

ONTARIO RESOURCE CENTRE FOR CLIMATE ADAPTATION

TOWN OF EAST GWILLIMBURY

Vulnerability and Risk Assessment
Summary Report



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INTRODUCTION

Across Ontario, municipalities are increasingly facing the harsh realities of climate change—from flooding and extreme heat to more frequent and severe storms. The Town of East Gwillimbury has likewise felt the impacts of these climate challenges, witnessing significant flooding, heatwaves, and storms. These events have underscored the urgent need for proactive local action.

To address these challenges and enhance its resilience, the Town is developing a Climate Change Adaptation Plan. This plan will guide the Town in integrating adaptation actions into its operations to better respond to the impacts of climate change and build long-term resilience. This report summarizes the most significant climate risks to the Town as identified by municipal staff and the Adaptation Working Group (AWG). This report serves as a valuable output as the Town continues the process of developing the ***Thinking Green: East Gwillimbury Climate Change adaptation plan***.

PROJECT BACKGROUND

The development of the **Thinking Green: East Gwillimbury Climate Change Adaptation Plan** is being supported through the [Ontario Resource Centre for Climate Adaptation \(ORCCA\)](#) Staff Capacity Program. This program aims to support adaptation efforts throughout Ontario by providing capacity and expertise. ORCCA is a pilot initiative led by [ICLEI Canada](#) and supported by the [Ontario Ministry of Environment, Conservation and Parks](#) (MECP) alongside financial support from the Government of Canada through the federal [Department of Environment and Climate Change Canada](#). This pilot initiative supported East Gwillimbury from February until December 2024. The town will continue its efforts in 2025.

BARC Methodology

The Town of East Gwillimbury's climate adaptation work is guided by ICLEI's Building Adaptive and Resilient Communities (BARC) Framework. The BARC Framework guides municipalities through a comprehensive planning methodology that includes research and climate impact assessment, plan development, action-setting, implementation planning, and monitoring and review strategies. ICLEI's BARC Framework is a proven methodology that has been implemented by municipalities across the country. A model of BARC's Milestone process is shown in Figure 1 below.

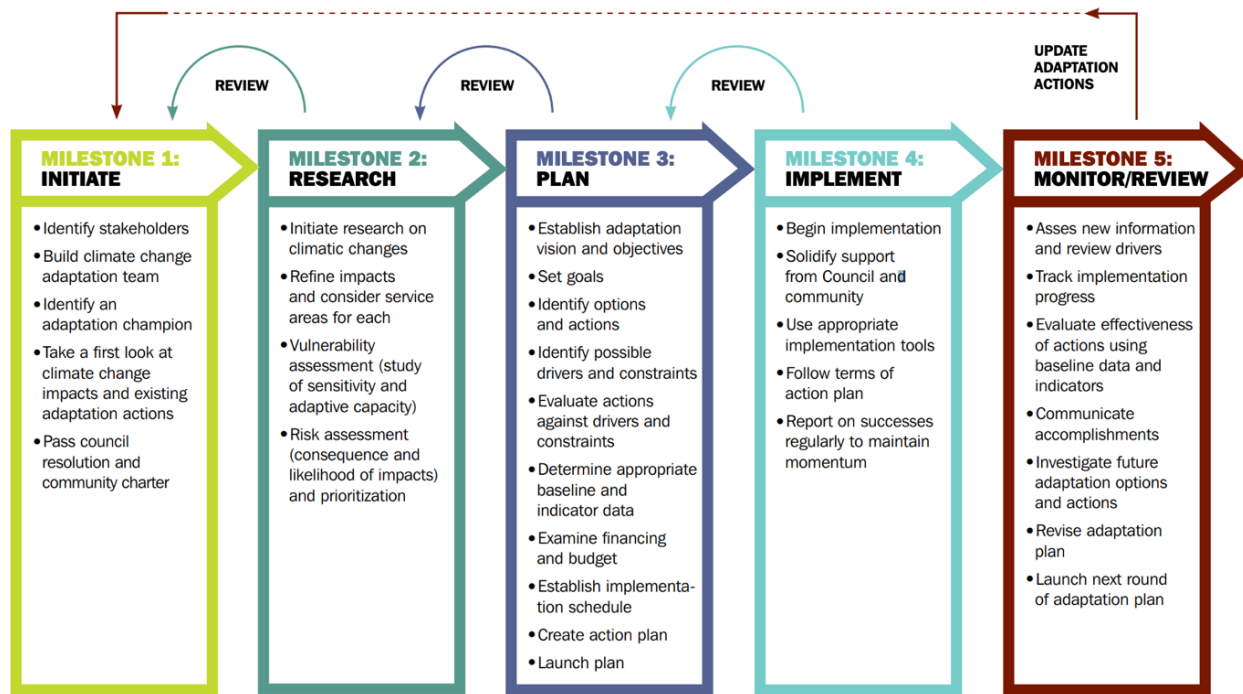


Figure 1: BARC 5-Milestone Framework

This project fulfills Milestone One and Two of the BARC Framework. Following the Vulnerability and Risk Assessments, the Town will begin the planning stage (Milestone Three) process.

ADAPTATION PLANNING PARTICIPANTS

In fulfilling the criteria of Milestone One, the Town worked with ORCCA to identify relevant stakeholders to the adaptation planning process. The BARC process allows for the individual examination of impacts, vulnerabilities, and risks to the municipality. However, this process brings together a wide variety of corporate and community collaborators and helps to build partnerships for long-term and sustained climate action. Further, this allows us to learn of and capitalize on existing resources and programs within the region to support adaptation efforts.

Ultimately, through collaborator identification and engagement, an Adaptation Working Group (AWG) comprised of Town staff and their partners was formed.

Adaptation Working Group

The Town and representatives from partner organizations that continue to provide valuable direction and input for climate change adaptation planning include the following members:

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Table 1: Adaptation Working Group Members

Department/Organization	Member
Town of East Gwillimbury - Development Services	Ian Ding
Town of East Gwillimbury - Development Services	Brennan Kenny
Town of East Gwillimbury - Engineering and Public Works	Krista Chaney
Town of East Gwillimbury – Finance Department	Carolyn Brown
Town of East Gwillimbury - Corporate Services (Environmental Services)	Cristina Ross
Town of East Gwillimbury – Corporate Services (EDI)	Shannon Giannitsopoulou
Town of East Gwillimbury - Fire and Emergency Services	Sarah Galvin
Town of East Gwillimbury - Legal Services	Keith Tso
Town of East Gwillimbury - Parks, Recreation and Culture	Frank Mazzotta
York Region - Health	Morgan Levison
Lake Simcoe Region Conservation Authority	Lauren Moretto
EG Environmental Advisory Committee	Elaine Jackson

To date, the AWG has attended two online workshops as well as participated in an online survey of a vulnerability assessment. The first workshop, held on July 18th, 2024, was focused on presenting climate change projections for the Town as well as brainstorming climate change impacts, and assessing how climate change could affect the social, built, economic, and natural systems in the community and Town’s operations. After this, the AWG participated in an online vulnerability assessment (through surveys) of the identified climate change impacts. Subsequently, a second workshop was held on November 22, 2024, focused on presenting the results of the vulnerability assessment, and capturing the Working Group’s perceptions of risk associated with each climate change impact.

LOCAL CLIMATE CONTEXT

The Town of East Gwillimbury is already experiencing the impacts of climate change. The region has experienced a range of significant climatic events, including major rainfall and flooding events that resulted in infrastructure damage and large recovery costs. An extreme rainfall event on June 23, 2017 caused severe flooding and affected several water and wastewater sites (pumping stations and wastewater treatment facilities) across York Region¹. During this event, East Gwillimbury experienced rainfall levels comparable to a 1 in 50-year event¹. These events have not only affected the natural environment but have also had profound effects on the infrastructure, economy, and daily lives of the residents. These recent events have highlighted the need to be prepared for ongoing challenges, especially as the Town’s climate will continue to change over the next century.

To gain an understanding of the changes to come and to help with adaptation planning and decision-making, ORCAA team worked with the Town to develop a climate science report. This report examines

¹ Regional Municipality of York. (2018). *York Region inflow and infiltration reduction strategy annual report*. Newmarket, ON: Regional Municipality of York. Retrieved from <https://www.york.ca/wps/wcm/connect/yorkpublic/b22ae2f3-5140-48f2-869ea803d2552893/2017+Inflow+and+Infiltration+Reduction+Strategy+Annual+Report.pdf?MOD=AJPERE>

climate trends and projections on a global, national, and local scale. It further informs some of the climate change impacts that are expected to occur in the Town over the next century. Projections in this report are focused on temperature, precipitation, agricultural indices, and extreme weather (e.g. extreme rainfall). A summary of these projections is outlined below:

- **Temperature:** All temperature indices show significant warming across seasons, with an increase in the frequency of days above 30°C and a decline in days below -15°C.
- **Precipitation:** Precipitation events in general are expected to become more intense. Annual precipitation is expected to increase, and winter and spring are projected to become significantly wetter.
- **Growing season:** First frost dates will be later and last frost dates will be earlier contributing to a longer growing season.
- **Freeze Thaw Days:** Freeze-thaw cycles are projected to decrease due to overall warmer temperatures.

A more complete graphic breakdown of these results is included within the Climate Science Infographic in Appendix A.

IMPACT STATEMENTS, VULNERABILITY AND RISK ASSESSMENT

Analyzing both vulnerability and risk based on climate change projections for the Town is a key step in adapting to climate change and planning for the future. The AWG went through a process of identifying existing weather stressors in the community, assessing how those could be exacerbated by climate change, and drafting a series of climate impact statements. These impact statements were then evaluated by the AWG through a vulnerability and risk assessment framework to create a prioritized list of impacts from which actions for each impact, or impact area, can be planned.

The assessment of vulnerability and risk was supplemented by additional external expert knowledge where necessary. The outcomes from the risk assessment reflect our current understanding of present climate conditions and consider anticipated climate projections for the community. The risk assessment will be revisited at regular future intervals as climate science and capacity to respond changes over time.

Impact Statements

Climate-related impact statements are the foundation of the vulnerability and risk assessment process and must be tailored to each municipality's context. These are concise statements that outline locally relevant projected threats and how these changes are expected to affect the built, natural, social, and economic systems across the Town. They bring together knowledge of climate change and projected changes into the medium- and long-term as well as knowledge of the local conditions in the jurisdiction that is being studied. Impact statements are formed by answering the following questions:

- What are the climatic changes we are concerned about?
- What are the outcomes associated with these changes?
- What are the consequences associated with these outcomes?

At the first workshop, a long list of 75+ impact statements were initially brainstormed by the AWG. This list was reviewed, edited, and revised to more closely and concisely reflect the changes that are expected to affect the community. Ultimately, 33 impact statements were shortlisted for the working group's review.

The impact statements cover a range of affected areas including infrastructure, natural environment, public health and safety, employee productivity, and more. The statements have been further organized by climate event to help the working group better understand the focus and scope of each impact. Climate event categories include:

- Increase in temperature (annual, fall, spring, summer, winter)
- Increase in frequency/duration of hot days (> 30°C)
- Increase or Changes in frequency and/or intensity of precipitation events (annual, all seasons)
- Increase in frequency/intensity of extreme weather events (e.g. ice storms, windstorms, thunderstorms, freezing rain, hailstorms, tornadoes, etc.)

Vulnerability Assessment

Vulnerability refers to the susceptibility of a given asset, service, or group to harm arising from climate change impacts. Vulnerability is a function of two criteria – the **sensitivity** of the community to a given climate change impact, and its **adaptive capacity** (ability to respond, recover and/or cope).

A vulnerability assessment necessitates an understanding of both biophysical and socioeconomic factors, as the focus is on understanding the processes involved with climate change impacts and the factors that influence sensitivity and adaptive capacity. This understanding can help assist with the development of suitable adaptive actions later in the Milestone Three – planning stage.

When asked to determine **sensitivity**, the working group was asked to consider how the impact would affect the community/asset/department's ability to function (carry out day-to-day activities and provide services as usual) if the impact occurred today. A high **sensitivity** would mean that the community/asset/department is susceptible to significant risk or damage if the impact were to occur.

In contrast, **adaptive capacity** refers to the ability of systems, institutions, individuals, and other assets to adjust to potential damage, take advantage of opportunities, or respond to consequences with minimal cost or disruption. When asked to determine **adaptive capacity**, the working group considered the time and resources required to restore the community or assets to its previous functionality should the impact occur today, and consider any plans, policies, and actions already in place to address this issue. A low **adaptive capacity** would mean that the community/asset/department would need significant time and/or resources to cope with the impact.

The vulnerability assessment was carried out using an online survey and was completed by the AWG. A 'dotmocracy' methodology was used, and under the premise of the impact occurring today, both **sensitivity** and **adaptive capacity** were considered when assigning a vulnerability ranking to each of the 33 impact statements. The following scale was used to assign the vulnerability rankings:

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- **High vulnerability** indicates that the community is highly vulnerable to harm arising from the impact. It represents threats that could cause the most severe disruption, damage, or resource costs if they were to occur.
- **Medium vulnerability** indicates that the community is somewhat vulnerable to harm arising from the impact.
- **Low vulnerability** indicates that the community is not very/not at all vulnerable to harm arising from the impact. It suggests that the community is not very sensitive to the impact and possesses a sufficient existing adaptive capacity to manage the concern.

As previously noted, a total of 33 impact statements were put through the Vulnerability Assessment, the results of which are indicated below.

Table 2: Vulnerability Assessment Ranking Distribution

Vulnerability Ranking	Number of Impacts
High - Red	19
Medium - Yellow	9
Low – Green	4

The vulnerability assessment results provided an initial prioritization of climate impacts before conducting a more detailed risk analysis. Impacts ranked as “high” vulnerability indicate impacts to which the Town is highly *sensitive* or has low *adaptive capacity* (i.e., ability to cope/recover). Conversely, the four impacts that received a “low” vulnerability ranking were not carried forward into the risk assessment, leaving a total of 29 impacts to be further analyzed.

The low-ranking impacts were primarily social or recreational in nature, such as the effects of climate change on outdoor activities, spaces, and scheduling. These were not seen as significant threats to public health and safety by the working group. It was also noted that the Town has adequate the availability of indoor community spaces that can help lessen consequences of such events. One of the other low-ranking impacts involved increasing water temperatures and levels, with subsequent consequences such as more algal blooms. While the issue has potential regional implications, the working group highlighted that this may not be a direct threat for the Town. Moreover, many of these concerns are already addressed in other impact statements, and existing protocols are in place to manage them effectively. While these impacts should be monitored moving forward, they are not prioritized in the immediate risk assessment process.

Impacts with a high vulnerability ranking represents threats that could cause the most severe disruption, damage, or resource demands if they were to occur. The key impacts for which the Town was highly *sensitive* or had limited *adaptive capacity* to withstand are outlined in the table below.

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Table 3: High Vulnerability Impacts

Impact ID	System Affected	Climatic Threat	Impact Statement
2	Natural, Socio-economic	Increase in summer temperatures without summer precipitation	Increase in summer temperatures without corresponding summer precipitation resulting in unreplenished wells, affected agricultural practices (e.g. crop rotation), and decreased crop production (particularly lavender farms leading to mental and financial stress to farmers and heightened food insecurity).
3	Natural	Increase in average summer temperatures combined with increased humidity	Increase in average summer temperatures combined with increased humidity leading to mold growth, hay browning, and heat stress in livestock causing increased shedding of bacteria, with higher risk of illness and mortality among animals.
9	Socio-economic	Average summer temperatures and increased frequency/duration of hot days (>30°C)	Average summer temperatures and increased frequency/duration of hot days (>30°C) leading to increased health and safety risks (e.g. heat stress, domestic violence/violent altercations, cardiovascular disorders, food-borne/water-borne illnesses, etc.). especially for vulnerable populations (e.g. outdoor workers, seniors, women, children, those with chronic health conditions, unhoused, socially isolated, those without AC, etc.) and frontline staff.
11	Natural	Increase in average annual temperature	Increase in average annual temperatures driving the spread of invasive species and pests, leading to altered species distribution due to disrupted seasonal cues, drying of wetlands and loss or damage of local flora and fauna.
12	Socio-economic	Increase in average annual temperature	Increase in average annual temperatures, early snowmelt, and increased precipitation resulting in more ideal conditions for vectors (i.e. more heat, more standing water), leading to increased spread of vector-borne diseases like Lyme disease, West Nile virus, and emerging diseases in the York region such as Anaplasmosis, Babesiosis, and Powassan virus infection.
13	Natural	Increase in winter temperatures	Increase in winter temperatures leading to early thawing of ice on lakes, rivers, and other water bodies, impacting water quality and availability in the spring and summer months and causing disruption to aquatic ecosystems.
14	Natural	Increased frequency and/or intensity of precipitation events	Increased frequency and/or intensity of precipitation events, particularly during the winter and spring seasons, combined with warmer water bodies causing disrupted water ecosystems, leading to more damaged cold-water species habitat, altered species distribution and species die-offs.

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15	Built	Increased frequency and/or intensity of precipitation events (especially in winter and spring)	Increased frequency and/or intensity of precipitation events causing overland flooding, leading to increased damage to public buildings, assets, and infrastructure (e.g. roads, sidewalks, parks, signs, trails, etc.)
17	Natural, Socio-economic	Shifting summer precipitation and increased summer temperatures	Shifting summer precipitation and increased summer temperatures leading to more drought and/or more rain falling at once, resulting in soil erosion, flooding of agricultural fields, stressed or failed crops, delayed spring planting, reduced ability to work the land, and loss of viable farmland.
19	Natural	Changing precipitation patterns and rising temperatures	Changing precipitation patterns and rising temperatures leading to increased use of herbicides and pesticides and more frequent washouts into waterways, causing contaminated aquatic ecosystems, harming fish and other wildlife, and disrupting the surrounding natural environment (including water quality, soil health and vegetation).
22	Built	Increased intensity and/or frequency of precipitation events	Increased intensity and/or frequency of precipitation events causing more frequent breaks in wastewater and sewage treatment plants, leading to more repairs, system disruptions, and elevated bacteria levels, straining both wastewater and septic systems.
23	Natural	Changes in temperatures and precipitation patterns	Changes in temperatures and precipitation patterns disrupting the natural timing of crop budding, availability of food sources affecting the arrival of pollinators and migratory patterns of birds.
25	Natural	Increased winter precipitation	Increased winter precipitation causing change and/or increase in salt use patterns leading to higher runoff causing deterioration or damage to natural systems (e.g. altered soil composition, increased aquatic salinity, toxic effects to wildlife, reduced water quality, etc.)
31	Natural	Increase in the frequency and/or intensity of extreme weather events (e.g. ice storms, windstorms, thunderstorms, freezing rain, hailstorm, tornado, etc.)	Increase in the frequency and/or intensity of extreme weather events (e.g. ice storms, windstorms, thunderstorms, freezing rain, hailstorm, tornado, etc.) causing significant soil erosion and damage to trees and the canopy, resulting in uprooted, broken, and severely damaged trees with long-term impacts such as slow canopy recovery and the loss of essential ecosystem services like shade, flood attenuation, and air quality improvement.
32	Built	Increased frequency and/or intensity of extreme weather events e.g. ice storms, windstorms, thunderstorms, freezing	Increased frequency and/or intensity of extreme weather events e.g. ice storms, windstorms, thunderstorms, freezing rain, hailstorm, tornado, etc.) causing damage to power infrastructure, leading to power outages causing disruptions to water pumping and wastewater systems.

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		rain, hailstorm, tornado, etc.	
33	Built, Socio-economic	Increase in the frequency and/or intensity of extreme weather events (e.g. ice storms, windstorms, thunderstorms, freezing rain, hailstorm, tornado, etc.)	Increase in the frequency and/or intensity of extreme weather events e.g. ice storms, windstorms, thunderstorms, freezing rain, hailstorm, tornado, etc.) resulting in increased damage/disruption of transportation networks (active, vehicular, transit) leading to disruptions to traffic/commutes, local business, emergency services, and other essential services (i.e. food systems, medical care/hospitals, airports, etc.).

These high-ranking impacts represent significant risks to the Town's natural environment, built infrastructure, and social systems. Impacts were primarily related to warmer summer temperatures, more extreme heat days (>30°C), shifts in precipitation patterns, heavier precipitation and flooding, and more frequent/intense extreme weather events.

The areas of concern fall into three main categories:

- **Natural Environment:** Biodiversity loss altered species distribution, ecosystem disruption and damage, reduced water quality, disruption in crop timing and pollinator patterns, livestock stress, and the spread of vector-borne diseases.
- **Built Environment:** Damage to municipal assets and property, power outages, and disruptions to transportation networks.
- **Socio-economic Systems:** Power and service interruptions, displacement, public health and safety concerns, and strain on emergency response services.

It is worth noting that the vulnerability survey process faced some limitations, including personal time constraints that prevented the Working Group from fully completing the survey. In some cases, only a third or half of the vulnerability assessment survey was completed. Consequently, impacts earlier in the survey received input from more participants, while the later impacts had fewer votes. To address this, the Project Team reviewed the survey results in detail, ensuring the final results were accurate, consistent, and grounded in their knowledge of local conditions and on-the-ground expertise in East Gwillimbury.

For impacts with tied rankings (for example, those that may have had a tied scoring for 'Medium' and 'High'), the Project Team applied their municipal knowledge to determine a single ranking. As well, overlapping impacts (i.e. an impact statement that may, upon review, have had similar language/wording to another impact statement) were consolidated where appropriate.

For example, impacts #5 and #29, which had overlapping components relating to increased wildfire risks due to changes in climate were consolidated into a single impact statement. This looked like the following:

- Original impact #5: Increased summer temperatures and changes in precipitation leading to increased risk of wildfires and wildfire smoke, resulting in decreased air quality and significant health and safety risks, including heat-related illnesses, respiratory issues, etc.
- Original impact #29: Increase in average annual temperatures and changing precipitation patterns resulting in greater wildfire risk, leading to more displacement and evacuation of community members and increased physical and mental health impacts (e.g. physical injuries, respiratory conditions, stress, anxiety, trauma, etc.)
- New consolidated impact #29: Increase in average annual temperatures and changing precipitation patterns resulting in greater wildfire risk and wildfire smoke, leading to more displacement and evacuation of community members and increased physical and mental health impacts (e.g., physical injuries, respiratory conditions, stress, anxiety, trauma, etc.).

Collectively, this process ensured that the final vulnerability rankings and impact statements were robust, comprehensive, and aligned with the Town's understanding of climate risks.

Risk Assessment

The risk assessment process is used to further analyze and prioritize which impacts are most pertinent in a climate-adjusted future. Risk is the combination of the likelihood of an event occurring and its negative consequences, expressed as a function of *likelihood* x *consequence*. In this context, *likelihood* refers to the probability of a projected impact occurring, while *consequence* refers to the known or estimated outcomes of that impact.

Likelihood

The first part of the risk assessment involved determining *likelihood*. *Likelihood* was based on the probability of the projected impact occurring and considered the outcome of the impact statement occurring rather than the climatic event itself (e.g., assessing the likelihood of road washouts or basement flooding rather than the increased precipitation itself). This was informed by considering, historical weather events and anecdotal knowledge of past events, localized climate projections, and an understanding of how sensitive the Town is to the impact (i.e., by considering *sensitivity* from the vulnerability assessment).

Likelihood ratings were assigned to each of the identified impacts by the Project Team prior to the Risk Assessment Workshop and then reviewed by ORCCA. Likelihood ratings were adjusted in response to any additional expert input to ensure they were as accurate and representative of the Town as possible. *Likelihood* was measured on a scale of 1 to 5, whereby 1 indicates a 'Rare' occurrence, and 5 indicates an 'Almost Certain' occurrence.

When determining *likelihood*, it was also important to identify if something would be recurrent impact or a slow onset event. This helped to determine whether to assign a *likelihood* rating based on a probability of occurrence or a frequency of occurrence. A recurrent impact is something that can happen more than once – such as a flood event or infrastructure damage. A slow onset impact is one

that evolves gradually from incremental changes occurring over many years of from an increased frequency or intensity of recurring events. This could include events such as a loss of biodiversity, a species becoming endangered, or long-term move of or displacement of a population. The *likelihood* matrix is presented below.

Table 4: Likelihood Matrix

Likelihood	Rating	Recurrent Impact	Slow Onset
Almost Certain	5	At least once per year (Annual chance: 100%)	Almost certain - 95% or greater chance of occurrence in next 50 years
Likely	4	Once in 1 to 5 years (Annual chance: 20%-100%)	Likely - 65% to 90% chance of occurrence in next 50 years
Possible	3	Once in 5 to 10 years (Annual chance: 10% to 20%)	Possible - 35%-65% chance of occurrence in next 50 years
Unlikely	2	Once in 10 to 50 years (Annual chance: 2% to 10%)	Unlikely - 5% to 35% chance of occurrence in next 50 years
Very unlikely	1	Once in 50 years or more (Annual chance: <2%)	Very unlikely - less than 5% chance of occurrence in next 50 years

Consequence

The second part of the risk assessment involved assessing the *consequence* of each impact. Completed by the AWG at the Risk Assessment Workshop, participants assigned a *consequence* rating ranging from negligible (1) to catastrophic (5) for each of the *consequence* criteria. These criteria were divided into social, economic, and environmental categories, as shown in the figure below. In addition to the numerical score, participants were asked to provide justifications for the ratings. The detailed consequence tables can be found in Appendix B. After the workshop, the Project Team validated the scores and addressed any gaps.

Table 5: Consequence Categories

Social Factors	Economic Factors	Environmental Factors
Health and Safety	Property Damage	Air
Displacement	Local Economy and Growth	Soil and Vegetation
Loss of livelihood	Community Livability	Water
Cultural Aspects	Public Administration	Ecosystem Function

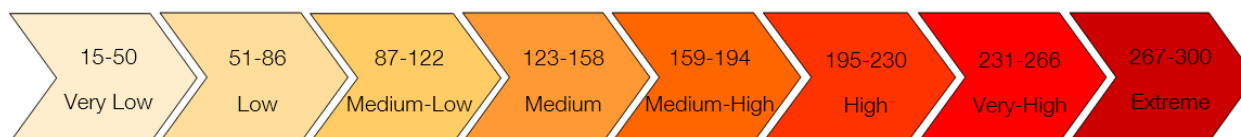
Risk Spectrums

The evaluation of *likelihood* and *consequence* resulted in risk scores for each consequence category (e.g., social, economic, and environmental) as well as one overall risk score. The level of risk per consequence category was calculated using the spectrum below:

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The total risk score (the sum of each risk category score multiplied by *likelihood* of the impact occurring) was obtained using the spectrum below:



The purpose of providing one overall risk score, as well as three category-specific risk scores, is to try and capture certain impacts that may score high in certain categories, but low in other categories. This is intended to ensure the impacts that may pose a high risk to certain aspects of the Town will still be captured, despite having a lower overall risk score.

Limitations of the Risk Assessment

It is important to recognize the subjective nature of the risk assessment process. The results rely on the professional expertise and lived experiences of the participants, who evaluated the risks that impacts pose to the Town's infrastructure, services, environment, and community. Outputs of this exercise are dependent on those that participated in the assessment. While great effort was made to engage key stakeholders in the Town and in the community, it is possible that. It is also important to acknowledge that the impact statements themselves are also subjective, however, great effort was made to ensure the lists were both inclusive and exhaustive, captured how climate change could impact the Town.

RISK ASSESSMENT RESULTS

For the Town of East Gwillimbury, 29 impact statements were brought forward to the risk assessment. The distribution of the Risk Assessment results is displayed in Table 6. These results are discussed below, with the complete breakdown of the results shown in detail in Appendix C.

Table 6: Risk Assessment Ranking Distribution

Risk Ranking	Number of Impacts
High	1
Medium-High	7
Medium	3
Medium-Low	15
Low	3

High-Ranking Impacts

There were no “extreme” impacts identified. This is not unusual in the risk assessment process, as an impact will rarely rank high or extreme across all three risk categories (e.g., social, environmental, and economic). The highest overall risk score of 225 was attributed to Impact #19 which highlights changing precipitation patterns and rising temperatures creating favorable conditions for pests and weeds, necessitating increased use of herbicides and pesticides to maintain crop yields. Runoff of these chemicals into waterways can deteriorate water quality, disrupt aquatic ecosystems, degrade soil health, and disrupt vegetation. A community with a strong agricultural base, East Gwillimbury is particularly vulnerable to this impact due to its interconnected effects on the natural environment (aquatic ecosystems, soil health, vegetation), the social systems (economic losses for farmers, health risks), and the built environment (water quality management systems).

Medium-High Ranking Impacts

The seven impacts (#2, #9, #18, #22, #23, #28, and #32) that received this ranking primarily focus on the consequences of rising temperatures, changing precipitation patterns, and increased extreme weather events. For a detailed review, please refer to Appendix C.

- Impacts #2 and #23 highlight how rising summer temperatures and shifting precipitation disrupt agricultural practices, alter crop patterns, and affect pollinators and local biodiversity.
- Impact #9 underscores public safety and health risks caused by higher average temperatures and more frequent hot days, particularly for vulnerable populations.
- The remaining medium-high impacts collectively emphasize disruptions to transportation and extensive damage to infrastructure, including wastewater systems, septic tanks, power infrastructure, and water pumping facilities, due to extreme weather events such as heavy rainfall, hailstorms, and windstorms.

Medium and Medium-Low Ranking Impacts

The three impacts that received the medium ranking (#3, #6, #17) focus on effects to livestock health and agricultural yield due to rising summer temperature and shifting precipitation patterns, such as drought.

The fifteen impacts that received a medium-low ranking (#1, #7, #8, #10, #11, #12, #14, #15, #16, #24, #26, #27, #30, #31 and #33) collectively focus on cascading effects of rising temperatures, including heat stress, strained infrastructure, and health and safety risks, particularly those in vulnerable groups.

- Impacts #1 and #8 highlight how increasing summer temperatures drive demand for cooling spaces, strain the electrical grid, cause potential power outages, and disrupt essential services.
- Impacts #7 emphasizes how increased hot days (>30°C) cause thermal expansion and drier conditions leading to the deterioration of public infrastructure (e.g., roads, sidewalks, parking lots) and natural assets, requiring more frequent maintenance.
- Impacts #10 and #24 underscore the stressful conditions created by rising summer temperatures and hot days, leading to heat-related illnesses and injuries for outdoor staff and the public, as well as a reduction in outdoor activities, tourism, and potential business closures.

- Impacts #15, #16, #27 and #26 highlight how increased precipitation results in overland flooding, damaging public buildings, assets, and infrastructure, raising insurance premiums, displacing residents, and causing physical and mental health challenges (e.g., injuries, stress, mold exposure).
- Impacts #30, #31, and #33 show how extreme weather events such as heavy rainfall, hailstorms, and windstorms cause health issues, displacement, ecosystem damage, and transportation disruptions, affecting vulnerable populations, businesses, and essential services.
- Impacts #11, #14, and #15 point to rising annual temperatures driving the spread of invasive species, altering species distribution, damaging local flora and fauna, and creating favorable conditions for disease vectors.

Together, these impacts span a range of climate events and categories and underscore the need for adaptive measures to protect public health, community well-being, and essential services.

Low-Ranking Impacts

The three impacts that received this ranking (#13, #25 and #29) were related to early ice thaw affecting water quality and aquatic ecosystems, higher runoff from increased salt use damaging natural systems, and heightened wildfire risks leading to displacement. These were assessed as having minimal risk to the Town at present by the AWG. These were not perceived as having the potential to cause significant harm to the community under current conditions and are likely manageable into the future.

An example of this was impact #29 related to wildfire risks and associated smoke. The working group discussed that this currently poses minimal threat to the Town due to the absence of a history of such events in the area though of course smoke or indirect effects from fires in nearby areas could still have some implications.

Impacts Moving Forward to Planning

The Vulnerability and Risk Assessment process informed the selection of priority impacts that pose a significant threat to the Town of East Gwillimbury. Typically, impacts that scored higher in the assessment process are brought forward into Milestone Three (planning phase) of the BARC Framework. In Milestone Three, the AWG will brainstorm adaptive actions to address the priority impacts. Resources for adaptation planning should be directed towards the highest priority impacts first but designed to address as many impacts as possible whenever feasible.

When selecting priority impacts for the planning phase, the Project Team first included impacts that had an overall risk score of 'Medium' or higher. Next, the Project Team reviewed the 'Medium-Low' ranking impacts to assess whether a subset of these should be brought forward into the planning phase. This was done to ensure that impacts that posed significant risk (i.e. Medium or higher) to one or two specific consequences (e.g. certain individuals, groups, assets, natural areas, etc.) were not left out of the process. The Project Team concluded that four of the fifteen Medium-Low impacts have larger social consequences for the community and are important to better plan for into the future. Finally, Low-ranking impacts were not moved forward as the working group deems that they are typically well-managed to address these over the medium-long term.

It is to be noted that those impacts that were not included in this final, prioritized list will require ongoing monitoring for changes in their likelihood or potential consequences. These impacts may be re-evaluated and reconsidered in future iterations of the Plan as conditions evolve. This approach allows resources to be focused on more pressing issues while maintaining flexibility to address emerging risks.

The final list of 15 impacts to be brought forward to the planning phase are outlined below.

Table 7: Impacts Moving Forward to Planning

Impact Statement	Risk Ranking
Impact 19: Changing precipitation patterns and rising temperatures leading to increased use of herbicides and pesticides and more frequent washouts into waterways, causing contaminated aquatic ecosystems, harming fish and other wildlife, and disrupting the surrounding natural environment (including water quality, soil health and vegetation).	High
Impact 2: Increase in summer temperatures without corresponding summer precipitation resulting in unreplenished wells, affected agricultural practices (e.g. crop rotation), and decreased crop production (particularly lavender farms leading to mental and financial stress to farmers and heightened food insecurity).	Medium-High
Impact 9: Average summer temperatures and increased frequency/duration of hot days (>30°C) leading to increased health and safety risks (e.g. heat stress, domestic violence/violent altercations, cardiovascular disorders, food-borne/water-borne illnesses, etc.). especially for vulnerable populations (e.g. outdoor workers, seniors, women, children, those with chronic health conditions, unhoused, socially isolated, those without AC, etc.) and frontline staff.	Medium-High
Impact 18: Increased frequency and/or intensity of precipitation events (especially in winter and spring) and freezing rain events resulting in rapid melting and refreezing, leading to transportation disruptions and hazardous travelling conditions for all users of the transportation network (e.g. pedestrians, cyclists, public transit users, vehicles, etc.)	Medium-High
Impact 22: Increased intensity and/or frequency of precipitation events causing more frequent breaks in wastewater and sewage treatment plants, leading to more repairs, system disruptions, and elevated bacteria levels, straining both wastewater and septic systems.	Medium-High
Impact 23: Changes in temperatures and precipitation patterns disrupting the natural timing of crop budding, availability of food sources affecting the arrival of pollinators and migratory patterns of birds.	Medium-High
Impact 28: Increased frequency and intensity of extreme weather events (especially freezing rain) causing extensive damage to public infrastructure, assets (e.g. buildings, signs, streetlights, roads, etc.), underground servicing (wastewater management systems, stormwater management systems) and increased maintenance requirements (i.e. more rounds of maintenance, changing schedules, etc.)	Medium-High

MOVING INTO BARC MILESTONE THREE: RECOMMENDATIONS AND NEXT STEPS

Impact Statement	Risk Ranking
Impact 32: Increased frequency and/or intensity of extreme weather events e.g. ice storms, windstorms, thunderstorms, freezing rain, hailstorm, tornado, etc.) causing damage to power infrastructure, leading to power outages causing disruptions to water pumping and wastewater systems.	Medium-High
Impact 3: Increase in average summer temperatures combined with increased humidity leading to mold growth, hay browning, and heat stress in livestock causing increased shedding of bacteria, with higher risk of illness and mortality among animals.	Medium
Impact 6: Increase in heat waves and heat wave duration resulting in the disruption or cancellation of outdoor events, sports, and community gatherings, limiting opportunities for social interaction and recreational activities, and reducing the ability to foster community connections.	Medium
Impact 17: Shifting summer precipitation and increased summer temperatures leading to more drought and/or more rain falling at once, resulting in soil erosion, flooding of agricultural fields, stressed or failed crops, delayed spring planting, reduced ability to work the land, and loss of viable farmland.	Medium
Impact 1: Increase in summer temperatures resulting in increased demand for indoor activities, cooling spaces (i.e. cooling centres, climate-controlled public buildings, air-conditioned businesses, etc.) leading to a strained electrical grid and potential power outages.	Medium-Low
Impact 10: Increased average summer temperatures and increased frequency/duration of hot days (>30°C) creating stressful conditions for East Gwillimbury outdoor staff and frontline workers leading to increased incidences of heat-related illnesses and workplace injuries.	Medium-Low
Impact 12: Increase in average annual temperatures, early snowmelt, and increased precipitation resulting in more ideal conditions for vectors (i.e. more heat, more standing water), leading to increased spread of vector-borne diseases like Lyme disease, West Nile virus, and emerging diseases in the York region such as Anaplasmosis, Babesiosis, and Powassan virus infection.	Medium-Low
Impact 30: Increase in the frequency/intensity of extreme weather events & back-to-back events resulting in higher mental & physical health implications (from hazardous travel/living conditions, displacement/evacuation, emotional loss, power outages, carbon monoxide exposure from fuel-burning devices, unsafe food safety practices, boil advisories, disruptions to social gatherings and social events etc.) for residents, especially those that might be more exposed/sensitive (e.g. seniors, socially isolated, children, those with chronic health conditions, low-income households, etc.).	Medium-Low

The risk assessment marks the completion of Milestone Two of ICLEI's Building Adaptive and Resilient Communities (BARC) Framework for the Town of East Gwillimbury. With this milestone reached, the Town is set to move into Milestone Three starting in January 2025, where the East Gwillimbury Project Team and Adaptation Working Group will focus on the following tasks:

- Establishing a clear vision for climate adaptation
- Setting actionable goals and objectives

Town of East Gwillimbury and Vulnerability Assessment Summary Report

- Brainstorming and prioritizing adaptation actions
- Addressing potential constraints and drivers (e.g. staff capacity, budget considerations, partnerships, etc.).
- Creating a plan for implementation
- Drafting and finalizing the Adaptation Plan

The final outcome of Milestone Three is Thinking Green: East Gwillimbury Climate Change Adaptation Plan. This will include a set of actions that address their prioritized climate impacts, which are discussed in detail in the Risk Assessment Section and Table 7 above.

For each of these actions, an implementation schedule will be created. This should include, at a minimum, the following:

- Responsibilities (i.e. who is to lead and support implementation)
- Existing work and current conditions to build upon
- Immediate next steps
- Baseline data and indicators to measure progress and effectiveness

To support East Gwillimbury in the transition from Milestone Two to Milestone Three, ORCCA has reviewed adaptation actions and practices from municipalities across Canada. Adaptation actions play a critical role in helping communities address the localized impacts of climate change. These actions can be anticipatory, taken before impacts are observed, or reactive, in response to already occurring impacts. In most cases, anticipatory measures are more cost-effective and yield better long-term results.

This review focused on plans, policies, and actions from communities facing similar climatic challenges, as well as recommended actions from key provincial plans, updated reports, case studies, and literature from organizations employing innovative or exemplary approaches to addressing climate impacts. The following municipalities were included in the review:

- [City of Kawartha Lakes](#)
- [City of Hamilton](#)
- [Durham Region](#)
- [Dufferin County](#)
- [City of Burlington](#)
- [Town of Caledon](#)

Additionally, the review incorporated insights from various reports, case studies, and best-practice guides on climate adaptation and resilience, as listed below:

- [Ontario Provincial Climate Change Impact Assessment \(OPCCIA\)](#)
- [Intact Centre - Irreversible Extreme Heat: Protecting Canadians and Communities from a Lethal Future](#)
- [Map of Adaptation Actions](#)

- [Case Studies from ICLEI Canada's Advancing Adaptation Project](#)
- [York Region Climate Change and Health Vulnerability Assessment Report](#)
- [Electricity Canada - Adapting to Climate Change – State of Play and Recommendations for the Electricity Sector in Canada](#)

The review focused on actions to address the prioritized list of climate change impacts moving into Milestone Three, as further discussed in Table 7 earlier in the report. A total of 50 sample actions are presented below. These are organized by its relevant prioritized climate impact.

Note: The specific language for each action has been adapted from its original source.

Infrastructure and Buildings

In recent years, the Town of East Gwillimbury has seen an increase in damage and wear on both municipal infrastructure and private properties. These impacts are linked to more frequent extreme weather events, including heavier rainfall, increased runoff and erosion, more frequent flooding, and changes to freeze-thaw cycles. As these conditions continue to evolve, they will significantly affect the design, construction, management, and maintenance of buildings, road infrastructure, and landscapes. By investing in climate-resilient infrastructure now, the Town can reduce the future costs of climate impacts and safeguard the health and safety of the community. The table below outlines the key impacts related to infrastructure, buildings, and services, along with suggested actions to address them.

Prioritized Impacts Related to Infrastructure and Buildings
Impact 1: Increase in summer temperatures resulting in increased demand for indoor activities, cooling spaces (i.e. cooling centres, climate-controlled public buildings, air-conditioned businesses, etc.) leading to a strained electrical grid and potential power outages.
Impact 18: Increased frequency and/or intensity of precipitation events (especially in winter and spring) and freezing rain events resulting in rapid melting and refreezing, leading to transportation disruptions and hazardous travelling conditions for all users of the transportation network (e.g. pedestrians, cyclists, public transit users, vehicles, etc.)
Impact 22: Increased intensity and/or frequency of precipitation events causing more frequent breaks in wastewater and sewage treatment plants, leading to more repairs, system disruptions, and elevated bacteria levels, straining both wastewater and septic systems.
Impact 28: Increased frequency and intensity of extreme weather events (especially freezing rain) causing extensive damage to public infrastructure, assets (e.g. buildings, signs, streetlights, roads, etc.), underground servicing (wastewater management systems, stormwater management systems) and increased maintenance requirements (i.e. more rounds of maintenance, changing schedules, etc.)
Impact 32: Increased frequency and/or intensity of extreme weather events e.g. ice storms, windstorms, thunderstorms, freezing rain, hailstorm, tornado, etc.) causing damage to power

infrastructure, leading to power outages causing disruptions to water pumping and wastewater systems.

Action Option	Source	Impacts Addressed
Conduct a vulnerability assessment of urban infrastructure such as roads, culverts, bridges, and power lines focusing on their susceptibility to washouts and extreme weather events using tools like the Public Infrastructure Engineering Vulnerability Committee (PIEVC) Protocol.	OPCCIA Report, City of Hamilton	18, 28, 22, 28, 32
Revise engineering standards for roads and bridges to use climate-resilient materials and techniques, like elevated roads, reinforced foundations, and permeable surfaces, prioritizing upgrades based on vulnerability assessments.	Adapted from Town of Caledon, Dufferin County	18
Enhance public awareness during hazardous conditions by providing real-time updates on road conditions, outages, service disruptions, and facility closures through platforms like radio, social media, and mobile apps.	ORCCA Team	1, 18, 22, 38, 32
Work with local groups to create a communication campaign outlining the benefits of work-from-home option during extreme weather and consider safer transportation options for essential works who must be on-site.	City of Hamilton	1, 18
Establish priority response and power restoration protocols, including the provision of backup power, to protect wastewater systems during power outages caused by extreme weather, ensuring service continuity and minimizing disruptions.	Adapted from State of Play and Recommendations for Electricity Sector in Canada	22, 32
Increase green space and improve stormwater management by planting urban street trees, incorporating parkland with features like rain gardens and permeable surfaces, and applying low-impact development (LID) practices such as bioswales, green roofs, and vegetative swales.	Adapted from Dufferin County, Town of Caledon, Map of Adaptation Actions: Township of Nipigon , City of Brampton	22, 28

Develop contingency responses for power outages by collaborating with utility companies on power infrastructure vulnerability assessments and diversifying energy backups.	ORCCA Team	1, 32
Integrate green infrastructure and climate change considerations into East Gwillimbury's Asset Management Plan by embedding dedicated budgets and/or creating a natural asset inventory.	Adapted from Dufferin County, Town of Caledon	28, 22
Update the Town's Thinking Green! Development Standards Program (TGDS) to require new municipal buildings and renovations to meet net-zero carbon and climate resiliency standards by incorporating eligible retrofits such as energy efficiency upgrades (e.g., windows, insulation, air sealing), renewable energy installations (e.g., heat pumps, solar panels), and flood prevention measures (e.g., backwater valves, rain gardens, and reduced impervious surfaces).	Adapted from Town of Caledon, Dufferin County	18, 22, 28, 32
Enhance the Town's Salt Management Plan to minimize salt use in ecologically and agriculturally sensitive areas, consider salt alternatives and pilot new approaches/ technologies.	Town of Caledon	18, 29
Implement business continuity planning and staff training for all employees to ensure they can effectively adapt to extreme weather events keeping services running smoothly.	Adapted from Dufferin County	1, 28
Prune and remove trees or branches near critical infrastructure to minimize the risk of ice-laden limbs causing damage during freezing rain events.	ORCCA Team	18, 28
Enhance water quality monitoring near treatment plants and septic systems to promptly detect and address elevated bacteria levels during extreme weather events.	ORCCA Team	22, 32

Agriculture and the Natural Environment

Changing seasonal patterns, water availability, extreme weather events, and pests and diseases pose significant challenges to East Gwillimbury's agricultural sector and natural environment. The Town of East Gwillimbury has a rich natural heritage and a vibrant agricultural community, which is inherently sensitive to the impacts of a changing climate. Rising temperatures, shifting precipitation patterns, and increasing frequency and intensity of severe weather events are expected to affect crops, livestock, and biodiversity. The actions outlined below aim to manage, rehabilitate, and enhance natural systems that support the farming community, strengthening resilience to climate change in East Gwillimbury.

Prioritized Impacts Related to Agriculture and the Natural Environment
Impact 2: Increase in summer temperatures without corresponding summer precipitation resulting in unreplenished wells, affected agricultural practices (e.g. crop rotation), and decreased crop production (particularly lavender farms leading to mental and financial stress to farmers and heightened food insecurity).
Impact 3: Increase in average summer temperatures combined with increased humidity leading to mold growth, hay browning, and heat stress in livestock causing increased shedding of bacteria, with higher risk of illness and mortality among animals.
Impact 17: Shifting summer precipitation and increased summer temperatures leading to more drought and/or more rain falling at once, resulting in soil erosion, flooding of agricultural fields, stressed or failed crops, delayed spring planting, reduced ability to work the land, and loss of viable farmland.
Impact 19: Changing precipitation patterns and rising temperatures leading to increased use of herbicides and pesticides and more frequent washouts into waterways, causing contaminated aquatic ecosystems, harming fish and other wildlife, and disrupting the surrounding natural environment (including water quality, soil health and vegetation).
Impact 23: Changes in temperatures and precipitation patterns disrupting the natural timing of crop budding, availability of food sources affecting the arrival of pollinators and migratory patterns of birds.

Action Options	Source	Impacts Addressed
Investigate innovative drainage techniques for managing flooding and runoff issues on agricultural lands such as controlled drainage systems, swales and berms, subsurface drip irrigation, etc.	City of Hamilton, OCCPIA	19, 17
Collaborate with conservation authorities, Parks Canada, academic institutions, and community organizations to expand tree planting, naturalization, and research on agricultural best management practices while connecting farmers with researchers to enhance resilience.	City of Hamilton, Dufferin County, Durham Region, Town of Caledon, OPCCIA	19,23, 17
Increase tree planting and restoration of wetlands, streams, and meadows on public lands including Town-owned Parks, conservation Areas, public right of ways and other areas.	Town of Caledon	19, 17
Increase financial and wellness support for farmers to install sustainable and resilient management practices (e.g., Sustainable Canadian Agricultural	City of Kawartha Lakes	19, 2, 17

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Partnership Program – Environmental Farm Plan, and other provincial programs).		
Develop agricultural adaptation strategy/plan that focuses on water management and drought resilience and consider soil health practices that mitigate erosion and enhance water retention capabilities.	Adapted from Durham Region	2, 17, 23
Promote green infrastructure such as cover crops, hedgerows, and rain gardens to reduce soil erosion, enhance water retention, and mitigate the impacts of extreme rainfall events.	Durham Region	2, 17, 19
Utilize agri-food asset mapping to assess vulnerability in rural areas and identify areas where water infrastructure (e.g., wells) can be improved to handle increased demand during dry periods.	Durham Region	2, 17, 19
Explore adaptive agricultural measures, including diversifying production and utilizing cover crops, to leverage a longer growing season and increased atmospheric CO ₂ and nitrogen, boosting yields and enabling additional plantings of crops like corn, soybeans, and wheat.	Adapted from Durham Region	2, 17, 23
Engage with local agricultural leaders to understand existing resources for farmers in addressing climate adaptation, and how the Town can support or expand on those efforts.	City of Hamilton	2, 17, 23
Partner with veterinary services to offer health check-ups and resources for managing heat stress in livestock.	ORCCA team	3
Consider green infrastructure enhancements on farms, such as planting hedgerows and natural systems to provide shade and regulate temperatures, reducing heat stress on livestock.	Durham Region	3
Work with local agricultural and environmental groups to monitor changes in pollinator and bird patterns and adapt practices accordingly.	City of Hamilton	23
Promote integrated land-use practices on agricultural properties that include natural systems to support biodiversity, such as planting native species that benefit pollinators and wildlife.	Durham Region	23
Launch local campaigns to engage the community on protecting pollinators and their habitats.	ORCCA team	23
Support community agriculture initiatives to enhance local food security (e.g. community gardens, farmer's	Town of Caledon, City of Hamilton	2

markets, Farm-to-schools/restaurants/grocery store programs, etc.).		
Host and promote workshops, training, and informational sessions in partnership with local agricultural stakeholders, academic institutions, and organizations like the Ontario Federation of Agriculture (OFA), to share climate adaptation knowledge, best practices for livestock producers, and strategies for extreme weather preparedness and emergency management for farmers.	Adapted from Durham Region, Town of Caledon, Dufferin County	2, 3, 17, 19, 23
Engage local agricultural community through meetings or social gatherings to identify greater collaboration opportunities (e.g. assisting them in completing funding applications, promoting agritourism/agribusinesses, etc.) in the Town.	Adapted from City of Hamilton	2, 17
Raise awareness among agricultural staff about climate change challenges and equip them with knowledge to support farmers.	ORCCA Team	2, 17, 19, 3

People and Health

Climate change presents both direct and indirect risks to the health and safety of East Gwillimbury's community members. Direct health risks stem from severe weather events like floods, storms, and heatwaves. Indirect risks are influenced by a variety of social, environmental, cultural, and economic factors that impact overall health.

It is important to recognize that these health risks are not felt equally across the community. Certain groups are more vulnerable to the effects of climate change, including but not limited to:

- Seniors
- Children
- Youth
- Indigenous and racialized populations
- 2SLGBTQIA+ individuals
- Recent immigrants and refugees
- Outdoor workers
- People experiencing homelessness
- Socially and physically isolated individuals
- People with low socio-economic status
- Individuals with low literacy
- Those with chronic health conditions

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- People experiencing mental health challenges
- Individuals with disabilities

The list of actions below can help mitigate these impacts and strengthen East Gwillimbury's resilience to the growing health and safety threats posed by climate change.

Prioritized Impacts Related to Public Health and Safety
Impact 6: Increase in heat waves and heat wave duration resulting in the disruption or cancellation of outdoor events, sports, and community gatherings, limiting opportunities for social interaction and recreational activities, and reducing the ability to foster community connections.
Impact 9: Average summer temperatures and increased frequency/duration of hot days (>30°C) leading to increased health and safety risks (e.g. heat stress, domestic violence/violent altercations, cardiovascular disorders, food-borne/water-borne illnesses, etc.). especially for vulnerable populations (e.g. outdoor workers, seniors, women, children, those with chronic health conditions, unhoused, socially isolated, those without AC, etc.) and frontline staff.
Impact 10: Increased average summer temperatures and increased frequency/duration of hot days (>30°C) creating stressful conditions for East Gwillimbury outdoor staff and frontline workers leading to increased incidences of heat-related illnesses and workplace injuries.
Impact 12: Increase in average annual temperatures, early snowmelt, and increased precipitation resulting in more ideal conditions for vectors (i.e. more heat, more standing water), leading to increased spread of vector-borne diseases like Lyme disease, West Nile virus, and emerging diseases in the York region such as Anaplasmosis, Babesiosis, and Powassan virus infection.
Impact 30: Increase in the frequency/intensity of extreme weather events & back-to-back events resulting in higher mental & physical health implications (from hazardous travel/living conditions, displacement/evacuation, emotional loss, power outages, carbon monoxide exposure from fuel-burning devices, unsafe food safety practices, boil advisories, disruptions to social gatherings and social events etc.) for residents, especially those that might be more exposed/sensitive (e.g. seniors, socially isolated, children, those with chronic health conditions, low-income households, etc.).

Action options	Source	Impacts Addressed
Regularly update municipal plans and policies to mitigate health and safety risks for outdoor workers during extreme weather by adjusting work schedules,	Adapted from City of Hamilton	10, 9

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and reviewing worker training on recognizing heat stress, implementing preventive measures, and ensuring access to emergency medical care during extreme heat events.		
Collaborate with existing networks, such as York Region and community service organizations, to better identify and address the needs of vulnerable populations in preparing for climate-related health risks.	Adapted from City of Kawartha Lakes, City of Hamilton,	9, 12, 30
Update the Town's communication strategy to deliver climate change and extreme weather alerts (e.g., flooding, heat waves) via email, phone, and text, while coordinating with key partners to avoid duplication.	Adapted from City of Kawartha Lakes	9, 12, 30
Develop a toolkit, with educational campaigns that address the risks associated with climate change (e.g., health impacts, property damage), and provide actionable steps for residents to prepare and respond.	Adapted from City of Hamilton, Dufferin County	9, 30
Establish community support programs, such as buddy systems or neighborhood connections, to facilitate assistance with tasks like checking in on neighbors, providing transportation, or offering supplies, ensuring the safety and well-being of individuals at higher risk, including seniors, people with disabilities, and those living in isolation.	Adapted from ICLEI Canada's Advancing Adaptation Case Studies: Greater Sudbury Strong Neighbourhood Initiative, City of London	6, 9, 30
Establish a program to distribute household emergency kits and increase uptake among vulnerable populations through community partnerships such as schools, libraries, religious institutions, etc.	Adapted from City of Hamilton, Dufferin County	6, 9, 30
Create educational campaigns to communicate the risks of climate change, such as health impacts and property damage, and provide residents with actionable steps to prepare, including utilizing Low Impact Development (LID) techniques like rain gardens, permeable pavements, green roofs, and rainwater harvesting systems to manage stormwater, reduce flooding, and improve water quality on their properties.	Adapted from City of Hamilton	9, 30
Improve internal monitoring, data collection, and notification surrounding flooding & extreme weather/temperatures.	City of Hamilton	9, 30
Collaborate with local conservation authority to plant and maintain trees and implement blue-green infrastructure strategies, such as green corridors and	Adapted from Intact Centre on Climate Adaptation	9

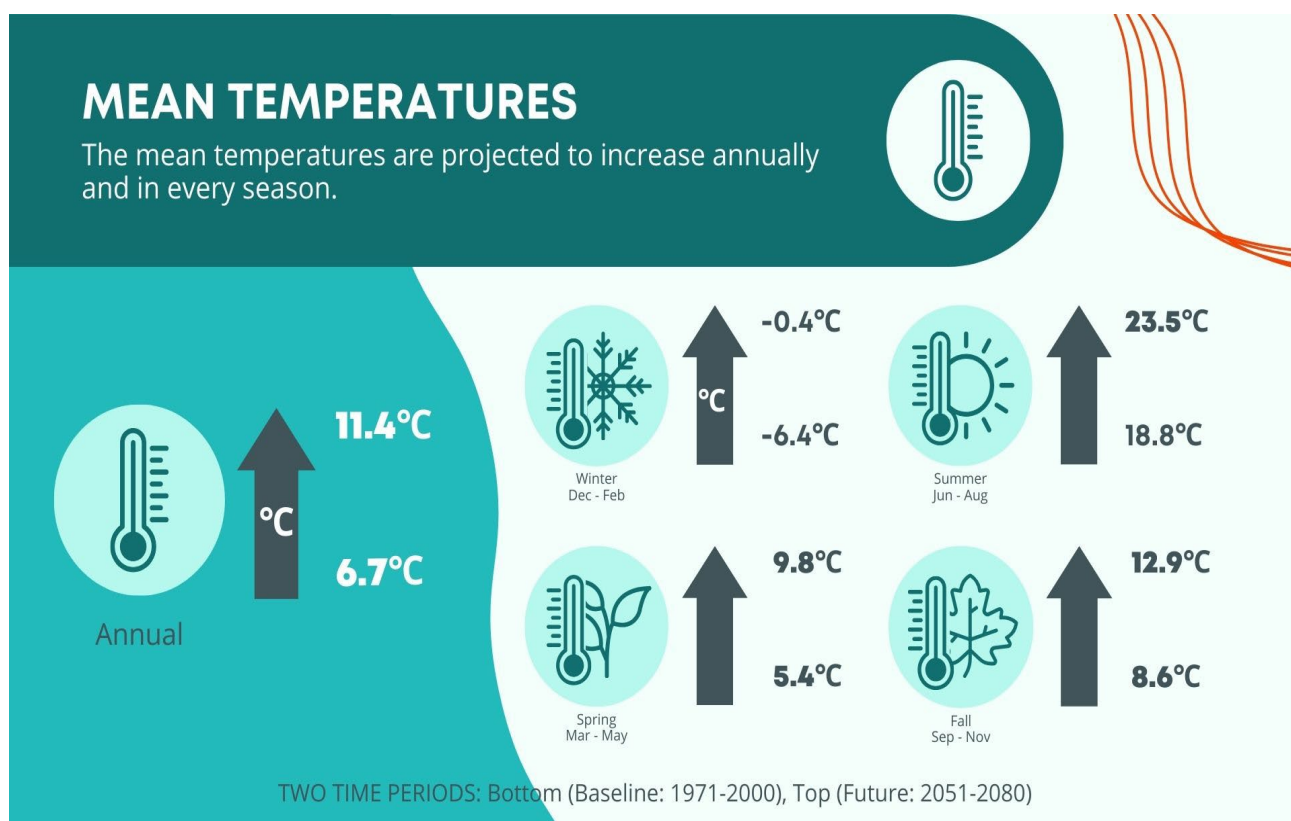
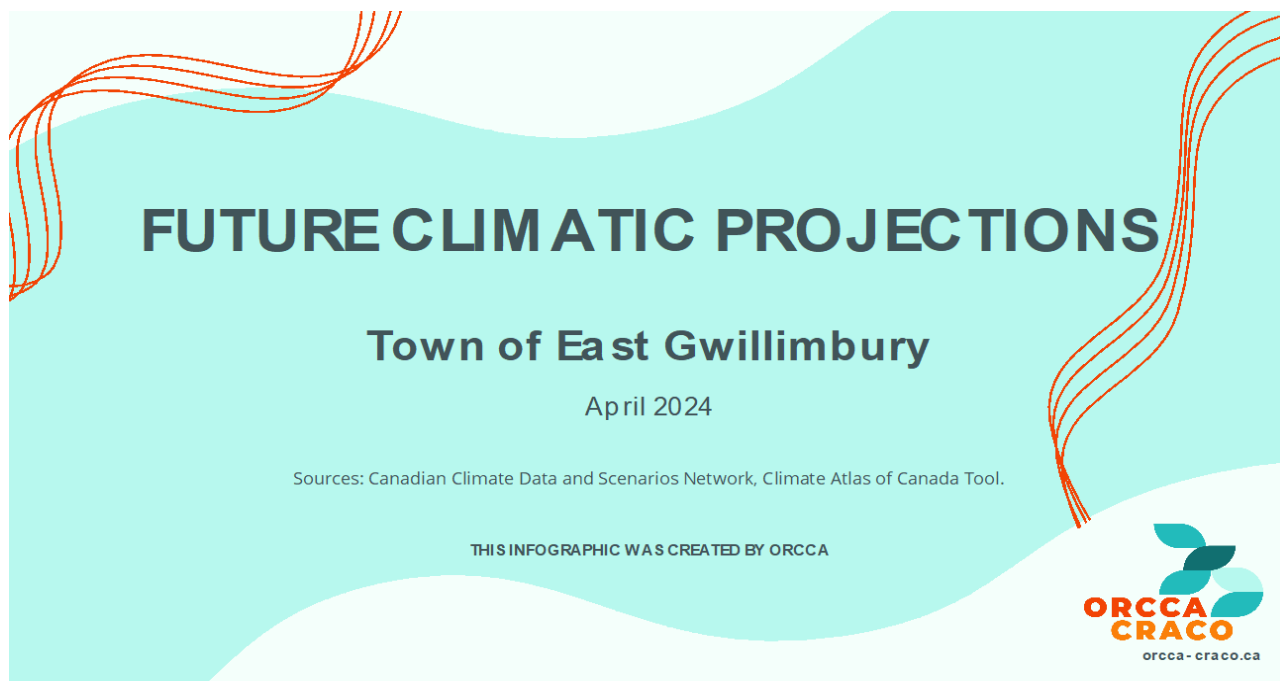
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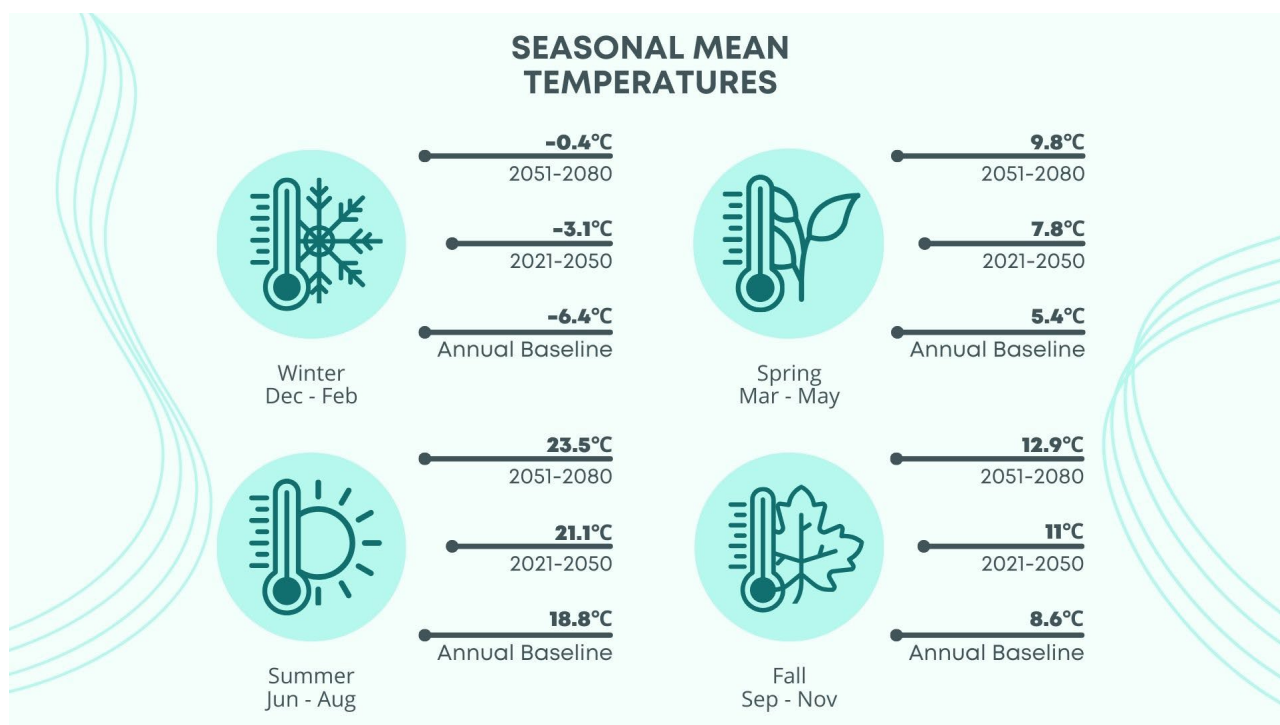
stormwater management, to mitigate heat impacts, enhance biodiversity, and provide recreational opportunities while addressing flood and erosion risks.		
Set up and expand cooling and warming center programs by designating accessible areas of refuge, such as town halls, libraries, community centers, places of worship, and high/medium-rise buildings, to provide vulnerable populations—especially seniors, those without AC, and the unhoused—access to relief during extreme weather events.	Adapted from City of Hamilton, City of Kawartha Lakes, Dufferin County	9,30
Set up more public water refill stations, shading seating/playground areas, splash pads or misting stations in Town parks and playgrounds and at community events during summer.	ORCCA team	6, 9, 10, 30
Conduct training on social vulnerabilities and resilience for emergency response staff, volunteers, and health practitioners.	Dufferin County	9, 30, 12
Collaborate with York Region Public Health to enhance tick and mosquito surveillance and investigate standing water complaints, conducting larviciding on breeding sites during summer.	Adapted from York Region Climate Change and health Vulnerability Assessment	10, 12
Offer workshops and create online materials to educate the public, particularly vulnerable groups (e.g., homeless populations, children in summer day camps and school boards), on minimizing tick exposure by identifying tick habitats, properly using tick-repellent products, and adopting preventive measures during outdoor activities, especially during peak tick seasons.	Adapted from York Region Climate Change and health Vulnerability Assessment	10, 12
Direct residents to heat relief services and mental health support provided by York Region such as York Region Homelessness Community Programs, drop-in programs, etc.	Adapted from York Region Heat Relief Strategy for People Experiencing Homelessness	9, 30
Integrate disease vector risks into the design of stormwater infrastructure by considering measures to prevent standing water or ponding.	Adapted from York Region Climate Change and health Vulnerability Assessment	12
Support local venues, parks, and recreational spaces in installing heat-resilient infrastructure, such as tree	ORCCA Team	6, 9, 30

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canopies, cooling tents, or portable air conditioning units for large events, sports fields, and outdoor gathering areas.		
Install backup power systems, like generators, at cooling centers and key community facilities to ensure continued service during power outages caused by extreme heat events.	Adapted from Intact Centre on Climate Adaptation	6, 30
Integrate climate change, energy management, and natural heritage into the Town's Economic Development Strategy and its implementation.	Town of Caledon	6, 10

Appendix A – Climate Science Infographic





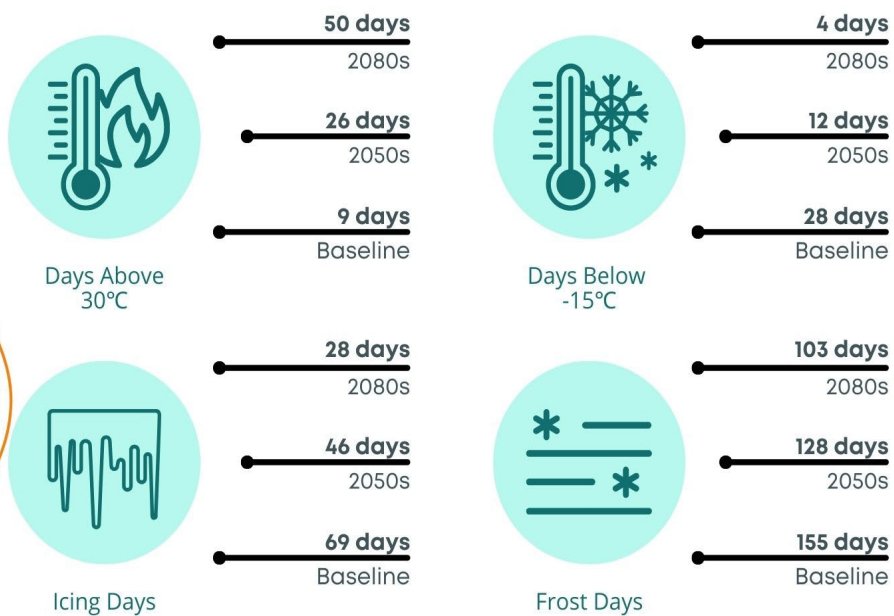
TEMPERATURES EXTREMES

Extreme heat is projected to increase annually and Ice Days, days that do not exceed 0°C, are expected to decrease.



TWO TIME PERIODS: Bottom (Baseline: 1971-2000), Top (Future: 2051-2080)

TEMPERATURE EXTREMES



MEAN PRECIPITATION

Annual precipitation is expected to increase. All seasons except for summer are projected to get significantly wetter.



Annual

901 mm

795 mm



Winter
Dec - Feb

217 mm

178 mm



Summer
Jun - Aug

229 mm

222 mm



Spring
Mar - May

232 mm

199 mm



Fall
Sep - Nov

244 mm

220 mm

TWO TIME PERIODS: Bottom (Baseline: 1971-2000), Top (Future: 2051-2080)

SEASONAL MEAN PRECIPITATION



Winter
Dec - Feb

217 mm

2051-2080

204 mm

2021-2050

178 mm

Baseline



Spring
Mar - May

232 mm

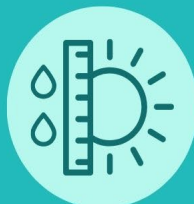
2051-2080

217 mm

2021-2050

199 mm

Baseline



Summer
Jun - Aug

229 mm

2051-2080

232 mm

2021-2050

222 mm

Baseline



Fall
Sep - Nov

244 mm

2051-2080

229 mm

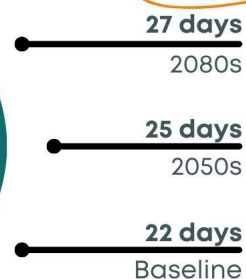
2021-2050

220 mm

Baseline

HEAVY RAINFALL DAYS

Days with precipitation over 10 mm and 20 mm are considered Heavy Rainfall days, and are projected to increase. Data indicated is for days over 10 mm.



PRECIPITATION EVENTS

Precipitation events in general are projected to become more intense and extreme.



Frequency

Precipitation will fall at a faster rate (mm/h)

Intensity

Shorter storms will have an increasingly high intensity

Duration

Return periods of heavy storm will shorten (increased frequency)

GROWING SEASONS

First frost dates will be later, and last frost days will be earlier.



901 mm

2051-2080

860 mm

2021-2050

795 mm

Annual Baseline

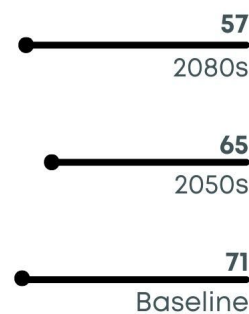


ANNUAL MEAN PRECIPITATION

Annual precipitation is expected to increase. Winter and Spring are projected to get significantly wetter, with a slight decline in the Summer.

ANNUAL MEAN FREEZE-THAW CYCLES

There will be a decrease in freeze-thaw cycles, where the daily maximum temperature is higher than 0°C and the daily minimum temperature is less than or equal to -1°C



Appendix B – Risk Assessment Materials

CONSEQUENCE TABLES

Social Factors

CONSEQUENCE RATING	SOCIAL FACTORS			
	Public Health & Safety	Displacement	Loss of Livelihood	Cultural Aspects
Catastrophic	Large number of fatalities or serious injuries, or permanent illness	Large number of permanently displaced people on a widespread scale	Large disturbances leading to permanent changes in people's normal routines and way of life	Unprecedented loss of cultural identity (i.e. traditions and customary practices) across the wider community (i.e. cancellation of flagship annual event)
	5	5	5	5
Major	Isolated instances of fatalities or serious injuries, or long-term illness	Isolated instances of permanently displaced people on a widespread scale	Large disturbances leading to prolonged changes in people's normal routines and way of life	Significant loss of cultural identity (i.e. traditions and customary practices) for multiple social groups
	4	4	4	4
Moderate	Small number of injuries or cases of illness	Isolated instances of temporary displaced people on a widespread scale	Moderate disturbances leading to short-term changes in people's normal routines and way of life	Moderate impact on cultural identity (i.e. traditions and customary practices) for multiple social groups
	3	3	3	3
Minor	Near misses or minor injuries	Isolated instances of temporary displaced people in localized areas	Minor and short-term changes to people's normal routines and way of life	Minor impact on cultural identity (i.e. traditions and customary practices) for a small number of social groups
	2	2	2	2
Negligible	Appearance of a threat but no actual harm	Appearance of a threat but no actual displacement	No changes to people's normal routine and way of life	Appearance of a threat but no actual impact on cultural identity (i.e. traditions and customary practices)
	1	1	1	1

Economic Factors

CONSEQUENCE RATING	ECONOMIC FACTORS			
	Property Damage	Local Economy & Growth	Community Livability	Public Administration
Catastrophic	Catastrophic damage and costs incurred by the owner (\$\$\$\$\$)	City-scale decline leading to widespread business failure, loss of employment and hardship	Permanent decline in services, causing the city to be seen as very unattractive, moribund, and unable to support the community	Public administration would fall into decay and cease to be effective
	5	5	5	5
Major	Major damage and costs incurred by the owner (\$\$\$\$)	City-scale stagnation such that businesses are unable to thrive	Widespread and severe decline in services and quality of life within the community	Public administration would struggle to remain effective and would be in danger of failing
	4	4	4	4
Moderate	Moderate damage and costs incurred by the owner (\$\$\$)	Isolated areas of reduction in economic performance relative to current forecasts	Isolated but noticeable examples of decline in services	Public administration would be under severe pressure on several fronts
	3	3	3	3
Minor	Minor damage and costs incurred by the owner (\$\$)	Inconveniences that cause minor shortfall relative to current forecasts	There would be minor areas in which the community is unable to maintain its current services	There would be minor instances of public administration being under more than usual stress
	2	2	2	2
Negligible	No damage and costs incurred by the owner (\$)	No real impact to the local economy and growth	No real pressure on current services	No real stress on public administration
	1	1	1	1

Environmental Factors

CONSEQUENCE RATING	ENVIRONMENTAL FACTORS			
	Air	Water	Soil & Vegetation	Ecosystem Function
Catastrophic	Very frequent periods of reduced air quality.	Irreversible, widespread reduction in water quality/quantity	Irreversible, widespread impacts to soil or vegetation	Major and widespread loss of ecological functions and irrecoverable damage
	5	5	5	5
Major	Considerable increase in periods of reduced air quality in the medium term	Major, widespread reduction in water quality/quantity in the medium/long-term	Major, widespread impacts on soil or vegetation in the medium/long-term	Severe and widespread loss of ecological functions and damage that could be reversed with intensive efforts
	4	4	4	4
Moderate	Moderate increase in periods of reduced air quality in the short/medium term	Moderate, widespread reduction in water quality/quantity in the short/medium-term	Moderate, widespread impacts on soil or vegetation in the short/medium-term	Isolated but moderate instances of damage to the ecosystem that could be reversed with intensive efforts
	3	3	3	3
Minor	Minor increase in periods of reduced air quality in the short term	Minor, localized reduction in water quality/quantity in the short-term	Minor, localized impacts on soil or vegetation in the short-term	Isolated but minor instances of damage to the ecosystem that could be reversed
	2	2	2	2
Negligible	Appearance of a threat but no real impact to air quality	Appearance of threat but no real reduction in water quality/quantity	Appearance of threat but no real impacts on soil or vegetation	Appearance of a threat but no real damage to the ecosystem and its functions
	1	1	1	1

Appendix C – Detailed Vulnerability and Risk Assessment Results

Impact ID	Impact Statement	Vulnerability Ranking	Likelihood (/5)	Social Risk Score (/100)	Economic Risk Score (/100)	Environmental Risk Score (/100)	Total Risk Score (/300)	Overall Risk Ranking
1	Impact 1: Increase in summer temperatures resulting in increased demand for indoor activities, cooling spaces (i.e. cooling centres, climate-controlled public buildings, air-conditioned businesses, etc.) leading to a strained electrical grid and potential power outages.	Medium	5	40	40	20	100	Medium-Low
2	Impact 2: Increase in summer temperatures without corresponding summer precipitation resulting in unreplenished wells, affected agricultural practices (e.g. crop rotation), and decreased crop production (particularly lavender farms leading to mental and financial stress to farmers and heightened food insecurity).	High	4	64	48	48	160	Medium-High
3	Impact 3: Increase in average summer temperatures combined with increased humidity leading to mold growth, hay browning, and heat stress in livestock causing increased shedding of bacteria, with higher risk of illness and mortality among animals.	High	4	60	44	44	148	Medium
6	Impact 6: Increase in heat waves and heat wave duration resulting in the disruption or cancellation of outdoor events, sports, and community gatherings, limiting opportunities for social interaction and recreational activities, and reducing the ability to foster community connections.	Medium	4	56	52	40	148	Medium
7	Impact 7: Increased frequency and duration of hot days over 30°C leading to greater public infrastructure and natural asset deterioration (e.g. thermal expansion in roads, sidewalks, parking lots etc. and water requirements for parks, trees, etc.) and increased maintenance requirements (e.g. changing schedules, more maintenance rounds, etc.).	Medium	3	27	36	30	93	Medium-Low

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8	Impact 8: Increased frequency and duration of hot days (>30°C), resulting in increased demand and pressure on electric grid, causing more power outages (blackouts and brown outs) and service disruptions (i.e. business, flow of goods/services, access to essential services like hospitals, airports, long-term care, and food, etc.)	Medium	5	45	40	20	105	Medium-Low
9	Impact 9: Average summer temperatures and increased frequency/duration of hot days (>30°C) leading to increased health and safety risks (e.g. heat stress, domestic violence/violent altercations, cardiovascular disorders, food-borne/water-borne illnesses, etc.). especially for vulnerable populations (e.g. outdoor workers, seniors, women, children, those with chronic health conditions, unhoused, socially isolated, those without AC, etc.) and frontline staff.	High	5	55	50	60	165	Medium-High
10	Impact 10: Increased average summer temperatures and increased frequency/duration of hot days (>30°C) creating stressful conditions for East Gwillimbury outdoor staff and frontline workers leading to increased incidences of heat-related illnesses and workplace injuries.	Medium	5	50	40	20	110	Medium-Low
11	Impact 11: Increase in average annual temperatures driving the spread of invasive species and pests, leading to altered species distribution due to disrupted seasonal cues, drying of wetlands and loss or damage of local flora and fauna.	High	4	28	36	56	120	Medium-Low
12	Impact 12: Increase in average annual temperatures, early snowmelt, and increased precipitation resulting in more ideal conditions for vectors (i.e. more heat, more standing water), leading to increased spread of vector-borne diseases like Lyme disease, West Nile virus, and emerging diseases in the York region such as Anaplasmosis, Babesiosis, and Powassan virus infection.	High	4	36	28	24	88	Medium-Low
13	Impact 13: Increase in winter temperatures leading to early thawing of ice on lakes, rivers, and other water	High	4	16	16	28	60	Low

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	bodies, impacting water quality and availability in the spring and summer months and causing disruption to aquatic ecosystems.							
14	Impact 14: Increased frequency and/or intensity of precipitation events, particularly during the winter and spring seasons, combined with warmer water bodies causing disrupted water ecosystems, leading to more damaged cold-water species habitat, altered species distribution and species die-offs. leading to more damaged cold-water species habitat, altered species distribution and species die-offs.	High	4	24	24	52	100	Medium-Low
15	Impact 15: Increased frequency and/or intensity of precipitation events causing overland flooding, leading to increased damage to public buildings, assets, and infrastructure (e.g. roads, sidewalks, parks, signs, trails, etc.)	High	3	30	36	42	108	Medium-Low
16	Impact 16: Increased frequency and/or intensity of precipitation events causing overland flooding, resulting in rising insurance premiums for residents.	Low	3	39	39	33	111	Medium-Low
17	Impact 17: Shifting summer precipitation and increased summer temperatures leading to more drought and/or more rain falling at once, resulting in soil erosion, flooding of agricultural fields, stressed or failed crops, delayed spring planting, reduced ability to work the land, and loss of viable farmland.	High	3	39	51	48	138	Medium
18	Impact 18: Increased frequency and/or intensity of precipitation events (especially in winter and spring) and freezing rain events resulting in rapid melting and refreezing, leading to transportation disruptions and hazardous travelling conditions for all users of the transportation network (e.g. pedestrians, cyclists, public transit users, vehicles, etc.)	Medium	5	55	65	55	175	Medium-High
19	Impact 19: Changing precipitation patterns and rising temperatures leading to increased use of herbicides and pesticides and more frequent washouts into	High	5	75	60	90	225	High

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	waterways, causing contaminated aquatic ecosystems, harming fish and other wildlife, and disrupting the surrounding natural environment (including water quality, soil health and vegetation).							
22	Impact 22: Increased intensity and/or frequency of precipitation events causing more frequent breaks in wastewater and sewage treatment plants, leading to more repairs, system disruptions, and elevated bacteria levels, straining both wastewater and septic systems.	High	5	55	65	55	175	Medium-High
23	Impact 23: Changes in temperatures and precipitation patterns disrupting the natural timing of crop budding, availability of food sources affecting the arrival of pollinators and migratory patterns of birds.	High	5	55	55	60	170	Medium-Low
24	Impact 24: Long-term changes in weather patterns, such as shifts in temperature, precipitation, and increased extreme weather events leading unfavorable out door conditions and water quality leading to reduced/closures of outdoor activities (e.g. fishing, bird-watching, cycling, trails, playgrounds, baseball fields, winter recreation, etc.), reduced tourism, and potential business closures.	Medium	3	39	42	30	111	Low
25	Impact 25: Increased winter precipitation causing change and/or increase in salt use patterns leading to higher runoff causing deterioration or damage to natural systems (e.g. altered soil composition, increased aquatic salinity, toxic effects to wildlife, reduced water quality, etc.)	High	3	15	21	45	81	Medium-Low
26	Impact 26: Increased frequency and severity of precipitation events leading to more overland, riverine, and basement flooding causing displacement of residents and potential physical and mental health implications (i.e. injuries, waterborne diseases, chemical exposure, mold exposure, stress and anxiety, etc.).	Medium	3	45	39	33	117	Medium-Low

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27	Impact 27: Increased frequency and/or severity of precipitation events leading more overland, riverine flooding, and basement flooding leading to increased damage of private assets and infrastructure (e.g. vehicles, homes, businesses, inventory/goods, etc.)	Medium	3	36	39	36	111	Medium-Low
28	Impact 28: Increased frequency and intensity of extreme weather events (especially freezing rain) causing extensive damage to public infrastructure, assets (e.g. buildings, signs, streetlights, roads, etc.), underground servicing (wastewater management systems, stormwater management systems) and increased maintenance requirements (i.e. more rounds of maintenance, changing schedules, etc.)	Medium	5	50	75	50	175	Medium-High
29	Impact 29: Increase in average annual temperatures and changing precipitation patterns resulting in greater wildfire risk and wildfire smoke, leading to more displacement and evacuation of community members and increased physical and mental health impacts (e.g. physical injuries, respiratory conditions, stress, anxiety, trauma, etc.)	Low	2	22	16	20	58	Low
30	Impact 30: Increase in the frequency/intensity of extreme weather events & back-to-back events resulting in higher mental & physical health implications (from hazardous travel/living conditions, displacement/evacuation, emotional loss, power outages, carbon monoxide exposure from fuel-burning devices, unsafe food safety practices, boil advisories, disruptions to social gatherings and social events etc.) for residents, especially those that might be more exposed/sensitive (e.g. seniors, socially isolated, children, those with chronic health conditions, low-income households, etc.).	Medium	3	39	42	36	117	Medium-Low
31	Impact 31: Increase in the frequency and/or intensity of extreme weather events (e.g. ice storms, windstorms, thunderstorms, freezing rain, hailstorm, tornado, etc.)	High	3	27	39	45	111	Medium-Low

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	causing significant soil erosion and damage to trees and the canopy, resulting in uprooted, broken, and severely damaged trees with long-term impacts such as slow canopy recovery and the loss of essential ecosystem services like shade, flood attenuation, and air quality improvement.							
32	Impact 32: Increased frequency and/or intensity of extreme weather events e.g. ice storms, windstorms, thunderstorms, freezing rain, hailstorm, tornado, etc.) causing damage to power infrastructure, leading to power outages causing disruptions to water pumping and wastewater systems.	High	5	60	70	45	175	Medium-High
33	Impact 33: Increase in the frequency and/or intensity of extreme weather events e.g. ice storms, windstorms, thunderstorms, freezing rain, hailstorm, tornado, etc.) resulting in increased damage/disruption of transportation networks (active, vehicular, transit) leading to disruptions to traffic/commutes, local business, emergency services, and other essential services (i.e. food systems, medical care/hospitals, airports, etc.).	High	3	30	45	12	87	Medium-Low