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Okotoks Historic Past. Sustainable Future

REPORT

Town of Okotoks

Climate Infrastructure Vulnerability Assessment

OCTOBER 2023

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EXECUTIVE SUMMARY

The objective of this study is to assess the vulnerability of and risks to the Town of Okotoks's (the Town's) infrastructure from climate change. The results should inform and target investment to the highest at-risk assets. By the Town not taking action to adapt to climate change, essential services like water and wastewater could be compromised, supporting services including power and communications could be interrupted, and the Town's insurance premiums could increase, to name but a few key impacts.

The project includes two phases which are reflected in **Figure ES-1**. Phase 1 assesses the vulnerability and risk of all infrastructure systems, or service lines. Following this project, each service line should develop an action plan targeted to mitigating their highest risks. Facilities is the first service line to have developed an action plan as part of Phase 2 of this study including a more detail risk assessment for 19 Town facilities, actions addressing the highest risks, a potential timeline for implementation and a high-level cost estimate. The project involved a series of workshops to incorporate the knowledge from Town staff across services lines, including operations and engineering.

Figure ES-1 Project Scope

The next steps following this project include:

- Distribute this Climate Infrastructure Vulnerability Assessment Report to each service line to support project prioritization and budget planning.
- Develop an action plan based on the results of this project, either separate plans for each service line or a consolidated plan.
- Town Council should refer to the highest risks identified in this project to allocate budgets for projects.

Phase 1 Results – Highest Risks Across All Infrastructure Systems

Risk is evaluated as the product of **likelihood** of the hazard, events, or condition that could occur, and the level of the **consequence** of the impact. In terms of climate risk, we develop an understanding of how the variability of climate patterns impact the built and natural environment, and in turn, how this impacts the society and economy. **The purpose of a risk assessment is to identify the highest risks so that subsequent adaptation actions are focused on these highest risks.** High risks for the Town's infrastructure are summarized in **Table ES-1**. Additional impacts are determined to be a lower risk and are summarized for each service line in **Appendix C**.

Table ES-1 High Climate Risks to Town Infrastructure

Asset Type	Climate Hazard	Highest Scoring Climate Risks
Wastewater Treatment Plant	River Flooding	The wastewater treatment plant and surrounding site are flooded in a 100-year return period. This could result in untreated wastewater being discharged to the river. The wastewater treatment plant does not have temporary flood protection measures. Site level flood protection should be assessed.
Water Treatment Plant	River Flooding	Flooding of the water treatment plant. The water treatment plant has on-site temporary flood protection, but access to the plant is cut off for floods larger than a 50-yr return period. Site level flood protection should be assessed.
GUDI Wells	Drought	Lower river and groundwater levels can limit water supply for water treatment and not meet water demand during extended periods of drought.
	Extreme Heat	Extreme temperatures increase water demand and have the potential to exceed capacity and limit fire water supply. Heat can overheat electrical systems and cause power outages. Only 50% of the wells have backup power.
Constructed Wetlands	Biodiversity	Long term ecoregion shift will bring more invasive species, pests, and diseases that can disrupt the balance of ecosystems in constructed wetlands and potentially cause irreversible die-off. Wetlands should re-establish after drought.
Public Trees	Drought & Biodiversity	Die-off of public trees from severe drought and an increase in invasive species, pests, and diseases from ecoregion shift. Monoculture in some areas which are more susceptible to disease. Reduced biodiversity, shade from extreme heat and carbon storage.
Manicured Parks and Sports Fields	Drought & Biodiversity	Limited water available for irrigation and die-off of vegetation. An increase in invasive species, pests, and diseases can cause die-off of plants in parks and grasses in sports fields, impeding their use.
Various Facilities	River Flooding	Several facilities are flooded for events less than a 50-year return period: Water Treatment Plant, Fleet Building, EcoCentre, Municipal Centre, Okotoks Public Library and the Former Library at 7 Riverside Dr (Cameron Crossing and Bow Valley Schools). Additional facilities flooded for events less than a 100-year return period: Wastewater Treatment Plant, Operations Centre, Operations Shop, Okotoks Art Gallery, and Okotoks Museum and Archive

Phase 2 Results - Highest Risks for Facilities

Facilities are somewhat unique in that they are impacted by the largest number of different climate hazards, some having more severe consequences than others like loss of power and communications. Climate hazards will reduce the life span of many assets by increasing the wear and tear from more frequent and intense events and will increase operation and maintenance needs such as increase debris cleanup from storms, more frequent replacement of filters from wildfire smoke, increased management of invasive species and pests. Facilities will also experience costly damages from flooding or storms which may or may not be covered by insurance and disaster recovery funds. The highest risks across all facilities are summarized in **Table ES-2**.

Table ES-2 Highest Climate Risks for Facilities

Rank	Building System	Highest Scoring Climate Risks
1	 Power and Communications	• Communications equipment is at risk of damage from **lightning** strikes • Rooftop equipment is exposed to **hail** and **high winds** • Equipment located in basements is at risk of **flooding** from either river flooding or high intensity rainfall
2	 Site Grading, Landscaping, and Features	• **Hot temperatures** and **drought** can cause stress of die-off of native species • Improper site grading can lead to **flooding** of facilities and prevent access to facility services • **Hail** and **high winds** can damage trees, knocking them into buildings or powerlines • Increased management of **invasive species and pests**
3	 HVAC	• **High temperatures** or **high winds** can cause power outages, losing access to HVAC systems • Electrical and mechanical equipment located in basements is at risk of **flooding** from either river or localized flooding
4	 Structural	• Greater **snow loads** (heavy, wet snow) in the future may exceed design loads for roofs (each facility should be assessed further based on building code at time of construction, asset condition and projected changes in snow loads)
5	 Exterior Envelopes	• **Hail** can damage roofs, skylights, and vents • **Hot temperatures** will put additional burdens on a facility's ability to rely on passive cooling • Localized **flooding** can cause leaks in roofs, or water ingress around windows and doors

Phase 2 Planning - Facility Actions

For the 19 facilities assessed, 76 risk mitigation actions are identified to address risks with a score of "Medium" or higher. These highest risk actions are primarily targeted at critical facilities, where the facility provides services that can not be interrupted or are required during an emergency event. **The preliminary estimate to complete these actions is $3.71 million to be spread across multiple business cycles**.

Some actions will require further study to refine the scope and cost before the actions are implemented such as assessing appropriate structural measures for heavy snowfall if vulnerable. River flooding is a widespread issue and a more community-wide river flood management plan should be conducted before investing heavily in flood measures at each facility. The flood actions included in the report cards focus more on lower cost options to reduce vulnerability if water enters the facility, such as elevating or removing electrical and mechanical systems from the basement.

Preliminary implementation timeframes include immediate (current budget cycle), 2026-2029 (next budget cycle), 2030-2033 (future budget cycle), and Future/Further Consideration (timing and scope to be assessed). **Timeframes can be adjusted and should consider planned asset retrofit and replacement activities to align actions where possible**. Similar actions may also be grouped across facilities to find cost savings. **Table ES-3** provides a summary of the types of actions, estimates of cost and timeframes for implementation.

Table ES-3 Risk Mitigation Action Summary Table

Implementation Timeframe	Estimated Cost	Sample Action Types
Immediate	$645,000	• Reducing the risk power outages from lightning strikes • Controlling invasive species, pest control and trimming tree branches overhanging facilities and above ground power lines (recurring maintenance)
2026-2029	$747,500	• Protecting rooftops and exposed rooftop assets (e.g., HVAC, communications equipment) from hail • Installing backup power (e.g., generators, solar power) and/or hookups for mobile power sources • Landscaping upgrades to improve drainage to prevent localised flooding, placement of trees on S and SW for heat reduction, and using drought-tolerant vegetation • Flood protection measures in alignment with community flood planning • Assess structural integrity of roofs for future snow loads
2030-2033	$1,824,500	• Mitigating extreme heat through exterior envelope upgrades • Burying power lines
Future/ Further Consideration	$488,000	• Installing snow guard systems on roofs • Upgrading HVAC system cooling capacity
Grand Total	**$3,705,000**	

Report cards for each facility provided as reference for facility managers and operations staff to support their asset management and climate adaptation planning. An example report card is shown in **Figure ES-2** with report cards for all facilities in **Appendix D**. The report cards include:

- Vulnerability of facility to each climate hazard,
- Water depths for various river flood return periods, and
- Summary of top risks to the facility and their associated potential mitigation actions, high-level cost estimate and timeframe for implementation.

Figure ES-2 Example – Facility Report Card

Water Treatment Plant (excl. process equipment)

101 Woodhaven Drive

Facility Description:

A new water treatment plant will be operational in 2025, bringing water from the Bow River to Okotoks.

River Flood Return:	Water Depth (cm)
50-Year	69.3
100-Year	104.4
200-Year	138.3
350-Year	149.1
Risk Ranking:	6

Okotoks

Facility Vulnerability by Hazard:

Extreme Heat	Low Temps
Freeze-Thaw	Local Flooding
Heavy Snowfall	River Flooding
Hail	Lightning
High Winds	Wildfire Smoke
Drought	Biodiversity

High Vuln, Medium Vuln, Low Vuln
Based on Survey Results

Rank out of 19 facilities -
Lower ranks are higher risk

Top Risk Mitigation Actions:

Top Risks	Risk Score	Top 5 Risk Mitigation Actions	Cost	Timeframe
Heavy Snowfall - Structural	48	-Evaluate adequacy of roof to meet snow-load capacity	$5,000	2026-2029
Heavy Snowfall and Hail - Structural	40	-When installing a new roof, utilize a hailguard system or install hail-resistant solar panels to mitigate the risk of hail damage to the roof. -Have operations staff regulary unclog gutters and roof drains to ensure quick removal of hail.	$450,000	Immediate
Hail - Power and Communications	40	- Consider deploying temporary protection barriers to shield vulnerable equipment during forecasted hail events. - Ensure availability of spares or backup communication equipment. - Confirm the operability of alternative equipment before the hail event.	$25,000	2030-2033
High Winds - Site Grading, Landscaping and Features	36	- Trim back any branches near the building to reduce the potential for windborne debris.	$5,000	Immediate
High Winds - Power and Communications	36	- Anchor rooftop electrical or communications devices securely to prevent them from becoming airborne during high winds.	$5,000	Immediate

Risk Score out of 100
(100 is highest)

Further Considerations

The National Adaptation Strategy (NAS) released in 2023 sets the direction for climate resilience across five interconnected systems: infrastructure, disaster resilience, nature and biodiversity, health and wellbeing, economy and workers. The NAS provides a strong framework for the various dimensions climate adaptation plans should consider. The primary focus of this project was to assess risks to the Town's infrastructure, which is linked to many of the other systems show in the NAS. Some considerations to evolve climate planning for Town infrastructure and/or facilities includes:

- Consider the health and wellbeing of Town staff working in facilities and the impacts from extreme heat and wildfire smoke.
- Consider the health and wellbeing of Town staff that work outdoors including extreme heat, wildfire smoke, and intense storms.
- Assess and enhance facilities that can act as emergency centres (i.e., cooling and clean air centres, evacuation centres, etc.) and consider decentralized/multiple buildings targeted to vulnerable population areas.
- Develop emergency response plans for extreme heat, wildfire smoke and other climate hazards where emergency response plan do not currently exist.
- Further assess the criticality of Town facilities building on the three levels of criticality initially considered as part of this study. This should include the multi-use function of buildings, the severity of interruption of services if the facility is damaged, opportunities to utilize the facilities in different capacities during an emergency, and the ability to support vulnerable groups and needs.
- Assess facilities through a disability and accessibility lens and enhance as appropriate. This includes consideration of different languages, cultures, and other demographics.
- Assess the climate risk and develop action plans to protect the Town natural assets (e.g., wetlands, forest, etc.).

1 INTRODUCTION

1.1 Project Background

The Town of Okotoks (the Town) engaged Associated Engineering (Associated) to develop an understanding of the climate vulnerabilities and risk for the Town's municipal infrastructure. The results of this risk assessment will guide adaptation action planning to reduce the impacts of climate change. The Town is conducting this work with funding from Municipal Climate Change Action Centre (MCCAC) Climate Resilience Capacity Building Program.

Municipal Climate Change Action Centre

A series of risk identification and assessment workshops was conducted with the Town using the Public Infrastructure Engineering Vulnerability Committee (PIEVC) Protocol, developed by Engineers Canada. The assessment was conducted on the following assets and areas:

- Water,
- Wastewater,
- Stormwater,
- Waste,
- Facilities,
- Roads, and
- Parks.

In addition to looking directly at the risk to the assets owned and operated by the groups above, the risk assessments also looked to capture impacts to municipal operations staff, public users, and the impacts to service delivery.

1.2 Purpose

The purpose of this assessment is to conduct a climate-based risk assessment for the Town's infrastructure to identify the highest risks. The project includes two phases which are reflected in **Figure 1-1**. Phase 1 assesses the vulnerability and risk of all infrastructure systems, or service lines. Following this project, each service line should develop an action plan targeted to mitigating their highest risks. Facilities is the first service line to have developed an action plan as part of Phase 2 of this study including a more detail risk assessment for 19 Town facilities, actions addressing the highest risks, a potential timeline for implementation and a high-level cost estimate.

Figure 1-1 Project Scope

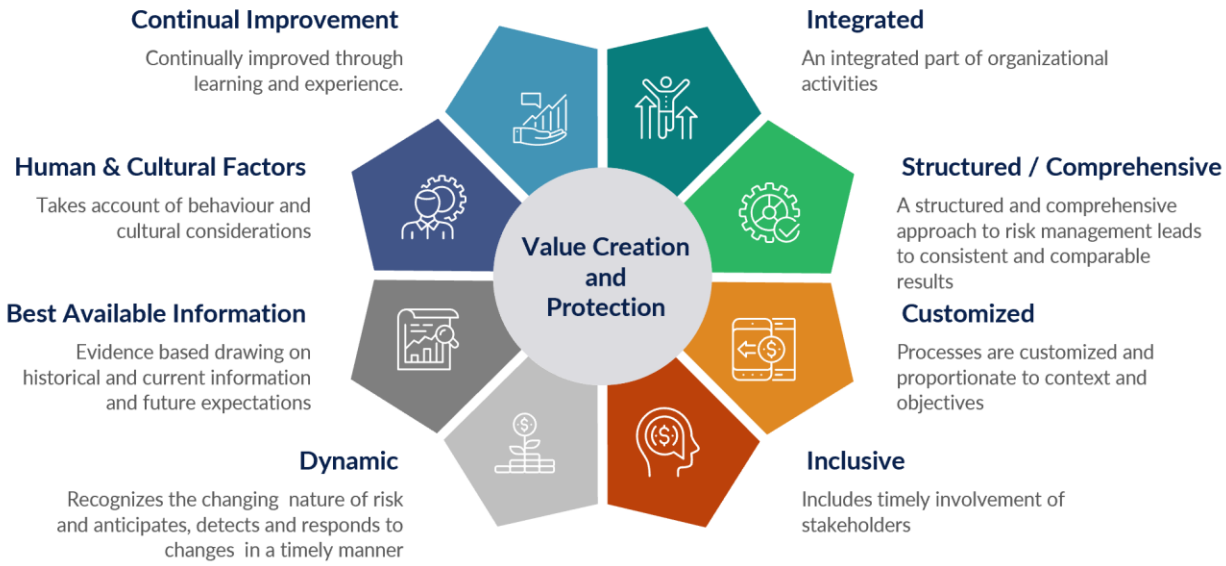
The results of this study will assist the Town to incorporate climate risks discussion and adaptation measures into future land use planning, engineering design standards, operational practices, infrastructure assessment, capital planning, and human resource programming. The assessment includes:

- Analysis of climate hazards relevant to the Town considering historic values and future climate projections,
- A high-level climate risk assessment of the Town's assets for the following service lines: Water, Wastewater, Stormwater, Waste, Facilities, Roads, and Parks,
- A more detailed climate risk assessment of 19 of the Town's facilities,
- Assessment of river flood depths for various flood return periods for the Town's facilities using recently updated flood mapping (2023),
- Development of a list of high-level adaptation measures to address the highest risks for Town facilities, and
- Estimate preliminary costs for actions and implementation scheduling for Town facilities.

1.3 International Standard Guidelines (ISO)

The risk assessment process that this project adopted is based on the ISO 31000's principles of risk management. The principles follow a systematic cycle of actions to create and protect the value of the community. **Figure 1-2** illustrates the process starting from integration of organizational activities that requires the collaboration of all departments, using a structured approach to assess risk that is customized for the appropriate context. The discussion is also inclusive and dynamic, drawing from evidence-based information. Finally, the risk management process identifies a continual improvement through leaning and experience.

Figure 1-2 Principals of Risk Management (ISO 31000)

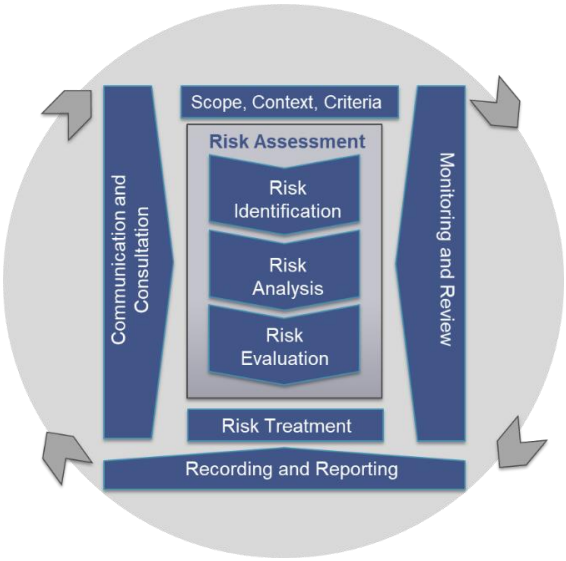


Another ISO guideline that was consulted is ISO 14092. Our approach to the climate risk assessment employed a 'best practice' methodology, which is based on the "*Climate Resilience Express – Community Climate Adaptation Planning Guide*" (https://mccac.ca/app/uploads/CRE_Planning-Guide_Final.pdf), which was developed by All One Sky Foundation for the Municipal Climate Change Action Centre and the Climate Resilience Capacity Building Program. Our work is also aligned with the recently published International Standards Organization (ISO) guideline 14092: Adaptation to Climate Change—Requirements and guidance on adaptation planning for local governments and communities, and with the Intergovernmental Panel on Climate Change's (IPCC) latest conceptualization of climate risk assessment methods.

In the PIEVC guidance, **Risk** is defined as the product of the likelihood of the "impact" and the consequence of the "impact" on the system. The "impact" in this discussion referred to the climate change impacts or climate hazards.

Vulnerability is defined as how the system fares against the climate hazards when exposed. It can also be viewed as the ability of the system to absorb the inundation of the climate hazards. In other words, vulnerability is the inability of a system to cope with the adverse effects of climate change and the climate variability. The sensitivity of the system when exposed to the climate change is often evaluated based on level of use, service life/age, maintenance/operations costs, and replacement costs. Adaptive capacity is assessed based on the cost and time required for the system to resume to its original service.
In this report, vulnerability was not assessed in detail for all service lines but was assessed qualitatively within the consequence scoring. During consequence scoring, which took place in a series of workshops, Town of Okotoks staff were asked how their infrastructure and buildings systems would behave when exposed to the various climate hazards at their current conditions. Their qualitative assessment was based on their engineering/technical experience and their understanding of their assets/infrastructure. This **qualitative vulnerability** discussion, coupled with the risk assessment, provides an overall understanding of the current status of the Town's infrastructure. This initial assessment of risk will allow the Town to formulate a more focused and detailed risk and vulnerability assessment for the components of each infrastructure system.

Figure 1-3 ISO 31000 Risk Management Process (High Level Screening)



The **adaptation** measures identified in this report will provide the Town will potential activities to consider, plan and implement. The international standard for risk management, ISO 31000 shows the progression from Risk assessment to treatment that will require monitoring, review, consultation, and communication (**Figure 1-3**). In this project, risks to service lines and buildings were identified, setting the stage for the development of risk reduction and risk treatment measures. Beyond this project, the Town can identify site-specific risk reduction strategies and activities.

2 CLIMATE PROJECTIONS

2.1 Climate Data

The Government of Canada has several data sources where historical climate data and future climate projections can be obtained. The PIEVC High Level Screen (HLS) Guideline indicates that although Climate data is now available in higher spatial and temporal resolution, there are some climate parameters and geographic areas that are more difficult to obtain. Where possible, proxy datasets and modelled data was used to cover the gaps. Some complex parameters including extreme wind and complex precipitation events like hail, snowfall. **Table 2-1** lists the climate data sources available. For this Assessment, the Climate Atlas of Canada and Climate Data Canada were used to obtain data and projections.

Table 2-1 Climate Data Sources

Climate Portal Name	Source	Link
Climate Atlas of Canada	Prairie Climate Centre	https://climateatlas.ca/
Climate Data Canada	Environment and Climate Change Canada/ OURANOS/ CRIM/ PCIC/ Prairie Climate Centre	https://climatedata.ca
Downscaled Climate Scenarios	Environment and Climate Change Canada	https://climate-change.canada.ca/climate-data/#/
PCIC Climate Explorer	Pacific Climate Impacts Consortium	https://www.pacificclimate.org/analysis-tools/pcic-climate-explorer
Climate-resilient buildings and core public infrastructure 2020 Report	Environment and Climate Change Canada	https://publications.gc.ca/collections/collection_2021/eccc/En4-415-2020-eng.pdf

2.2 Timescale and Parameters

For this project, the time horizons for assessment were chosen to align with the design life/expected lifecycle of the infrastructure, or period of time before a planned retrofit or reassessment of climate impacts. This assessment considered the following climate periods:

- 2020s (2020 – 2040) i.e., current conditions
- 2050s (2041 – 2070)
- 2080s (2071 – 2100)

Parameters were selected based on potential ongoing and future impacts to the physical infrastructure, as well as impacts to operation and maintenance. In all cases, the Representative Concentration Pathway 8.5 (RCP8.5, i.e., upper-end, most emissions) scenario was chosen to reflect a worse-case scenario for the infrastructure. Climate parameters investigated in this assessment are noted in **Table 2-2** below:

Table 2-2 Climate Parameters

Climate Parameters	Climate Sub-Parameters
Temperature	• Days above +30°C • Warmest Maximum Temperature (◦C) • Days below -25°C • Coldest Minimum Temperature (◦C) • # Freeze/ Thaw Events
Precipitation	• 15 min 100-year Rainfall (mm/hr) • Winter Precipitation (mm) • Severe Summer Hail Days (% Change Relative to Present) • Change in Ice Accumulation
River Flooding	• 24 hour 100-year Rainfall (mm/hr)
Drought	• Relative Change in Standardized Precipitation Evapotranspiration Index-based
Wildfire	• Change in Average Annual Forested Area Burned
Heavy Winds	• 1-in-50 Year Gust Pressures
Lightning	• # of Annual Lightning Strikes
Biodiversity	• Ecoregion Shift, representing the impacts to biodiversity from the change from native to non-native plant, animal, and insect species

For all parameters, quantitative present and future values were determined from reputable and widely used national climate data sources, and peer-reviewed scientific literature. Datasets were sourced to be as relevant as possible to identified infrastructure vulnerabilities. The most proximal data and was used, and a consistent approach with gridded data extraction was maintained. Estimates of future changes to climate parameters that have potential to impact the Town come with varying levels of uncertainty. Detailed climate data and projections for each Climate parameter for each timeframe are included in the risk assessment worksheet. See **Appendix A**.

2.3 Climate Projection Assumptions

The following assumptions should be noted with respect to the climate risk assessment:

- There is the potential for individual models to produce baseline values that are possibly inaccurate (e.g. too warm or cold, too wet or dry, or have difficulty reproducing specific parameters).
    - Note: This inaccuracy was reduced through the creation of a spread of projected values from an ensemble of many climate models.
- The climate downscaling procedure implemented in ClimateData.ca, and other sources noted, may under-estimate or over-estimate the climate parameters used in this project.
- The Assessment did not account for cumulative effects of multiple climate events occurring concurrently.

The Assessment should be updated based on new specific climate projections when they are available.

3 SERVICE LINE RISK ASSESSMENT – METHODOLOGY

The project was conducted in the phases shown in **Figure 3-1** below.

Figure 3-1 Project Overview

During the **Workshop 1, PIEVC Orientation**, Associated provided a discussion of climate change principles and parameters, the PIEVC High Level Screen (HLS) tools and process, and to provide an overview of the project. Following this, Associated provided a presentation template for Town staff to help understand the types and scale of assets for different service lines. Each group presented the information on the assets during **Workshop 2, Tell Us About Your System**. The initial information used in these workshops were used to create asset lists and provide insights for **Workshop 3, Risk Assessment**. An additional workshop was conducted with the Facilities group, **Workshop 4, Facilities Building Systems Risk Assessment,** looking at risk to the specific building systems from climate hazards to support an in-depth assessment of risk for Town facilities.

The risk assessment workshops were conducted virtually by Associated between February 21 and April 17, 2023. A presentation of the results was given to the Town stakeholders engaged. The complete list of workshops is summarized below:

Workshop 1, PIEVC Orientation, consisted of one session:

- **Workshop 1:** All groups.

Workshop 2 Series, Tell Us About Your System, consisted of two separate sessions:

- **Workshop 2A:** Water, Wastewater, Stormwater; and
- **Workshop 2B**: Facilities, Roads, Waste, Parks

Workshop 3 Series, Risk Assessment, was conducted in the following sessions:

- **Workshop 3A**: Water, Wastewater, Stormwater;
- **Workshop 3B**: Roads, Waste, Parks; and
- **Workshop 3C**: Facilities

Workshop 4 Series, Facilities Detailed Risk Assessment, consisted of one session:

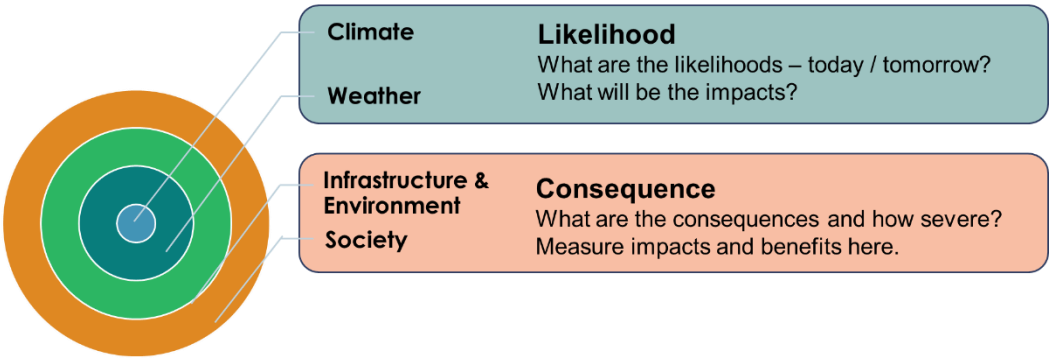
- **Workshop 4**: Facilities

3.1 Risk Identification and Assessment

Risk is discussed in terms of likelihood and consequences. The likelihood is described as the hazards, events or conditions that could occur, and consequence as the result occurring in varying levels of negative or positive impacts or effects. In quantitative terms, risk is evaluated as the product of the likelihood and consequence.

In terms of climate risk, we begin to understand how the variability of climate patterns impact the built environment and environment, and in turn, how this impacts the society. This can be illustrated in **Figure 3-2** below.

Figure 3-2 Risk Inputs



For this project, the PIEVC High-Level Screening tool was used in assessing the built infrastructure and assets. The methods are discussed in the following sections.

3.2 Assets Identification

The municipal owned assets that were assessed were part of the following infrastructure systems:

- Water,
- Wastewater,
- Stormwater,
- Waste,
- Facilities,
- Roads, and
- Parks.

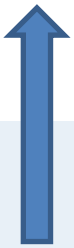
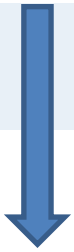
The risk assessment focused on risk to Town-owned assets and the services they provide. The scope is limited to these assets and does not cover whole-of-community impacts.

Although certain assets, such as greenspaces in parks and landscaping around facilities, possessed natural features, it is important to note that natural assets were not in scope for this project. **It is recommended that future assessments explicitly examine the potential impact of climate change on the Town's natural assets**.

3.3 Climate Likelihood Scoring

The likelihood scoring in PIEVC High Level Screening was based on the climate projections. The climate parameter trends and projections were translated into likelihood scores (L), with increasing/decreasing values reflecting increasing/decreasing occurrence over the specified time horizon. Translation into likelihood scores normalized the various climate change trend measures into a common numerical ranking. For each climate parameter, an appropriate likelihood score was applied to determine the direction-of-change for potential impact. **Table 3-1** lists the method for determining climate likelihood scores. For the Town of Okotoks assessment, we have used the PIEVC Middle Baseline Approach for likelihood scoring.

Table 3-1 PIEVC Likelihood Scoring

Likelihood Score (L)	Middle Baseline Approach – Establish Base	Method	Suggested Rational
1		Likely to occur less frequently than current climate	50-100% reduction in frequency or intensity with reference to Baseline Mean
2			10-50% reduction in frequency or intensity with reference to Baseline Mean
3	Establish Current Climate Baseline Per Parameter	Likely to occur as frequently as current climate	Baseline Mean Conditions or a change in frequency or intensity of +-10% with reference to the Baseline Mean
4			10-50% increase in frequency or intensity with reference to Baseline Mean
5		Likely to occur more frequently than current climate	50-100% increase in frequency or intensity with reference to Baseline Mean

3.4 Consequence Scoring

These assessments were completed by evaluating the consequences of the interactions between each climate parameter and each piece of infrastructure or assets. The determination of consequence was guided by a consequence rubric shown in **Table 3-2**.

Table 3-2 PIEVC Consequence Scoring Method

Consequence	Town Services
High – 5	• Added costs far exceed contingency and extreme weather reserves • Operations and services severely interrupted – additional resources required to clear backlog, taking months • Public reaction is significant – negative view of Town (Council & staff) is held by several community groups or a neighbourhood
Medium-high – 4	↕
Medium – 3	• Added costs amount to 50% contingency/extreme weather reserve • Operations and services temporarily interrupted for weeks before backlog is cleared • Public reaction is moderate – negative view of Town (Council & staff) is held by several community groups or a neighbourhood
Medium-low – 2	↕
Low – 1	• Little or no expected additional costs to Town • Minimal or no impact on operations and delivery of services • Public reaction is minimal-little or no erosion of trust in Town (Council & staff)

3.5 Risk Scoring

Using the likelihood and consequence scoring, the final risk score for each climate hazard and asset pair (e.g. Extreme Heat – Roads, Localized Flooding – Stormwater Ponds) falls on a scale between **0 and 25** (refer to **Figure 3-3**):

- **Between 0 and 2** are considered **very low risk (dark green)**;
- **Between 3 and 7** are considered **low (light green)**;
- **Between 8 and 14** are considered **medium risk** (yellow);
- **Between 15 and 19** are considered **high risk** (orange); and
- **Between 20 and 25** are considered **very high risk** (**red**) items.

Upon completion of the risk assessment, the **risk scores** across all climate-infrastructure interactions were assessed.

The results of the assessment for each infrastructure system were compiled on a master worksheet, along with comments on the rationale for individual component consequence scoring as shown in **Figure 3-4** below. **Section 4** describes the results of the assessment. The complete risk assessment worksheet is given in **Appendix B.**

Figure 3-3 Risk Assessment Matrix Example Scoring

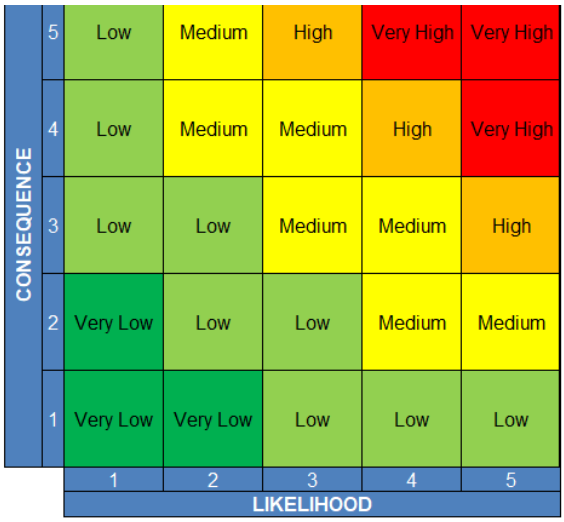


Figure 3-4 Example – Risk Assessment Worksheet

Okotoks

Risk Assessment Worksheet

Consequence Score

0 - No Effect
1 - Insignificant
2 - Minor
3 - Moderate
4 - Major
5 - Catastrophic

			Precipitation											
			24 hour 100-year Rainfall (mm/hr)				Winter Precipitation (mm)				Severe Summer Hail Days (% Change Relative to Present)			
			River Flooding				Snow Accumulation				Hail			
Climate Projections (RCP 8.5)		Baseline	3.8	3			56	3			-	3		
		2050	4.9	4			59	3			+	4		
		2080	5.6	4			64	4			+	4		
			Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R
Asset Category														
Water														
1	13 GUDI Wells (Water Supply)	Baseline	Y	3	3.4	10	Y	3	3	9	Y	3	2.67	8
		2050		4		14		3		9		4		11
		2080		4		14		4		12		4		11
2	Water Treatment Plant (process equipment)	Baseline	Y	3	4.5	14	Y	3	3	9	Y	3	3	9
		2050		4		18		3		9		4		12
		2080		4		18		4		12		4		12
3	3 Treated Water Reservoirs	Baseline	Y	3	3	9	Y	3	3	9	Y	3	2.67	8
		2050		4		12		3		9		4		11
		2080		4		12		4		12		4		11
4	3 Booster Stations	Baseline	Y	3	3	9	Y	3	3	9	Y	3	2.67	8
		2050		4		12		3		9		4		11
		2080		4		12		4		12		4		11

4 SERVICE LINE RISK ASSESSMENT – RESULTS

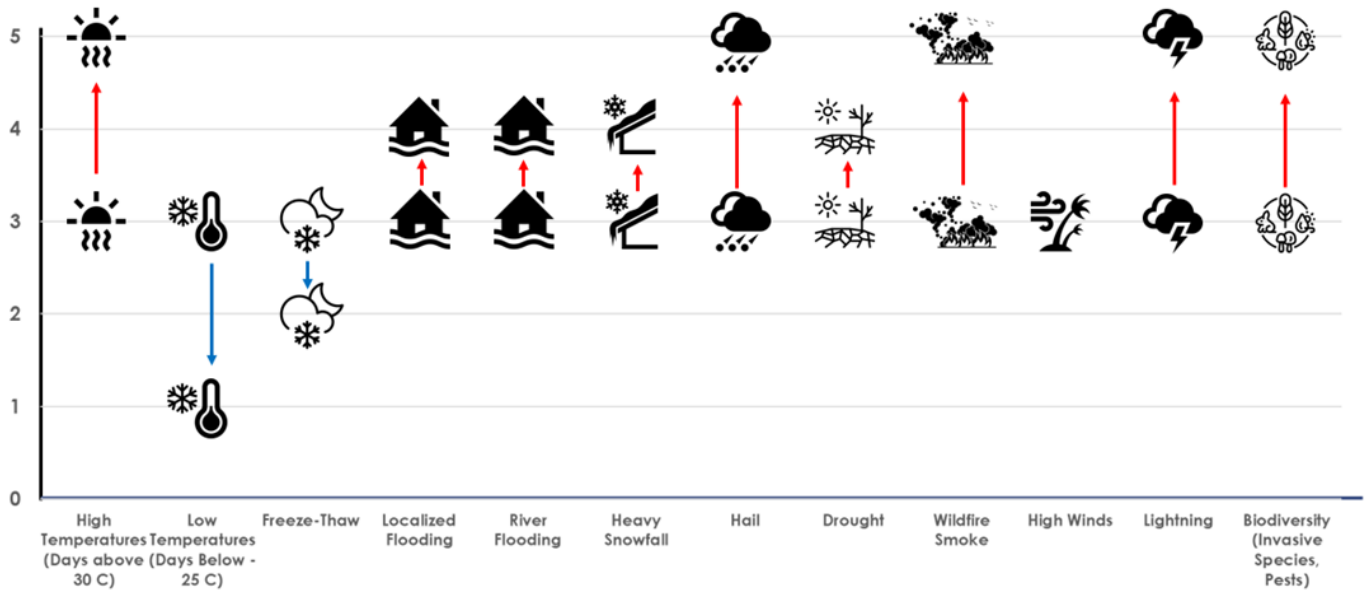
Section 4.1 gives an overview of the change of likelihood of climate hazards between now and 2080. Section 4.2 covers the results for all service lines.

4.1 Change in Climate Hazards Over Time

Risk is driven by both the consequence of different climate hazards and their likelihoods. Changes in likelihoods drive a large portion of risk, as rare events become more common.

Many hazards will see an increase in how likely they are to occur between now and 2080. **The largest shifts are for extreme heat (days above +30°C), hail, wildfire smoke, lightning and storm events, and biodiversity/ecoregion shift**. The only hazards that are likely to see a decrease in likelihood between now and 2080 are low temperature days (days below -25 °C) and the number of freeze-thaw cycles. The change in climate hazard likelihood scores is shown in Figure 4-1. Tables for the change in each climate parameter are given in Appendix A.

Figure 4-1 Change in Hazard Likelihood (2020 to 2080)



4.2 Results for All Service Lines

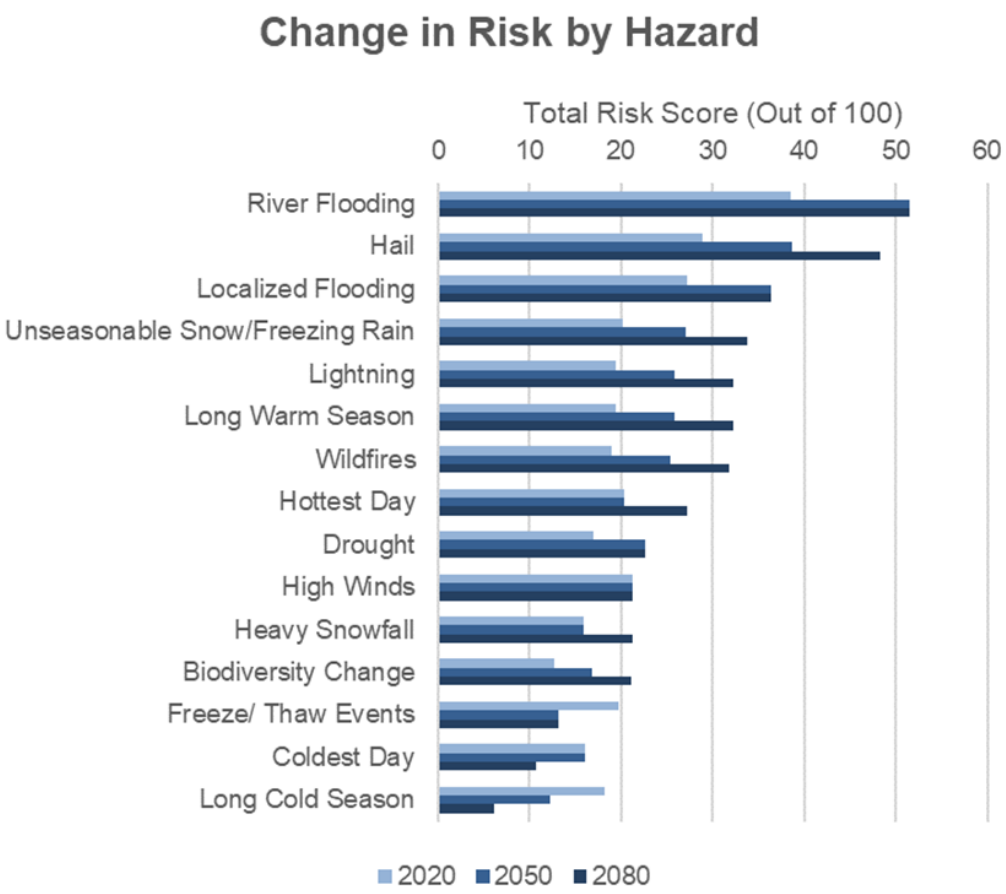
The risk scores for each asset were calculated for each climate hazard and asset pair by multiplying the likelihood score (1 to 5) by the consequence score (1 to 5), with the highest risk score of 25. The highest scoring risks across all hazards and assets were determined to help identify areas where the Town should prioritize reducing risk. Climate risks that scored “Very High” (scores of 20 or greater) 6 in 2080 are shown in Table 4-1.

Table 4-1 Highest Climate Risks to Town Infrastructure

Asset Type	Climate Hazard	Highest Scoring Climate Risks
Wastewater Treatment Plant	River Flooding	The wastewater treatment plant and surrounding site are flooded in a 100-year return period. This could result in untreated wastewater being discharged to the river. The wastewater treatment plant does not have temporary flood protection measures. Site level flood protection should be assessed.
Water Treatment Plant	River Flooding	Flooding of the water treatment plant. The water treatment plant has on-site temporary flood protection, but access to the plant is cut off for floods larger than a 50-yr return period. Site level flood protection should be assessed.
GUDI Wells	Drought	Lower river and groundwater levels can limit water supply for water treatment and not meet water demand during extended periods of drought.
	Extreme Heat	Extreme temperatures increase water demand and have the potential to exceed capacity and limit fire water supply. Heat can overheat electrical systems and cause power outages. Only 50% of the wells have backup power.
Constructed Wetlands	Biodiversity	Long term ecoregion shift will bring more invasive species, pests, and diseases that can disrupt the balance of ecosystems in constructed wetlands and potentially cause irreversible die-off. Wetlands should re-establish after drought.
Public Trees	Drought & Biodiversity	Die-off of public trees from severe drought and an increase in invasive species, pests, and diseases from ecoregion shift. Monoculture in some areas which are more susceptible to disease. Reduced biodiversity, shade from extreme heat and carbon storage.
Manicured Parks and Sports Fields	Drought & Biodiversity	• Limited water available for irrigation and die-off of vegetation. • An increase in invasive species, pests, and diseases can cause die-off of plants in parks and grasses in sports fields, impeding their use.
Various Facilities	River Flooding	• Several facilities are flooded for events less than a 50-year return period: Water Treatment Plant, Fleet Building, EcoCentre, Municipal Centre, Okotoks Public Library and the Former Library at 7 Riverside Dr (Cameron Crossing and Bow Valley Schools). • Additional facilities flooded for events less than a 100-year return period: Wastewater Treatment Plant, Operations Centre, Operations Shop, Okotoks Art Gallery, and Okotoks Museum and Archive

The average risk score across all the assets in the system was also calculated to determine which hazards pose greater risks across multiple service lines and which service lines are most at risk on average from certain hazards. Looking across all systems, **increased precipitation and the impacts of accompanying storms are driving a significant amount of risk**. The change in risk for each climate hazard across all systems over time is shown in **Figure 4-2.**

Figure 4-2 Change in Risk by Infrastructure System % Change (2020 to 2080)



Each infrastructure system is exposed to the impacts of climate change in some way. Even if a service line does not have risks which were scored "Very High", it would be worthwhile for each service line to evaluate and address their top risks. A table of the top risks to different infrastructure systems is given in **Table 4-2**. **Detailed results of the top risks for each service line are provided in Appendix C.**

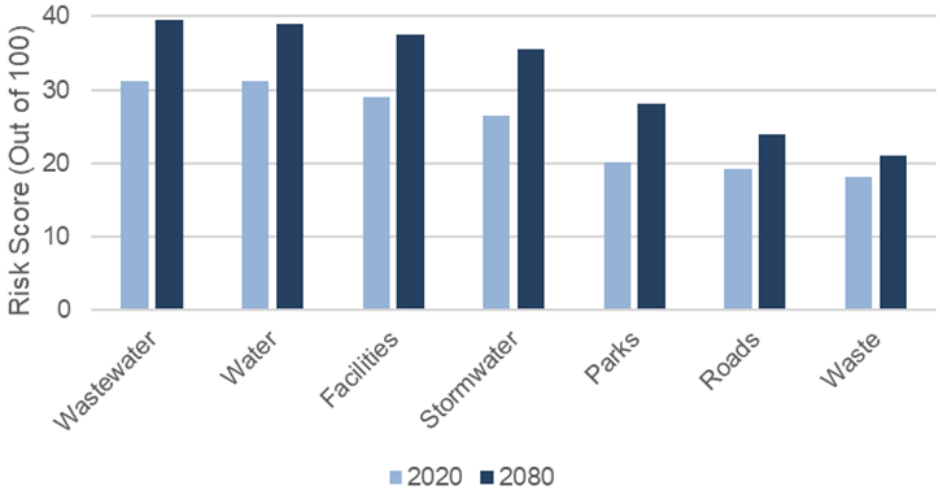
Table 4-2 Highest Risks for Each Infrastructure System

Infrastructure System	Top Impacts
Wastewater	• The wastewater treatment plant is located in a low-lying area at risk of river flooding • Localized flooding can flood wastewater treatment, as well as lift stations and manholes • Communications equipment is at risk of damage from lightning strikes
Water	• Drought and hot temperatures can impact the water supply as well as treatment processes • The water treatment plant is at risk of river flooding during high return period events • Communications equipment is at risk of damage from lightning strikes
Facilities	• Many facilities are located in the river valley and are at risk of flooding • Hail can damage facility roofs • Most facilities do not have surge protection and are at risk of damage from lightning strikes
Stormwater	• Localized flooding can overload the stormwater collection system • River flooding can damage stormwater infrastructure, including mains, catch basins, vegetated drainage ditches and stormponds • Drought can put stress on stormwater wet ponds and constructed wetlands, potentially leading to die-off within the stormponds, as well as issues with algae and odors.
Parks	• Parks and greenspaces in the river valley are at risk of damage from river flooding • Drought and high temperatures will impact trees and greenspaces, and strain irrigation systems • Hail and unseasonable snow can damage trees • Shifting eco-regions will impact biodiversity, potentially causing die-off of native plants and animal species
Roads	• Bridges are at risk of damage from river flooding • More frequent freezing rain events and heavy snowfall will strain snow clearance and road sanding budgets
Waste	• Very hot days can limit the ability of waste collection crews to operate • Heavy precipitation can impede waste collection crews

All systems have assets which are at risk from climate change. However, some systems will be more heavily impacted than others. The average risk score points towards the magnitude of the need for adaptation measures for those assets and systems. It will be important to prioritize investments and actions to improve the resilience of Wastewater, Water, Facilities, and Stormwater, which present the highest overall risk, while also considering the risks associated with Parks, Roads, and Waste.

The average risk scores for each system in 2020 and 2080 is shown in **Figure 4-3**.

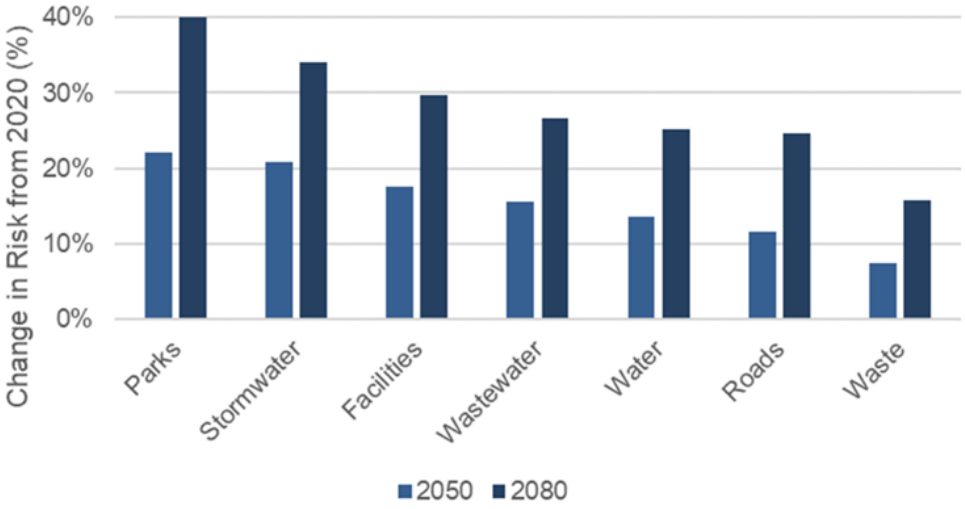
Figure 4-3 Change in Risk by Infrastructure System (2020 to 2080)



Looking at the average risk to the systems gives an idea of which systems will require the most effort or investment to improve their resilience. However, it is also important to look at which systems will see the greatest increase in risk relative to their risk in the present day. **While Parks sees a lower average risk than Water, Wastewater, Stormwater, and Facilities, it is projected to see a greater change in risk relative to its baseline** in 2020. This means that **systems like Parks, Stormwater, and Facilities will see higher operations and maintenance costs from increasing reactive maintenance**. Contingency spending for these systems may increase a greater amount relative to its current rate than other systems, straining budgets.

The percentage change in risk scores for each system in 2020 and 2080 is shown in **Figure 4-4**.

Figure 4-4 Change in Risk by Infrastructure System - % Change (2020 to 2080)



Detailed results of the risk assessment for each service line are provided in Appendix C.

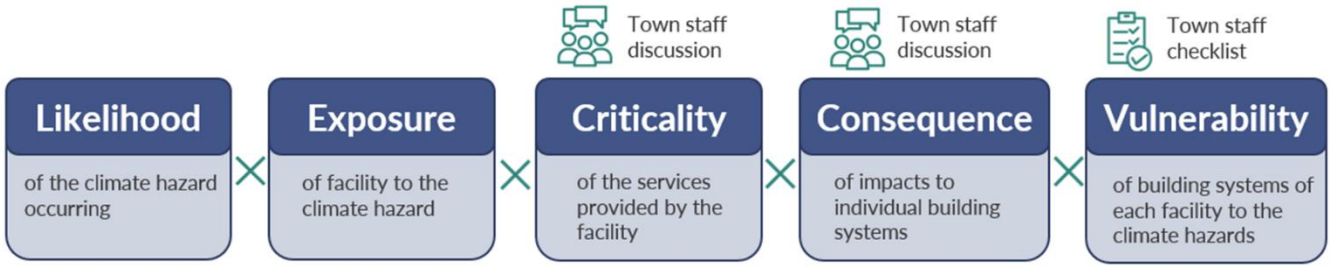
5 FACILITIES RISK ASSESSMENT – METHODOLOGY

5.1 Facilities Risk Detailed Assessment

Workshop 4 of the risk identification and assessment process focused on undertaking a detailed facilities building systems risk assessment. This workshop aimed to provide a comprehensive understanding of the potential impacts of climate change on specific building systems within the Town's facilities. The assessment explored the exposure to climate hazards and the vulnerabilities of specific buildings systems to those climate hazards. This allowed for a more targeted and in-depth analysis of the potential consequences for Town facilities.

The methodology for this part of the risk assessment is shown in **Figure 5-1.**

Figure 5-1 Facilities Risk Assessment Methodology



The detailed risk assessment process starts by determining the exposure of each facility to different climate hazards. **Climate exposure** is the degree to which an asset is subjected to climate-related hazards. All the facilities were equally exposed to most hazards (e.g., all facilities are subject to very hot days, or subject to heavy rainfall), with the exception of river flooding. Some facilities are within the floodplain, while others are outside of it. Flood maps developed by the Government of Alberta (2023) were used to determine the inundation depth of each facility during different return-period events.

The **criticality** of each facility was determined during Workshop 4. A facility is deemed more critical if it provides services that cannot be interrupted and/or which are required during an emergency. Facilities that cannot have their services relocated, or facilities that act as emergency accommodation centres are scored as more critical. **It should be noted that the heritage value of buildings is not factored into criticality scores, and their heritage value should be considered separately.** The criticality scoring rubric is given in **Table 5-1**.

Table 5-1 Facility Criticality Scoring Method

Criticality	Town Services
Most Critical – 3	• The facility provides services that can not be interrupted or are required during an emergency. • The facility acts as an emergency accommodation centre. • Services can not be temporarily relocated to another facility.
Moderately Critical – 2	• The facility municipal services that can be temporarily interrupted during an emergency for days to a week. • Some services could be moved temporarily for days to a week.
Less Critical – 1	The facility provides municipal services that can be interrupted for a week to a month. Services could be moved temporarily for a week to a month.

Vulnerability scores for each pair of building systems and climate hazards were determined for each facility. **Vulnerability** is the susceptibility or sensitivity of an asset to the impacts of climate change and includes a combination of the potential of a hazard to damage that building system and the building systems adaptive capacity. An example question is "Can the facility's HVAC systems be run on backup power?" for the extreme heat hazard and the HVAC system. A survey was distributed with 90+ questions for each facility. The survey had questions about the vulnerability of the following seven groups of buildings systems:

- HVAC
- Plumbing
- Openings (Windows & Doors)
- Exterior Envelope
- Structural
- Site Grading, Landscaping and Features
- Power and Communications

Each question had a score assigned to it based on how significant the vulnerability is, with higher scores being more vulnerable. Where a question was not applicable for the facility, its scores don't count for or against the total vulnerability scores for that facility. These scores were multiplied together and normalized into a final risk score out of 100, where 100 is the highest risk.

5.2 Risk Mitigation Actions

A list of 76 risk mitigation actions addressing climate risks for different building systems was created to help facilities reduce their climate risk. These risk mitigation actions include one-off retrofits, operations and maintenance activities, and one-time studies.

Actions were assigned to a facility if they met both a risk threshold ("Medium" risk or higher) and met the vulnerability criteria in the facilities vulnerability survey. As an example, if a facility's power and communications system had a risk score of "Medium" or higher, and the survey results showed that the facility did not have backup

power, the risk mitigation action to install a backup power supply would be assigned to the facility. The actions were reviewed by Town Facilities staff to ensure that they were appropriate for each facility.

Each risks mitigation action has a preliminary high level cost estimate developed to assist with conceptual adaptation planning. Preliminary costs were estimated using RSMeans construction cost estimating software and professional judgement. These costs were estimated as either:

- a lump sum (e.g., the cost to install surge protection for a facility), or
- scaled with the current replacement value of a building (e.g., costs to replace a facility's windows).

Operations costs are only included as one-time costs for this exercise as the implementation timeline has not been fully determined, **but they should be considered as recurring costs** to inspect and maintain assets in a way that mitigates climate hazards.

Figure 5-2 Example – Risk Mitigation Action List

Facility	Mitigation Action	Building System	Risk	Category	Cost	Timeframe
Pason Centennial Arenas	- Ensure the connection for temporary backup power is easily accessible and not prone to water pooling. - Retrofit the connection to be elevated or protected, if possible.	Power and Communications	40	Retrofit	$65,000	2026-2029
Fire Station	- Install a drip irrigation system that operates on a timer to reduce water waste and optimize water usage.	Landscaping and Grading	37	Retrofit	$45,000	2030-2033
Water Treatment Plant	- Consider deploying temporary protection barriers to shield vulnerable equipment during forecasted hail events. - Ensure availability of spares or backup communication equipment. - Confirm the operability of alternative equipment before the hail event.	Power and Communications	40	Retrofit and Operations	$25,000	2030-2033

Some actions may reduce the risk from multiple hazards or affect multiple building systems (e.g., backup power reduces the risk from extreme heat, but also from other hazards that cause power outages, like high winds. Backup power can support multiple operations such as communications, automated and HVAC systems). Where apparent, overlapping actions have been removed and their costs have not been double counted. **Facility managers will need to review priority list of action at each facility as a whole and identify potential synergies**.

Each action was assigned a preliminary timeframe to act as a starting point for implementation planning. Based on risk scores and the costs of actions, each recommended action was assigned a preliminary timeframe of:

- **Immediate** for low-cost actions that could be incorporated in existing budgets and address the highest risks,
- **2026-2029** to include in planning for the upcoming budget cycle and addresses higher risks,
- **2030-2033** for the following budget cycle and having high to medium risk,
- **Future/Further Consideration** for actions with risks that are not immediately pressing, or which will become more pressing towards the middle of the century, and
- **Low Risk, Lower Priority** for actions that are not addressing medium to high risks and are not currently recommended but could be integrated as part of other initiatives if low cost. (Costs not provided.)

Facility managers will need to review the list of priority actions and refine the timing through the budget planning process as well as the scope where appropriate.

6 FACILITIES RISK ASSESSMENT – RESULTS

In addition to the risk assessments conducted for each service line, a more detailed assessment was conducted for facilities and their building systems. A discussion of the top risks seen across facilities and their buildings systems is given in **Section 6.1.** An overview of which facilities are most at risk is given in **Section 6.2.** Risk mitigation actions and implementation planning are discussed in **Section 6.3.**

6.1 Top Risks Across Facilities and Building Systems

The risk scores for all building systems and climate hazard pairs were calculated for all in-scope facilities. All scores were then all normalized to a 100-point scale, with 100 being the highest risk. The average risk score across all the assets in the system was calculated to determine which hazards posed the greatest risk to facilities. These impacts are limited to the facilities themselves and exclude impacts to utilities process equipment. Impacts to utilities operations, like drought's impacts on water treatment systems, are included in the service line risk assessments. The highest risk climate hazards in 2080 are shown in **Table 6-1.**

Table 6-1 Climate Hazards with Highest Risk to Facilities

Rank	Climate Hazard		Example Hazard Impacts
1		High Temperatures	• Risk of power outages during heatwaves • Increased cooling demand for facilities • Heat stress on landscaping and vegetation
2		Hail	• Damage to facility roofs • Potential damage to HVAC or power and communications equipment on roofs • Damage to trees
3		Heavy Snowfall	• Snow loads on roofs will increase, potentially exceeding design loads on flat roofs • Heavy snowfall can block air intakes for building HVAC systems • Snowmelt can cause leaks in roofs • Increased risk of slips and falls on public sidewalks and pathways
4		High Winds	• Damage to power and communications equipment • Potential to cause power outages if overhead wires are damaged • Damage to trees • Greater off-season snow and ice loads on facilities
5		River Flooding	• Damage to facilities power and communications equipment • Potential to damage water and wastewater process equipment and distribution assets like booster stations

These top hazards show a spread between hazards which are already impacting facilities in the present day and hazards which are likely to become more prevalent towards the end of the century. **Taking action to mitigate extreme heat, hail, high winds, or river flooding would have benefits in the present day**. Hazards like heavy snowfall should be assessed further to identify appropriate actions specific to the condition of each facility.

While on average these hazards have the highest scores across all facilities, the **single highest risks identified are from lightning strikes to facilities without surge protection**. Likewise, pests and invasive species at the wastewater treatment plant have already been identified as an issue and can be addressed immediately.

The building systems with the highest risk averaged across all facilities are shown in **Table 6-2.**

Table 6-2 Highest Risk Buildings Systems

Rank	Building System	Highest Scoring Climate Risks
1	 Power and Communications	• Communications equipment is at risk of damage from **lightning** strikes • Rooftop equipment is exposed to **hail** and **high winds** • Equipment located in basements is at risk of **flooding** from either river flooding or high intensity rainfall
2	 Site Grading, Landscaping, and Features	• **Hot temperatures** and **drought** can cause stress of die-off of native species • Improper site grading can lead to **flooding** of facilities and prevent access to facility services • **Hail** and **high winds** can damage trees, knocking them into buildings or powerlines • Increased management of **invasive species and pests**
3	 HVAC	• **High temperatures** or **high winds** can cause power outages, losing access to HVAC systems • Electrical and mechanical equipment located in basements is at risk of **flooding** from either river or localized flooding
4	 Structural	• Greater **snow loads** (heavy, wet snow) in the future may exceed design loads for roofs (each facility should be assessed further based on building code at time of construction, asset condition and projected changes in snow loads)
5	 Exterior Envelopes	• **Hail** can damage roofs, skylights, and vents • **Hot temperatures** will put additional burdens on a facility's ability to rely on passive cooling • Localized **flooding** can cause leaks in roofs, or water ingress around windows and doors

6.2 Facilities Most At-Risk

Facility criticality plays a large role in determining which facilities are most at-risk. While many facilities like the Former Library at 7 Riverside Dr. (Cameron Crossing and Bow Valley Schools) are vulnerable to river flooding, facilities like the Wastewater Treatment Plant which are also vulnerable to flooding are more critical if a flood happens. High criticality facilities tend to be the facilities that are at-most risk. The list of facilities by their risk rank is given in **Table 6-3** (refer to **Figure 5-1** for description of facility criticality scoring).

Table 6-3 Highest Risk Facilities

Criticality	Facility	Risk Rank
Most Critical Score = 3	Wastewater Treatment Plant (excl. process equipment)	1
	Operations Centre	2
	Okotoks Recreation Centre	3
	Fire Station	4
	Southridge Emergency Centre	5
	Water Treatment Plant (excl. process equipment)	6
	Pason Centennial Arenas	7
Moderately Critical Score = 2	Operations Shop	8
	Fleet Building	9
	Drake Landing Energy Centre	11
Less Critical Score = 1	Okotoks Public Library (Arts and Learning Centre)	10
	Former Library (7 Riverside Dr.)	12
	EcoCentre (excl. process equipment)	13
	Okotoks Art Gallery	14
	Foothills Centennial Centre	15
	Rotary Performing Arts Centre	16
	Okotoks Museum & Archives	17
	Municipal Centre	18
	Southside Program Building	19

The high consequences of failure combined with its exposure to river flooding makes the Wastewater Treatment Plant a uniquely high-risk asset. Likewise, the Operations Centre is also at risk of flooding, although the consequences of failure for this facility are not as high as the Wastewater Treatment Plant. The Okotoks Recreation Centre was

identified as an emergency reception centre, and while it is located outside of the river valley, it is at risk of localized flooding.

Within the lower criticality facilities, the facilities within the river valley are at higher risk, like the Okotoks Public Library and Former Library at 7 Riverside Dr (Cameron Crossing and Bow Valley Schools). The EcoCentre currently has no air conditioning and is at high risk from extreme heat considering the staff working conditions inside of the facility.

The results of the risk assessment for each facility are summarized in two-page report cards in **Appendix D** with an example provided in **Figure 6-1**. Each report includes the top climate hazards impacting the facility, the risk scores for these hazards, the facility's criticality score (from 1 for least critical to 3 for most critical), recommended risk mitigation actions, a preliminary estimate of the cost of the risk mitigation options, and a preliminary timeframe for when it is suggested the action is implemented.

Figure 6-1 Example – Facility Report Card

Water Treatment Plant (excl. process equipment)

101 Woodhaven Drive

Facility Description:

A new water treatment plant will be operational in 2025, bringing water from the Bow River to Okotoks.

River Flood Return:	Water Depth (cm)
50-Year	69.3
100-Year	104.4
200-Year	138.3
350-Year	149.1
Risk Ranking:	6

Okotoks

Facility Vulnerability by Hazard:

Extreme Heat	Low Temps
Freeze-Thaw	Local Flooding
Heavy Snowfall	River Flooding
Hail	Lightning
High Winds	Wildfire Smoke
Drought	Biodiversity

High Vuln, Medium Vuln, Low Vuln
Based on Survey Results

Rank out of 19 facilities -
Lower ranks are higher risk

Top Risk Mitigation Actions:

Top Risks	Risk Score	Top 5 Risk Mitigation Actions	Cost	Timeframe
Heavy Snowfall - Structural	48	-Evaluate adequacy of roof to meet snow-load capacity	$5,000	2026-2029
Heavy Snowfall and Hail - Structural	40	-When installing a new roof, utilize a hailguard system or install hail-resistant solar panels to mitigate the risk of hail damage to the roof. -Have operations staff regulary unclog gutters and roof drains to ensure quick removal of hail.	$450,000	Immediate
Hail - Power and Communications	40	- Consider deploying temporary protection barriers to shield vulnerable equipment during forecasted hail events. - Ensure availability of spares or backup communication equipment. - Confirm the operability of alternative equipment before the hail event.	$25,000	2030-2033
High Winds - Site Grading, Landscaping and Features	36	- Trim back any branches near the building to reduce the potential for windborne debris.	$5,000	Immediate
High Winds - Power and Communications	36	- Anchor rooftop electrical or communications devices securely to prevent them from becoming airborne during high winds.	$5,000	Immediate

Risk Score out of 100
(100 is highest)

These report cards are intended to be a starting point for facility managers' to conduct their adaptation planning. Some actions, like mitigating the impact of greater snow loads on roofs will require further study. The costs tagged to the adaptation actions reflect order of magnitude cost estimates and should be further refined by facilities managers during capital planning. Likewise, preliminary timeframes are given as a potential starting point for planning based on relative order of importance and should be adjusted during capital planning.

6.3 Risk Mitigation Actions and Implementation Planning

For the 19 in-scope facilities, there are 76 risk mitigation actions that address risks with a score of "Medium" or higher. These actions are primarily targeted at critical facilities. Of the 19 facilities, 16 facilities have risk mitigation actions recommended for them.

The preliminary estimate to complete these actions is $3.71 M. These actions do not all need to be completed immediately, and some actions may require further study before the actions are implemented. There may be opportunities to implement risk mitigation actions or conduct studies across all facilities, resulting in some economies of scale. **Timeframes can be adjusted and should consider planned asset retrofit and replacement activities to align actions where possible**. A breakdown of costs over time is given in **Table 6-4.**

Table 6-4 Risk Mitigation Action Summary Table

Implementation Timeframe	Preliminary Cost
Immediate	$645,000
2026-2029	$747,500
2030-2033	$1,824,500
Future / Further Consideration	$488,000
Grand Total	**$3,705,000**

Actions that fall under the "Immediate" timeframe include low-cost actions ($10,000 or less) that will focus on addressing high risks to the facilities, or actions are already planned to be undertaken, such as the planned replacement of the Water Treatment Plant roof. These include:

- Reducing the risk of lightning strikes: Installing lightning roads or surge arresters, remove protruding metal objects, anchor rooftop electrical or communications devices.
- Landscaping inspections and management: Controlling invasive species, pest control and trimming overhanging tree branches by facilities.
- Installing air condition in the Fire Station (Note: ranked as a higher risk due to the criticality of the facility).

Actions that fall under the "2026-2029" timeframe include a wider range of actions addressing flooding, high temperatures, drought, and hail and heavy snowfall. These include:

- Protecting rooftops and exposed rooftop assets from hail: Installing hail-resistant covers and guards on skylights and rooftop equipment and ongoing operations to quickly remove hail after an event and repairing roofs prone to leaking. This includes the planned replacement of the Water Treatment Plant roof in 2024-2026.
- Installing backup power: Installing hookups for temporary backup power.
- Landscaping for heat reduction: Planting trees on the south and southwest sides of buildings for shade, and transitioning landscaping to drought resistant species.
- River and localized flood protection: A mixture of strategies, including, locating temporary flood protection on-site (water tubes, stop logs, etc.), improving site grading and ensuring access/egress road low spots are not inundated, and regularly inspecting and clearing eavestroughs and downspouts.

- Evaluating adequacy of roofs for future snow loads: Conducting studies to assess whether roofs can accommodate greater snow loads in the future.

Actions that fall under the “2030-2033” timeframe are similar to the actions in the “2026-2029” timeframe but are focused on lower risk facilities. In addition to the similar actions, this timeframe also includes:

- Mitigating extreme heat through building envelope improvements: shading building exteriors, painting roofs white or covering them with reflective coatings, cooling indoor spaces and providing PPE for staff, and ensuring windows and doors are properly sealed.
- Burying power lines: Where possible, burying exposed power lines to reduce the risk of failure during high wind or freezing rain events.

Actions that fall under the “Future/Further Consideration” timeframe include actions that will mitigate hazards that are likely to become greater risk towards the end of the century but are not as high risk in the present day. These actions also include larger capital interventions for lower risk facilities. These actions include:

- Addressing greater snow loads on roofs: Installing snow guard systems on roof to ensure that snow melting from the roof does not create water run-off that would damage the building or property below.
- Upgrading HVAC cooling capacity: Upgrade building HVAC systems to handle appropriate cooling demands and ensuring that building's power systems can sustain additional electric loads.

Generally, larger facilities or facilities with higher replacement values will have higher costs to implement all climate mitigation actions. A breakdown of costs by facility is given in **Table 6-5.** A list of each of the actions for each facility along with their costs and the proposed timeframe are given in **Appendix D.**

Table 6-5 Risk Mitigation Action Costs by Facility

Facility	Total Cost
Pason Centennial Arenas	$1,068,500
Wastewater Treatment Plant	$678,500
Okotoks Recreation Centre	$652,000
Water Treatment Plant	$569,000
Operations Shop	$324,000
Fire Station	$231,500
Operations Centre	$39,000
Southridge Emergency Centre	$17,500
Drake Landing Energy Centre	$15,000
Eco Centre	$15,000
Foothills Centennial Centre	$15,000
Okotoks Art Gallery	$15,000
Okotoks Museum & Archives	$15,000
Okotoks Public Library (Arts and Learning Centre)	$15,000
Rotary Performing Arts Centre	$15,000
Southside Program Building	$15,000
Fleet Building	$5,000
Grand Total	**$3,705,000**

The Pason Centennial Arenas, and the Okotoks Recreation Centre have higher costs given they may require roof repairs or replacements in the future to mitigate hail damage and accommodate greater snow loads. The Wastewater Treatment Plant includes costs for the planned roof replacement in 2024-2026.

Actions and costs in this report did not analyze river flood protection measures unique to each facility but are provided as more general guidance. Community-wide flood protection measures may be more cost effective than trying to reduce risk for individual facilities in the river valley.

7 RIVER FLOOD EXPOSURE ANALYSIS

A preliminary analysis of river flooding exposure for the Town's assets was conducted as part of the risk assessment. Provincial flood mapping was obtained from Government of Alberta. Inundation maps for river flooding were provided for 50-year, 100-year, 200-year, 350 and 500-year return period events. The Town's asset data was overlaid with these maps to determine at what return periods certain assets would be inundated. The inundation depths for each facility at each return period were determined and recorded in the two-page report cards in **Appendix D.** Inundation depths for facilities in the river valley are given in **Table 7-1.**

Table 7-1 Approximate River Flood Inundation Depth at Facilities (m)

Facility	50-year	100-year	200-year	350-year	500-year
Wastewater Treatment Plant (excl. process equipment)	0	0.1	0.9	1.7	2.2
Water Treatment Plant (excl. process equipment)	0.7	1.0	1.4	1.5	1.7
Operations Centre	0	0.5	1.3	2.1	2.6
Operations Shop	0	0.3	1.2	1.9	2.4
Fleet Building	1.1	1.9	2.8	3.5	4.1
EcoCentre (excl. process equipment)	0.5	1.3	2.1	2.9	3.4
Municipal Centre	0.3	0.7	0.8	1.0	1.2
Okotoks Art Gallery	0	0.4	0.5	0.7	0.8
Okotoks Museum and Archive	0	0.3	0.3	0.5	0.6
Okotoks Public Library (Arts and Learning Centre)	0.4	0.8	1.1	1.3	1.5
Former Library (7 Riverside)	0.1	0.3	0.7	0.8	1.0

The values above represent the approximate inundation depth at the facility. They do not account for pooling around facilities or the height of facility openings. These depths should be compared with facilities' doors and openings to determine if floodwaters will enter the building at a given return period. The river flood models can be referred to support more detailed analysis.

The recommendations in this report primarily focus on measures that can be taken on a facility-by-facility basis to mitigate the impacts of river flooding. **Given the low return period at which flooding occurs (50-year or smaller) and the number of Town owned and privately owned assets within the river valley, it is recommended that a community-wide flood mitigation strategy be developed.** Inundation maps are provided in **Appendix E.**

8 FURTHER CONSIDERATIONS

The impacts of climate change are already being felt in the Town of Okotoks. Heat waves, droughts, floods, and storms are currently a risk to the community. These impacts pose significant risks to our health, safety, economy, environment, and quality of life. According to the Insurance Bureau of Canada, Alberta has experienced more severe weather events this decade than any other region in Canada.

The National Adaptation Strategy (NAS) released in 2023 sets the direction for climate resilience across five interconnected systems. The NAS provides a strong framework for the various dimensions climate adaptation plans should consider.

The primary focus of this project was to assess risks to the Town's infrastructure, which is linked to many of the other systems show in the NAS. Some next steps to evolve climate planning for Town infrastructure and/or facilities includes:

National Adaptation Strategy - Key Systems

- Consider the health and wellbeing of Town staff working in facilities and the impacts from extreme heat and wildfire smoke.
- Consider the health and wellbeing of Town staff that work outdoors including extreme heat, wildfire smoke, and intense storms.
- Assess and enhance facilities that can act as emergency centres (i.e., cooling and clean air centres, evacuation centres, etc.) and consider decentralized/multiple buildings targeted to vulnerable population areas.
- Develop emergency response plans for extreme heat, wildfire smoke and other climate hazards where emergency response plan do not currently exist.
- Further assess the criticality of Town facilities building on the three levels of criticality initially considered as part of this study. This should include the mutli-use function of buildings, the severity of interruption of services if the facility is damaged, opportunities to utilize the facilities in different capacities during an emergency, and the ability to support vulnerable groups and needs.
- Assess facilities through a disability and accessibility lens and enhance as appropriate. This includes consideration of different languages, cultures, and other demographics.
- Assess the climate risk and develop action plans to protect the Town natural assets (e.g., wetlands, forest, etc.).

9 CONCLUSION

The objective of this climate risk assessment is to identify and evaluate the potential impacts climate change may have on the Town's infrastructure. The buildings and infrastructure that form the physical backbone of the Town must be designed and managed in a way that the impacts of extreme climate events are reduced. This will help to protect Town's investments and ensure that assets are protected well into the future, safeguarding its social and economic well being.

The services provided by Associated Engineering Alberta Ltd. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,

Associated Engineering Alberta Ltd.

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APPENDIX A – CLIMATE HAZARD PARAMETERS

Table A-1: Climate Parameters and Projections

General Climate Measures	Climate Parameters	Climate Indicator	Present-day value (average period)	Present Probability Score	2050s Estimated Value	2050s Probability Score	2080s Estimated Value	2080s Probability Score	Parameter source	Direction Confidence	Magnitude Confidence
Temperature	Very Hot Days	# of Days above +30°C	12	**3**	20	**4**	28	**5**	ClimateData.ca. Values obtained for the Town of Okotoks location.	High	High
	Hottest Day	Warmest Maximum Temperature (◦C)	34◦C	**3**	36◦C	**3**	39◦C	**4**	ClimateData.ca. Values obtained for the Town of Okotoks location.	High	High
	Very Cold Days	# of Days below -25°C	10	**3**	5	**2**	1	**1**	ClimateData.ca. Values obtained for the Town of Okotoks location.	High	High
	Coldest Day	Coldest Minimum Temperature (◦C)	-33◦C	**3**	-30◦C	**3**	-26◦C	**2**	ClimateData.ca. Values obtained for the Town of Okotoks location.	High	High
	Freeze/ Thaw events	# Freeze/ Thaw Events	111	**3**	100	**2**	81	**2**	ClimateData.ca. Values obtained for the Town of Okotoks location.	Medium	Medium
Precipitation	Localized Flooding	15 min 100-year Rainfall (mm/hr)	122	**3**	139	**4**	164	**4**	ClimateData.ca. Values obtained from IDF curves for the Calgary International Airport weatherstation.	High	Medium
	River Flooding	24 hour 100-year Rainfall (mm/hr)	3.8	**3**	4.9	**4**	5.6	**4**	ClimateData.ca. Values obtained from IDF curves for the Calgary International Airport weatherstation.	High	Medium
	Heavy Snowfall	Snow Accumulation	56	**3**	59	**3**	64	**4**	ClimateData.ca. Values obtained for the Town of Okotoks location. Winter precipitation assessed assuming continued significant snow during this period (not rain), focused in heavy snowfall events.	Medium	Low
	Hail	Severe Summer Hail Days (% Change Relative to Present)	-	**3**	+	**4**	+	**4**	Brimelow et al. (2017). The changing hail threat over North America in response to anthropogenic climate change. Nature Climate Change 7, 516-522. Values estimated from inspection of Figure 1e.	Low	Low
	Freezing Rain / Unseasonal Snow	Change in 1:50 year Ice Accumulation	0%	**3**	+35%	**4**	+58%	**5**	Climate-resilient buildings and core public infrastructure 2020 : an assessment of the impact of climate change on climatic design data in Canada / Authors: Alex J. Cannon, Dae Il Jeong, Xuebin Zhang, and Francis W. Zwiers. Appendix 1.2.	Low	Low
	Drought	Relative Change in Standardized Precipitation Evapotranspiration Index-based (change in standard deviation)	0.04	**3**	-0.06	**4**	-0.25	**4**	ClimateData.ca. Values obtained for the Town of Okotoks location. 3-month index for the months June-July-August.	Medium	Medium

Table A-1: Climate Parameters and Projections

General Climate Measures	Climate Parameters	Climate Indicator	Present-day value (average period)	Present Probability Score	2050s Estimated Value	2050s Probability Score	2080s Estimated Value	2080s Probability Score	Parameter source	Direction Confidence	Magnitude Confidence
Extreme Events	Wildfire Smoke	Change in Average Annual Area Burned	0%	**3**	+79%	**4**	+190%	**5**	Change in average area burned for the Boreal Plains region from: Wang, Xianli, Tom Swystun, and Mike D. Flannigan. "Future wildfire extent and frequency determined by the longest fire-conducive weather spell." *Science of the total environment* 830 (2022): 154752.	High	Low
	Heavy Winds	1-in-50 Year Gust Pressures (kPa)	0.48	**3**	0.48	**3**	0.48	**3**	Climate-resilient buildings and core public infrastructure 2020 : an assessment of the impact of climate change on climatic design data in Canada / Authors: Alex J. Cannon, Dae Il Jeong, Xuebin Zhang, and Francis W. Zwiers. Appendix 1.2.	Low	Low
	Lightning	Convective available potential energy linear trend over full 1960-2099 period)	-	**3**	+	**4**	++	**5**	Paquin et al. (2014). Change in North American atmospheric conditions associated with deep convection and severe weather using CRCM4 climate projections. Atmosphere-Ocean 52, 175-190. Baseline values could not be determined but the trend towards larger storms increases over time.	Low	Low
Biodiversity Change	Eco-region Shift	Change in eco-region	-	**3**	+	**4**	+	**5**	Stralberg, D. 2018. Climate-projected distributional shifts and refugia for North American ecoregions [Data set]. http://doi.org/10.5281/zenodo.1407176. Available at https://adaptwest.databasin.org. Values determined by a qualitative estimate of eco-region shift over time.	High	Low

APPENDIX B – RISK ASSESSMENT WORKSHEET

Okotoks

Risk Assessment Worksheet

Consequence Score

0 - No Effect
1 - Insignificant
2 - Minor
3 - Moderate
4 - Major
5 - Catastrophic

Climate Parameter

Temperature

	Days above +30°C				Warmest Maximum Temperature (°C)				Days below -25°C				Coldest Minimum Temperature (˚C)				# Freeze/ Thaw Events			
	Very Hot Days				Hottest Day				Very Cold Days				Coldest Days				Freeze/ Thaw Events			
Climate Projections (RCP 8.5)	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R
Baseline	12	3			34	3			10	3			-32.5	3			111.3	3		
2050	20	4			36	3			5	2			-29.7	3			99.65	2		
2080	28	5			39	4			1	1			-25.5	2			81.2	2		

Precipitation

	15 min 100-year Rainfall (mm/hr)				24 hour 100-year Rainfall (mm/hr)				Winter Precipitation (mm)				Severe Summer Hail Days (% Change Relative to Present)				Change in Ice Accumulation				Relative Change in Standardized Precipitation Evapotranspiration Index-based			
	Localized Flooding				River Flooding				Snow Accumulation				Hail				Freezing Rain / Unseasonal Snow				Drought			
Climate Projections (RCP 8.5)	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R
Baseline	122	3			3.8	3			56	3			-	3			0%	3			0.04	3		
2050	139	4			4.9	4			59	3			+	4			35%	4			-0.06	4		
2080	164	4			5.6	4			64	4			+	4			58%	5			-0.25	4		

Extreme Events

	Change in Average Annual Area Burned				1-in-50 Year Gust Pressures				Lightning				Biodiversity			
	Wildfire Smoke				Heavy Winds				Lightning				Insect, invasive plants and disease			
Climate Projections (RCP 8.5)	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R
Baseline	-	3			0.48	3			-	3			-	3		
2050	+	4			0.48	3			+	4			+	4		
2080	++	5			0.48	3			++	5			++	5		

Asset Category

Water

			Temperature																				Precipitation																				Extreme Events															
			Days above +30°C				Warmest Maximum Temperature (°C)				Days below -25°C				Coldest Minimum Temperature (˚C)				# Freeze/ Thaw Events				15 min 100-year Rainfall (mm/hr)				24 hour 100-year Rainfall (mm/hr)				Winter Precipitation (mm)				Severe Summer Hail Days (% Change Relative to Present)				Change in Ice Accumulation				Relative Change in Standardized Precipitation Evapotranspiration Index-based				Change in Average Annual Area Burned				1-in-50 Year Gust Pressures				Lightning				Biodiversity			
			Very Hot Days				Hottest Day				Very Cold Days				Coldest Days				Freeze/ Thaw Events				Localized Flooding				River Flooding				Snow Accumulation				Hail				Freezing Rain / Unseasonal Snow				Drought				Wildfire Smoke				Heavy Winds				Lightning				Insect, invasive plants and disease			
			Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R
1	13 GUDI Wells (Water Supply)	Baseline		3		12		3		11		3		9		3		5		3		5		3		2		3		10		3		9		3		8		3		6		3		15		3		6		3		8		3		10		3		5
		2050	Y	4	4	16	Y	3	3.8	11	Y	2	3	6	Y	3	1.5	5	Y	2	1.67	3	Y	4	0.67	3	Y	4	3.4	14	Y	3	3	9	Y	4	2.67	11	Y	4	2	8	Y	4	5	20	Y	4	2	8	Y	3	2.67	8	Y	4	3.33	13	Y	4	1.5	6
		2080		5		20		4		15		1		3		2		3		2		3		4		3		4		14		4		12		4		11		5		10		4		20		5		10		3		8		5		17		5		8
2	Water Treatment Plant (process equipment)	Baseline		3		11		3		11		3		7		3		7		3		7		3		9		3		14		3		9		3		9		3		6		3		15		3		8		3		9		3		11		3		4
		2050	Y	4	3.8	15	Y	3	3.8	11	Y	2	2.33	5	Y	3	2.33	7	Y	2	2.33	5	Y	4	3	12	Y	4	4.5	18	Y	3	3	9	Y	4	3	12	Y	4	2	8	Y	4	5	20	Y	4	2	8	Y	3	3	9	Y	4	3.75	15	Y	4	1.33	5
		2080		5		19		4		15		1		2		2		5		2		5		4		12		4		18		4		12		4		12		5		10		4		20		5		13		3		9		5		19		5		7
3	3 Treated Water Reservoirs	Baseline		3		9		3		11		3		8		3		3		3		3		3		11		3		9		3		9		3		8		3		6		3		12		3		7		3		9		3		11		3		0
		2050	Y	4	3	12	Y	3	3.67	11	Y	2	2.67	5	Y	3	1	3	Y	2	1	2	Y	4	3.5	14	Y	4	3	12	Y	3	3	9	Y	4	2.67	11	Y	4	2	8	Y	4	4	16	Y	4	2.33	9	Y	3	3	9	Y	4	3.67	15	N	4	0	0
		2080		5		15		4		15		1		3		2		2		2		2		4		14		4		12		4		12		4		11		5		10		4		16		5		12		3		9		5		18		5		0
4	3 Booster Stations	Baseline		3		6		3		8		3		8		3		3		3		6		3		9		3		9		3		9		3		8		3		6		3		12		3		8		3		9		3		11		3		0
		2050	Y	4	2	8	Y	3	2.5	8	Y	2	2.67	5	Y	3	1	3	Y	2	2	4	Y	4	3	12	Y	4	3	12	Y	3	3	9	Y	4	2.67	11	Y	4	2	8	Y	4	4	16	Y	4	2.5	10	Y	3	3	9	Y	4	3.67	15	N	4	0	0
		2080		5		10		4		10		1		3		2		2		2		4		4		12		4		12		4		11		5		10		4		16		5		13		3		9		5		18		5		0
5	151 km of water mains	Baseline		3		4		3		8		3		8		3		5		3		8		3		1		3		3		3		3		3		1		3		0		3		3		3		5		3		3		3		3		0
		2050	Y	4	1.25	5	Y	3	1	3	Y	2	2.8	6	Y	3	1.67	5	Y	2	2.67	5	Y	4	0.2	1	Y	4	1	4	Y	3	1	3	Y	4	0.33	1	N	4	0	0	Y	4	1	4	Y	4	1.5	6	Y	3	1	3	Y	4	1	4	N	4	0	0
		2080		5		6		4		4		1		3		2		3		2		5		4		1		4		4		4		4		4		1		5		0		4		4		5		8		3		3		5		5		5		0
6	480 hydrants	Baseline		3		2		3		4		3		8		3		9		3		8		3		1		3		5		3		7		3		2		3		6		3		3		3		5		3		6		3		3		3		0
		2050	Y	4	0.75	3	Y	3	1.25	4	Y	2	2.8	6	Y	3	3	9	Y	2	2.5	5	Y	4	0.33	1	Y	4	1.5	6	Y	3	2.33	7	Y	4	0.67	3	Y	4	2	8	Y	4	1	4	Y	4	1.5	6	Y	3	1	3	Y	4	1	4	N	4	0	0
		2080		5		4		4		5		1		3		2		6		2		5		4		1		4		6		4		9		4		3		5		10		4		4		5		8		3		3		5		5		5		0
7	2,024 main valves	Baseline		3		2		3		3		3		8		3		9		3		7		3		1		3		5		3		7		3		1		3		5		3		1		3		5		3		3		3		3		0
		2050	Y	4	0.67	3	Y	3	1	3	Y	2	2.67	5	Y	3	3	9	Y	2	2.33	5	Y	4	0.33	1	Y	4	1.67	7	Y	3	2.33	7	Y	4	0.33	1	Y	4	1.67	7	Y	4	1	4	Y	4	1.5	6	Y	3	1	3	Y	4	1	4	N	4	0	0
		2080		5		3		4		4		1		3		2		6		2		5		4		1		4		7		4		9		4		1		5		8		3		3		5		8		3		3		5		5		5		0

Wastewater

			Temperature																				Precipitation																				Extreme Events															
			Days above +30°C				Warmest Maximum Temperature (°C)				Days below -25°C				Coldest Minimum Temperature (˚C)				# Freeze/ Thaw Events				15 min 100-year Rainfall (mm/hr)				24 hour 100-year Rainfall (mm/hr)				Winter Precipitation (mm)				Severe Summer Hail Days (% Change Relative to Present)				Change in Ice Accumulation				Relative Change in Standardized Precipitation Evapotranspiration Index-based				Change in Average Annual Area Burned				1-in-50 Year Gust Pressures				Lightning				Biodiversity			
			Very Hot Days				Hottest Day				Very Cold Days				Coldest Days				Freeze/ Thaw Events				Localized Flooding				River Flooding				Snow Accumulation				Hail				Freezing Rain / Unseasonal Snow				Drought				Wildfire Smoke				Heavy Winds				Lightning				Insect, invasive plants and disease			
			Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R
7	134 km of Collection Mains	Baseline		3		2		3		3		3		7		3		5		3		7		3		5		3		12		3		3	N	3		0		3		6		3		2		3		5		3		3		3		3		3
		2050	Y	4	0.67	3	Y	3	1	3	Y	2	2.33	5	Y	3	1.5	5	Y	2	2.33	5	Y	4	1.67	7	Y	4	4	16	Y	3	1	3	N	4	0	0	Y	4	2	8	Y	4	0.75	3	Y	4	1.5	6	Y	3	1	3	Y	4	1	4	Y	4	1	4
		2080		5		4		4		4		1		2		2		3		2		5		4		7		4		16		4		4		4		0		5		10		4		3		5		8		3		3		5		5		5		5
8	6 Lift stations (5-10% of system flows, remaining is gravity)	Baseline		3		5		3		7		3		5		3		3		3		7		3		12		3		12		3		7		3		9		3		6		3		3		3		5		3		7		3		9		3		3
		2050	Y	4	1.67	7	Y	3	2.33	7	Y	2	1.75	4	Y	3	1	3	Y	2	2.33	5	Y	4	4	16	Y	4	4	16	Y	3	2.33	7	Y	4	3	12	Y	4	2	8	Y	4	1	4	Y	4	1.5	6	Y	3	2.33	7	Y	4	3	12	Y	4	1	4
		2080		5		8		4		9		1		2		2		2		2		5		4		16		4		16		4		9		4		12		5		10		4		4		5		8		3		7		5		15		5		5
9	1,482 Sanitary Manholes	Baseline		3		3		3		3		3		5		3		4		3		6		3		12		3		11		3		9		3		6		3		6		3		3		3		5		3		3		3		3		3
		2050	Y	4	1	4	Y	3	1	3	Y	2	1.67	3	Y	3	1.33	4	Y	2	2	4	Y	4	4	16	Y	4	3.67	15	Y	3	3	9	Y	4	2	8	Y	4	2	8	Y	4	1	4	Y	4	1.5	6	Y	3	1	3	Y	4	1	4	Y	4	1	4
		2080		5		5		4		4		1		2		2		3		2		4		4		16		4		15		4		12		4		8		5		10		4		4		5		8		3		3		5		5		5		5
10	Wastewater Treatment Plant (Conventional BNR)	Baseline		3		4		3		8		3		11		3		9		3		7		3		12		3		15		3		9		3		9		3		6		3		7		3		8		3		7		3		11		3		6
		2050	Y	4	1.33	5	Y	3	2.5	8	Y	2	3.67	7	Y	3	3	9	Y	2	2.33	5	Y	4	4	16	Y	4	5	20	Y	3	3	9	Y	4	3	12	Y	4	2	8	Y	4	2.33	9	Y	4	2.5	10	Y	3	2.33	7	Y	4	3.67	15	Y	4	2	8
		2080		5		7		4		10		1		4		2		6		2		5		4		16		4		20		4		12		4		12		5		10		4		9		5		13		3		7		5		18		5		10

Okotoks

Risk Assessment Worksheet

Consequence Score

- 0 - No Effect
- 1 - Insignificant
- 2 - Minor
- 3 - Moderate
- 4 - Major
- 5 - Catastrophic

Climate Parameter

Temperature

#	Asset Category	Climate Projections (RCP 8.5)	Days above +30°C				Warmest Maximum Temperature (°C)				Days below -25°C				Coldest Minimum Temperature (˚C)				# Freeze/ Thaw Events			
			Very Hot Days				Hottest Day				Very Cold Days				Coldest Days				Freeze/ Thaw Events			
		Baseline	12	3			34	3			10	3			-32.5	3			111.3	3		
		2050	20	4			36	3			5	2			-29.7	3			99.65	2		
		2080	28	5			39	4			1	1			-25.5	2			81.2	2		
			Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R
	Stormwater																					
10	20 Stormceptors (Private and Public)	Baseline		3		4		3		3		3		5		3		3		3		2
		2050	Y	4	1.33	5	Y	3	1	3	Y	2	1.67	3	Y	3	1	3	Y	2	0.5	1
		2080		5		7		4		4		1		2		2		2		2		1
11	14 Storm outfalls	Baseline		3		3		3		3		3		6		3		3		3		4
		2050	Y	4	1	4	Y	3	1	3	Y	2	2	4	Y	3	1	3	Y	2	1.25	3
		2080		5		5		4		4		1		2		2		2		2		3
12	2,162 Catch Basins	Baseline		3		3		3		3		3		6		3		3		3		8
		2050	Y	4	1	4	Y	3	1	3	Y	2	2	4	Y	3	1	3	Y	2	2.8	6
		2080		5		5		4		4		1		2		2		2		2		6
13	132 km of Storm Mains	Baseline		3		3		3		3		3		4		3		3		3		7
		2050	Y	4	1	4	Y	3	1	3	Y	2	1.33	3	Y	3	1	3	Y	2	2.33	5
		2080		5		5		4		4		1		1		2		2		2		5
14	16 wet ponds, 3 private	Baseline		3		7		3		6		3		3		3		3		3		3
		2050	Y	4	2.25	9	Y	3	2	6	Y	2	1	2	Y	3	1	3	Y	2	1	2
		2080		5		11		4		8		1		1		2		2		2		2
15	1 constructed wetland	Baseline		3		7		3		7		3		2		3		2		3		4
		2050	Y	4	2.33	9	Y	3	2.33	7	Y	2	0.67	1	Y	3	0.5	2	Y	2	1.25	3
		2080		5		12		4		9		1		1		2		1		2		3
16	2 dry ponds	Baseline		3		3		3		5		3		2		3		0		3		0
		2050	Y	4	1	4	Y	3	1.75	5	Y	2	0.5	1	N	3	0	0	N	2	0	0
		2080		5		5		4		7		1		1		2		0		2		0
17	Crystal Shores Lake	Baseline		3		6		3		6		3		2		3		3		3		1
		2050	Y	4	2	8	Y	3	2	6	Y	2	0.5	1	Y	3	1	3	Y	2	0.25	1
		2080		5		10		4		8		1		1		2		2		2		1
18	3 Drainage Ditches (vegetated)	Baseline		3		3		3		6		3		9		3		3		3		4
		2050	Y	4	1	4	Y	3	2	6	Y	2	3	6	Y	3	1	3	Y	2	1.33	3
		2080		5		5		4		8		1		3		2		2		2		3
19	1 Spring Creek	Baseline		3		5		3		6		3		2		3		0		3		2
		2050	Y	4	1.5	6	Y	3	2	6	Y	2	0.5	1	N	3	0	0	Y	2	0.75	2
		2080		5		8		4		8		1		1		2		0		2		2
20	1 Snow Dump Sites	Baseline		3		0		3		2		3		5		3		6		3		5
		2050	N	4	0	0	Y	3	0.5	2	Y	2	1.67	3	Y	3	2	6	Y	2	1.6	3
		2080		5		0		4		2		1		2		2		4		2		3
	Roads																					
20	14 Bridges	Baseline		3		6		3		3		3		8		3		2		3		9
		2050	Y	4	2	8	Y	3	1	3	Y	2	2.5	5	Y	3	0.5	2	Y	2	3	6
		2080		5		10		4		4		1		3		2		1		2		6
21	165 km of roads	Baseline		3		8		3		6		3		9		3		2		3		9
		2050	Y	4	2.5	10	Y	3	2	6	Y	2	3	6	Y	3	0.5	2	Y	2	3	6
		2080		5		13		4		8		1		3		2		1		2		6
22	150 km of sidewalks	Baseline		3		4		3		3		3		9		3		3		3		11
		2050	Y	4	1.33	5	Y	3	1	3	Y	2	3	6	Y	3	1	3	Y	2	3.5	7
		2080		5		7		4		4		1		3		2		2		2		7
23	24 intersections with traffic lights	Baseline		3		3		3		6		3		0		3		0		3		3
		2050	Y	4	1	4	Y	3	2	6	N	2	0	0	N	3	0	0	Y	2	1	2
		2080		5		5		4		8		1		0		2		0		2		2
24	Bike lanes by Darcy Ranch	Baseline		3		6		3		6		3		2		3		0		3		2
		2050	Y	4	2	8	Y	3	2	6	Y	2	0.5	1	N	3	0	0	Y	2	0.5	1
		2080		5		10		4		8		1		1		2		0		2		1

Precipitation

#	Asset Category	Climate Projections (RCP 8.5)	15 min 100-year Rainfall (mm/hr)				24 hour 100-year Rainfall (mm/hr)				Winter Precipitation (mm)				Severe Summer Hail Days (% Change Relative to Present)				Change in Ice Accumulation				Relative Change in Standardized Precipitation Evapotranspiration Index-based			
			Localized Flooding				River Flooding				Snow Accumulation				Hail				Freezing Rain / Unseasonal Snow				Drought			
		Baseline	122	3			3.8	3			56	3			-	3			0%	3			0.04	3		
		2050	139	4			4.9	4			59	3			+	4			35%	4			-0.06	4		
		2080	164	4			5.6	4			64	4			+	4			58%	5			-0.25	4		
			Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R
	Stormwater																									
10	20 Stormceptors (Private and Public)	Baseline		3		10		3		11		3		3		3		4		3		5		3		3
		2050	Y	4	3.33	13	Y	4	3.75	15	Y	3	1	3	Y	4	1.33	5	Y	4	1.5	6	Y	4	1	4
		2080		4		13		4		15		4		4		4		5		5		8		4		4
11	14 Storm outfalls	Baseline		3		11		3		14		3		4		3		5		3		5		3		3
		2050	Y	4	3.67	15	Y	4	4.5	18	Y	3	1.25	4	Y	4	1.75	7	Y	4	1.5	6	Y	4	1	4
		2080		4		15		4		18		4		5		4		7		5		8		4		4
12	2,162 Catch Basins	Baseline		3		12		3		12		3		5		3		12		3		8		3		3
		2050	Y	4	4	16	Y	4	4	16	Y	3	1.5	5	Y	4	4	16	Y	4	2.667	11	Y	4	1	4
		2080		4		16		4		16		4		6		4		16		5		13		4		4
13	132 km of Storm Mains	Baseline		3		11		3		12		3		3		3		8		3		4		3		3
		2050	Y	4	3.67	15	Y	4	4	16	Y	3	1	3	Y	4	2.67	11	Y	4	1.25	5	Y	4	1	4
		2080		4		15		4		16		4		4		4		11		5		6		4		4
14	16 wet ponds, 3 private	Baseline		3		11		3		12		3		3		3		5		3		4		3		11
		2050	Y	4	3.67	15	Y	4	4	16	Y	3	1	3	Y	4	1.67	7	Y	4	1.33	5	Y	4	3.5	14
		2080		4		15		4		16		4		4		4		7		5		7		4		14
15	1 constructed wetland	Baseline		3		9		3		12		3		3		3		8		3		7		3		11
		2050	Y	4	3	12	Y	4	4	16	Y	3	1	3	Y	4	2.8	11	Y	4	2.2	9	Y	4	3.75	15
		2080		4		12		4		16		4		4		4		11		5		11		4		15
16	2 dry ponds	Baseline		3		11		3		12		3		4		3		2		3		3		3		9
		2050	Y	4	3.67	15	Y	4	4	16	Y	3	1.25	4	Y	4	0.67	3	Y	4	1	4	Y	4	3	12
		2080		4		15		4		16		4		5		4		3		5		5		4		12
17	Crystal Shores Lake	Baseline		3		6		3		11		3		2		3		3		3		3		3		11
		2050	Y	4	2	8	Y	4	3.5	14	Y	3	0.67	2	Y	4	1	4	Y	4	1	4	Y	4	3.67	15
		2080		4		8		4		14		4		3		4		4		5		5		4		15
18	3 Drainage Ditches (vegetated)	Baseline		3		11		3		13		3		6		3		8		3		3		3		5
		2050	Y	4	3.75	15	Y	4	4.2	17	Y	3	2	6	Y	4	2.5	10	Y	4	1	4	Y	4	1.5	6
		2080		4		15		4		17		4		8		4		10		5		5		4		6
19	1 Spring Creek	Baseline		3		8		3		14		3		2		3		6		3		5		3		9
		2050	Y	4	2.67	11	Y	4	4.67	19	Y	3	0.5	2	Y	4	2	8	Y	4	1.75	7	Y	4	3	12
		2080		4		11		4		19		4		2		4		8		5		9		4		12
20	1 Snow Dump Sites	Baseline		3		5		3		10		3		12		3		6		3		3		3		3
		2050	Y	4	1.75	7	Y	4	3.33	13	Y	3	4	12	Y	4	2	8	Y	4	1	4	Y	4	1	4
		2080		4		7		4		13		4		16		4		8		5		5		4		4
	Roads																									
20	14 Bridges	Baseline		3		8		3		12		3		9		3		8		3		6		3		2
		2050	Y	4	2.5	10	Y	4	4	16	Y	3	3	9	Y	4	2.5	10	Y	4	2	8	Y	4	0.5	2
		2080		4		10		4		16		4		12		4		10		5		10		4		2
21	165 km of roads	Baseline		3		9		3		11		3		10		3		9		3		6		3		0
		2050	Y	4	3	12	Y	4	3.5	14	Y	3	3.33	10	Y	4	3	12	Y	4	2	8	N	4	0	0
		2080		4		12		4		14		4		13		4		12		5		10		4		0
22	150 km of sidewalks	Baseline		3		8		3		9		3		11		3		3		3		8		3		0
		2050	Y	4	2.5	10	Y	4	3	12	Y	3	3.5	11	Y	4	1	4	Y	4	2.5	10	N	4	0	0
		2080		4		10		4		12		4		14		4		4		5		13		4		0
23	24 intersections with traffic lights	Baseline		3		3		3		6		3		3		3		3		3		3		3		0
		2050	Y	4	1	4	Y	4	2	8	Y	3	1	3	Y	4	1	4	Y	4	1	4	N	4	0	0
		2080		4		4		4		8		4		4		4		4		5		5		4		0
24	Bike lanes by Darcy Ranch	Baseline		3		3		3		3		3		2		3		3		3		5		3		0
		2050	Y	4	1	4	Y	4	1	4	Y	3	0.5	2	Y	4	1	4	Y	4	1.5	6	N	4	0	0
		2080		4		4		4		4		4		2		4		4		5		8		4		0

Extreme Events

#	Asset Category	Climate Projections (RCP 8.5)	Change in Average Annual Area Burned				1-in-50 Year Gust Pressures				Lightning				Biodiversity			
			Wildfire Smoke				Heavy Winds				Lightning				Insect, invasive plants and disease			
		Baseline	-	3			0.48	3			-	3			-	3		
		2050	+	4			0.48	3			+	4			+	4		
		2080	++	5			0.48	3			++	5			++	5		
			Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R
	Stormwater																	
10	20 Stormceptors (Private and Public)	Baseline		3		8		3		4		3		3		3		6
		2050	Y	4	2.67	11	Y	3	1.33	4	Y	4	1	4	Y	4	2	8
		2080		5		13		3		4		5		5		5		10
11	14 Storm outfalls	Baseline		3		7		3		3		3		1		3		8
		2050	Y	4	2.33	9	Y	3	1	3	Y	4	0.4	2	Y	4	2.67	11
		2080		5		12		3		3		5		2		5		13
12	2,162 Catch Basins	Baseline		3		8		3		3		3		1		3		8
		2050	Y	4	2.75	11	Y	3	1	3	Y	4	0.25	1	Y	4	2.67	11
		2080		5		14		3		3		5		1		5		13
13	132 km of Storm Mains	Baseline		3		6		3		3		3		1		3		8
		2050	Y	4	2	8	Y	3	1	3	Y	4	0.25	1	Y	4	2.5	10
		2080		5		10		3		3		5		1		5		13
14	16 wet ponds, 3 private	Baseline		3		6		3		3		3		0		3		11
		2050	Y	4	2	8	Y	3	1	3	N	4	0	0	Y	4	3.67	15
		2080		5		10		3		3		5		0		5		18
15	1 constructed wetland	Baseline		3		6		3		3		3		0		3		12
		2050	Y	4	2	8	Y	3	1	3	N	4	0	0	Y	4	4	16
		2080		5		10		3		3		5		0		5		20
16	2 dry ponds	Baseline		3		6		3		3		3		0		3		10
		2050	Y	4	2	8	Y	3	1	3	N	4	0	0	Y	4	3.25	13
		2080		5		10		3		3		5		0		5		16
17	Crystal Shores Lake	Baseline		3		6		3		4		3		2		3		9
		2050	Y	4	2	8	Y	3	1.33	4	Y	4	0.75	3	Y	4	3	12
		2080		5		10		3		4		5		4		5		15
18	3 Drainage Ditches (vegetated)	Baseline		3		4		3		3		3		0		3		9
		2050	Y	4	1.33	5	Y	3	1	3	N	4	0	0	Y	4	3	12
		2080		5		7		3		3		5		0		5		15
19	1 Spring Creek	Baseline		3		3		3		3		3		0		3		8
		2050	Y	4	1	4	Y	3	1	3	N	4	0	0	Y	4	2.6	10
		2080		5		5		3		3		5		0		5		13
20	1 Snow Dump Sites	Baseline		3		1		3		3		3		0		3		6
		2050	Y	4	0.25	1	Y	3	1	3	N	4	0	0	Y	4	2	8
		2080		5		1		3		3		5		0		5		10
	Roads																	
20	14 Bridges	Baseline		3		0		3		0		3		3		3		0
		2050	N	4	0	0	N	3	0	0	Y	4	1	4	N	4	0	0
		2080		5		0		3		0		5		5		5		0
21	165 km of roads	Baseline		3		0		3		0		3		0		3		0
		2050	N	4	0	0	N	3	0	0	N	4	0	0	N	4	0	0
		2080		5		0		3		0		5		0		5		0
22	150 km of sidewalks	Baseline		3		0		3		0		3		0		3		0
		2050	N	4	0	0	N	3	0	0	N	4	0	0	N	4	0	0
		2080		5		0		3		0		5		0		5		0
23	24 intersections with traffic lights	Baseline		3		0		3		5		3		6		3		0
		2050	N	4	0	0	Y	3	1.5	5	Y	4	2	8	N	4	0	0
		2080		5		0		3		5		5		10		5		0
24	Bike lanes by Darcy Ranch	Baseline		3		0		3		0		3		0		3		0
		2050	N	4	0	0	N	3	0	0	N	4	0	0	N	4	0	0
		2080		5		0		3		0		5		0		5		0

Okotoks

Risk Assessment Worksheet

Consequence Score

0 - No Effect
1 - Insignificant
2 - Minor
3 - Moderate
4 - Major
5 - Catastrophic

Climate Parameter

Asset Category

Temperature

Asset	Year	Days above +30°C (Very Hot Days)				Warmest Maximum Temperature (°C) (Hottest Day)				Days below -25°C (Very Cold Days)				Coldest Minimum Temperature (°C) (Coldest Days)				# Freeze/ Thaw Events (Freeze/ Thaw Events)			
Climate Projections (RCP 8.5)	Baseline	12	3			34	3			10	3			-32.5	3			111.3	3		
	2050	20	4			36	3			5	2			-29.7	3			99.65	2		
	2080	28	5			39	4			1	1			-25.5	2			81.2	2		
		Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R
Waste																					
25 Okotoks Eco Centre	Baseline		3		5		3		9		3		5		3		4		3		1
	2050	Y	4	1.67	7	Y	3	3	9	Y	2	1.67	3	Y	3	1.33	4	Y	2	0.33	1
	2080		5		8		4		12		1		2		2		3		2		1
26 Waste Fleet	Baseline		3		9		3		9		3		8		3		9		3		6
	2050	Y	4	3	12	Y	3	3	9	Y	2	2.5	5	Y	3	3	9	Y	2	2	4
	2080		5		15		4		12		1		3		2		6		2		4
Parks																					
27 94 km of pathways	Baseline		3		5		3		6		3		2		3		2		3		11
	2050	Y	4	1.5	6	Y	3	2	6	Y	2	0.5	1	Y	3	0.5	2	Y	2	3.5	7
	2080		5		8		4		8		1		1		2		1		2		7
28 15,000 public trees	Baseline		3		9		3		11		3		3		3		3		3		6
	2050	Y	4	3	12	Y	3	3.5	11	Y	2	1	2	Y	3	1	3	Y	2	2	4
	2080		5		15		4		14		1		1		2		2		2		4
29 72 playgrounds	Baseline		3		5		3		6		3		2		3		2		3		3
	2050	Y	4	1.5	6	Y	3	2	6	Y	2	0.5	1	Y	3	0.5	2	Y	2	1	2
	2080		5		8		4		8		1		1		2		1		2		2
30 6 picnic shelters	Baseline		3		5		3		3		3		0		3		0		3		3
	2050	Y	4	1.5	6	Y	3	1	3	N	2	0	0	N	3	0	0	Y	2	1	2
	2080		5		8		4		4		1		0		2		0		2		2
31 15 toilet buildings (w/ septic tanks)	Baseline		3		5		3		3		3		3		3		3		3		6
	2050	Y	4	1.5	6	Y	3	1	3	Y	2	1	2	Y	3	1	3	Y	2	2	4
	2080		5		8		4		4		1		1		2		2		2		4
32 2 racquet courts	Baseline		3		5		3		6		3		0		3		0		3		0
	2050	Y	4	1.5	6	Y	3	2	6	N	2	0	0	N	3	0	0	N	2	0	0
	2080		5		8		4		8		1		0		2		0		2		0
33 1 sports court	Baseline		3		6		3		6		3		0		3		0		3		0
	2050	Y	4	2	8	Y	3	2	6	N	2	0	0	N	3	0	0	N	2	0	0
	2080		5		10		4		8		1		0		2		0		2		0
34 179 ha of manicured parks	Baseline		3		9		3		9		3		0		3		0		3		0
	2050	Y	4	3	12	Y	3	3	9	N	2	0	0	N	3	0	0	N	2	0	0
	2080		5		15		4		12		1		0		2		0		2		0
35 326 ha of naturalized parks lands	Baseline		3		7		3		6		3		0		3		0		3		0
	2050	Y	4	2.33	9	Y	3	2	6	N	2	0	0	N	3	0	0	N	2	0	0
	2080		5		12		4		8		1		0		2		0		2		0
36 36 sports fields w/ irrigation	Baseline		3		9		3		12		3		0		3		0		3		0
	2050	Y	4	3	12	Y	3	4	12	N	2	0	0	N	3	0	0	N	2	0	0
	2080		5		15		4		16		1		0		2		0		2		0

Precipitation

Asset	Year	15 min 100-year Rainfall (mm/hr) (Localized Flooding)				24 hour 100-year Rainfall (mm/hr) (River Flooding)				Winter Precipitation (mm) (Snow Accumulation)				Severe Summer Hail Days (% Change Relative to Present) (Hail)				Change in Ice Accumulation (Freezing Rain / Unseasonal Snow)				Relative Change in Standardized Precipitation Evapotranspiration Index-based (Drought)			
Climate Projections (RCP 8.5)	Baseline	122	3			3.8	3			56	3			-	3			0%	3			0.04	3		
	2050	139	4			4.9	4			59	3			+	4			35%	4			-0.06	4		
	2080	164	4			5.6	4			64	4			+	4			58%	5			-0.25	4		
		Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R
Waste																									
25 Okotoks Eco Centre	Baseline		3		3		3		4		3		0		3		0		3		0		3		0
	2050	Y	4	1	4	Y	4	1.33	5	N	3	0	0	N	4	0	0	N	4	0	0	N	4	0	0
	2080		4		4		4		5		4		0		4		0		5		0		4		0
26 Waste Fleet	Baseline		3		3		3		6		3		8		3		3		3		4		3		0
	2050	Y	4	1	4	Y	4	2	8	Y	3	2.5	8	Y	4	1	4	Y	4	1.33	5	N	4	0	0
	2080		4		4		4		8		4		10		4		4		5		7		4		0
Parks																									
27 94 km of pathways	Baseline		3		8		3		14		3		11		3		8		3		11		3		0
	2050	Y	4	2.5	10	Y	4	4.5	18	Y	3	3.5	11	Y	4	2.5	10	Y	4	3.5	14	N	4	0	0
	2080		4		10		4		18		4		14		4		10		5		18		4		0
28 15,000 public trees	Baseline		3		6		3		7		3		3		3		11		3		9		3		12
	2050	Y	4	2	8	Y	4	2.33	9	Y	3	1	3	Y	4	3.67	15	Y	4	3	12	Y	4	4	16
	2080		4		8		4		9		4		4		4		15		5		15		4		16
29 72 playgrounds	Baseline		3		6		3		9		3		2		3		6		3		3		3		0
	2050	Y	4	2	8	Y	4	3	12	Y	3	0.5	2	Y	4	2	8	Y	4	1	4	N	4	0	0
	2080		4		8		4		12		4		2		4		8		5		5		4		0
30 6 picnic shelters	Baseline		3		3		3		9		3		0		3		6		3		0		3		0
	2050	Y	4	1	4	Y	4	3	12	N	3	0	0	Y	4	2	8	N	4	0	0	N	4	0	0
	2080		4		4		4		12		4		0		4		8		5		0		4		0
31 15 toilet buildings (w/ septic tanks)	Baseline		3		6		3		12		3		0		3		3		3		0		3		0
	2050	Y	4	2	8	Y	4	4	16	N	3	0	0	Y	4	1	4	N	4	0	0	N	4	0	0
	2080		4		8		4		16		4		0		4		4		5		0		4		0
32 2 racquet courts	Baseline		3		8		3		3		3		0		3		6		3		3		3		0
	2050	Y	4	2.5	10	Y	4	1	4	N	3	0	0	Y	4	2	8	Y	4	1	4	N	4	0	0
	2080		4		10		4		4		4		0		4		8		5		5		4		0
33 1 sports court	Baseline		3		8		3		3		3		0		3		6		3		3		3		0
	2050	Y	4	2.5	10	Y	4	1	4	N	3	0	0	Y	4	2	8	Y	4	1	4	N	4	0	0
	2080		4		10		4		4		4		0		4		8		5		5		4		0
34 179 ha of manicured parks	Baseline		3		2		3		3		3		0		3		3		3		0		3		9
	2050	Y	4	0.67	3	Y	4	1	4	N	3	0	0	Y	4	1	4	N	4	0	0	Y	4	3	12
	2080		4		3		4		4		4		0		4		4		5		0		4		12
35 326 ha of naturalized parks lands	Baseline		3		4		3		6		3		0		3		6		3		0		3		10
	2050	Y	4	1.33	5	Y	4	2	8	N	3	0	0	Y	4	2	8	N	4	0	0	Y	4	3.33	13
	2080		4		5		4		8		4		0		4		8		5		0		4		13
36 36 sports fields w/ irrigation	Baseline		3		6		3		12		3		0		3		3		3		9		3		13
	2050	Y	4	2	8	Y	4	4	16	N	3	0	0	Y	4	1	4	Y	4	3	12	Y	4	4.33	17
	2080		4		8		4		16		4		0		4		4		5		15		4		17

Extreme Events

Asset	Year	Change in Average Annual Area Burned (Wildfire Smoke)				1-in-50 Year Gust Pressures (Heavy Winds)				Lightning (Lightning)				Biodiversity (Insect, invasive plants and disease)			
Climate Projections (RCP 8.5)	Baseline	-	3			0.48	3			-	3			-	3		
	2050	+	4			0.48	3			+	4			+	4		
	2080	++	5			0.48	3			++	5			++	5		
		Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R
Waste																	
25 Okotoks Eco Centre	Baseline		3		3		3		2		3		0		3		0
	2050	Y	4	1	4	Y	3	0.5	2	N	4	0	0	N	4	0	0
	2080		5		5		3		2		5		0		5		0
26 Waste Fleet	Baseline		3		2		3		6		3		0		3		2
	2050	Y	4	0.5	2	Y	3	2	6	N	4	0	0	Y	4	0.67	3
	2080		5		3		3		6		5		0		5		3
Parks																	
27 94 km of pathways	Baseline		3		2		3		6		3		2		3		0
	2050	Y	4	0.5	2	Y	3	2	6	Y	4	0.5	2	N	4	0	0
	2080		5		3		3		6		5		3		5		0
28 15,000 public trees	Baseline		3		5		3		11		3		8		3		14
	2050	Y	4	1.5	6	Y	3	3.5	11	Y	4	2.5	10	Y	4	4.5	18
	2080		5		8		3		11		5		13		5		23
29 72 playgrounds	Baseline		3		3		3		3		3		3		3		0
	2050	Y	4	1	4	Y	3	1	3	Y	4	1	4	N	4	0	0
	2080		5		5		3		3		5		5		5		0
30 6 picnic shelters	Baseline		3		2		3		3		3		0		3		0
	2050	Y	4	0.5	2	Y	3	1	3	N	4	0	0	N	4	0	0
	2080		5		3		3		3		5		0		5		0
31 15 toilet buildings (w/ septic tanks)	Baseline		3		2		3		0		3		0		3		0
	2050	Y	4	0.5	2	N	3	0	0	N	4	0	0	N	4	0	0
	2080		5		3		3		0		5		0		5		0
32 2 racquet courts	Baseline		3		5		3		6		3		3		3		0
	2050	Y	4	1.5	6	Y	3	2	6	Y	4	1	4	N	4	0	0
	2080		5		8		3		6		5		5		5		0
33 1 sports court	Baseline		3		3		3		0		3		3		3		0
	2050	Y	4	1	4	N	3	0	0	Y	4	1	4	N	4	0	0
	2080		5		5		3		0		5		5		5		0
34 179 ha of manicured parks	Baseline		3		0		3		3		3		3		3		12
	2050	N	4	0	0	Y	3	1	3	Y	4	1	4	Y	4	4	16
	2080		5		0		3		3		5		5		5		20
35 326 ha of naturalized parks lands	Baseline		3		0		3		3		3		3		3		10
	2050	N	4	0	0	Y	3	1	3	Y	4	1	4	Y	4	3.33	13
	2080		5		0		3		3		5		5		5		17
36 36 sports fields w/ irrigation	Baseline		3		5		3		3		3		8		3		12
	2050	Y	4	1.5	6	Y	3	1	3	Y	4	2.5	10	Y	4	4	16
	2080		5		8		3		3		5		13		5		20

Okotoks

Risk Assessment Worksheet

Consequence Score

0 - No Effect
1 - Insignificant
2 - Minor
3 - Moderate
4 - Major
5 - Catastrophic

Climate Parameter

Temperature

			Days above +30°C (Very Hot Days)				Warmest Maximum Temperature (°C) (Hottest Day)				Days below -25°C (Very Cold Days)				Coldest Minimum Temperature (˚C) (Coldest Days)				# Freeze/ Thaw Events (Freeze/ Thaw Events)			
Climate Projections (RCP 8.5)		Baseline	12	3			34	3			10	3			-32.5	3			111.3	3		
		2050	20	4			36	3			5	2			-29.7	3			99.65	2		
		2080	28	5			39	4			1	1			-25.5	2			81.2	2		
			Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R
Facilities																						
36	Wastewater Treatment Plant (excl. process equipment)	Baseline		3		5		3		3		3		6		3		6		3		6
		2050	Y	4	1.5	6	Y	3	1	3	Y	2	2	4	Y	3	2	6	Y	2	2	4
		2080		5		8		4		4		1		2		2		4		2		4
37	Water Treatment Plant (excl. process equipment)	Baseline		3		6		3		3		3		6		3		6		3		6
		2050	Y	4	2	8	Y	3	1	3	Y	2	2	4	Y	3	2	6	Y	2	2	4
		2080		5		10		4		4		1		2		2		4		2		4
38	EcoCenter (excl. process equipment)	Baseline		3		9		3		8		3		9		3		9		3		3
		2050	Y	4	3	12	Y	3	2.5	8	Y	2	3	6	Y	3	3	9	Y	2	1	2
		2080		5		15		4		10		1		3		2		6		2		2
39	Drake Landing Energy Center	Baseline		3		5		3		3		3		8		3		6		3		5
		2050	Y	4	1.67	7	Y	3	1	3	Y	2	2.5	5	Y	3	2	6	Y	2	1.5	3
		2080		5		8		4		4		1		3		2		4		2		3
40	Operations Center	Baseline		3		3		3		3		3		3		3		6		3		6
		2050	Y	4	1	4	Y	3	1	3	Y	2	1	2	Y	3	2	6	Y	2	2	4
		2080		5		5		4		4		1		1		2		4		2		4
41	Municipal Center	Baseline		3		3		3		3		3		3		3		6		3		6
		2050	Y	4	1	4	Y	3	1	3	Y	2	1	2	Y	3	2	6	Y	2	2	4
		2080		5		5		4		4		1		1		2		4		2		4
42	Southridge Emergency Center	Baseline		3		3		3		3		3		3		3		6		3		6
		2050	Y	4	1	4	Y	3	1	3	Y	2	1	2	Y	3	2	6	Y	2	2	4
		2080		5		5		4		4		1		1		2		4		2		4
43	Fire Station	Baseline		3		3		3		3		3		3		3		6		3		6
		2050	Y	4	1	4	Y	3	1	3	Y	2	1	2	Y	3	2	6	Y	2	2	4
		2080		5		5		4		4		1		1		2		4		2		4
44	Operations Shop	Baseline		3		3		3		3		3		3		3		6		3		6
		2050	Y	4	1	4	Y	3	1	3	Y	2	1	2	Y	3	2	6	Y	2	2	4
		2080		5		5		4		4		1		1		2		4		2		4
45	Okotoks Art Gallery	Baseline		3		5		3		5		3		3		3		6		3		11
		2050	Y	4	1.5	6	Y	3	1.5	5	Y	2	1	2	Y	3	2	6	Y	2	3.5	7
		2080		5		8		4		6		1		1		2		4		2		7
46	Rotary Performing Arts Center	Baseline		3		3		3		3		3		3		3		6		3		6
		2050	Y	4	1	4	Y	3	1	3	Y	2	1	2	Y	3	2	6	Y	2	2	4
		2080		5		5		4		4		1		1		2		4		2		4
47	Okotoks Museum & Archives	Baseline		3		3		3		3		3		3		3		6		3		6
		2050	Y	4	1	4	Y	3	1	3	Y	2	1	2	Y	3	2	6	Y	2	2	4
		2080		5		5		4		4		1		1		2		4		2		4
48	Southside Program Building	Baseline		3		5		3		5		3		3		3		5		3		3
		2050	Y	4	1.67	7	Y	3	1.67	5	Y	2	1	2	Y	3	1.5	5	Y	2	1	2
		2080		5		8		4		7		1		1		2		3		2		2
49	Okotoks Public Library (Arts and Learning Center)	Baseline		3		3		3		3		3		3		3		6		3		6
		2050	Y	4	1	4	Y	3	1	3	Y	2	1	2	Y	3	2	6	Y	2	2	4
		2080		5		5		4		4		1		1		2		4		2		4
49	Former Library (7 Riverside)	Baseline		3		3		3		3		3		3		3		6		3		6
		2050	Y	4	1	4	Y	3	1	3	Y	2	1	2	Y	3	2	6	Y	2	2	4
		2080		5		5		4		4		1		1		2		4		2		4
50	Fleet Building	Baseline		3		3		3		3		3		6		3		6		3		6
		2050	Y	4	1	4	Y	3	1	3	Y	2	2	4	Y	3	2	6	Y	2	2	4
		2080		5		5		4		4		1		2		2		4		2		4
51	Okotoks Recreation Center	Baseline		3		5		3		5		3		8		3		6		3		5
		2050	Y	4	1.5	6	Y	3	1.5	5	Y	2	2.5	5	Y	3	2	6	Y	2	1.75	4
		2080		5		8		4		6		1		3		2		4		2		4
52	Footfills Centennial Center	Baseline		3		5		3		3		3		8		3		6		3		5
		2050	Y	4	1.5	6	Y	3	1	3	Y	2	2.5	5	Y	3	2	6	Y	2	1.5	3
		2080		5		8		4		4		1		3		2		4		2		3
53	Pason Centennial Arenas	Baseline		3		5		3		5		3		8		3		6		3		5
		2050	Y	4	1.5	6	Y	3	1.5	5	Y	2	2.5	5	Y	3	2	6	Y	2	1.75	4
		2080		5		8		4		6		1		3		2		4		2		4

Precipitation

			15 min 100-year Rainfall (mm/hr) (Localized Flooding)				24 hour 100-year Rainfall (mm/hr) (River Flooding)				Winter Precipitation (mm) (Snow Accumulation)				Severe Summer Hail Days (% Change Relative to Present) (Hail)				Change in Ice Accumulation (Freezing Rain / Unseasonal Snow)				Relative Change in Standardized Precipitation Evapotranspiration Index-based (Drought)			
Climate Projections (RCP 8.5)		Baseline	122	3			3.8	3			56	3			-	3			0%	3			0.04	3		
		2050	139	4			4.9	4			59	3			+	4			35%	4			-0.06	4		
		2080	164	4			5.6	4			64	4			+	4			58%	5			-0.25	4		
			Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R
Facilities																										
36	Wastewater Treatment Plant (excl. process equipment)	Baseline		3		12		3		15		3		5		3		12		3		6		3		3
		2050	Y	4	4	16	Y	4	5	20	Y	3	1.5	5	Y	4	4	16	Y	4	2	8	Y	4	1	4
		2080		4		16		4		20		4		6		4		16		5		10		4		4
37	Water Treatment Plant (excl. process equipment)	Baseline		3		9		3		15		3		3		3		12		3		6		3		3
		2050	Y	4	3	12	Y	4	5	20	Y	3	1	3	Y	4	4	16	Y	4	2	8	Y	4	1	4
		2080		4		12		4		20		4		4		4		16		5		10		4		4
38	EcoCenter (excl. process equipment)	Baseline		3		6		3		14		3		5		3		6		3		6		3		3
		2050	Y	4	2	8	Y	4	4.67	19	Y	3	1.5	5	Y	4	2	8	Y	4	2	8	Y	4	1	4
		2080		4		8		4		19		4		6		4		8		5		10		4		4
39	Drake Landing Energy Center	Baseline		3		6		3		3		3		3		3		6		3		6		3		3
		2050	Y	4	2	8	Y	4	1	4	Y	3	1	3	Y	4	2	8	Y	4	2	8	Y	4	1	4
		2080		4		8		4		4		4		4		4		8		5		10		4		4
40	Operations Center	Baseline		3		8		3		12		3		3		3		12		3		6		3		3
		2050	Y	4	2.5	10	Y	4	4	16	Y	3	1	3	Y	4	4	16	Y	4	2	8	Y	4	1	4
		2080		4		10		4		16		4		4		4		16		5		10		4		4
41	Municipal Center	Baseline		3		6		3		14		3		3		3		12		3		6		3		3
		2050	Y	4	2	8	Y	4	4.5	18	Y	3	1	3	Y	4	4	16	Y	4	2	8	Y	4	1	4
		2080		4		8		4		18		4		4		4		16		5		10		4		4
42	Southridge Emergency Center	Baseline		3		6		3		6		3		3		3		12		3		6		3		3
		2050	Y	4	2	8	Y	4	2	8	Y	3	1	3	Y	4	4	16	Y	4	2	8	Y	4	1	4
		2080		4		8		4		8		4		4		4		16		5		10		4		4
43	Fire Station	Baseline		3		6		3		6		3		5		3		12		3		6		3		3
		2050	Y	4	2	8	Y	4	2	8	Y	3	1.5	5	Y	4	4	16	Y	4	2	8	Y	4	1	4
		2080		4		8		4		8		4		6		4		16		5		10		4		4
44	Operations Shop	Baseline		3		6		3		12		3		5		3		12		3		6		3		3
		2050	Y	4	2	8	Y	4	4	16	Y	3	1.5	5	Y	4	4	16	Y	4	2	8	Y	4	1	4
		2080		4		8		4		16		4		6		4		16		5		10		4		4
45	Okotoks Art Gallery	Baseline		3		8		3		12		3		3		3		12		3		6		3		3
		2050	Y	4	2.5	10	Y	4	4	16	Y	3	1	3	Y	4	4	16	Y	4	2	8	Y	4	1	4
		2080		4		10		4		16		4		4		4		16		5		10		4		4
46	Rotary Performing Arts Center	Baseline		3		6		3		11		3		9		3		12		3		6		3		3
		2050	Y	4	2	8	Y	4	3.5	14	Y	3	3	9	Y	4	4	16	Y	4	2	8	Y	4	1	4
		2080		4		8		4		14		4		12		4		16		5		10		4		4
47	Okotoks Museum & Archives	Baseline		3		6		3		12		3		3		3		12		3		6		3		3
		2050	Y	4	2	8	Y	4	4	16	Y	3	1	3	Y	4	4	16	Y	4	2	8	Y	4	1	4
		2080		4		8		4		16		4		4		4		16		5		10		4		4
48	Southside Program Building	Baseline		3		4		3		4		3		0		3		11		3		6		3		3
		2050	Y	4	1.33	5	Y	4	1.25	5	Y	3		0	Y	4	3.67	15	Y	4	2	8	Y	4	1	4
		2080		4		5		4		5		4		0		4		15		5		10		4		4
49	Okotoks Public Library (Arts and Learning Center)	Baseline		3		6		3		14		3		0		3		11		3		8		3		3
		2050	Y	4	2	8	Y	4	4.5	18	Y	3		0	Y	4	3.5	14	Y	4	2.5	10	Y	4	1	4
		2080		4		8		4		18		4		0		4		14		5		13		4		4
49	Former Library (7 Riverside)	Baseline		3		6		3		15		3		0		3		12		3		6		3		3
		2050	Y	4	2	8	Y	4	5	20	Y	3		0	Y	4	4	16	Y	4	2	8	Y	4	1	4
		2080		4		8		4		20		4		0		4		16		5		10		4		4
50	Fleet Building	Baseline		3		6		3		12		3		0		3		11		3		6		3		3
		2050	Y	4	2	8	Y	4	4	16	Y	3		0	Y	4	3.5	14	Y	4	2	8	Y	4	1	4
		2080		4		8		4		16		4		0		4		14		5		10		4		4
51	Okotoks Recreation Center	Baseline		3		6		3		8		3		0		3		10		3		8		3		3
		2050	Y	4	2	8	Y	4	2.5	10	Y	3		0	Y	4	3.33	13	Y	4	2.67	11	Y	4	1	4
		2080		4		8		4		10		4		0		4		13		5		13		4		4
52	Footfills Centennial Center	Baseline		3		6		3		6		3		0		3		10		3		6		3		3
		2050	Y	4	2	8	Y	4	2	8	Y	3		0	Y	4	3.33	13	Y	4	2	8	Y	4	1	4
		2080		4		8		4		8		4		0		4		13		5		10		4		4
53	Pason Centennial Arenas	Baseline		3		6		3		7		3		0		3		10		3		6		3		3
		2050	Y	4	2	8	Y	4	2.25	9	Y	3		0	Y	4	3.25	13	Y	4	2	8	Y	4	1	4
		2080		4		8		4		9		4		0		4		13		5		10		4		4

Extreme Events

			Change in Average Annual Area Burned (Wildfire Smoke)				1-in-50 Year Gust Pressures (Heavy Winds)				Lightning (Lightning)				Biodiversity (Insect, invasive plants and disease)			
Climate Projections (RCP 8.5)		Baseline	-	3			0.48	3			-	3			-	3		
		2050	+	4			0.48	3			+	4			+	4		
		2080	++	5			0.48	3			++	5			++	5		
			Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R	Y/N	L	C	R
Facilities																		
36	Wastewater Treatment Plant (excl. process equipment)	Baseline		3		9		3		9		3		9		3		0
		2050	Y	4	3	12	Y	3	3	9	Y	4	3	12	Y	4	0	0
		2080		5		15		3		9		5		15		5		0
37	Water Treatment Plant (excl. process equipment)	Baseline		3		9		3		9		3		3		3		0
		2050	Y	4	3	12	Y	3	3	9	Y	4	1	4	Y	4	0	0
		2080		5		15		3		9		5		5		5		0
38	EcoCenter (excl. process equipment)	Baseline		3		9		3		9		3		9		3		3
		2050	Y	4	3	12	Y	3	3	9	Y	4	3	12	Y	4	1	4
		2080		5		15		3		9		5		15		5		5
39	Drake Landing Energy Center	Baseline		3		0		3		6		3		6		3		0
		2050	N	4	0	0	Y	3	2	6	Y	4	2	8	Y	4	0	0
		2080		5		0		3		6		5		10		5		0
40	Operations Center	Baseline		3		6		3		9		3		11		3		0
		2050	Y	4	2	8	Y	3	3	9	Y	4	3.5	14	Y	4	0	0
		2080		5		10		3		9		5		18		5		0
41	Municipal Center	Baseline		3		6		3		9		3		9		3		0
		2050	Y	4	2	8	Y	3	3	9	Y	4	3	12	Y	4	0	0
		2080		5		10		3		9		5		15		5		0
42	Southridge Emergency Center	Baseline		3		6		3		9		3		9		3		0
		2050	Y	4	2	8	Y	3	3	9	Y	4	3	12	Y	4	0	0
		2080		5		10		3		9		5		15		5		0
43	Fire Station	Baseline		3		6		3		9		3		9		3		0
		2050	Y	4	2	8	Y	3	3	9	Y	4	3	12	Y	4	0	0
		2080		5		10		3		9		5		15		5		0
44	Operations Shop	Baseline		3		6		3		9		3		9		3		0
		2050	Y	4	2	8	Y	3	3	9	Y	4	3	12	Y	4	0	0
		2080		5		10		3		9		5		15		5		0
45	Okotoks Art Gallery	Baseline		3		8		3		9		3		9		3		2
		2050	Y	4	2.5	10	Y	3	3	9	Y	4	3	12	Y	4	0.5	2
		2080		5		13		3		9		5		15		5		3
46	Rotary Performing Arts Center	Baseline		3		6		3		9		3		9		3		0
		2050	Y	4	2	8	Y	3	3	9	Y	4	3	12	Y	4	0	0
		2080		5		10		3		9		5		15		5		0
47	Okotoks Museum & Archives	Baseline		3		8		3		9		3		9		3		2
		2050	Y	4	2.5	10	Y	3	3	9	Y	4	3	12	Y	4	0.5	2
		2080		5		13		3		9		5		15		5		3
48	Southside Program Building	Baseline		3		6		3		7		3		7		3		0
		2050	Y	4	2	8	Y	3	2.33	7	Y	4	2.33	9	Y	4	0	0
		2080		5		10		3		7		5		12		5		0
49	Okotoks Public Library (Arts and Learning Center)	Baseline		3		6		3		9		3		6		3		3
		2050	Y	4	2	8	Y	3	3	9	Y	4	2	8	Y	4	1	4
		2080		5		10		3		9		5		10		5		5
49	Former Library (7 Riverside)	Baseline		3		6		3		9		3		9		3		0
		2050	Y	4	2	8	Y	3	3	9	Y	4	3	12	Y	4	0	0
		2080		5		10		3		9		5		15		5		0
50	Fleet Building	Baseline		3		9		3		9		3		9		3		3
		2050	Y	4	3	12	Y	3	3	9	Y	4	3	12	Y	4	1	4
		2080		5		15		3		9		5		15		5		5
51	Okotoks Recreation Center	Baseline		3		6		3		7		3		7		3		2
		2050	Y	4	2	8	Y	3	2.33	7	Y	4	2.33	9	Y	4	0.5	2
		2080		5		10		3		7		5		12		5		3
52	Footfills Centennial Center	Baseline		3		7		3		7		3		9		3		2
		2050	Y	4	2.25	9	Y	3	2.33	7	Y	4	3	12	Y	4	0.5	2
		2080		5		11		3		7		5		15		5		3
53	Pason Centennial Arenas	Baseline		3		6		3		7		3		7		3		2
		2050	Y	4	2	8	Y	3	2.33	7	Y	4	2.33	9	Y	4	0.5	2
		2080		5		10		3		7		5		12		5		3

APPENDIX C – RISK ASSESSMENT RESULTS BY SERVICE LINE

Specific to the assets in each service line, the results of the risk assessment were aimed to answer the following **two key questions**:

1. ***Which assets are most at risk overall?*** Based on the average total risk scores by asset.
2. ***What are the assets with noteworthy high-risk scores?*** Based on what the highest risk scores are across assets.

The **first key question** illustrates which assets are most at risk from climate hazards overall. These were identified using average risk scores. Risk to the assets from climate hazards are generally lower in the present and that it is not until the 2050s where medium risk scores began to show and increase to high-risk scores in the 2080s as climate change impacts are estimated to become more severe. However, some climate hazards (cold days, number of freeze-thaw events) show a downward trend.

The **second key question** identified other individual asset components of medium, high, or very high-risk scores (over 15) that were noteworthy.

C.1 Water Treatment

The water treatment assets in scope for this assessment are:

Table C-1 In-Scope Water Treatment Assets

Assets	Quantity
GUDI Wells (Water Supply)	13
Water Treatment Plant (process equipment)	1
Treated Water Reservoirs	3
Booster Stations	3
Water Mains	151 km
Hydrants	480
Main valves	2,024

The Town also identified the following potential changes that would affect the Water system:

- Population growth and increased water demand;
- Regional Water Line (Bow River) – construction over next 2 years with commissioning in late 2025;
- Regulatory changes, including:
  - Water Licensing – Challenges with acquiring licenses; 10% holdback on transfers (AEP)
  - WTP Approval Renewal – December 2023
- Asset renewal – aging infrastructure including older/leaking water mains, lifecycle upgrades at WTP, Reservoirs and Booster Stations (5-10 year horizon)
  - Controls Hardware (e.g.: PLC, radio etc.) are becoming obsolete

- Supply Chain Pressures – impact to procurement of critical part/supplies.

The complete risk assessment for the Water system is found at the end of this section. The key questions are addressed here:

1. ***Which assets are the most at risk overall?*** The assets sorted by total risk score out of 25 are listed in **Table C-2**.

Table C-2 Average Climate Risk by Asset: Water Treatment

Assets	Present Day Risk Score	2050s Risk Score	2080s Risk Score
Water Treatment Plant (process equipment)	9	11	12
GUDI Wells (Water Supply)	8	9	10
Treated Water Reservoirs	8	9	10
Booster Stations	8	9	10
Hydrants	4	5	5
Main valves	4	4	5
Water Mains	3	3	4

2. ***What are the assets with high-risk scores that are noteworthy?*** The assets with climate risks that are "Medium", "High", or "Very High" risk by 2080 are listed in **Table C-3**.

Table C-3 Medium, High, or Very High Risks: Water Treatment

Impacted Infrastructure	Risk Score	Climate Hazard(s)	Climate Impacts
GUDI Wells (Water Supply) Raw Water Intake	20	Extreme Heat	• High temperatures can cause power outages. Wels do not currently have backup power • Elevated temperatures can accelerate the evaporation rate, leading to reduced groundwater levels in wells. • Elevated water temperatures can negatively affect the quality and potability of the groundwater
	20	Drought	• Drought can reduce groundwater levels in wells, impacting water supply.
	17	Lightning	• Lightning can damage the power and communications equipment at the wells.
Water Treatment Plant	20	Drought	• Risk that water demand can not be met. • Poor water quality can impact treatment system.

Impacted Infrastructure	Risk Score	Climate Hazard(s)	Climate Impacts
	19	Extreme Heat	• High temperatures can reduce the quality of source water. • Hot weather conditions can affect the efficiency and effectiveness of various treatment processes within water treatment plants • Elevated risk of equipment failure from overheating.
	18	Lightning	• Potentially impact all electrical systems or damage to the sensitive systems. • Damage to infrastructure resulting in temporary shut down until the service is restored. • Financial cost of restoring the infrastructure. • Increased need of emergency services.
	18	River Flooding	• Risk of river flooding interrupting access to water treatment plant • Poor water quality during flood events can impact treatment processes
Booster Stations	16	Drought	• Impact on water quantity and quality which will impact the treatment process. • Water level drops impact the efficiency of pumps or render pumps unusable. • Public would need to observe water conservation policies.
	18	Lightning	• Can cause damage to communications equipment or other electrical systems within booster stations. • Damage to infrastructure resulting in temporary shut down until the service is restored. • Financial cost of restoring the infrastructure

C.2 Wastewater Treatment

The wastewater treatment assets in scope for this assessment are:

Table C-4 In-Scope Wastewater Treatment Assets

Assets	Quantity
Wastewater Collection Mains	134 km
Lift Stations	6
Sanitary Manholes	1,482
Wastewater Treatment Plant	1

The Town also identified the following potential changes that would affect the Wastewater system:

- Population growth and increased wastewater flows: plant capacity may be reached;
- Regulatory
  - WWTP Approval Renewal – 2026 (stricter effluent limits may trigger additional upgrades)
- Asset Renewal – aging infrastructure including older/leaking collection mains, lifecycle upgrades at WWTP and Lift Stations (5-10 year horizon)
  - Controls Hardware (e.g.: PLC, radio etc.) becoming obsolete
- Supply Chain Pressures – impact to procurement of critical part/supplies

The complete risk assessment for the Wastewater system is found at the end of this section. The key questions are addressed here:

3. ***Which assets are the most at risk overall?*** The assets sorted by total risk score out of 25 are listed in **Table C-5**.

Table C-5 Average Climate Risk by Asset: Wastewater

Assets	Present Day Risk Score	2050s Risk Score	2080s Risk Score
Wastewater Treatment Plant	9	10	11
Lift Stations	7	8	9
Sanitary Manholes	6	6	7
Wastewater Collection Mains	4	5	5

4. ***What are the assets with high-risk scores that are noteworthy?*** The assets with climate risks that are “Medium”, “High”, or “Very High” risk by 2080 are listed in **Table C-6**.

Table C-6 Average Climate Risk by Asset: Wastewater

Impacted Infrastructure	Risk Score	Climate Hazard(s)	Climate Impacts
Collection Mains	16	River Flooding	• Risk of back flows into systems. • Potential that effluent can't be discharged. • Cost of service restoration.
Lift Stations	16	Extreme Rainfall	• High intensity rainfall can overwhelm system if there is significant I&I • Potential impact to customers, e.g., sewer backups. • Saturated grounds results in subsidence. • Cost to restore service.
	16	River Flooding	• Inundation impacting functioning of lift stations.
	15	Severe Summer Hail	• Damage to exposed equipment, need for increased O&M.
	15	Lightning	• Lightning strikes impacting electrical & controls infrastructure. • Potential for temporary shut down. • Financial cost to restore system components.
Sanitary Manholes	16	Extreme Rainfall	• Overflows during high intensity rainfall.
Wastewater Treatment Plant	20	River Flooding	• Facility at risk of inundation during high return period floods. • Plant pumping capacity is at risk due to inflow or infiltration into collection system. • Potential for raw WW bypass to Sheep River.
	18	Lightning	• Lightning strikes impacting electrical & controls infrastructure. • Potential for temporary shut down. • Financial cost to restore system components.
	16	Extreme Rainfall	• High intensity rainfall overwhelming system, potential for sewer backups. • Increased accumulation in storage ponds. • Greater water volume to be treated, more peak wet weather flow events.
	15	Severe Summer Hail	• Potential for damage to rooftop equipment

C.3 Stormwater

The stormwater treatment assets in scope for this assessment are:

Table C-7 In-Scope Stormwater Assets

Assets	Quantity
Stormceptors (private, public)	20
Storm Outfalls	14
Catch Basins	2162
Storm Mains	132 km
Wet Ponds	16 (3 private)
Constructed Wetland	1
Dry Ponds	2
Crystal Shores Lake	1
Drainage Ditches (Vegetated)	3
Spring Creek	1
Snow Dump Sites	1

The Town also identified the following potential changes that would affect the Stormwater system:

- Population growth will put added stress on the current system; need for more storm ponds to help treat the storm water before it makes its way back to the Sheep River.
- Land use development: more storm ponds needed and adding more catch basins, storm mains
- Wildlife (Beavers) Dams can cause potential flooding storm creeks and rivers. Muskrats in storm ponds are undermining the banks
- New Infrastructure upgrades and repairs (control structures)
- Dredging of silt from stormponds, maintenance costs, budgeting, increased costs effecting budgets.

The complete risk assessment for the Stormwater system is found at the end of this section. The key questions are addressed here:

5. ***Which assets are the most at risk overall?*** The assets sorted by total risk score out of 25 are listed in **Table C-8**.

Table C-8 Average Climate Risk by Asset: Stormwater

Assets	Present Day Risk Score	2050s Risk Score	2080s Risk Score
Constructed wetland	6	8	9
Catch Basins	6	8	8
Wet Ponds	6	7	8

Assets	Present Day Risk Score	2050s Risk Score	2080s Risk Score
Drainage Ditches (Vegetated)	6	7	7
Storm Outfalls	5	6	7
Crystal Shores Lake	5	6	7
Storm Mains	5	6	7
Spring Creek	5	6	7
Stormceptors (Private and Public)	5	6	7
Dry Ponds	5	6	7
Snow Dump Sites	5	5	5

6. ***What are the assets with high-risk scores that are noteworthy?*** The assets with climate risks that are "Medium", "High", or "Very High" risk by 2080 are listed in **Table C-9**.

Table C-9 Medium, High, or Very High Risks: Stormwater

Impacted Infrastructure	Risk Score	Climate Hazard(s)	Climate Impacts
Stormceptors	15	River Flooding	• More precipitation can result in more runoff, potentially overwhelming stormceptors leading to overflows and pollution of water sources.
Storm Outfalls	18	River Flooding	• River bank erosion & washouts. Limited or impeded access. • Danger to public in close proximity.
Catch Basins	20	Severe Summer Hail	• Blocking of catch basins, resulting in flooding.
	16	Extreme Rainfall	• Overwhelming the capacity of the systems causing overflows, spills, overland flooding, pipe/manholes surcharging and backdoor flooding. • Temporary shut down of services (e.g. roads) and access to facilities or sites.
	16	River Flooding	• Flooding resulting in damage to catch basins.
Storm Mains	16	Localized Flooding	• Pipe diameters and storage volumes may be insufficient to accommodate future events. Main diameters may need to be increased.
Wet Ponds	18	Biodiversity	• Changes in, and decreases to biodiversity will impair water retention and purifying ability of wet ponds, resulting in increased flooding and lower water quality
	16	River Flooding	• Sediments do not settle out properly, more pollution released into stormwater system.

Impacted Infrastructure	Risk Score	Climate Hazard(s)	Climate Impacts
			• Financial cost of restoration.
	16	Drought	• Increased erosion requiring repairs.
Constructed Wetland	20	Biodiversity	• Changes in, and decreases to biodiversity will impair water retention and purifying ability of wetlands, resulting in increased flooding and lower water quality
	16	River Flooding	• Diminished ability to reduce peak flow water level, resulting in increased storm runoff and impacts to wetland ecosystem
	15	Drought	• Permanent wetlands may become seasonal and subject to greater variations in water level.
Dry Ponds	16	Biodiversity	• Increasing heat impacts species growing near pond, coinciding with more invasive species.
	16	River Flooding	• Diminished ability to moderate peak flows of runoff; poorer water quality; more erosion.
Crystal Shores Lake	15	Biodiversity	• Increasing heat impacts species growing near lake, coincides with more invasive species.
Drainage Ditches	17	River Flooding	• Inundated drainage ditches. Floodwaters may damage ditches.
	15	Localized Flooding	• Overflowing ditches as result of high intensity precipitation.
	15	Biodiversity	• Increase in invasive species in or near ditches, especially during droughts or periods of extreme heat.
Spring Creek	19	River Flooding	• Creek overflows prevent nearby outfalls from draining properly.
Snow Dump Sites	16	Snow Accumulation	• Increased snow must be stored at site. There may be capacity concerns.

C.4 Roads

Table C-10 In-Scope Roads Assets

Assets	Quantity
Bridges	14
Roads	165 km
Sidewalks	150 km
Intersections with traffic lights	24
Bike lanes by Darcy Ranch	n/a

The Town also identified the following potential changes that would affect Roads assets:

- Population growth leads to more users of roads or other transportation networks, which leads to less down time to repair worn surfaces
- Supply Chain Pressures – impact to procurement of critical parts/supplies

The complete risk assessment for the Roads system is found at the end of this section. The key questions are addressed here:

7. ***Which assets are the most at risk overall?*** The assets sorted by total risk score out of 25 are listed in **Table C-11**.

Table C-11 Average Climate Risk by Asset: Roads

Assets	Present Day Risk Score	2050s Risk Score	2080s Risk Score
Bridges	5	6	6
Roads	5	6	6
Sidewalks	5	5	5
Intersections with traffic lights	3	3	4
Bike lanes, Darcy Ranch	2	2	3

8. ***What are the assets with high-risk scores that are noteworthy?*** The assets with climate risks that are "Medium", "High", or "Very High" risk by 2080 are listed in **Table C-12**.

Table C-12 Medium, High, or Very High Risks: Roads

Impacted Infrastructure	Risk Score	Climate Hazard(s)	Climate Impacts
Bridges	16	River Flooding	• Erosion near abutments and bridge approach slabs. • Scouring around bridge and piers, damaging bridge. • Damage from flood-borne debris. • Bridges can impede water flow and cause water to back up and flood elsewhere. • Increased repair costs. • Potential for temporary shut down of bridge.
Roads	15	Hail	• Plugged drains from excessive hail, creating local flooding and hazardous driving conditions.

C.5 Parks

The parks assets in scope for this assessment are:

Table C-13 In-Scope Parks Assets

Assets	Quantity
Pathways	94 km
Public trees	15,000
Playgrounds	72
Picnic shelters	6
Toilet buildings (with septic tanks)	15
Racquet courts	2
Sports court	1
Manicured parks	179 ha
Naturalized parks land	326 ha
Sports fields with irrigation	36

The Town also identified the following potential changes that would affect Parks assets:

- Population growth: increased pressures on naturalized areas and environmentally sensitive areas
- Increased use of turf fields and diamonds
- Lack of water for irrigation of turf
- Loss of natural areas due to development
- New introduced invasive species
- Management of invasive species under pressures to move away from pesticide/herbicide use
- Heavy grazing from high population of urban deer (decreased natural forest regeneration)
- More algal blooms in stormponds; need to clean filters in pumps more often

The complete risk assessment for the Parks system is found at the end of this section. The key questions are addressed here:

9. ***Which assets are the most at risk overall?*** The assets sorted by total risk score out of 25 are listed in **Table C-14**.

Table C-14 Average Climate Risk by Asset: Parks

Assets	Present Day Risk Score	2050s Risk Score	2080s Risk Score
Public Trees	8	9	11
Sports Fields with Irrigation	6	8	9
Pathways	6	6	7
Naturalized Parks Lands	4	5	6

Assets	Present Day Risk Score	2050s Risk Score	2080s Risk Score
Manicured Parks	4	5	5
Playgrounds	4	4	5
Racquet Courts	3	4	4
Sports Court	3	3	4
Toilet Buildings (with Septic Tanks)	3	3	3
Picnic Shelters	2	3	3

10. ***What are the assets with high-risk scores that are noteworthy?*** The assets with climate risks that are "Medium", "High", or "Very High" risk by 2080 are listed in **Table C-15**.

Table C-15 Medium, High, or Very High Risks: Parks

Impacted Infrastructure	Risk Score	Climate Hazard(s)	Climate Impacts
Pathways	18	River flooding	• Erosion, pavement breaking up; repairs or renewal. • Pathways may not be usable for weeks or months.
	18	Freezing rain	• Icy pathways, slips and falls (staff and public). • Increased need to salt or sand.
Public Trees	23	Invasive plants, insects	• Tree damage or die-offs resulting in increased replacement and maintenance costs.
	18	Hail	• Tree damage • Greater need for clean-up after hail events, increasing maintenance costs.
	15	Very hot days	• Increased irrigation/water use to sustain trees. • Damaged vegetation. • Increased replacement and maintenance activities.
	16	Drought	• Tree damage or die-offs resulting in increased replacement and maintenance costs.
	15	Freezing rain	• Ice damage to trees, loss of canopy. • More events requiring clearing of downed branches, leading to increased maintenance costs.
Toilet Buildings c/w septic tanks	16	River flooding	• Damage to toilet buildings and septic tanks. • Temporary closure.
Manicured Parks	20	Invasive plants, insects	• Invasive species outcompete native species. • Increase in maintenance required to remove invasive species.
	15	Very hot days	• Increased irrigation/water use to sustain trees. • Damaged vegetation. • Increased replacement and maintenance activities.

Impacted Infrastructure	Risk Score	Climate Hazard(s)	Climate Impacts
Naturalized Parks Lands	17	Invasive plants, insects	• Invasive species outcompete native species. • Increase in maintenance required to remove invasive species.
Sports Fields w/ Irrigation	20	Invasive plants, insects	• Invasive species outcompete native species. • Increase in maintenance required to remove invasive species.
	17	Drought	• Vegetation damage or die-offs resulting in increasing replacement and maintenance activities costs.
	16	Hottest Day	• Increased irrigation/water use to sustain trees. • Damaged vegetation. • Increased replacement and maintenance activities.
	16	River Flooding	• Saturated surfaces that must be temporarily closed to public use. • Damage to turf requiring replacement and additional maintenance costs.
	15	Very hot days	• Increased irrigation/water use to sustain trees. • Damaged vegetation. • Increased replacement and maintenance activities.
	15	Freezing Rain	• Slippery surfaces leading to slips and falls (staff and public). • Damage to sports field surface, resulting in temporary closure of field.

C.6 Waste

The waste assets in scope for this assessment are:

Table C-16 In-Scope Waste Assets

Assets	Quantity
EcoCentre	1
Waste Fleet	n/a

The Town also identified the following potential changes that would affect Waste assets:

- Population growth: EcoCentre capacity may be reached;
- New legislation targeting improved waste diversion could alter current practices.

The complete risk assessment for the Waste system is found at the end of this section. The key questions are addressed here:

11. ***Which assets are the most at risk overall?*** The assets sorted by total risk score out of 25 are listed in **Table C-17**.

Table C-17 Average Climate Risk by Asset: Waste

Assets	Present Day Risk Score	2050s Risk Score	2080s Risk Score
Waste Fleet	5	5	6
EcoCentre	2	3	3

12. ***What are the assets with high-risk scores that are noteworthy?*** The assets with climate risks that are "Medium", "High", or "Very High" risk by 2080 are listed in **Table C-18**.

Table C-18 Medium, High, or Very High Risks: Waste

Impacted Infrastructure	Risk Score	Climate Hazard(s)	Climate Impacts
Waste Fleet	15	Very Hot Days	• Conditions may be too hot for operators to work • Waste collection vehicles are at risk of overheating

APPENDIX D – FACILITIES RISK ASSESSMENT REPORT CARDS

Report cards are organized by facility name in alphabetical order:

Facility	Risk Rank
Drake Landing Energy Centre	11
EcoCentre (excl. process equipment)	13
Fire Station	4
Fleet Building	9
Foothills Centennial Centre	15
Former Library (7 Riverside)	12
Municipal Centre	18
Okotoks Art Gallery	14
Okotoks Museum & Archives	17
Okotoks Public Library (Arts and Learning Centre)	10
Okotoks Recreation Centre	3
Operations Centre	2
Operations Shop	8
Pason Centennial Arenas	7
Rotary Performing Arts Centre	16
Southridge Emergency Centre	5
Southside Program Building	19
Water Treatment Plant (excl. process equipment)	6
Wastewater Treatment Plant (excl. process equipment)	1

Drake Landing Energy Center

15 Drake Landing Common

Facility Description:

Drake Landing has successfully integrated Canadian energy efficient technologies with a renewable energy source - the sun.

River Flood Return:	Water Depth (cm)
50-Year	N/A
100-Year	N/A
200-Year	N/A
350-Year	N/A
Risk Ranking:	11

Facility Vulnerability by Hazard:

Extreme Heat	Low Temps
Freeze-Thaw	Local Flooding
Heavy Snowfall	River Flooding
Hail	Lightning
High Winds	Wildfire Smoke
Drought	Biodiversity

High Vuln, Medium Vuln, Low Vuln
Based on Survey Results

Rank out of 19 facilities -
Lower ranks are higher risk

Top Risk Mitigation Actions:

Top Risks	Risk Score	Top 5 Risk Mitigation Actions	Cost	Timeframe
High Temperatures (Days above 30 C) - HVAC	**40**	- Invest in portable or permanent backup power generators for HVAC system operability during power outages.	**$250,000**	2030-2033
Lightning - General	**40**	- Fully or partially remove any protruding metal objects that may attract lightning strikes. - Install lightning rods or surge arresters to provide protection against lightning strikes.	**$15,000**	Immediate
High Temperatures (Days above 30 C) - Power and Communications	**40**	- Upgrade facility backup power systems to ensure critical systems can remain operational during power outages on backup power generators.	**$250,000**	2030-2033

Risk Score out of 100
(100 is highest)

All High and Medium Risk Mitigation Actions:

HVAC	Risk Score	Category	Cost	Timeframe
- Invest in portable or permanent backup power generators for HVAC system operability during power outages.	**40**	Retrofit	**$250,000**	2030-2033
Power and Communications	**Risk Score**	**Category**	**Cost**	**Timeframe**
- Upgrade facility backup power systems to ensure critical systems can remain operational during power outages on backup power generators.	**40**	Retrofit	**$250,000**	2030-2033
- Fully or partially remove any protruding metal objects that may attract lightning strikes. - Install lightning rods or surge arresters to provide protection against lightning strikes.	**40**	Retrofit	**$15,000**	Immediate

EcoCenter

400, 1118 North Railway Street

Facility Description:

The Eco Center is a self-sorting, drop-off facility where the residents can take items to be recycled.

River Flood Return:	Water Depth (cm)
50-Year	45.9
100-Year	126.6
200-Year	214.3
350-Year	287.4
Risk Ranking:	13

Facility Vulnerability by Hazard:

Extreme Heat	Low Temps
Freeze-Thaw	Local Flooding
Heavy Snowfall	River Flooding
Hail	Lightning
High Winds	Wildfire Smoke
Drought	Biodiversity

High Vuln, Medium Vuln, Low Vuln
Based on Survey Results

Rank out of 19 facilities -
Lower ranks are higher risk

Top Risk Mitigation Actions:

Top Risks	Risk Score	Top Risk Mitigation Actions	Cost	Timeframe
High Temperatures (Days above 30 C) - General	**20**	- Consider providing protective wear for a safe working environment during high temperatures.	**$9,000**	Low Risk, Lower Priority
High Temperatures (Days above 30 C) - Power and Communications	**20**	- Install a new connection for temporary backup power that is easily accessible and not prone to water pooling.	**$65,000**	Low Risk, Lower Priority
Lightning - General	**20**	- Fully or partially remove any protruding metal objects that may attract lightning strikes. - Install lightning rods or surge arresters to provide protection against lightning strikes.	**$15,000**	Immediate

Risk Score out of 100
(100 is highest)

Fire Station

132 Milligan Drive

Facility Description:

Okotoks Fire & Rescue is staffed by 32 full time firefighters and up to 20 Community Firefighters.

River Flood Return:	Water Depth (cm)
50-Year	N/A
100-Year	N/A
200-Year	N/A
350-Year	N/A
Risk Ranking:	4

Facility Vulnerability by Hazard:

Extreme Heat	Low Temps
Freeze-Thaw	Local Flooding
Heavy Snowfall	River Flooding
Hail	Lightning
High Winds	Wildfire Smoke
Drought	Biodiversity

High Vuln, Medium Vuln, Low Vuln
Based on Survey Results

Rank out of 19 facilities -
Lower ranks are higher risk

Top Risk Mitigation Actions:

Top Risks	Risk Score	Top 5 Risk Mitigation Actions	Cost	Timeframe
Heavy Snowfall - Structural	**48**	-Evaluate adequacy of roof to meet snow-load capacity	**$5,000**	2026-2029
Heavy Snowfall - HVAC	**48**	- Install protective cages or guards on the HVAC system's intake and exhaust vents to prevent snow blockage. - Implement a snow clearing process during snow events to maintain proper airflow.	**$4,000**	Future/ Further Consideration
Hail - Structural	**40**	- Utilize a hail guard roof system or install hail-resistant solar panels to mitigate the risk of hail damage to the roof. - Have operations staff regularly unclog gutters and roof drainage to ensure quick removal of hail.	**$100,000**	2030-2033
Hail - Exterior Envelopes	**40**	- Install hail-resistant covers or grates over existing skylights, vents, or chimneys to provide protection from hail damage.	**$7,500**	2030-2033
High Temperatures - Site Grading, Landscaping, and Features	**40**	- Plant trees along the south and west side of the building for natural shade and to reduce heat absorption and cooling losses.	**$15,000**	2026-2029

Risk Score out of 100
(100 is highest)

All High and Medium Risk Mitigation Actions:

Exterior Envelope	Risk Score	Category	Cost	Timeframe
- Install hail-resistant covers or grates over existing skylights, vents, or chimneys to provide protection from hail damage.	**40**	Retrofit	**$7,500**	2030-2033
HVAC	**Risk Score**	**Category**	**Cost**	**Timeframe**
- Install protective cages or guards on the HVAC system's intake and exhaust vents to prevent snow blockage. - Implement a snow clearing process during snow events to maintain proper airflow.	**48**	Retrofit and Operations	**$4,000**	Future/ Further Consideration
- Utilize hail-resistant covers or hail-resistant solar panels to protect rooftop or outdoor mounted HVAC units from hail damage.	**40**	Retrofit	**$15,000**	2030-2033
Site Grading, Landscaping, and Features	**Risk Score**	**Category**	**Cost**	**Timeframe**
- Plant trees along the south and west side of the building for natural shade and to reduce heat absorption and cooling losses.	**40**	Retrofit	**$15,000**	2026-2029
- Install a drip irrigation system that operates on a timer to reduce water waste and optimize water usage.	**37**	Retrofit	**$45,000**	2030-2033
- Incorporate native plant species in the facility's landscaping that are adapted to the dry climate and require minimal or no additional irrigation.	**37**	Retrofit	**$15,000**	2026-2029
Power and Communications	**Risk Score**	**Category**	**Cost**	**Timeframe**
- Consider deploying temporary protection barriers to shield vulnerable equipment during forecasted hail events. - Ensure availability of spares or backup communication equipment. - Confirm the operability of alternative equipment before the hail event.	**40**	Retrofit and Operations	**$25,000**	2030-2033

Structural	Risk Score	Category	Cost	Timeframe
-Evaluate adequacy of roof to meet snow-load capacity	**48**	Study	**$5,000**	2026-2029
- Utilize a hail guard roof system or install hail-resistant solar panels to mitigate the risk of hail damage to the roof. - Have operations staff regularly unclog gutters and roof drainage to ensure quick removal of hail.	**40**	Retrofit and Operations	**$100,000**	2030-2033

Fleet Building

300, 1118 North Railway Street

Facility Description:

The new Operations Center houses the Infrastructure and Operations branch, as well as fleet management.

River Flood Return:	Water Depth (cm)
50-Year	111.8
100-Year	192.9
200-Year	280.9
350-Year	354.1
Risk Ranking:	9

Facility Vulnerability by Hazard:

Extreme Heat	Low Temps
Freeze-Thaw	Local Flooding
Heavy Snowfall	River Flooding
Hail	Lightning
High Winds	Wildfire Smoke
Drought	Biodiversity

High Vuln, Medium Vuln, Low Vuln
Based on Survey Results

Rank out of 19 facilities -
Lower ranks are higher risk

Top Risk Mitigation Actions:

Top Risks	Risk Score	Top Risk Mitigation Actions	Cost	Timeframe
Heavy Snowfall - Structural	**32**	-Evaluate adequacy of roof to meet snow-load capacity	**$5,000**	2026-2029

Risk Score out of 100
(100 is highest)

Foothills Centennial Center

#4, 204 Community Way

Facility Description:

The Foothills Centennial Center is a multi-purpose event venue.

River Flood Return:	Water Depth (cm)
50-Year	N/A
100-Year	N/A
200-Year	N/A
350-Year	N/A
Risk Ranking:	15

Facility Vulnerability by Hazard:

Extreme Heat	Low Temps
Freeze-Thaw	Local Flooding
Heavy Snowfall	River Flooding
Hail	Lightning
High Winds	Wildfire Smoke
Drought	Biodiversity

High Vuln, Medium Vuln, Low Vuln
Based on Survey Results

Rank out of 19 facilities -
Lower ranks are higher risk

Top Risk Mitigation Actions:

Top Risks	Risk Score	Top Risk Mitigation Actions	Cost	Timeframe
Lightning - General	**20**	- Fully or partially remove any protruding metal objects that may attract lightning strikes. - Install lightning rods or surge arresters to provide protection against lightning strikes.	**$15,000**	Low Risk, Lower Priority
Heavy Snowfall - Structural	**16**	-Evaluate adequacy of roof to meet snow-load capacity	**$5,000**	Low Risk, Lower Priority
Heavy Snowfall - Exterior Envelope	**16**	- Repair any existing leaks in the roof to prevent water - Regularly inspect the roof for signs of new leaks caused by snow accumulation.	**$3,500**	Low Risk, Lower Priority

Risk Score out of 100
(100 is highest)

Former Library (7 Riverside)

#101-311, 7 Riverside Drive West

Facility Description:

This was the site of the Public Library from 1990 to 2021.

River Flood Return:	Water Depth (cm)
50-Year	10.3
100-Year	34.9
200-Year	68.5
350-Year	79.1
Risk Ranking:	12

Facility Vulnerability by Hazard:

Extreme Heat	Low Temps
Freeze-Thaw	Local Flooding
Heavy Snowfall	River Flooding
Hail	Lightning
High Winds	Wildfire Smoke
Drought	Biodiversity

High Vuln, Medium Vuln, Low Vuln
Based on Survey Results

Rank out of 19 facilities -
Lower ranks are higher risk

Top Risk Mitigation Actions:

Top Risks	Risk Score	Top Risk Mitigation Actions	Cost	Timeframe
Heavy Snowfall - Structural	**16**	-Evaluate adequacy of roof to meet snow-load capacity	**$5,000**	Low Risk, Lower Priority
Heavy Snowfall - HVAC	**16**	- Install protective cages or guards on the HVAC system's intake and exhaust vents to prevent snow blockage. - Implement a snow clearing process during snow events to maintain proper airflow.	**$4,000**	Low Risk, Lower Priority
River Flooding - General	**14**	- Have emergency flood protection measures stored on-site or nearby, such as sandbags, water tubes, or stop logs.	**$16,000**	Low Risk, Lower Priority

Risk Score out of 100
(100 is highest)

Municipal Center

5 Elizabeth Street

Facility Description:

The Municipal Center is Okotoks' City Hall.

River Flood Return:	Water Depth (cm)
50-Year	30.0
100-Year	74.6
200-Year	79.0
350-Year	103.4
Risk Ranking:	18

Facility Vulnerability by Hazard:

Extreme Heat	Low Temps
Freeze-Thaw	Local Flooding
Heavy Snowfall	River Flooding
Hail	Lightning
High Winds	Wildfire Smoke
Drought	Biodiversity

High Vuln, Medium Vuln, Low Vuln
Based on Survey Results

Rank out of 19 facilities -
Lower ranks are higher risk

Top Risk Mitigation Actions:

Top Risks	Risk Score	Top Risk Mitigation Actions	Cost	Timeframe
Heavy Snowfall - Structural	**16**	-Evaluate adequacy of roof to meet snow-load capacity	**$5,000**	Low Risk, Lower Priority
Heavy Snowfall - Landscaping and Grading	**16**	- Trim branches or foliage near or overhanging the facility that may be susceptible to breakage or bending due to the weight of accumulated snow.	**$5,000**	Low Risk, Lower Priority
High Winds - Power and Communications	**12**	- Anchor rooftop electrical or communications devices securely to prevent them from becoming airborne during high winds.	**$10,000**	Low Risk, Lower Priority

Risk Score out of 100
(100 is highest)

Okotoks Art Gallery

53 North Railway Street

Facility Description:

The Okotoks Art Gallery includes two gallery spaces for exhibitions, a gift shop, and serves as the Visitor Information Center.

River Flood Return:	Water Depth (cm)
50-Year	N/A
100-Year	39.3
200-Year	47.8
350-Year	69.5
Risk Ranking:	14

Facility Vulnerability by Hazard:

Extreme Heat	Low Temps
Freeze-Thaw	Local Flooding
Heavy Snowfall	River Flooding
Hail	Lightning
High Winds	Wildfire Smoke
Drought	Biodiversity

High Vuln, Medium Vuln, Low Vuln
Based on Survey Results

Rank out of 19 facilities -
Lower ranks are higher risk

Top Risk Mitigation Actions:

Top Risks	Risk Score	Top Risk Mitigation Actions	Cost	Timeframe
High Temperatures (Days above 30 C) - General	**20**	- Consider providing employees with air-conditioned workspaces and break rooms. - Consider providing protective wear for a safe working environment during high temperatures.	**$9,000**	Low Risk, Lower Priority
High Temperatures (Days above 30 C) - Power and Communications	**20**	- Install a new connection for temporary backup power that is easily accessible and not prone to water pooling. - Retrofit the connection to be elevated or protected, if possible.	**$65,000**	Low Risk, Lower Priority
Lightning - General	**20**	- Fully or partially remove any protruding metal objects that may attract lightning strikes. - Install lightning rods or surge arresters to provide protection against lightning strikes.	**$15,000**	Immediate

Risk Score out of 100
(100 is highest)

Okotoks Museum & Archives

49 North Railway Street

Facility Description:

The Okotoks Museum and Archives is devoted to preserving artifacts and archival resources.

River Flood Return:	Water Depth (cm)
50-Year	N/A
100-Year	25.5
200-Year	33.3
350-Year	45.1
Risk Ranking:	17

Facility Vulnerability by Hazard:

Extreme Heat	Low Temps
Freeze-Thaw	Local Flooding
Heavy Snowfall	River Flooding
Hail	Lightning
High Winds	Wildfire Smoke
Drought	Biodiversity

High Vuln, Medium Vuln, Low Vuln
Based on Survey Results

Rank out of 19 facilities -
Lower ranks are higher risk

Top Risk Mitigation Actions:

Top Risks	Risk Score	Top Risk Mitigation Actions	Cost	Timeframe
High Temperatures (Days above 30 C) - General	**20**	- Consider providing employees with air-conditioned workspaces and break rooms. - Consider providing protective wear for a safe working environment during high temperatures.	**$9,000**	Low Risk, Lower Priority
High Temperatures (Days above 30 C) - Power and Communications	**20**	- Install a new connection for temporary backup power that is easily accessible and not prone to water pooling. - Retrofit the connection to be elevated or protected, if possible.	**$65,000**	Low Risk, Lower Priority
Lightning - General	**20**	- Fully or partially remove any protruding metal objects that may attract lightning strikes. - Install lightning rods or surge arresters to provide protection against lightning strikes.	**$15,000**	Immediate

Risk Score out of 100
(100 is highest)

Okotoks Public Library (Arts and Learning Center)

23 Riverside Drive West

Facility Description:

The Public Library offers visitor/information services, internet access, and access to 3 million items.

River Flood Return:	Water Depth (cm)
50-Year	39.7
100-Year	76.3
200-Year	113.8
350-Year	134.0
Risk Ranking:	10

Facility Vulnerability by Hazard:

Extreme Heat	Low Temps
Freeze-Thaw	Local Flooding
Heavy Snowfall	River Flooding
Hail	Lightning
High Winds	Wildfire Smoke
Drought	Biodiversity

High Vuln, Medium Vuln, Low Vuln
Based on Survey Results

Rank out of 19 facilities -
Lower ranks are higher risk

Top Risk Mitigation Actions:

Top Risks	Risk Score	Top Risk Mitigation Actions	Cost	Timeframe
Lightning - General	**20**	- Fully or partially remove any protruding metal objects that may attract lightning strikes. - Install lightning rods or surge arresters to provide protection against lightning strikes.	**$15,000**	Low Risk, Lower Priority
High Temperatures (Days above 30 C) - HVAC	**16**	- Invest in portable or permanent backup power generators for HVAC system operability during power outages.	**$750,000**	Low Risk, Lower Priority

Risk Score out of 100
(100 is highest)

Okotoks Recreation Center

99 Okotoks Drive

Facility Description:

The Recreation Center is home to indoor pools, fitness studio, ice arenas, curling rink, a child-minding service, and youth center.

River Flood Return:	Water Depth (cm)
50-Year	N/A
100-Year	N/A
200-Year	N/A
350-Year	N/A
Risk Ranking:	3

Facility Vulnerability by Hazard:

Extreme Heat	Low Temps
Freeze-Thaw	Local Flooding
Heavy Snowfall	River Flooding
Hail	Lightning
High Winds	Wildfire Smoke
Drought	Biodiversity

High Vuln, Medium Vuln, Low Vuln
Based on Survey Results

Rank out of 19 facilities -
Lower ranks are higher risk

Top Risk Mitigation Actions:

Top Risks	Risk Score	Top 5 Risk Mitigation Actions	Cost	Timeframe
Lightning - General	**60**	- Fully or partially remove any protruding metal objects that may attract lightning strikes. - Install lightning rods or surge arresters to provide protection against lightning strikes.	**$15,000**	Immediate
Heavy Snowfall - Structural	**48**	-Evaluate adequacy of roof to meet snow-load capacity	**$5,000**	2026-2029
Heavy Snowfall - Exterior Envelope	**48**	- Repair any existing leaks in the roof to prevent water - Regularly inspect the roof for signs of new leaks caused by snow accumulation.	**$3,500**	Future/ Further Consideration
Hail - Structural	**40**	- When replacing roof, utilize a hail guard roof system or install hail-resistant solar panels to mitigate the risk of hail damage to the roof. - Have operations staff regularly unclog gutters and roof drainage to ensure quick removal of hail.	**$500,000**	2030-2033
High Temperatures - Site Grading, Landscaping, and Features	**40**	- Plant trees along the south and west side of the building for natural shade and to reduce heat absorption and cooling losses.	**$15,000**	2026-2029

Risk Score out of 100
(100 is highest)

All High and Medium Risk Mitigation Actions:

Exterior Envelope	Risk Score	Category	Cost	Timeframe
- Repair any existing leaks in the roof to prevent water - Regularly inspect the roof for signs of new leaks caused by snow accumulation.	**48**	Retrofit and Operations	**$3,500**	Future/ Further Consideration
- Repair any existing leaks in the roof to prevent water infiltration caused by hail damage.	**40**	Retrofit	**$10,000**	Low Risk, Lower Priority
- Inspect the roof and surrounding areas for water leakage signs and repair affected areas.	**32**	Retrofit	**$3,500**	2026-2029
- Inspect eavestroughs for damage or blockages. - Ensure all downspouts are pointed away from the building and located 1m or more away.	**32**	Retrofit	**$1,000**	Low Risk, Lower Priority
HVAC	**Risk Score**	**Category**	**Cost**	**Timeframe**
- Utilize hail-resistant covers or hail-resistant solar panels to protect rooftop or outdoor mounted HVAC units from hail damage.	**40**	Retrofit	**$15,000**	2030-2033
Site Grading, Landscaping, and Features	**Risk Score**	**Category**	**Cost**	**Timeframe**
- Plant trees along the south and west side of the building for natural shade and to reduce heat absorption and cooling losses.	**40**	Retrofit	**$15,000**	2026-2029
- Fill or raise low spots or traps located in the roadways adjacent to the building. - Inspect roads adjacent to the building for water pooling and ensure proper maintenance and grading for drainage.	**32**	Retrofit	**$20,000**	2026-2029
Openings (Windows & Doors)	**Risk Score**	**Category**	**Cost**	**Timeframe**
- Inspect the building and surrounding areas for water pooling or accumulation, and regularly clean out and clear those areas.	**32**	Retrofit	**$10,000**	2026-2029

Power and Communications	Risk Score	Category	Cost	Timeframe
- Fully or partially remove any protruding metal objects that may attract lightning strikes. - Install lightning rods or surge arresters to provide protection against lightning strikes.	**60**	Retrofit	**$15,000**	Immediate
- Ensure the connection for temporary backup power is easily accessible and not prone to water pooling. - Retrofit the connection to be elevated or protected, if possible.	**40**	Retrofit	**$65,000**	2026-2029
Structural	**Risk Score**	**Category**	**Cost**	**Timeframe**
-Evaluate adequacy of roof to meet snow-load capacity	**48**	Study	**$5,000**	2026-2029
- When replacing roof, utilize a hail guard roof system or install hail-resistant solar panels to mitigate the risk of hail damage to the roof. - Have operations staff regularly unclog gutters and roof drainage to ensure quick removal of hail.	**40**	Retrofit and Operations	**$500,000**	2030-2033

Operations Center

100, 1118 North Railway Street

Facility Description:

The new Operations Center opened in October and houses the Infrastructure and Operations branch.

River Flood Return:	Water Depth (cm)
50-Year	N/A
100-Year	45.0
200-Year	134.3
350-Year	208.0
Risk Ranking:	2

Facility Vulnerability by Hazard:

Extreme Heat	Low Temps
Freeze-Thaw	Local Flooding
Heavy Snowfall	River Flooding
Hail	Lightning
High Winds	Wildfire Smoke
Drought	Biodiversity

High Vuln, Medium Vuln, Low Vuln
Based on Survey Results

Rank out of 19 facilities -
Lower ranks are higher risk

Top Risk Mitigation Actions:

Top Risks	Risk Score	Top 5 Risk Mitigation Actions	Cost	Timeframe
Lightning - General	**60**	- Fully or partially remove any protruding metal objects that may attract lightning strikes. - Install lightning rods or surge arresters to provide protection against lightning strikes.	**$15,000**	Immediate
Heavy Snowfall - Structural	**48**	-Evaluate adequacy of roof to meet snow-load capacity	**$5,000**	2026-2029
Heavy Snowfall - HVAC	**48**	- Install protective cages or guards on the HVAC system's intake and exhaust vents to prevent snow blockage. - Implement a snow clearing process during snow events to maintain proper airflow.	**$4,000**	Future/ Further Consideration
High Temperatures - Site Grading, Landscaping, and Features	**30**	- Plant trees along the south side of the building for natural shade and to reduce heat absorption and cooling losses.	**$15,000**	2026-2029

Risk Score out of 100
(100 is highest)

All High and Medium Risk Mitigation Actions:

HVAC	Risk Score	Category	Cost	Timeframe
- Install protective cages or guards on the HVAC system's intake and exhaust vents to prevent snow blockage. - Implement a snow clearing process during snow events to maintain proper airflow.	**48**	Retrofit and Operations	**$4,000**	Future/ Further Consideration
Site Grading, Landscaping, and Features	**Risk Score**	**Category**	**Cost**	**Timeframe**
- Plant trees along the south side of the building for natural shade and to reduce heat absorption and cooling losses.	**30**	Retrofit	**$15,000**	2026-2029
Power and Communications	**Risk Score**	**Category**	**Cost**	**Timeframe**
- Fully or partially remove any protruding metal objects that may attract lightning strikes. - Install lightning rods or surge arresters to provide protection against lightning strikes.	**60**	Retrofit	**$15,000**	Immediate
Structural	**Risk Score**	**Category**	**Cost**	**Timeframe**
-Evaluate adequacy of roof to meet snow-load capacity	**48**	Study	**$5,000**	2026-2029

Operations Shop

600, 1118 North Railway Street

Facility Description:

The new Operations Center opened in October and houses the Infrastructure and Operations branch.

River Flood Return:	Water Depth (cm)
50-Year	N/A
100-Year	34.7
200-Year	121.1
350-Year	193.6
Risk Ranking:	8

Facility Vulnerability by Hazard:

Extreme Heat	Low Temps
Freeze-Thaw	Local Flooding
Heavy Snowfall	River Flooding
Hail	Lightning
High Winds	Wildfire Smoke
Drought	Biodiversity

High Vuln, Medium Vuln, Low Vuln
Based on Survey Results

Rank out of 19 facilities -
Lower ranks are higher risk

Top Risk Mitigation Actions:

Top Risks	Risk Score	Top 5 Risk Mitigation Actions	Cost	Timeframe
Heavy Snowfall - HVAC	**32**	- Install protective cages or guards on the HVAC system's intake and exhaust vents to prevent snow blockage. - Implement a snow clearing process during snow events to maintain proper airflow.	**$4,000**	Future/ Further Consideration
Heavy Snowfall - Structural	**32**	-Evaluate adequacy of roof to meet snow-load capacity	**$5,000**	2026-2029
High Temperatures (Days above 30 C) - Power and Communications	**27**	- Invest in a permanent backup power generator to ensure HVAC system operability during power outages.	**$250,000**	Future/ Further Consideration
High Temperatures (Days above 30 C) - Power and Communications	**27**	- Ensure the connection for temporary backup power is easily accessible and not prone to water pooling. - Retrofit the connection to be elevated or protected, if possible.	**$65,000**	Future/ Further Consideration

Risk Score out of 100
(100 is highest)

All High and Medium Risk Mitigation Actions:

HVAC	Risk Score	Category	Cost	Timeframe
- Install protective cages or guards on the HVAC system's intake and exhaust vents to prevent snow blockage. - Implement a snow clearing process during snow events to maintain proper airflow.	**32**	Retrofit and Operations	**$4,000**	Future/ Further Consideration
Power and Communications	**Risk Score**	**Category**	**Cost**	**Timeframe**
- Invest in a permanent backup power generator to ensure HVAC system operability during power outages.	**27**	Retrofit	**$250,000**	Future/ Further Consideration
- Ensure the connection for temporary backup power is easily accessible and not prone to water pooling. - Retrofit the connection to be elevated or protected, if possible.	**27**	Retrofit	**$65,000**	Future/ Further Consideration
Structural	**Risk Score**	**Category**	**Cost**	**Timeframe**
-Evaluate adequacy of roof to meet snow-load capacity	**32**	Study	**$5,000**	2026-2029

Pason Centennial Arenas

#3, 204 Community Way

Facility Description:

Centennial Arenas is a year-round multi-use facility that includes 2 NHL-sized ice arenas - the Green Arena and the Gold Arena.

River Flood Return:	Water Depth (cm)
50-Year	N/A
100-Year	N/A
200-Year	N/A
350-Year	N/A
Risk Ranking:	7

Facility Vulnerability by Hazard:

Extreme Heat	Low Temps
Freeze-Thaw	Local Flooding
Heavy Snowfall	River Flooding
Hail	Lightning
High Winds	Wildfire Smoke
Drought	Biodiversity

High Vuln, Medium Vuln, Low Vuln
Based on Survey Results

Rank out of 19 facilities -
Lower ranks are higher risk

Top Risk Mitigation Actions:

Top Risks	Risk Score	Top 5 Risk Mitigation Actions	Cost	Timeframe
Heavy Snowfall - Structural	**48**	-Evaluate adequacy of roof to meet snow-load capacity	**$5,000**	2026-2029
Heavy Snowfall - Exterior Envelope	**48**	- Repair any existing leaks in the roof to prevent water - Regularly inspect the roof for signs of new leaks caused by snow accumulation.	**$3,500**	Future/ Further Consideration
High Temperatures (Days above 30 C) - Power and Communications	**40**	- Ensure the connection for temporary backup power is easily accessible and not prone to water pooling. - Retrofit the connection to be elevated or protected, if possible.	**$65,000**	2026-2029
High Temperatures (Days above 30 C) - Exterior Envelope	**40**	- Install shading devices like awnings or canopies to block direct sunlight from hitting the building's exterior.	**$120,000**	2026-2029
Hail - Structural	**40**	- When replacing roof, utilize a hail guard roof system or install hail-resistant solar panels to mitigate the risk of hail damage to the roof. - Have operations staff regularly unclog gutters and roof drainage to ensure quick removal of hail.	**$820,000**	2030-2033

Risk Score out of 100
(100 is highest)

All High and Medium Risk Mitigation Actions:

Exterior Envelope	Risk Score	Category	Cost	Timeframe
- Repair any existing leaks in the roof to prevent water - Regularly inspect the roof for signs of new leaks caused by snow accumulation.	**48**	Retrofit and Operations	**$3,500**	Future/ Further Consideration
- Install shading devices like awnings or canopies to block direct sunlight from hitting the building's exterior.	**40**	Retrofit	**$120,000**	2026-2029
- Paint roofs white or apply a reflective coating to reduce heat absorption.	**40**	Retrofit	**$25,000**	2030-2033
- Repair any existing leaks in the roof to prevent water infiltration caused by hail damage.	**40**	Retrofit	**$10,000**	Low Risk, Lower Priority
HVAC	**Risk Score**	**Category**	**Cost**	**Timeframe**
- Utilize hail-resistant covers or hail-resistant solar panels to protect rooftop or outdoor mounted HVAC units from hail damage.	**40**	Retrofit	**$15,000**	2030-2033
Site Grading, Landscaping, and Features	**Risk Score**	**Category**	**Cost**	**Timeframe**
- Plant trees along the south and west side of the building for natural shade and to reduce heat absorption and cooling losses.	**40**	Retrofit	**$15,000**	2026-2029
Power and Communications	**Risk Score**	**Category**	**Cost**	**Timeframe**
- Ensure the connection for temporary backup power is easily accessible and not prone to water pooling. - Retrofit the connection to be elevated or protected, if possible.	**40**	Retrofit	**$65,000**	2026-2029

Structural	Risk Score	Category	Cost	Timeframe
-Evaluate adequacy of roof to meet snow-load capacity	**48**	Study	**$5,000**	2026-2029
- When replacing roof, utilize a hail guard roof system or install hail-resistant solar panels to mitigate the risk of hail damage to the roof. - Have operations staff regularly unclog gutters and roof drainage to ensure quick removal of hail.	**40**	Retrofit and Operations	**$820,000**	2030-2033

Rotary Performing Arts Center

3 Elma Street East

Facility Description:

The Rotary Performing Arts Center hosts a variety of concerts, comedic acts, play, and entertainment throughout the year.

River Flood Return:	Water Depth (cm)
50-Year	N/A
100-Year	N/A
200-Year	N/A
350-Year	N/A
Risk Ranking:	16

Facility Vulnerability by Hazard:

Extreme Heat	Low Temps
Freeze-Thaw	Local Flooding
Heavy Snowfall	River Flooding
Hail	Lightning
High Winds	Wildfire Smoke
Drought	Biodiversity

High Vuln, Medium Vuln, Low Vuln
Based on Survey Results

Rank out of 19 facilities -
Lower ranks are higher risk

Top Risk Mitigation Actions:

Top Risks	Risk Score	Top Risk Mitigation Actions	Cost	Timeframe
High Temperatures (Days above 30 C) - General	**20**	- Consider providing employees with air-conditioned workspaces and break rooms. - Consider providing protective wear for a safe working environment during high temperatures.	**$9,000**	Low Risk, Lower Priority
High Temperatures (Days above 30 C) - Power and Communications	**20**	- Ensure the connection for temporary backup power is easily accessible and not prone to water pooling. - Retrofit the connection to be elevated or protected, if possible.	**$65,000**	Low Risk, Lower Priority
Lightning - General	**20**	- Fully or partially remove any protruding metal objects that may attract lightning strikes. - Install lightning rods or surge arresters to provide protection against lightning strikes.	**$15,000**	Immediate

Risk Score out of 100
(100 is highest)

Southridge Emergency Center

98 Woodhaven Drive

Facility Description:

The emergency services Center houses RCMP, Fire, and Municipal Enforcement officials.

River Flood Return:	Water Depth (cm)
50-Year	N/A
100-Year	N/A
200-Year	N/A
350-Year	N/A
Risk Ranking:	5

Facility Vulnerability by Hazard:

Extreme Heat	Low Temps
Freeze-Thaw	Local Flooding
Heavy Snowfall	River Flooding
Hail	Lightning
High Winds	Wildfire Smoke
Drought	Biodiversity

High Vuln, Medium Vuln, Low Vuln
Based on Survey Results

Rank out of 19 facilities -
Lower ranks are higher risk

Top Risk Mitigation Actions:

Top Risks	Risk Score	Top 5 Risk Mitigation Actions	Cost	Timeframe
Heavy Snowfall - Structural	**48**	-Evaluate adequacy of roof to meet snow-load capacity	**$5,000**	2026-2029
High Winds - Site Grading, Landscaping, and Features	**36**	- Trim back any branches near the building to reduce the potential for windborne debris.	**$5,000**	Immediate
Hail - Exterior Envelope	**32**	- Install hail-resistant covers or grates over existing skylights, vents, or chimneys to provide protection from hail damage.	**$7,500**	2030-2033

Risk Score out of 100
(100 is highest)

All High and Medium Risk Mitigation Actions:

Exterior Envelope	Risk Score	Category	Cost	Timeframe
- Install hail-resistant covers or grates over existing skylights, vents, or chimneys to provide protection from hail damage.	**32**	Retrofit	**$7,500**	2030-2033
Site Grading, Landscaping, and Features	**Risk Score**	**Category**	**Cost**	**Timeframe**
- Trim back any branches near the building to reduce the potential for windborne debris.	**36**	Operations	**$5,000**	Immediate
Structural	**Risk Score**	**Category**	**Cost**	**Timeframe**
-Evaluate adequacy of roof to meet snow-load capacity	**48**	Study	**$5,000**	2026-2029

Southside Program Building

#1, 204 Community Way

Facility Description:

The Southside Community Programs Building is a rec center that includes an arena and a Southside licensed school age care program.

River Flood Return:	Water Depth (cm)
50-Year	N/A
100-Year	N/A
200-Year	N/A
350-Year	N/A
Risk Ranking:	19

Facility Vulnerability by Hazard:

Extreme Heat	Low Temps
Freeze-Thaw	Local Flooding
Heavy Snowfall	River Flooding
Hail	Lightning
High Winds	Wildfire Smoke
Drought	Biodiversity

High Vuln, Medium Vuln, Low Vuln
Based on Survey Results

Rank out of 19 facilities -
Lower ranks are higher risk

Top Risk Mitigation Actions:

Top Risks	Risk Score	Top Risk Mitigation Actions	Cost	Timeframe
Lightning - General	**20**	- Fully or partially remove any protruding metal objects that may attract lightning strikes. - Install lightning rods or surge arresters to provide protection against lightning strikes.	**$15,000**	Immediate
High Temperatures (Days above 30 C) - Exterior Envelope	**20**	- Paint roofs white or apply a reflective coating to reduce heat absorption.	**$5,300**	Low Risk, Lower Priority
High Temperatures (Days above 30 C) - Openings (Windows & Doors)	**20**	- Install sun control window film, blinds or shades on the interior of windows on the east, south, or west sides to reduce incoming heat. - Install shade structures on the exterior of windows on the east, south, or west sides to reduce incoming heat.	**$25,000**	Low Risk, Lower Priority
High Temperatures (Days above 30 C) - HVAC	**20**	- Upgrade building HVAC systems to handle appropriate cooling demands. - Ensure the building's power systems can sustain additional electric loads.	**$25,000**	Low Risk, Lower Priority

Risk Score out of 100
(100 is highest)

Wastewater Treatment Plant (excl. process equipment)

200, 1118 North Railway Street

Facility Description:

The Wastewater Treatment Plant uses an Integrated Wastewater Treatment process that turns sewage into compost.

River Flood Return:	Water Depth (cm)
50-Year	N/A
100-Year	6.5
200-Year	92.9
350-Year	165.4
Risk Ranking:	1

Facility Vulnerability by Hazard:

Extreme Heat	Low Temps
Freeze-Thaw	Local Flooding
Heavy Snowfall	River Flooding
Hail	Lightning
High Winds	Wildfire Smoke
Drought	Biodiversity

High Vuln, Medium Vuln, Low Vuln
Based on Survey Results

Rank out of 19 facilities -
Lower ranks are higher risk

Top Risk Mitigation Actions:

Top Risks	Risk Score	Top 5 Risk Mitigation Actions	Cost	Timeframe
Biodiversity (Invasive Species, Pests) - Landscaping and Grading	**60**	- Regularly inspect the landscaping to identify potential invasive species and take necessary steps to contain or remove them. -Conduct regular pest control inspections of the facility and landscaping on the property to identify and remove existing pest infestations.	**$5,000**	Immediate
Heavy Snowfall - Structural	**48**	-Evaluate adequacy of roof to meet snow-load capacity	**$5,000**	2026-2029
Heavy Snowfall - Structural	**48**	-When replacing remaining roof elements, utilize a hailguard system or install hail-resistant solar panels to mitigate the risk of hail damage to the roof. -Have operations staff regulary unclog gutters and roof drains to ensure quick removal of hail.	**$200,000**	2026-2029
Hail - Power and Communications	**48**	- Utilize hail-resistant covers or hail-resistant solar panels to protect rooftop or outdoor mounted HVAC units from hail damage.	**$15,000**	2026-2029
Hail - Power and Communications	**48**	- Install hail-resistant covers or grates over existing skylights, vents, or chimneys to provide protection from hail damage.	**$7,500**	2026-2029

Risk Score out of 100

All High and Medium Risk Mitigation Actions:

Exterior Envelope	Risk Score	Category	Cost	Timeframe
- Repair any existing leaks in the roof to prevent water infiltration caused by hail damage.	**48**	Retrofit	**$10,000**	2026-2029
- Repair the roof in areas prone to leaking to prevent water infiltration. - Install waterproof covers on sensitive and critical equipment to protect them from snow or water leaks originating from the roof.	**48**	Retrofit	**$10,000**	2026-2029
- Install hail-resistant covers or grates over existing skylights, vents, or chimneys to provide protection from hail damage.	**48**	Retrofit	**$7,500**	2026-2029
HVAC	**Risk Score**	**Category**	**Cost**	**Timeframe**
- Utilize hail-resistant covers or hail-resistant solar panels to protect rooftop or outdoor mounted HVAC units from hail damage.	**48**	Retrofit	**$15,000**	2026-2029
- Install protective cages or guards on the HVAC system's intake and exhaust vents to prevent snow blockage. - Implement a snow clearing process during snow events to maintain proper airflow.	**48**	Retrofit and Operations	**$4,000**	Future/ Further Consideration

Site Grading, Landscaping, and Features	Risk Score	Category	Cost	Timeframe
- Regularly inspect the landscaping to identify potential invasive species and take necessary steps to contain or remove them. -Conduct regular pest control inspections of the facility and landscaping on the property to identify and remove existing pest infestations.	**60**	Operations	**$5,000**	Immediate
- Trim back any branches near the building to reduce the potential for windborne debris.	**36**	Operations	**$5,000**	Immediate
- Plant trees along the south and west side of the building for natural shade and to reduce heat absorption and cooling losses.	**30**	Retrofit	**$15,000**	2026-2029
Openings (Windows & Doors)	**Risk Score**	**Category**	**Cost**	**Timeframe**
- Replace single-paned and aging windows with triple-paned windows to increase efficiency and reduce cooling loss.	**30**	Retrofit	**$150,000**	Future/ Further Consideration
- Replace or repair damaged window and door seals to prevent cooling losses.	**30**	Retrofit	**$2,000**	2030-2033
Power and Communications	**Risk Score**	**Category**	**Cost**	**Timeframe**
- Consider deploying temporary protection barriers to shield vulnerable equipment during forecasted hail events. - Ensure availability of spares or backup communication equipment. - Confirm the operability of alternative equipment before the hail event.	**48**	Retrofit and Operations	**$25,000**	2026-2029
- Perform preventative maintenance and inspections on a regular basis to ensure all wiring and systems are secure. - Consider burying or removing power poles or overhead wires that are not necessary for operations.	**36**	Retrofit	**$200,000**	2030-2033
- Anchor rooftop electrical or communications devices securely to prevent them from becoming airborne during high winds.	**36**	Retrofit	**$10,000**	Immediate

Structural	Risk Score	Category	Cost	Timeframe
-Evaluate adequacy of roof to meet snow-load capacity	**48**	Study	**$5,000**	2026-2029
-When replacing remaining roof elements, utilize a hailguard system or install hail-resistant solar panels to mitigate the risk of hail damage to the roof. -Have operations staff regulary unclog gutters and roof drains to ensure quick removal of hail.	**48**	Retrofit and Operations	**$200,000**	2026-2029

Water Treatment Plant (excl. process equipment)

101 Woodhaven Drive

Facility Description:

A new water treatment plant will be operational in 2025, bringing water from the Bow River to Okotoks.

River Flood Return:	Water Depth (cm)
50-Year	69.3
100-Year	104.4
200-Year	138.3
350-Year	149.1
Risk Ranking:	6

Facility Vulnerability by Hazard:

Extreme Heat	Low Temps
Freeze-Thaw	Local Flooding
Heavy Snowfall	River Flooding
Hail	Lightning
High Winds	Wildfire Smoke
Drought	Biodiversity

High Vuln, Medium Vuln, Low Vuln
Based on Survey Results

Rank out of 19 facilities -
Lower ranks are higher risk

Top Risk Mitigation Actions:

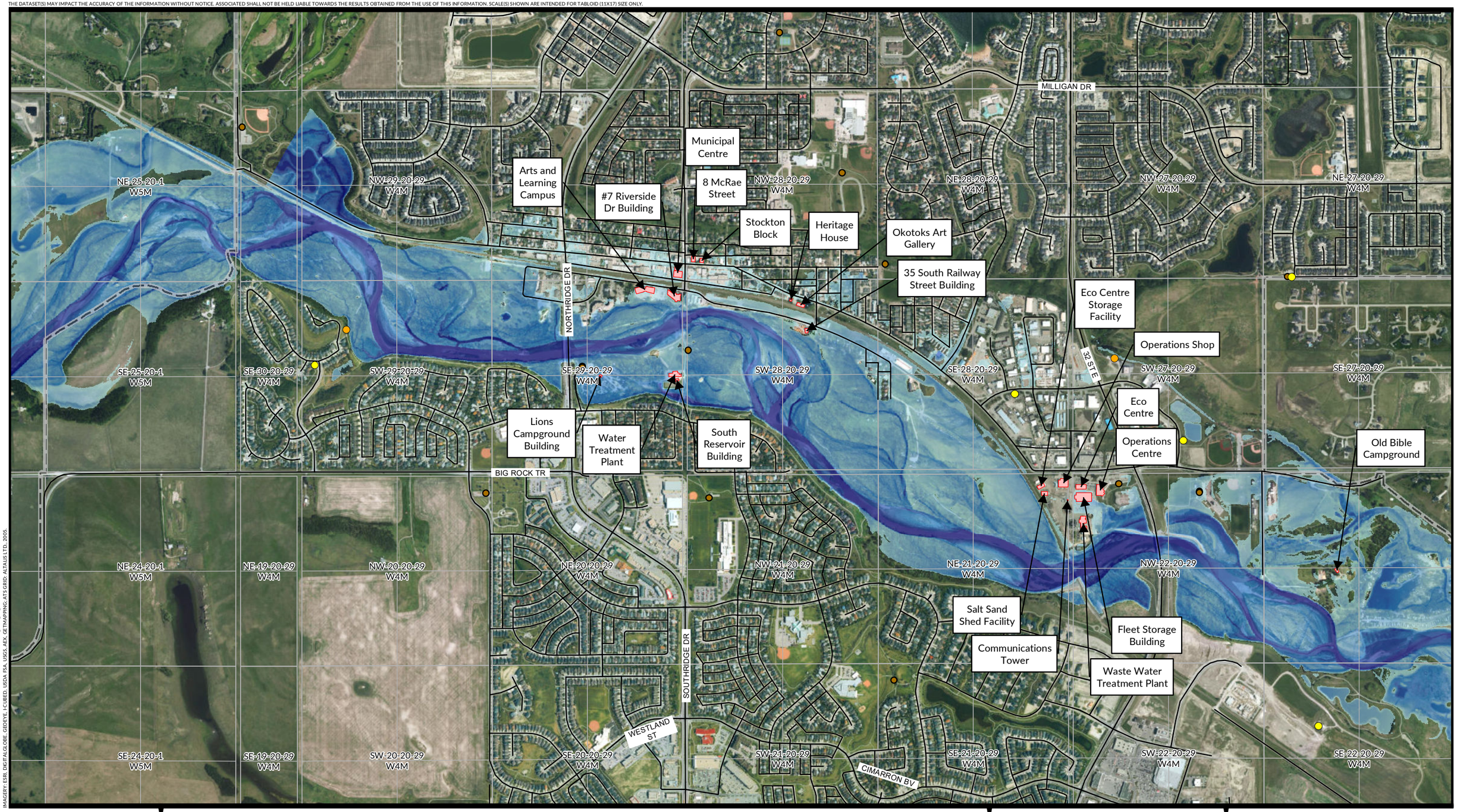
Top Risks	Risk Score	Top 5 Risk Mitigation Actions	Cost	Timeframe
Heavy Snowfall - Structural	**48**	-Evaluate adequacy of roof to meet snow-load capacity	**$5,000**	2026-2029
Heavy Snowfall and Hail - Structural	**40**	-When installing a new roof, utilize a hailguard system or install hail-resistant solar panels to mitigate the risk of hail damage to the roof. -Have operations staff regulary unclog gutters and roof drains to ensure quick removal of hail.	**$450,000**	Immediate
Hail - Power and Communications	**40**	- Consider deploying temporary protection barriers to shield vulnerable equipment during forecasted hail events. - Ensure availability of spares or backup communication equipment. - Confirm the operability of alternative equipment before the hail event.	**$25,000**	2030-2033
High Winds - Site Grading, Landscaping and Features	**36**	- Trim back any branches near the building to reduce the potential for windborne debris.	**$5,000**	Immediate
High Winds - Power and Communications	**36**	- Anchor rooftop electrical or communications devices securely to prevent them from becoming airborne during high winds.	**$5,000**	Immediate

Risk Score out of 100
(100 is highest)

Exterior Envelope	Risk Score	Category	Cost	Timeframe
- Install hail-resistant covers or grates over existing skylights, vents, or chimneys to provide protection from hail damage.	**40**	Retrofit	**$7,500**	2030-2033
- Inspect eavestroughs for damage or blockages. - Ensure all downspouts are pointed away from the building and located 1m or more away.	**32**	Retrofit	**$1,000**	2026-2029
HVAC	**Risk Score**	**Category**	**Cost**	**Timeframe**
- Utilize hail-resistant covers or hail-resistant solar panels to protect rooftop or outdoor mounted HVAC units from hail damage.	**40**	Retrofit	**$15,000**	2030-2033
Site Grading, Landscaping, and Features	**Risk Score**	**Category**	**Cost**	**Timeframe**
- Trim back any branches near the building to reduce the potential for windborne debris.	**36**	Operations	**$5,000**	Immediate
- Fill or raise low spots or traps located in the roadways adjacent to the building. - Inspect roads adjacent to the building for water pooling and ensure proper maintenance and grading for drainage. - Inspect roads adjacent to the building for water pooling and ensure proper maintenance and grading for drainage.	**32**	Retrofit	**$20,000**	2026-2029
- Inspect access/egress roads to the facility for water pooling and ensure proper maintenance and grading for drainage.	**32**	Retrofit	**$20,000**	2026-2029
- Clear surrounding areas of debris, vegetation, or obstructions that could lead to water pooling.	**32**	Operations	**$500**	2026-2029

Openings (Windows & Doors)	Risk Score	Category	Cost	Timeframe
- Inspect the building and surrounding areas for water pooling or accumulation, and regularly clean out and clear those areas.	**32**	Retrofit	**$10,000**	2026-2029
Power and Communications	**Risk Score**	**Category**	**Cost**	**Timeframe**
- Consider deploying temporary protection barriers to shield vulnerable equipment during forecasted hail events. - Ensure availability of spares or backup communication equipment. - Confirm the operability of alternative equipment before the hail event.	**40**	Retrofit and Operations	**$25,000**	2030-2033
- Anchor rooftop electrical or communications devices securely to prevent them from becoming airborne during high winds.	**36**	Retrofit	**$10,000**	Immediate
Structural	**Risk Score**	**Category**	**Cost**	**Timeframe**
-Evaluate adequacy of roof to meet snow-load capacity	**48**	Study	**$5,000**	2026-2029
-When installing a new roof, utilize a hailguard system or install hail-resistant solar panels to mitigate the risk of hail damage to the roof. -Have operations staff regulary unclog gutters and roof drains to ensure quick removal of hail.	**40**	Retrofit and Operations	**$450,000**	2024-2026

APPENDIX E – FLOOD INUNDATION MAPS



C:\USERS\LAW\DESKTOP\PROJ\OKOTOKS\ARCMAP\FLOOD\AE2022\572_FIG1_50_230726.MXD
IMAGERY: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, FSA, USGS, AEX, GETMAPPING, AYS, GRID, ALTALIS LTD, 2005

LEGEND

- Lift Station
- Pump Station
- Washroom
- Road
- Municipal Boundary
- Town Owned Building

50 Year Flow

Depth (m)

7.2

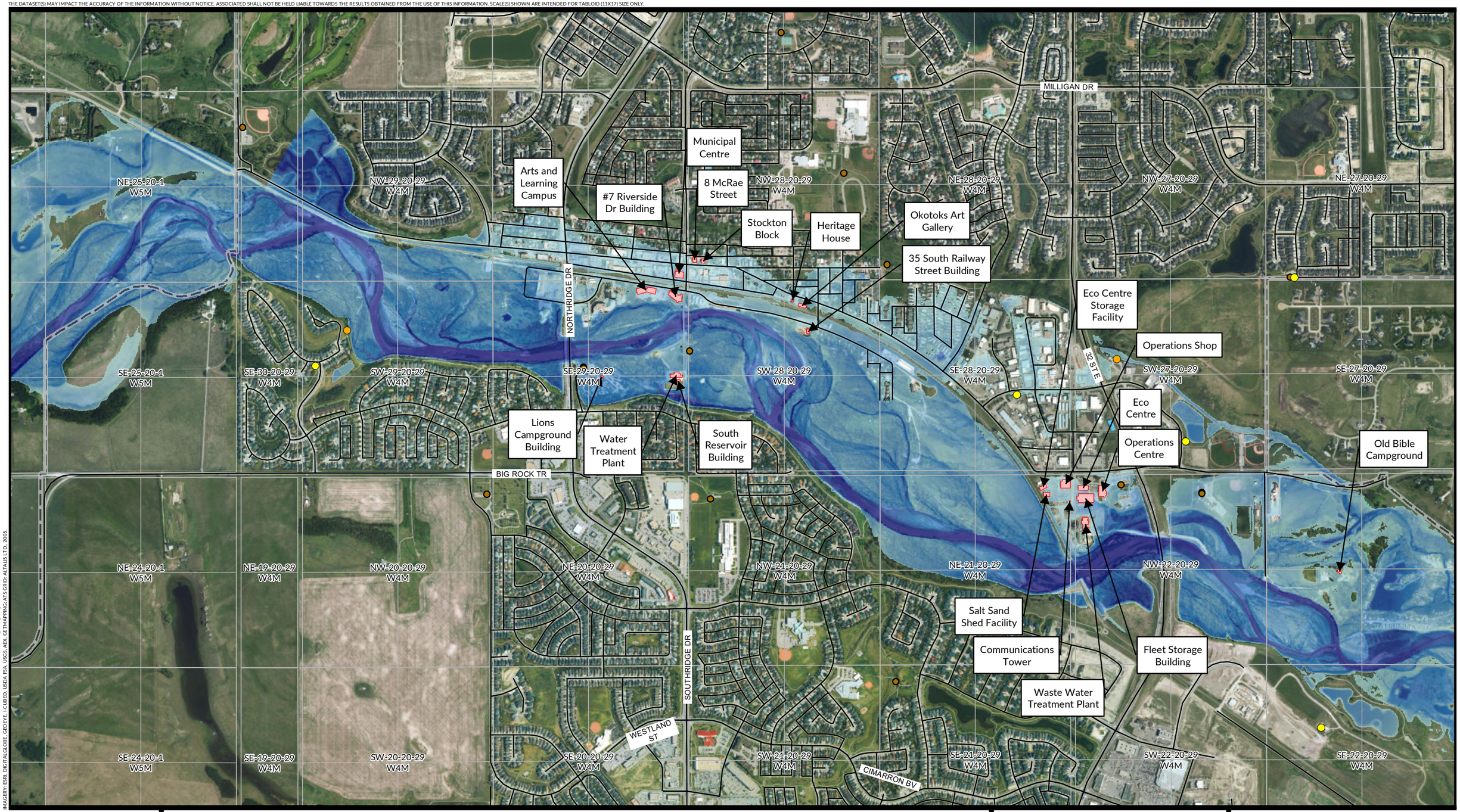
0.0

0 100 200 300 400 500 m

AE PROJECT NO.	2022-3572-00
SCALE	1:15000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2023-07-31
REV	00
DRAWN BY	WL
CHECKED BY	CM/TK
DESCRIPTION	ISSUED FOR DRAFT

FIGURE 1
FLOOD INUNDATION
50 YEAR FLOW

TOWN OF OKOTOKS
OKOTOKS CLIMATE INFRASTRUCTURE
VULNERABILITY ASSESSMENT



C:\USERS\LANA\DESKTOP\PROJ\OKOTOKS\ARCMAP\FLOOD\AE2022\3572_FIG2_100_230728.MXD
IMAGERY ESRI, DIGITALGLOBE, GEOEYE, EARTHED, USDA FSA, USGS, AEX, GETMAPPING, AUS GRID, ALTALIS LTD, 2005

LEGEND

- Lift Station
- Pump Station
- Washroom
- Road
- Municipal Boundary
- Town Owned Building

100 Year Flow

Depth (m)

8.1

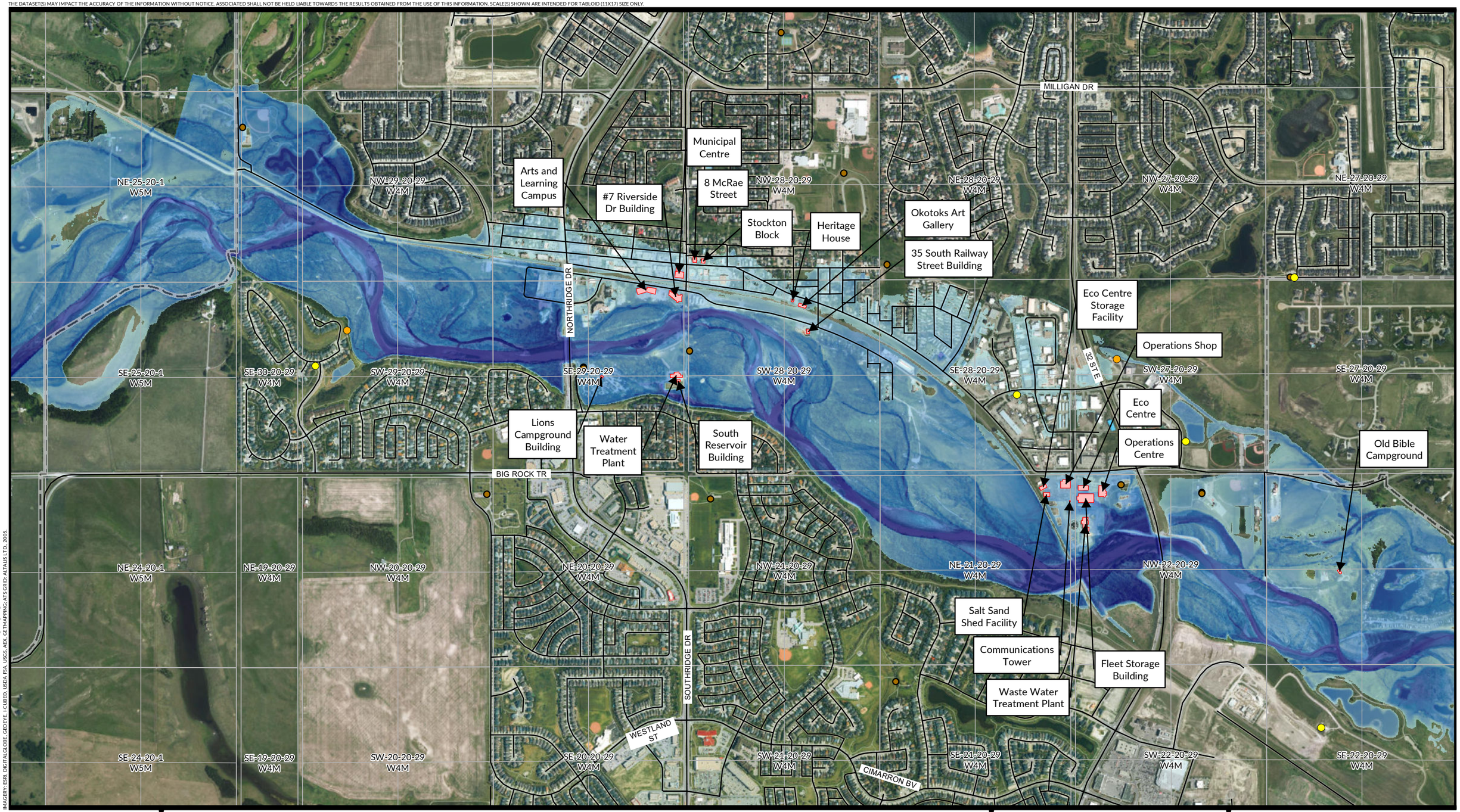
0.0

0 100 200 300 400 500 m

AE PROJECT NO.	2022-3572-00
SCALE	1:15000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2023-07-31
REV	00
DRAWN BY	WL
CHECKED BY	CM/TK
DESCRIPTION	ISSUED FOR DRAFT

FIGURE 2
FLOOD INUNDATION
100 YEAR FLOW

TOWN OF OKOTOKS
OKOTOKS CLIMATE INFRASTRUCTURE VULNERABILITY ASSESSMENT



C:\USERS\LANV\DESKTOP\PROJ\OKOTOKS\ARCMAP\FLOOD\AE2022\3572_FIG3_200_230728.MXD
IMAGERY ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, USDA FSA, USGS, AEX, GETMAPPING, AUS GRID, ALTALIS LTD. 2005

LEGEND

- Lift Station
- Pump Station
- Washroom
- Road
- Municipal Boundary
- Town Owned Building

200 Year Flow

Depth (m)

8.8

0.0

Associated Engineering

Okotoks

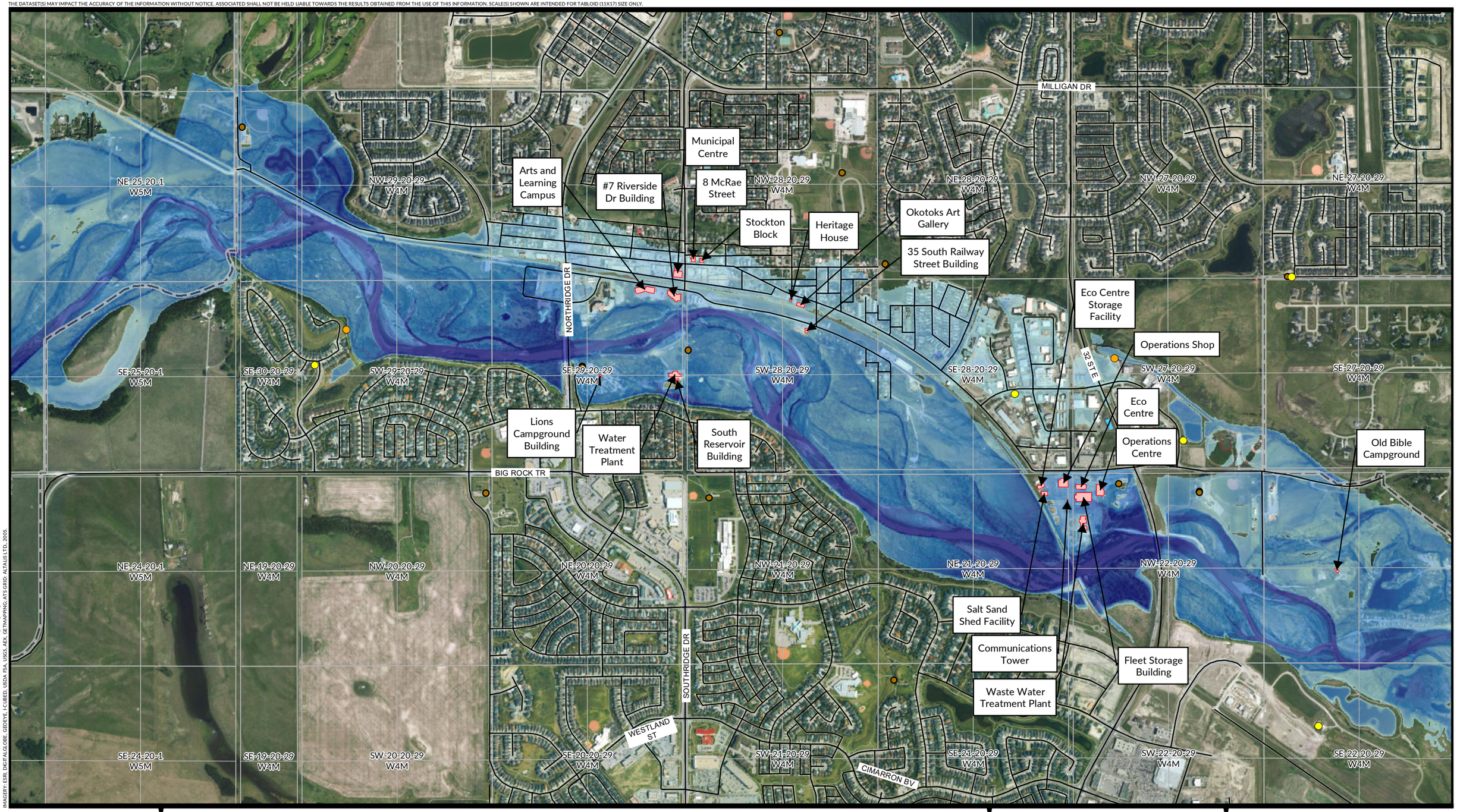
N

0 100 200 300 400 500 m

AE PROJECT NO.	2022-3572-00
SCALE	1:15000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2023-07-31
REV	00
DRAWN BY	WL
CHECKED BY	CM/TK
DESCRIPTION	ISSUED FOR DRAFT

FIGURE 3
FLOOD INUNDATION
200 YEAR FLOW

TOWN OF OKOTOKS
OKOTOKS CLIMATE INFRASTRUCTURE VULNERABILITY ASSESSMENT



C:\USERS\LIAM\DESKTOP\PROJ\OKOTOKS\ARCMAP\FLOOD\AE2022\3572_FIG4_350_230728.MXD
IMAGERY: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AYS,GRID, ALTALIS LTD, 2005

LEGEND

- Lift Station
- Pump Station
- Washroom
- Road
- Municipal Boundary
- Town Owned Building

350 Year Flow

Depth (m)

9.6

0.0

0 100 200 300 400 500 m

AE PROJECT NO.	2022-3572-00
SCALE	1:15000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2023-07-31
REV	00
DRAWN BY	WL
CHECKED BY	CM/TK
DESCRIPTION	ISSUED FOR DRAFT

FIGURE 4
FLOOD INUNDATION
350 YEAR FLOW

TOWN OF OKOTOKS
OKOTOKS CLIMATE INFRASTRUCTURE VULNERABILITY ASSESSMENT

APPENDIX F – STAKEHOLDER LIST

Table F-1 – Staff Stakeholder List

Name	Division	Workshop #						
		1	2A	2B	3A	3B	3C	4
Sheri Young	Sustainability	●	●	●	●	●	●	●
Senjuti Basak	Sustainability	●	●	●	●	●	●	●
Jared Pitcher	Facilities	●	●	●	●	●	●	
Nick Ginakos	Facilities	●		●	●		●	
Louis Palacsko	Operations							●
Christa Michailuck	Parks and Recreation	●		●		●		
Daryn Hitchner	Parks and Recreation	●		●		●		
Jamie Dillabough	Recreation	●		●			●	
Jesse Gimbel	Recreation	●		●			●	●
Peter McDowell	Roads				●	●	●	●
Paul Lyons	Waste Management	●		●		●		
Davey Robertson	Water Services	●	●		●			●
James McElmon	Water Services	●	●		●			
Pacer Wilson	Water Services	●	●		●			
Pierce Mimura	Water Services	●	●	●	●			

Table F-2 – Stakeholder Engagement Workshop Summary

Workshop Group	Workshop #	Goal / Content
PIEVC Orientation	**1**	Discuss climate change principles and parameters, the PIEVC High Level Screen (HLS) tools and process, and provide an overview of the project.
Tell Us About Your Syststem	**2A**	Understand the types and scale of assets for Water, Wastewater, Stormwater assets.
	2B	Understand the types and scale of assets for Facilities, Roads, Waste, and Parks assets.
Service Line Risk Assessment	**3A**	Assess the risk to assets within the Water, Wastewater, Stormwater service lines.
	3B	Assess the risk to assets within the Roads, Waste, Parks service lines.
	3C	Assess the risk to assets within the Facilities service lines.
Facilities Risk Assessment	**4**	Assess the risk to the specific building systems from climate hazards to support an in-depth assessment of risk for Town facilities.