Climate Influences on Source Water Supply and Community Resiliency in the Athabasca Watershed

This document provides communities in the Athabasca watershed with general information about climate change, in particular, how it might affect the Water for Life goal of "safe, secure drinking water supplies." Looking through a local climate lens, it is intended to help communities think about how they might build capacity for climate change resiliency.

Mcleod River, Yellowhead County
- Photo R. G. Holmberg/Athabasca River Basin Image Bank

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for the Athabasca Watershed Council

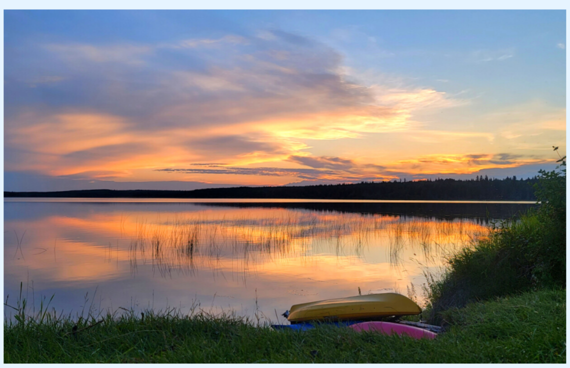
In partnership with University of Alberta's Adaptation Resiliency Training Program. Funded by Natural Resource Canada Building Regional Adaptation Capacity and Expertise (BRACE) Program and Alberta Environment and Parks.

THE PEOPLE & COMMUNITIES

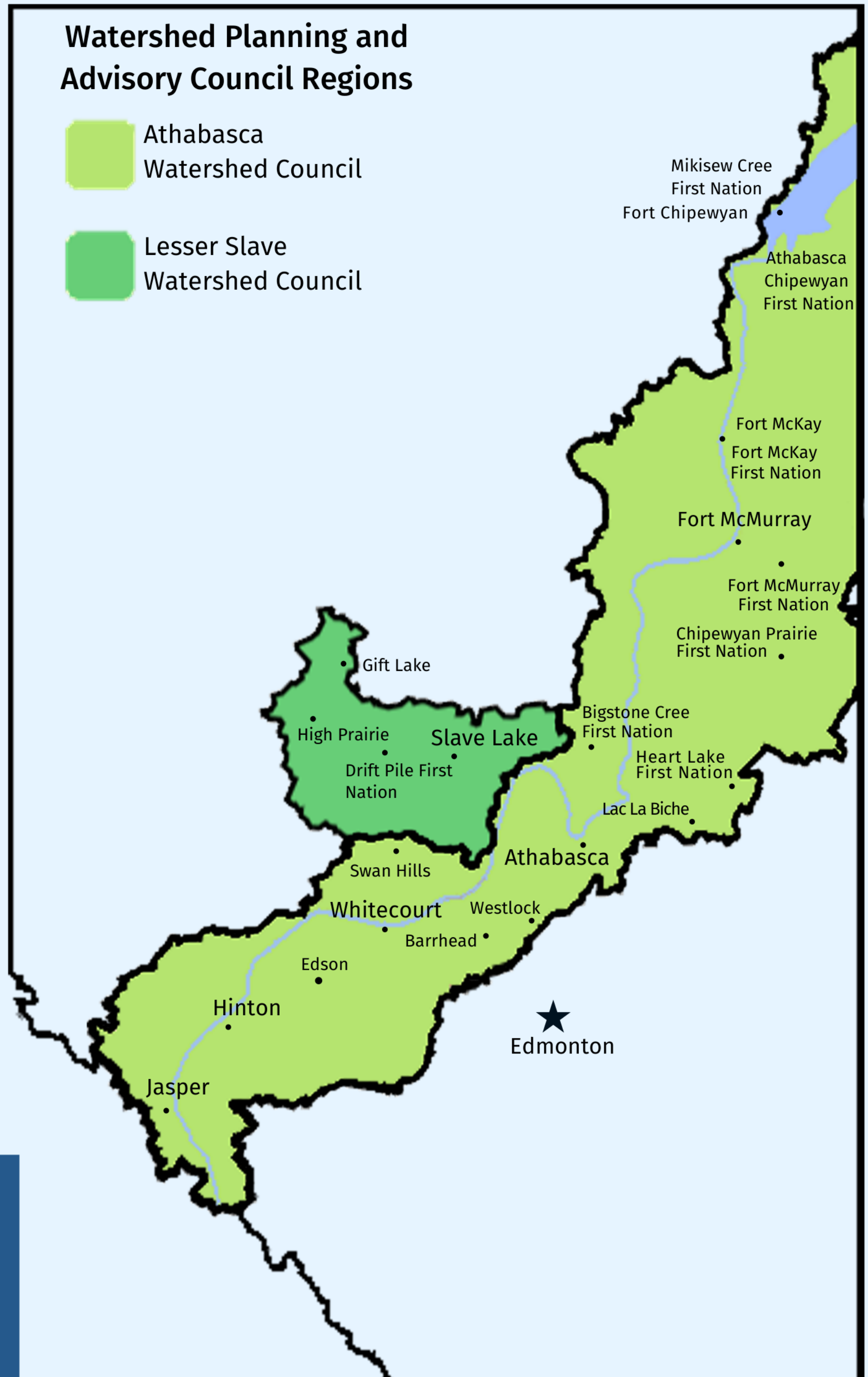
The Athabasca Watershed is home to more than 150,000 residents. It is an attractive region for its job opportunities and natural beauty, making it popular for tourism and recreation with visitors from across the country and internationally.

About 112 communities depend on water resources found within the Athabasca watershed.

- Towns (9)
- First Nation Settlements (15)
- Hamlets (71)
- Villages (2)
- Summer Villages (11)
- Métis Settlements (3)
- Specialized Municipality (1)



Lakeland Provincial Park, Lac La Biche County



The Athabasca and Lesser Slave watershed councils together make up the Athabasca Watershed. The map shows some of the communities located within the watershed.

We acknowledge Treaty 6, 8, and 10 territories—the traditional and ancestral territory of the Cree, Dene, Blackfoot, Saulteaux, and Nakota Sioux. We acknowledge the many First Nations, Métis, and Inuit who have, and continue to live in and care for these lands. We are grateful for the traditional Knowledge Keepers and Elders who are still with us today and those who have gone before us. We make this acknowledgment as an act of gratitude to those whose territory we reside on or are visiting.

From The Mountain Headwaters To The Delta Lowlands

The Athabasca Watershed

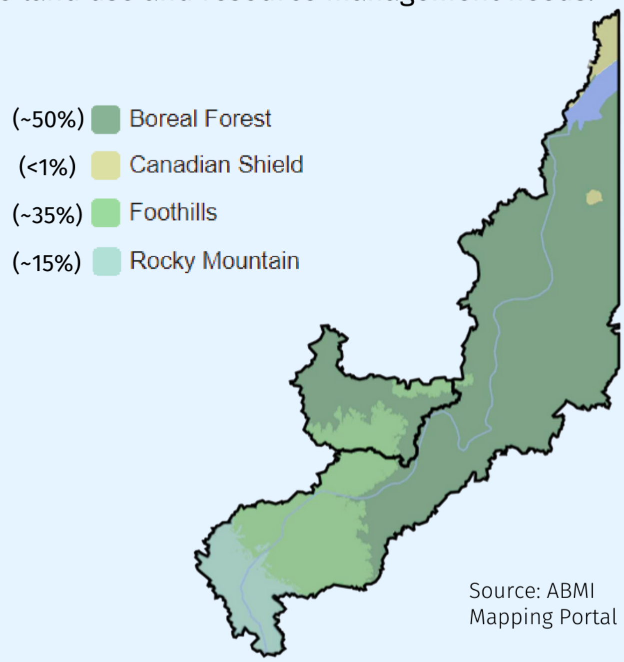
Watershed boundaries are determined by the topography of the landscape. The Athabasca watershed carries and stores water in its many rivers, creeks, lakes, wetlands, and groundwater aquifers.

The Athabasca River mainstem begins at the Columbia Icefield in Jasper National Park. It stretches northeast, collecting water from hundreds of sources before it empties into Lake Athabasca. The entire watershed represents 24% of Alberta's land base, spanning approximately 160,000 square km. In total, the watershed is composed of 94 rivers, 153 lakes, 150 titled creeks, and many untitled creeks and wetlands.

All water originates from rain, snow, hail, groundwater upwelling, and glacier melt. The Columbia Glacier can account for up to 30% of streamflow for the Athabasca River mainstem during its summer melting. The remainder of its annual flow is from snow and rain runoff from the smaller sub-basins that feed into the Athabasca River. The major tributaries are the McLeod, Berland, Pembina, Lesser Slave, La Biche, Clearwater, and Muskeg rivers.

Natural Regions

The watershed has four distinct natural regions distinguished by their climate (precipitation and temperature), physiography, vegetation, soil, and wildlife patterns. These categories can provide insight into land use and resource management needs.



Source: ABMI Mapping Portal

Economy and Land Use

Water is essential for more than the people and other living things located in the watershed. All industries rely on water for its continued functioning. The oil and gas industry in the lower Athabasca region took off in 1967, making the region a major contributor to Alberta's economy. Other major activities in the watershed are forestry, agriculture, tourism, recreation, and mining.

The Upper Athabasca Region

Agriculture and forestry are important economic drivers with a significant area dedicated as farming land and several Forest Management Agreements. Recreation and tourism are key industries; Jasper National Park—a world-renowned tourist destination—coincides with this region.

According to the Alberta Biodiversity Monitoring Institute (ABMI), the human footprint occupies 30.6% of the region.

- Agriculture 13.6%
- Forestry 12.2%
- Energy 2.1%
- Transportation 1.7%

Wildlife in Jasper National Park

The Lower Athabasca Region

Energy development in the oil sands areas and forestry are the dominant land use activities. Increasing mineral extraction, agriculture, and tourism have led to more human activity.

According to the ABMI, the human footprint occupies 8.9% of the region.

- Agriculture (2.8%)
- Forestry (2.6%)
- Energy (1.9%)

Agricultural land near Calling Lake

"If you do not like the weather, wait an hour."

There are likely many residents living within the watershed who are familiar with this phrase. In fact, northern Alberta has one of the most variable climates in the world, both in terms of weather and climate.

Weather, natural variability and climate change

Weather can indeed change rapidly from hour to hour, but historically, Alberta's overall climate (the long-term patterns and averages) has seen about decade-long swings from extended drought conditions to heavier rain and snow amounts.

While some years may be more 'wet' or 'dry' than the few years prior, when viewed from one decade to the next there is a distinct trend of wet or dry conditions. This represents the natural variability that affects local and regional climates.

Natural disasters such as droughts, fires, and floods also have a long history in the watershed. The frequency and intensity of extreme events are heavily incorporated into our land use planning and infrastructure.

Climate change is expected to alter weather patterns and the natural climate variability that a region experiences. Precipitation, temperatures, and drought frequency are expected to increase in future climate models. Due to the largely forested regions of the watershed, this combination could make forest fires more common and severe. As a result of the decrease in vegetation cover in burned areas, the landscape is less able to absorb runoff, increasing the risk of flash flooding during heavy precipitation events or wet years.

Decision making often needs to consider many different time scales.

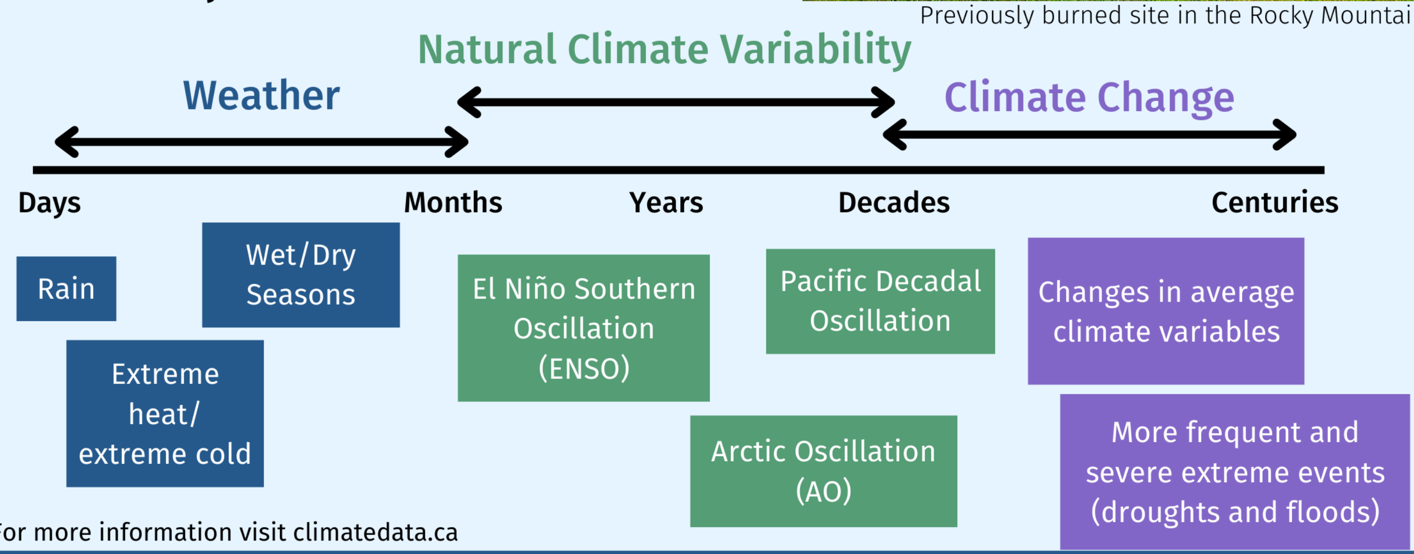
Risks associated with climate change are expected to vary widely across the watershed due to its size and diversity.

Some of the most significant risks include:

- Conditions are less favourable to locally adapted species
- Lower quality and quantity of freshwater
- More extreme weather events (ex. hail and floods)
- Increase in droughts and wildfires
- Decreased air quality
- Invasive and disease-carrying species can expand their range, impacting agriculture, people, water and ecosystems
- Exceeding infrastructure thresholds

Many areas of the world and North America are currently experiencing and adapting to these new challenges. We can adapt and mitigate these risks by taking proactive and restorative measures, learn from and collaborate with other jurisdictions, and consider the prior and emerging research from experts.

Previously burned site in the Rocky Mountains



For more information visit climatedata.ca

Climate Change Influences on Source Water

There are a number of factors that affect water quality and quantity, including the landscape, the natural climate, seasonal weather patterns, other water users, and the basin in which the water originates. Water providers across the region have different priorities and finite resources, including those that are available to build resiliency to climate change impacts. In order to determine if climate change will adversely affect a community's water supply and infrastructure, specific details about local conditions are needed. In particular, climate change could cause water availability and quality to fluctuate or change beyond what a specific system and water management were designed for.

Recent trends and future projections for water availability include:

- Loss of water stored as ice and snow is expected to affect the timing and level of water flow in major river basins
- Lower summer stream flows, falling lake levels, and retreating glaciers
- Net result of less surface water and soil moisture, as well as greater variations in soil moisture from season to season and year to year - impacting groundwater recharge

> **Climate is the master control variable on hydrology.**
> -AWC (2018)

Some ways to help mitigate these impacts are to promote water conservation practices such as reducing water waste, wastewater reuse partnerships with industry, and improving water management and protection. Researchers are working on new technologies that could help improve treatment efficiencies, increase water storage, and reuse capabilities of community and industrial wastewater in the basin.

Examples of potential climate interactions with water quality and quantity

	Increased temperatures (air and water)	**Increased Precipitation (rain and snow)**
Quantity	• Increased frequency (less predictable) and severity of droughts • Increased evaporation rates • Less runoff reaching low lying waterbodies • Lower groundwater recharge	• Widely variable and dependent on location, topography, and geology • Flooding risk: damage, loss or failure of water infrastructure (e.g. stormwater ponds), access roads, or control systems
Quality/ Treatability	• Warm water holds less dissolved oxygen (DO) making hypoxic conditions more likely - might require altered treatment • Fosters Harmful Algal Blooms • Alters toxicity of some pollutants • Increases stratification (stagnant layers) and lowers turnover events (mixing) • Dilution capacity would likely decline	• Increased runoff • Higher flood risk • Increases in suspended sediment, nutrients, and contaminant loading to a water supply • Fertilizer runoff promotes rapid growth of algae

Watershed Health: Flood, Drought and Source Water Resiliency

Floods, droughts and watershed health are extremely important influences on the quality and quantity of the source water used for drinking. Due to the anticipated and increasingly observed risks to source water quality and quantity, adaptation and resiliency planning that target these three influences are likely to generate the best results.

Structural solutions are sometimes necessary to provide resilient systems, but these are often costly. Non-structural solutions such as policy and Soft Engineering Solutions/green infrastructure (e.g. wetland and shoreline restoration) typically provide superior value. Protection and restoration of natural assets such as forests and forested shores contribute to reduced flood risks with co-benefits for watershed integrity, human health, and the survival of biodiversity in a changing climate.

As a general rule, in order of preference, the most cost-effective means to mitigate flood and drought hazard is as follows:

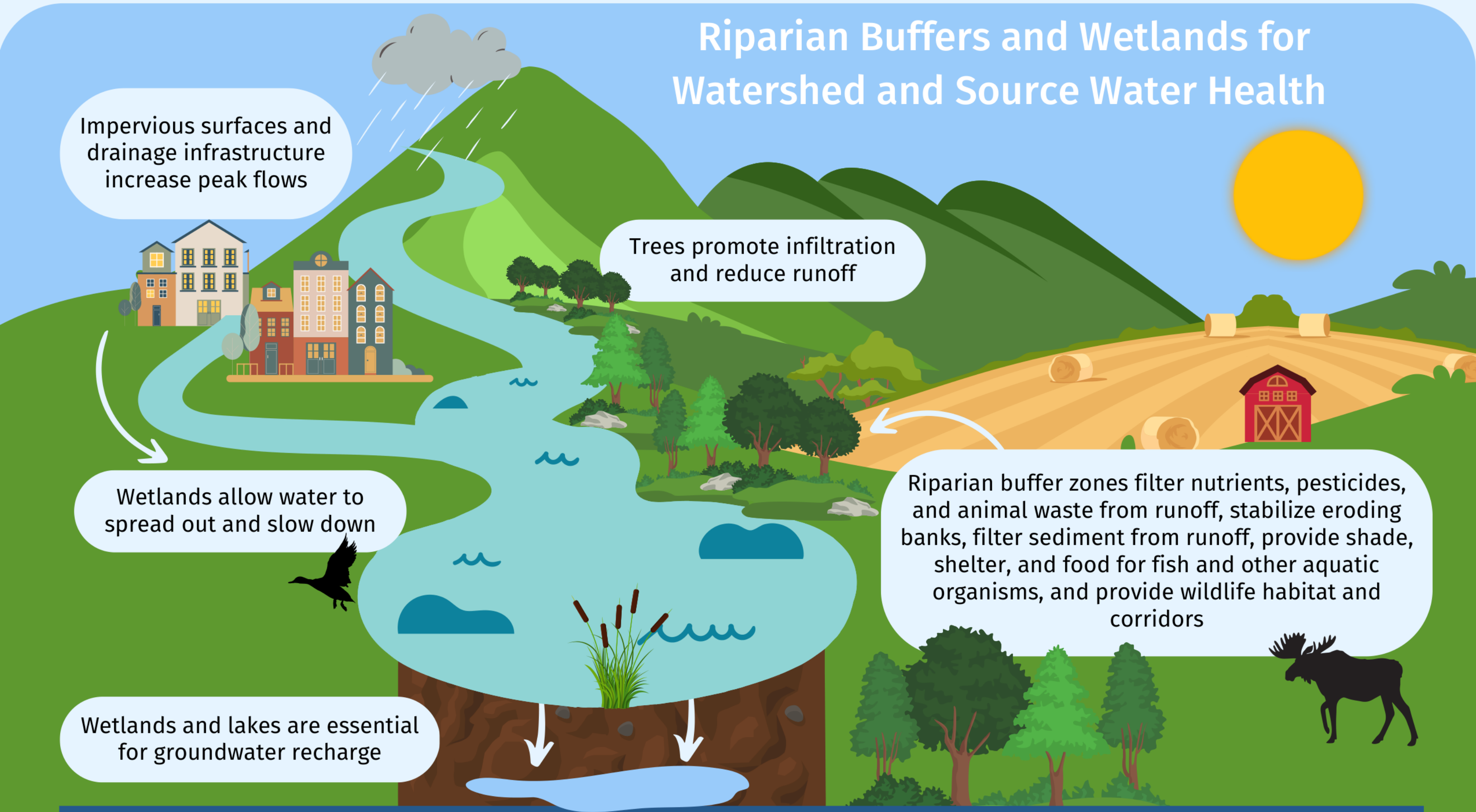
1. Retain what you have
2. Restore what you've lost
3. Build what you must

ADAPTED FROM CLIMATE WEST & ASSOCIATED ENGINEERING

Adaptation Examples

	Flood	Drought
Structural	• Dyking (flood boxes and pump stations) • Diversion • Storage	Supply Management • Storage • Diversion • Irrigation network • Wastewater reuse
Non-Structural	• Floodplain mapping/bylaws • Managed retreat/floodplain retreat • **Wetland and riparian protection/restoration*** ***More details below**	Demand Management • Agricultural practices • Low volume fixtures • Water use restrictions • Wetland and riparian protection/restoration

Riparian Buffers and Wetlands for Watershed and Source Water Health



Climate Projections and Scenarios

Climate modelling has become a valuable tool to develop adaptation and resiliency plans and strategies. Progress in the development of climate projections at the local scale has made them even more relevant for communities.

Climate models are used together with emission scenarios to calculate the probable future climate, so-called climate projections. The climate models describe how the earth's climate functions, while the emission scenarios describe the impact of humans on the environment.

Need to know:
The projected climate conditions up until the 2050s will be very similar regardless of a high-emission or a low-emission scenario. This is because the next 20-30 years climate will be influenced by the carbon that is currently in the atmosphere today.

Climate projections in the short-term (2050) have a relatively high likelihood of occurring as projected. However, they are subject to slight variability due to the complex systems that drive our climate.

Long-term planning (>30 years) such as between 2050-2100 is where the different emissions scenarios are important to consider but also subject to a range of possibilities based on human activities and the complexity of a changing climate.

The rate and magnitude of climate change under high versus low emission scenarios project two very different futures for Canada. Scenarios with large and rapid warming illustrate the profound effects on Canadian climate of continued growth of global greenhouse gas emissions. Scenarios with limited warming will only occur if Canada and the rest of the world reduce carbon emissions to near zero early in the second half of the century and reduce emissions of other greenhouse gases substantially. Thus projections based on a range of emission scenarios are needed to inform impact assessment, climate risk management, and policy.

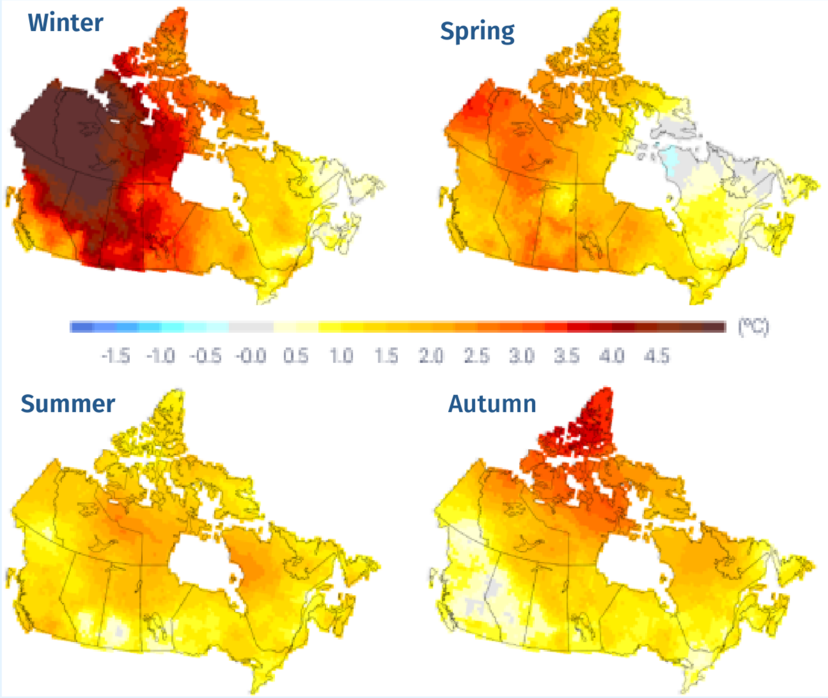


Figure from Canada's Changing Climate Report 2019 which reports observed changes (ºC) in seasonal mean temperatures between 1948 and 2016 for the four seasons. Canada's mean temperatures are increasing at a rate of 2x the global average. In winter, temperatures in Northern Alberta have increased 4x the global average.

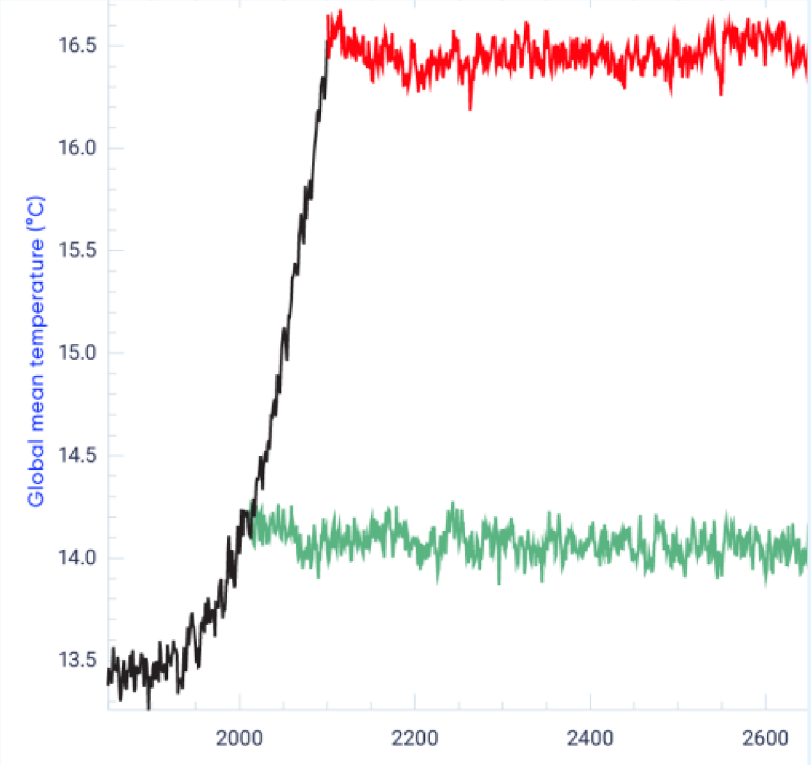


Figure from Canada's Changing Climate Report 2019 shows global temperature scenario of increasing CO_2 emissions (black), followed by a cessation of emissions in 2010 (green) or in 2100 (red). Canada is already seeing an average annual increase of 2 degrees.

Community Level Climate Data Examples

Regionally specific climate projections are available for communities in Canada.
To find the projected climate for your community visit:
https://climateatlas.ca/find-local-data
Enter community name and click download full climate report.

HINTON ALBERTA CLIMATE REPORT

Climate Variable	Past **1976-2005**	Projected **2050**	Low Carbon Future **2051-2080**	High Carbon Future **2051-2080**
Average Temperature Spring Summer Fall Winter	2.2 (°C) 2.1 (°C) 13 (°C) 2.7 (°C) -9.2 (°C)	3.9 (°C) 3.9 (°C) 14.8 (°C) 4.2 (°C) -7.5 (°C)	4.9 (°C) 4.9 (°C) 15.8 (°C) 5.1 (°C) -6.2(°C)	6.1 (°C) 5.9 (°C) 17.3 (°C) 6.4 (°C) -5.2 (°C)
Average snow/rainfall Spring Summer Fall Winter	561 (mm) 118 (mm) 255 (mm) 107 (mm) 81 (mm)	596 (mm) 133 (mm) 261 (mm) 116 (mm) 86 (mm)	602 (mm) 137 (mm) 259 (mm) 118 (mm) 89 (mm)	625 (mm) 145 (mm) 264 (mm) 124 (mm) 93 (mm)
Very hot days (+30°C)	1	4	8	15
Very cold days (-30°C)	9	6	4	3
Date of last spring frost	May 27	May 14	May 8	May 1
Date of first fall frost	Sep. 9	Sep. 18	Sep. 22	Sep. 29
Frost free season (days)	102	124	134	147

FORT MCMURRAY ALBERTA CLIMATE REPORT

Climate Variable	Past **1976-2005**	Projected **2050**	Low Carbon Future **2051-2080**	High Carbon Future **2051-2080**
Average Temperature Spring Summer Fall Winter	0.4 (°C) 1.1 (°C) 15.2 (°C) 1.3 (°C) -16.6 (°C)	2.6 (°C) 3.2 (°C) 17.2 (°C) 3.4(°C) -13.9 (°C)	3.4 (°C) 3.9 (°C) 17.8 (°C) 4.1 (°C) -12.5 (°C)	4.9 (°C) 5.0 (°C) 19.3 (°C) 5.6 (°C) -10.6 (°C)
Average snow/rainfall Spring Summer Fall Winter	476 (mm) 82 (mm) 221 (mm) 105 (mm) 67 (mm)	507 (mm) 90 (mm) 231 (mm) 113 (mm) 73 (mm)	518 (mm) 97 (mm) 230 (mm) 116 (mm) 75 (mm)	528 (mm) 101 (mm) 230 (mm) 120 (mm) 77 (mm)
Very hot days (+30°C)	3	7	11	19
Very cold days (-30°C)	24	15	10	5
Date of last spring frost	May 20	May 12	May 9	May 5
Date of first fall frost	Sep. 16	Sep. 25	Sep. 28	Oct. 5
Frost free season (days)	115	131	138	150

Adapted from Climate Atlas Canada

Climate Trends Across The Region

RAINFALL

- Increasing overall
- Variable by location and season
- Winter and spring increased
- Summers and falls less change
- Extreme rainfall events will increase

STREAM FLOW

- Variable by size and water source
- Snowmelt dependent small rivers and streams will continue to see reduced streamflow overall
- Occasional high levels with heavy rainfall events.

EXTREME EVENTS

- Increasing
- Changing of temperature and rain extremes can be expected to lead to a change in the likelihood of events such as wildfires, droughts, and floods.

GLACIAL MELT

- Increasing
- Short term results in higher flow in spring and summer
- Long term reduced flow as the glaciar is diminished

SNOWFALL

- Decreasing overall
- Melting earlier
- Impacts to run off and the many snow melt dominant waterways

RUNOFF

- Variable by region, land use type and watershed connectivity.

AIR TEMPERATURE

- Increasing
- Largest increases are currently in winter where 4x the global increase in temperature is seen.

HEATWAVES

- (+30°C)
- Likely to be more frequent, longer lasting, and more severe
- Increased energy demands and health risks

GROWING SEASON

- Increasing by several weeks by end of century
- Earlier last frost and first frost dates.

LAKE TEMPERATURE

- Increasing in smaller lakes fastest
- Warmer water holds less oxygen for fish and other animals
- Lowers habitat quality and promotes algal blooms and invasive species

DROUGHT

- Increased temperatures are speeding up water lost to the air by land and surface water
- Less rainfall in late summer and fall increases drought impact
- Increasing fire risk and crop loss

EXTREME COLD

- Number of (-30°C) are likely to occur less frequently.
- Reduced winter kill potential for invasive pests

ICE COVER

- Decreasing overall
- Variable by lake/river and region

Community Level Water Management

Weighing the Effects of Changing Climate Averages

Now that community-specific climate projections are available, next comes the task of interpreting what these changes can influence at a community level. Climate change could alter the context we have built a society around. The three primary questions are:

1) how large an effect will this be 2) how fast will the effects occur and 3) what will water managers do about it?

The overarching challenge that we now face is the increasing variability and uncertainty in our freshwater resources. The likelihood of climate-driven events exceeding the design thresholds of our management systems and infrastructure is increasing, and our ability to predict this based on historical data is becoming limited. Existing methods may be less reliable for management and planning. This creates an imperative to assess current water management philosophies, strategies, and methods within the context of a changing climate and how it may require additional adaptation support.

This is most effectively achieved by tailoring management and strategies to the unique community needs, while also considering the interconnections of the watershed and the people and industries that rely on it.

Adaptive management is becoming a frequently quoted phrase.
The principles behind adaptive management;

- The future cannot be predicted perfectly
- Learn from experience
- Flexibility to cope with changing expectations and demands

Decision-making using various possible futures is done all the time, (i.e., economic fluctuations) a similar approach can be applied to using climate change information in the decision-making process.

Source Water Protection Plans

The development of a Source Water Protection Plan (SWP) is a risk management process designed to maintain or improve sources of drinking water. While it is useful to review drinking water resources and climate change influences at the community level, protecting sources of drinking water is challenging, particularly for smaller public, private, and individual drinking water providers that may not have the capacity or resources to spearhead an SWP initiative on their own.

Therefore, it is often necessary and beneficial to take a collaborative approach to protect a communities source of water. Drinking water providers and others can collaborate by pooling their resources together to address common risks in their source water areas.

Towns, municipalities, drinking water providers (utilities), Indigenous communities, Watershed Planning and Advisory Councils (WPACs), Watershed Stewardship Groups (WSGs), and other interested groups can all play a role in the implementation of SWP as a cost-effective way to ensure safe and secure water quality and quantity conditions.

Industry	Non-Government	Government	Other
– chemical and petrochemical – irrigation – cropping – mining – oil and gas – forestry – livestock – power generation	– WPACs – WSGs – environmental groups – recreation groups – land trusts – agricultural groups – water co-operatives	– municipalities (e.g., planning, parks, environment, water, and transportation departments) – Government of Alberta – provincial authorities (e.g., the Alberta Energy Regulator and Alberta Health Services) – Government of Canada – Indigenous communities	– water utilities – landowners – neighbourhood associations – individuals – universities and colleges – golf courses – research groups (e.g., Alberta Innovates) – schools – campgrounds

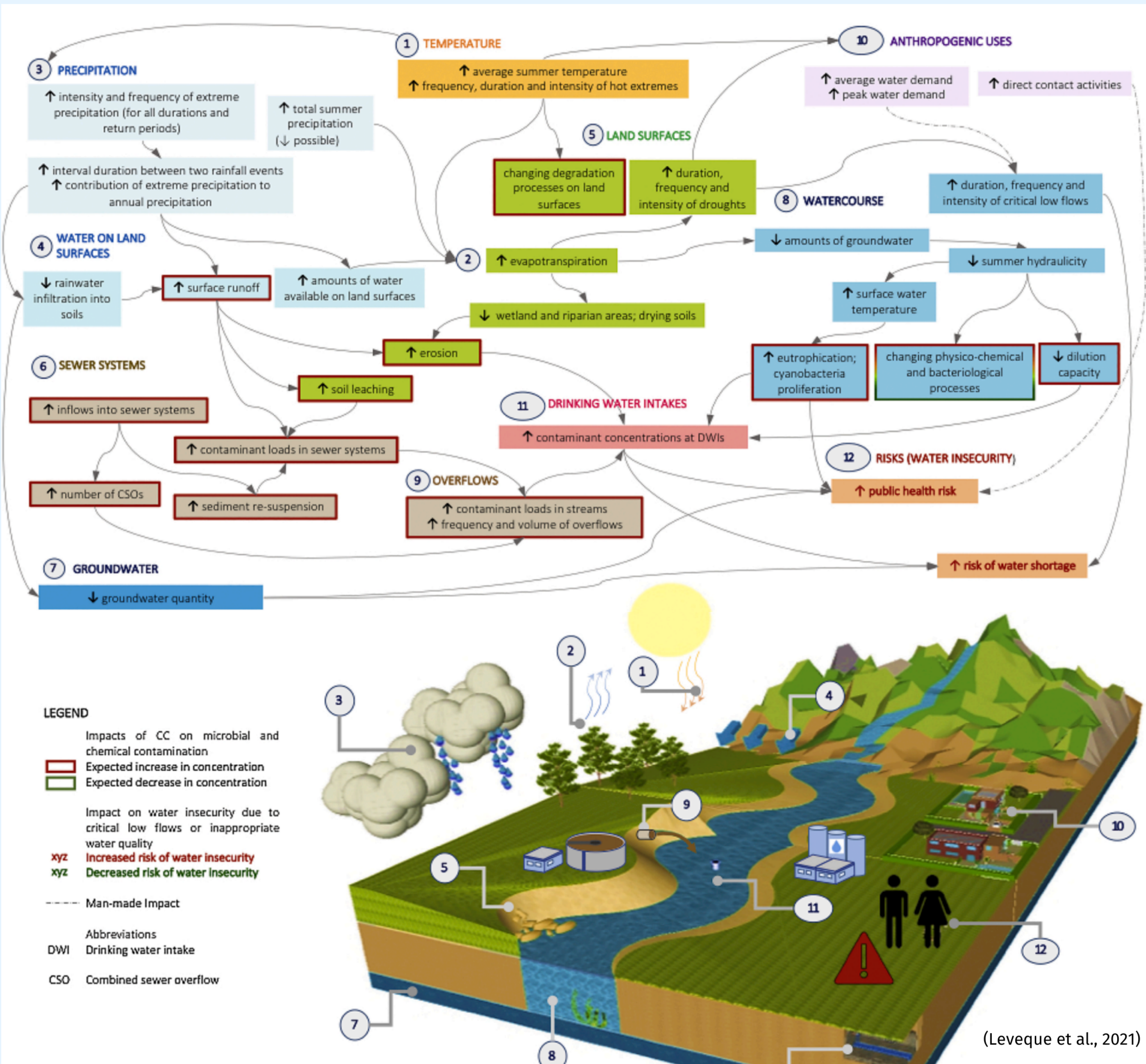
Source: AWC 2018 Guide to Source Water Protection Planning

For more information see Protecting Sources of Drinking Water in Alberta | Alberta Water Council (awchome.ca)
or contact the Athabasca Watershed Council (awc-wpac.ca)

Impacts of climate change on drinking water sources at intake

Climate change uncertainties arise mainly from future GHG emissions, natural climate variability and climate and hydrological models. Regardless of the uncertainties, change is occurring and the protection of drinking water supplies and infrastructures in the context of global changes requires scientific advances that cannot be achieved without the active and coordinated participation of a multitude of water resource stakeholders.

Global change will be one of the main challenges of the 21st century, impacting all spheres of human activities and health, and it must be addressed collectively among politicians, economists, scientists and citizens. Without a concrete and rapid change in management, the effects on human and environmental systems will accumulate, and some may be irreversible. The way the built environment, and especially engineered water systems are constructed as well as the underlying assumptions and priorities dictating their design and operations should be questioned with change and uncertainty in mind. As major investments in aging water infrastructure are required, there is a unique opportunity to prioritize the mitigation of climatic and anthropogenic hazards to our water resources by adopting water sensitive design approaches.



(Leveque et al., 2021)

DRINKING WATER MANAGEMENT FOR CLIMATE RESILIENCE

IDEAS FOR ACTION

Assets

- Aquifers
- Dams
- Pipes
- Pumping stations
- Reservoirs
- SCADA controls (supervisory control and data acquisition)
- Valves, valve chambers, hydrants
- Water bodies (rivers, lakes, etc.)
- Water meters
- Water service connections
- Water storage towers
- Water treatment plants
- Watermains
- Wells

Potential Hazards

- Changes to the timing of snow melt
- Extreme heat and rain
- Extreme storms
- Frost heaves
- Increased frequency and duration of drought
- Lower groundwater recharge
- Reduction in snowpack
- Flooding
- Wildfires in the watershed

Possible Impacts to Assets & Services

- Changes in surface source water quality
- Corrosion of equipment and materials
- Damage or loss of water infrastructure, access roads, or control systems
- Increased water demands combined with dry conditions causing stresses on source water quantity
- More energy intensive water treatment processes
- Reduction in water supply
- Water restrictions can lead to water staying in the distribution system longer
- Inability to reliably supply water may lead to restrictions on new development, population growth, and loss of industries
- Increased maintenance and repair costs of water treatment infrastructure leading to increasing water rates for customers
- Increased water use advisories due to water quality issues
- Increased water use restrictions or outages

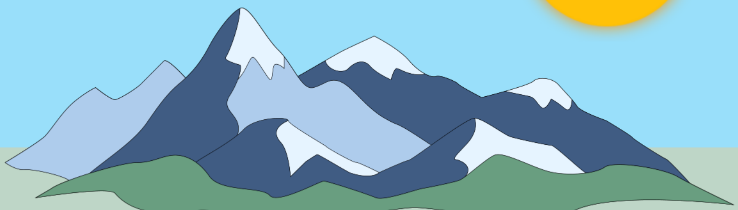
Adaptation & Resilience Actions

- Monitor source water quantity patterns (e.g., monitor aquifer levels, snowpack, and reservoir levels) and proactively adapt water restrictions
- Identify relationships between source water quality monitoring data and climate change and weather event data to improve response planning for water treatment
- Develop a Source Water Protection Plan
- Limit the extraction of water from shallow aquifers and work regionally to seek alternative sources
- Maintain emergency generators to ensure generators will operate in an emergency
- Identify backup communication systems and alternative access roads to operate remote water systems
- If increased residence time of water in the distribution system is an issue, increase water main flushing
- Relocate or raise pump stations and surface infrastructure out of flood plains

Adapted from Tools: Operations and maintenance for climate resilience | Federation of Canadian Municipalities (fcm.ca)

The impacts of climate on water security vary across time and space. They are experienced differently by users across the basin and are affected by the local hydro-climatic conditions of the area. Improving our understanding of how current and future climate affect water security is critical to building resilience.

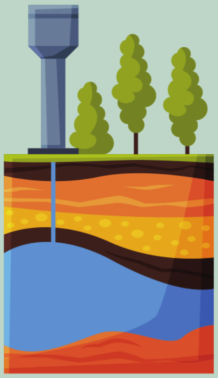
Climate Change is altering the water cycle. Decision makers need more relevant, local climate information to ensure water security.



Climate impacts on water resources are not equal but vary by user and location in the basin, requiring a break down by context to understand differentiated risks.

Heavy rainfall increases runoff that can carry sediment, fertilizers, herbicides, pesticides, and animal waste contamination.

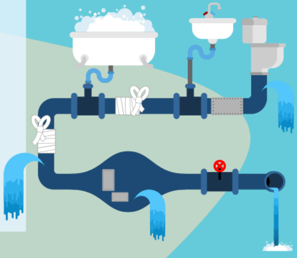
Rural communities often rely on multiple water sources, with associated risks for water safety, affordability and sustainability of systems.



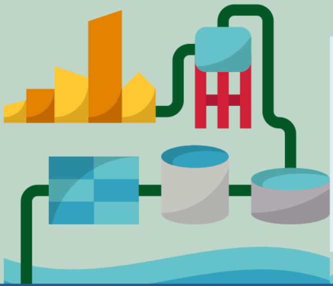
Seasonal groundwater recharge varies geographically. Sustainable groundwater use requires better data on recharge to safeguard water supplies and manage usage.

Pollution risks from industrial and municipal wastewater is a threat to ecosystems and health, particularly in dry periods.

Deteriorating water sources, and aging infrastructure can impact household and community welfare. Greater access to financial resources and better informed management of water supply source and infrastructure are necessary to mitigate climate risks.



People and communities affected by poverty and marginalization have unequal opportunities to cope with climate shocks and must be accompanied by strengthened governance or facilitation to support.



Smaller systems require investment in climate information at appropriate temporal and spatial scales to support climate resilience.

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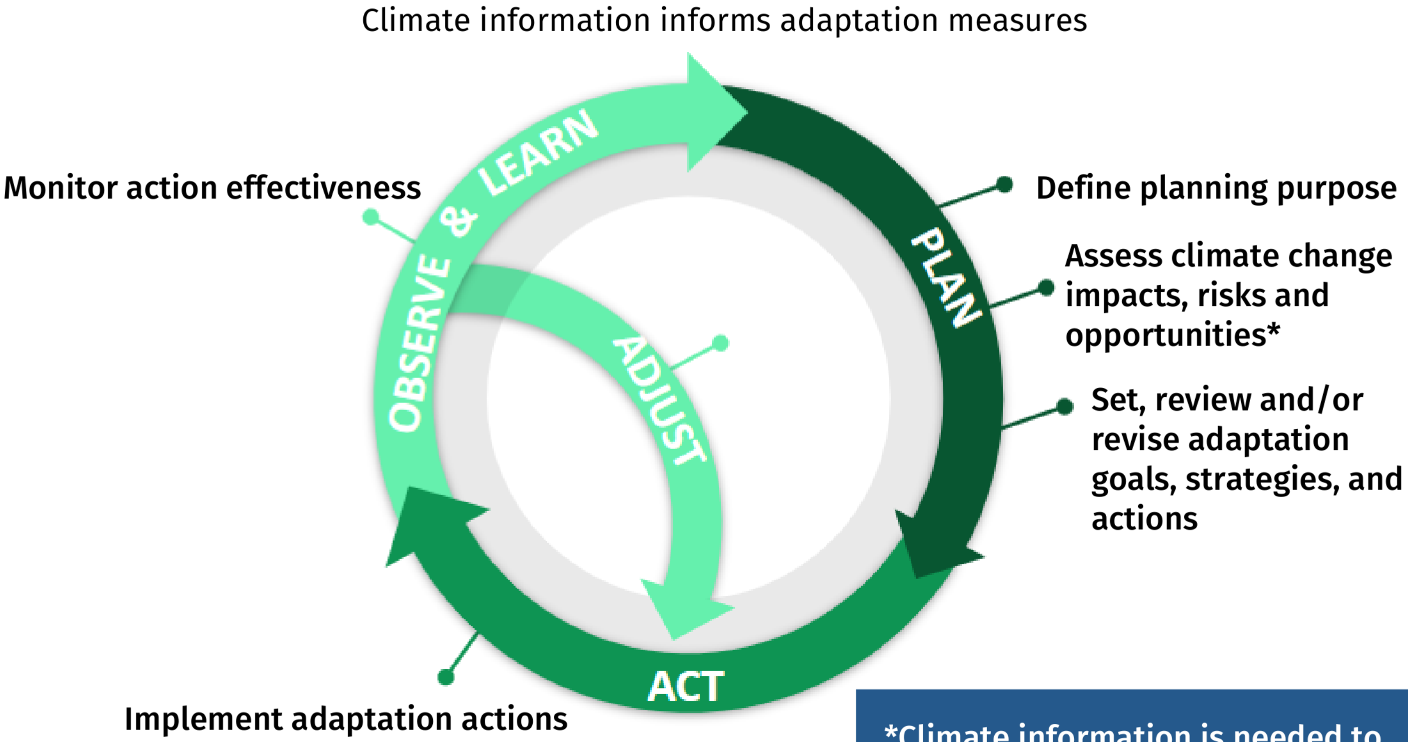
Climate Change Adaptation Process



Source: Modified from blackfeetclimatechange.com
For more information visit climatedata.ca

***Climate information is needed to assess impacts, risks and opportunities**

Above is an adaptation cycle that includes planning, acting, observing, learning, and then adjusting actions as needed before starting the cycle again. Resiliency is "the ability of people and systems to anticipate, adapt to and recover from the negative effects of shocks and stresses (including natural disasters and climate change) in a manner that reduces vulnerability, protects livelihoods, accelerates and sustains recovery, and supports economic and social development, while preserving cultural integrity." - Global Water Partnership and United Nations Children's Fund.

In order to plan, there first needs to be an understanding of the potential climate change impacts that are facing the region and municipality. In order to do this, climate information and data are needed to understand how the climate is expected to change.

A watershed represents a region where many water users are interconnected in complex ways. Not only do most people share and rely on the same water source within and between our communities, we also share the economic benefits derived from industries dependent on the water in our region. Effective adaptation requires thinking about our contexts in new ways and building the skills to tackle complex problems. Collaboration and partnership, often outside of our usual habits and networks, will strengthen this effort.

The Athabasca Watershed Council (AWC) is a registered charity and not-for-profit organization. We work with academia, industry, environmental and stewardship groups, various levels of government, communities, citizens, and Indigenous peoples together to promote, foster respect, and plan for an ecologically healthy watershed that supports resilient communities and a sustainable economy.

Reasons for Optimism

Adaptation and resiliency strategies are becoming increasingly common and new ones are being implemented all over the country. It is likely steps are being taken in communities across the region. If you are implementing adaptation and resiliency planning and strategies in your communities, we would love to hear more about it and share it with others in the watershed, reach out to us at Outreach@awc-wpac.ca.

Help is everywhere! Learn from other communities or spearhead your own resiliency-building adventure. There is a considerable push for, and increasing opportunities for funding to help communities ensure resiliency planning. The Athabasca Watershed Council may be able to provide support or connect with a partnership who can.

Check back on the AWC-WPAC website (2023) for a list of community resiliency and adaptation tools and resources. Several are included on the last page.

WWW.AWC-WPAC.CA

Visit our website for more information about the Athabasca Watershed

Water For Life

The AWC is one of eleven designated Watershed Planning and Advisory Councils (WPACs) working in partnership with the Government of Alberta towards achieving the goals of the **WATER FOR LIFE STRATEGY**:

- Safe, secure drinking water and supplies
- Healthy aquatic ecosystems
- Reliable, quality water supplies for a sustainable economy

Athabasca WATERSHED COUNCIL

Additional Resources

Alberta/Watershed Specific:

Protecting Sources of Drinking Water in Alberta | Alberta Water Council (awchome.ca)

Watershed Reporting, Streamflow Monitoring, Water Use Analytics | Alberta Water Tool (

Alberta Climate Information Service ACIS Data Products & Tools (gov.ab.ca)

local data search | Climate Atlas of Canada

Adapt-action | Alberta-specific drought and flood adapting strategies.

Flood mitigation | Alberta.ca

Climate Resources for Prairie Water Management | ClimateWest

The Athabasca River - Tracking Change (trackingchange.ca)

Water Reports | Athabasca Watershed Council (awc-wpac.ca)

Watershed management | Alberta Municipalities (abmunis.ca)

Climate Change Impacts (abmi.ca)

Alberta Tomorrow | (simulator.albertatomorrow.ca)

Datasets for Alberta land use planning - Land Use Planning Hub (landusehub.ca)

How future-ready are municipalities in Alberta? - Land Use Planning Hub (landusehub.ca)

Climate Risk Institute – Evidence serving climate change

Alberta Water Portal | Climate Change in the Athabasca River Basin

Mackenzie River Basin Board: State of the Aquatic Ecosystem Report | (soaer.ca/athabasca)

Water Management | Alberta Municipalities (abmunis.ca)

ABMI Mapping Portal | (maps.abmi.ca)

Alberta Environment and Parks - Alberta River Basins flood alerting, advisories, reporting and water management

WaterYieldMap.pdf (albertawater.com)

Hydrological Behaviour Under Environmental Change in Alberta (alberta.ca)

Hydrogeological Regions of Alberta (arcgis.com)

DRINKING WATER INFRASTRUCTURE RISK AND VULNERABILITY ASSESSMENT Provincial Overview Report (albertainnovates.ca)

Canada Wide:

Asset management resource library | Federation of Canadian Municipalities (fcm.ca)

Tools: Operations and maintenance for climate resilience | Federation of Canadian Municipalities (fcm.ca)

Council of Canadian Academies | CCA | Canada's Top Climate Change Risks (cca-reports.ca)

Welcome | Indigenous Guardians Toolkit

Climate_Gathering_Report_ENG.pdf (afn.ca)

Canadian Drought Monitor - agriculture.canada.ca

Canadian Drought Outlook - agriculture.canada.ca

Living Guide to the Principles of Climate Change Adaptation - Adaptation Professionals