Camrose Drought Policy Revamp: Paving the Way for Resilient Water Governance

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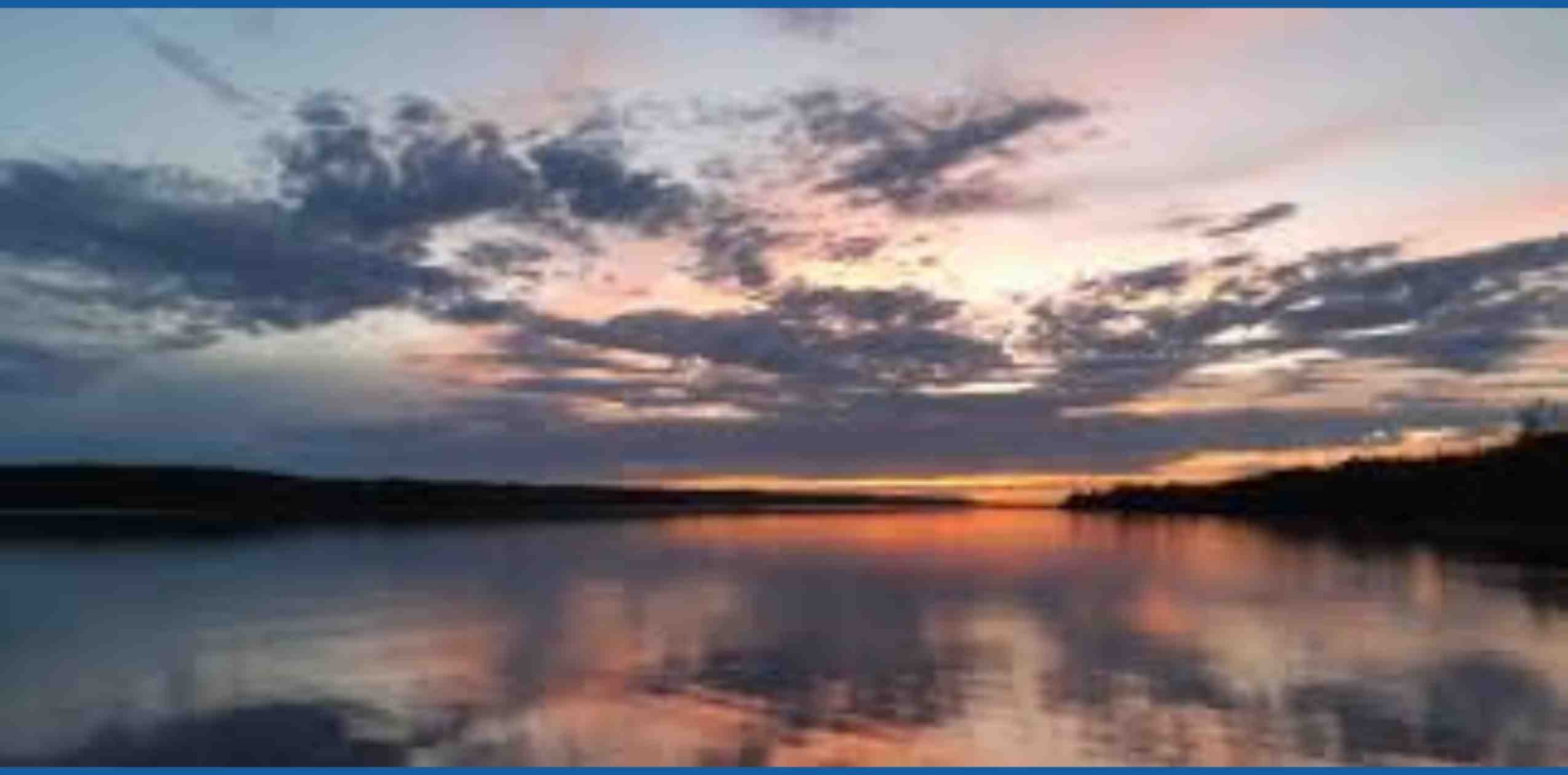

CITY OF Camrose

UNIVERSITY OF ALBERTA

Land Acknowledgement

We acknowledge that the land on which we gather, traditionally known as asiniskaw sipisis (Stoney Creek), is Treaty 6 territory and a traditional meeting ground for many Indigenous peoples. The land on which the City of Camrose is located provided a traveling route and home to the Maskwacis Nêhiyawak, Niitsitapi, Nakoda, and Tsuut'ina Nations, the Métis, and other Indigenous peoples. Their spiritual and practical relationships to the land create a rich heritage for our learning and our life as a community.

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Executive Summary

There is now a commonly accepted understanding that climate change will bring about large-scale changes to the world we live in. These changes include rising temperatures, an increase in extreme weather events, shifts in ecological regimes, and increased instances of severe drought. Specifically for the city of Camrose, Alberta, drought has been identified as a high-risk threat to the community. Though drought does not occur abruptly like many other instances of extreme weather, it provides a unique opportunity: to take advantage of the possibility to be proactive and build climate resilience, with respect to moderating the potential harms of drought on the community.

This white paper was developed as a result of concern for the impacts of drought on the community. The development of this document acts as one of the many proactive measures the community of Camrose has taken to prepare for drought and encourage conscious water use within the community. This document was developed by a team of university students conducting a comprehensive literature review and analysis, investigating the characteristics and potential impacts of drought, in addition toeffective strategies and changes that could be implemented to the existing drought policy for the city to facilitate the development of climate resilience for Camrose. In addition toolicy changes, this document provides the framework of an action plan that can be implemented before and during multiple stages of drought.

The major conclusions and proposed changes to the existing water use and conservation policy target three primary areas. The first recommendation is the addition of a fifth stage of drought, called Stage 0, which emphasizes proactive action on behalf of residents, local businesses, and the city. The second area in which major changes were recommended was communication. There, the recommendations focus on more proactive, efficient, and inclusive communication strategies to maximize public outreach without significantly increasing the effort to do so. Finally, the last recommendation proposes alternative strategies to charge for residential water use. The alternative water pricing strategies have multiple uses in that they can increase financial input for the city to reallocate resources to other water conservation initiatives, but the alternative water pricing strategies can promote more conscious water use among residents.

These, along with many other recommendations to improve the current drought policy and the action plan, aim to strengthen the community's resilience to drought and climate vulnerabilities promoting a sustainable future for generations to come

Introduction

In an era marked by escalating climate uncertainty and environmental unpredictability, drought poses as a persistent threat to ecosystems, economies, and livelihoods.

The City of Camrose, situated in a transitional region between the prairies and boreal forests in Alberta, Canada, faces an imminent challenge as climate change escalates across the Canadian prairies. Within the complexities of climate change, drought emerges as a persistent condition with devastating consequences for society and the environment. Climate change, driven by the increase of greenhouse gases, causes a shift in global climate dynamics (1). These changes can disrupt traditional precipitation patterns, heighten evaporation rates, and alter regional weather patterns, amplifying the frequency and severity of a drought (1). Consequently, water scarcity poses a significant threat to water resources, agricultural productivity, and ecosystems, as well as multiple other sectors such as energy, transportation, public health, recreation, and tourism (2).

With climate change and urban expansion reshaping both supply and demand dynamics, drought emerges as a damaging threat Camrose faces. This threat will intensify the unpredictability of spring water flows and elevated summer temperatures, consequently diminishing water availability with the rising demand throughout the municipality. Water is the core of sustainable development and is critical for socio-economic development, energy and food production, maintenance of healthy ecosystems, and human survival (3). Water continues and will always be the heart of adaptation to climate change, serving as a link between society and the environment (3).

Seen as a pervasiveness challenge, drought calls for the necessity of a comprehensive strategy that not only addresses crisis management but also long-term resilience and sustainability.

With drought comes some major consequences that can be sorted into three major categories for the City of Camrose. These categories include physical, social, and economic.

Physically, the city will contend with heightened risks of illness and mortality, exacerbated by challenges in maintaining adequate human health and hygiene, as well as the potential exposure to wildfire smoke (4). Socially, the impact can affect the quality of life for residents, potential societal conflicts stemming from water scarcity, and the ability to adapt to the impacts of drought (4). Economically, the city faces challenges such as increased living costs, reduced opportunities for recreational pursuits and tourism due to

water constraints, and the strain on businessesreliant on water resources for their operations (4). The imminent threat of drought in the City of Camrose highlights the necessity for proactive preparedness measures to mitigate its impacts across physical, social, and economic aspects.

Preparedness towards drought is important due to its potentially devastating impacts on communities and surrounding ecosystems. By taking proactive measures, the City of Camrose can mitigate the severity of drought and enhance the city's resilience to the effects of drought.

With the predicted increase in frequency and severity of drought, preparedness allows for the development and implementation of policy and action plans outlining strategies for water conservation, allocation, and emergency response (2). Furthermore, being prepared facilitates investments in infrastructure and technology that are aimed at increasing water efficiency, storage capacity, and providing alternative water sources.

The impacts of drought are largely non-structural and make it difficult to assess the effects of drought and respond to it in a timely and effective manner. These impacts are not as visual as the impacts of other natural disasters but still require a significant amount of attention (2). Implementing measures such as rainwater harvesting, lawn improvement, and weather-determined sprinklers can help reduce reliance on dwindling water supply during periods of drought. Additionally, public awareness plays a crucial role in preparedness efforts by informing the community about the importance of water conservation practices. Empowering people with knowledge equips them to make informed decisions and adopt behaviours that contribute to drought resilience.

By investing in these measures, Camrose can build resilience, adaptability, and increase societal resilience to mitigate the adverse effects of drought and these climate shocks (2).

Amid rising concerns surrounding the efficacy and applicability of the existing drought plan, the imperative for comprehensive policy and action plans becomes an effective tool for mitigating drought risks in Camrose.
Within this framework, our group aims to evaluate the effectiveness of various policies and incorporate the most relevant elements into our drought policy recommendations and action plan. In doing so, these recommendations will contribute to a resilient and adaptive strategy for the City of Camrose.

Background

Climate Change and Drought

A growing body of literature suggests that Canada's prairie provinces, particularly Alberta, are predicted to undergo significant changes in the coming century as a result of global warming. By 2050, even if steps are taken to reduce carbon emissions, the mean annual temperature is predicted to increase by 2-4 degrees as compared to 50 years ago (5). Despite a possible increase in precipitation during the spring and fall months, most regions in Alberta are expected to become drier due to an increase in evaporation and surface drying efficacy caused by higher temperatures (5). With a changing climate, ecosystem distribution is predicted to undergo changes predominantly marked by an increase in grassland in place of the existing parkland and boreal forests currently found throughout Alberta (5).
With these changes, a major concern for Alberta's future as climate change progresses is an increase in the frequency and severity of droughts across the province (6). Global climate models (GCMs) project future increases in summer continental interior regions drying and an increase in the associated risks of drought on municipalities and populations within those areas.

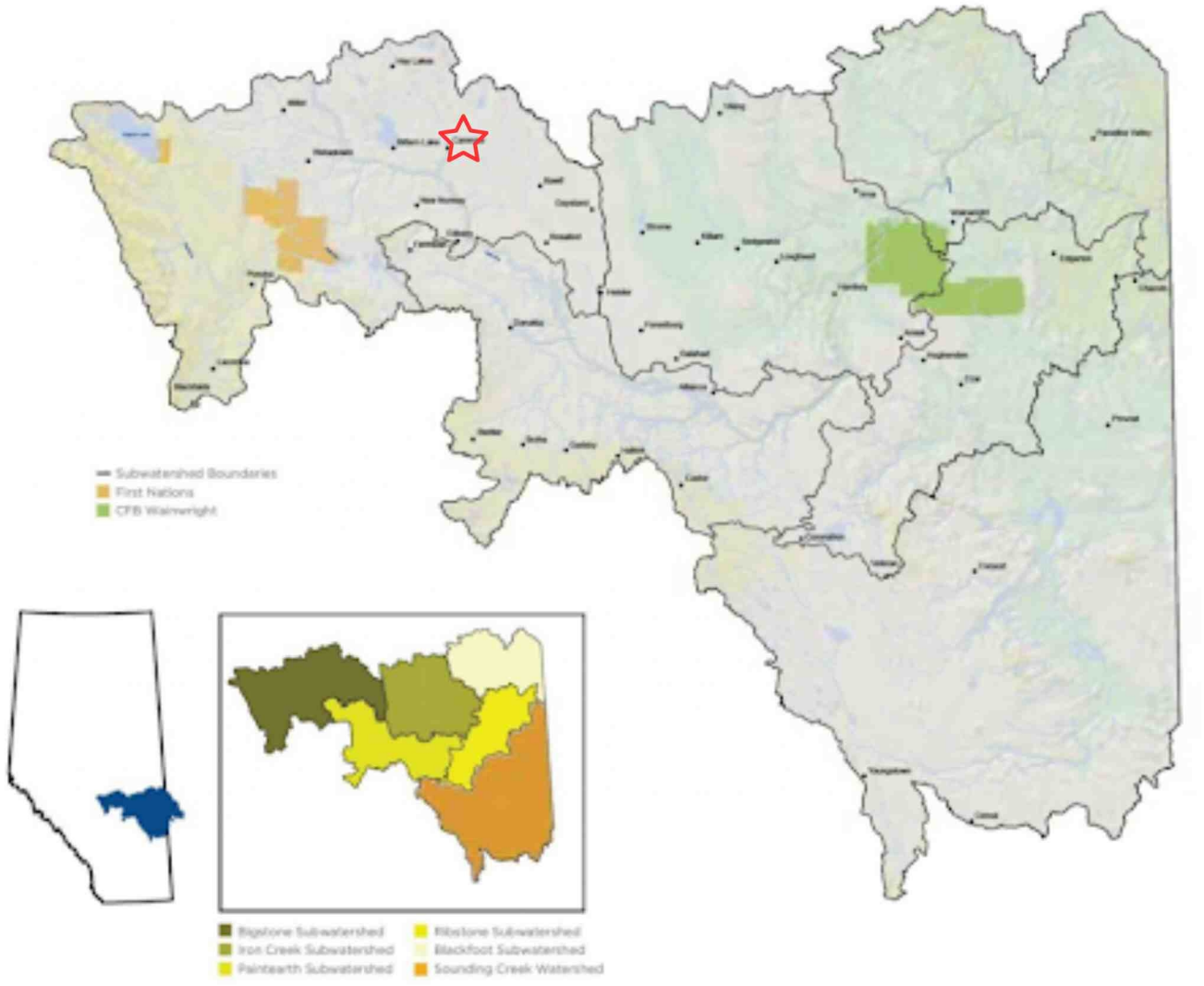
Impacts of Drought on the Public and Municipalities

Drought can have significant physical, social, and economic impacts on both individuals and whole communities (7). Globally, there is an agreement that drought leads to an increase in morbidity and mortality, more commonly observed in the forms of negative implications for public health (7). Already present on the Canadian prairies, drought has been linked to an increase in the presence of respiratory impacts related to dust and an increased risk of water-borne diseases (7). Access to clean water also plays a role in maintaining hygiene, which is directly related to the prevention of diseases. Increased temperatures and decreased availability of clean water contribute to an increased likelihood of the proliferation of some foodborne pathogens, known for causing tens of thousands of illnesses each year in Canada (7). Drought is also linked to the spread of wildfires across Canada. The occurrence and severity of wildfires are predicted to increase specifically in the Canadian prairies, and they threaten the safety of Alberta residents and municipalities not only via the destruction of property and infrastructure or risks and stress related to displacement but also an increase in respiratory illnesses associated with prolonged wildfire exposure (7). It is also important to consider that the impact of drought will not affect everyone equally. Socioeconomic status plays a prominent role in an individual's ability to preserve and adapt to drought. Additionally, different economic sectors that rely on water, such as agriculture or golf courses, experience major economic losses due to drought-related challenges (7). Infants, elderly people, and those suffering from disabilities have been determined

to be the most vulnerable to the impacts of climate change, particularly those at a socioeconomic disadvantage who will have more difficulty taking protective actions against threats posed by climate change (7)

Drought in Camrose

Camrose is a city of roughly nineteen thousand people but serves as a regional center for more than 100,000 people. The city is located on the Battle River watershed in Alberta's interior. The city of Camrose draws its water from Driedmeat Lake, which is stabilized by a dam installed in 1973. The city's combined three water licenses permit them to draw approximately 3,083,800 m^3 of water annually from the reservoir, assuming the lake level remains above the minimum operating level of 684.27 meters. Additionally, the increase in Camrose's population growth is projected to be 2% each year and is predicted to rise to 36,000 people by 2036. This increase in population will mean a rising water demand, either requiring the city to obtain an additional water license or an alternative source in the future. (8)



Region in Alberta Situated on the Battle River Watershed. Camrose, Alberta is indicated by the red star "☆". The image was produced by the Battle River Watershed Alliance (13).

Camrose is faced with many of these challenges listed above because it is situated in the interior region of Alberta. Thus, in the coming century, the community and inhabiting residents face very real social, physical, and economic threats posed by climate change and drought. However, steps are being taken to be proactive and accurately gauge risks to the community and infrastructure in addition to strategies that can be implemented to mitigate the impacts of drought. In 2023, the Climate Vulnerability and Risk Assessment (CVRA) was developed for Camrose by Associated Engineers (9). This project intended to develop an understanding of the climate vulnerabilities and risks to the city of Camrose's infrastructure. This document identified drought as a threat to infrastructure, including Driedmeat Lake (where Camrose sources its water), the water treatment plant, and various outdoor and recreational park areas in the city. Concern for the impacts of drought was also expressed for the safety of maintenance staff, the public, and customers (9). Drought impacts both the quantity and quality of water, which impacts the efficacy of the treatment process and the pumps. The pumps can be rendered unusable if water levels become too low, developing further problems in distributing clean water to community members (9). Additionally, drought reduces available water for consumption and sanitation for Camrose residents, as water restriction guidelines are implemented. The risk assessment for Camrose indicated that extended periods of drought had a high likelihood with a high level of consequence, effectively making it a high-risk threat, and over the next decades, it is only predicted to worsen (9).

The CRVA was one of the proactive measures towards developing climate resiliency within the Camrose community. Additional practices the community is taking, specifically to mitigate the impacts of drought, include promoting the "Be Wise with Water" campaign, offering water audits to residential and non-residential properties to assess and improve water reduction infrastructure, reusing and distributing non-potable water from the water treatment plants, upgrading water meters to prevent leakage, and billing consumers on a consumption-based water and wastewater utility rate, among others.

Unlike other natural hazards (floods, earthquakes, etc.), drought does not occur abruptly. Thus, with drought, it is possible to devise and implement drought management plans in advance, improving both preparedness and resiliency. Investing energy and resources into drought preparedness and developing already-made plans work to mitigate much of the harm that would otherwise impact communities (10). Both drought policy/water use policy and action plans are kinds of proactive efforts that work to prepare communities for the impacts of drought.

The purpose of this White Paper is to research drought and existing strategies to moderate the harms of drought and suggest policy recommendations to be implemented for Camrose's existing drought policy.

Additionally, the city council has expressed the need for an action plan that can be implemented during a drought. This action plan will be included in this white paper, along with policy suggestions for the common goal of improving Camrose's overall climate resiliency

Government Recommendation for Developing Drought Policy

The Alberta Government released a document outlining water shortage response plans (WSRP) to assist water license holders in developing preparedness for water shortage events such as drought. The first step recommended in developing a WSRP is assessing the risks and likelihood of water shortage events occurring, as well as the magnitude and frequency of impending shortages (11). As previously addressed in the CRVA developed for Camrose, prolonged drought was determined to be a high-risk threat for the community in future years. The following recommended steps emphasized investigating options for dealing with a water shortage. These options can be divided into two categories: demand reduction and supply augmentation. Our policy suggestions and action plan will primarily consider those focusing on reducing water demand within the community in the event of drought because of the increased feasibility compared to increasing the water supply (11).

Increasing the water supply for the whole community would entail obtaining another water license or finding an alternative water source, both of which are extremely costly and act more as long-term solutions that are outside the scope of this current project. These will likely be required in years to come as a result of the growing population in Camrose. Reducing water demand is more feasible, and strategies to encourage this can be implemented more rapidly. However, our focus on demand reduction efforts does not discredit the potential for the implementation of effective supply augmentation such as obtaining additional water licenses, water trucking, and assignment of tie-ins with other systems or primary license holders, all of which have previously been effective water management strategies in the past for other communities (11).

Various general but effective options for dealing with a water shortage can be implemented at different stages of a water shortage. Options for dealing with a water shortage at the minor stage include efforts towards reducing water losses, recycling available water, and offering conservation retrofit kits. The moderate stage builds on the options mentioned for the minor stage and includes additional suggestions such as collecting stormwater to be recycled and being conscientious of outdoor water use. Finally, the severe stage is marked by the previous options listed in addition to the regulated reduction in residential and non-residential consumption and making water-sharing agreements with senior priority

license holders. The third step in developing a WSRP is implementing the plan. This requires developing triggering criteria and formulating a schedule and monitoring the effectiveness of different strategies (11). Currently, Camrose has in place triggering criteria based on the amount (in days) of water left before the primary license no longer has priority over water export from Dried Meat Lake. The triggering criteria are associated with different stages of drought and various water use regulations. Some of the most effective strategies in mitigating the impacts of drought are listed as follows.

Monitoring data is essential in responding to threats of drought. Currently, the water levels at Dried Meat Lake are monitored every 15 minutes as well as the speed of stream flow. This gives the city an indication of drought risk and when water conservation strategies require implementation (8). Additionally, monitoring other kinds of drought indicators such as weather patterns (extreme heat waves or predicted forecast without precipitation for an extended period) (12). Building resilience to drought includes conducting a risk assessment (which has been successfully done in the CRVA) and developing both a water shortage response plan and a drought management plan. Camrose currently has a Water Shortage Response Plan that discusses what regulations and actions will be initiated in response to each stage of drought, however, this document is not available to the public. With the action plan we present, we aim to provide something similar that can assist with informing residents on necessary actions to take to decrease their water consumption during a drought.

Optimizing the existing supply of water is a primary concern for building climate resilience, especially considering it is one of the more feasible and rapid options for managing drought (12). In the recommendations for managing the existing water supply, it is highly suggested to form water-sharing agreements with other license holders, specifically if the city's water license is no longer valid due to minimum water requirements being met at the source. By doing so, if the water levels do fall below the minimum operating level at Dried Meat Lake, the city continues to have access to a source of water. Finally, recommendations for managing water supply suggest finding alternative water sources. Seeing as purchasing a new water license or finding an alternative major water source is not within the scope of this project, minor alternative sources such as rainwater collection are more appropriate and have been demonstrated to be an effective way to reduce domestic water use per capita (12).

As for **managing water demand,** developing regulatory tools has proven effective. A drought and water use policy is considered a water regulatory tool because it outlines the restrictions that are in effect. Managing demand can also be encouraged through education as opposed to mandatory

restrictions. This includes educating the public on drought and effective strategies to reduce personal water use (12). Finally, there are land use planning strategies that can act as more long-term conservation strategies. These include providing incentives to encourage residents and businesses to change their landscaping to something more drought-tolerant (12). With all strategies dedicated to building community resilience, it is crucial to ensure effective monitoring to assess whether continually investing efforts into such strategies is worth the cost.

Battle River Watershed Recommendations on Drought Policy and Water Use

The policy advice from the Battle River watershed consists of two components, one being drought adaptation strategies employed prior to the impacts of drought being observed, and the other being drought management, which is the response applied after the impacts of drought are experienced (13). The main point of advice for drought adaptations was to work proactively, effectively minimizing the later impacts of drought on communities (13). One way this can be achieved is through education that promotes an increase in community knowledge and skills in the community that can thereby assist with implementing self-reliant approaches to managing the social, economic, and environmental effects of drought (13). Specifically, the Battle River watershed encourages three goals for policymakers to consider when formulating drought policy:

1. Encouraging collaboration between urban and rural management during low-water periods.
2. Encourage the development of appropriate support networks for watershed residents to successfully manage the social, economic, and environmental impacts of drought.
3.. Encourage watershed sustainability to enable recovery of economic, ecological, and community well-being to longer-term sustainable levels after a drought event (13).

Additionally, the Battle River watershed released actions that are recommended to be implemented across the watershed, thereby including Camrose. The first action is to increase efforts in education and awareness. This entails awareness about the causes and impacts of drought as well as dialogue about the trade-offs. This could be achieved through engagement with the community members, keeping them informed of any plans or decision-making processes, and empowering residents to make changes (13).

The second recommendation is championing rebates and incentive programs that promote water conservation like low-flush toilets and rain barrels. This incentive need not be exclusively financially motivated but could also be in support of drought management efforts or facilitated through offering materials and personnel to install water-smart hardware

and appliances in the home. These could benefit as a temporary fix or engaging in more long-term action (13).

Successful Water Conservation Efforts

Research assessing the effectiveness of water conservation strategies has revealed that efforts in the installation of weather-sensitive irrigation switches (WSICS) in residential properties and sports fields are one of the most effective means by which water consumption can be reduced (14). Weather-sensitive switches regulate irrigation patterns based on the current weather data to properly adapt irrigation schedules, adjusting appropriately to fluctuations in temperature and precipitation. This eliminates unnecessary outdoor watering, which is one of the major uses of domestic water during the most drought-prone periods of the year. When installed in outdoor recreational fields, the WSICS reduced outdoor water irrigation by 121,000 gallons/acre/year (14).

Additionally, research revealed there were benefits from the installation of residential rainwater harvesting systems designed to capture runoff from rooftops. This water is later used for activities that do not require potable water, like gardening, watering lawns, or washing cars. Installation of rainwater capturing technology results in a decrease in domestic water use on residential properties (14). The current Camrose Drought policy prohibits the outdoor use of potable domestic water for gardens in severe stages of drought. The existing water restrictions could offer incentives to residents to install rainwater harvesting systems which could then later be used for outdoor activities that do not require potable water during severe drought by giving them access to an alternative water source.

Additional strategies to minimize the irrigation requirements for outdoor regions in municipalities include soil amendments. This has been achieved through soil enhancement with zeolite which helps retain soil moisture and nutrients. In the case study investigating the effectiveness of the zeolite additive to the soil in recreational fields, it was estimated that zeolite addition can save approximately 38,000 gallons/acre/year, which equated to a 37% reduction in water irrigation volume (14). In addition to the use of soil amendments, the use of drought-resistant turf minimizes irrigation requirements and is more resilient to prolonged instances of drought. In addition to a reduced amount of water required for irrigation, there will be a decrease in the amount of labour required for turf upkeep, which also decreases maintenance costs. Regions around the world that have experienced some of the worst droughts in the past decades (Las Vegas, California, Cape Town) have since developed highly detailed and descriptive action plans for drought and drought policies to increase community preparedness and climate resiliency. This preparedness has increased the communities' drought resiliency. A study based in southern

California looked into the efficacy of different water conservation strategies (voluntary, mandatory, and market-based strategies). The three primary findings from their work determined that water pricing as a conservation tool worked, not only as a cost-recovering instrument but was associated with a decrease in water demand. Additionally, investing in water-efficient tools only when they provide significant savings in water (15). Findings from the study indicated that mandates curbing outdoor water use were correlated with reductions in residential per capita water usage. These results also aligned with the idea that policy plays an important role in regulating municipal water consumption.

Traditionally, water is billed using a combination of a fixed fee component in addition to a variable component based on the volume of water a household uses. This means that water is billed at a constant rate. An alternative, yet effective option for billing water during drought would be adding a surcharge to the existing water rate (16). These surcharges would be implemented to the base rate after water use has surpassed a threshold declared by the City. Surcharges on water rates have been demonstrated to be an effective tool to encourage contentious water use. Water utility rate surcharges need not be used frequently, rather only doing so in severe or critical stages of prolonged drought. Consumers could be informed when they have neared the threshold, and again once it has been met, they will be charged an increased amount for additional water used. However, using an increased water unity rate as a water conservation technique may disadvantage those at a lower socioeconomic position as they will be disproportionately impacted by increased prices in the event they need to use more water. This would be something to consider when implementing the rate changes for which water is charged (16).

Proposed Solutions

Based on the research conducted regarding drought adaptation techniques and mitigation strategies concerning the development of policy and drought action plans, we have implemented various innovative changes to the existing framework policies that regulate municipal water use and conservation for the city of Camrose. These changes extend beyond just policy, emphasizing many proactive approaches to reducing domestic water use for residents and local businesses. The proposed strategies promote better communication and education about drought, providing realistic steps individual businesses can take to reduce their water consumption, and suggesting changes the city can implement to reduce the overall municipal water consumption in times of drought.

Availability of Water Use/Conservation Framework Policies

For residents and businesses to abide by the municipal Water Use Conservation Policies and Bylaws, these documents need to be made easily available on the Camrose website. In addition to the policy and Bylaw, the Water Shortage Response Plan (WSRP) designed for Camrose needs also to be made available alongside the other two governing documents. Currently, the WSRP is not publicly available. Still, it is fundamental to understanding the municipal Water Use and Conservation Policies and Bylaws, considering it provides comprehensive rationale and background information for the existing policy (which acts as the foundations for the bylaws). Currently, in the Water Use/Conservation Policy, there are references made to “Emergency Measures” for water use in Table 1. However, the emergency water use measures are not described in the policy; rather, they are described in the WSRP, making them unavailable to the public, which would be necessary during and before a Stage 4 drought.

We recommend that on the City of Camrose Website there be an additional section that provides descriptions and publicly accessible links to the three previously mentioned documents in one area. The document descriptions should provide a summary of the contents, objectives, and relevance of each document. Additionally, within all three mentioned documents, names and URLs to other related documents should be provided. Having comprehensive water use and conservation framework policies readily available and described will assist with the education of the businesses and residents about their role in drought prevention. In addition to the three core framework policy documents (Water Use/Conservation Policy, Water Use/Conservation Bylaw, and the WSRP), the Risk Assessment and Climate Vulnerability report for Camrose provides

valuable insight into the community's current and future climate resilience. It also discusses the genuine threats posed to the city due to changing climate, including drought. Including this report alongside the framework, policies would contribute insight into the threat of drought to the community, validating the need for water use/conservation restrictions and bylaws.

Obtaining A Water-Sharing Agreement

Collaboration among communities and water license holders is one of the most frequently mentioned strategies for preparing for drought. This collaboration specifically entails the development of water-sharing agreements with priority license holders. Currently, Camrose does not have an existing water-sharing agreement with any license holders with higher priority. Based on this current situation, if the water from the city's single water source drops below the minimum operating level (684.27m), the city's ability to divert water from Dried Meat Lake would be restricted. Establishing a water-sharing agreement with other notable water license holders on the Battle River watershed for Dried Meat Lake would reduce the threat of restrictions placed on the amount of water that the City of Camrose can divert from Dried Meat Lake.

In the process of formulating policy recommendations for the City of Camrose, we must stress the significance of taking proactive steps to mitigate and monitor drought situations. By taking proactive measures instead of reactive ones, we can reduce the negative effects of drought on our community's environment and socioeconomic structure while simultaneously improving our ability to manage water scarcity.

Proactive Efforts

First and foremost, we recommend the revision of the current drought mitigation policies and practices to increase the preparedness of the city. The term "preparedness" describes pre-disaster actions intended to improve the standards for operational and institutional capacities in the event of a drought or improve the overall level of preparation. Mitigation refers to both short- and long-term measures taken both during and before a drought to lessen the risk to people's lives, property, and productive capacity. These strategies should outline water conservation, water supply resilience, impacts on vulnerable populations, and overall drought mitigation. Don Wilhite, a Climatologist and Drought Management Specialist had this to say ”It seems clear that investments in preparedness and mitigation will pay large dividends in reducing the impacts of drought”, this along with the CRVA emphasizes the importance of proactive measures (17). As an effort to assist in the revision process, we have developed several recommendations. Our recommendations include a 5 stage action plan as well as drought policy improvements that emphasize communication and incremental risk management. Our team's

objective is to assist the City of Camrose with reducing the risk and uncertainty brought on by the complex, slowly developing stages of drought.

The Addition of Stage Zero Drought

We propose the addition of a fifth category of drought, "Stage 0," as one of the major changes the city makes to its drought policy and master action plan documents. Currently, the City of Camrose identifies four existing categories of drought:

- Stage 1: Watch
- Stage 2: Warning
- Stage 3: Critical
- Stage 4: Emergency

In each of these stages of drought, various water usage restrictions are in place to reduce municipal water usage and prolong available supplies. The Stage 0 drought shares the same objectives as other stages but would be the city's default stage when there is no or very little concern for impending drought. Thus, there would be no restrictions on water usage, and initiatives in this stage would approach water conservation from an educational and awareness standpoint (rather than mandatory restrictions) that promote long-term water reduction strategies that both individuals and businesses can adopt to be more conservative with their water consumption even in the absence of drought. The proactive efforts in Stage 0 will ideally reduce personal water consumption year-round, effectively reducing the likelihood of meeting the triggering criteria for more serious stages of drought that are accompanied by more strict restrictions on municipal water use. Water conservation and drought awareness initiatives that are to be included in the Stage 0 drought are listed and described as follows.

Collaboration

Public education and awareness campaigns are essential components of drought mitigation methods when it comes to communication. We encourage a proactive water management culture in the community by educating residents about the effects of drought and the value of water conservation. The best time to spread knowledge and awareness is before a drought happens. We were able to identify a few interesting factors that affect successful collaboration from a study conducted by the Wilder Research Centre regarding what makes cooperation thrive.

Proposed Solutions

Factors	Description	Percent
Open and frequent communication	Collaborative group members interact often, update one another, discuss issues openly, and convey all necessary information to one another and to people outside the group.	82%
History of collaboration or cooperation in the community	A history of collaboration or cooperation exists in the community and offers the potential collaborative partners an understanding of the roles and expectations required in collaboration and enables them to trust the process.	55%
Members share a stake in both the process and the outcome	Members of a collaborative group feel 'ownership' of both the way the group works and the results or product of its work.	55%
Establish informal and formal communication links	Channels of communication exist on paper so that information flow occurs. In addition, members establish personal connections producing a better, more informed, and cohesive group working on a common project.	55%
Shared Vision	Collaborating partners have the same vision, with clearly agreed upon mission, objectives, and strategy. The shared vision may exist at the outset of collaboration, or the partners may develop a vision as they work together.	36%

** Percent of studies that identified the factor based on 11 studies **

Figure 1: Key Factors Influencing the Success of Collaboration (Source: Collaboration: What Makes It Work)

Keeping these things in mind, we can start creating a communication strategy that works. Our research revealed that to be effective, you should routinely evaluate policies and processes to improve and broaden communications. We encourage extending communication to platforms such as the Voyent Alert App, City Website, and other city-operated media outlets such as Instagram, Facebook and Twitter (X). These newer forms of communication should be used in conjunction with the radio ads, newspaper ads and the daily booster. Meetings, workshops, and interagency work groups are examples of communication activities that should encourage mutual understanding, collaboration, and information sharing. We propose bringing the topic of drought to schools as a means of spreading awareness of the issue and its possible effects. Raising awareness about drought through workshops and discussions is a low-cost and efficient

approach to convey a shared goal. Along with being consistent with what parents see in the newspaper, emails from the city, or the daily booster, this will also encourage participation and conversations at home. Community involvement is critical in a scenario like drought. Setting goals for a collaborative effort should consider the community's degree of development, acceptability, and knowledge of cooperation.

We encourage the City of Camrose to provide incentives for residents to participate and continue to do so. These may include incentives for Rain Barrels, Lawn Replacements, Smart Sprinklers and water-smart appliances like Washing Machines. It is important to review to see if residents are motivated by those incentives, as incentives come with an opportunity cost. Additionally, our research found it important to acknowledge that issues will arise and that they need to be shared. Understand that disagreements are often healthy and that there are some subjects where individuals can "agree to disagree"(18). When a collaborative group is newly established, they need to come up with a shared objective. Participate in vision-building activities and use the agreed vision to inform language and actions.

The following garden analogy should help us better understand the concept. One thing that a garden needs is sunlight. If totally absent, the garden will not grow at all. Nonetheless, the garden will continue to yield benefits if there is some degree of sunlight. Similar to the garden, it's conceivable that cooperation can still yield some benefits even in cases when the success elements aren't met to perfection. Collaborative efforts that lack trust, and communication, for instance, have about as much chance of success as a garden that receives no sunlight (18).

Outdoor Water Use

Outdoor use displays a relatively strong and positive relationship with home square footage. An effective way to dissect this information is through the lens of price elasticity. The quantity demanded of a good or service (water) in response to price fluctuations is measured by the price elasticity of demand. It is computed by dividing the percentage change in price by the percentage change in quantity demanded. When the price elasticity coefficient's absolute value is more than one, demand is considered elastic; when it is less than one, demand is considered inelastic. When the water demand is elastic with respect to price, consumers react accordingly. A price rise reduces overall revenue because it causes the amount demanded to fall more than it would have otherwise. Conversely, when a price decreases, the amount that is demanded rises in line with it, boosting revenue.

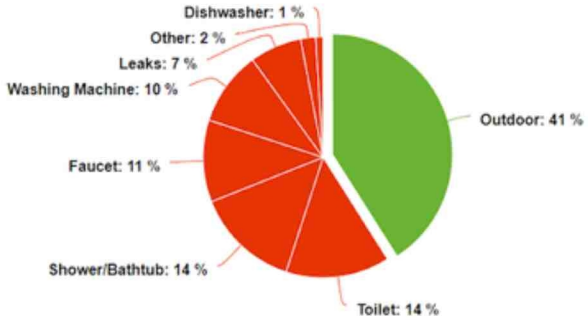


Figure 2: Average Residential Water Use: North America 2016 (Source: DeOreo et al. 2016)

Given that outdoor use has an estimated price elasticity of (-0.82), it may be concluded that outdoor water consumption is more responsive to changes in price (19). This indicates that when it comes to outdoor usage as opposed to inside usage, customers are more sensitive to fluctuations in the price of water. According to the common understanding of demand elasticity, the elasticity coefficient's negative sign (-0.82) indicates an inverse relationship between the amount demanded and price. The notion that outdoor water use is more voluntary and, therefore, more elastic in terms of cost than inside water use is supported by this conclusion. In contrast to indoor water usage, which includes necessary tasks like bathing, cooking, and cleaning, outdoor water use, such as watering lawns and filling swimming pools, is typically viewed as voluntary or non-essential. Because of this, residents are more likely to modify their outdoor water usage rather than their indoor water usage in response to price changes, which results in a higher price elasticity for outdoor water consumption.

Homes with in-ground sprinkler systems use 35 percent more water outdoors than those who do not have an in-ground system.
Households that employ an automatic timer to control their irrigation systems used 47 percent more water outdoors than those that do not.
Households who water with a hand-held hose use 33 percent less water outdoors than other households.
Households who maintain a garden use 30 percent more water outdoors than those without a garden.

Figure 3: Results of the Outdoor Use Model (Source: Residential End Uses of Water)

Based on our findings, we found that the most effective way to increase water conservation was to focus on outdoor water use, which on average comprises 41% of household consumption. Given the comments by others and the sources we reviewed here, we estimate that smart irrigation controllers reduce water use by up to 40% or more when targeting excessive irrigators and 15% or less when including typical users (19).

Smart Sprinklers (Controllers)

According to survey results, the major factor for low adoption rates is the cost of the smart controller. Homeowners prefer smart controllers, but water rates and annual savings, water savings potential, and price perception are the most important factors in deciding to upgrade to a smart controller (19).

However, we believe homeowners will be more inclined to pay the controller's initial cost if the City of Camrose provides a small financial incentive. If community involvement proves to be problematic, starting the process with places that need regular irrigation, such as parks, golf courses, soccer fields, and other city-owned green spaces, might be an alternative strategy. Leading a project like this could also inspire community involvement if we can convincingly show the advantages and possible savings.

Waterless Wednesdays

Waterless Wednesdays can play a pivotal role in Stage 0 of the drought action plan for the city of Camrose. Drawing inspiration from the successful implementation of this initiative in Weyburn, we propose designating Wednesdays as waterless days. This strategic measure aims to proactively address water scarcity issues and minimize the strain on our city's water resources and infrastructure, particularly during heightened demand or drought conditions. By encouraging residents to reduce their water usage on Wednesdays, we can promote sustainable water management practices and foster a culture of conservation within our community. Through regular participation in Waterless Wednesdays, individuals will become more conscientious of their water consumption habits and empowered to adopt more water-efficient practices in their daily routines (22).

Water Pricing

In light of our research findings, it is evident that adjusting the water pricing strategy can also play a pivotal role in managing water scarcity effectively. Implementing a surcharge on water usage beyond a certain threshold, along with different pricing strategies tailored for residential, commercial, and recreational purposes, can incentivize water conservation and discourage excessive usage. Based on the current water rates for the city of Camrose, which include a fixed charge of $30.62 per month and a consumption charge of $2.23 per cubic meter, here are three pricing scenarios the city could adopt:

Scenario 1: Progressive Tiered Pricing

- The city implements a progressive tiered pricing structure with 3 levels based on water usage, measured in square meters.
- Tier 1 (0-15 cubic meters) is priced at $1.50 per square meter, Tier 2 (15-30 cubic meters) at $2.80 per cubic meter, Tier 3 (over 30) at $3.50 per cubic meter
- This approach imposes steeper increases in pricing as water usage climbs, providing stronger incentives for conservation among high-volume users.
- It rewards households or businesses with lower water consumption by offering lower rates in the initial tiers. (23)

Scenario 2: Seasonal Tiered Pricing

- The city combines tiered pricing with seasonal adjustments to create a more dynamic rate structure.

- During the summer months (June to September), when water demand is highest, the city implements three tiers with higher rates: Tier 1 (0-15 cubic meters) at $2.3 per cubic meter, Tier 2 (15-30 cubic meters) at $2.8 per cubic meter, Tier 3 (over 30 square meters) at $3.5 per cubic meter
- In the winter months (October to May), when water demand decreases, the city reduces rates and simplifies the tiers: Tier 1 (0-30 cubic meters) at $2.3 per cubic meter, Tier 2 (over 30) at $2.8 per cubic meter.
- This approach reflects seasonal variations in water usage while still incentivizing conservation through tiered pricing.
- It may encourage consumers to adjust their water usage based on seasonal rates, leading to more efficient water management. (24)

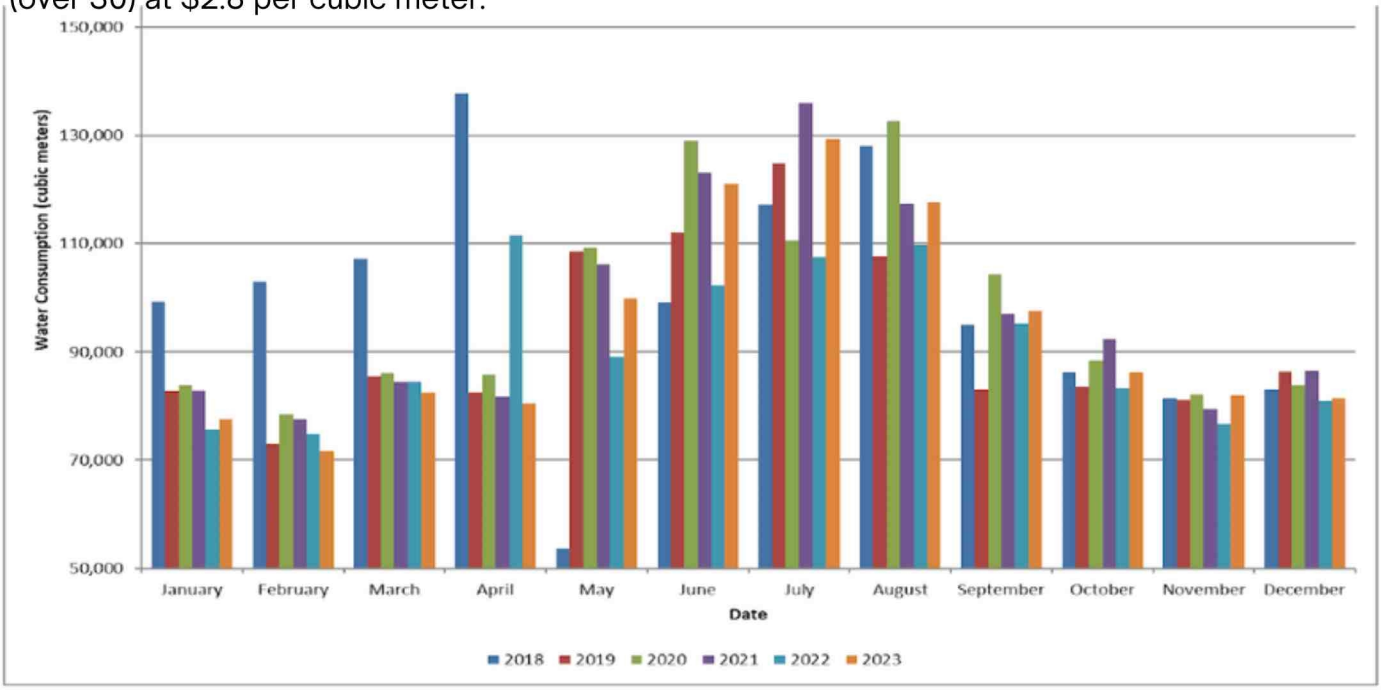


Figure 4: Water Consumption per Month from 2018-2023 (Source: City of Weyburn 2023)

Scenario 3: Combination of Fixed and Variable Pricing

- In this pricing model, the first 30 cubic meters of water usage are charged at a fixed rate of $125. This fixed charge represents the base fee similar to a progressive pricing model's baseline rate.
- After the initial 30 cubic meters, the pricing becomes variable, similar to a progressive pricing model where the rate increases with higher consumption.
- For every additional 5 cubic meters of water used beyond the initial 30 cubic meters, customers are charged an extra $10. This incremental charge represents the variable component that increases with usage, similar to the progressive pricing models.
- Use any additional money gained from the new pricing to invest in other ways to conserve water
- Smart sprinklers, water audits, rebates, water sourcing... etc

Action Plan

	Stage 0	Stage 1	Stage 2	Stage 3	Stage 4
New Incentives	• Lawn Replacement rebate • Rain Barrel rebates • Washing machince rebates	Same as pervious	Same as pervious	Same as pervious	Same as pervious
Retained Incentives	• Toilet Rebate program • Water conservation kits	• Same as pervious • Raffle water kits	Same as pervious	Same as pervious	Same as pervious
Removed Incentives	None	None	None	None	None
New Restrictions	Waterless Wednesdays	Same as pervious	• Watering lawns between 8pm-8am • Sprinkler use can't exceed 20 minutes	Watering flower and vegetable gardens with rain barrel or other non-potable water sources	Watering vegetable gardens with rain barrel or other non-potable water sources
Retained Restrictions	None	None	• Odd/even watering • Watering done by hand or restricted hose • No filling > 1000L pool	• No lawn watering • No washing outdoor surfaces • No pool filling, sprinklers and water toys	• All outdoor water use is prohibited • Bulk water sales are suspended

	Stage 0	Stage 1	Stage 2	Stage 3	Stage 4
Removed Restrictions	None	None	Watering between 6am-9am and 7pm-11pm	Potable watering of flowers and veggtables	No vegetable watering
New Communication	Advertise incentives on website and social media	Increase educational materials about water conservation on the website and city buildings, and in classrooms	Restrictions announced on website, Voyent Alert, and Social Media	• Same as previous • Ask businesses to have a poster for drought restrictions	Same as pervious
Retained Communication	None	None	Restrictions announced in newspaper, radio, electronic billboards, city posters	• Same as previous • Road signs placed in high-traffic areas	• Same as pervious • Door-to-door campaign
Removed Communication	None	Advertisement in newspaper	None	None	None
New City Details	Weather sensing sprinklers	Train city employees on drought policy	Limit timer on spray park	Turn off mirror lake fountain	None
Retained City Details	None	None	City follows same water restrictions as public	• The city does not use outdoor water • Spray park suspended	Emergency water plan measures
Removed City Changes	None	None	None	None	None

Restrictions

Restrictions are used mainly in times of drought as a way to make rapid reductions in water usage. In stages 0 and 1 a fairly limited response is recommended so that residents are not fatigued by drought response. For stages 0-1 we suggest implementing Waterless Wednesdays (25). Under Waterless Wednesdays, outdoor watering would be prohibited. This will reduce water usage and get the residents thinking about water reduction. In stage 3 our recommendation changes are limited. We suggest changing 6:00 am – 9:00 am and 7:00 pm – 11:00 pm to 8 pm - 8 am to increase clarity on watering time. We also suggest that sprinkler watering or play be restricted to 20 minutes per day. In stage 4 drought flower beds and vegetable gardens may only be watered using collected rainwater or other non-potable water using a watering can or trigger shut-off hose. In stage 5 drought we would like to still allow vegetable gardens to be watered using rainwater or other non-potable collections. This is to prevent harm to lower-income populations that might depend on gardens for food.

Communication

Due to the date of the original drought policy, some communication methods are outdated. In stage 0 the incentives listed above could be advertised on the website, social media, electronic billboards, and possibly the booster. In stage 1 increase educational materials about water conservation on the website, in city buildings, and in classrooms. Announcement of drought restrictions in stages 2, 3, and 4 will be enhanced by the city website, social media, the voyent alert app, and requesting businesses put up posters. This will help the city reach a wider audience about drought restrictions. During stages 3 and 4 educational material about drought safety should be distributed on the website and city buildings.

City Propositions

We are recommending that the city install weather-sensing sprinkles as a preparation measure to reduce water use regardless of drought conditions. Prioritizing drought training, especially for workers who spend time outdoors. We also think the spray park timer should be deduced in stage 2. Finally turning off the fountain in Mirror Lake, because it might negatively affect public perception of drought measures.

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