresses>



#### **Example 9 – Installation of water meters and consumption-based pricing (Saint-Colomban, Laurentides)**

The city imposes a base rate for annual drinking-water consumption of up to two hundred and fifty (250) cubic metres, with an additional progressive rate applied per block of cubic metres consumed beyond this threshold (By-law No. 1001-2025, sections 13 and 14). <https://st-colomban.qc.ca/storage/app/media/ville/administration/avis-publics/2025/1001-2025%20-%20Taxation%202025.pdf>



#### **Example 10 – Good Practices Guide: examples from regional stakeholders (Re-Source project, Montérégie)**

The selected best practices are grouped under six thematic areas: 1) water conservation, 2) contamination prevention, 3) municipal land-use planning, 4) promotion of water infiltration and aquifer recharge, 5) monitoring and surveillance, and 6) knowledge transfer and capacity-building (support). <https://coba-ver-vs.org/re-source-bonne-pratique/>

# Collaborative activity : tools and actions to address our issues



1. Identify the tools and actions currently in place to address your issue.
2. For these tools and actions, identify the gaps and limitations related to their use.
3. Identify a spokesperson for each sub-group to share the results of the reflection exercise with all participants.

OUR ISSUE

	THE TOOLS WE ARE CURRENTLY USING			OTHER ACTIONS
	WHO ?	WHAT ?		
REGULATION 				
PLANNING/ COLLABORATION 				
VOLUNTARY EDUCATION 				
INCENTIVE 				
KNOWLEDGE ACQUISITION 				
TECHNOLOGY/ ENGINEERING 				
NATURE BASED SOLUTIONS 				
				LIMITATIONS / GAPS IN OUR ACTIONS

Réseau québécois sur les eaux souterraines, 2026.



# Discussion : the limitations of tools and actions for our issues







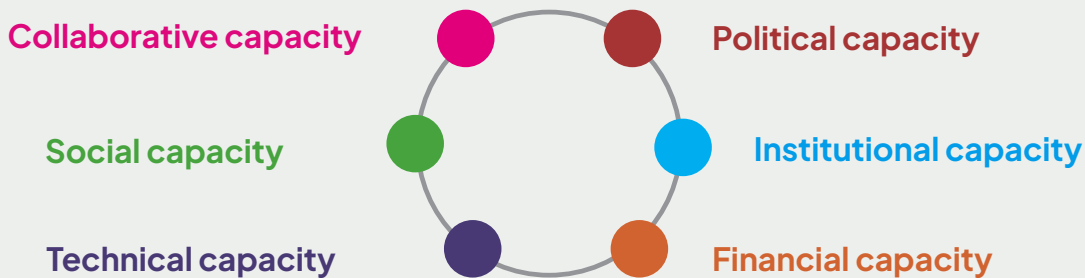
# Activity 3

Stakeholders' capacities for groundwater protection and management

---

# Capacities for Groundwater Protection and Management

An actor's capacity to take action for groundwater protection and management (GPM) does not depend solely on the regulatory or non-regulatory tools available. It relies on six interdependent capacities which, taken together, influence stakeholder mobilization, the implementation of tools, and monitoring mechanisms, as well as the alignment of each actor's actions with those of others.



## Political capacity

Political capacity refers to an organization's ability to make decisions related to GPM. It is linked to the leadership of decision-makers within the organization and their awareness and sensitivity to GPM issues. Strong political capacity enables the organization to more readily implement regulatory or non-regulatory measures, unlock funding, and allocate human resources to support groundwater protection and management.

*High capacity: Decision-makers within my organization (e.g., elected officials, board of directors) would not hesitate to take measures to protect groundwater and to allocate a larger share of the budget to groundwater management. They understand the importance of groundwater within their area of responsibility.*

## Institutional capacity

Institutional capacity refers to the capacity granted to an organization by the institutional framework (laws, policies) that defines its roles, responsibilities, and the types of measures—regulatory or non-regulatory—it can adopt in relation to GPM. It depends both on the clarity of the institutional framework and on the organization's knowledge of, and familiarity with, the use of the regulatory and non-regulatory measures available to it.

*High capacity: The institutional framework grants my organization regulatory authority in the area of GPM. It allows the development of GPM policies, awareness-raising campaigns, as well as the implementation of economic measures (e.g., property tax reductions in support of GPM). In addition, all of these GPM tools are well understood within my organization. In other words, my organization knows how to mobilize them if it were required to do so. Finally, the use of these tools would be facilitated, as all individuals involved in their development and monitoring are accustomed to working together.*

---

## Financial capacity

Financial capacity refers to the budgets allocated to GPM activities within an organization. It encompasses both the availability of funding and its predictability or recurrence over time. Financial capacity enables the hiring of qualified staff to understand GPM issues, as well as to implement measures and ensure ongoing monitoring and follow-up related to groundwater protection and management.

*High capacity: My organization has a budget dedicated to GPM, or it would be easy for it to establish one. This budget is sufficiently robust to enable the organization to fulfill its role, including knowledge development, implementation of regulations, awareness-raising campaigns, and the application and monitoring of GPM measures.*

## Technical capacity

Technical capacity refers to an organization's ability to understand GPM issues. It is linked to the human resources available, their level of expertise, and their interest in GPM issues within the organization's area of action. It also depends on the data and information the organization has access to for groundwater protection and management.

*High capacity: There are individuals within my organization who are familiar with GPM issues, who can work with groundwater data and generate useful knowledge to inform decision-making. The organization also has sufficient resources to monitor and follow up on the GPM measures that have been implemented.*

## Social capacity

Social capacity refers to the level of awareness and concern among citizens regarding GPM issues within the organization's area of action. It can be measured, for example, by the degree of public involvement in discussions, activities, and initiatives related to GPM, or by the existence of citizen committees or protection groups, among other indicators.

*High capacity: Within my organization's area of action, citizen groups are already actively mobilized around water protection issues. This civic engagement is considered credible by decision-makers.*

## Collaborative capacity

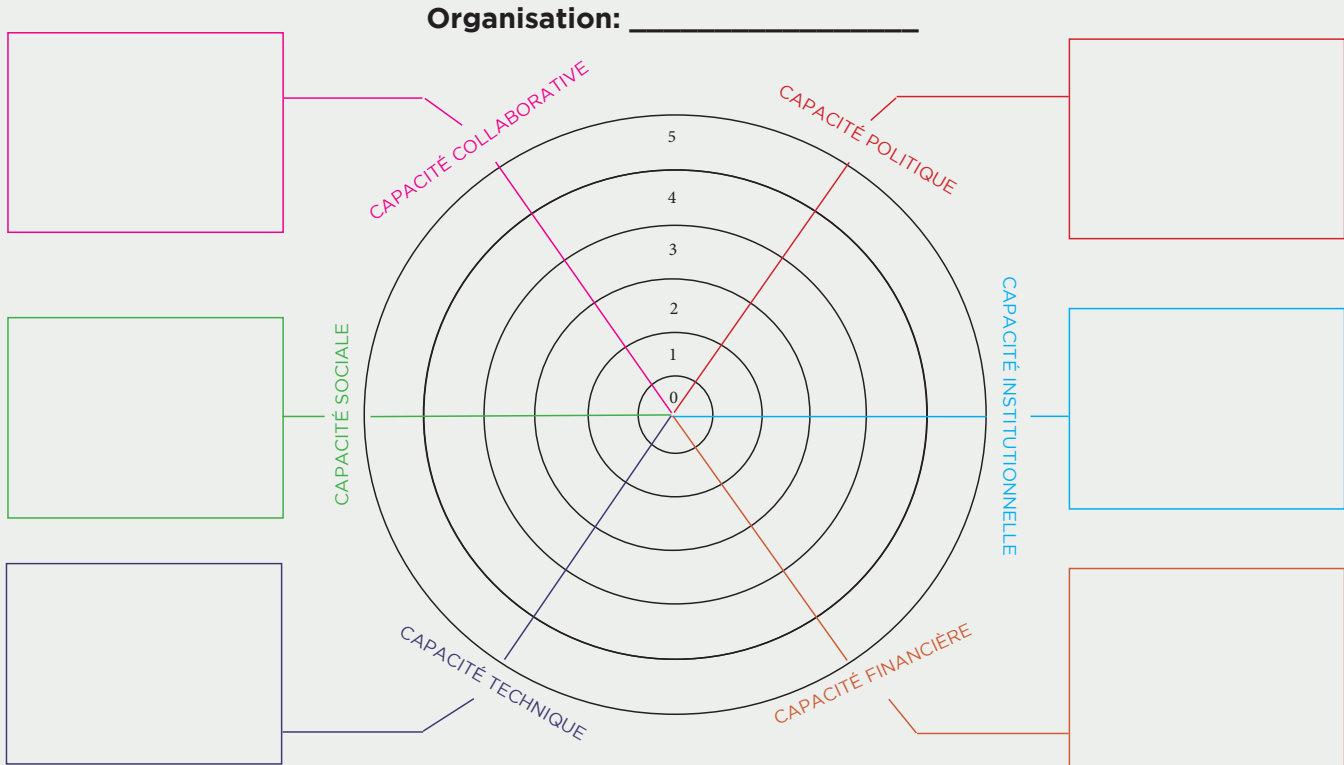
Collaborative capacity refers to an organization's ability to work effectively with other stakeholders in the community. It is linked to the organization's credibility within its environment and to its past collaborative experiences. Collaborative capacity enables the organization to combine its expertise with that of others, seek support, and develop more integrated GPM measures, including initiatives that extend beyond administrative boundaries.

*High capacity: My organization is credible within the community. Its action plan is consistent with those of other organizations operating in the area. The partnerships it has developed contribute to greater coherence in water management actions across all organizations involved. These partnerships do not benefit the organization alone.*

# Individual activity: assessing your capacities



1. Individually assess your organization's capacity to protect and manage groundwater on a scale from 0 to 5 (0 = low capacity and 5 = high capacity).
2. For each capacity, explain your rating in the designated boxes.





# Discussion: assessment of regional capacity for GPM

Political capacity

Institutional capacity

Financial capacity

Technical capacity

Social capacity

Collaborative capacity





# Activity 4

Strategies for groundwater protection  
and management

---

# Defining objectives for our issues

## Issues, objectives, and actions: clearly distinguishing them

- An issue refers to a problem that needs to be addressed to ensure sustainable groundwater management.
- An objective describes what we aim to improve in order to respond to that issue.
- An action is what is implemented in practice to achieve the objective.

## Examples of GPM issues

*(to help you choose your starting point)*

- Increased risk of water shortages during low-flow periods or seasonal peak demand.
- Vulnerability of private wells to supply interruptions.
- Development not aligned with the actual availability of groundwater.
- Increased vulnerability of aquifers to anthropogenic contamination.
- Presence of natural or anthropogenic contaminants exceeding acceptable thresholds.
- Cumulative pressures from human activities on aquifers.
- Risk of contamination or disturbance linked to poorly regulated uses.
- Incompatibility between certain activities and aquifer vulnerability.
- Degradation of ecological functions that depend on groundwater.
- Loss of connectivity between aquifers, wetlands, and watercourses.
- Insufficient organizational capacity to act effectively.

## Examples of objectives

- Reduce peak summer water demand.
- Protect and restore recharge areas.
- Reduce pressure from major consumers (industrial, commercial, and institutional sectors – ICI).
- Develop an inter-organizational drought management plan.
- Align residential development with water availability.
- Increase water testing and reduce non-compliance with bacteriological standards.
- Reduce the risk of accidental or chronic contamination linked to land-use activities.
- Regulate new wells and improve well registries.
- Improve groundwater knowledge among elected officials, municipal staff, and partners.
- Adapt agricultural and forestry practices in vulnerable areas.
- Reduce the impacts of land-use planning on groundwater-ecosystem interactions.

---

# How can capacities for GPM be strengthened?



## Political capacity

*(Leadership, willingness to act, prioritization of GPM)*

- Raise decision-makers' awareness of real risks (water shortages, contamination, future costs).
- Highlight the costs of inaction versus the benefits of prevention.
- Create forums for dialogue between elected officials, experts, and citizens.
- Support decision-making with credible assessments (watershed organizations, studies).

## Institutional capacity

*(Powers, rules, and mastery of available tools)*

- Clarify what the organization can legally do (and what it cannot do).
- Train teams in the use of regulatory and non-regulatory tools.
- Develop organizational reflexes (zoning, SPAIP/PIIA, permits, policies).
- Harmonize practices across departments (planning, environment, finance).

## Financial capacity

*(Budgets, stability, and long-term investment capacity)*

- Identify existing funding sources (provincial and federal).
- Pool resources among organizations to increase efficiency and impact.
- Integrate GPM into recurring budgets, rather than relying solely on one-off projects.
- Demonstrate long-term cost savings, by comparing prevention approaches with corrective or remediation measures.

## Technical capacity

*(Knowledge, data, and internal expertise)*

- Train staff in the basic concepts of GPM.
- Access and make use of existing data (e.g., from OBV and the MELCCFP).
- Build links between internal and external experts to strengthen analysis and decision-making.
- Develop simple decision-support tools to facilitate the integration of groundwater considerations into daily practices.

## Social capacity

*(Social acceptability and citizen engagement)*

- Communicate clearly, without jargon.
- Give citizens an active role, not merely a consultative one.
- Highlight and build on existing local initiatives.
- Establish feedback mechanisms to ensure on-going dialogue and continuous improvement.

## Collaborative capacity

*(Inter-organizational collaboration and consistency of actions)*

- Identify interdependencies (shared aquifers, common watersheds).
- Establish permanent coordination or consultation tables among organizations.
- Harmonize plans and action timelines to ensure coherent and complementary interventions.
- Share successes and lessons learned to foster continuous improvement and collective learning.

# Collaborative activity : developing an action strategy



1. Choose an issue that reflects your territorial reality. You may draw inspiration from the proposed examples, but reformulate it in your own words. Identify the nature of the issue and its likely causes.
2. Determine the objectives you consider a priority to address this issue. Specify a time horizon (short- or medium-term, or ongoing).
3. Identify who will take part in the action strategy (lead organization, partners/ collaborators, target audience).
4. Assess your strengths and weaknesses for action (capacities) with respect to this issue.
5. Select the tools to be mobilized (minimum of three). For each selected tool, describe a concrete action (what will be done) and identify who could be responsible for carrying it out.

OUR ACTION STRATEGY FOR THE ISSUE:

**1 TARGETED PROBABLE CAUSES**

What is the nature of the problem?

What are the likely causes?

**2 OBJECTIVES AND TARGETED TIME HORIZON**

**3 WHO IS INVOLVED IN THE STRATEGY?**

Lead organization, partners, target audience ?

**4 OUR CAPACITIES**

**5 OUR PROPOSED ACTIONS**

TOOLS TO BE MOBILIZED (MINIMUM OF 3)	OUR ACTIONS	BY WHOM



# Discussion : different action strategies for GPM

---

# My personal notes



## Workshop partners



---

This initiative is funded by the Blue Fund as part of the National Water Plan under the Québec Water Strategy, which implements concrete measures to protect, use, and manage water and aquatic environments in a responsible, integrated, and sustainable manner.

Québec 