Building Resiliency to Multi-Year Drought in Alberta

GUIDE
January 2021

Amended February 2024

About the Alberta Water Council

The Alberta Water Council (AWC) is a collaborative partnership that provides leadership, expertise, and sector knowledge and perspectives to help governments, Indigenous Peoples, industry, and non-governmental organizations to advance the outcomes of *Water for Life*. It advises the Government of Alberta (GoA) on matters pertaining to the successful achievement of the outcomes of the *Water for Life* strategy and on effective water resources management policies, practices, and tools.

The AWC regularly reviews the implementation progress of the *Water for Life* strategy and champions the achievement of the strategy's goals. The Alberta Water Council also advises the Government of Alberta, stakeholders, and the public on effective water-management practices, solutions to water issues, and priorities for water research. The AWC may advise on government policy and legislation in some instances. However, the Government of Alberta remains accountable for the implementation of the *Water for Life* Strategy and continues to administer water and watershed management activities throughout the province.

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Update to Guide Module 3: Government of Alberta Roles and Responsibilities

An update to Module 3: Roles and Responsibilities was provided by the Government of Alberta in February 2024, and the updated table is included here. This updated table reflects changes in the responsibilities of the Government of Alberta ministries since the report's original publication.

Actor	Role
Government of Alberta (GoA) — Environment and Protected Areas	■ Implement the *Water Act* legislation, which governs the allocation (quantity) of water from natural watercourses where the allocations are recorded in licences and registrations or are otherwise exempted from the prior allocation system. This includes management of water licence priorities, tracking water conservation objectives, suspension of temporary diversion licenses, or other actions regarding the *Water Act* provisions during water shortage.
	■ Implement the Alberta Wetland Policy, which provides a strategic framework for conserving, restoring and protecting wetlands. Wetlands are instrumental for storing water and can lessen the impacts of drought and water shortage.
	■ Oversee the *Environmental Protection and Enhancement Act*, the legislation that governs specific activities that impact water quality and monitors the state of the environment to ensure the maintenance of healthy, sustainable aquatic ecosystems.
	■ Monitor and forecast groundwater resources through the Groundwater Observation Well Network, which is a network of groundwater monitoring wells located in various aquifers throughout the province. Most wells are fitted with data loggers and sensors that continuously record groundwater levels.
	■ Monitor and forecast surface water resources. River Forecast Centre (RFC) generates a monthly Water Supply Outlook report. It contains an estimate of the March to September seasonal run-off at 20 locations across the North Saskatchewan, Red Deer, Bow, Oldman, and Milk River basins and includes a summary of snowpack conditions (mountain and plains), monthly and seasonal precipitation as a percentage of normal, current natural river flows, and long lead weather forecasts from the National Oceanic and Atmospheric Administration and Environment and Climate Change Canada.

Actor	Role
Government of Alberta (GoA) — Environment and Protected Areas (continued)	■ Provide internal GoA operational guidance for water allocation through the Surface Water Allocation Directive used by EPA and Alberta Energy Regulator (AER) staff to set water licences. Each municipality has a unique water licensing structure.
	■ Provide information about the Interim Guidance to Authorize Reuse of Municipal and Industrial Wastewater. EPA issued this policy, which enables the use of recycled municipal and industrial wastewater.
	■ Implement and maintain updates to the South Saskatchewan and Milk River Water Shortage Plan, including facilitating the South Saskatchewan and Milk River Water Shortage Committee and the Intra-basin Water Coordinating Committee. The South Saskatchewan and Milk River Water Shortage Committee coordinates water shortage response activities and communicates advisories for the two basins based on stages in the plan, current conditions at GoA infrastructure, and flow and water supply forecasts from the RFC. The Intra-basin Water Coordination Committees is responsible for preparing an operations plan to guide the decision making required for Alberta to meet the Master Agreement on Apportionment.
	■ Enter into and manage existing agreements with other governments regarding water planning and ministerial orders (e.g., stopping applications and crown reservations).
	■ Manage, approve, and play a part in the broader water reuse requests in Alberta (per provincial guidelines for water reuse).
	■ Develop a Drought Emergency Response Plan.
	■ Establish a Regional Emergency Operation Centre (REOC) or the Department Coordination Centre (DCC), provide support to the Provincial Emergency Coordination Center (PECC) as required.
	■ Conduct a post-incident assessment of environmental emergency responses.

Actor	Role
GoA — Alberta Agriculture and Irrigation	■ Provide the Agriculture Drought and Excess Moisture Risk Management Plan which is a framework for a coordinated, proactive approach to reduce the short- and long-term effects of drought and excess moisture on Alberta farmers and ranchers.
	■ Provide the Alberta Climate Information Service which is an online, interactive tool which helps producers, farm consultants, and researchers see Alberta weather forecasts, browse maps of weather and climate-related information, and access near-real-time station data from almost 500 meteorological stations operating in Alberta.
	■ Provide support via Climate Services staff resources, Agricultural Water Specialists, and various programs.
	■ Facilitate the Drought and Excessive Moisture Advisory Group to provide consistent and consolidated advice and recommendations to complement government actions on drought and excessive moisture related issues affecting agricultural producers in Alberta.
	■ Support the Association of Alberta Agricultural Fieldmen to develop, implement, and control programs designed to carry out priorities and policies set by their Agricultural Service Board, whose expertise remain in weed control, soil and water resource conservation, and pest management.
	■ Produce monthly Farm Gate Allocation Forecast leading up to and during the irrigation season for irrigation districts in the Southern Tributaries of the Oldman River.
	■ Operate and maintain Government of Alberta-owned water infrastructure within the province of Alberta.

Actor	Role
GoA — Health	■ Implement and maintain legislation that would engage in situations of extreme drought where risk to human health becomes apparent.
	■ Along with Alberta Health Services, may put a stop to water reuse opportunities where there are broader risks to public health.
	■ Communicate via Alberta Health Services website regarding heat warnings in effect, and environmental public health concerns, as well as information on coping with emergencies.

Actor	Role
GoA — Forestry and Parks	■ Maintain a year-round fire weather forecast office consisting of four fire weather meteorologists and two seasonal technicians. During fire season (March-October) they produce two fire weather forecasts and briefings per day. These briefings are also used by the River Forecast Centre at EPA.

Actor	Role
GoA — Alberta Municipal Affairs	■ Provide access to the Community Emergency Management Program that provides municipalities with emergency planning tools.

Actor	Role
Alberta Energy Regulator	■ Implement the *Water Act* that governs the allocation of water (quantity) from natural water bodies for licences related to oil and gas activity. This includes the suspension of temporary diversion licences or other action regarding the *Water Act* during water shortages.

Table of Contents

List of Acronyms

AEMA	Alberta Emergency Management Agency
AER	Alberta Energy Regulator
AEP	Alberta Environment and Parks
AAF	Alberta Agriculture and Forestry
ALMS	Alberta Lake Management Society
AUMA	Alberta Urban Municipalities Association
AWC	Alberta Water Council
ALUS	ALUS Canada
BMP	Best Management Practice
BRWA	Battle River Watershed Alliance
CAPP	Canadian Association of Petroleum Producers
CEP	Water Conservation, Efficiency, and Productivity
DUC	Ducks Unlimited Canada
GoA	Government of Alberta
IFN	Instream Flow Need
IO	Instream Objective
LUF	Land-Use Framework
NGO	Non-Governmental Organization
PFRA	Prairie Farm Rehabilitation Administration
RMA	Rural Municipalities of Alberta
SOLE	State of Local Emergency
SWAD	Surface Water Allocation Directive
ToR	Terms of Reference
TUC	Trout Unlimited Canada
WCO	Water Conservation Objective
WPAC	Watershed Planning and Advisory Council
WSG	Watershed Stewardship Group
WSRP	Water Shortage Response Plan

Executive Summary

This guide is intended for small urban and rural communities, including towns, villages, and municipal districts. This guide documents lessons learned from previous droughts in Alberta and brings together current information, tools, and resources as a reference for communities before, during, and after a multi-year drought.

The guide is separated into four modules, each presenting information on different aspects of multi-year drought.

Module 1 — Definitions

This module provides definitions of the four main types of drought: meteorological, agricultural, hydrological, and socio-economic. It also outlines why municipalities should care about multi-year drought and the need for drought-resilient municipalities so these communities can survive, adapt, and grow following multi-year drought.

Module 2 — Multi-Year Droughts in Alberta: Past, Present, and Future

Multi-year droughts have been recurrent events throughout the province's history. Over the last 120 years, at least five major droughts have occurred in the Canadian Prairies, some of which have lasted close to a decade. This module provides an overview of the history of drought in Alberta, the present situation, and what can be expected in the future.

Module 3 — Roles and Responsibilities

Municipalities, the provincial government, Watershed Planning and Advisory Councils[1] (WPACs), and local organizations all play a role in planning for, responding to, and recovering from drought. This module provides an overview of the various actors and how they can play a role in supporting a municipality before, during, and after a drought.

Module 4 — Management Objectives, Strategies, Tools, and Resources

This module makes up the bulk of the guide and is organized based on management objectives before, during, and after a drought. Each section provides general information, tools, and resources about the specific themes that are relevant to prepare for, mitigate, respond to, or recover from a drought. Under each theme, the key strategies to consider before a drought, when warning signs of a drought appear, during a drought, and after a drought are listed.

The appendices include an interview report with information on lessons learned from previous droughts in Alberta, and a case study report detailing approaches to drought management taken in other jurisdictions.

1 https://www.alberta.ca/watershed-planning-and-advisory-councils.aspx

Module 1: Definitions

1.0 What is drought?

Drought can generally be described as a prolonged period of dry weather that depletes water resources.[2] Water resources may include the following:

- natural sources such as rivers, streams, lakes, wetlands, and groundwater
- human-made storage such as reservoirs and dugouts
- soil moisture

Drought is a complex phenomenon; there are several mechanisms by which drought can occur, its duration can be variable (e.g., decades to weeks) and it may have unique impacts to the economy, people, and the environment, depending on where and when it occurs. As a result, drought can be defined in several ways. Listed below are four types of drought, which may occur independently or simultaneously:[3]

- A **meteorological drought** is a result of less precipitation than normal over a prolonged period in a specific region. As this type of drought refers to water shortage and not impacts which typically appear later, this is usually the first type of drought to occur.
- An **agricultural drought** occurs when there is not enough soil moisture to meet the needs of crops and pastures during the growing season. It usually occurs next after a meteorological drought.
- A **hydrological drought** occurs when surface water or groundwater levels fall to below-average levels because of a lack of precipitation. It usually occurs more slowly than a meteorological or agricultural drought.
- A **socio-economic drought** occurs when the prolonged absence of water in a region begins to impact people and the economy.

2 https://www.publicsafety.gc.ca/cnt/rsrcs/cndn-dsstr-dtbs/rfrnc-tbl-smbls-dfntns-en.aspx

3 https://albertawater.com/what-is-drought

It should be recognized that these definitions of drought are classifications and do not describe the full complexity of drought, including the unique impacts each may have, such as increased forest fire frequency, reduced soil quality, wildlife migration, and many more.

1.1 Why focus on multi-year drought?

Multi-year droughts are critical to understand and prepare for because their impacts on the environment, economy, and society are cumulative. Globally, droughts have resulted in land degradation, heatwaves, wildfires, water scarcity, vegetation loss, and reduction in livestock and crop productivity.[4] Natural systems may take decades or centuries to recover,[5] and socio-economic and health effects can also be long-lasting.

The prolonged nature of multi-year droughts can result in widespread consequences that extend to many sectors in our economy. This was true of the 2001 – 2002 Canada-wide drought that affected several sectors including agriculture, recreation, tourism, health, hydroelectricity, transportation, and forestry.

The impacts of drought on individuals can also be significant. In its 2018 *Climate Change Vulnerability and Risk Assessment*, the City of Edmonton identified drought as one of the top four climate hazards, with the biggest direct physical health effects, including stress, anxiety, and depression, as well as food-borne and water-borne disease.

In a multi-year drought, the environmental, economic, and social effects are multiplied every year by management decisions made during previous years. Because we do not know in advance whether a drought will become a multi-year event, the potential for prolonged droughts requires greater preparedness and resiliency.

1.2 What is a drought-resilient municipality?

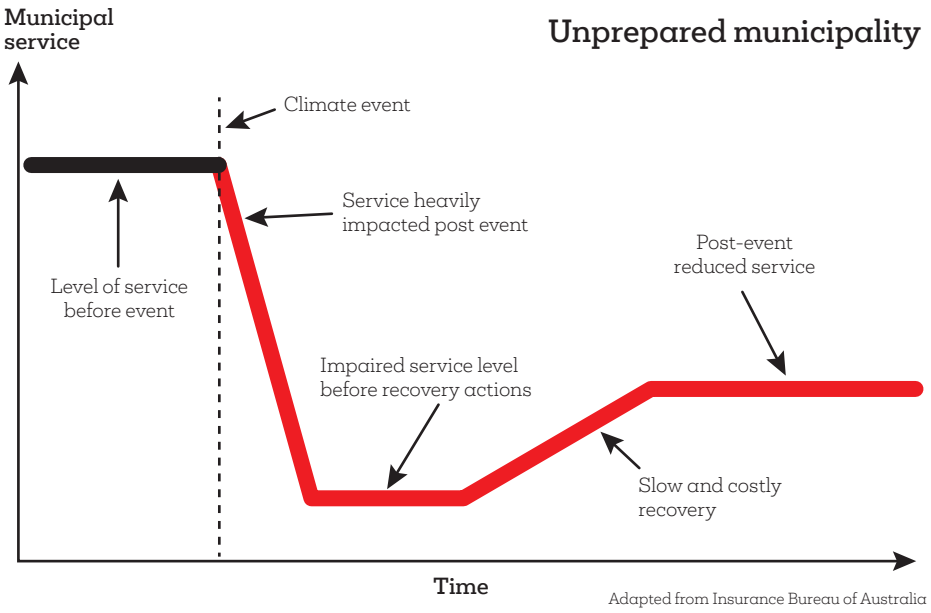
A drought-resilient municipality is one in which its institutions, communities, businesses, and individuals are able to "survive, adapt and grow" in response to drought.[6]

4 https://www.ipcc.ch/srccl/chapter/summary-for-policymakers/

5 https://press.ucalgary.ca/books/9781552388198/

6 http://prairieclimatecentre.ca/wp-content/uploads/2017/04/pcc-brief-climate-resilient-city-transformational-adaptation.pdf

On a practical level, this means that a municipality is able to proactively prepare for and respond to a drought, and recover with minimal long-term consequences. A drought-resilient municipality will also be able to learn from its experience and adapt, thus improving its capacity to withstand future drought events.



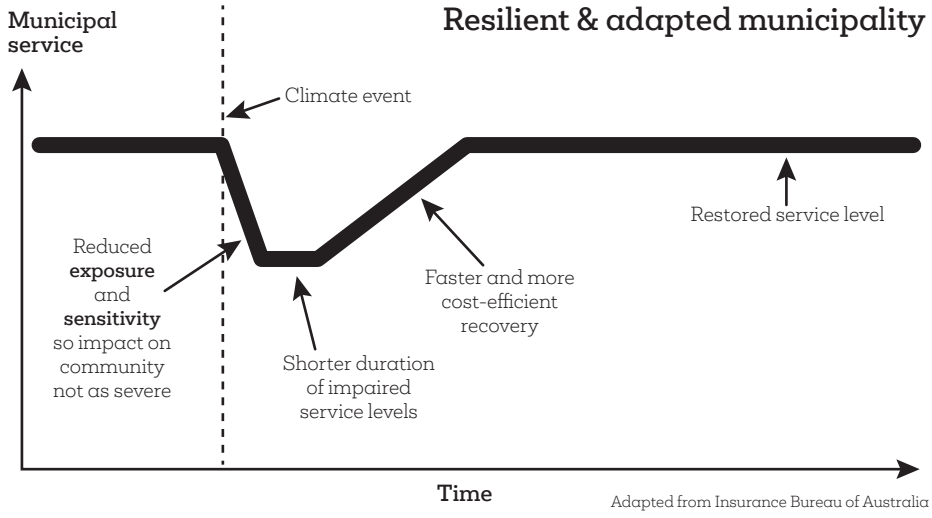


Figure 1. Resiliency at the municipal level (Source: All One Sky Foundation)

1.3 Who is this guide for?

This guide is intended for small urban and rural communities, including towns, villages, and municipal districts. The purposes of the guide are two-fold: to document lessons learned from previous droughts in Alberta, thereby increasing public awareness of the importance of conserving water, and to bring together the most current information, tools, and resources as a reference for communities before, during, and after a multi-year drought. While the guide was built with the objective of supporting small communities, much of the content is also applicable to larger municipalities and other organizations and is also relevant for short-term droughts.

Module 2: Multi-Year Droughts in Alberta: Past, Present, and Future

Drought is a natural phenomenon in Alberta, and multi-year droughts have been recurrent events throughout the province's history. Over the last 120 years, at least five major droughts have occurred in the Canadian Prairies, some of which have lasted close to a decade. Looking back at the history of drought, however, the Prairie provinces have experienced relatively fewer and less severe dry periods in the last century compared to the prolonged and severe droughts that occurred in the 18th and 19th century. Sauchyn and Kerr said, "Our capacity to withstand and prepare for water scarcity has developed in response to the droughts that have occurred since the Prairies were first settled for agriculture, which have been shown to be much less intense than those that occurred before the Prairies were settled. Greater adaptive capacity will be required if future drought conditions are more intense or prolonged than those previously experienced."[7]

This section highlights our most recent learnings about the recurrence of multi-year droughts throughout Alberta's history. Preparedness and adaptability are the keys to successfully responding and adapting to the risk of multi-year drought.

The Alberta Water Council (AWC) conducted interviews to inform this module. The interview focus was on multi-year droughts, but interviewees were encouraged to share relevant experiences from shorter droughts as well. More detail on the interviews can be found in Appendix I.

2.1 A history of drought

Over the last century, the Prairies have experienced several episodes of multi-year drought. The most well-known of these is perhaps the Dust Bowl, which began in 1929 and resulted in grasshopper plagues, crop failure, erosion of topsoil, and soil salinization. By the mid-1930s, the federal Prairie Farm Rehabilitation Administration (PFRA) was developed in response to the widespread land degradation and farm abandonment that was occurring. In 1938, the Government of Alberta established the Special Areas Board to provide municipal services and support in areas of Alberta that were particularly hard-hit by drought. The next major drought did not occur until the 1970-1980s, with 1984 marking the eighth consecutive dry year in a row.

7 https://press.ucalgary.ca/books/9781552388198/

Recent research has shed light on the history of drought in the Canadian Prairies as early as the 18th and 19th centuries. Dr. Sauchyn's research with the Prairie Adaptation Research Collaborative[8] has been key in reconstructing this history of drought: "We've been collecting dead wood for 25 years now; we have more than 8000 pieces. To grow, trees need light, heat, soil, and water, and they have plenty of all of those in summertime except water. So, the pattern of tree growth tells us very much about the amount of water available every year for the last thousand years," Sauchyn explains. "We've found droughts that were much more severe and much more prolonged than anything we've seen on the Prairies in the last 120 years, including the 1930s. For example, just before Europeans came to the Canadian Prairies, there were droughts of 10 or 20 years in duration."[9]

In more recent history, the drought of 2001 – 2002 affected most of Canada, costing the Canadian economy $5.8 billion and making it one of Canada's most expensive natural disasters.[10] Interviews conducted for this project are detailed in Appendix I and focused on the impacts of the 2001-2002 drought on Alberta, and the lessons learned. Communities in southern Alberta were hit particularly hard, experiencing one of the worst droughts in known history and an uncontrolled influx of grasshoppers that devastated croplands and vegetation.[11] Some of the main impacts of this drought in the province included the following[12]:

- Biophysical impacts included wind erosion, reduced streamflow, dry dugouts, and groundwater reductions.
- Crop yields and harvested areas were well below average for 2001 and 2002 and reduced farm cash income in both years. Alberta experienced a loss of $413 million in gross farm cash receipts in 2001 and $1.4 billion in 2002.
- Forest fire occurrences were five times higher than the previous 10-year average during 2002.
- Recreational areas were also affected due to open-fire restrictions.
- Economic costs: beyond crop production losses, communities experienced other economic costs, such as reduced fertilizer sales, increased costs for market-garden operations, reduced new farm-machinery sales, and increased water costs for the oil and gas industry. Other costs included upgrading water supply systems after the drought.

8 https://www.youtube.com/watch?v=aecq9-zW8m4

9 https://link.springer.com/article/10.1007/s00382-012-1422-0

10 https://agriculture.canada.ca/en/agricultural-production/weather/managing-agroclimate-risk/lessons-learned-canadian-drought-years-2001-and-2002

11 http://www.parc.ca/mcri/pdfs/comm_vul/can1.pdf

12 https://press.ucalgary.ca/books/9781552388198/

- Social impacts: low water supplies resulted in municipal water restrictions and restrictions on the agricultural community's access to town water. Agricultural producers had to find alternative water supplies and both the federal and provincial governments had to help farmers and ranchers find water for livestock.

In other regions of Alberta, for example in the Peace Region and northeastern Alberta, droughts have not been as common. However, between 2002 and 2004, municipalities in the Peace Region were hit hard, followed by a second two-year drought period between 2009 and 2010. In both episodes, many communities suffered socially and economically. Ten municipalities, including the counties of Grande Prairie, Saddle Hills, and Birch Hills, as well as the Municipal Districts of Big Lakes, Northern Sunrise, Spirit River, Fairview, Clear Hills, Smoky River, and Greenview, declared agricultural disaster zones in 2010.[13]

In 2015, lack of precipitation and one of the hottest summers in years parched rural municipalities in northeastern and southern Alberta. Although the 2015 drought was not a multi-year event, its impacts, severity, and extent were unusual:[14]

- Significantly higher temperatures during the winter and spring caused snowpack to melt midwinter and led to an earlier spring snowmelt.
- Unusually warm ocean temperatures off the West Coast caused a high-pressure system that settled over Western Canada and blocked out precipitation that normally falls over the region. Impacts included low stream and river flows, depleted reservoirs, record loss of glacial ice in a single year, and parched crops.
- Alberta declared a state of agricultural disaster by early August because of the significant loss in crop and pastureland.
- Restrictions on water use by irrigators and oil sands operators were implemented.
- Trout fishing was closed due to stress on the fish from warm water temperatures and low streamflow.

13 http://www.albertafarmexpress.ca/2010/08/30/peace-region-suffers-third-year-of-drought-for-aug-30-2010/.

14 https://www.researchgate.net/publication/311679017_The_2015_Extreme_Drought_in_Western_Canada

Experiencing drought has made the province better prepared for future droughts and has fostered positive changes for water conservation, opportunities to learn and innovate, and investment in infrastructure and regionalization of drinking water systems. Lessons learned from the droughts experienced since the turn of the century include:[15]

- Several adaptation measures were used in the 2001 – 2002 drought, but many were too costly, disruptive, and insufficient to deal with severe and large-scale droughts.
- The risk of drought is greater than previously thought.
- The Canadian Prairies have experienced extreme floods and droughts in recent years that have been unprecedented in over a century of observations. These extreme events are expected to become more frequent and severe in the future.

2.2 What does the future hold?

Based on our knowledge of past droughts, scientists expect that droughts of greater intensity and longer duration are likely to reoccur in the future. Overall, periods of dry conditions are expected to become drier and wet times wetter. In addition, climate change further increases the probability that future droughts will be more severe than those experienced in recent years. Projections using climate models and emission scenarios point to the risk of increased intensity, duration, frequency, and areas of future droughts and extremes in the Canadian Prairies.[16]

Although annual precipitation is expected to increase with climate change, precipitation during midsummer, when moisture stress is the greatest, is expected to decline. Alberta and Saskatchewan have experienced the largest increase in temperature of all Canadian provinces over the last 100 years. By increasing the rate of evapotranspiration from soils and vegetation, warmer temperatures are likely to contribute to drier conditions.[17]

15 https://link.springer.com/article/10.1007/s00382-012-1422-0

16 https://press.ucalgary.ca/books/9781552388198/

17 http://biodiversityandclimate.abmi.ca/wp-content/uploads/2015/01/Schneider_2013_AlbertaNaturalSubregionsUnderaChangingClimate.pdf

Module 3: Roles and Responsibilities

The following table outlines the roles and responsibilities that a municipality can be responsible for, depending on their local circumstances. It is also important to understand the roles of the provincial government, WPACs, and local agencies.

Actor	Role
Municipality[18]	■ Is responsible for water treatment and distribution to communities.
	■ Is responsible for wastewater and stormwater drainage.
	■ Provide municipal land-use bylaw provisions and implementation procedures for drought-tolerant landscaping and xeriscaping, riparian area building development setbacks, environmental reserves, natural areas, and conservation reserves to address drought management land-use issues.
	■ Support Alberta Environment and Parks (AEP)[19] and Alberta Emergency Management Agency (AEMA)[20] in identifying water-sharing agreements among major water licence holders in the municipality, which can be impacted by drought.
	■ Develop community drought management plans and emergency preparedness and response plans.
	■ Set up water committees (i.e., local stakeholders that will inform and implement the drought responses strategies).
	■ Develop community-wide water shortage response plans.
	■ Develop and enforce bylaws for water conservation and restrictions in times of shortage.
	■ Manage the first line of response during an emergency.
	■ Communicate and create awareness among community groups, including the Chamber of Commerce and non-governmental organizations, during an emergency or drought.
	■ Coordinate collaborative action among the community during a drought.
	■ Provide family and community support services to affected residents and others.
	■ Provide fire, emergency, and police services.
	■ Declare a state of local emergency in extreme drought conditions.
	■ Declare a state of agricultural disaster when applicable.[21]

18 https://www.abmunis.ca/news/essential-information-munis-101-orientation-courses

19 https://www.alberta.ca/environment-and-protected-areas.aspx

20 https://www.alberta.ca/alberta-emergency-management-agency.aspx

21 https://rmalberta.com/wp-content/uploads/2022/02/RMA-Guide-for-Declaring-Municipal-Agriculture-Disasters-May-2022.pdf

Each actor listed below can play a role either directly or indirectly in municipal support, e.g., providing information, tools, resources, financial support, or other assistance relevant to prepare for, mitigate, respond to, or recover from a drought.

Actor	Role
Government of Alberta (GoA) – Alberta Environment and Parks[22]	■ Operate and maintain GoA-owned water infrastructure within the province of Alberta.
	■ Enter into and manage existing agreements with other governments regarding water planning and ministerial orders (e.g., stopping applications and crown reservations).
	■ Implement the *Water Act*[23] legislation, which governs the allocation (quantity) of water from natural watercourses where the allocations are recorded in licences and registrations or are otherwise exempted from the prior allocation system. This includes management of water licence priorities, tracking water conservation objectives,[24] suspension of temporary diversion licences,[25] or other actions regarding the *Water Act* provisions during water shortages.
	■ Implement the Alberta Wetland Policy,[26] which is instrumental for maintaining water storage in watersheds.
	■ Oversee the *Environmental Protection and Enhancement Act*,[27] the legislation that governs specific activities that impact water quality and monitors the state of the environment to ensure the maintenance of healthy, sustainable aquatic ecosystems.
	■ Monitor and forecast groundwater resources through the Groundwater Observation Well Network,[28] which is a network of groundwater monitoring wells located in various aquifers throughout the province. Most wells are fitted with data loggers and sensors that continuously record groundwater levels.

22 https://www.alberta.ca/environment-and-protected-areas.aspx
23 https://www.alberta.ca/water-legislation-and-guidelines.aspx
24 https://www.alberta.ca/water-conservation-objectives.aspx
25 https://open.alberta.ca/publications/water-act-online-submission-of-tdl-temporary-diversion-licence-applications
26 https://open.alberta.ca/publications/9781460112878
27 http://www.qp.alberta.ca/documents/Acts/E12.pdf
28 https://www.alberta.ca/groundwater-observation-well-network.aspx

Actor	Role
Government of Alberta (GoA) – Alberta Environment and Parks	■ Monitor and forecast surface water resources. River Forecast Centre (RFC) generates a monthly Water Supply Outlook[29] report. It contains an estimate of the March to September seasonal run-off at 20 locations across the North Saskatchewan, Red Deer, Bow, Oldman, and Milk River basins and includes a summary of snowpack conditions (mountain and plains), monthly and seasonal precipitation as a percentage of normal, current natural river flows, and long lead weather forecasts from the National Oceanic and Atmospheric Administration and Environment and Climate Change Canada.
	■ Provide internal GoA operational guidance for water allocation through the Surface Water Allocation Directive[30] used by AEP and AER staff to set water licences. Each municipality has a unique water licensing structure.
	■ Provide information about the Interim Guidance to Authorize Reuse of Municipal and Industrial Wastewater.[31] AEP issued this policy, which enables the use of recycled municipal and industrial wastewater.
	■ Implement and maintain updates to the South Saskatchewan and Milk River Water Shortage Plan, including facilitating the South Saskatchewan and Milk River Water Shortage Committee and the Intra-basin Water Coordinating Committee. The South Saskatchewan and Milk River Water Shortage Committee coordinates water shortage response activities and communicates advisories for the two basins based on stages in the plan, current conditions at GoA infrastructure, and flow and water supply forecasts from the RFC. The Intra-basin Water Coordination Committees is responsible for preparing an operations plan to guide the decision making required for Alberta to meet the Master Agreement on Apportionment.
	■ Manage, approve, and play a part in the broader water reuse requests in Alberta (per provincial guidelines for water reuse).
	■ Conduct a post-incident assessment of environmental emergency responses.

29 To access water supply outlook reports, go to https://rivers.alberta.ca/ and select "Water Supply" from the menu

30 https://open.alberta.ca/publications/9781460143339

31 https://open.alberta.ca/publications/interim-guidance-to-authorize-reuse-of-municipal-and-industrial-wastewater

Actor	Role
GoA — Alberta Agriculture and Forestry[32]	■ Provide the Agriculture Drought and Excess Moisture Risk Management Plan[33] which is a framework for a coordinated, proactive approach to reduce the short- and long-term effects of drought and excess moisture on Alberta farmers and ranchers.
	■ Provide the Alberta Climate Information Service[34] which is an online, interactive tool to helps producers, farm consultants, and researchers see Alberta weather forecasts, browse maps of weather and climate- related information, and access near-real-time station data from more than 350 meteorological stations operating in Alberta.
	■ Provide support via Climate Services staff resources.
	■ Facilitate the Drought and Excessive Moisture Advisory Group to provide consistent and consolidated advice and recommendations to complement government actions on drought and excessive moisture related issues affecting agricultural producers in Alberta. They also advise and provide recommendations to government on long-term strategies for mitigating the effects of drought and excessive moisture.
	■ Support the Association of Alberta Agricultural Fieldmen[35] to develop, implement, and control programs designed to carry out priorities and policies set by their Agricultural Service Board, whose expertise remain in weed control, soil and water resource conservation, and pest management.
	■ Produce monthly Farm Gate Allocation Forecast leading up to and during the irrigation season for irrigation districts in the Southern Tributaries of the Oldman River.
	■ Maintain a year-round fire weather forecast office consisting of four fire weather meteorologists and two seasonal technicians. During fire season (March-October) they produce two fire weather forecasts and briefings per day. These briefings are also used by the RFC at AEP.

32 https://www.alberta.ca/agriculture-and-irritation.aspx

33 http://www1.agric.gov.ab.ca/$Department/deptdocs.nsf/all/ppe3883/$FILE/2016_06_16_ADEMP_Extreme_Weather_Events.pdf

34 https://agriculture.alberta.ca/acis/

35 https://aaaf.ab.ca/

Actor	Role
GoA — Health[36]	■ Is responsible for legislation that would engage in situations of extreme drought where risk to human health becomes apparent.
	■ Along with Alberta Health Services, may put a stop to water reuse opportunities where there are broader risks to public health.
	■ Communicate via Alberta Health Services[37] website links regarding heat warnings in effect, and environmental public health concerns, as well as information on coping with emergencies.
GoA — Alberta Support and Emergency Response Team (roles and responsibilities related to drought response under review and subject to change)	■ Activate and coordinate the Inter-Agency Drought Working Group during drought emergencies and coordinate all department drought response activities.
	■ Ensure that roles and responsibilities during drought conditions are clearly defined, communicated, and understood by both internal and external stakeholders.
	■ Ensure post-incident assessments from droughts are documented and disseminated internally and externally.
	■ Ensure effective delivery of AEP's Drought Response Plan.
	■ Establish Regional Emergency Operation Centre (REOC) that focuses on the coordination of drought response activities at the local level.
	■ Assign an Emergency Response Officer to each provincial region as identified in the Drought Response Plan to support the municipalities and REOC.
GoA — Alberta Municipal Affairs[38]	■ Provide access to the Community Emergency Management Program that provides municipalities with emergency planning tools.
Alberta Energy Regulator[39]	■ Is responsible for implementing the *Water Act* that governs the allocation of water (quantity) from natural water bodies for licences related to oil and gas activity. This includes the suspension of temporary diversion licences or other action regarding the *Water Act* during water shortages.

36 https://www.alberta.ca/health.aspx
37 https://www.albertahealthservices.ca/
38 https://www.alberta.ca/municipal-affairs.aspx
39 https://www.aer.ca/

Actor	Role
Alberta Emergency Management Agency[40]	■ On behalf of the GoA, coordinate large, multi-jurisdictional emergency responses when a community or municipality is overwhelmed by emergency events. Events are coordinated in the Provincial Operations Centre.
	■ On behalf of the GoA, declare a state of emergency relating to all or any part of Alberta.
Alberta Urban Municipalities Association[41] and Rural Municipalities of Alberta[42]	■ Provide resources and support for drought prevention, mitigation, and recovery.
	■ Provide draft land-use bylaw provisions to urban municipalities for addressing drought prevention and mitigation through land-use planning.
	■ Provide draft templates of drought management plans to urban municipalities.
	■ Provide draft templates of water conservation and water restriction bylaws.
	■ Provide draft water reuse plans to urban municipalities for water-related projects and activities such as storm drainage collection and treatment.
Watershed Planning and Advisory Councils[43]	■ Provide a forum for a multi-stakeholder group to steward water resources and communicate and create awareness about water-related concerns such as drought.
	■ Participate in municipal and regional initiatives for the collaboration of planning for droughts in watersheds.
	■ Develop shared and integrated watershed management goals and recommend actions and policy changes to appropriate decision makers.
	■ Support municipal drought planning, awareness, and coordination among key community groups.
	■ Develop State of the Watershed reports.
	■ Link to AEP's drought forecasting information on their websites and share information with communities and groups in drought-affected areas.

40 https://www.alberta.ca/alberta-emergency-management-agency.aspx
41 **https://www.abmunis.ca/**
42 https://rmalberta.com/
43 https://www.alberta.ca/watershed-planning-and-advisory-councils.aspx

Actor	Role
Other Local Agencies	■ Local authorities may establish or participate in multi-agency water-management teams that work with regional government teams to coordinate drought response activities.
	■ Local authorities play a part in the approval of Water Reuse projects in their areas.
	■ The Agriculture Financial Services Corporation is a provincial Crown corporation that provides loans, crop insurance, and farm income disaster assistance to farmers, agribusinesses, and small businesses. They help municipalities in times of drought through the Crop Reports, Insurance Program Response, AgriStability Response, and AgriRecovery Process.
	■ There are other water infrastructure owners and operators of wastewater, stormwater, and potable water assets. In some cases, water infrastructure owners are outside Alberta; the Transboundary Section of AEP can help facilitate information gathering in these situations.
	■ Watershed Stewardship Groups[44] (WSGs) take community-level action to safeguard water supplies. They are community, volunteer-based partnerships engaged in stewardship of their watershed and include individuals, organizations, agriculture, industry, municipalities, and other forms of local government. They set common goals to achieve shared outcomes. WSGs may work with affected stakeholders to develop informal agreements to share limited water supplies during a multi-year drought. WSGs may share resources with others at a tributary or local scale.

Indigenous communities also have a role in drought impact management. Their role will depend on the nature of the community undertaking drought planning and its source watershed.

Municipalities that border on federally owned land may have additional considerations.

Please see 4.2.10 Theme J — Collaboration for more information.

44 http://www.landstewardship.org/

Module 4: Management Objectives, Strategies, Tools, and Resources

4. 1 Management objectives

The information in this module is organized to support different management objectives at each stage of a drought:

Stage	Management objectives
Before a drought Ensure that tools, resources, networks, and the community are ready and that warning signs are clearly defined.	■ Gather information to support decision making. ■ Conduct a risk assessment to identify critical risks. ■ Identify the chain of command and determine by whom and how decisions are made. ■ Identify clear communication plans with supporting documents. ■ Identify the process outlining how to declare a drought. ■ Identify sources of funding to support drought-related work. ■ Implement strategies to mitigate the effects of drought. ■ Encourage stakeholders to implement best practices. ■ Develop tools, resources, and programs to educate and raise awareness for the public on the importance of water conservation and drought management. ■ Identify who you should collaborate with and how. ■ Identify performance measures to track the impacts of drought on the municipality.
When warning signs appear Acknowledge when warning signs are reached and alert the community.	■ Raise awareness of best management practices and water conservation measures. ■ Start to implement a drought response plan, including collaboration with other stakeholders. ■ Increase communication to the public. ■ Consider implementing local regulatory tools. ■ Remind citizens of the water conservation opportunities to which they can contribute to help with drought mitigation. ■ Continue close monitoring of warning signs.

During a drought Work with the community to implement management actions in response to drought impacts.	■ Secure essential services. ■ Manage water demand, including reviewing business practices to conserve water. ■ Enforce water restrictions. ■ Provide support to stakeholders and the public to implement water conservation measures. ■ Maintain communication and collaboration with key stakeholders to continue implementing strategies. ■ Raise awareness of available services to support public health. ■ Track the impacts of drought on the municipality.
After a drought Look back at what happened and assess what went well and what did not. Find ways to improve your community's response.	■ Obtain commitment from all those involved to reflect on, and document lessons learned. ■ Summarize lessons learned and evaluate main barriers and next steps to address them. ■ Recognize successes. ■ Continue raising awareness of drought. ■ Amend drought management plans to address new or emergent issues. ■ Develop recommendations for future decision making related to drought.

4.2 List of strategies

Each section will provide general information, tools, and resources about the specific themes that are relevant to prepare for, mitigate, respond to, or recover from a drought. Under each theme, we list key strategies to consider before a drought, when warning signs of a drought appear, during a drought, and after a drought. Included under each strategy are also additional relevant tools and resources to support implementation, where relevant. This list is meant to be comprehensive, and drought management plans for individual communities may include a subset of these items rather than the full list.

Theme	Strategy	Before	Warning signs	During	After
A. Monitoring and data	A1. Know your water supply	✓	✓	✓	✓
	A2. Identify and monitor your drought indicators	✓	✓	✓	✓
	A3. Identify and track performance measures and related impacts to the municipality	✓		✓	✓
	A4. Evaluate drought response and lessons learned	✓		✓	✓
B. Planning for drought	B1. Conduct a risk assessment	✓			✓
	B2. Develop a water shortage response plan	✓			✓
	B3. Develop a drought management plan	✓			✓
C. Supply management	C1. Optimize existing supply	✓	✓	✓	✓
	C2. Develop ongoing and responsive water-sharing agreements	✓	✓	✓	✓
	C3. Identify and use alternative water supplies	✓			✓
D. Demand management	D1. Develop regulatory tools	✓			✓
	D2. Develop a CEP plan	✓			✓
	D3. Implement and encourage water conservation and curtailment strategies and programs	✓	✓	✓	✓
E. Land-use planning	E1. Maintain and restore riparian areas and wetlands	✓			✓
	E2. Provide incentive programs to encourage drought-tolerant landscaping	✓	✓	✓	✓

Theme	Strategy	Before	Warning signs	During	After
F. Agriculture	F1. Ensure stakeholders know where to get resources	✓	✓	✓	✓
	F2. Encourage best practices for drought preparedness	✓	✓		✓
G. Ecological systems	G1. Monitor conflicts between human needs and Instream Flow Needs	✓		✓	
	G2. Develop and implement Instream Objectives	✓			✓
H. Community and health	H1. Provide resources for people experiencing drought-related stress	✓	✓	✓	✓
I. Public education	I1. Educate citizens and stakeholders and encourage them to implement best practices	✓	✓	✓	✓
	I2. Prepare communication materials	✓	✓	✓	✓
J. Collaboration	J1. Identify other water users and stakeholders you should be collaborating with	✓			
	J2. Assemble a stakeholder committee	✓	✓	✓	✓
	J3. Foster ongoing communication with other stakeholders	✓	✓	✓	✓
K. Emergency management	K1. Develop a municipal emergency management plan	✓			✓
	K2. Declare a municipal agricultural disaster			✓	
	K3. Declare a state of local emergency			✓	
L. Funding	L1. Identify funding to support your actions and disaster relief	✓			✓

At a Glance:

Theme A — Monitoring and Data

Why:

Monitoring and collecting data can help reveal major trends, determine key triggers, and inform important management decisions regarding multi-year drought.

Applicable for:

Before a Drought	Warning Signs	During a Drought	After a Drought
✓	✓	✓	✓

Strategies:

- Know your water supply
- Identify and monitor your drought indicators
- Identify and track performance measures
- Evaluate drought response and lessons learned

Key Supporting Tools:

- Alberta River Basins
- Alberta Climate Information Service
- Alberta Agriculture and Forestry — Moisture Situation Updates
- Alberta Rivers Mobile App
- Groundwater Observation Well Network
- Canadian Drought Monitor
- Environment and Climate Change Canada — Temperature and Precipitation Forecast Map
- Alberta Environment and Parks — Surface Water Quality Data
- Alberta Wildfire and Alberta Fire Bans Websites
- Water Survey of Canada
- Environment and Climate Change Canada — Climate Data
- Alberta Agriculture and Forestry — Wildfire Status Map
- Alberta Climate Records
- Prairie Adaptation Research Collaborative
- Prairie Climate Centre
- Agriculture and Agri-Food Canada's Drought Watch
- Alberta Biodiversity Monitoring Institute, Biodiversity Management and Climate Change Adaptation

4.2.1 Theme A — Monitoring and Data

Monitoring and collecting data can help reveal major trends, determine key triggers, and inform important management decisions regarding multi-year drought. Monitoring and data collection can also help identify potential problems ahead of time and determine possible solutions. The following are some strategies that can help facilitate this process:

Theme	Strategy	Before	Warning signs	During	After
A. Monitoring and data	A1. Know your water supply	✓	✓	✓	✓
	A2. Identify and monitor your drought indicators	✓	✓	✓	✓
	A3. Identify and track performance measures and related impacts to the municipality	✓		✓	✓
	A4. Evaluate drought response and lessons learned	✓		✓	✓

STRATEGY A1: Know your water supply

Municipalities in Alberta obtain their water from a variety of sources, including lakes, rivers, reservoirs, and groundwater. Some municipalities own and operate their own water supply while others are served through regional systems or infrastructure owned and operated by other bodies like irrigation districts. Knowing where your water comes from will help you determine how you can best obtain information to support your decision making. Questions to consider include the following:

- **Where does your water come from?**
  Where you get information from to predict and forecast water supply will depend on your water supply. Determine if your water supply has a Source Water Protection Plan.
- **Who owns and operates your water supply?**
  With the operator, determine critical data and the frequency of reporting that will be necessary during a drought (e.g., any operational impacts, such as maintenance schedules, demand curves, pumping rates, and storage levels).

- **Who else has an impact on your water supply?**
  If your water supply is dependent on an organization other than your municipality, they will be an important contact as you determine what to monitor and how. For example, TransAlta operates a series of hydroelectric dams and power plants upstream of the City of Calgary. The City of Calgary is in regular communication with TransAlta to know how upcoming management of the reservoirs might impact their supply, including weekly water user calls to discuss operational needs. You may need to connect with government staff responsible for transboundary waters agreements if organizations are outside Alberta.
- **How will a changing climate impact your future water supply?**
  Climate change may result in changes to weather patterns, water flows, timing of spring run-off, and amplification of natural cycles. Improving your understanding of the climate-related factors that contribute to changes in water supply will help support decision making.

STRATEGY A2: Identify and monitor your drought indicators

Several online resources provide data and information that can assist municipalities in assessing their local conditions. Relevant drought indicators and the associated triggers for implementing given strategies will vary from one municipality to another, depending on factors such as the source of water, key land uses, and monitoring capacity. The following section provides examples of indicators to consider along with resources to access available data to monitor them. For more information on how to develop triggers for specific indicators, refer to Strategy B3, which outlines how to develop a Water Shortage Response Plan.

Surface Water

The Alberta River Basins[45] website houses a variety of information on surface water across the province. If your community relies on surface water, this website allows you to track indicators such as river flow, lake or reservoir levels, water shortage advisories, and water supply forecasts:

Type	What is it?	How to access it
River flow and lake levels	Uses an interactive map that allows readers to zoom in to see local conditions for river flow and lake levels.	Home page.
Water shortage advisories	Indicates areas where water shortage advisories are in effect. Any associated management actions relating to angling, temporary diversion licences, or licensed water withdrawals are also indicated.	Select "Advisories" from the menu.
Water supply outlook	Provides forecasts throughout the open water season as to how the water supply is likely to be compared to average conditions.	Select "Water Supply" from the menu.
Reservoir storage summary report	Provides reservoir levels, current volume, and percentage of total storage, along with a comparison to previous year's storage volume.	Available under "Maps and Data Summaries" in the menu.
Provincial natural flow summary	Provides modelled daily natural flows for the Bow River, Oldman River, Red Deer River, and South Saskatchewan River at apportionment point. Licence holders can refer to current conditions and check with threshold conditions on their licence(s).	Select "Provincial Natural Flow Summary" from the menu.

45 https://rivers.alberta.ca/

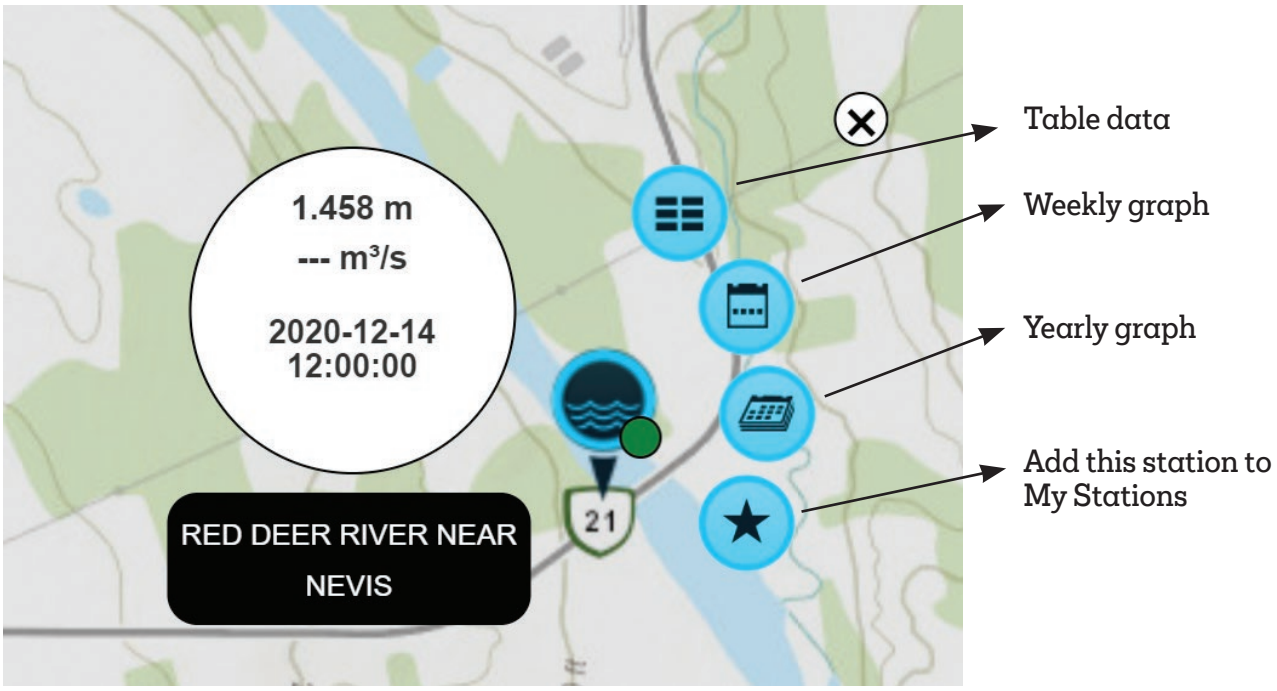


Figure 2. River flow data point on the Alberta River Basins website

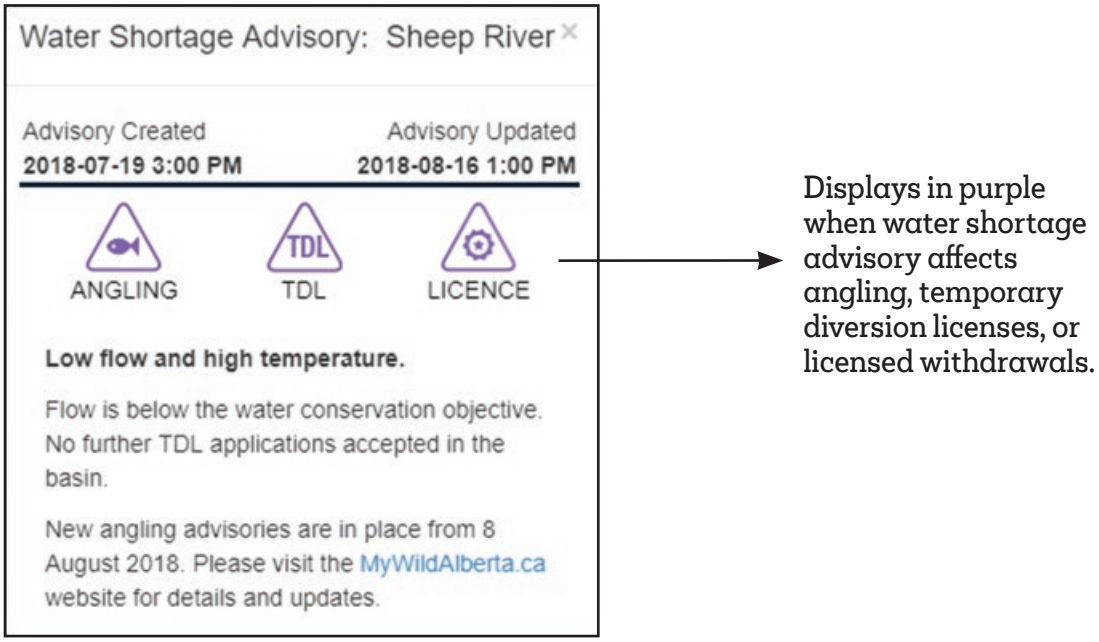


Figure 3. Example of water shortage advisory information on the Alberta River Basins website

Precipitation, Temperature, and Soil Moisture

The Alberta Climate Information Service (ACIS)[46] is an interactive tool that houses maps and weather data that can assist municipalities in planning and decision making. Precipitation, temperature, and soil moisture can be useful indicators to track weather trends in your area. Precipitation, temperature, and climate information on ACIS includes the following:

Type	What is it?
Alberta weather station data and graphs	Provides near-real-time data from more than 350 stations across Alberta on precipitation, temperature, and other weather variables.
Alberta climate and atlas maps	Provides maps that include precipitation, temperature, soil moisture, snowpack, drought indices, and others. Each week about 40 new maps are added to the viewer that describe current conditions and trends.

Alberta Agriculture and Forestry also publishes frequent agricultural moisture situation updates.[47]

Alberta climate and weather data is also available through the Alberta Rivers mobile app,[48] which provides detailed information on river flows, river and lake levels, precipitation, snowpack, and ice conditions across the province.

Groundwater

The Groundwater Observation Well Network (GOWN)[49] provides near-real-time water-level data for groundwater wells located in various aquifers throughout the province. Users can select individual well points to access the associated groundwater levels and well information.

46 https://agriculture.alberta.ca/acis/
47 https://open.alberta.ca/publications/moisture-situation-update
48 https://rivers.alberta.ca/
49 https://www.alberta.ca/groundwater-observation-well-network.aspx

Drought Conditions

Agriculture and Agri-Food Canada monitors drought conditions across the country and produces an interactive drought intensity map available on the Canadian Drought Monitor website.[50] This map provides a quick indicator of drought conditions in your area, according to five stages:

Stage	What does it mean?
D0 — Abnormally Dry	Represents an event that occurs once every 3 to 5 years
D1 — Moderate Drought	5- to 10-year event
D2 — Severe Drought	10- to 20-year event
D3 — Extreme Drought	20- to 25-year event
D4 — Exceptional Drought	50+ year event

Seasonal Forecasts

Looking at seasonal forecast information can be another useful indicator of whether you should be ramping up efforts to prepare for drought. Environment and Climate Change Canada produces a temperature and precipitation forecast map.[51]

Water Quality

While drought more obviously affects water quantity, it also has impacts on water quality. Your WPAC can be a useful source of information about water quality in your area, and AEP provides access to surface water quality data[52] across the province.

Fire

Drought increases the incidence of wildfire, which can have devastating consequences at the municipal level. Keep an eye on fire weather information and fire bans through the following resources:

- Alberta Wildfire[53]
- Alberta Fire Bans[54]

50 https://agriculture.canada.ca/en/agricultural-production/weather/canadian-drought-monitor
51 https://weather.gc.ca/saisons/prob_e.html
52 https://www.alberta.ca/surface-water-quality-data.aspx
53 https://www.alberta.ca/alberta-wildfire.aspx
54 https://albertafirebans.ca/

Weather and Climate

Alberta Agriculture and Forestry provides up-to-date weather and climate data to Albertans using the ACIS.[55] It is an online, interactive tool that helps producers, farm consultants, and researchers to see Alberta weather forecasts, browse over 10,000 maps of weather- and climate-related information and access near-real-time station data from over 350 meteorological stations operating in Alberta. The ACIS provides the following weather and climate information:

Type	What is it?
Alberta weather station conditions summary	Up-to-date current weather conditions measured by the weather station of your choice. Dynamic graphs allow users to select specific time periods. Additionally, view at-a-glance weather derivatives for the current growing season can help users make more informed operational decisions.
Alberta weather station data and graphs	An interactive tool that allows you to locate the meteorological stations in Alberta and download, graph, and compare near-real-time data from more than 350 stations. Both hourly and daily data are available; hourly data is usually about two hours old and daily data current as of the previous day. Data flags that are included with the downloaded data indicate if the data is actual, computed, or missing.
Alberta climate and atlas maps	A viewer that, as of 2020, had over 30,000 maps in the archive. Many of these maps date as far back as 1961. Each week about 40 new maps are added to the viewer that describe current conditions and trends. The maps explore Alberta's current and historical climate trends and extremes. Current map categories include precipitation, temperature, soil moisture, snowpack, drought indices, and others.
Alberta weather conditions map	Provides a map of current and historical weather conditions near any location or across the province and values for a variety of weather elements plotted on an interactive map interface.
Alberta weather radar imagery	Displays current and past (last few hours) weather radar imagery showing areas of precipitation on an interactive map.

55 https://agriculture.alberta.ca/acis/

Other sources of real-time hydrometric and metrological data for rivers in Alberta and Canada include the following:

- Water Survey of Canada[56] — real-time water levels and archived hydrometric data
- Environment and Climate Change Canada[57] — historical climate data
- Alberta Agriculture and Forestry[58] — wildfire status map

Climate Forecasting

The following are some resources that can help with projected future climate models:

- Alberta Climate Records[59] — provides past climate data and trends for Alberta
- Prairie Adaptation Research Collaborative[60] — gives access to climate change predictions and related research
- Prairie Climate Centre, Prairie Climate Atlas[61] — gives future climate data for the Prairies, geo-visualizations, and a multi-media webpage
- Alberta Biodiversity Monitoring Institute, Biodiversity Management and Climate Change Adaptation[62] — provides maps of climate change projections and future distributions of Alberta's species and ecosystems
- Handbook of Drought Indicators and Indices[63] — by the World Meteorological Organization and the Global Water Partnership
- The Drought Preparedness and Response, Manual of Water Supply Practices[64] — in the American Waterworks Association's M60 manual, which provides information about establishing triggering levels

Water Demand

Knowing and planning for water demand in the future must be an integral part of creating and monitoring drought indicators. Water supplies should be assessed relative to current and future water demand and should influence a response plan, including identification of measures that can be taken proactively to increase efficiency and decrease demand.

56 https://wateroffice.ec.gc.ca/index_e.html
57 https://climate.weather.gc.ca/
58 https://www.alberta.ca/wildfire-maps-and-data.aspx
59 http://albertaclimaterecords.com/
60 http://www.parc.ca/
61 https://climateatlas.ca/prairie-climate-centre
62 http://biodiversityandclimate.abmi.ca/
63 https://www.droughtmanagement.info/literature/GWP_Handbook_of_Drought_Indicators_and_Indices_2016.pdf
64 https://www.awwa.org/Store/Product-Details/productId/75759388

STRATEGY A3: Identify and track performance measures and related impacts to the municipality

Performance measures inform your response to drought. It is important to identify performance measures before a drought occurs and to have a system in place to track the measures during a drought. Examples of performance measures could include the following:

- temperature and nutrients as indicators of algal growth
- dilution issues associated with wastewater and stormwater treatment
- water demand (e.g., The City of Calgary looks at expected temperatures to predict water demand)
- new sources of water
- new water-sharing agreements

These measures should be cross-referenced with drought management plans and actions to help determine what else should be monitored. Additional examples are provided in the table below.

Ecological	■ Air quality ■ Tree health ■ Changes in land uses (e.g., positive changes because of new bylaws) ■ Aquatic ecosystem instream flow requirements (see Strategy G1 for more information)
Social	■ Health and health impacts ■ Reported cases of respiratory illness or depression (for example) ■ Use of food banks ■ Bankruptcies
Economic	■ Water restrictions on citizens and industrial, commercial, and institutional sectors ■ Population changes (consider age — are young people leaving?) ■ Business failure ■ Property tax assessment ■ Infrastructure costs (restoration, construction, etc.) ■ Agricultural production and reserve (e.g., yield, head per hectare, winter feed volume)

STRATEGY A4: Evaluate drought response and lessons learned

Conduct a debrief with municipal staff and partners shortly after the drought to discuss the effectiveness of, and improvements to, response activities. Consider the following:

- Did you have the necessary data to make informed decisions?
- Did the drought stages, triggers, and implemented actions achieve the anticipated results?
- Were the demand reduction measures too prescriptive or did they not provide enough direction to customers?
- Were the communications effective? Were there any gaps or overlaps? Consider the following:
  - communication with the public
  - internal communications with municipal staff and council
  - communication and coordination with other levels of government (i.e., provincial and federal) and other involved groups. For example, municipalities should inform the GoA of early warning drought signs as soon as they can.

The period immediately after a drought provides you with a short window of opportunity to implement new practices at a moment when drought awareness is at its highest. Take advantage of this and consider which of the "before a drought" actions highlighted in this guide could be implemented.

Additional Resources

Agriculture and Agri-Food Canada's Drought Watch[65]

Provides information on weather and climate relevant to the agricultural sector in Canada, including current and historic weather and climate conditions, impacts to agriculture, and ways to manage farms during drought conditions.

Climate Atlas of Canada[66]

Provides an interactive tool for citizens, researchers, and business, community, and political leaders to learn about climate change in Canada. It combines climate science, mapping, and storytelling to bring the global issue of climate change closer to home and is designed to inspire local, regional, and national action and solutions.

Lessons Learned

In California, the 2012-2016 drought highlighted the vulnerability of their water supply and led to recommendations for reforms to address these gaps. See Appendix II for more information.

65 https://agriculture.canada.ca/en/agricultural-production/weather

66 https://climateatlas.ca/

Provincial Natural Flow Summary[67]

Provides modelled daily natural flows for the Bow River, Oldman River, Red Deer River, and South Saskatchewan River at the apportionment point. Licence holders can refer to current conditions and check with threshold conditions on their licence(s).

Reservoir Storage Summary Report[68]

Provides reservoir levels, current volume, and percentage of total storage, along with a comparison to previous year's storage volume.

67 Go to https://rivers.alberta.ca/ and select "Provincial Natural Flow Summary" from the menu.

68 Go to https://rivers.alberta.ca/ and select "Maps and Data Summaries" and then "Reservoir Storage Summary Report" from the menu.

At a Glance:

Theme B — Planning for Drought

Why:

Drought planning is an important means of facilitating management actions before, during, and after drought to reduce associated risks.

Applicable for:

Before a Drought	Warning Signs	During a Drought	After a Drought
✓			✓

Strategies:

- Conduct a risk assessment
- Develop a water shortage response plan
- Develop a drought management plan

Key Supporting Tools:

- The Adapt-action Tool
- Municipal Flood and Drought Action Planning Primer
- Drought Preparedness and Response, Manual of Water Supply Practices
- Alberta Environment and Parks — Guide for Preparing Water Shortage Response Plans
- Climate Resilience Express Action Kit

4.2.2 Theme B — Planning for Drought

Drought planning is an important means of facilitating management actions before, during, and after drought to reduce associated risks. As the impacts of drought reach beyond a shortage of water, ecosystems, human health, and the economy are also affected. A holistic approach to drought planning that includes education, legislation, and water conservation measures has been used successfully in other jurisdictions. For more examples of drought planning actions, see Appendix II.

It is critical to have a plan in place; following are some strategies that can help facilitate the planning process.

Theme	Strategy	Before	Warning signs	During	After
B. Planning for drought	B1. Conduct a risk assessment	✓			✓
	B2. Develop a water shortage response plan	✓			✓
	B3. Develop a drought management plan	✓			✓

STRATEGY B1: Conduct a risk assessment

A risk assessment is the process of evaluating risks of drought and determining appropriate management actions to respond to, recover from, or build resiliency to drought. Some actions that can be taken are as follows:

- Complete a risk vulnerability exercise that identifies both internal and external risk factors, including who you are managing risks for and why.
- Undertake dynamic risk assessments that include regular reviews and updates.
- The Climate Resiliency for Municipalities — The Adapt – action Tool[69] — the Miistakis Institute has developed a web-based, climate resiliency tool that municipalities can use to explore critical adaptation issues. It includes information about environmental changes, implications for municipalities, and potential municipal strategies and actions. Links to external tools are provided within each topic.

69 http://www.adaptaction.ca/

- Municipal Flood and Drought Action Planning Primer[70] — the Miistakis Institute has created a primer that uses a question and answer approach to provide a starting point for municipal staff and elected officials thinking about initiating a flood and drought mitigation planning process.
- Drought Preparedness and Response, Manual of Water Supply Practices[71] — the American Waterworks Association's M60 manual provides information about planning.

STRATEGY B2: Develop a Water Shortage Response Plan

A Water Shortage Response Plan (WSRP) (1) assesses the risks of water shortages, (2) outlines options to deal with those water shortages, and (3) establishes a plan for implementation, including triggering criteria and a monitoring program. AEP's guide Preparing Water Shortage Response Plans[72] provides a framework to guide municipalities and other licence holders in developing these three components of a WSRP. The guide lists several indicators to consider in developing triggers that indicate a water shortage is developing or becoming more severe. These include the following:

- condition of storage reservoirs in the basin
- watercourse flows against minimum flow requirements for the protection of the aquatic environment (i.e. Water Conservation Objectives (WCOs)/ Instream Objectives (IOs))
- precipitation records (rainfall and snowpack)
- extended weather forecasts
- water supply forecast by AEP
- river water quality
- ground water table levels in the basin
- water demand

Example: City of Camrose Water Shortage Response Plan

The City of Camrose WSRP is based on four water shortage stages:

Trigger Point: Reservoir Storage (Days until "Available Storage" reaches zero)	Water Shortage Stage	Response Target: Water Use Reduction Goal (as %)
> 120 days	Stage 1 — Watch	0 to 5%
60 – 120 days	Stage 2 — Warning	5 to 15%
30 – 60 days	Stage 3 — Critical	15 to 25%
< 30 days	Stage 4 — Emergency Measures	25 to 33%

The WSRP further outlines actions that could be implemented by the City under each stage, including water conservation education, incentive-based programs, and water restrictions.

70 http://www.rockies.ca/miradm/uploads/1c6f89bf3c419806ff8791b2e11b5128f2b6717c.pdf
71 https://www.awwa.org/Store/Product-Details/productId/75759388
72 https://open.alberta.ca/publications/preparing-water-shortage-response-plans

The Drought Preparedness and Response, Manual of Water Supply Practices[74] from the American Waterworks Association's M60 provides information about developing a staged demand reduction program.

STRATEGY B3: Develop a drought management plan

A drought management plan outlines the goals and main actions that can be taken to respond to, recover from, or build resiliency to drought. Some helpful resources include the following:

- Municipal Toolkit for Flood and Drought Action Planning in Alberta[73] — the Miistakis Institute is currently undertaking this work. The action planning process proposes to build on the Flood and Drought Action Planning Primer to create a step-by-step guide for developing local flood and drought mitigation action plans.
- WSRPs
- Drought management plans

WSRPs and drought management plans are often confused. The table below provides some key points about each plan to help differentiate them:

Type of Plan	Description
Water Shortage Response Plan (WSRP)	■ Manage demand or needs based on risks to availability of source water supplies. ■ Focus on reducing the demand for outdoor water use using targeted actions. ■ Use a staged approach that ranges from a low level of water restrictions for a set time interval (e.g., hydrant flushing, lawn sprinkling) combined with timely public notification to high levels of restrictive activities (e.g., temporary closure of public swimming pools and car washes, refilling of garden ponds and hot tubs banned). ■ Define how the staged approach will be enforced (e.g., all users at once, specific zones of the city or town first, postal codes). ■ Use defined triggers to initiate the staged approach. ■ Have widespread and ongoing community communication during all stages. ■ Typically ensure consistent implementation throughout the region by adopting the WSRP into municipal bylaw.

73 http://www.rockies.ca/research.php?area=conplan&id=125

Type of Plan	Description
Drought Management Plan	■ Provide a path forward that will ensure readiness for a drought event. ■ Regularly monitor water resource information, climatic conditions, and seasonal forecasts. ■ Introduce drought management actions that are proactive, well-considered, and planned. ■ Define triggers and management actions. ■ Communicate with the community about water restrictions and access to information and support services in time of need. ■ Ensure that council and municipal staff have a clear understanding of the operating procedures outlined in the plan. ■ Ensure that water users and others are aware of the requirements of the plan. ■ Periodically review the effectiveness of management actions and consider alternative measures that may be more effective.

Additional Resources

Climate Resilience Express[74]

The All One Sky Foundation has developed an action kit to help small communities in Alberta develop a climate action plan. The foundation uses a workshop-based approach focused on understanding local climate trends and projections, assessing climate change risks and opportunities, and identifying climate resilience actions. The action kit is designed to take a community through the entire process of preparing and implementing an action plan in a full-day workshop. This includes tools such as climate science presentations, a scale for scoring risks and opportunities, and example action plans.

74 https://www.allonesky.ca/climate-resilience-express

At a Glance:

Theme C — Supply Management

Why:

Managing source water supplies and systems supplying users enables the provision of adequate and suitable water for all users at a reasonable cost, even during a drought.

Applicable for:

Before a Drought	Warning Signs	During a Drought	After a Drought
✓	✓	✓	✓

Strategies:

- Optimize the existing supply
- Develop ongoing and responsive water-sharing agreements
- Identify and use alternative water supplies

Key Supporting Tools:

- Regional Groundwater Assessments
- Agricultural Land Resource Atlas of Alberta
- Interim Guidance to Authorize Reuse of Municipal and Industrial Wastewater
- American Waterworks Association's Drought Preparedness Manual
- Environmental Protection Agency's Drought Response and Recovery

4.2.3 Theme C — Supply Management

Supply management means being able to provide adequate and suitable water supplies for all users at a reasonable cost. Long-term, supply management strives to balance the needs of the current generation with those of future generations. The following are some strategies that can help facilitate this process:

Theme	Strategy	Before	Warning signs	During	After
C. Supply management	C1. Optimize the existing supply	✓	✓	✓	✓
	C2. Develop ongoing and responsive water-sharing agreements	✓	✓	✓	✓
	C3. Identify and use alternative water supplies	✓			✓

STRATEGY C1: Optimize the existing supply

Water saved through efficient operation of both water treatment and distribution systems can reduce the need to identify alternative water supplies. Strategic asset management and maintenance is also important to consider when mitigating operational risk during drought. If the municipality does not operate its own system, communication with the operator is essential (see STRATEGY A1: Know your water supply.)

Some additional methods of optimizing the existing supply include the following:

- Leak detection and repair — this is often a low-hanging fruit for water suppliers and operators
- Evaluation and upgrading of processes to reduce water waste in treatment operations (e.g., The City of Calgary now has a process to recycle water used in filter flushing)
- Asset management — identify critical infrastructure
- Review maintenance schedules to determine whether downtime for repair or maintenance can be completed when the risk for drought is low

STRATEGY C2: Develop water-sharing agreements

The development of water-sharing agreements allows licensees to share their knowledge and agree to reductions that reduce consumption to adapt to the forecasted supply. Water-sharing agreements protect water interests while encouraging cooperation with other jurisdictions. The particulars pertaining to agreements to temporarily assign water are included under Section 33 of the *Water Act*.[75] Agreements can be between a minimum of two licensees up to all the licensees in a basin or sub-basin.

For development of an effective water-sharing agreement, licensees must have knowledge of the following:

- other licensees within the basin
- the water supply forecast for their area and the potential water supply shortage expected
- their consumption to determine their thresholds for proposed reductions

AEP approvals officers should be informed of any intent to enter into a water-sharing agreement; any proposed agreement requires AEP approval. The creation of standing committees for continued conversation, especially during periods of above average precipitation when water supply is not a concern, enhances the ability of a community to react to a predicted or occurring drought.

Case Study: 2001 Water-sharing Agreement in Southern Alberta

Alberta's 13 irrigation districts deliver water to over 500,000 hectares of land to grow more than 50 different crops. The districts also deliver water to 48 communities and thousands of rural households. Most irrigation districts have been operating irrigation infrastructure for more than 100 years and consequently hold some of the most senior water licences in southern Alberta and some of the largest allocations. In times of water shortage, these senior licences have the first right to water, based on Alberta's *Water Act* "first in time, first in right" principle.[76]

In 2000 and 2001, southern Alberta experienced one of the worst droughts in recent history. Storage reservoirs relying on the St. Mary, Waterton, and Belly

75 https://kings-printer.alberta.ca/documents/Acts/w03.pdf

76 In Alberta, the right to divert water is prioritized according to the principle of prior allocation or "first in time, first in right." This means that water users with a more senior licence can take their entire water allocation before junior licence holders are entitled to take any water. Licence seniority is established based on the historical date of authorization.

Rivers, known as the "Southern Tributaries" of the Oldman River, were drawn down to historic low levels. In November 2000, the irrigation districts began to invite other water users in the basin to attend committee meetings to prepare for the possibility of a water shortage the next year. This formed the basis for an expanded advisory committee that brought together the irrigation districts, municipalities, Alberta Environment, Alberta Agriculture, Food and Rural Development, the Blood Tribe Agricultural Project, and river irrigators.

By 2001, the water supply forecast was insufficient to meet the needs of all licensed water users in the Southern Tributaries, which included stock watering, private irrigation, irrigation districts, municipalities, industry, In-stream Flow Needs, and other uses. According to priority, all licensees junior to 1950 would have been required to suspend diversion for the irrigation operating season had the irrigation districts decided to "call priority" on their licences. As a solution, the advisory committee proposed a water-sharing agreement, which allowed irrigation districts to assign water to other licensees: "In an unprecedented action, the Irrigation Districts initiated a plan that would see all water users affected by the water shortage share the available water equally, regardless of the water licence priority held by each user."[77] This water-sharing agreement affected approximately 650 licences in the basin and required complex management and collaboration for allocating and monitoring the available water throughout 2001. It is one of the best examples of how a water-sharing agreement under the *Water Act* has been used successfully during a water shortage in Alberta, allowing a rationed amount of water to be available to all users, rather than full allocations being available for only senior licensees.

The expanded advisory committee still exists today and is brought together as needed. The exceptional cooperation among nearly all licensees was recognized with an award from the U.S.-based Irrigation Association. Because of the 2001 drought, the Alberta Irrigation Districts Association (AIDA) developed the Human Use of Water and Livestock Sustenance Declaration in 2010. The document affirms that in the case of water shortage due to drought conditions water required to meet basic human needs and for livestock sustenance will take priority over any water use for irrigation. The 13 irrigation districts have agreed to participate in water-sharing agreements with other licence holders to achieve this.

77 Alberta Environment. 2002. 2001 Water Administration Summary Report, Southern Tributaries: St. Mary — Belly — Waterton Rivers.

STRATEGY C3: Identify and use alternative water supplies

Identification and use of alternative water supplies is a critical component of supply management. Municipalities should work with all agencies, irrigation districts, and neighbouring municipalities to inventory both treated and domestic water supplies and raw untreated sources. This should include quantification of water resources necessary for community domestic water needs, fire suppression and prioritization of essential water use. Defined triggers can be set to explore cut-off options and use of alternatives.

Use Existing Alternative Water Supplies

Prior to the use of existing alternative water supplies, users must ensure that they are using proper policies and have consulted with GoA before approving an alternate use. When identifying existing alternate water supplies, consider:

- non-potable sources of fire suppression water.
- opportunities for using storm water or reusing greywater to water the fire break green strips in communities.
- abandoned groundwater wells or surface water intakes (with proper regulatory approvals).
- reuse of water from wastewater treatment plants or water main flushing for non-potable uses, such as landscape irrigation, vehicle washing, or non-food crop irrigation.
- potential for both indirect and direct potable reuse, in accordance with drinking water treatment standards.
- on-farm water supplies (e.g., springs, shared water line, dugout); depending on the method, there are different types and procedures to be followed, and the GoA may have to be consulted at certain times.
- ratepayers being encouraged to identify privately held emergency farm water supplies and ensuring that ratepayers are informed of Alberta Agriculture and Forestry's Emergency Farm Water pumping program.
- consultation with Provincial Dam Safety Officers to determine if alternate operation of dam infrastructure could take place to increase supply.
- blending of brackish or lower quality water with higher quality water supplies at the existing water treatment plant or the leasing of portable treatment equipment to demineralize or desalinate the water.
- enhancement of treatment of brackish or lower quality water.

Opportunities for New Alternative Sources

In addition to existing water supplies that are not being used, alternative water supplies can be developed in the following ways:

- Identify potential groundwater resources and drilling locations that can help establish a network of community wells to sustain water needs in a prolonged drought. The Camrose County community well and bulk filling station network is an example. Resources include:
  - Regional Groundwater Assessments[78]
  - Agricultural Land Resource Atlas of Alberta — Groundwater Quality Risk for Agricultural Area of Alberta[79]
- Encourage community bulk water fill stations within rural municipalities to meet the needs of ratepayers by providing fire suppression tanks for farm and non-domestic water use.
- Contact the local AEP approvals director about potential emergency temporary diversion licence approvals in case of a significant emergency that depletes water resources.
- Build a pipeline to an existing water supply.
- Engage in bulk water purchases or leases.
- Establish emergency interconnections with nearby water or power utilities.
- Use temporary drinking water distribution centres where customers can fill containers from portable tanks and haul the water to their homes.
- Haul water from nearby suppliers.
- Swap lower quality water with agricultural or industrial users in exchange for raw water that can be treated at existing plants.
- Install a surface water infiltration gallery to access subsurface water flows.
- Acquire or develop unappropriated (unpermitted) groundwater or surface water supplies.
- Drill new groundwater wells.
- Enhance aquifer storage and recovery.
- Enhance reservoir storage to capture and store more water from the available source in advance of shortages.
- Acquire temporary or emergency surface water rights or permits.
- Where regulatory requirements can be met, encourage and support landowners in efforts to convert unirrigated agricultural crop land to irrigated agricultural crop land to lessen the effects of agricultural drought.

78 https://www.hcl.ca/reports

79 See p.44 of https://open.alberta.ca/publications/agricultural-land-resource-atlas-of-alberta-2nd-edition

Balancing Water Supply and Demand

Balancing the current water supply with demand is a critical aspect of planning for a drought and will help with the efficient use of alternative water supplies. Methods to achieve this include the following:

- Source water protection plans — a risk-management process designed to maintain or improve the conditions of water through proactive and collaborative identification, validation, assessment, and management of risk. The AWC completed a project[80] to provide guidance on protecting public, private, and individual drinking water supplies in Alberta.
- Water reuse — AEP has issued Interim Guidance to Authorize Reuse of Municipal and Industrial Wastewater.[81] This interim policy enables the use of recycled municipal and industrial wastewater for hydraulic fracturing and other secondary uses. The development of a water reuse and storm water use policy is being led by AEP and involves cross-ministry and regulatory partners.
- Rainwater harvesting — the collection and conveyance of rainwater from a building's roof to storage in a rain barrel or a cistern for reuse in irrigation or other approved non-potable uses; Alberta has issued guidelines[82] for residential rainwater harvesting systems. Strathcona County,[83] for example, encourages the use of rain barrels among its residents.
- Reclaimed water systems within a single property — an Alberta Municipal Affairs policy that addresses the recapture and reuse of wastewater within a single residence.
- Water trading or transfer to a higher valued use within existing licences.

Case Study: Demand Management in Australia

Demand management strategies are often the fastest and most effective drought response. For example, the Millennium Drought of Australia was the worst one recorded since European settlement. Low rainfall coupled with dry years made parts of the country extremely dry. Because of the resulting stress on agricultural production, the environment, and water supplies, six seawater desalination plants were constructed to provide water to Sydney, Melbourne, Brisbane, Perth, and Adelaide. The drought resulted in a national plan for water security.

80 https://www.awchome.ca/projects/protecting-sources-drinking-water-alberta-2/

81 https://open.alberta.ca/publications/interim-guidance-to-authorize-reuse-of-municipal-and-industrial-wastewater

82 https://open.alberta.ca/publications/5917517

83 https://www.strathcona.ca/agriculture-environment/footprint/water-conservation/outdoor-water-saving-tips/rain-barrels/

Case Study: Recycling of Wastewater & Demand Management in California

Droughts are a recurring feature of California's climate. In the last century, the most significant statewide droughts occurred in 1929 – 1934, 1976 – 1977, 1987 – 1992, and 2012 – 2016.

Water reuse is the use of reclaimed water from business and home wastewater for drinking, irrigation, industrial, or other beneficial uses. It is integral to California's water management and allows for economic and population growth. Greywater is the primary type of wastewater reclaimed because contaminants can be filtered and cleaned using membranes or through biological treatment methods.

For more information, see Appendix II.

Case Study: Australia's Snowy Mountains Hydro-electric Scheme

The Snowy River is in southeastern Australia, originating on Mount Kosciuszko. Until the construction of the Snowy Mountains Hydro-electric Scheme, it was the largest snowmelt river in Australia. The Snowy Mountains Hydro-electric Scheme was jointly built by the New South Wales, Victorian, and Commonwealth governments over a 25-year period from 1949 to 1974. The scheme was designed following one of the worst droughts on record in the area (1939 – 1945) to provide around 1,000 gigalitres of water to each of the Murray and the Murrumbidgee river valleys each year.

The scheme was designed to collect and store water, including water that would otherwise flow east down the Snowy River to the coast, divert it through trans-mountain tunnels and power stations, and then release it west of the Snowy Mountains into the catchments of the Murray River and the Murrumbidgee River. There the water can be used for town water supply, irrigation, and environmental purposes.

For more information, see Appendix II.

Below are some suggestions from the American Waterworks Association's Drought Preparedness manual[84] on Supply Augmentation Methods:

Supply Augmentation Method	Examples
Increase existing supplies, draw from reserve supplies, or develop new supplies	■ Increase groundwater pumping. ■ Increase use of recycled water. ■ Require use of non-potable water for non-potable uses. ■ Reactivate abandoned dams. ■ Import water by truck. ■ Rehabilitate operating wells. ■ Deepen wells. ■ Add wells. ■ Reactivate abandoned wells. ■ Renegotiate contractually controlled supplies. ■ Use reservoir dead storage.
Increase supplier water use efficiency	■ Compile an annual system water audit. ■ Employ proactive leakage management. ■ Reduce distribution system pressure, as feasible. ■ Replace inaccurate meters. ■ Detect and thwart unauthorized consumption. ■ Minimize reservoirs spills. ■ Suppress reservoir evaporation. ■ Recirculate wash water. ■ Blend primary supply with water of lesser quality. ■ Transfer surplus water to areas of deficit. ■ Change pattern of water storage and release operations. ■ Stop turf irrigation at supplier facilities.

84 https://www.awwa.org/Store/Product-Details/productId/75759388

Supply Augmentation Method	Examples
Cooperate with other agencies	■ Negotiate purchases or options. ■ Arrange for exchanges. ■ Establish transfers or interconnections. ■ Employ mutual aid agreements.

Additional Resources

Environmental Protection Agency's Drought Response and Recovery[85]

This guide provides practical solutions to help drinking water utilities respond to and recover from drought. It includes information on staffing, response plans, funding, water supply and demand management, communications and partnerships, as well as case studies and videos.

85 https://www.epa.gov/sites/production/files/2016-03/documents/epa_drought_response_and_recovery_guide.pdf

At a Glance:

Theme D — Demand Management

Why:

Demand management improves water use efficiency, stretching water supplies further.

Applicable for:

Before a Drought	Warning Signs	During a Drought	After a Drought
✓	✓	✓	✓

Strategies:

- Develop regulatory tools
- Develop a CEP plan
- Implement and encourage water conservation, curtailment strategies, and programs

Key Supporting Tools:

- Land Use Bylaws
- Water Utility Bylaws
- Water Conservation Bylaws
- Alberta Urban Municipalities Association — Inventory of Municipal Water CEP Plans
- Drought Preparedness and Response, Manual of Water Supply Practices

4.2.4 Theme D — Demand Management

Demand management refers to management actions that are taken to limit the quality and quantity of water that is needed to achieve a task; alter a task so that it can be accomplished using a lower quality of water or less; decrease water loss from source to tap; regulate water use to off-peak periods; and increase the capacity of the water-management system to operate effectively during a drought. The following are some strategies that can help facilitate this process:

Theme	Strategy	Before	Warning signs	During	After
D. Demand management	D1. Develop regulatory tools	✓			✓
	D2. Develop a CEP plan	✓			✓
	D3. Implement and encourage water conservation and curtailment strategies and programs	✓	✓	✓	✓

STRATEGY D1: Develop regulatory tools

The Alberta Urban Municipalities Association (AUMA) provides a list of examples of legal tools[86] that various municipalities in Alberta have already implemented. These include bylaws to support water restrictions during shortages and water efficiency requirements. Water utility bylaws and water conservation bylaws are important tools to support water conservation at the municipal level. However, it is important to note that not all bylaws have enforcement components. Examples include the following:

-
- The City of St. Albert Water Conservation Bylaw[87] helps promote the efficient use of water in the community and reduces water waste. It focuses on low-flow fixtures for new developments and major renovations, as well as restrictions for outdoor daytime sprinkler use.
- The Town of Cochrane Water Utility Bylaw[88] includes details about hydrants, utility accounts, rates and billing, water conservation, plumbing fixtures, water quality, and bulk water.

86 https://www.abmunis.ca/sites/default/files/Advocacy/Programs_Initiatives/Water/water_conservation_-_examples_of_legal_tools_pdf.pdf
87 https://stalbert.ca/site/assets/files/1878/bylaw_22-2015_-_water-conservation-bylaw.pdf
88 https://www.cochrane.ca/ArchiveCenter/ViewFile/Item/224

- Town of Okotoks Water Utility Bylaw[89] includes water conservation restrictions for both indoors and outdoors.
- The City of Calgary Water Utility Bylaw includes details on water meters, drainage, emergency shut-off, and water restrictions in the event of a water shortage. Millennium Drought

Land Use Bylaws can also include several provisions to support drought mitigation efforts.

- The Strathcona County Land Use Bylaw[90] has provisions for minimum setbacks from watercourses and water bodies.
- The Town of Cochrane Land Use Bylaw[91] has provisions for the following:
  - restrictions on development in riparian lands and wetlands
  - requirements for development permits for stripping and grading on riparian lands adjacent to water bodies
  - xeriscaping requirements

The Drought Preparedness and Response, Manual of Water Supply Practices[92] in the American Waterworks Association's M60 manual provides information about forecasting supply in relation to demand and balancing supply and demand, as well as assessing mitigation options.

STRATEGY D2: Develop a CEP plan

Water Conservation, Efficiency and Productivity (CEP) Plans[93] help communities assess their water use and identify opportunities to make better use of water resources. CEP plans typically include targets for improving water use along with strategies to achieve them. For examples of municipal water CEP plans, see the inventory[94] produced by AUMA. For example, Strathcona County's Water CEP Plan[95] developed in 2012 aims to reduce per capita residential water usage by 20% from 2006 levels by 2020.

89 https://www.okotoks.ca/sites/default/files/2021-07/Bylaw%2023-21%20-%20Water_Bylaw.pdf
90 https://www.strathcona.ca/council-county/bylaws-and-policies/land-use-bylaw/
91 https://www.cochrane.ca/637/Land-Use-Bylaw
92 https://www.awwa.org/Store/Product-Details/productId/75759388
93 https://www.awchome.ca/projects/water-conservation-efficiency-productivity-1/
94 https://auma.ca/sites/default/files/Advocacy/Programs_Initiatives/Water/water_conservation_-_municipal_conservation_efficiency_productivity_plans.pdf
95 https://www.strathcona.ca/files/files/at-ut-waterplan.pdf

STRATEGY D3: Implement water conservation, curtailment strategies, and programs

General examples of water conservation and curtailment strategies include the following:

- water metering
- water rate systems: consumption-based water rates, tiered water rates, and full-cost accounting
- water restrictions
- documentation of historical knowledge and experience from past municipal staff members so that it is not lost in staff turnovers
- determination of the impacts of additional water licences on the overall water-management system
- water savings audits or rebate programs targeting different sectors (e.g., industrial, commercial, institutional, residential) depending on the municipality
- forecasting future municipal growth and measures in place to adapt to these over time (e.g., implementing standards for water efficiency in newer homes, low-flow faucet aerators and showerheads, dual flush toilets, incentives for rainwater harvesting)
- incentives for building renovations

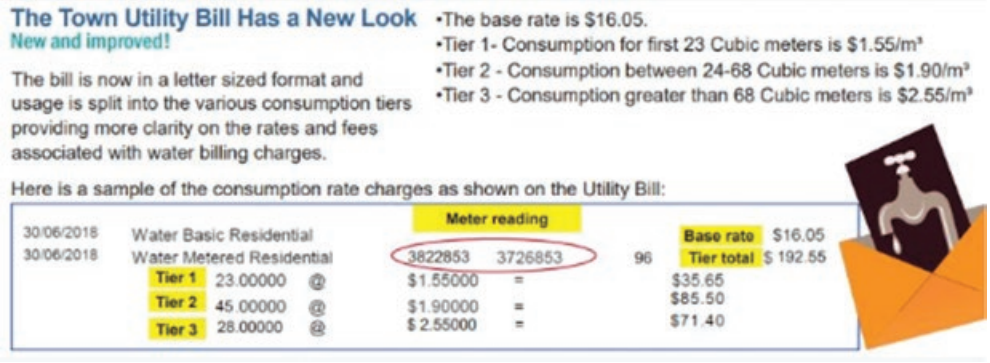


Figure 4. The Town of Okotoks' three-tiered water rate system

Examples of programs implementing these measures include:

- the Outdoor Watering Schedule[96] in Okotoks which is in effect annually from May 1 to October 31; the website outlines the four outdoor watering schedule levels as per the Water Shortage Response Plan
- the Okotoks' Water Conservation Rebate Program[97] includes drought-tolerant plants, mulch, rain barrels, irrigation controllers, and rainwater harvesting systems
- the Camrose Water Shortage Response Plan lists several water conservation strategies
- The City of Calgary's Water Efficiency Plan[98] outlines water conservation efforts, including programs, goals, strategies, and targets to address water supply challenges
- the City of Edmonton's Rehabilitation Incentive Qualification[99]

Case Study: Conserving Water in Vancouver

The water supply for Metropolitan Vancouver originates from the Capilano, Seymour, and Coquitlam watersheds. In 2015, Vancouver experienced an extreme drought because of a lack of winter precipitation, and water restrictions were placed on residents. Climate change projections for the region estimate that while total annual precipitation will increase, there will be lower levels of precipitation on average in the summer, which is already the driest season of the year.

Several options are being explored to increase the water supply, including expanding existing reservoirs and identifying new water sources (e.g., the Fraser River). However, most of the City's efforts are focused on decreasing demand through public awareness initiatives. These efforts have seen some success — the average daily per capita water use for Metro Vancouver has been steadily decreasing since 2009.

See Appendix II for more information.

96 https://www.okotoks.ca/sustainability/your-environment/water/outdoor-watering-schedule
97 https://www.okotoks.ca/sustainability/rebate-programs/water-conservation-rebate-program
98 https://www.calgary.ca/UEP/Water/Documents/Water-Documents/water_efficiency_plan.pdf?noredirect=1
99 https://www.edmonton.ca/city_government/edmonton_archives/financial-rehabilitation-incentives.aspx

At a Glance:

Theme E — Land-Use Planning

Why:

Land-use planning aims to balance the needs of environmental, economic, and social aspects of a community. Land-use planning can play a key role in determining how resilient a community is to multi-year drought.

Applicable for:

Before a Drought	Warning Signs	During a Drought	After a Drought
✓	✓	✓	✓

Strategies:

- Maintain and restore riparian areas and wetlands
- Provide incentive programs to encourage drought-tolerant landscaping

Key Supporting Tools:

- Land-use Framework
- Conservation Priority Mapping Tool
- *Municipal Government Act*
- Stepping Back from the Water: A Beneficial Management Practices Guide for New Development
- Canadian Agricultural Partnership
- Miistakis' Institute's Conservation Easement Guide for Municipalities
- Ducks Unlimited — Wetland Restoration Programs
- Alberta Riparian Habitat Management Society
- Cows and Fish — Caring for the Green Zone
- Watershed Resiliency and Restoration Program
- Alberta Wetland Policy
- Alberta Wetland Restoration Directive
- Alberta Wetland Offset Program
- Alberta Wetland Mitigation Directive
- Alternative Land Use Services (ALUS)
- WPACs and Integrated Watershed Management Plans

4.2.5 Theme E — Land-Use Planning

Land-use planning aims to balance the environmental, economic, and social needs of a community. It is an essential component of governing the growth of various activities (e.g., controlling urban sprawl in environmentally sensitive areas). Land-use planning can play a key role in determining how resilient a community is to multi-year drought. Alberta's Land-use Framework (LUF)[100] and its legislation, the *Alberta Land and Stewardship Act* is an approach for managing private and public lands in Alberta and advancing long-term economic, environmental, and social outcomes. The LUF sets out guiding principles and identifies key strategies that will guide future land-use management in Alberta. The LUF established seven land-use regions and calls for the development of a regional plan for each. The following are some strategies that can help facilitate this process:

Theme	Strategy	Before	Warning signs	During	After
E. Land-use planning	E1. Maintain and restore riparian areas and wetlands	✓			✓
	E2. Provide incentive programs to encourage drought-tolerant landscaping	✓	✓	✓	✓

STRATEGY E1: Maintain and restore riparian areas and wetlands

Riparian areas — the spongy soils and vegetation in land adjacent to lakes, rivers, streams, and wetlands — are important for drought mitigation because they capture and store water during spring snowmelt and during high precipitation events, allowing infiltration to groundwater aquifers. Water is slowly released over the summer months, which regulates water levels and river flows. Similarly, wetlands and riparian land provide many ecological goods and services to society along with natural water storage and release. The conservation and management of natural riparian areas and wetlands, as well as the development of artificial wetlands, is an important drought management strategy. The creation of vegetated filter strips or buffers in riparian lands adjacent to water bodies conserves and manages healthy aquatic ecosystems.

100 https://landuse.alberta.ca/regionalplans/Pages/default.aspx

Several resources and tools already exist in Alberta to support efforts to conserve, manage, and restore riparian lands and wetlands:

Conservation Priority Mapping Tool

This is a new planning decision tool that evaluates, prioritizes, and maps natural assets that support healthy hydrologic functions. Currently, the tool is in the testing stages and available for the Bow River Basin only. The tool provides updated Geographic Information System (GIS) layers for natural assets including crop cover, wetlands, and hydrology.

Developing riparian setback guidelines

The *Municipal Government Act*[101] includes several provisions that enable a local council to create policies and land-use bylaw provisions to conserve and manage riparian lands and wetlands. For example, municipalities can develop building development setbacks from water bodies and low-lying areas, such as ephemeral wetlands, riparian lands, and lands subject to flooding. Municipalities may also require the dedication of wetlands and riparian lands adjacent to most water bodies during the process of land subdivision. Municipalities can create local riparian land and wetland conservation and management policies to include in their municipal development plans, area structure plans, and land-use bylaws. Rocky View County,[102] The City of Calgary,[103] the City of Edmonton,[104] Strathcona County,[105] and the Town of Cochrane[106] provide some useful examples of such polices and land-use bylaw provisions.

Determining appropriate setback distances may require assistance from specialists because all water bodies and riparian lands are unique, and there is no one size fits all. However, the GoA has developed a guide to help municipal planners determine these distances during new development applications called Stepping back from the water: a beneficial management practices guide for new development near water bodies in Alberta's settled region.[107] The guide provides decision makers with information for policy development and directions for how to scientifically determine appropriate distances from the water body where development and buildings may be restricted, or regulated and controlled.

101 http://www.qp.alberta.ca/documents/Acts/m26.pdf
102 https://www.rockyview.ca/Portals/0/Files/Government/Bylaws/RVC-Land-Use-Bylaw.pdf
103 **https://www.calgary.ca/planning/land-use.html**
104 https://webdocs.edmonton.ca/InfraPlan/zoningbylaw/bylaw_12800.htm
105 https://www.strathcona.ca/council-county/bylaws-and-policies/land-use-bylaw/
106 **https://www.cochrane.ca/ArchiveCenter/ViewFile/Item/255**
107 https://open.alberta.ca/publications/9781460100592

Canadian Agricultural Partnership

The Canadian Agricultural Partnership[108] is a five-year, $3 billion investment by federal, provincial, and territorial governments to strengthen the agriculture and agri-food sector. The partnership features programs and services and key enhancements to programs that help farmers manage significant risks that threaten the viability of their farm and are beyond their capacity to manage. For example, there are programs[109] related to environmental sustainability and farm water development for producers.

Conservation easements

Conservation easements are a tool whereby a landowner gives up certain rights or opportunities to develop private lands to protect the conservation values of all or part of their land. Conservation easements can be used for different purposes, including the protection, conservation, and enhancement of the environment. For more information about how municipalities can use conservation easements, refer to the Miistakis Institute's Conservation Easement Guide for Municipalities.[110]

Ducks Unlimited programs

Ducks Unlimited partners with landowners to help restore and protect land and water resources through a variety of programs.[111] In particular, its wetland restoration programs[112] focus on restoring naturally occurring water levels of drained and altered wetlands.

Cows and Fish

The Alberta Riparian Habitat Management Society, also known as Cows and Fish,[113] works with landowners and communities on riparian health and management, providing technical assistance and information. Cows and Fish can support communities in carrying out riparian health assessments to identify concerns and address issues.

Among the many resources Cows and Fish offers is the Caring for the Green Zone[114] book that provides effective approaches for riparian areas and grazing management.

108 https://agriculture.canada.ca/en/department/initiatives/sustainable-canadian-agricultural-partnership
109 https://cap.alberta.ca/CAP/Programs
110 https://www.communityconserve.ca/wp-content/uploads/2017/05/Cons-Easement-Guide-for-Municipalities-_Oct-2017_Final.pdf
111 https://www.ducks.ca/resources/landowners/
112 https://www.ducks.ca/resources/landowners/wetland-restoration/
113 http://cowsandfish.org/
114 https://cowsandfish.org/publications/riparian-areas-and-grazing-management/

Watershed Resiliency and Restoration Program (WRRP)

The WRRP[115] aims to build long-term watershed resiliency to flood and drought by improving natural watershed functions and engaging Albertans in the conservation, restoration, enhancement, and stewardship of critical watershed features including wetlands, riparian areas, and floodplains. WRRP was established in 2014, in recognition of the importance of improving natural watershed functions to build long-term resiliency for flood and drought. The original three-year program was extended by four years to March 2021. A total of $32.5 million in grant funding will be awarded under the program to external partners working to improve Alberta's natural watershed resiliency. By June 2018, over $29 million has been granted to 52 organizations partnering with others on 80 watershed resiliency projects involving thousands of Alberta's landowners, watershed stewards, scientists, and industry practitioners.

The WRRP has also conducted a needs assessment survey[116] to better understand how to work with municipalities to ensure the functions of riparian areas and wetlands are maintained.

Alberta Genuine Progress Indicators Accounts: Wetlands and Peatlands

This report[117] examines the extent of peatlands and wetlands in Alberta and provides insight into the following:

- the state of Alberta's wetlands and peatlands
- what is being mined for horticultural purposes
- how much carbon peatlands sequester annually
- the environmental and economic impacts of wetland drainage
- the benefits of ecological services
- the full costs of degrading Alberta's wetlands

115 https://www.alberta.ca/watershed-resiliency-and-restoration-program.aspx

116 https://open.alberta.ca/publications/riparian-areas-and-wetlands-municipal-engagement-needs-assessment-survey-summary

117 https://www.pembina.org/pub/wetlands-and-peatlands

Alberta Wetland Policy

The policy[118] provides the strategic direction and tools required to make informed management decisions in the long-term interest of Albertans. The policy will minimize the loss and degradation of wetlands while allowing for continued growth and economic development in the province.

Alberta Wetland Restoration Directive

The purpose of this directive[119] is to provide assurance that wetland restoration actions are meeting intended outcomes to restore wetland area and function.

Alberta Wetland Offset Program description

The Wetland Offset Program[120] is the first offset program that meets the requirements for wetland replacement outlined in the Alberta Wetland Policy.

Alberta Wetland Mitigation Directive

This directive[121] gives direction and criteria for implementing the mitigation hierarchy (Avoid, Minimize, Replace) for wetlands. The directive reiterates the strong preference for avoiding all impacts to wetlands and for proponents to give evidence for avoidance. If avoidance is not possible, proponents should then minimize these impacts. The last option a proponent should pursue for mitigation is wetland replacement. The directive outlines three mechanisms for replacements: through a wetland offset registry (not yet available), a fee in lieu, or permittee-responsible replacement. A replacement proposal must be submitted with an application if wetland loss is unavoidable.

Alberta Wetland Regulatory Requirements Guide

This guide's[122] purpose is to improve public knowledge of the regulatory instruments and processes applicable to the Alberta Wetland Policy Implementation.

Agroforestry and Woodlot Extension Society

This is a non-profit organization[123] made up of members from government, industry, and non-profit sectors that share the common goal of encouraging sustainable forest management on private lands.

118 https://www.alberta.ca/alberta-wetland-policy-implementation.aspx
119 https://open.alberta.ca/publications/9781460131497
120 https://open.alberta.ca/publications/wetland-offset-program-description
121 https://open.alberta.ca/publications/9781460130025
122 https://open.alberta.ca/publications/9781460123591
123 https://www.awes-ab.ca/

Alternative Land Use Services (ALUS)

ALUS Canada[124] is a national charitable organization that supports the delivery of a program that invests in farmers and ranchers, allowing them to conserve and/or manage their land to maintain or increase the production of ecosystem services, instead of developing the land.

WPACs and Integrated Watershed Management Plans

WPACs often address riparian areas and wetlands in their watershed management plans. Battle River Watershed Alliance has recommendation documents for riparian areas[125] as well as wetlands.[126] Other WPACs have made management recommendations, including:

- develop incentive and support programs (financial and expertise) to enable and assist landowners to retain naturally occurring wetlands, restore drained and altered wetlands, and create new wetlands on their own land.
- improve the security and volume of water supplies in the Milk River watershed using storage and/or water pipeline options that will attract industry and provide agricultural producers security for expanding operations. Additional benefits could include stable water supplies for municipalities and rural water users, power generation, recreation, flood mitigation, and flow regulation for aquatic life and riparian habitat.
- include in livestock grazing plans the creation of riparian pastures within a rotational grazing system.
- implement remote watering systems.
- re-establish preferred native tree and shrub species.
- determine permitted and restricted activity in riparian setbacks.

STRATEGY E2: Provide incentive programs to encourage drought-tolerant landscaping

During land-use development in many municipalities the natural spongy soils and vegetation are stripped of trees, vegetation, and topsoil to put in water and other servicing. After servicing is installed, the lands are compacted to flat level surfaces to construct buildings. Because of soil compaction, during snowmelt and heavy rains, water can no longer infiltrate the soils and be stored for slow release during the summer months. Sometimes, new homeowners also replace drought-tolerant species with grasses and ornamentals that require irrigation throughout the summer.

124 https://alus.ca/

125 http://www.battleriverwatershed.ca/watershed-management-planning/riparian-areas/

126 http://www.battleriverwatershed.ca/watershed-management-planning/wetlands/

Many communities provide incentives to encourage landowners moving to new subdivisions to use drought-tolerant landscaping. Additional incentive options include the promotion and installation of drought-tolerant landscapes and plants by landscaping professionals, irrigation professionals, and retailers. Cochrane's Land Use Bylaw[127] defines the use of drought-tolerant landscaping as "xeriscaping" meaning "landscape design that seeks to reduce or eliminate the requirement for supplemental water. This can be accomplished through various means including the use of native or drought-tolerant plants, the structure of the sub-soil, proper use of mulch, and the potential integration of inorganic material in the landscape."

The Alliance for Water Efficiency launched its Outdoor Water Savings Research Initiative[128] in 2015. It was a North American-wide research study that examined various landscape transformation programs for their effectiveness and assessed a diverse selection of stakeholder attitudes regarding water-efficient landscapes. After cost, the research found the two major barriers to customers adopting landscape transformations were perception of drought-tolerant landscapes and their design, installment, and maintenance. Several methods can be used to help address these barriers:

- emphasize that drought-tolerant landscapes can be beautiful, and provide examples such as model gardens
- deliver instructional workshops
- provide support for installment and maintenance services to older, or less able, homeowners

Cochrane has developed Xeriscaping Standards/Specifications (18/2016) that are now part of the Land Use Bylaw[127] requirements for new developments.

Other urban centres and some of Alberta's cities have water conservation and xeriscaping rebate programs to provide incentives for drought-tolerant landscaping. A few examples are listed below.

City of Calgary

The City of Calgary offers free mulch and compost pick-up days in additions to their YardSmart Program,[130] which provides information on water-wise plants that are drought tolerant and act as filters and sponges for rainwater run-off.

127 https://www.cochrane.ca/ArchiveCenter/ViewFile/Item/255

128 https://www.allianceforwaterefficiency.org/sites/www.allianceforwaterefficiency.org/files/highlight_documents/AWE-OWSRI-Phase-1-Final-Report-01-2015.pdf

129 https://www.calgary.ca/water/programs/water-wise-annuals-and-perennials.html

City of Edmonton

The City of Edmonton has an Eco-Landscaping[130] section of its website that provides information on designing yards to conserve water, using selective plantings, collecting rainwater, watering wisely, backyard composting, mulching, grass-cycling, and using a push or electric mower.

City of Medicine Hat

The City of Medicine Hat has a Water Efficient Landscaping initiative.[131] It is a collaborative initiative between the City of Medicine Hat and the Medicine Hat College to educate local and regional homeowners about alternatives to traditional landscaping while promoting practices that conserve water and protect the environment. The garden showcases a seven-step approach to developing a water-wise landscape. The seven steps work in any climate. A landscape designed, installed, and managed according to the seven steps uses up to 50% less water than a traditional landscape.

Case Study: Diversification of Tree Inventory in Grande Prairie

Multi-year drought can be a significant stressor for some tree species, not just because of a shortage of water. Certain species of stressed trees release chemical signatures into the air that are detectable by insects. The insects recognize the chemicals as a signal that the tree that will generally lack defence due to its stress, and the insects will target these trees. Drought can therefore escalate outbreaks of certain insects which can significantly impact tree populations.

In Grande Prairie, the drought in the early 2000s triggered an outbreak of the bronze birch borer (*Agrilus anxius* Gory) which is still ongoing. The outbreak resulted in die-offs of paper birch (*Betula papyifera*) and European cutleaf weeping birch (*Betula pendula*). In addition to being strict monetary assets as part of the urban forest, these trees provide several benefits to the community including improved air quality, regulation of stormwater flows, and can contribute to personal health and well-being. Grande Prairie has since increased the diversity of its tree inventory, which may reduce the impact of future multi-year droughts on the community, including a reduction in the likelihood and severity of future insect outbreaks.

130 https://www.edmonton.ca/residential_neighbourhoods/gardens_lawns_trees/eco-landscaping.aspx

131 https://www.medicinehat.ca/government/departments/environmental-utilities/water-utility/water-initiatives/water-efficient-landscaping

City of Lethbridge

The City of Lethbridge has created a brochure called Xeriscape: The Seven Principles of Landscape Water Conservation.[132] It provides information on the seven principles as well as the benefits of xeriscaping.

Other

The following references provide additional xeriscaping information from programs in Canada and the United States:

- Canadian Mortgage and Housing Corporation's Household Guide to Water Efficiency,[133] in the section on "Water-efficient landscapes and more"
- Glendale, Arizona — Landscape Rebate Program[134]
- New Mexico — EPCOR Landscape Rebate Program[135]
- Water Smart Irrigation Professional (WSIP)[136] — Landscape Ontario, in partnership with the Region of Peel, the Regional Municipality of York, and the City of Hamilton, developed the WSIP program to provide select irrigation companies with specialized training and certification to provide "Water Smart" irrigation system efficiency and maintenance services.

132 https://www.lethbridge.ca/living-here/water-wastewater/Documents/XeriscapeBrochure_CityofLethbridge_Edited.pdf

133 Click continue to publication to access the document: http://publications.gc.ca/collections/collection_2016/schl-cmhc/NH15-362-2014-eng.pdf

134 https://www.glendaleaz.com/live/city_services/water_services/water_conservation_and_sustainable_living/landscape_rebate

135 https://www.epcor.com/learn/efficiency-conservation/rebate-programs/Pages/default.aspx#landscape

136 https://horttrades.com/wsip

At a Glance:

Theme F — Agriculture

Why:

In Alberta, agriculture plays a critical part of our economy and as seen in the past, can be devastated by multi-year droughts.

Applicable for:

Before a Drought	Warning Signs	During a Drought	After a Drought
✓	✓	✓	✓

Strategies:

- Ensure stakeholders know where to get resources
- Encourage best practices for drought preparedness

Key Supporting Tools:

- Agriculture Drought and Excess Moisture Risk Management Plan for Alberta
- Canadian Drought Monitor
- Grasshopper Forecast
- Agricultural Moisture Situation Updates
- Drought Proofing Farm Water Supplies

4.2.6 Theme F — Agriculture

In Alberta, agriculture plays a critical part of our economy and as seen in the past, can be devastated by multi-year droughts. For example, drought can negatively impact crop and livestock. It is important for producers to be prepared and know where to get help. The following are some strategies that can help facilitate this process:

Theme	Strategy	Before	Warning signs	During	After
F. Agriculture	F1. Ensure stakeholders know where to get resources	✓	✓	✓	✓
	F2. Encourage best practices for drought preparedness	✓	✓		✓

STRATEGY F1: Ensure stakeholders know where to get resources

It is important to raise awareness of agriculturally-focused drought management resources and where they can be accessed by municipalities and other involved groups. The following are some examples available:

Agriculture Drought and Excess Moisture Risk Management Plan for Alberta[137]

This plan outlines risk management actions to mitigate the effects of drought and excess moisture on Alberta's agricultural areas and provides links to several other GoA resources, including soil moisture and precipitation conditions.

Canadian Drought Monitor[138]

The Canadian Drought Monitor (CDM) is Canada's official source for the monitoring and reporting of drought in Canada. From this page, you can access a variety of products and information about current drought conditions across the country.

Managing Agroclimate Risk[139]

This is a list of items for farmers to consider when making management decisions related to drought conditions.

137 https://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/ppe3883/$file/2016_06_16_ADEMP_Extreme_Weather_Events.pdf?OpenElement

138 https://agriculture.canada.ca/en/agricultural-production/weather/canadian-drought-monitor

139 https://agriculture.canada.ca/en/agricultural-production/weather/extreme-weather-indices

Grasshopper forecast[140]

This forecast map is based on an annual grasshopper count conducted in the previous year by participating Agriculture Fieldmen. Environmental factors can result in higher or lower actual populations than the forecast.

Agricultural moisture situation updates[141]

The Agricultural Moisture Situation Update is developed by the drought modelling team and published frequently as appropriate during the growing season and less frequently during winter months.

STRATEGY F2: Encourage best practices for drought preparedness

A best practice is any process that has been shown by research and experience to produce optimal results and that is established as a valuable model or example to be followed. Best practices should be documented throughout the drought management process and used to improve responsiveness. Some examples of best practices that producers can undertake for their own drought preparedness, as well as examples of ways they can contribute to collaborative efforts, are provided below.

Drought response planning

- Establish a drought response committee with municipal staff and other relevant groups who are knowledgeable in operations, communications, regulatory requirements, legal impacts, and financial planning.
- Establish a drought response plan that includes trigger levels and water use reduction measures. Develop a clear but flexible plan, including specific reduction goals and restrictions to address current and anticipated conditions. Do not wait for an emergency to occur before developing a plan for action.
- Simulate a drought with municipal staff, involved groups, and other external stakeholders to uncover the operational difficulties and details associated with drought contingency strategies before the next crisis begins.

Communication

- Understand the communication venues and media your municipality uses to get information and target messages to your audience using these preferred channels.

140 https://www.alberta.ca/grasshopper-forecast.aspx

141 https://open.alberta.ca/publications/moisture-situation-update

- Keep communication messages clear, simple, and consistent and collaborate with other involved groups to share the same message.

Funding and budget

- Implement water conservation and curtailment measures to adapt to drought and save on capital costs.
- Partner with local and regional entities to leverage municipal, provincial, and federal funds.
- Develop a marketing plan that includes drought considerations. The plan should cover herd management, and contingencies for poor crop quality including salvaging for feed.
- Consider drought in a business plan and the potential for a sudden change in income. The business plan should include back-up options to ensure financial obligations are met and direction as to when to communicate with financial institutes to ensure they are aware of the current situation and to discuss options.

Water supply

- Explore innovative approaches for water supply options.
- Know the emergency water supplies in your local area, such as community tank loaders and water haulers.

Community health

- What tools and resources are available for producers and their families to support mental health during a drought?

An additional resource to help with this is Drought Proofing Farm Water Supplies[142] from Alberta Agriculture and Forestry.

142 https://open.alberta.ca/dataset/4252750

At a Glance:

Theme G — Ecological Systems

Why:

Ecological systems can be severely impacted by multi-year droughts, which are also known as ecological droughts.

Applicable for:

Before a Drought	Warning Signs	During a Drought	After a Drought
✓		✓	✓

Strategies:

- Monitor conflicts between human needs and Instream Flow Needs
- Develop and implement Instream Objectives

Key Supporting Tools:

- Stakeholder Committees
- Desktop Method for Establishing Environmental Flows in Alberta Rivers and Streams

4.2.7 Theme G — Ecological Systems

Ecological systems can be severely impacted by multi-year droughts, which are also known as ecological droughts. Some impacts can include reductions in plant growth; increases in fire and insect outbreaks; changed rates of carbon, nutrient, and water cycling; and species extinctions in extreme cases. It is important to be aware of these impacts and prepare for them. The following are some strategies that can help facilitate this process:

Theme	Strategy	Before	Warning signs	During	After
G. Ecological systems	G1. Monitor conflicts between human needs and Instream Flow Needs	✓		✓	
	G2. Develop and implement Instream Objectives	✓			✓

STRATEGY G1: Monitor conflicts between human needs and Instream Flow Needs

During multi-year droughts, the demand for water for human needs is often in direct competition with stream flows required to support a healthy, resilient aquatic environment. The provincial government may restrict certain human uses during a drought to protect the aquatic environment, including the needs of fish and other life forms and the ecosystems that they depend on for survival.

Municipal councils may need to develop their own policies and programs in collaboration with their stakeholders to identify ecological parameters to protect and address these conflicts should a severe, multi-year drought occur. For example, policies and programs may include gathering information on which human uses of water could be discontinued for short or rotating periods of time without destroying valuable patterns of social and institutional community life. Discussions should take place during drought planning to ensure everyone understands the social, economic, and ecological consequences and conflicts that may occur specific to the community.

In this example, a group of local stakeholders could form a task group such as a stakeholder committee (see STRATEGY J2: Assemble a stakeholder committee) that would be responsible for the following:

- identifying users
- identifying user requirements

- identifying when Instream Flow Needs could conflict with other uses and options to mitigate conflict

The activities of a stakeholder committee could be assessed with possible support from AEP or consultants. It is important for water users to understand instream flow requirements needed to maintain ecological integrity, as well as their own water use needs.

An understanding of how low-flow conditions can impact the health of the local aquatic ecosystem will contribute to better informed discussions. Recognizing that while aquatic ecosystems may be somewhat resilient, extremely low flows or droughts of longer duration could cross thresholds that may have severe and even irreversible impacts to aquatic and wildlife communities and the resultant ecological services they provide for humans within a watershed. Decision making must consider the potential for permanent loss of fish and invertebrate communities and irreversible damage to the aquatic environment.

Methods used to estimate instream flow requirement thresholds (such as the method outlined in the Surface Water Allocation Directive[143]) could be used as a conflict monitoring tool. Such "desktop" tool thresholds are based on environmental principles such that the effects of further habitat loss are disproportionately greater when a system is already under stress from drought. Thresholds could be used to trigger the need for water use restrictions. Flow objectives should distinguish between human water use and instream flows, where possible, to provide a clear understanding of when and where management actions are required.

Many water conflict situations are effectively addressed through facilitated in-person meetings and discussions. When everyone has the best data and information available, it provides a foundation for common understanding and allows for effective group collaboration and progress on issues. Possible water-sharing agreements, water prioritization discussions, water limits, and other conservation measures should be discussed as part of a drought plan. The tools and processes, in addition to communication and education strategies, are best laid out in advance of a drought. A group, such as a stakeholder committee, becomes important for providing a base for these discussions to happen before a drought.

143 https://open.alberta.ca/publications/9781460143339

Some municipalities in Alberta have attempted to address hypothetical conflicts that may arise during their drought management planning sessions. A few examples are listed below.

- The City of Calgary has developed a Water Efficiency Plan[144] based on monitoring data and projected water supply and demand scenarios, including times of drought.
- The City of Calgary has also set targets for environmental flows in their draft drought management plan.
- Lethbridge has developed a multi-staged process for water rationing[145] during severe drought conditions. Citizens monitor their own uses of water and respond to the rationing restriction. Violators are subject to significant fines if rationing is in place and enforced.
- Okotoks has developed a Water Conservation, Efficiency and Productivity Plan,[146] outlining how the municipality will manage its water supply. The plan notes that Instream Objectives are monitored for its rivers on a regular basis.

An article by three prominent legal scholars, Michael Wenig, Arlene Kwasniak and Michael Quinn called "Water Under the Bridge"[147] provides information on the need for understanding and responding to Instream Flow Needs in Alberta's regulatory system.

STRATEGY G2: Develop and implement Instream Objectives

Water allocations within a watershed may impact the health of the aquatic environment, including fish, wildlife, and their habitat. It is important to acknowledge instream requirements and include them in decision making when managing droughts and building resiliency. There are several methods used to determine instream flow requirement thresholds, including Instream Objectives (IOs), Instream Flow Needs (IFNs), and Water Conservation Objectives (WCOs).

- An IO is a regulated flow that should remain in the river via dam operations or as a restriction on licences.

144 https://www.calgary.ca/UEP/Water/Documents/Water-Documents/water_efficiency_plan.pdf?noredirect=1

145 https://www.lethbridge.ca/living-here/water-wastewater/Pages/Water-Rationing.aspx

146 https://www.okotoks.ca/sites/default/files/2020-12/Okotoks%20Water%20CEP%20Plan%202014_FINAL.pdf

147 https://live-cirl.ucalgary.ca/sites/default/files/External%20Publications/Water%20under%20the%20Bridge%20-%20The%20Role%20of%20Instream%20Flow%20Needs%20(IFNs)%20Determinations%20in%20Alberta's%20River%20Management.pdf

- An IFN is the scientifically determined amount of water, flow rate, water level, or water quality that is required in a river or other body of water to sustain a healthy aquatic environment or to meet human needs (e.g., recreation, navigation, waste assimilation).
- A WCO is defined and legislated under the *Water Act* as an amount and quality of water necessary to protect a natural water body or its aquatic environment, manage fish and wildlife, or to protect tourism, recreation, transportation, or waste assimilation of water. WCOs are established by the Director under Section 15 of the *Water Act*, following a public consultation process that can include development of a Water Management Plan, such as in the case of the South Saskatchewan River Basin Approved Water Management Plan.

For rivers and lakes not covered by Ministerial Orders, Water Management Plans, WCOs, LUF regional plans, or environmental management frameworks, the Surface Water Allocation Directive (SWAD) provides water allocation guidance for water licences. The SWAD thresholds are based on environmental protection principles, with consideration for economic requirements. The SWAD is derived from the Desk-top Method for Establishing Environmental Flows in Alberta Rivers and Streams,[148] whose objective is to provide full aquatic ecosystem protection from water withdrawals in rivers and streams. The SWAD and other desktop methods provide preliminary triggers to advise and inform when flow is getting low and aquatic ecosystems may be under stress.

148 https://open.alberta.ca/publications/9780778599791

At a Glance:

Theme H — Community and Health

Why:

Drought-induced depression, anxiety, psychological distress, and other mental health illnesses can have devastating impacts on individuals, families, and communities.

Applicable for:

Before a Drought	Warning Signs	During a Drought	After a Drought
✓	✓	✓	✓

Strategies:

- Provide resources for people experiencing drought-related stress

Key Supporting Tools:

- Alberta Mental Health Hotline
- PACE Crisis Line
- Farmer Distress Line
- Canadian Mental Health Association
- Crisis Centres and Mental Health Clinics
- Alberta Health Link
- 211 Alberta
- Alberta Health Services Access Mental Health
- Canadian Association for Suicide Prevention

4.2.8 Theme H — Community and Health

Drought-induced depression, anxiety, psychological distress, and other mental health illnesses can have devastating impacts on individuals, families, and communities. Because they experience drought first-hand, farmers are especially vulnerable to drought-related stress and associated mental health issues. The following strategy can help mitigate this:

Theme	Strategy	Before	Warning signs	During	After
H. Community and health	H1. Provide resources for people experiencing drought-related stress	✓	✓	✓	✓

STRATEGY H1: Provide resources for people experiencing drought-related stress

Resources to help people manage drought-related stress include local support groups, crisis hotlines, crisis centres and mental health clinics, information lines and websites, and counselling services.

Crisis hotlines

- Alberta Mental Health Hotline[149] — provides support for individuals dealing with an individual, family, and/or community crisis with a 24-hour crisis line at 1-877-303-2642.
- PACE Crisis line (Providing Assistance, Counselling, and Education) — serves the Peace Region with a 24-hour crisis line at 780-539-6666.
- Distress Line of Southwestern Alberta (Canadian Mental Health Association)[150] — serves the Chinook Health Region and the southern part of Calgary and be reached 24 hours a day at 1-888-787-2880 and 403-327-7905 and online.
- Farmer Distress Line — serves communities across Alberta with access to mental health professionals available to individuals, family members, concerned others, and community agencies dealing with stress, anxiety, depression, suicide, and other emotional or psychiatric crises. It can be reached at 1-877-303-2642.

149 https://www.albertahealthservices.ca/amh/amh.aspx
150 http://lethbridge.cmha.ca/

- Canadian Mental Health Association (Regional Resources)[151] — delivery of mental health recovery services, housing, advocacy, and mental health promotion. Their divisional office supports and promotes this work across Alberta for collective impact. They offer a mental help hotline (1-877-303-2642), suicide help line (911), Distress Line Edmonton and area (780-482-4357), Distress Line Calgary and area (780-403-266-4537), Distress Line of Southwestern Alberta (403-327-7905), First Nations and Inuit Hope for Wellness Help Line (1-855-242-3310), and Rural Distress Line (1-800-232-7288).

Crisis centres and mental health clinics

- Doctor Margaret Savage Crisis Centre — located in Cold Lake and can be reached 24 hours a day at 1-866-594-0533 or 780-594-3353 or email at crisis@telusplanet.net.
- St. Paul & District Crisis Centre — serves all Alberta and northeastern Saskatchewan and located in St. Paul. They can be reached 24 hours a day toll-free at 1-800-263-3045 or 780-645-5195 or email at crisis84@mcsnet.ca.
- Distress Centre Calgary[152] — serves Calgary and surrounding areas and be reached 24 hours at 403-266-4357 or at 403-264-TEEN. Online chat support is available here.[153] Their email is info@distresscentre.com.
- Crisis Support Centre,[154] a program of The Support Network — serves Edmonton and northern Alberta and can be reached 24 hours a day at 1-800-232-7288 (toll-free service available for northern Alberta) and 780-482-HELP (4357). Their email is main@cmha-edmonton.ab.ca.
- Community mental health clinics — these clinics provide voluntary clinical community-based mental health services to individuals of all ages who reside in Alberta. Treatment services from the various programs are provided free of charge. For more information, call the confidential helpline at 1-877-303-2642. Another option is to call Alberta Health Link's 811 Service to be assessed and to obtain a referral.

151 Visit links within to find mental health resources for your region https://cmha.ca/
152 https://www.distresscentre.com/
153 https://calgaryconnecteen.com/
154 https://edmonton.cmha.ca/

Information lines and websites

- Alberta Health Link — Pphone 811 for advice, support, and resources on dealing with a variety of health challenges.
- 211 Alberta — phone 211, a 24-hour service providing contact information for social and community services including counselling, financial, and legal resources.
- Alberta Health Services Access Mental Health[155] — provides information, consultation, and referral to individuals residing in Calgary who have addiction and/or mental health concerns.
- Canadian Association for Suicide Prevention[156] — provides information and resources to communities to reduce the suicide rate and minimize the harmful consequences of suicidal behaviour.
- Canadian Mental Health Association[157] — in addition to branches in Calgary and Edmonton, the association has offices in Grande Prairie, Lethbridge, Camrose, Medicine Hat, and Red Deer.

Counselling services

- Some Other Solution — provides counselling to northeastern Alberta. They can be reached 24 hours a day on their toll-free line at 1-800-565-3801.

155 https://www.albertahealthservices.ca/services/Page11443.aspx
156 https://www.suicideprevention.ca/
157 https://cmha.ca/

At a Glance:

Theme I — Public Education

Why:

Drought education is an important part of the management process because it creates awareness among key groups and the public about multi-year drought triggers, impacts, management actions, and how and where residents can find help and resources in times of emergency.

Applicable for:

Before a Drought	Warning Signs	During a Drought	After a Drought
✓	✓	✓	✓

Strategies:

- Educate citizens and stakeholders and encourage them to implement best practices
- Prepare communications materials

Key Supporting Tools:

- Working Well Program
- Communications Plans
- Environmental Protection Agency's Drought Response and Recovery

4.2.9 Theme I — Public Education

Drought education is an important part of the management process because it creates awareness among key groups and the public about multi-year drought triggers, impacts, management actions, and how and where residents can find help and resources in times of emergency. The following are some strategies that can help facilitate this process:

Theme	Strategy	Before	Warning signs	During	After
I. Public education	I1. Educate citizens and stakeholders and encourage them to implement best practices	✓	✓	✓	✓
	I2. Prepare communication materials	✓	✓	✓	✓

STRATEGY I1: Educate citizens and stakeholders and encourage them to implement best practices

Key messages in relation to a drought should be developed before a drought occurs to ensure that they are available when needed. Common messaging from different sources (e.g., provincial government, municipalities, irrigation districts) is important. Communication about drought and water conservation should be purposeful and impactful to avoid desensitizing people about drought and decreasing people's awareness about the importance of drought. It should also reinforce positive messages (e.g., we have enough water to deal with the drought) and emphasize positive actions with quantifiable results. Let your ratepayers know that their actions to implement best practices are working with real-time monitoring results and provide media releases that state how much water usage has been reduced.

When possible, best management practices related to drought should be communicated to stakeholders and citizens through existing channels; doing so may provide cost savings and allow a broader audience to be reached. For example, after conducting research on residential customers, The City of Calgary found the Calgary Horticultural Society[158] to be a trusted source for sustainable landscaping information. Through a partnership model, The City of Calgary and the Calgary Horticultural Society encourage drought-tolerant landscapes through workshops, the creation of model gardens, and various gardening events.

158 https://www.calhort.org/

Communications should also acknowledge any psychological or physical barriers to implementing best practices. For example, the perceived maintenance of The City of Calgary's sustainable landscaping program, YardSmart,[159] was found to be a major barrier to implementation. Communications and education now emphasize the potential simplicity, easy maintenance, and accessibility of YardSmart landscaping.

Conducting research to better understand the audience, including characteristics such as values, desires, and barriers to implementing best practices, will allow communications to emphasize the intersection between desired behaviour change and the audiences' values and preferences.

Considerations for an education and outreach plan include the following:

- Provide regular updates to the community during the drought, including updates on water supply levels (e.g., reservoir levels, supply projections), current conditions, and drought forecasts to ratepayers.
- Ongoing education is key. There is a short period when people are very responsive to messaging before they return to regular habits. It is easy to forget about drought and related resources, especially when there are a few wet years in a row.
- Profile best practices such as xeriscaping or innovative projects (rainwater collection, subsurface irrigation in urban areas, etc.).
- Ensure an evaluation plan is established at the beginning of the communications plan to have desired base-line measures. A pre-knowledge survey or interviews may be necessary.
- Information on drought stages and triggers is useful. Drought stages define actions required to respond during various phases of drought severity.
- Include water use reduction goals. Have a clear understanding of water use allows reduction goals to be expressed as percentage reductions or as reductions of a specific quantity. Monitor water use frequently to see if reduction goals are being met and adjust the plan, as necessary.

159 https://www.calgary.ca/water/programs/yardsmart.html

Rural municipalities can also host extension workshops regarding on-farm water usage. Examples include the following:

- Working Well Program[160]
- workshops on decommissioning abandoned water wells for aquifer protection
- farm water planning workshops
- water-management demonstration tours

STRATEGY I2: Prepare communication materials

It is important to have communication resources in place before and when a drought is happening. It is also advisable to ensure that communication is ongoing whether a drought is happening. These measures help ensure that the community and important groups are involved and proactively preparing for a drought.

The following are a few steps that can be taken to help with developing communications materials:

- Consult communication experts, those who have been impacted by drought, and others to determine what is required.
- Prepare a communications plan that includes:
  - the goals and what you would like to achieve
  - target audiences
  - resources you need to implement the plan (e.g., time, funding, technology, experts)
  - key messages — what are the main items your target audience should know about drought?
  - communication channels — which ones are most effective for your purposes and audiences? For example, non-media approaches (e.g., public information houses, information sessions, demonstration sites), media communication (e.g., social media platforms such as Facebook, Twitter, and YouTube; radio, video, booklets), or a combination of these approaches can be used. A good example is the Town of Castle Rock Drought Management Plan's Public Drought Campaign[161] and the Corporation of the Township of Tudor and Cashel Drought Management Plan's Social Media Tips and Tricks.[162]
- Implement the communications plan with the support of experts.

160 https://www.alberta.ca/working-well-overview.aspx

161 https://crgov.com/DocumentCenter/View/20830/Drought-Managment-Plan-2018-PDF?bidId=

162 http://www.tudorandcashel.com/userfiles/files/2017-27A%20-%20Drought%20Management%20Plan%20document.pdf

- Evaluate and assess the progress of the plan over periodic intervals.

Some examples of communication materials include the following:

- A Guide for Declaring Municipal Agricultural Disasters in Alberta[163] — put together by the Rural Municipalities Association (RMA), this guide serves as a tool to enable municipalities to use informed decision-making process before making a formal declaration of agricultural disaster as conditions evolve.
- Centers for Disease Control and Prevention's Drought Communication Toolkit[164] — provides several e-learning materials related to monitoring dry conditions, fire precautions and restrictions, water resources, and planning with a focus on public health.
- Cowichan Valley Regional District's Drought Smart Campaign[165] — provides information, tools, and updates on the signs and impacts of drought to help homeowners, business owners, and farmers adapt to the "new normal."
- American Water Works Association Public Communications Toolkit[166] — outlines the main steps required for successful communications planning.
- 10 Essential Messages about Drought[167] — offers problem, solutions, and outcome messages that create a narrative for use on social media, community engagement, and government relations.
- The Alberta Climate Narratives project[168] is an Alberta-based communications research project that aims to discover what language works well and what language poses an obstacle to productive conversations around climate change.

163 https://rmalberta.com/wp-content/uploads/2022/02/RMA-Guide-for-Declaring-Municipal-Agriculture-Disasters-May-2022.pdf
164 https://www.cdc.gov/nceh/drought/toolkit/default.htm
165 http://cvrdnewnormalcowichan.ca/drought-smart/
166 https://www.awwa.org/Resources-Tools/Public-Affairs/Public-Communications-Toolkit#2213174-strategic-planning
167 https://poliswaterproject.org/files/2022/06/Drought_Message_Guide_-_Summer_2018.pdf
168 https://climateoutreach.org/reports/alberta-narratives-project-core-narratives/

Additional Resources

Environmental Protection Agency's Drought Response and Recovery[169]

Includes a section on Communications and Partnerships (Page 19) that has tips for effective messaging, best practices, examples, and additional resources.

Case Study: Okanagan's Focus on Drought Communication

Communication is a key focus of the Okanagan's drought response. The Okanagan Basin Water Board (OBWB) aims to develop consistent drought communication tools and messaging to reduce public confusion and uncertainty. The OBWB has hosted numerous workshops and webinars since 2009, including drought planning workshops, drought tournaments, and water supply webinars. These events have served to engage stakeholders and increase understanding of the water supply and the impacts water management decisions can have on that supply.

See Appendix II for more information.

169 https://www.epa.gov/sites/production/files/2016-03/documents/epa_drought_response_and_recovery_guide.pdf

At a Glance:

Theme J — Collaboration

Why:

If you are in a drought, neighbouring municipalities and other water users in your region are most likely experiencing similar challenges and looking for solutions.

Applicable for:

Before a Drought	Warning Signs	During a Drought	After a Drought
✓	✓	✓	✓

Strategies:

- Identify other water users and stakeholders that you should be collaborating with
- Assemble a stakeholder committee
- Foster ongoing communication with other stakeholders

Key Supporting Tools:

- Intermunicipal Collaboration Framework
- Family and Community Support Services
- Local Drought Impact Committees
- Drought Preparedness and Response, Manual of Water Supply Practices
- Community Groups

4.2.10 Theme J — Collaboration

If you are in a drought, neighbouring municipalities and other water users in your region are most likely experiencing similar challenges and looking for solutions. As part of their Intermunicipal Collaboration Framework,[170] municipalities are required to undertake emergency management planning. This section explores how you can leverage collaboration to support you as you plan for drought, respond to it, or recover. The following are some strategies that can help facilitate this process:

Theme	Strategy	Before	Warning signs	During	After
J. Collaboration	J1. Identify other water users and stakeholders that you should be collaborating with	✓			
	J2. Assemble a stakeholder committee	✓	✓	✓	✓
	J3. Foster ongoing communication with other stakeholders	✓	✓	✓	✓

STRATEGY J1: Identify other water users and groups that you should be communicating with

The table below lists groups that you should be in communication with and why the communication is valuable.

Who	Why
Neighbouring municipalities	Find out what type of actions neighbouring municipalities are taking. Share resources (e.g., public information messaging, water conservation measures) and work through regulatory issues together.
Neighbouring Indigenous communities	Reach out to Indigenous communities in your source watershed to share information and strategies. Methods and interest in engagement for each Indigenous community will be different. Begin by reaching out to the band office or Alberta's First Nations Relations branch.

170 https://www.alberta.ca/intermunicipal-collaboration-framework.aspx

Who	Why
Licence holders with large volumes	Reach out to other water users who rely on the same source of water as you to discuss strategies to meet everyone's water needs. For example, irrigation districts and oil and gas companies will have drought management plans in place that need cooperation and support and may be able to support municipal water needs during droughts.
Government of Alberta	Some drought response actions may require approvals from the GoA. Both AEP and AAF can also provide information on water supply data and resources to cope with drought (refer to Themes A and F for more information).
Federal government	Federal public land covers approximately 10% of the province. Management of these lands is administered through the federal government. Municipalities that border on federally owned land may have different considerations and requirements for drought planning and will need to contact the appropriate federal government branch for information (e.g., Parks Canada).
Watershed Planning and Advisory Councils (WPACs)	WPACs are in place for each major river basins in Alberta. WPACs advise the provincial government on water quantity and quality issues, prepare state of the river reports, and prepare watershed management plans. Individuals that are interested may become members of their local WPAC.
Watershed Stewardship Groups (WSGs)	WSGs manage tributaries and lakes throughout Alberta. For example, Pigeon Lake Watershed Association[171] is actively involved in promoting lake and lakeshore management activities in municipalities around Pigeon Lake. These organizations prepare toolkits and information brochures to help private landowners address water conservation and drought management issues specific to their locale.
Other non-government organizations	Groups such as Cows and Fish,[172] Ducks Unlimited,[173] and Trout Unlimited,[174] can provide support and knowledge (including best management practices) before, during, and after droughts.

171 http://www.plwa.ca/
172 https://cowsandfish.org/
173 https://www.ducks.ca/
174 https://www.tu.org/

Who	Why
Schools, hospitals, seniors' facilities	Schools, hospitals, and seniors' facilities are all high-water users that will be directly affected during droughts and require a secure, reliable source of water for their clients. Each of these institutions should develop their own drought management plans in collaboration with the municipality and the provincial government.
Chamber of Commerce and business community	The Chamber of Commerce and business community will want to know that the municipality had a drought management plan in place, and they will be able to provide insights and solutions for addressing a multi-year drought based on economic considerations.
Banks and insurance companies	Funding and insuring people's activities during and after multi-year droughts can be difficult. Municipal councils can work with their local and regional banks and insurance companies to understand how they will respond to needs during droughts. This information will allow municipalities to understand the programs and services that people affected by droughts will need their municipal councils to provide.
Elected officials (e.g., Members of Parliament, councils)	Bringing together elected representatives and advising them of drought issues is a critical step, especially when many elected officials are involved, such as when the geographic area impacted by the drought is large. Elected officials should have a clear understanding of all aspects of the drought (e.g., scientific, economic), which will allow them to speak to the issues and make informed and appropriate funding, management, or other decisions.
Family and Community Support Services	Family and Community Support Services (FCSS)[175] are jointly funded arrangements between the provincial and municipal governments in Alberta. FCSS will be a valuable partner in the community during droughts because they often connect people and services and find sources of funding to help those most affected by drought.

175 https://www.alberta.ca/family-and-community-support-services-fcss-program.aspx

STRATEGY J2: Assemble a stakeholder committee

Create a local drought impact committee

While the GoA may lend support and drought monitoring information, local agencies will have the best "on-the-ground" information regarding drought impacts and needs.

Local agencies from various water sectors or affected water users may need to self-organize to monitor short-term and long-term drought status and impacts, and to coordinate communication within the group and to the provincial government.

Roles and responsibilities

Determine the roles and responsibilities of a local drought impact committee. Example roles and responsibilities[176] include the following:

- Identify tasks and make recommendations.
- Recruit members to workgroups — assure adequate representation from various sectors.
- Convene and determine frequency of meetings.
- Set up working groups as necessary and coordinate and monitor efforts and progress of these groups.
- Develop and submit reports to a lead agency including the following:
  - drought mitigation and response efforts (including emergency response activities)
  - identification of needs (e.g., legislative, financial)
  - recommendations for changes

176 Pima County, Arizona, provides a framework for agencies to gather and provide input to state level officials and monitor the status of drought conditions. Their roles and responsibilities document have been modified and condensed to reflect a potential Alberta example.

Communication is another responsibility that may need to be separated into a working group. A communications working group should consider the following responsibilities:

- Improve public awareness regarding drought, wise water use habits, and conservation practices.
- Communicate current drought conditions and reasons that mitigation and response measures are necessary or beneficial:
  - determine effectiveness of drought education and awareness (if being implemented by local agencies or other level of government) at the local level
  - hold public meetings or workshops
  - work with local media to increase the quantity and quality of drought messages and develop tailored messages
  - build capacity among members
- Monitor and help the community and local government define impacts of drought in the local area for better planning and response:
  - collect data — qualitative and/or quantitative
  - identify tools for monitoring that can be shared among local agencies
  - collectively review information on water usage, weather and climate, and drought-planning efforts
  - submit data to AEP to confirm drought conditions in the local watershed
  - Develop mitigation and response strategies to reduce drought impacts on local water users
  - prioritize drought vulnerability in coordination with other water use sectors to steer monitoring and planning efforts
  - develop mitigation and response strategies for different drought stages (as per AEP)
  - identify unmet needs or needs for response — legislation, funding, etc.
  - coordinate efforts with local water suppliers

Best Practice

In North Carolina, a collaborative drought group or network helped focus management efforts and served as a hub for contacts, tools, and resources.

See Appendix II for more information.

Case Study: North Carolina Drought Management Advisory Council

The N.C. Drought Management Advisory Council's (NCDMAC) website is a central location for drought-related resources for the state. The main product is a drought map based on the US Drought Monitor's Drought Monitor maps and is specific to North Carolina. The information from the drought map provides water users with a reliable basis for managing and calling for drought-response actions in their regions.

The NCDMAC website also has tabs that link to available resources for drought information, some with real-time data about current conditions, news, drought contacts, information and drought education, drought monitor archives, and water conservation tips.

The site includes time lapse animations of the weekly U.S. Drought Monitor maps for North Carolina since January 2000. Viewers can also see drought classifications nationwide, statewide, countywide, or by river basin.

For more information, see Appendix II.

The Drought Preparedness and Response, Manual of Water Supply Practices[177] by the American Waterworks Association's M60 manual provides information on forming a water shortage response team.

STRATEGY J3: Foster ongoing communication with other stakeholders

Foster ongoing communication by leveraging existing community groups. Seek out groups and organizations who have already formed collaborative groups (e.g., larger municipalities, WPACs) to discuss water use, water operations, or water demand in your area. They may not have focused on drought recently but propose adding this to the agenda.

For example, in the Bow River Basin, irrigation districts, TransAlta, GoA, and the City of Calgary hold a weekly call to discuss operational needs and to work in a collaborative fashion. While the focus on the call is a check-in with respect to each other's operations, water supply and management are critical discussion items that arise during drought conditions.[178]

Interview Key Message

Interviewees for this project highlighted the importance of communication on two levels: with other key water users and with the public. Both channels are critical to communicate with during all phases of drought.

See Appendix I for more information.

177 https://www.awwa.org/Store/Product-Details/productId/75759388

178 http://www.ncdrought.org/

At a Glance:

Theme K — Emergency Management

Why:

In times of a multi-year drought, organizing and managing resources and responsibilities for emergency preparedness, response, mitigation, and recovery is important for reducing the impacts of multi-year droughts on a community.

Applicable for:

Before a Drought	Warning Signs	During a Drought	After a Drought
✓		✓	✓

Strategies:

- Develop a municipal emergency management plan
- Declare a municipal agricultural disaster
- Declare a state of local emergency

Key Supporting Tools:

- AEMA's Community Emergency Management Plan
- Government of Saskatchewan's Emergency Management and Fire Safety
- Municipal Emergency Plans
- RMA Guide for Declaring Municipal Agricultural Disasters
- Alberta's *Emergency Management Act*
- Alberta Emergency Alert
- Public Safety Training
- Recovery and Resiliency Roadmap: A Toolkit for Economic Preparedness
- Community Disaster Recovery
- Disaster Recovery Toolkit for Local Government

4.2.11 Theme K — Emergency Management

In times of a multi-year drought, organizing and managing resources and responsibilities for emergency preparedness, response, mitigation, and recovery is important for reducing the impacts to a community. The following are some strategies that can help facilitate this process:

Theme	Strategy	Before	Warning signs	During	After
K. Emergency management	K1. Develop a municipal emergency management plan	✓			✓
	K2. Declare a municipal agricultural disaster			✓	
	K3. Declare a state of local emergency			✓	

STRATEGY K1: Develop a municipal emergency management plan

Municipal emergency management plans strive to reduce life and health risks residents may face and reduce the damage to property and infrastructure that often results from an emergency. Elected officials and other agencies in the community should prepare calmly and realistically for emergencies. This will help the appropriate parties locate resources and equipment required and inform citizens of dangers and the ways to avoid these dangers without panicking. Proactive and collaborative planning can reduce the long-term effects of both human-caused and natural disasters and help municipalities recover faster.

AEMA's Community Emergency Management Program is a free online tool only available to municipalities through MAConnect.[179] It enables communities to develop emergency management plans that meet their needs and follow standardized emergency management practices. The tool includes a hazard identification and risk assessment, which allows municipalities to enter relevant information related to the presence, frequency, and severity of impacts from hazards within their jurisdictions, including drought. The Government of Saskatchewan's Emergency Management and Fire Safety has also released Nine Steps for Emergency Plan Development[180] that can be used as a reference.

179 http://www.maconnect.alberta.ca

180 http://www.nitha.com/wp-content/uploads/2017/09/9_steps_for_Emergency_Plan_Development-Govt_of_Sask.pdf

Some examples of municipal emergency plans in Alberta include the following:

- City of Medicine Hat Municipal Emergency Management Plan[181]
- Town of High River Municipal Emergency Management Plan[182]
- Town of Hinton Emergency Management Plan[183]
- Regional Municipality of Wood Buffalo Regional Emergency Management Plan[184]

Municipalities in Alberta also have bylaws related to emergency management:

- Town of Banff[185]
- Town of Slave Lake[186]
- Town of Blackfalds[187]

STRATEGY K2: Declare a municipal agricultural disaster

A municipal agricultural disaster can include the loss of harvest or livestock, severe impacts to water quality and quantity, and loss of infrastructure. These impacts can have long-term effects on production and livelihood for those who rely on these activities as their sole income source.

The RMA's Guide for Declaring Municipal Agricultural Disasters[188] in Alberta is a tool that provides a consistent mechanism for municipalities to collect and monitor data to support decision-making priorities when making a formal declaration of agricultural disaster.

The guide stresses that "Municipal declarations do not automatically trigger access to increased funding programs, provincially or federally." Municipal declarations bring awareness to an issue in a specific area of the province, but they do not trigger a provincial declaration or any access to funding to support the issue. To access additional funds, the GoA must declare an agricultural disaster, which in turn enables the Agriculture Financial Services Corporation

181 https://www.medicinehat.ca/home/showdocument?id=12826
182 https://hrready.ca/wp-content/uploads/2015/05/Municipal_Emergency_Management_Plan.pdf
183 https://www.hinton.ca/DocumentCenter/View/2531/Town-of-Hinton-Emergency-Management-Plan---Not-Including-Appendices-reduced?bidId
184 https://www.rmwb.ca/en/fire-and-emergency-services/resources/Documents/RMWB-Regional-Emergency-Management-Plan-REMP---22-05-20-.pdf
185 https://banff.ca/DocumentCenter/View/219/Municipal-Emergency-Organization-Bylaw-11-6?bidId=
186 https://www.slavelake.ca/DocumentCenter/View/255/Bylaw-19-2013-Town-of-Slave-Lake-Emergency-Management-PDF
187 https://www.blackfalds.ca/Home/DownloadDocument?docId=68a95702-566e-4abc-9684-0f48b61f18d9
188 https://rmalberta.com/wp-content/uploads/2022/02/RMA-Guide-for-Declaring-Municipal-Agriculture-Disasters-May-2022.pdf

to access reserve funds. RMA's guide provides several questions that should be considered before a municipality formally declares a state of agricultural disaster, along with a tool to assist municipalities in tracking data to enable informed decision making.

STRATEGY K3: Declare a State of Local Emergency (SOLE)

Under Alberta's *Emergency Management Act* (EMA),[189] a SOLE can be declared. This Act provides a legislative framework for local provincial management of emergencies and disasters and outlines the roles and responsibilities of local authorities. It also provides the authority for the granting of additional powers during a state of emergency or a SOLE and governs the coming into force, expiration, and termination of these states of emergency.

In most cases, a SOLE is declared so local authorities can take centralized control in a crisis, enact emergency plans, and order the evacuation of people, livestock, and personal property. A SOLE also allows government to fix prices for food, clothing, fuel, equipment, medical supplies, and other essential supplies. Under a SOLE, municipalities can "borrow any money necessary" to pay for services provided by the provincial or federal governments.

The Act allows government to acquire any property to prevent or combat a disaster, demolish or remove trees or crops, and control access to or from any area of Alberta (although not inside a national park or Indian reserve). It also has the power to use any property, service, resource, or equipment anywhere in Alberta for the duration of the crisis. If property is damaged as a result, the owner must be compensated.

Before declaring a SOLE, the municipality is encouraged to consult with other agencies involved in water management within the area with the goal of ensuring any currently functioning beneficial drought mitigation or response activities are maintained or enhanced during the SOLE.

189 https://kings-printer.alberta.ca/documents/Acts/E06P8.pdf

The following are resources that can be used in emergency management and disaster response as it relates to drought events:

- Alberta Emergency Alert[190]
- Your Emergency Preparedness Guide[191]
- Public Safety Training[192]
- Recovery and Resiliency Roadmap: A Toolkit for Economic Preparedness[193]
- Community Disaster Recovery[194]
- Disaster Recovery Toolkit for Local Government[195]
- FireSmart® Resources and Programs[196]

190 **https://www.alberta.ca/alberta-emergency-alert.aspx**
191 https://www.getprepared.gc.ca/cnt/rsrcs/pblctns/yprprdnssgd/yprprdnssgd-eng.pdf
192 **https://www.alberta.ca/emergency-management-training.aspx**
193 **https://www.edaalberta.ca/page-1861533**
194 https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/local-government/disaster_recovery_guide.pdf
195 https://www.emv.vic.gov.au/how-we-help/disaster-recovery-toolkit-for-local-government
196 https://firesmartcanada.ca/

At a Glance:

Theme L — Funding

Why:

Funding can greatly assist with many activities from implementing management actions to supporting disaster relief.

Applicable for:

Before a Drought	Warning Signs	During a Drought	After a Drought
✓			✓

Strategies:

- Identify funding to support your actions and disaster relief

Key Supporting Tools:

- Alberta Community Partnership
- Alberta Emergency Management Agency
- Office of the Fire Commissioner Grants
- Municipal Sustainability Initiative
- Grants in Place of Taxes (GIPOT)
- Watershed Resiliency and Restoration Program
- Agriculture Opportunities Fund
- Agriculture Financial Services Corporation
- Disaster Mitigation and Adaptation Fund
- Federation of Canadian Municipalities
- Federal Small Communities Fund

4.2.12 Theme L — Funding

Funding can greatly assist with many activities from implementing management actions to supporting disaster relief. Various funding programs are available at a municipal, provincial, and federal levels.

Theme	Strategy	Before	Warning signs	During	After
L. Funding	L1. Identify funding to support your actions and disaster relief	✓			✓

STRATEGY L1: Identify funding to support your actions and disaster relief

Funding can be used to develop, test, and pilot plans or other initiatives, and can also help cope with and recover from the impacts of drought. Disaster funding is usually provided by governments to help direct, coordinate, manage, and fund eligible response and recovery efforts associated with domestic major disasters and emergencies that overwhelm communities.

There are several funding and resource programs in place at a federal and provincial level to help manage drought impacts, outlined in the table below:

Program	Description
Municipal and Provincial	
Alberta Community Partnership (ACP)	The ACP aims to improve the viability and long-term sustainability of municipalities by providing support for regional collaboration and capacity-building activities. The ACP comprises five components: Intermunicipal Collaboration, Municipal Restructuring, Mediation and Cooperative Processes, Municipal Internship, and Strategic Initiatives.
Alberta Emergency Management Agency	This agency provides grant funding opportunities to support emergency management practitioners in communities across the province. These grants build resiliency in local communities by enhancing their ability to prepare for and respond to emergencies. See here[197] for more information.

197 https://www.alberta.ca/disaster-recovery-programs.aspx

Program	Description
Office of the Fire Commissioner Grants	Through the Office of the Fire Commissioner, several training programs are available to support the enhancement of municipal services. Some include regional fire services and ground search and rescue enhancement programs.
Municipal Sustainability Initiative	The Municipal Sustainability Initiative provides municipalities with funding to assist them in meeting the challenges of growth and enhancing their long-term sustainability.
Grants in Place of Taxes (GIPOT)	GIPOT assists municipalities with the cost of providing municipal services. Although Crown-owned properties are exempt from taxation, the Province of Alberta pays a grant equivalent to the property taxes that would otherwise be levied on many of these properties. Approximately 168 municipalities receive grants in place of taxes for 5,900 Crown properties.
Watershed Resiliency and Restoration Program	This program aims to increase the natural ability of the province's watersheds to reduce the intensity, magnitude, duration, and effects of flooding and drought through watershed mitigation measures. The program also aims to address impacts of past flooding or droughts through the restoration of degraded priority areas of watersheds that will enhance the ability of communities to withstand future flooding or droughts. Priority areas for flood and drought across the province are considered in the allocation of funds.
Agriculture Opportunities Fund	This fund is provided to eligible agriculture extension organizations to enhance or maintain their human resource and extension capacity to promote the long-term sustainability of the agriculture industry and rural communities in Alberta. These organizations will use a collaborative approach and sound extension methodology to promote production practices that enhance competitiveness while maintaining responsible stewardship of the natural resources for the public good.
Agriculture Financial Services Corporation	This government-run corporation provides crop insurance, farm income disaster assistance, and loans to producers, agribusinesses, and other small businesses. When a drought is declared a disaster, the GoA enables the Agriculture Financial Services Corporation to access reserve funds to process insurance payments more rapidly.

Program	Description
FEDERAL	
Disaster Mitigation and Adaptation Fund	This fund supports large-scale infrastructure projects to help communities better manage the risks of disasters triggered by natural hazards (minimum $20 million in eligible infrastructure).
Western Cattle Price Insurance Program	This risk management tool allows producers to purchase price protection on cattle and hogs, in the form of an insurance policy. Available in British Columbia, Alberta, Saskatchewan, and Manitoba, the program provides producers with protection against an unexpected drop in prices over a defined period.
Community Pasture Program	This program conserves the land resource, protecting it from deterioration due to drought while using the land primarily for the grazing and breeding of livestock.
AgriInsurance	This fund provides producers with cost-shared insurance for natural hazards to minimize the financial implications of production and/or asset losses.
Canadian Agricultural Partnership	This partnership is a five-year federal-provincial-territorial investment in the agriculture, agri-food, and agri-based products sector. It is the successor of the 2013 – 2018 Growing Forward 2 partnership. The program began in April 2018. Programs are organized under five themes, including environmental sustainability and climate change, and risk management.
Farm Debt Mediation Service	This service provides financial counselling and mediation services to farmers experiencing financial difficulty. It is a free and voluntary service for both producers and for creditors. The service helps bring producers and their creditor(s) together with a mediator in a neutral forum to reach a mutually acceptable solution.
Federation of Canadian Municipalities	Municipalities for Climate Innovation Program[198] provides grant funding to help Canadian cities and communities of all sizes adapt to the impacts of climate change, including drought. Regional climate advisors[199] offer local expertise, resources, and support to help municipalities develop and implement local climate action plans. These services a provided exclusively to members of the Partners for Climate Protection program, which is open to Canadian cities and communities of all sizes and is free to join.

198 https://fcm.ca/en/programs/municipalities-climate-innovation-program

199 https://fcm.ca/en/programs/partners-climate-protection

Program	Description
Federal Gas Tax Fund	This fund provides predictable, long-term, and stable funding for Canadian municipalities to help them build and revitalize their local public infrastructure while creating jobs and long-term prosperity.
Federal Small Communities Fund	This fund is a competitive program that provides infrastructure funding to communities with populations fewer than 100,000.
Centre for Emergency Preparedness and Response	This centre is Canada's central coordinating point for public health security issues. Among its many responsibilities, it develops and maintain national emergency response plans for the Public Health Agency of Canada and Health Canada and assesses public health risks during emergencies.
Environmental Damages Fund	This fund provides financial awards to community groups, academic organizations, and local governments to support projects aimed at remediation or restoration of the environment and natural resources. The fund serves as a mechanism for redistributing funds received by polluters through voluntary or liability payments.
AgriRecovery	AgriRecovery is a disaster relief framework that provides a coordinated process for federal, provincial, and territorial governments to respond rapidly when disasters strike, filling gaps not covered by existing programs.
National Emergency Strategic Stockpile	This stockpile provides emergency supplies for use during a major disaster or national emergency that can be set up in existing buildings or temporary shelters. The system consists of a central depot in Ottawa and regional warehouses located across Canada that contain hospital supplies, such as pharmaceutical drugs, folding beds, blankets, generators, mini medical clinics, mobile quarantine units, and water decontamination facilities.

CASE STUDY: Truck fill stations in Athabasca County

Seed funding from the Prairie Farm Rehabilitation Administration was key for Athabasca County to pilot its first truck fill station in 2003. The cost for each station ranged from $80,000 to $100,000, and the construction of the first site would likely not have been possible without external funding. Following the success of the first station and positive feedback, the municipality largely funded the development of additional sites.

See Appendix I for more information.

Appendix I: Interview Report

Interview Report

AWC Multi-Year Drought Project Team

Background

As part of its work, the Alberta Water Council's Building Resiliency to Multi-Year Drought in Alberta Project Team identified the need to build the case for multi-year drought management by illustrating historical examples of multi-year droughts in Alberta and lessons learned from them. The team conducted interviews to inform this part of the work and to identify key tools, strategies, and examples to highlight in the guide being developed. While the focus of this work is on multi-year droughts, interviewees were encouraged to share relevant experiences from shorter droughts as well. This report summarizes our interview findings as of September 2018.

Lessons learned

Impacts of Drought

The period from 2000 to the spring of 2002 is the most recent significant multi-year drought in Alberta. The impacts of drought are economic, ecological, and social.

The economic impacts of drought include constrained business activities and the cost of fighting wildfires. Drought can be particularly damaging economically to the agricultural sector. Ecological impacts include effects on fish populations, effects on wetlands, increases in the incidence of wildfires, stress on trees, and increases in grasshoppers and army worms. Social impacts include stress on ranchers and farmers, compromised water recreation activities, and negative impacts on water quality because of the increased incidence of wildfires.

Strategies to Adapt to and Cope with Multi-Year Drought

Interviewees reported strategies used in past droughts for agriculture, land-use planning, water supply and infrastructure, tree health, water demand management, water conservation measures, collaboration, communication, and the environment.

Communication

The importance of communication with other key water users and with the public was highlighted by the interviewees.

Positive Outcomes of Previous Droughts

Experiencing drought has helped the province to better prepare for future droughts and has fostered some positive changes, particularly in the areas of water conservation, opportunities to learn and innovate, investment in infrastructure, and regionalization of drinking water systems.

Preparing for Multi-Year Droughts

Alberta communities are not well prepared for multi-year drought, and they need better communication, more mitigation strategies, and more preparation for climate variability.

Who we interviewed

Thirteen interviews were completed as outlined in the table on the next page.

	Organization	Name	Position
Government of Alberta	Alberta Agriculture and Forestry	Rick Atkins	Retired (formerly Director of Environmental Extension and Program Branch)
		Brent Paterson	Retired (formerly Executive Director of Irrigation and Farm Water Division)
	Alberta Environment and Parks	Dave McGee	Retired (formerly District Approvals Manager)
Municipalities	Aspen Regional Water Services Commission (Athabasca)	Jamie Giberson	Commission Manager
	Athabasca County	Ron Jackson	Director of Agriculture and Emergency Services
	The City of Calgary	John Jagorinec	Manager, Water Treatment
	City of Grande Prairie	Amy Needham	Acting Integrated Pest Management Coordinator
	M.D. of Smoky River	Normand Boulet	Agricultural fieldman
	Town of Okotoks	Dawn Smith	Environment and Sustainability Coordinator
Irrigation Districts	Bow River	Richard Phillips	Manager
	Raymond	Gordon Zobell	Manager
Others	Ducks Unlimited	Tracy Scott	Head — Industry and Government Relations
	Special Areas Board	Jay Slemp	Former chair

Multi-year droughts in Alberta since 2000

Almost all interviewees referred to the period from 2000 to the spring of 2002 as the most recent significant multi-year drought in the province. In the south, some interviewees indicated that the period from 2015 to 2018 could be considered a multi-year drought, with 2015 marking the end of several wet years in a row. People also referred to droughts that occurred in 2009 and 2010, both in southern and northern Alberta.

Impacts of drought

Economic

- The impacts of drought are particularly devastating for the agricultural sector. In urban settings, people with a reliable source of water will often experience drought as a nice sunny summer, but for farmers, droughts affect crops, forage, and pastures and have serious economic impacts. People pay a lot of money for water and have to liquidate assets and sell off cattle. Drought brings additional problems, such as more resilient weeds, requiring farmers to invest more time and money in weed control before planting crops. Interviewees also distinguished between impacts to dryland farming versus irrigated farming; areas that rely more on dryland farming have been more severely impacted by some of the recent droughts.
- In water-scarce areas like Okotoks, economic growth is limited because of water scarcity.
- Water restrictions in times of drought can also limit the activities of businesses.
- Drought increases the incidence of wildfire, which affects all operations in a municipality and has huge economic impacts. The cost of fighting a wildfire for a municipality can run from several hundred thousand dollars to over a million dollars.

Ecological

- Low river flows impact fish and invertebrate communities (e.g., changes to habitat, food supplies). Low flows may also result in degraded water quality; costs may increase if additional water treatment is needed.
- Multi-year droughts impact our wetlands, which in turn affects birds, mammals, and amphibians.

- Drought also brings other problems, such as grasshoppers and army worms, which create an additional management challenge that can change rapidly.
- Drought is a major stress for trees. Some trees are more drought-tolerant than others. Drought often triggers the outbreak of insects that will attack the drought-stressed trees. This was the case in Grande Prairie following the drought in the early 2000s, which triggered an outbreak of the bronze birch borer. The outbreak has not yet ended and is affecting birch trees in town, which leads to additional costs associated with pruning the dead wood to prevent more insects from breeding.
- Drought increases the incidence of wildfire and associated impacts on water quality and biodiversity.

Social

- Droughts are stressful for ranchers and farmers who are usually self-reliant and self-sufficient and not used to asking for help from someone else. Mental health impacts, such as stress, depression, and suicide, are very high on farms.
- Droughts have raised the awareness of the need to conserve water and have contributed to a growing culture of water conservation.
- Water recreation activities have been compromised by low reservoir levels in past droughts. It is challenging to remind people that the primary purpose of reservoirs is not recreation.
- Droughts increase the risk of wildfire, which in turn has impacts on water quality for drinking water systems downstream.

Strategies used to adapt to and cope with multi-year droughts

Interviewees reported various strategies that were used in past droughts or that they consider important as part of adapting to multi-year droughts in Alberta. The table below summarizes the strategies by theme.

Strategy	Details and Examples
Agriculture	
Water storage	■ Storing as much water as possible: good storage and management under the assumption that drought can happen at any time. This is what helped the Bow River Irrigation District get through past droughts.
Water supply inventory	■ You must manage the water before a drought. You can't manage drought if you don't know your water supplies beforehand. ■ We need to start managing subsurface water better and expand to ■ long-term well identification. Big dugouts are only good for short-term solutions.
Conservation, efficiency, and productivity (CEP) planning	■ CEP has been instrumental in improving water use efficiency in the irrigation sector.
Water use policy on maximum water use limits	■ In the 2000 – 2002 drought, there were no restrictions on how much water farmers could use in the Bow River Irrigation District. At the end of 2001, the levels in the reservoir were lower than ever before going into winter, which resulted in the Irrigation District implementing maximum water use limits for how much a water user can take. These limits are not too restrictive, but they encourage people to think about how they use their water and how much they really need.

Strategy	Details and Examples
Alternative water and forage supplies	■ Ducks Unlimited (DU) has made both its land and wetlands available to farmers in times of drought. DU developed a way to fast track the process to acquire temporary diversion licences with the GoA in the 1990s, which allowed farmers to divert water from DU wetlands to build dugouts. They have also partnered with farmers to allow them to harvest forage on their land in times of drought.
Long-term planning	■ Farmers in water-scarce regions like Montana keep a three-year supply of hay on hand while people in Alberta sell their excess when they have a good year. We need to start thinking more long-term. ■ Good range management practices are important for long-term planning and preparation for multi-year droughts.
Land-use planning	
Wetland conservation and restoration	■ Wetland conservation and restoration are very effective and cost-effective tools for both flood and drought mitigation. DU is seeing an increase in the uptake of its programs around wetland restoration, but we need to make better use of the Wetland Policy in relation to drought mitigation. Any storage is helpful, but natural storage, such as wetlands, is ideal.
Water supply and infrastructure	
Regionalization	■ Regionalization of drinking water systems in Athabasca has gone a long way toward easing stresses on drinking water and reducing reliance on water hauling in times of drought.
Water pumping/ hauling	■ Athabasca County sees an increase in truck fill volumes and water hauling when it gets dry. During the 1999 – 2003 drought, they relied on Alberta Agriculture's water pumping equipment to maintain treated water supply to a couple of smaller hamlets.

Strategy	Details and Examples
Truck fill stations	■ In 2003, Athabasca County initiated a pilot to set up truck fill stations following the multi-year drought. They obtained funding through the Prairie Farm Rehabilitation Administration (PFRA) to develop a first site to provide non-potable water, mostly for agricultural uses. Over the next six years, eight more sites were built so that everyone has access to a site within 30 kilometres. All the sites are served from groundwater supplies. They are self-serve stations where people can fill up a water tank. The sites are still very well used today. Having access to seed funding to develop the first site was key as it helped bring the council on board to fund the other sites following the positive feedback that was received.
Tree health	
Increased diversification of tree inventory	■ In the event that we get a pest outbreak, the impacts are much smaller if we only lose a small portion of the tree inventory. Grande Prairie is looking at diversifying with drought-resistant tree species.
Water demand management	
Tiered water rate	■ Okotoks has a three-tiered water rate system whereby water rates increase with greater water consumption.
Water shortage response plan	■ This plan defines water restrictions that can be implemented at each stage of a water shortage.
Full-cost accounting	■ Costs are passed on to the user so that demand decreases as the price for water is increasing.
Water conservation measures	
Landscape management	■ This includes recycling the mulch from chipping dead wood to make tree beds and retain moisture.
Water metering	■ Many municipalities in southern Alberta put in water meters following the 2000 – 2002 drought.
Watering schedules	■ There is an outdoor watering schedule in Okotoks, in effect annually from May 1 to October 31. The town's website outlines the four outdoor watering schedule levels as per the Water Shortage Response Plan.

Strategy	Details and Examples
Incentive programs	Examples from Okotoks: ■ Water Conservation Rebate Program, which includes drought-tolerant plants, mulch, rain barrels, irrigation controllers, and rainwater harvesting systems ■ Xeriscape Pilot Program Rebate
Water reuse	■ It would be a huge step forward if we can resolve the health and safety issues associated with recycled water. Other jurisdictions, such as Australia and California, are ahead of Alberta on this.
Collaboration	
Bring stakeholders together	■ Irrigation districts in southern Alberta brought together an advisory committee of all affected stakeholders with their expertise and knowledge to deal with the 2000 – 2002 drought. The committee still exists today and is convened when conditions are too dry.
Cooperation and water sharing	■ Cooperation and water sharing were the foundation that allowed water users to avoid calling licence priority in the 2000 – 2002 drought in southern Alberta. ■ Water trading, both within a farm and among farmers, allowed the available water to be used as efficiently as possible. ■ Irrigation districts worked closely with AEP and AAF to define a scientific method on how to allocate the water so that everybody got a proportional share regardless of their water licences. That policy has now been enshrined by the irrigation districts so that that in future droughts, they agree to forego this priority basis.

Strategy	Details and Examples
Communication	
Water conservation messaging	■ Having water conservation messaging available is important so it is ready to ramp up when needed. ■ Communication about water conservation should keep going whether in a drought or not. ■ Common messaging (province, municipalities, irrigation districts, etc.) is important. ■ Keep providing regular updates to the community during the drought. ■ Ongoing education is key. There is about a two-week window when people are very responsive, and then they start to slip into their regular habits again. ■ Communication should also reinforce positive messages (e.g., we have enough water to deal with the drought).
Environment	
Instream flows	■ The City of Calgary's draft drought management plan has set limits and targets for environmental flows. ■ Okotoks has instream flow objectives for its rivers.

In general, interviewees said there is often some reluctance at first by the public with regards to new measures or strategies to manage drought, but overall people have been supportive of strategies and adaptations. However, it requires ongoing education efforts. Many interviewees mentioned that flooding gets more attention than drought, because floods happen quickly while drought impacts become more intense over a longer period. It takes only a few wet years for people to forget about drought and the resources that are available to deal with it.

Communication

Interviewees highlighted the importance of communication on two levels:

1. **With other key water users**
   - Greater communication with key water users before and during a drought to coordinate use and operations has been very important. For example, irrigation districts, TransAlta, the Government of Alberta and The City of Calgary hold weekly calls to discuss everyone's needs and to work in a collaborative fashion. It is a priority for all parties involved to work collaboratively and avoid calling priority on water licences because that would have negative consequences for everyone.
   - During a drought, constant communication between government and the different entities (agriculture industry, irrigation districts, municipalities) is critical, and there can't be too much information (even on a daily basis). The different entities worry about what's going to happen, whether there is going to be some support, and what that support is going to look like.
   - There is a need to build more drought networks and groups to be better prepared and coordinated.
2. **With the public**
   - Whether it is before, during, or after a drought, ongoing education is necessary so that people don't forget what to do or panic. Education and communication are key.
   - One interviewee pointed out that publishing stories about drought and the need to save water can also set people off into panic mode. For example, in the 2000 – 2002 drought, farmers started applying a lot more water in the fall to build up soil moisture when it was not necessary, and it brought down the reservoir level unnecessarily. Similarly, water restrictions can sometimes have the opposite effect; for example, people might water their lawn on every day they are allowed to, whereas they wouldn't have, had there been no restriction. Careful messaging is necessary.
   - Make sure all MLAs have the same information because some people will call there first.

Positive outcomes of previous droughts

Most interviewees noted that while drought is always bad, living through it has made us better prepared and has fostered some positive changes, such as the following:

- Increased awareness about the importance to conserve water and growth in the water conservation culture since the early 2000s.
- Increased collaboration with other major water users: Drought can be devastating on individuals and communities. The collaboration we saw in the 2000 – 2002 drought was the most positive response possible. It showed that people are willing to work together, and even competitors are willing to share information.
- Opportunities to learn, innovate, and adapt are leaving us in better shape today to handle a drought. Municipalities became much more efficient by putting in water meters. The irrigation sector has increased its efficiency by 30% since the early 2000s.
- Stakeholders are motivated to invest in infrastructure and regionalization of drinking water systems. For example, before regionalization, Athabasca County was running numerous small water treatment plants for several local hamlets. In the 2009 drought, several hamlets had to rely on ad hoc water pumping and hauling to respond to emergency situations. Construction of the regional plant in Athabasca along with 145 kilometres of regional transmission line has improved water security for all the hamlets.

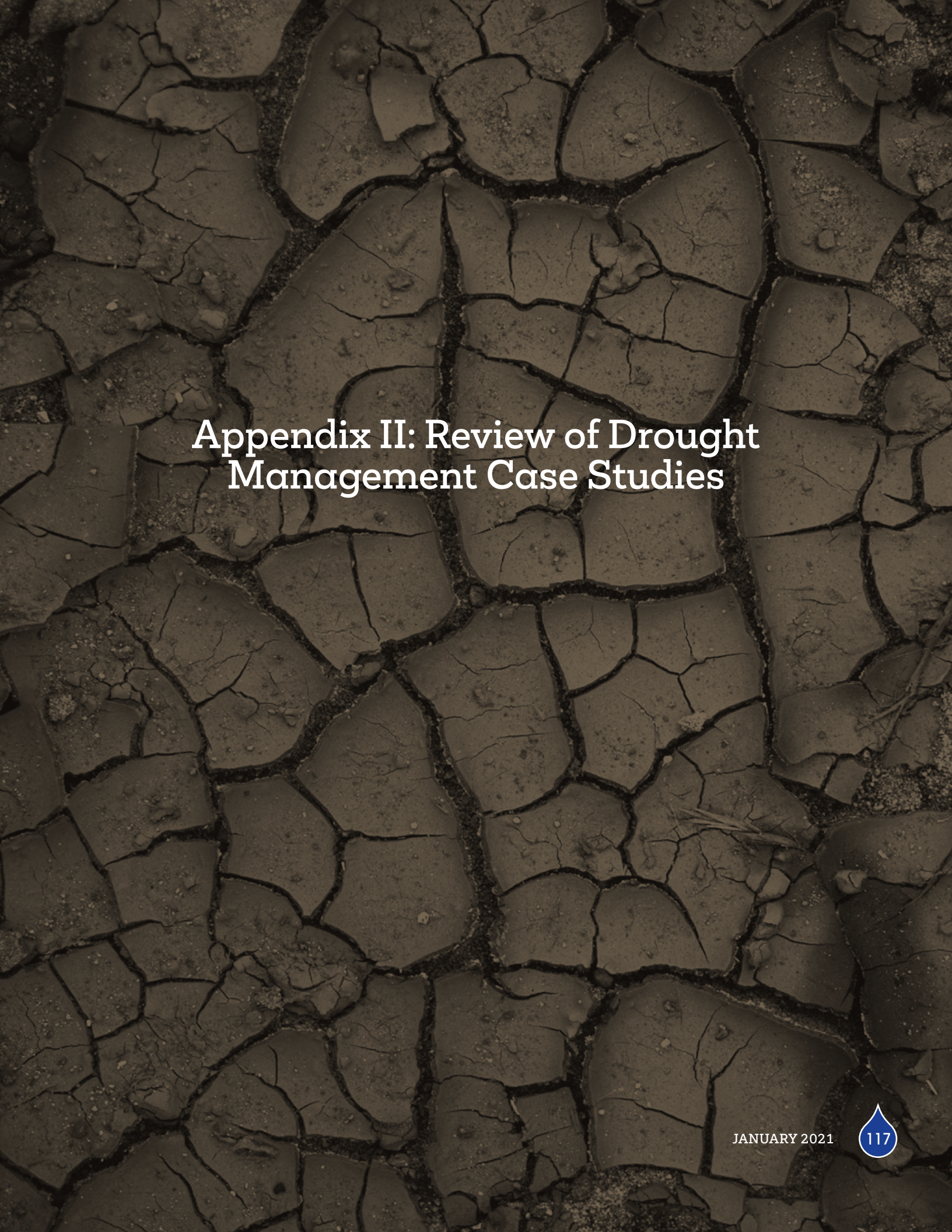
Preparing for multi-year droughts

Most interviewees agreed that Alberta communities are not well prepared for a multi-year drought. Many highlighted that people have short memories, and it's hard to get people to remember drought when it is followed by several wet years. Some highlights include the following:

- We need additional water storage in the south to cope with a multi-year drought.
- There is a need to better balance flood and drought mitigation. There has been an emphasis on flood mitigation over the last few years. It's hard to predict when a flood will happen, but we need to prepare for drought when there are warning signs. The one-sided emphasis on flood mitigation worried many of the interviewees. Many communities are working to floodproof their areas, but we don't see the same commitment to prepare for drought, despite the evidence that droughts will likely become more frequent and

more intense. It's really difficult before a drought to get any traction by the municipalities and the agricultural sector to do some planning, especially if we are going through a normal or wet year.

- We need more communication materials (e.g., last year Town of Okotoks had to impose water bans and this shocked people at first). We need to have materials and resources in place for when a drought happens.
- Water users, including municipalities, need to develop a drought strategy before they are in a drought situation. For example, 2018 was wet in the beginning, but precipitation has been very low afterward. Yet nobody thought about considering 2018 as potentially the first year of a drought. We need to have something that triggers people to think about how to manage water in a normal year in a way that allows flexibility in a dry year. We need something practical that irrigation districts, industry, and municipalities can apply — a trigger mechanism.
- We need to recognize the fact that we are seeing greater climatic variability, regardless of the cause. People have to stop debating about whether climate change is happening; it is more important to figure out how you are going to adapt to increased climatic variability.



Appendix II: Review of Drought Management Case Studies

Review of Drought Management Case Studies

February 2019

Background

The Alberta Water Council (AWC)'s Building Resiliency to Multi-Year Drought in Alberta Project Team was tasked with producing a guide and workshop materials to assist Watershed Planning and Advisory Councils (WPACs) as they engage municipalities and communities within their watershed to better plan for, mitigate, respond to, and recover from multi-year droughts. The project will highlight the importance of multi-year drought management in Alberta, compile existing drought management information and resources in the province, and facilitate the delivery of customizable information to support small urban and rural municipalities before, during, and after a drought.

Using case studies, part of this work consisted of compiling existing drought management information and resources from selected jurisdictions. The following jurisdictions were chosen by the project team based on the following rationale:

Jurisdiction	Rationale
California	California has well-established drought management programs in place because it has experienced persistent drought for several decades, including water scarcity challenges and heavy reliance on groundwater.
Saskatchewan	Saskatchewan is located adjacent to Alberta and has many small and rural municipalities that are agricultural.
Australia	The Snowy River Communities in Australia have relevant legislation and their governance structure is like Canada's (federal, provincial, municipal). Australia also has significant experience with drought.
Okanagan Valley, British Columbia	The Okanagan Valley experienced a significant drought in 2015 and has recent applicable drought management plans and approaches.
Vancouver, British Columbia	Vancouver is an example of a large city surrounded by several small neighbouring municipalities, a scenario that also occurs in Alberta.
North Carolina	North Carolina has undergone severe drought and has excellent drought management practices.

The following topics were researched for each jurisdiction:

- **Cost** — What was the economic impact of drought? How much was spent to mitigate drought? What types of investment were most effective in mitigating drought?
- **Drought management outcomes and best practices** — examples of positive outcomes and effective drought management practices employed.
- **Education and communication** — examples of effective education and communication programs and campaigns.
- **Collaboration and drought networks** — are there groups that collectively work on drought management?
- **Water allocation during a drought** — is water use prioritized during drought and how is priority determined?

Information on each topic was not available or reliable for every jurisdiction; as such, not every topic is included in each case study.

The following case studies outline examples of best practices for small and rural municipalities to consider when planning for, mitigating, responding to, and recovering from multi-year droughts in Alberta. For information about this project, please visit the following webpage:

https://www.awchome.ca/projects/building-resiliency-multi-year-drought-6/

Australia

Background

The Snowy River is in southeastern Australia, originating on Mount Kosciuszko. Until the construction of the Snowy Mountains Hydro-electric Scheme, it was the largest snowmelt river in Australia. The Snowy Mountains Hydro-electric Scheme was jointly built by the New South Wales, Victorian, and Commonwealth governments over a 25-year period from 1949 to 1974. The scheme was designed following one of the worst droughts on record in the area (1939 – 1945) to provide around 1,000 gigalitres of water to each of the Murray and the Murrumbidgee river valleys each year.

Since corporatization of the Snowy Mountains Hydro-electric Scheme in 2002, much of southeastern Australia has experienced extreme drought, resulting in low water availability for the Snowy River and for the Murray, Murrumbidgee, and Goulburn-Murray river systems, which has impacted the environment, water users, and the communities that depend on these river systems.

The scheme was designed to collect and store water, including water that would otherwise flow east down the Snowy River to the coast, divert it through trans-mountain tunnels and power stations, and then release it west of the Snowy Mountains into the catchments of the Murray River and the Murrumbidgee River. There, the water can be used for town water supply, irrigation, and environmental purposes.

Successful outcomes and best practices

The scheme provides an annual supply of reliable, high-quality water for the Murray and Murrumbidgee river valleys, which has enabled irrigation development and increased the capacity for electricity generation in these areas.

While the diversion of water for irrigation was always the original vision of the scheme, the engineers were aware of the potential generation of hydroelectricity. The government was able to pay for the massive undertaking through the sale of that hydroelectricity, making the scheme a reality. By directing the water through a series of power stations as it plunges 800 metres down the western escarpment, the scheme can generate large amounts of peak-load electricity to meet the daily fluctuating demands for power in eastern Australia.

Snowy Hydro currently provides around 32 percent of all renewable energy available to the eastern mainland grid of Australia and today, this clean, efficient, and renewable energy continues to help light up the morning and evening rush hours of Sydney, Melbourne, Canberra, Brisbane, and Adelaide through the National Electricity Grid that runs from Rockhampton in Queensland right around the east coast to Adelaide and Tasmania.

The drought in southeastern Australia has changed the way water resources are managed in other ways as well. For example, Australia previously relied solely on water from dams for agriculture and consumption, but today, six major seawater desalination plants provide water to Australia's major cities. In addition, the Murray-Darling Basin Authority was established to manage water in the Murray-Darling basin. With the long-term effects of the drought only recently coming to light, many state governments are now attempting to "drought-proof" their states through initiatives such as greywater water-recycling, government rebates for homeowners to install water tanks, and tougher restrictions on industries.

Water allocation during a drought

The New South Wales, Victorian, and Commonwealth governments underwent major legislative reform in the 1990s, including the development of the *Snowy Hydro Corporatization Act 1997* in New South Wales and concurrent legislation in Victoria and the Commonwealth. The *Snowy Hydro Corporatization Act 1997* provides for a corporatized entity to operate and maintain the Snowy Mountains Hydro-electric Scheme through a water licence, the development of a Snowy Water inquiry to examine the environmental impacts of the scheme and options for dealing with them, and a scientific committee to advise on the pattern of environmental releases.

Key Finding

- Long-term planning and investment in water storage infrastructure can boost a community's drought resiliency.

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California

Background

Droughts are a recurring feature of California's climate. In the last century, the most significant statewide droughts occurred in 1929 – 1934, 1976 – 1977, 1987 – 1992, and 2012 – 2016. The 2012 – 2016 drought was due to record-high temperatures and record-low levels of snowpack and precipitation. The Sierra snowpack was at 30 percent or less of normal.[200]

Successful outcomes and best practices

California mitigates drought through several means:

Water desalination — The Claude "Bud" Lewis Carlsbad Desalination Plant is located on the southern shore of Agua Hedionda Lagoon in the city of Carlsbad, California. This plant is the nation's largest seawater desalination plant, producing an average daily flow of 50 million gallons of drinking water from seawater through a reverse osmosis process.[201]

Recycling wastewater — Water reuse is the use of reclaimed water from business and home wastewater for drinking, irrigation, industrial, or other beneficial uses. It is integral to California's water management and allows for economic and population growth. Greywater is the primary type of wastewater reclaimed because contaminants can be filtered and cleaned using membranes or through biological treatment methods.

Increased ground water storage — Several projects have been proposed to expand ground water storage by approximately 22 million acre-feet. This figure represents more than the current annual use of ground water in California. Combined, estimates indicate total water-storage capacity statewide (ground and surface) to be between 184 and 491 million acre-feet. California has a significant amount of untapped groundwater storage capacity — more than 400 million acre-feet.

Increased surface water storage — California's Department of Water Resources manages 17 above-ground reservoirs.[202] Additional surface water storage is planned following a $2.7 billion funding program approved in 2018 by the California Water Commission.[203]

200 https://www.californiadrought.org/drought/background/

201 https://www.waterboards.ca.gov/sandiego/water_issues/programs/regulatory/carlsbad_desalination.html

202 https://water.ca.gov/What-We-Do/Water-Storage-And-Supply

203 https://www.latimes.com/local/lanow/la-me-water-storage-20180724-story.html

Repairing and replacing fragile levees — A Levee Repairs Program[204] is administered by the California Department of Water Resources to monitor, maintain, and repair levees as required.

Lessons learned from the 2012 – 2016 drought

The 2012 – 2016 drought served to highlight vulnerabilities in California's water supply and management that could be used to help the state better prepare for, mitigate, and respond to future drought conditions. Four essential reforms are outlined in *Managing Drought in a Changing Climate: Four Essential Reforms* (Mount et al, 2018)[205] and are summarized below:

Plan ahead — stronger planning for urban water management, groundwater sustainability, safe drinking water, and freshwater ecosystems is critically important.

- Update the water grid — A comprehensive program to address above- and below-ground storage, conveyance, and operational challenges is needed. This should include repairing broken facilities, expanding conveyance and storage capacity, and modernizing and integrating operations.
- Update water allocation rules — update water allocation governance to be equitable and efficient at allocating limited supplies among competing demands during drought and promote efforts to capture and store water while not in drought.
- Identify funding sources — new and reliable sources of funding are needed to fill gaps in the water system and adapt to climate change.
- Education and communication campaigns

California's Water Resources Control Board adopted the Drought Response Outreach Program for Schools (DROPS) Guidelines after the 2012 – 2016 drought to educate students on projects to help manage water resources, including projects for reducing storm water pollution, water conservation, water supply augmentation, energy savings, water resources sustainability, and reducing dry weather run-off.[206]

204 https://water.ca.gov/Programs/Flood-Management/Maintenance/Levee-Repairs
205 https://www.ppic.org/publication/managing-drought-in-a-changing-climate-four-essential-reforms/
206 https://www.waterboards.ca.gov/water_issues/programs/grants_loans/drops/

Costs

As the most populous state in the U.S. and a major agricultural producer, drought in California can have severe economic and environmental impacts. Agriculture is by far the largest consumer of water in California, accounting for about 80 percent of all water consumption. Estimates for the economic cost of the most recent California drought of 2012 – 2016 are approximately $10 billion USD, with the agriculture sector alone at $3.8 billion USD.[207]

While the costs of drought can be difficult to quantify,[208] it is likely they will continue to grow due to several factors, including population growth and predicted increases in the frequency and severity of drought.

The cost of drought can be reduced in several ways, including adaptation, as mentioned above, but also through actions undertaken while drought is occurring. For example, a program in California transfers water from low-value agricultural uses to higher value-value urban uses during drought.[209]

Key Findings

- Long-term, secure funding is critical for effective drought management.
- Drought management requires a holistic approach from drought management planning, public education, and implementation of key legislation, to the construction of appropriate infrastructure.

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https://www.ppic.org/wp-content/uploads/managing-drought-in-a-changing-climate-four-essential-reforms-september-2018.pdf

https://library.wmo.int/doc_num.php?explnum_id=3401

North Carolina

Background

North Carolina experiences short-term droughts that are often very localized; long-term, serious droughts are rare. North Carolina's continued growth combined with climate change could result in more significant droughts in the future.

North Carolina's worst drought in recorded history occurred in 2007 – 2008, which led, in part, to the development of the *Drought Management Act*. The Act encourages planning, conservation, and cooperation with the aim of preserving economic health and quality of life during times of drought.

Collaboration and drought networks

The North Carolina Division of Water Resources collaborates with the United States Geological Survey to monitor ground water levels in response to rainfall at specific wells. The wells were selected to be Drought Indicator Wells because they can be used as an indicator of the amount of subsurface water available to discharge to surface water.

North Carolina Drought Management Advisory Council (NC DMAC) Website

The NC DMAC website[210] is a central location for drought-related resources for the state. The main product is a drought map based on the US Drought Monitor's Drought Monitor maps,[211] specific to North Carolina.

The information from the drought map provides water users with a reliable basis for managing and calling for drought-response actions in their regions.

The NC DMAC website also has tabs that link to available resources for drought information, some with real-time data about current conditions, news, drought contacts, information and drought education, drought monitor archives, and water conservation tips.

The site includes time lapse animations of the weekly U.S. Drought Monitor maps for North Carolina since January 2000. Viewers can also see drought classifications nationwide, statewide, countywide, or by river basin.

210 www.ncdrought.org

211 https://droughtmonitor.unl.edu/

Successful outcomes and best practices

The North Carolina Drought Assessment and Response Plan[212] was implemented in 2005. Its objective is to support local government efforts during drought emergencies and to coordinate state and federal emergency activities.[213]

This operations plan supports the North Carolina Emergency Operations Plan and outlines drought-specific actions and coordination procedures for the State Emergency Operations Center, the State Emergency Response Team, and other state agencies to take and follow during drought conditions. It is intended to provide a systematic, effective method for assessing and responding to the impacts of drought on water supply in North Carolina.

Key Findings

- Regional drought knowledge can be supplemented by local expertise to create specialized tools for use by those in the area.
- Emergency operations plans should include clear, systematic actions and procedures to deal with drought, where possible.

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https://drought.unl.edu/archive/plans/Drought/state/NC_2005.pdf

212 https://files.nc.gov/ncdps/documents/files/Divisions/EM/EOP/ANNEX-B_APPENDIX-3_Drought-Assessment-and-Response-Plan_NCEOP_2019.pdf
213 https://drought.unl.edu/archive/plans/Drought/state/NC_2005.pdf

Okanagan Valley, British Columbia

Background

The Okanagan Valley region has experienced several droughts over the last two decades: 2009, 2015, and the most severe in 2003. In 2003, low streamflow events caused serious damage to fish and fish habitat in the Okanagan and Thompson regions in the Okanagan Valley region. In response, the Okanagan Basin Water Board (OBWB) along with the water suppliers and local government officials, held a Southern Interior Drought Management Workshop in March 2004 to summarize the issues and experiences related to the 2003 drought and identify opportunities to better manage water in the future. There was a consensus on the need for proactive management strategies to address potential water supply limitations and associated low flows, more water and fisheries information, and improved sharing of this information to resource agency managers, water users and suppliers, and the public.[214]

Successful outcomes and best practices

As a result of the 2003, 2009, and 2015 droughts, there have been several initiatives launched to mitigate drought impacts. Some of these programs are outlined below.

Communication and engagement

The OBWB has hosted numerous workshops and webinars since 2009, including drought planning workshops, drought tournaments, and water supply webinars. These events have served to engage stakeholders and increase understanding of the water supply and the impacts water management decisions can have on that supply.

Information on these events, including any presentations or materials provided to attendees and any resulting reports, are available on the OBWB website.

Assessment of the barriers to drought planning

Work has been completed through the OBWB to identify the barriers to drought planning and response and to make recommendations on how to address these to allow the region to better plan for future drought.[214]

214 https://www.obwb.ca/newsite/wp-content/uploads/building_drought_resilience_finalreport_jan2016.pdf

Below are some of the barriers to drought planning in the Okanagan Valley region from the report *Building Drought Resilience in the Okanagan, Phase I: Gap Analysis and Recommendations* written by Associated Environmental for the OBWB in January 2016:

- It is difficult to gather and distribute timely information about the status and vulnerability of water supplies.
- There are many water suppliers with little coordination between them. Water suppliers have different water supply and demands and different drought responses (i.e., bylaws and policies); water supplier watershed boundaries are different than provincial basin boundaries.
- Current measures focus on crisis response instead of proactive planning. Information is lacking on early warning mechanisms.
- There is no formal valley-wide drought response strategy, and there is a lack of communication between local drought management authorities and provincial drought response teams.
- Financial and staffing capacity, particularly among smaller water suppliers, is a barrier to drought planning.
- There are information gaps on demand and withdrawals, streamflow requirements, aquifer recharge, evaporation, and requirements of downstream water users.

The recommendations in the report focus on information gathering, planning, conservation, coordination, and communication.

Drought Response Implementation Plan

The Thompson Okanagan Region developed a *Drought Response Implementation Plan* that outlines an approach to water management that is complementary to B.C.'s Provincial Drought Response Plan.[215] The plan provides guidance on preparation for drought, assessing, and responding to drought conditions, mitigating drought impacts on ecosystems and water users, and on communication with stakeholders.

215 https://www.obwb.ca/newsite/wp-content/uploads/2016_Thompson_Okanagan_Region_DRIP_July2016.pdf

Key Findings

- Drought-related data and information are critical to develop a baseline understanding of the area. The data and information can be used as the basis for stakeholder discussions to identify opportunities and to communicate with the public.
- Regional Drought Response Plans may be developed to supplement geographically broader plans where guidance may be lacking.

References

www.makewaterwork.ca

https://www.obwb.ca

Recommendations for Drought Proofing the Okanagan

British Columbia Drought Response Plan

Saskatchewan

Background

Droughts have occurred frequently and have sometimes extended for decades in the Canadian Prairies. Major droughts included the "dustbowl" of the 1930s and 2001 – 2002, but shorter, localized droughts are also commonplace.

The drought of the 1930s resulted in the creation of federal and provincial agencies to mitigate drought impacts. One initiative was the Prairie Farm Rehabilitation Administration (PFRA), which assisted prairie farmers by aiding them in improving water storage and, in some cases, moving to more suitable areas.

The 2001 – 2002 drought had significant economic impacts, and Saskatchewan and Alberta were the hardest hit provinces, particularly the agricultural sector.[216] For the first time in 25 years, net farm income in Saskatchewan was negative in 2002.

These droughts have resulted in numerous adaptation measures and recommendations to allow the province to better prepare for and respond to future drought conditions.

Successful outcomes and best practices

Adaptation measures for the prairies have been implemented both federally and provincially and focus on mitigation of impacts to agriculture, and community engagement.

Prairie Farm Rehabilitation Administration (PFRA)

The PFRA was a federal initiative headquartered in Saskatchewan that was created in response to the extreme drought in the 1930s and was in operation for nearly 80 years.

Many prairie communities benefited from the work of the PFRA. The agency was involved in irrigation projects and programs to help build on-farm dugouts as a water source for livestock. It also ran large-scale tree-planting projects to protect soil from wind erosion.[217]

216 https://agriculture.canada.ca/en/agricultural-production/weather/managing-agroclimate-risk/lessons-learned-canadian-drought-years-2001-and-2002
217 https://www.thecanadianencyclopedia.ca/en/article/prairie-farm-rehabilitation-administration

The agency was dissolved in 2009 when its programs were merged with the Agri-Environment Services branch.

Community Engagement

The Saskatchewan Research Council worked with the Saskatchewan government to complete a provincial *Flood and Natural Hazard Risk Assessment*.[218] One of the main conclusions of the assessment was that drought is one of the province's highest risk natural hazards. Six workshops were held throughout the project with more than 200 invited stakeholders to gather local knowledge on impacts, mitigations, and priorities for regional areas. The results of the project will help the province prioritize natural hazard mitigation measures.

Key Findings

- Financial and technical assistance at the federal level should be used when available.
- Public engagement may be useful to identify drought-related risks.

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218 https://www.src.sk.ca/blog/saskatchewan-flood-and-natural-hazard-risk-assessment

Vancouver, British Columbia

Background

The water supply for Metropolitan Vancouver originates from the Capilano, Seymour, and Coquitlam watersheds. In 2015, Vancouver experienced an extreme drought caused by a lack of winter precipitation, and water restrictions were placed on residents. Climate change projections for the region estimate that while total annual precipitation will increase, there will be lower levels of precipitation on average in the summer, which is already the driest season of the year.[219] In combination with the increased water demand of a growing population, drought may be more common in Vancouver in the future.

Successful outcomes and best practices

Several options are being explored to increase the water supply, including expanding existing reservoirs and identifying new water sources (e.g., the Fraser River). However, most of the City's efforts are focused on decreasing demand through public awareness initiatives, which are described in the next section. These efforts have seen some success — the average daily per capita water use for Metro Vancouver has been steadily decreasing since 2009.[220]

Part of the challenge of lowering demand in Vancouver is that water use is unknown for many residences as water meters are not mandatory in every region. Residential water metering is encouraged as a best management practice for local governments in the Metropolitan Region.[221]

Education and communication campaigns

Education and communication campaigns related to drought in Metro Vancouver include the following:

- **We Love Water campaign**[222] — expands awareness of the region's water supply and how it is used, including tips for residents on how to conserve water indoors and outdoors.

219 http://www.metrovancouver.org/services/air-quality/AirQualityPublications/ClimateProjectionsForMetroVancouver.pdf

220 http://www.metrovancouver.org/dashboards/services/water/Pages/Average-day-per-capita-water-use.aspx

221 http://www.metrovancouver.org/services/water/about/resources-government/water-metering/Pages/default.aspx

222 http://www.metrovancouver.org/welovewater/Pages/default.aspx

- **Sustainable Landscaping Initiative** — a non-profit organization based in Vancouver that provides resources and information aimed at the landscape industry to improve their sustainability, including water usage.
- **City of Vancouver website**[223] — includes several pages on water restrictions, current practices the City is undertaking to conserve water, and what residents can do to reduce water use.

Key Finding

- Public awareness campaigns can be effective at reducing water demand.

References

We Love Water Campaign

http://www.metrovancouver.org/services/water/Pages/default.aspx

http://www.metrovancouver.org/welovewater/Pages/default.aspx

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223 https://vancouver.ca/home-property-development/conserving-and-protecting-water.aspx

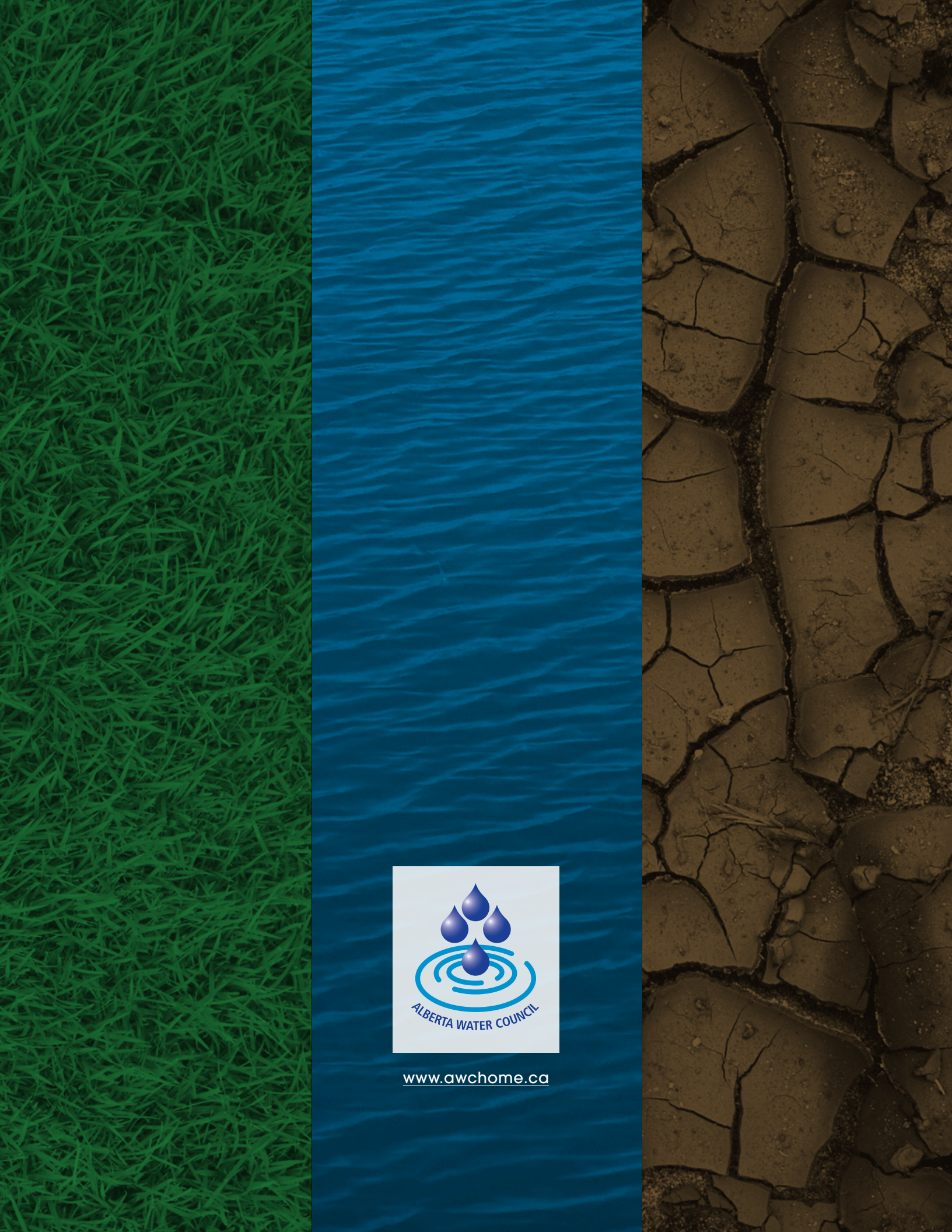
Conclusions

Many small and rural municipalities in Alberta may lack the resources to undertake the activities to the same degree as outlined in the case studies. However, there are a few themes that emerge from this jurisdictional review.

It is critical for all jurisdictions to have access to real-time data and information to develop appropriate drought preparation, mitigation, and response plans. Based on what other jurisdictions have done, a starting point may be to develop more precise tools based on those used in a broader geographic area.

While some jurisdictions responded to droughts after they happened, a few developed planning tools to predict, characterize, and respond to drought; small and rural municipalities in Alberta should also undertake action to mitigate drought before it happens, where possible. Actions undertaken during and following a drought are equally important, such as the implementation of water restrictions and education and communication campaigns.

Long-term successful drought management requires looking beyond one's fence line. Engagement in collaborative drought initiatives and other related activities with stakeholders in the region is critical. Drought is often a transboundary issue, and even if extremely localized, should not be managed in isolation.



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