

C O R P O R A T E

# Climate Change Adaptation Plan



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# Foreword

Climate change is already impacting global economies, communities, and built and natural environments. It remains the most significant global threat to quality of life and security – for current and future generations. Bold and collective action at global, national, and community levels is required to effect change, build resilience, mitigate future threats, and ensure a prosperous future for generations to come.

The Town of Lincoln aims to take such action and contribute to the global shift towards sustainable growth and resilience. The Corporate Climate Adaptation Plan (CCAP) was developed by the Town of Lincoln as a guideline to support and inform climate adaptation at the Corporate municipal level. It outlines how the municipality as a corporation will adapt its assets, operations, and services to the current and future impacts of climate change.

The CCAP includes 47 actions that the municipality will undertake to adapt to climate change. These actions contribute to eight high-level goals that the Town will strive towards as it implements the CCAP. The Goals are:

- Goal 1:** Integrate climate change considerations into Town strategies, plans, policies, procedures, operations, & services
- Goal 2:** Increase resiliency & adaptive capacity within economic development, community services, parks, & recreation
- Goal 3:** Protect natural resources, promote ecosystem services, & minimize environmental degradation
- Goal 4:** Mitigate harmful consequences of extreme weather & emergency events
- Goal 5:** Minimize health & safety risks to community members and staff
- Goal 6:** Foster Lake Ontario shoreline resilience through planning, management & protection
- Goal 7:** Consider climate change impacts in built infrastructure & asset management
- Goal 8:** Increase climate change literacy among staff & public

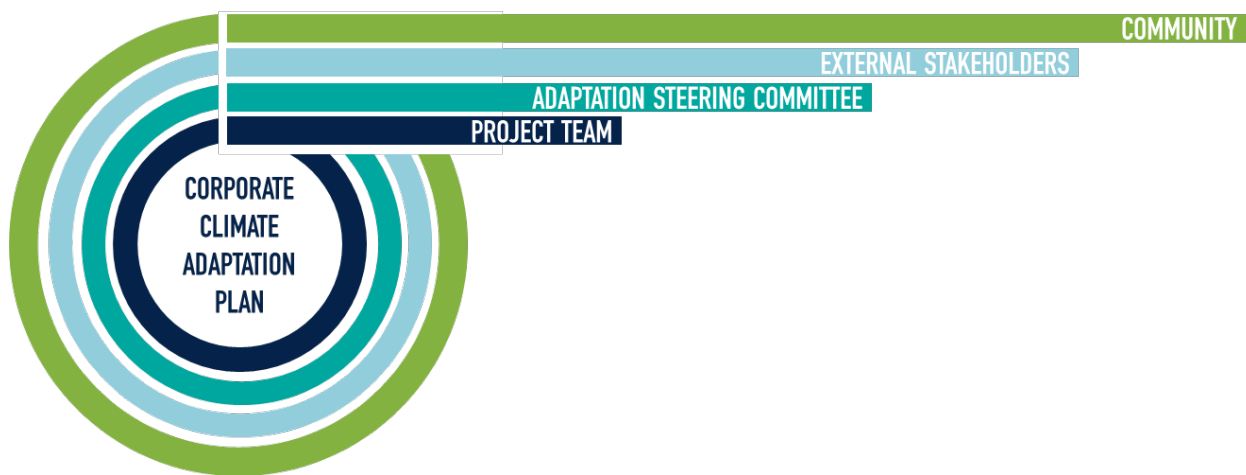
The CCAP is intended to be a living document and will be updated annually to reflect implementation progress, new opportunities, and scientific advancements.



# Acknowledgements

The Town of Lincoln Corporate Climate Adaptation Plan (CCAP) was developed with the support and funding provided by Infrastructure Canada through the Federation of Canadian Municipalities (FCM) and the Municipalities for Climate Innovation Program (MCIP). The Town would like to thank FCM, the coaches, and the Community of Practice for their support, guidance, and expertise.

This CCAP was a collaboration between Council, Niagara Adapts, municipal staff, members of the Adaptation Steering Committee, and many community stakeholders. The Project Team would like to thank all those who contributed their time, expertise, and support.



*Climate Adaptation Planning Contributors*

## Project Team

**Shannon Fernandes**, Climate Change Coordinator, Town of Lincoln  
**Gillian Harris**, Manager, Environmental Services, Town of Lincoln

## Council

The Project Team would like to thank the Town of Lincoln Council. Their ongoing support, input, and expertise were instrumental in the development of the CCAP and championing climate action in Lincoln.



## Niagara Adapts

Niagara Adapts is a novel partnership between Brock University and municipalities in the Niagara Region. The partnership is designed to enhance effectiveness and realize efficiencies by leveraging resources and expertise to enable collaborative climate change adaptation assessment, planning and implementation, while at the same time acknowledging and supporting the uniqueness of each participating municipality. The Project Team would like to acknowledge the staff, administration, municipal partners, and stakeholders at Brock University and the Environmental Sustainability Research Centre including:

**Dr. Ryan Plummer**, Director

**Dr. Jessica Blythe**, Assistant Professor

**Amanda Smits**, Centre Administrator

**Angela Mallette**, Research Assistant

**Michaela Jennings**, Research Assistant

## Adaptation Steering Committee

To ensure the CCAP reflects staff expertise and corporate priorities, and can ultimately be integrated into departmental functions, findings were derived from or refined through workshops with the Adaptation Steering Committee. The Steering Committee was multi-departmental, comprised Town staff that have diverse expertise and experience with the Town's communities, infrastructure, assets, and services.

**Matt Bruder**, Planning and Development

**Liliana Busnello**, Communications

**Paul Di Ianni**, Economic Development and Communications

**Gillian Harris**, Public Works

**Cathy McGrath**, Fire and Emergency Services

**Cameron Rotz**, Economic Development

**Melissa Shih**, Planning and Development

**Ian Tasker**, Public Works

**Teri Trewolla**, Finance and Administration

**Erik Vonk**, Planning and Development

**Dave Warden**, Community Services

The Project Team would also like to acknowledge the contributions of additional staff that contributed to the development of the Plan, including Creative Services, the Extended Management Team, and the Senior Management Team.

## External Stakeholders & Community

To ensure the CCAP reflects local context and community priorities external stakeholders were consulted, including the Niagara Peninsula Conservation Authority, Niagara Region Public Health, residents, and local businesses. The Project Team would like to acknowledge these stakeholders, their contributions, and ongoing support.



# Message from the Mayor



On behalf of Lincoln Council, I am pleased to present to you the Town of Lincoln's Corporate Climate Adaptation Plan. Council recognizes the need to be prepared for and respond to a changing climate. One of the four pillars of our Council Priorities is to be a Resilient Community, and as part of that pillar we have set out the goal to adapt and respond to a changing climate.

This Plan is our first step in moving forward our vision. As we begin to implement our plan, we will look to build community resilience and thereby reduce the risks associated with climate change. The backbone of the plan lies in its eight over-arching goals, outlining numerous actions we will undertake in order to achieve resiliency.

Like other communities, the Town of Lincoln is not immune to climate change. We are noticing changing weather patterns that lead to physical, ecological and financial impacts to our community, infrastructure, homes, and natural spaces.

Lincoln is a leader in Niagara, and we strive to provide Lincoln residents with a quality of life that is second to none, within a prosperous and ecologically sustainable community. We have a responsibility to anticipate and prepare for potential impacts of climate change on our community and are committed to taking a leadership role in facing this uncertainty.

**-Mayor Sandra Easton**



# 1. Climate Change Science

In 2019, Environment and Climate Change Canada published a report called Canada's Changing Climate Report. The report summarizes the evidence that the Earth has warmed during the Industrial Era and that the main cause of this warming is human influence. Current and future changes, as outlined in the report, include:

- increases in near-surface and lower-atmosphere air temperature, sea surface temperature, and ocean heat content;
- widespread warming consistent with the observed increase in atmospheric water vapour and with declines in snow and ice cover; and
- global sea level rise from the expansion of ocean waters caused by warming and from the addition of water previously stored on land in glaciers and ice sheets<sup>i</sup>.



These gradual shifts in average conditions (temperature, precipitation, and sea level) will be accompanied by changes in the frequency and intensity of extreme weather events. For example, extreme hot temperatures will become more frequent and more intense, leading to increased severity of heatwaves, droughts, and wildfire risks<sup>ii</sup>.

These observed climate changes cannot be explained by natural factors such as internal variations within the climate system, but rather, by human influences such as changes in atmospheric greenhouse gases (principally carbon dioxide) and aerosols, and changes to the land surface (deforestation)<sup>iii</sup>.

## 1.1. Climate Change in Canada

The impacts of changing climate are already evident across the country. Environment and Climate Change Canada highlights Canada's changing climate, anticipated impacts, and projections for the future.

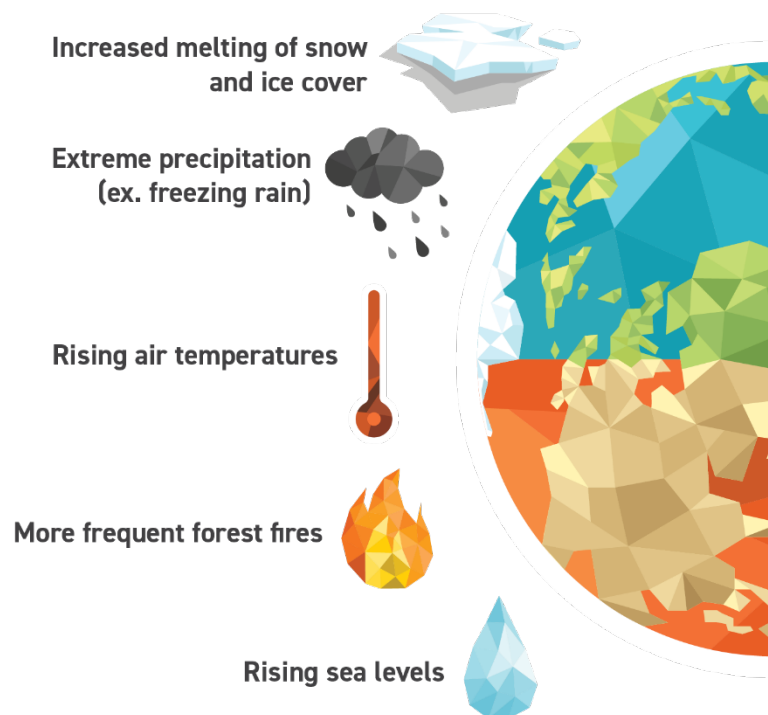




Key findings include:

- Canada's climate has warmed and will warm further in the future, driven by human influence. Both past and future warming in Canada is, on average, about double the magnitude of global warming.
- Precipitation has increased in many parts of Canada, and there has been a shift toward less snowfall and more rainfall. However, reductions in summer rainfall are projected for parts of southern Canada under a high emission scenario toward the late century.
- Temperature extremes have changed in Canada, consistent with the increase in mean temperature. Extreme warm temperatures have become hotter, while extreme cold temperatures have become less cold.
- Increased frequency and severity of extreme weather events (e.g. heat waves, floods, coastal storm surges and droughts), more smog episodes and disease outbreaks, thawing of permafrost, loss of northern sea ice, and rising sea levels<sup>iv</sup>.

## Impacts of Climate Change in Canada



The Ontario Climate Change Data Portal also modelled wind speeds under RCP 8.5 (a high emissions climate change scenario). Wind speeds will be increasing in the spring months, which could lead to more frequent and severe storm surges accompanying spring storms<sup>v</sup>.

Climate change continues to put significant pressure on shoreline communities, natural and built infrastructure, and the ecological integrity in the Great Lakes Basin. Usually in winter, when Lake Ontario is ice-covered, especially when there is shore-fast ice, flood risk and damage is significantly reduced. Due to climate change, warmer temperatures reduce the duration and extent of ice cover which, combined with seasonal winds cycles that are highest in winter, increase shoreline impacts. Models indicate a trajectory of climate change for at least the next 20 years – despite efforts to reduce global carbon emissions – which may lead to significant increases in future shoreline flooding and damage during periods of high lake levels.

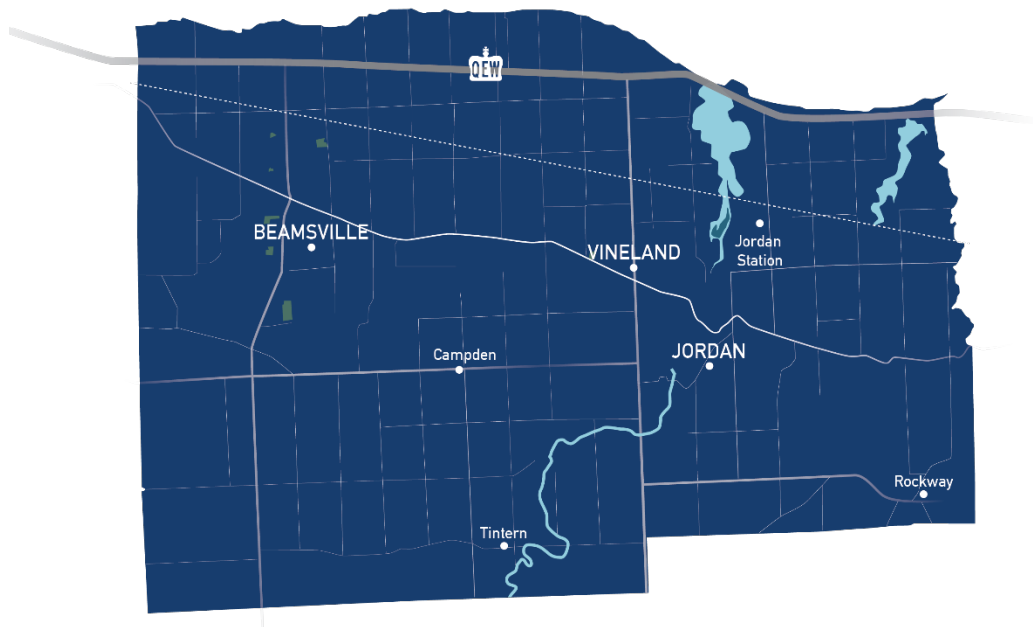


## 1.2. Climate Change in Lincoln

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*The impacts of climate change will continue to affect municipalities of all sizes and with positive and negative implications on infrastructure, social and economic systems, and natural environments<sup>vi</sup>.*

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*The Town of Lincoln*

Climate projections for the Town of Lincoln are based on climate models from [climatedata.ca](http://climatedata.ca), a collaboration between Environment and Climate Change Canada, the Computer Research Institute of Montréal, Ouranos, the Pacific Climate Impacts Consortium, the Prairie Climate Centre, and Habitat Seven. Models and projections are based upon many possible future scenarios of emissions and concentrations of greenhouse gases, aerosols, and chemically active gases, as well as land use and land cover. A projection is based on assumptions of future socioeconomic and technological developments that may or may not be realized and thus are subject to uncertainty<sup>vii</sup>.

Niagara Adapts agreed to work with RCP 8.5, the high emissions scenario, which assumes minimal global effort to mitigate greenhouse gas emissions. As most evidence suggests that a high emission future is very likely, the intent is to prepare for the “worst-case” climate scenario. An extensive list of the trends and projections for Lincoln under the high emissions scenario is outlined in Appendix B. Below are the key climatic threats that have the potential to impact the Town of Lincoln:





### Annual Mean Temperature

1976-2005 Avg.	9 °C
2050s	12 °C
2100s	15 °C



### Annual Total Precipitation

1976-2005 Avg.	864mm
2050s	1016mm
2100s	955mm



### Annual Freeze-Thaw Cycles

1976-2005 Avg.	64
2050s	55
2100s	46



### Extreme Wet Days >10mm

1976-2005 Avg.	26
2050s	33
2100s	32



### Extreme Hot Days >30°C

1976-2005 Avg.	11 days
2050s	47 days
2100s	91 days



### Max 1 Day Total

1976-2005 Avg.	39mm
2050s	39mm
2100s	38mm



### Extreme Cold Days <-15°C

1976-2005 Avg.	8 days
2050s	0 days
2100s	0 days



### Number of Heatwaves

1976-2005 Avg.	1
2050s	4
2100s	6



### Number of Frost Days

1976-2005 Avg.	124 days
2050s	85 days
2100s	46 days



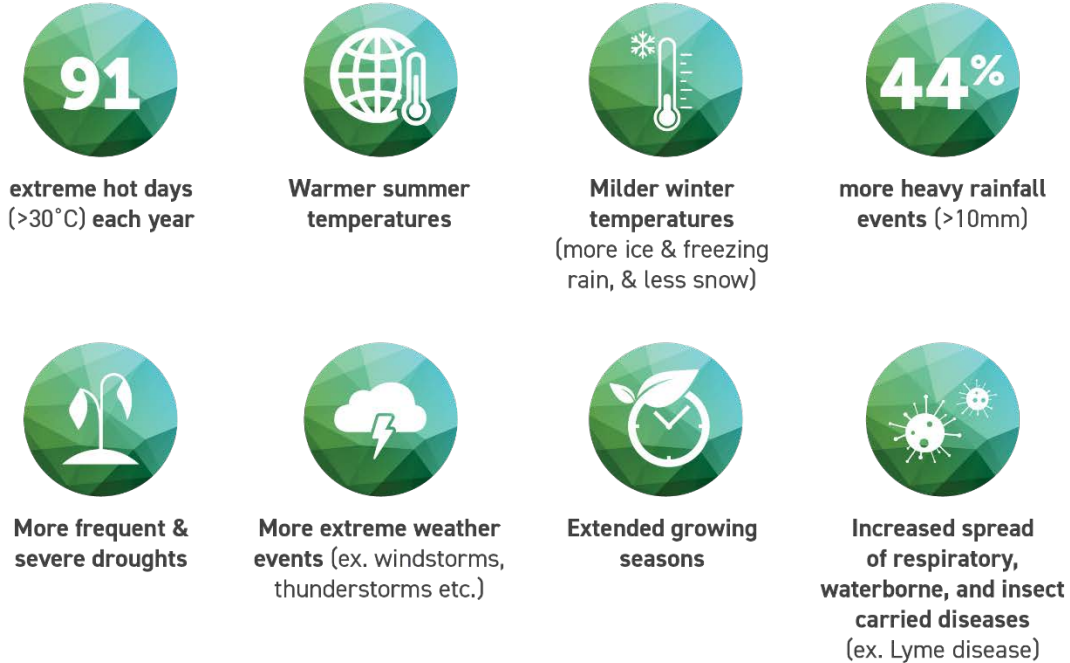
### Avg. Length of Heatwaves

1976-2005 Avg.	3 days
2050s	5 days
2100s	8 days



In summary:

## By 2100, Lincoln can expect:



The projected changes in climate have the potential to greatly impact the Town's assets, operations, and services. Climate impacts are the social, environmental, and economic consequences that arise due to climate change. More freezing rain events, extreme weather, and volatile temperatures will likely lead to increased infrastructure maintenance and replacement costs. Extreme heat, cold, and weather events will likely lead to health and safety concerns for staff and the broader community. Climate change will likely also add to existing pressures on eco- and agricultural systems and could impact the integrity of Lincoln's natural environment.

### 1.3. Climate Change and COVID-19

The COVID-19 pandemic has and will have long-lasting impacts on public health, economic growth, national security, and built and natural environments. Not unlike the climate crisis, the challenges and impacts of the global pandemic are multi-faceted, exacerbate existing inequalities, and require significant investment and action to resolve. The Town of Lincoln, like many global municipalities, has the opportunity to build a more resilient, healthy, and equitable community and reduce the vulnerability of its economy, society, and environment to climate change and human health crises.

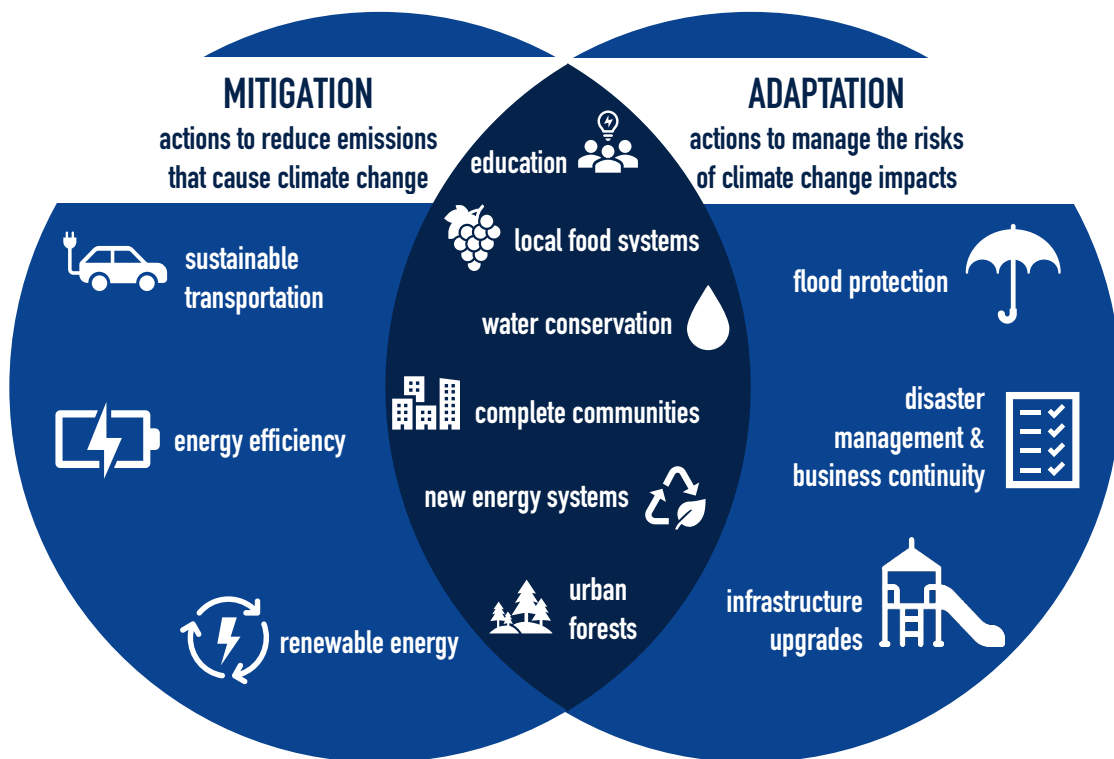


# 2. Climate Change Adaptation

## 2.1. Adaptation vs. Mitigation

*Climate change adaptation refers to “actions that reduce the negative impact of climate change, while taking advantage of potential new opportunities [and] involves adjusting policies and actions because of observed or expected changes in climate”<sup>viii</sup>.*

While adaptation can be reactive (in response to climate impacts) or anticipatory (before impacts are observed), anticipatory adaptations often result in lower long-term costs and can be more effective than reactive adaptations<sup>ix</sup>. Examples of adaptation actions include increasing the capacity of stormwater management systems, flood preparedness, and modifying outdoor work policies. Mitigation refers to reducing the emissions that cause climate change. Examples include investing in renewable energy and using low-emission vehicles. Adaptation and mitigation are not mutually exclusive – some actions, known as low-carbon resilience actions, have co-benefits, contributing to both objectives. For example, conserving and expanding the urban forest assists in adapting to extreme heat, mitigating greenhouse gas emissions, and potentially lowering energy use in summer and winter.



## 2.2. Federal and Provincial Direction on Climate Adaptation

According to a 2020 Report Federation of Canadian Municipalities (FCM) and Insurance Bureau of Canada (IBC), every dollar invested in mitigating the effects of severe weather in Canada saves \$3 to \$5 in recovery costs<sup>x</sup>. Additionally, flood and erosion climate risks are associated with the highest costs as a percentage of GDP at 1.25%, 0.12% respectively and will require the greatest investment in adaptation. Other studies also estimate the benefit-to-cost ratio of investing in adaptation strategies. The National Round Table on the Environment and the Economy found that adaptation strategies range in a benefit-to-cost ratio of 38:1 under a high climate change, high growth scenario, to 9:1 under a low climate change, slow growth scenario. The US National Institute of Buildings Sciences found mitigation funding can save the nation \$6 in future disaster costs, for every \$1 spent on hazard mitigation<sup>xi</sup>.

Climate change impact costs in Canada are also expected to accelerate, increasing from an average of \$5bn/yr. in 2020 to an average of between \$21bn and \$43bn/yr. by 2050. Results of a recent impacts cost estimate for Ontario demonstrated that both the monthly total number of rainfall-related water damage claims and incurred losses could increase by 13%, 20% and 30% for the periods 2016-2035, 2046-2065 and 2081-2100 respectively<sup>xii</sup>.

The federal government encourages action on climate change at the federal, provincial, and local level through providing strategic direction, establishing reduction and temperature targets, supporting research, and providing funding opportunities.

- In 2015, Canada joined 195 other countries in signing the Paris Agreement. The agreement aims to limit the increase in global average temperature to 1.5°C. While the agreement prioritizes mitigation, it also includes the goal to enhance adaptive capacity, resilience strengthening, and reducing vulnerabilities to climate change at a global scale<sup>xiii</sup>.
- The 2016 Pan Canadian Framework on Clean Growth and Climate Change aims to build climate resilient infrastructure, protect, and enhance human health and well-being, and reduce the risks of climate-related hazards and disasters<sup>xiv</sup>.
- In 2019, the federal government produced Canada's Changing Climate Report, a national assessment on climate change. The aim is to support evidence-based decision-making through providing the science behind Canada's changing and future climate.

The Ontario Government's commitment to climate change action is focused on greenhouse gas mitigation, resiliency, and building a low-carbon economy.

- Ontario's 2014 Provincial Policy Statement provides strategic direction on land use and development patterns.
- The Made-in-Ontario Environment Plan aims to protect the environment and address climate change. The plan aims to build the resilience of families and communities through addressing vulnerabilities and sectors that will be most impacted and reduce risk of flooding within communities. The plan also aims to hold polluters accountable and activating the private sector through the support of clean technology.



- The 2020 Flooding Strategy outlines how the Province will support the reduction of flood risk and help Ontarians be better prepared for flooding events.

## 2.3. Lincoln’s Commitment to Climate Change Adaptation

Local governments play a unique and important role in managing the risks of a changing climate. Given the local nature of many climate impacts, municipalities are often the front line to manage risks, protect community safety, and promote economic sustainability. Through processes such as land use planning, community energy planning, and mechanisms like zoning regulations, municipalities are effectively able to identify and implement adaptive measures<sup>xv</sup>.

The Town of Lincoln is committed to providing its community with an equitable, sustainable, and prosperous quality of life. This commitment is reflected in several initiatives the Town has developed and continues to be a priority at all levels of operations.

The development of a CCAP for the Town of Lincoln is supported by the 2016 Asset Management Plan which states, “infrastructure is inextricably linked to the economic, social and environmental advancement of a community” and that “broader environmental and weather patterns have a direct impact on the reliability of critical infrastructure services”. Accordingly, overarching principles of the Asset Management Plan include sustainability, delivering “optimal asset life cycles”, and ensuring that Town services “preserve and protect the natural and heritage environment”.<sup>xvi</sup>

The Town’s 2014 Official Plan also affirms the commitment to sustainability, “reviewing opportunities for reducing the impact of climate change, ... meet[ing] the challenges of climate change and other environmental issues through integrated solutions, ... [and] incorporat[ing] low impact design and other site design strategies to mitigate environmental impacts”<sup>xvii</sup>.

The development of a CCAP is also driven and supported by the 2017 Growth Plan for the Greater Golden Horseshoe, of which a guiding principle is to “integrate climate change considerations into planning and managing growth such as planning for more resilient communities and infrastructure – that are adaptive to the impacts of a changing climate”<sup>xviii</sup>.

## 2.4. Adaptation Planning

The purpose of a CCAP is to prepare the Town of Lincoln to adapt to anticipated climatic change and extreme weather, thereby minimizing the severity of the resulting impacts, through:

1. A vision for the Town of Lincoln’s Corporate Climate Adaptation Plan;
2. Identification of the potential climate change and extreme weather impacts in Lincoln, and the risk to the Town’s infrastructure, assets, operations, services, and shoreline;



3. Prioritized adaptation actions to reduce risk and vulnerability associated with climate change and extreme weather impacts; and
4. A detailed implementation plan, including estimated costs, funding sources, responsibilities, timelines, and a framework to monitor and evaluate progress.

The framework guiding the Town’s climate adaptation process is grounded in the MCIP Climate Adaptation Maturity Scale<sup>xix</sup>:



*Climate Adaptation Planning Framework*



*Town of Lincoln’s Climate Adaptation Planning Process*





# 3. Climate Change Impacts, Vulnerability & Risk

## 3.1. Corporate Vulnerability Assessments

The impacts of climate change are already being experienced in the Niagara Region. It is anticipated that these impacts will only intensify in frequency and severity in the future. Understanding the Towns risks and vulnerability to climate change is, therefore, a critical component of effective climate change adaptation planning.

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*Vulnerability refers to the susceptibility of a given region, municipality, social group, or sector to harm arising from climate change impacts. Risk is the combination of an event's likelihood and its consequences.*

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### Community Vulnerability Survey

In the fall of 2019, a vulnerability survey was developed by Niagara Adapts and implemented in Lincoln. Secondary and primary data were also collected from multiple sources including Statistics Canada, Niagara Region Public Health, municipal input by Niagara Adapts partners, and a community survey. One-hundred and fifty members of the Lincoln public completed the survey.

The results from the survey provide critical insights into how people in the region are experiencing climate change as well as their potential capacity to adapt and shed light on areas of missing data that may be useful to collect in the future. These findings also provide data to inform the ongoing climate change adaptation planning process. For example, 64% of respondents believe climate change is creating impacts in their community, and 83% of respondents support municipal resources going towards adaptation planning in Lincoln<sup>xx</sup>. Samples of the qualitative feedback include:



## Please briefly explain the consequences of recent flooding in your home:

"The first flood required removal and disposal of all flooring, wall coverings, appliances etc. The second flood was caught earlier on and did only localized damage."

"Creeks overflow across roads, major damage to Lake Ontario shoreline, buildings flooded, docks made inaccessible."

"Houses had to be evacuated due to shoreline erosion and emergency services not being able to gain access. Neighbors have also had their basements flood due to excessive water in the storm drains backing up into their homes."

"Walking path was washed out. Some neighbors had property damage."

## Please briefly explain how you coped/responded:



"Stayed with family. Relocated to another area of Lincoln"

"Avoided use of favourite parks due to poor waterfront conditions."

"1<sup>st</sup> [flood] was an insurance claim, second was handled by ourselves. Did not have to leave our home either time. Installed battery backup but have since taken that out as it seized up."

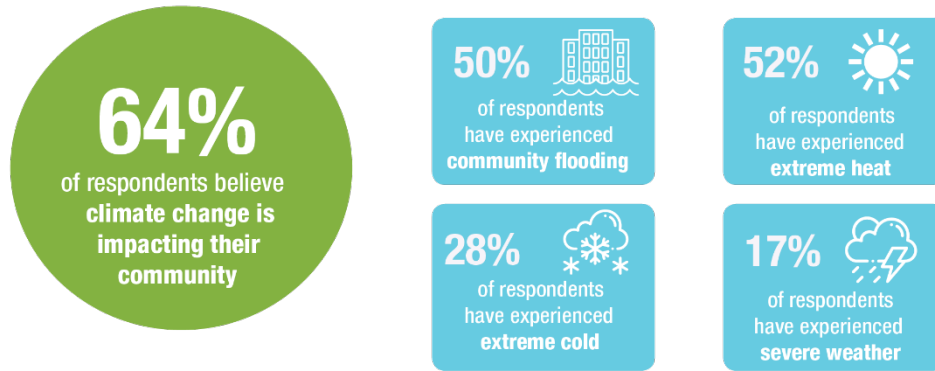
"Stayed inside, avoided particular streets, offered support to neighbors."

Findings from the analysis revealed a final vulnerability index value of 0.386 for Lincoln, where 0 represents highly vulnerable and 1 represents highly robust or resilient. This describes the current state of vulnerability in Lincoln, and indicates the need to build adaptive capacity, and shed light on areas of missing data that may be useful to collect in the future<sup>xxi</sup>.

Some of the highly vulnerable areas for improvement include: stormwater management (flooding in community, storm and wastewater infrastructure, rain barrels, green roofs, cisterns, low lying roads); extreme weather events (extreme heat); vulnerable populations (elderly residents, prevalence of infectious diseases, pre-existing health conditions, public transit); and gaps in asset management information<sup>xxii</sup>. The complete vulnerability report can be found on the Town of Lincoln's website. A summary of the results is presented below:

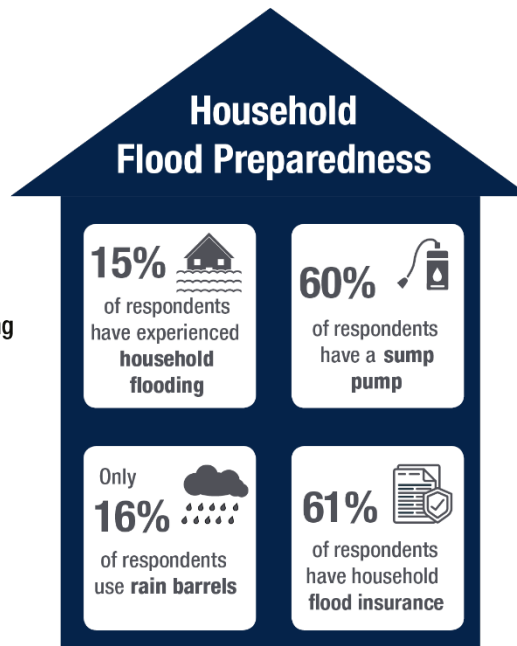
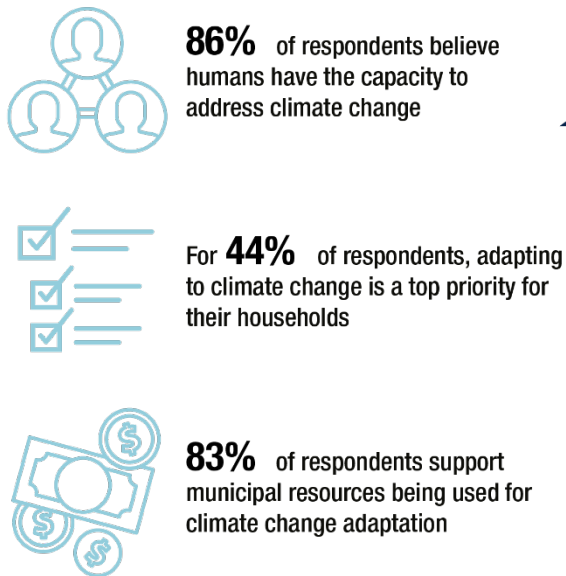


## Exposure to climate change in Lincoln



Only **24%** of respondents feel that Lincoln is prepared to adapt to climate change

## Opportunities for adaptation



**Note:** Percentages reported on this page reflect the 150 people who completed surveys from Lincoln.

## Council Workshop

A climate adaptation workshop was conducted with Council. The purpose of the workshop was to identify Council's priorities and perspectives on how climate projections will impact Lincoln, which areas are most vulnerable to those impacts, and a vision for the CCAP. A summary of the vulnerability evaluation of the climate change impact activity is presented below:



Climate Change Impacts	Vulnerability
1. Increased annual temperatures leading to increased spread of respiratory, waterborne, and insect carried diseases	↑↑↑↑
2. More extreme summer and winter temperatures resulting in decreased use of outdoor recreation areas and facilities, and increased demand for indoor facilities	↑↑↑
3. Milder winter temperatures leading to more ice and freezing rain and less snow resulting in infrastructure damage and public safety concerns throughout the community and on rural roads (e.g. visibility with snow drift)	↑↑
4. Milder winter temperatures leading to more ice and freezing rain and less snow resulting in increased salt usage and impacts to soil and water quality	↑
5. More extreme hot days >30°C and increased humidity resulting in increased heat stress in youth, elderly, vulnerable populations, and those with pre-existing health conditions	↑↑↑↑
6. More extreme hot days >30°C leading to increased energy consumption resulting in increased energy costs	↑↑↑↑
7. Increased temperature variability in shoulder seasons, leading to less confidence in historical weather patterns and planting / harvesting schedules	↑
8. More extreme weather events (e.g. windstorms, thunderstorms etc.) and more extreme temperatures resulting in power disruptions	↑↑↑↑
9. More frequent/severe droughts leading to lower crop yields, damage to vegetation and gardens, and economic loss	↑
10. More frequent/severe droughts leading to water shortages and possible usage restrictions	↑↑↑↑
11. More frequent/severe rainstorms leading to rising lake water levels resulting in wave uprush hazards and impacts to shoreline access, water quality, and damage to infrastructure adjacent to shoreline	↑
12. More heavy rainfall events leading to increased flooding resulting in building damage, basement flooding, and public health water quality concerns	↑↑↑↑



Council and members of the Adaptation Steering Committee also completed a risk and vulnerability indicator ranking exercise. Based on an extensive literature review and expert opinion, Niagara Adapts developed a set of 50 indicators specific for the Niagara Region.

To ensure that the 50 indicators were highly relevant to Lincoln, municipal partner(s) from Lincoln prioritized the indicators, from most to least important, using the QSort method. These rankings, specific to Lincoln, were then used to develop weights which were applied during the vulnerability survey analysis. The completed Ranking Chart can be found in Appendix C.

## 3.2. Impact Identification

To systematically identify how the Town's assets, operations, and services could be impacted by climate change, a set of 59 impact statements were developed by the Adaptation Steering Committee (see Appendix F). Impact statements are formulaic, concisely describing the anticipated change, outcome, and consequence of a specific climate threat. These impact statements encompass several areas including infrastructure, the natural environment, employee and public health and safety, communications.

These risk and vulnerability of the Town to these 59 impacts were then assessed.

## 3.3. Assessing the Risk and Vulnerability of Climate Impacts

Vulnerability refers to the susceptibility of a given region, municipality, social group, or sector to harm arising from climate change impacts. Risk is the combination of an event's likelihood and its consequences. When evaluating likelihood, the Adaptation Steering Committee considered how likely is it that a projected impact will occur. When considering consequence, the known or estimated consequences (economic, ecological, social, and legal) of a particular climate change impact were evaluated.

The 59 climate impact statements were scored on:

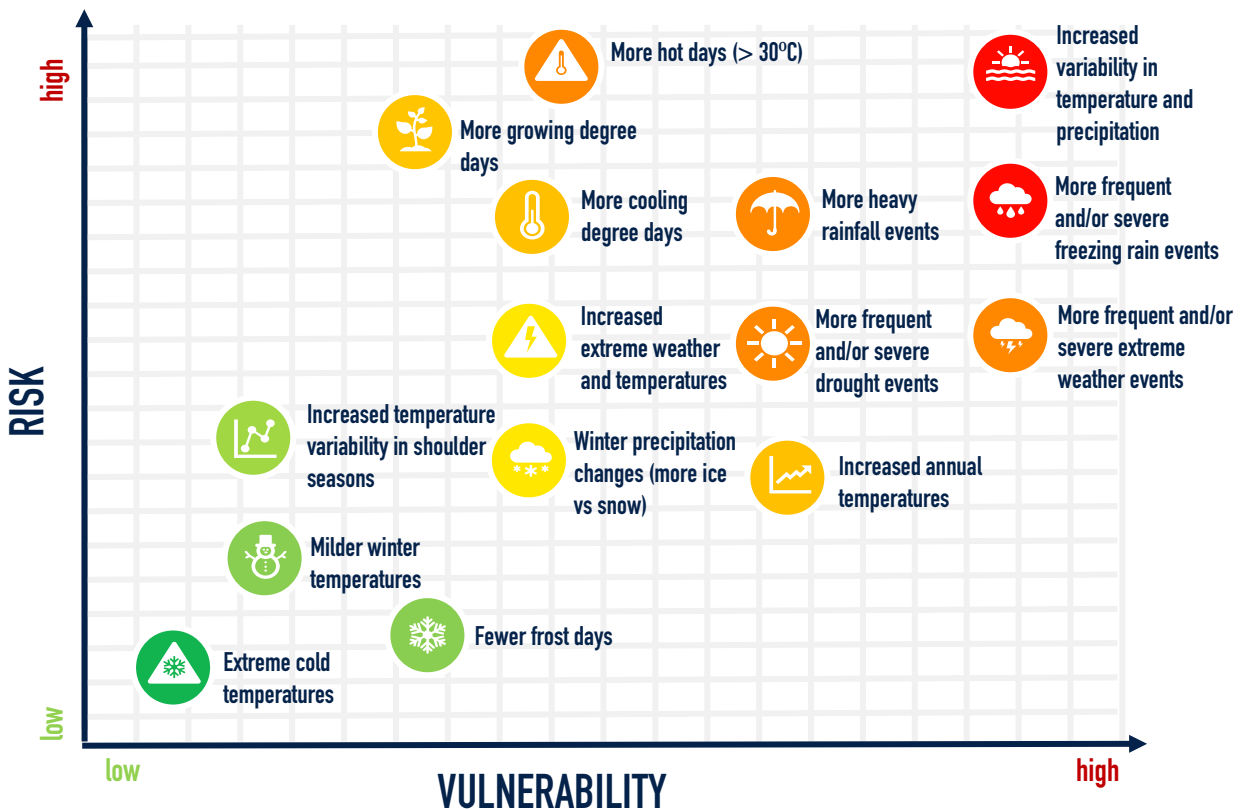
- **Sensitivity:** Will this climate impact affect functionality of given departments?
- **Adaptive Capacity:** Can departments adjust to the projected climate impact with minimal cost and disruption?
- **Likelihood:** What is the probability of the climate impact occurring?
- **Consequence:** What are the known or estimated consequences of the climate impact to Public Health & Safety, Local Economy & Growth, Community & Lifestyle, Environment & Sustainability, and Public Administration.



The overall risk and vulnerability of each impact statement determined its priority and if action to address the impact would be taken. The priority of the 59 impact statements fell between a Very Low to Medium, indicating that the Corporation of the Town of Lincoln has the potential adaptive capacity (i.e. reasonable increases in resources and ability) to mitigate and manage the risks and vulnerabilities posed by a changing climate through action planning. Impacts with a Very Low priority were not carried forward to the action planning stages. By assessing vulnerability and risk, the following climatic threats were identified as top priority to the Town of Lincoln, within the corporate scope. The threats that pose the highest risks and those to which the Town is most vulnerable to were prioritized when developing the CAP's vision and goals and when planning actions and implementation.

It is important to note that climate impacts were assessed on the Town's corporate vulnerability and risk. The vulnerability and risk of climate change to the overall Lincoln community was not assessed.

The vulnerability and risk assessment frameworks can be found in Appendix D and E respectively. A summary of results is presented below:



Results of the Impact Vulnerability and Risk Assessments



# 4. Vision, Goals & Actions

## 4.1. Vision

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*To be intentional in building stronger community resilience. To strengthen our community's response and adaptation to a wide array of future changes, the Town of Lincoln is committed to expanding and utilizing our available resources (people and assets) to prepare for, respond to, and move towards a more sustainable future. Our community-driven approach and progressive public policies are foundational to achieving our shared vision of One Lincoln.*

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## 4.2. Goals

Eight goals were developed by the Project Team and Adaptation Steering Committee. They are high level objects that the CCAP will work towards. They are:

-  **Goal 1: Integrate climate change considerations into Town strategies, plans, policies, procedures, operations & services**
-  **Goal 2: Increase resiliency & adaptive capacity within economic development, community services, parks & recreation**
-  **Goal 3: Protect natural resources, promote ecosystem services & minimize environmental degradation**
-  **Goal 4: Mitigate harmful consequences of extreme weather & emergency events**
-  **Goal 5: Minimize health & safety risks to community members and staff**
-  **Goal 6: Foster Lake Ontario shoreline resilience through planning, management & protection**
-  **Goal 7: Consider climate change impacts in built infrastructure & asset management**
-  **Goal 8: Increase climate change literacy among staff & public**





## 4.3. Actions

The Town has committed to implementing the following 48 actions. These action items were identified by the Adaptation Steering Committee, Council, staff, and community stakeholders, through surveys, workshops, and interviews. Actions are organized under the goal it contributes to. During the action identification process, actions related to corporate mitigation and community low-carbon resilience were also identified. These will be included in actions 1.7 and 1.8 respectively.



### Goal 1: Integrate climate change considerations into Town strategies, plans, policies, procedures, operations & services

1.1	Review plans, policies, & procedures for alignment with adaptation goals and update where appropriate
1.2	Declare a climate emergency
1.3	Establish a Corporate Environmental Committee
1.4	Develop & implement a Resiliency Lens and a database to keep track of all corporate plans, policies, and procedures that have been reviewed
1.5	Ensure climate change impacts and risks are considered as part of Project & Risk Management frameworks
1.6	Identify corporate champion(s) to help lead implementation of adaptation actions
1.7	Develop & implement a Corporate Mitigation Plan
1.8	Develop & implement a Community Low-Carbon Resiliency Plan
1.9	Establish an Environmental Advisory Committee
1.10	Develop & implement a Single-use Plastics Ban
1.11	Incorporate a Green Decision-Making Lens into current Procurement Policy
1.12	Establish a process for reviewing localized climate projections at regular time intervals
1.13	Continue to lobby provincial and federal governments to support adaptation initiatives at the municipal level.
1.14	Continue to identify and take advantage of external funding opportunities



### Goal 2: Increase resiliency & adaptive capacity within economic development, community services, parks & recreation

2.1	Continue to expand and improve Shop Lincoln
2.2	Investigate opportunities for more indoor programming
2.3	Develop a database for climate adaptation financial resources (ex. grants, incentives, rebates)
2.4	Improve resilience of public & active transportation infrastructure/assets
2.5	Develop a business resilience framework & toolkit
2.6	Investigate climate proofed standards for design, construction, M&O of parks & facilities



2.7	Investigate the feasibility of adapted crops and varieties, insurance as a risk management tool, agro-forestry, agro-technology and crop diversification
2.8	Explore the feasibility of initiating a program to encourage and support climate action among key stakeholders, including local businesses and youth groups
2.9	Choose landscaping for drought tolerance and ensure diversity and native plants in plantings for new development and on Town property



### Goal 3: Protect natural resources, promote ecosystem services & minimize environmental degradation

3.1	Conduct a Natural Assets Inventory (NAI) and an Ecosystem Services Assessment (ESA)
3.2	Conduct a Tree Inventory, develop & implement canopy cover targets and an action plan
3.3	Develop & implement a Tree By-law
3.4	Consider initiatives that takes municipal owned lands unfit for agriculture back to forest with trees that are climate change resistant species
3.5	Review and update procedures on Invasive Species (ex. Phragmites, Gypsy Moth, Emerald Ash Borer)
3.6	Strengthen community tree & garden planting networks
3.7	Review winter control practices to ensure climate change impacts are considered and to identify opportunities for improvement



### Goal 4: Mitigate harmful consequences of extreme weather & emergency events

4.1	Review and update the Emergency Circumstances (annual), Extreme Weather Policy (as needed) and the Thermal Stress Procedure (as needed) to account for climate change impacts.
4.2	Map areas vulnerable to heat extremes and use mapping to inform planning and programming initiatives
4.3	Investigate the feasibility of community stormwater management programs
4.4	Update drought Responses and Risk Reduction - Fire and water conservation, water restrictions and consumption cuts specifically for rural areas



### Goal 5: Minimize health & safety risks to community members and staff

5.1	Carry out outreach activities that target vulnerable populations during extreme heat and cold events
5.2	Review and update public 72-hour Emergency Preparedness and Response Guide
5.3	Develop a Residential Flood Preparation and Recovery Guide



### Goal 6: Foster Lake Ontario shoreline resilience through planning, management & protection

6.1	Increase community communications around shoreline protection
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- 6.2 Review alternatives through an Environmental Assessment (EA) for resiliency of municipal infrastructure along shoreline



### Goal 7: Consider climate change impacts in built infrastructure & asset management

- 7.1 Reduce inflow and infiltration (I/I)
- 7.2 Develop Green Infrastructure/Low-Impact Development Design Guidelines
- 7.3 Review & update engineering and development standards with consideration for climate change mitigation and adaptation to increase Green Infrastructure/Low-Impact Development implementation on public property
- 7.4 Ensure the consideration of climate impacts in asset management.
- 7.5 Review and update Hazard Identification and Risk Assessments to include climate change considerations



### Goal 8: Increase climate change literacy among staff & public

- 8.1 Continue reviewing and updating internal and external communication processes related to climate change and extreme weather
- 8.2 Investigate the feasibility of a corporate intranet
- 8.3 Develop communication strategy to showcase municipal initiatives to the community that are related to adaptation and resilience.
- 8.4 Establish a Green Infrastructure/Low-Impact Development education program

## 4.4. Community Vision & Goals Survey

A stakeholder engagement survey was conducted in Lincoln to generate feedback on the municipality’s draft vision and goals for the CCAP. The survey was created and distributed by Niagara Adapts using Qualtrics, an online survey platform.

The survey provided an opportunity for stakeholders to provide feedback in order to inform the collaborative planning process. The survey received a total of 31 responses from community stakeholders, with 81% of respondents stating that they Support or Strongly Support the CCAP’s vision. A sample of provided feedback can be found below:



## Feedback on Goals:

Goal 1: “Residents and businesses will look to the Town to show leadership in this area.”

Goal 2: “Agree with this as these are all steps toward lowering eco footprint, critical to the future.”

Goal 3: “We have to plant more trees in our urban areas and maintain those trees. For example, in parks on streets and municipal facility properties.”

Goal 4: “Need to consider monetary implications of this, what it means to the taxpayer, this will dictate level of support of residents.”

Goal 4: “Need to update and not only suggest but require the use of alternative development standards such as [soil] cells, green roofs, more tree planting, etc.”

Goal 6: “I believe our existing framework to support and protect employee is robust. Yes, there can be tweaks but I would not rate it as highly as others since there is already a framework in place.”

Goal 7: “Need to avoid/minimize further land loss.”

Goal 8: “Boosting willingness of public to support Climate Change through information will be essential.”



## General Feedback:

“Residents and businesses will look to all levels of government to show leadership in adapting to and preventing further climate change.”

“I’d like to see the vision overtly linked not only to management and mitigation but also prevention. An intersectional social justice lens must be integrated to mitigate disproportionate impacts on different folks.”

“They are all wonderful goals and needed to be integrated into future planning; my concern is that we may not be able to achieve all of them.”

“I support Climate Change Adaptation plans and would also support “mitigation” plans.”



# 5. Implementation, Monitoring & Evaluation

## 5.1. Planning for Success

In order for the town to successfully implement and continuously improve the CCAP adaptation plan, it is important that the following four key principles are met:

### Financial & Human Resources

The CCAP identifies high level indicators of staffing and financial resources required to implement given actions. As implementation of the actions begin, it is anticipated that applicable funding and staffing requests will be made on a project-by-project basis. The Town of Lincoln is committed to maximizing the co-benefits of actions to achieve multiple environmental, social, and financial sustainability goals.

### Internal & Community Education & Training

In order to successfully implement the CCAP, the Town of Lincoln will need to leverage our collective knowledge, partnerships, networks, resources, and leadership. It is important to build internal and community awareness of climate change in order to build capacity to take meaningful and sustainable climate action. Normalizing climate considerations, increasing climate literacy, and effectively communicating climate science will be key to the Town's ability to prepare for and adapt to climate change.

### Strategic Partnerships

The CCAP was developed through extensive community engagement and outreach and with the expertise of key stakeholders, local subject matter experts, and academic researchers. The CCAP identifies actions where the proposed lead may not, at present, have the strategic direction or resources (human and financial) to implement the action. The successful implementation of the CCAP depends on the individual and organizational capacity to collaboratively take leadership. The Town of Lincoln will continue to leverage existing community partnerships (for example, with the NPCA, Brock University, and the Niagara Region) and form new partnerships to achieve shared goals, identify co-benefits, maximize resources, and build collective adaptive capacity.

### Governance

Moving from awareness and planning to implementation and continuous improvement requires strong and committed leadership. The Town of Lincoln will retain ownership and governance of the CCAP and will take responsibility for the implementation and continuous improvement of the plan, as the plan in corporate in scope. While municipal government will lead the governance of CCAP, it will take collaboration with residential, institutional, industrial, and commercial sectors focused on sustained and significant action to realize and prioritize the change that is needed.










The Town of Lincoln is committed to taking an inclusive and collaborative approach as a corporation to build capacity to act and adapt. As many of the actions are require leadership and support from multiple departments, inter-departmental collaboration will be key to leveraging resources, meeting shared goals, and successfully implementing the CCAP’s actions. Due to the scale of climate action, it will take one or more champions (inside or outside the municipality) to keep adaptation initiatives alive in the face of many competing priorities.

## 5.2. Implementation Schedule

The preliminary Implementation Schedule outlines which department is responsible for implementation, anticipated staff and financial resources required, and projected project timelines. The CCAP is intended to be a living guide and is designed to be flexible to allow for modifications in strategy, scope, resources, and delivery, as well as the inclusion of new opportunities should they arise. The implementation schedule will be further refined as each action progresses and based on individual action workplans. Individual action work plans are subject to Council approval and budget considerations. Projects that require significant staffing or capital funding are included in the CCAP as feasibility studies, as the development of project specific workplans builds capacity for successful project delivery and implementation.

*Implementation Schedule Legend*

LEVEL OF RESOURCES		STAFF		FINANCIAL	
Low		 ex. within existing staff capacity		\$ ex. few funds required or within existing budget capacity	
Medium		 ex. some additional staff effort required		\$ \$ ex. some additional funds or consultant hires required	
High		 ex. significant staff time, new full-time or part-time staff required		\$ \$ \$ ex. significant funding over current budget required	
PRIORITY					
Low				High 	
Medium				Very High 	
ANTICIPATED START					
Ongoing: Preliminary work has begun			Immediate: 2021		
Short-term: 2022-2023			Long-term: 2023 forward		



Implementation Schedule

#	ACTIONS	LEAD DEPARTMENT	SUPPORTING DEPARTMENT(S)	PRIORITY	RESOURCES	ANTICIPATED START	DURATION   REVIEW & UPDATE FREQUENCY
<b>Goal 1: Integrate climate change considerations into Town strategies, plans, policies, procedures, operations &amp; services</b>							
1.1	Review plans, policies, & procedures for alignment with adaptation goals and update where appropriate	All	Council	!	\$ ●	Ongoing	Ongoing
1.2	Declare a climate emergency	Council	All	!	\$ \$ ●	Immediate	Annual review
1.3	Establish a Corporate Environmental Committee	Planning & Development	Climate Change Coordinator	!	\$ ● ●	Immediate	Periodic meetings; Ongoing review
1.4	Develop & implement a Resiliency Lens & a database to track corporate plans, policies, & procedures that have been reviewed	Climate Change Coordinator	All	!	\$ ●	Ongoing	6-8 months; Review every 2-3 yrs.
1.5	Ensure climate change impacts & risks are considered as part of Project & Risk Management frameworks	PW - Environmental Services	Community Services	!	\$ ●	Ongoing	Annual review
1.6	Identify corporate champion(s) to help lead implementation of adaptation actions	Climate Change Coordinator		!	\$ ●	Immediate	Annual review
1.7	Initiate a Corporate Mitigation Plan	Climate Change Coordinator	Community Services Public Works	!	\$ ● ●	Immediate	12-18 months; Review every 2-3 years
1.8	Initiate a Community Low-Carbon Resiliency Plan	Climate Change Coordinator	Community Services Public Works Economic Development	!	\$ ● ●	Short-term	12-18 months; Review every 2-3 years
1.9	Establish a Sustainability Advisory Committee	Climate Change Coordinator	PW - Environmental Services Fire & Emergency Services Council / Clerks	!	\$ ●	Immediate	Ongoing meetings; Ongoing review

#	ACTIONS	LEAD DEPARTMENT	SUPPORTING DEPARTMENT(S)	PRIORITY	RESOURCES	ANTICIPATED START	DURATION   REVIEW & UPDATE FREQUENCY
1.10	Develop & implement a Single-use Plastics Ban	Climate Change Coordinator	All	!	\$ 1 person	Immediate	6-8 months; Review period TBD
1.11	Incorporate a Green Decision-Making Lens into current Procurement Policy	Finance & Administration	Climate Change Coordinator	!	\$ 1 person	Short-term	6 months; Review every 2 yrs.
1.12	Establish a process for reviewing localized climate projections at regular time intervals	Climate Change Coordinator	Community Services Public Works	!	\$ 1 person	Long-term	Annual review
1.13	Continue to lobby provincial and federal governments to support adaptation initiatives at the municipal level.	Economic Development	Community Services Public Works	!	\$ 1 person	Ongoing	Project basis
1.14	Continue to identify and take advantage of external funding opportunities	All		!	\$ 1 person	Ongoing	Project basis
<b>Goal 2: Increase resiliency &amp; adaptive capacity within economic development, community services, parks &amp; recreation</b>							
2.1	Continue to expand & improve Shop Lincoln	Economic Development	Planning & Development	!	\$ 1 person	Ongoing	Ongoing; Project basis
2.2	Investigate opportunities for more indoor programming	Community Services		!	\$ 2 people	Ongoing	12 months; Annual review
2.3	Develop a database for climate adaptation financial resources (ex. grants, incentives, rebates)	Economic Development Communications	Climate Change Coordinator	!	\$ 1 person	Short-term	Bi-annual review
2.4	Improve resilience of public & active transportation infrastructure/assets	Planning & Development Public Works	Community Services - Parks & Facilities	!	\$ \$ 1 person	Ongoing	Review annually on a project basis; Review construction on a project basis
2.5	Develop a business resilience framework & toolkit	Economic Development	Climate Change Coordinator	!	\$ 1 person	Short-term	3-4 months; Annual review



#	ACTIONS	LEAD DEPARTMENT	SUPPORTING DEPARTMENT(S)	PRIORITY	RESOURCES	ANTICIPATED START	DURATION   REVIEW & UPDATE FREQUENCY
2.6	Investigate climate proofed standards for design, construction, M&O of parks & facilities	Community Services	Public Works	!	\$ 👤	Ongoing	Ongoing; Project basis
2.7	Investigate the feasibility of adapted crops and varieties, insurance as a risk management tool, agro-forestry, agro-technology and crop diversification	Economic Development	Public Works Climate Change Coordinator	!	\$ \$ 👤	Long-term	Ongoing; Project basis
2.8	Explore the feasibility of initiating a program to encourage and support climate action among key stakeholders, including local businesses and youth groups	Economic Development	Climate Change Coordinator	!	\$ 👤	Ongoing	Ongoing; Annual review
2.9	Choose landscaping for drought tolerance and ensure diversity and native plants in plantings for new development and on Town property	Community Services	Planning & Development Climate Change Coordinator	!	\$ 👤	Ongoing	Project basis
<b>Goal 3: Protect natural resources, promote ecosystem services &amp; minimize environmental degradation</b>							
3.1	Conduct a Natural Assets Inventory (NAI) & an Ecosystem Services Assessment (ESA)	Community Services	Planning & Development Finance & Administration Climate Change Coordinator	!	\$ \$ 👤	Short-term	NAI 6m-1yr.; ESA 6m-1yr.; Ongoing updates
3.2	Conduct a Tree Inventory, develop & implement canopy cover targets and an action plan	Community Services	Planning & Development Finance & Administration Climate Change Coordinator	!	\$ \$ 👤 👤 👤	Short-term	2023 Ongoing updates
3.3	Develop & implement a Tree By-law	Planning & Development	Community Services Climate Change Coordinator	!	\$ 👤 👤 👤	Ongoing	6m-1 yr.; Review every 3-5 yrs.
3.4	Consider initiatives that takes municipal owned lands unfit for agriculture back to forest with trees that are climate change resistant species	Planning & Development	Community Services	!	\$ \$ \$ 👤	Long-term	Ongoing; Project basis

#	ACTIONS	LEAD DEPARTMENT	SUPPORTING DEPARTMENT(S)	PRIORITY	RESOURCES	ANTICIPATED START	DURATION   REVIEW & UPDATE FREQUENCY
3.5	Review and update procedures on Invasive Species (ex. Phragmites, Gypsy Moth, Emerald Ash Borer)	Community Services	Public Works Climate Change Coordinator	!	\$ 👤	Ongoing	Ongoing
3.6	Strengthen community tree & garden planting networks	Environmental Advisory Committee	Economic Development Community Services Climate Change Coordinator	!	\$ 👤	Ongoing	Ongoing; Project basis
3.7	Review winter control practices to ensure climate change impacts are considered and to identify opportunities for improvement	PW – Transportation & Operations	Climate Change Coordinator	!	\$ \$ 👤	Short-term	Annual review
<b>Goal 4: Mitigate harmful consequences of extreme weather &amp; emergency events</b>							
4.1	Review and update the Emergency Circumstances (annual), Extreme Weather Policy (as needed) and the Thermal Stress Procedure (as needed) to account for climate change impacts.	Human Resources	Fire & Emergency Services Public Works Community Services	!	\$ 👤	Short-term	TBD
4.2	Map areas vulnerable to heat extremes and use mapping to inform planning and programming initiatives	Planning & Development	Fire & Emergency Services Community Services	!	\$ 👤	Short-term	TBD
4.3	Investigate the feasibility of community stormwater management programs	Public Works	Finance & Administration Community Services Climate Change Coordinator	!	\$ \$ 👤	Short-term	6m-1yr.; Annual review
4.4	Update drought Responses and Risk Reduction - Fire and water conservation, water restrictions and consumption cuts specifically for rural areas	PW - Environmental Services	Fire & Emergency Services	!	\$ 👤	Short-term	Annual review
<b>Goal 5: Minimize health &amp; safety risks to community members and staff</b>							
5.1	Carry out outreach activities that target vulnerable populations during extreme heat and cold events	Fire & Emergency Services	Community Services Communications	!	\$ 👤	Completed	Review as needed
5.2	Review and update public 72-hour Emergency Preparedness and Response Guide	Fire & Emergency Services	Communications Economic Development	!	\$ 👤	Short-term	1yr.; Annual review

#	ACTIONS	LEAD DEPARTMENT	SUPPORTING DEPARTMENT(S)	PRIORITY	RESOURCES	ANTICIPATED START	DURATION   REVIEW & UPDATE FREQUENCY
5.3	Develop a Residential Flood Preparation and Recovery Guide	Fire & Emergency Services	Communications PW - Environmental Services Economic Development Climate Change Coordinator	!	\$ 👤	Short-term	1yr.; Review as needed
<b>Goal 6: Foster Lake Ontario shoreline resilience through planning, management &amp; protection</b>							
6.1	Increase community communications around shoreline protection	Public Works Communications	Community Services Fire & Emergency Services	!	\$ 👤	Ongoing	2yrs to complete; Ongoing
6.2	Review alternatives through an Environmental Assessment (EA) for resiliency of municipal infrastructure along shoreline.	Public Works Communications	Community Services Fire & Emergency Services	!	\$ 👤	Immediate	1-2yrs to complete EA; Ongoing for 10yrs
<b>Goal 7: Consider climate change impacts in built infrastructure &amp; asset management</b>							
7.1	Reduce inflow and infiltration (I/I)	PW - Environmental Services	Planning & Development	!	\$ \$ \$ 👤	Short-term	2-5yrs. for public; Ongoing for private; Review every 5yrs for both
7.2	Develop Green Infrastructure/Low-Impact Development Design Guidelines	PW - Environmental Services	Planning & Development Public Works Community Services Climate Change Coordinator	!	\$ 👤	Immediate	6-8 months.; Annual review
7.3	Review & update engineering & development standards with consideration for climate change mitigation & adaptation to increase Green Infrastructure/Low-Impact Development implementation on public property and opportunities for permeable surfaces	Public Works	Community Services Planning & Development	!	\$ \$ 👤	Immediate	6m-1yr; Review every 5-10yrs (external); Annual review (internal)



#	ACTIONS	LEAD DEPARTMENT	SUPPORTING DEPARTMENT(S)	PRIORITY	RESOURCES	ANTICIPATED START	DURATION   REVIEW & UPDATE FREQUENCY
7.4	Ensure the consideration of climate impacts in asset management.	Finance & Administration	All Climate Change Coordinator		\$ \$ 	Immediate	1 yr.; Ongoing review; Legislated in 2023-2024
7.5	Review & update Hazard Identification and Risk Assessments to include climate change considerations.	Fire & Emergency Services Human Resources	All		\$ 	Ongoing	Annual review
<b>Goal 8: Increase climate change literacy among staff &amp; public</b>							
8.1	Continue reviewing & updating internal & external communication processes related to climate change and extreme weather	Communications Fire & Emergency Services	All		\$ 	Ongoing	Q4 2021; Annual review in Q4
8.2	Investigate the feasibility of a corporate intranet	Communications IT Services	Human Resources		\$ \$ 	Short-term	2022
8.3	Develop communication strategy to showcase municipal initiatives to the community that are related to adaptation and resilience.	Communications	Climate Change Coordinator		\$ 	Ongoing	Annual review
8.4	Establish a public Green Infrastructure/Low-Impact Development education program	Climate Change Coordinator	Communications Community Services Planning & Development		\$ 	Ongoing	2022 Review on project basis

## 5.3. Indicators and Measuring Plan Progress

Indicators are factors that describe an issue, can be quantitatively or qualitatively measured, and can be tracked overtime relative to a baseline. The following indicators will be used to measure the progress of the CCAP, and the completion and success of the actions. Indicators are grouped under the overarching goal(s) they contribute to. After the first year of implementation, the indicators will be reviewed and modified, if necessary, to ensure efficacy.

### *Climate Adaptation Monitoring and Evaluation Indicators*

INDICATOR	DATA SOURCE
<b>Goal 1: Integrate climate change considerations into Town strategies, plans, policies, procedures, operations &amp; services</b>	
# of plans, policies, procedures, projects, & strategies that include climate adaptation considerations	All departments
# of applications of the Resiliency Lens	All departments
# of Corporate Environmental Committee initiatives	Corporate Environmental Committee
# of CCAP actions implemented, in progress	All departments
# of Environmental Advisory Committee initiatives	Environmental Advisory Committee
# of external funding opportunities applied for & awarded	All departments
Greenhouse gas / energy savings	Community Services
<b>Goal 2: Increase resiliency &amp; adaptive capacity within economic development, community services, parks &amp; recreation</b>	
# of external partnerships focusing on adaptation actions	All departments
Engagement metrics by Shop Lincoln	Economic Development
# of public inquiries related to municipal service disruption	All departments
# of businesses that adopt the business resilience framework & toolkit	Economic Development
# of public infrastructure, programming, transportation & facility installations, inspections, & reviews that consider climate change impacts	Community Services
% of native to non-native plants & # of diverse species planted on Town properties	Community Services
% of new landscaping that includes climate change considerations	Community Services



INDICATOR	DATA SOURCE
<b>Goal 3: Protect natural resources, promote ecosystem services &amp; minimize environmental degradation</b>	
% of total tree canopy	Community Services
# of natural assets & value of ecosystem services	Community Services
# of work orders for invasive species management	Community Services Public Works
# of external partnerships & # of community led adaptation actions	Community Services
% of roads determined to be salt vulnerable	Public Works
# of Green Infrastructure/Low Impact Development installations within the municipality	Public Works Planning & Development
Communities in Bloom score	Community Services
<b>Goal 4: Mitigate harmful consequences of extreme weather &amp; emergency events</b>	
% of land/population vulnerable to extreme heat	Planning & Development
# of town supported community stormwater management installations	Public Works
# of public inquiries related to municipal service disruptions	Communications Public Works
<b>Goal 5: Minimize health &amp; safety risks to community members and staff</b>	
# of municipal staff provided relevant training	Public Works Human Resources
# of public reached during emergency preparedness campaign	Communications Fire & Emergency Services
# of days that cooling/warming centres are open (protocol activation)	Community Services Fire & Emergency Services
Attendance to cooling/warming centres	Community Services Fire & Emergency Services
Average response time for municipal staff to respond during extreme weather events	Public Works
# of accident/incident reports from staff & community	Public Works Community Services Human Resources
# & severity of road closures	Public Works



INDICATOR	DATA SOURCE
<b>Goal 6: Foster Lake Ontario shoreline resilience through planning, management &amp; protection</b>	
# of briefings sent to shoreline residents on resiliency, planning, management, & protection	Public Works
# of public utilizing available municipal communications tools	Public Works
<b>Goal 7: Consider climate change impacts in built infrastructure &amp; asset management</b>	
# of briefings sent to municipal staff on natural & Green Infrastructure/Low Impact Development	Public Works
# of reported properties experiencing flooding	Public Works Communications
# of Green Infrastructure/Low Impact Development installations within the municipality	Public Works Planning & Development
Results of flow monitoring tests	Public Works
# of properties disconnected	Public Works
# of public projects	Public Works
% of roads determined to be salt vulnerable	Public Works
<b>Goal 8: Increase climate change literacy among staff &amp; public</b>	
Average response time for municipal staff to respond during extreme weather events	Public Works Fire & Emergency Services
# of public utilizing available municipal communications tools	Communications
Emergency preparedness campaign engagement	Communications
Flood preparedness campaign engagement	Communications
Climate awareness campaign engagement	Communications
Green Infrastructure/Low Impact Development campaign engagement	Communications
# of briefings sent to municipal staff on natural & Green Infrastructure/Low Impact Development	Public Works Planning & Development
# of Green Infrastructure/Low Impact Development demonstration sites/events	Public Works Planning & Development
Uptake & usage of corporate intranet	Communications IT Services



## 5.4. Plan Review

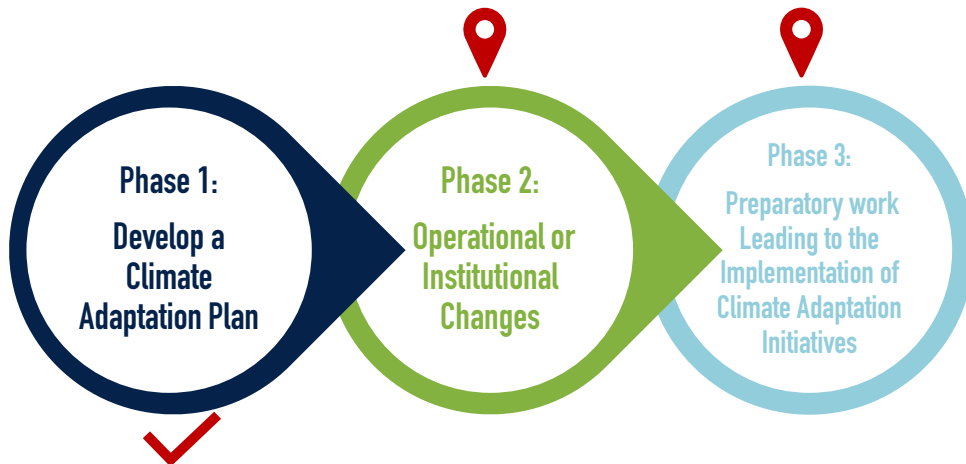
Check-ins between the Project Team, Lead Departments, and Supporting Departments will occur annually to evaluate the CCAP and implementation progress, or more frequently on a project-by-project basis.

Feedback from residents remains a valued and essential component of investigating, identifying, and implementing plans and programs. Ongoing engagement with residents, businesses, stakeholders, and industry will continue to be an important part of the implementation process and empower Council to play a vital leadership role in increasing the resilience of the Town and the community.

## 5.5. Climate Action Next Steps

The implementation of the CCAP will begin after Council approves and adopts the CCAP. The Corporation of the Town of Lincoln is committed to working with Council, administration, staff, residents, the Niagara Peninsula Conservation Authority, the Niagara Region, Brock University, and other community stakeholders to execute the Plan's vision and achieve its goals.

Through the CCAP, the Town of Lincoln has completed the first Phase of the MCIP Climate Adaptation Framework and is now in Phases 2 and 3.

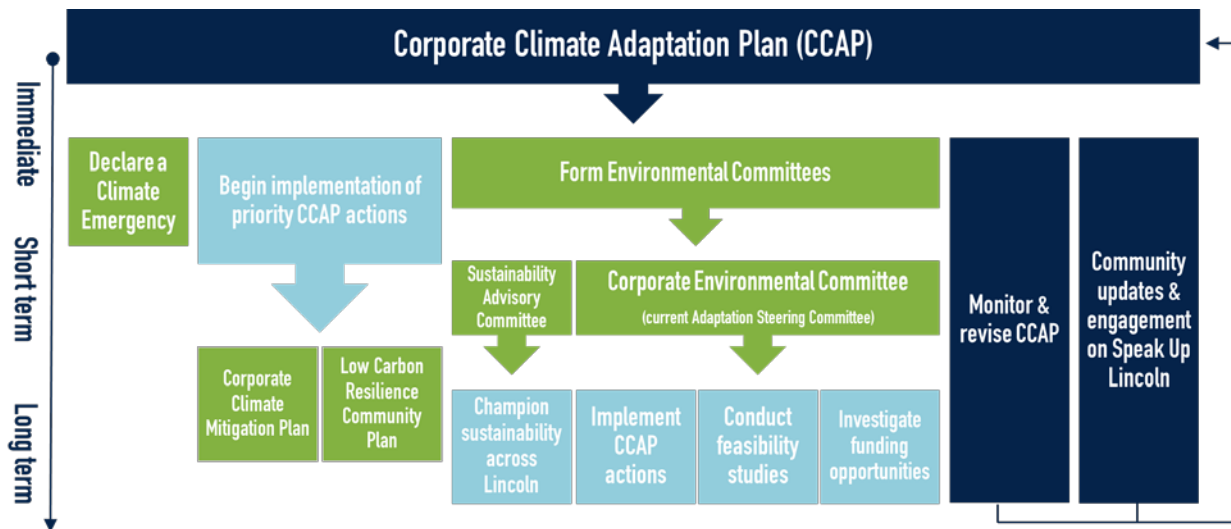


*Climate Adaptation Planning Framework*

Through following the Phases of the MCIP climate adaptation framework, the summarized climate action next steps (colour coded to correspond with the climate framework phases) for the Town of Lincoln will include:







Timeline of Climate Action Next Steps

## Declare a Climate Emergency

A climate emergency helps to raise the profile and urgency of collaborative action by individuals, businesses, communities, and all levels of government. Over 400 Canadian municipalities have declared a Climate Emergency and committed to taking climate action. Examples of the high-level commitments in the declarations include:

- Lower greenhouse gas emissions caused by human influences to reduce the impact of climate change
- Adapt to the changes that we are already experiencing
- Deepen the city’s commitment to protecting our economy, environment, and community from climate change; and immediately increase the priority of the fight against climate change
- Acknowledge the global scale of the economic, health, environmental and human impacts of climate change and recognize international research indicates the world needs to massively reduce carbon emissions in the next 11 years to avoid further and devastating economic, ecological, and societal loss

The Climate Emergency Declaration will be created collaboratively with Council, the Corporate Environmental Committee, and Senior Management.

## Corporate Climate Mitigation Plan

A Corporate Mitigation Plan will address the greenhouse gas (GHG) emissions from the Town’s infrastructure, assets, operations, and services. In order to complete a mitigation plan to reduce emissions, the Town will join the Partners of Climate Protection (PCP) program delivered by the Federation of Canadian Municipalities (FCM) and ICLEI-Local Governments for Sustainability. This program supports and guides municipalities in reducing GHG emissions through a Milestone Framework.



The five milestones are:

- Milestone 1: Creating a baseline emissions inventory and forecast
- Milestone 2: Set emissions reduction target
- Milestone 3: Develop a local action plan
- Milestone 4: Implement the local action plan
- Milestone 5: Monitor progress and report results

Examples of Corporate Climate Mitigation Actions include green fleets, sustainable energy initiatives, or active transportation planning.

## Community Low-Carbon Resilience Plan

Low carbon resilience (LCR) refers to climate change strategies that integrate and achieve co-benefits between greenhouse gas emissions reduction (mitigation) and planning designed to reduce vulnerability to climate change impacts (adaptation)<sup>xxiii</sup>.

A Community LCR Plan will evaluate both adaptation and mitigation strategies, as well as identify other co-benefit opportunities from community driven climate action. The purpose of the plan is to develop a set of LCR actions that will be accomplished in partnership with residents, public and private sectors, and local stakeholders.

Examples of Community LCR actions include: building a resilient irrigation network, promote resident energy conservation initiatives, or partnerships with local community groups to advance sustainable actions.

## Environmental Committees

**Sustainability Advisory Committee:** The Sustainability Advisory Committee will be an advisory committee comprised of members of Council and citizen members and which reports to Council. The purpose of the committee will be to advise Council on matters related to climate change and environmental action, and encourage, promote, and participate in the planning of sustainable policies, programs, and facilities.

**Corporate Environmental Committee:** Currently the staff Adaptation Steering Committee, the Corporate Environmental Committee will support the delivery of the CCAP's actions, and the development and implementation of the Corporate Climate Mitigation Plan and the Community Low-Carbon Resilience Plan.



# Appendix A: Glossary

Term	Description
<b>Adaptation</b>	Includes any initiatives or actions in response to actual or projected climate change impacts and which reduce the effects of climate change on built, natural and social systems.
<b>Adaptive Capacity</b>	The ability of built, natural and social systems to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.
<b>Climate Change</b>	Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forces, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.
<b>Coldest Day</b>	This is the lowest minimum temperature value in this time period.
<b>Cooling Degree Days</b>	Indication of the amount of air conditioning that may be required to maintain comfortable conditions in a building during warmer months. A threshold temperature of 18°C is used and for any day when the mean temperature exceeds this value, cooling degree days are accrued. So, if the daily mean temperature on a given day is 24°C, then 6 CDDs are accrued for this day. CDD values are totaled over the year; the larger the CDD value the greater the requirement for air conditioning.
<b>Cumulative Degree Days above 0C</b>	"...calculated by adding average daily temperature over a defined time period (e.g. a year or month) for those days when the mean temperature exceeds 0°C. This index can be used as an indicator for plant and insect growth. The warmer the weather, the more quickly these species develop, and the cooler the temperature, the slower they develop."
<b>Days below -15oC</b>	The number of days with minimum temperatures less than -15°C gives an indication of the number of very cold days in a given time period.
<b>Days below -25oC</b>	The number of days with minimum temperatures less than -25°C gives an indication of the number of extreme cold days in a given time period.
<b>Days over 30C</b>	This is the number of days when daily maximum temperature is greater than 30°C and gives an indication of the number of very hot days.



Term	Description
<b>Extreme Events</b>	<p>Extreme events refer to meteorological conditions that are rare for a particular place and/or time, such as an intense storm or heat wave and are beyond the normal range of activity. They can be the result of sudden and drastic changes in temperature, precipitation and sea-level or they may be the result of a more gradual, but prolonged, shift in temperature or precipitation that is beyond the normal range. Such events include severe thunderstorms, heat waves, floods, droughts, ice storms, fires etc.</p> <p>Extreme Weather Event is an event that is rare within its statistical reference distribution at a particular place; it would normally be as rare as or rarer than the 10th or 90th percentile.</p> <p>Extreme Climate Event is an average of a number of weather events over a certain period of time, an average which is itself extreme (e.g. rainfall over a season).</p>
<b>Frost Days</b>	<p>Number days when daily minimum temperature is less than 0°C and indicates when conditions are below freezing, usually overnight.</p>
<b>Growing Degree Days 10C</b>	<p>The number of days in which the daily temperature exceeds the threshold temperature (temperatures that support plant growth). A threshold temperature of 10°C is generally used for crops such as corn and beans that require warmer temperatures to reach maturity.</p>
<b>Growing Degree Days 5C</b>	<p>The number of days in which the daily temperature exceeds the threshold temperature (temperatures that support plant growth). “A threshold temperature of 5°C is generally used for forage crops and canola.”</p>
<b>Heating Degree Days</b>	<p>An indication of the amount of space heating that may be required to maintain comfortable conditions in a building during cooler months. A threshold temperature of 17°C is used and for any day when the mean temperature is below this value, heating degree days are accrued. So, if the daily mean temperature on a given day is 10°C, then 7 HDDs are accrued for this day. HDD values are totaled over the year; the larger the HDD value the greater the requirement for space heating.</p>
<b>Hottest Day</b>	<p>This is the highest maximum temperature value in this time period.</p>
<b>Ice Days (below 0C)</b>	<p>The number of days when the daily maximum temperature does not exceed 0°C.</p>
<b>Impact</b>	<p>The effects of existing or forecasted changes in climate on built, natural, and human systems. One can distinguish between potential impacts (impacts that may occur given a projected change in climate, without considering adaptation) and residual impacts (impacts of climate change that would occur after adaptation).</p>



<b>Term</b>	<b>Description</b>
<b>Maladaptation</b>	Any changes in built, natural, or human systems that inadvertently increases vulnerability to climate stimuli; an adaptation that fails in reducing vulnerability but instead increases it.
<b>Max 1 Day Total</b>	This is the largest precipitation total on a single day.
<b>Maximum Temperature</b>	This is the average maximum temperature for a given time period and is derived by averaging all the daily maximum temperatures in that time period.
<b>Mean Temperature</b>	Mean temperature is the average temperature on a given day and is usually obtained by averaging the daily maximum and minimum temperatures.
<b>Minimum Temperature</b>	This is the average minimum temperature for a given time period and is derived by averaging all the daily minimum temperatures in that time period.
<b>Mitigation</b>	The promotion of policy, regulatory and project-based measures that contribute to the stabilization or reduction of greenhouse gas concentrations in the atmosphere. Renewable energy programs, energy efficiency frameworks and substitution of fossil fuels are examples of climate change mitigation measures.
<b>Resilience</b>	The capacity of a system, community or society exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure.
<b>Risk</b>	Risk can be considered as the combination of an event, its likelihood, and its consequences – risk equals the probability of climate hazard multiplied by the consequence of that event. Risk = Likelihood x Consequence
<b>Sensitivity</b>	The degree to which a given system is directly or indirectly affected (either adversely or beneficially) by climatic conditions (i.e. temperature increases) or a specific climate change impact (i.e. increased flooding).
<b>Systems</b>	The built, natural, and human networks that provide services or activities within a municipality.
<b>Total Precipitation</b>	This is the total precipitation (rain and snow) for a given time period.
<b>Tropical Nights</b>	The number of days when the minimum temperature (which usually refers to night-time temperature) value does not go below [threshold]. Threshold can be set at 18°C, 20°C, 22°C



Term	Description
<b>Vulnerability</b>	The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of both the sensitivity and the adaptive capacity of a given sector. Those service areas with high sensitivity and low adaptive capacity are highly vulnerable; those with low sensitivity and high adaptive capacity have low vulnerability; and those service areas that have both high sensitivity and high adaptive capacity have a medium vulnerability.
<b>Wet Days &gt;10mm</b>	Number of days with daily precipitation totals greater than 10 mm.
<b>Wet Days &gt;20mm</b>	Number of days with daily precipitation totals greater than 20 mm.



# Appendix B: Lincoln Climate Change Projections

Variable	Sub-Variable	Average (1976-2005)	2050 Projection	2100 Projection	Trend
Temperature	Hottest day °C	33	37	40	↑
	Mean Temp °C	9	12	15	↑
	Min. Temp °C	4	7	11	↑
	Max. Temp °C	13	16	19	↑
	Days Over 30 °C	11	47	91	↑
	Coldest Day °C	-20	-13	-8	↑
	Days Below -15°C	8	0	0	↓
	Days Below -25°C	0	0	0	↓
	Frost Days	124	85	46	↓
	Cooling Degree Days	328	670	1200	↑
	Growing Degree Days 10°C	1390	1996	2725	↑
	Growing Degree Days 5°C	2390	3096	3977	↑
	Cumulative Degree Days >0 °C	3657	4440	5526	↑
	Heating Degree Days	3402	2669	2011	↓
	Ice Days (below 0°C)	48	24	6	↓
	Tropical Nights >18°C	26	61	106	↑
	Tropical Nights >20°C	10	39	84	↑
Tropical Nights >22°C	2	18	60	↑	
Precipitation	Total Precipitation	864	1016	955	↑
	Max 1 Day Total mm	39	39	38	↓
	Wet Days >10mm	26	33	32	↑
	Wet Days >20mm	6	9	9	↑



# Appendix C: Vulnerability Indicators Ranking Chart

LEAST IMPORTANT			NEUTRAL					MOST IMPORTANT		
-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
Learning Capacity	Risk Attitudes	Rain Barrels	Forests & Wetlands	Place Attachment	Social Capital	Infants/Young Children	Elderly Residents	Employment in Agriculture Sector	Low Lying Roads	Flooding in Your Community
Green Roofs	Permeable Roads	Recognition of Human Agency	Local Coping Strategies	Access	Recent Experience with Climate Related Hazard	Occupational Mobility	Flooding in Your Home	Air Conditioning	Severe Storm	Coastal Roads
Information Sources	Early Warning Signs	Recent Immigrants	Insurance	Pre-Existing Health Conditions	Expectation in Authority	Climate Change Mainstreamed in Municipal Policy	Competing Concerns	Political Leadership for Climate Adaptation	Extremely Hot Days	Storm and Wastewater Infrastructure
		Education Level	Sump Pump	Rental Household	Cisterns	Flexible Institutional Decision-Making	Public Support for Adaptation	Income		
			Emergency Preparedness Plan	Level of Trust in Authorities	Disconnected Downspout	Equity	Extremely Cold Days			
				Public Transit	Prevalence of Infectious Diseases	Public Awareness of Climate Change				
					Community Participation in Decision-Making Process					
					Parks					





# Appendix D: Vulnerability Framework

## Sensitivity Assessment

- S1- No, functionality will stay same
- S2- Unlikely, functionality will likely stay the same
- S3- Yes, functionality likely to get worse
- S4- Yes, functionality will get worse
- S5- Yes, functionality will become unmanageable

## Adaptive Capacity

- AC1- No, will require substantial cost and staff intervention
- AC2- No, will require significant costs and staff intervention
- AC3- Maybe, will require some costs and intervention
- AC4- Yes, some slight costs and staff intervention
- AC5- Yes, no costs or intervention needed

Vulnerability	AC1	AC2	AC3	AC4	AC5
S1	V2	V2	V4	V5	V5
S2	V2	V2	V3	V4	V5
S3	V2	V2	V3	V4	V4
S4	V1	V2	V2	V3	V3
S5	V1	V1	V2	V3	V3



# Appendix E: Risk Framework

Each of the 58 impacts were assessed for risk and assigned a likelihood and consequence score based on the following criteria:

Likelihood
L1- Rare, Unlikely during the next 25 years
L2 - Unlikely, May arise once in 10-25 years
L3- Possible, May arise once in 10 years
L4- Likely, May arise about once per year
L5 - Almost Certain, Could occur several times per year

Consequence refers to the known or estimated outcomes of a particular impact. To determine consequence, the ASC assessed the 59 impacts against 15 consequence criteria. The consequence criteria were divided into five categories: public health, economic growth, community lifestyle, environmental sustainability, and public administration. Consequence ratings from 1 to 5 were assigned to each criterion, where 1 was 'negligible' and 5 was 'catastrophic'. For each impact, an overall risk score out of 120 was calculated by multiplying the sum of the consequence ratings with likelihood rating



<b>Consequence: Public Health &amp; Safety</b>	<b>Consequence: Local Economy &amp; Growth</b>	<b>Consequence: Community &amp; Lifestyle</b>	<b>Consequence: Environment &amp; Sustainability</b>	<b>Consequence: Public Administration</b>
C1- Negligible, Appearance of a threat but no actual harm	C1- Negligible, Minor shortfall relative to current forecasts	C1- Negligible, There would be minor areas in which the region was unable to maintain its current services	C1- Negligible, No environmental damage	C1- Negligible, There would be minor instances of public administration being under more than usual stress but it could be managed
C2- Minor, Serious near misses or minor injuries	C2- Minor, Individually significant but isolated areas of reduction in economic performance relative to current forecasts	C2- Minor, Isolated but noticeable examples of decline in services	C2- Minor, Minor instances of environmental damage that could be reversed	C2- Minor, Isolated instances of public administration being under severe pressure
C3- Moderate, Small number of injuries	C3- Moderate, Significant general reduction in economic performance relative to current forecasts	C3- Moderate, General appreciable decline in services	C3- Moderate, Isolated but significant instances of environmental damage that might be reversed with intensive efforts	C3- Moderate, Public administration would be under severe pressure on several fronts
C4- Major, Isolated instances of serious injuries or loss of life	C4- Major, Regional stagnation such that businesses are unable to thrive, and employment does not keep pace with population growth	C4- Major, Severe and widespread decline in services and quality of life within the community	C4- Major, Severe loss of environmental amenity and a danger of continuing environmental damage	C4- Major, Public administration would struggle to remain effective and would be seen to be in danger of failing completely
C5- Catastrophic, Large numbers of serious injuries or loss of lives	C5- Catastrophic, Regional decline leading to widespread business failure, loss of employment and hardship	C5- Catastrophic, The region would be seen as very unattractive, moribund, and unable to support its community	C5- Catastrophic, Major widespread loss of environmental amenity and progressive irrecoverable environmental damage	C5- Public administration would fall into decay and cease to be effective



# Appendix F: Impact Statements

Climatic Threat	Impact Statement
<b>⚠️ Impact Priority: High</b>	
<b>Increased variability in temperatures and precipitation</b>	Increased lake level variability and extreme weather leading to shoreline damage/erosion/wave uprush hazards resulting in public health/emergency response/evacuation costs
<b>Increased variability in temperatures and precipitation</b>	Increased lake levels and extreme weather leading to shoreline damage/erosion/wave uprush hazards resulting in increased maintenance and labour costs (ex. to maintain water quality, waterfront trails, beaches)
<b>Increased variability in temperatures and precipitation</b>	Increased lake levels and extreme weather leading to shoreline damage/erosion/wave uprush hazards resulting in built and natural infrastructure damage, loss of agricultural land, and economic impacts.
<b>More frequent/severe freezing rain events</b>	Increased potential for extended power outage compromising critical infrastructure and service levels leading to increased demand and costs of backup systems and emergency planning.
<b>⚠️ Impact Priority: Medium-High</b>	
<b>Increased variability in temperatures and precipitation</b>	Increased rainfall events during winter while ground is frozen, resulting in overland flooding
<b>Increased variability in temperatures and precipitation</b>	Extreme heat, cold, and variability (freeze-thaw cycles) resulting in increased damage(frost heaving, culvert freezing, watermain breaks, storm sewer freezing, bridge damage, reduced asphalt lifecycle) to infrastructure (roads, culverts, sidewalks, trails, parking lots, and outdoor recreation facilities) leading to increased preventative maintenance, repair, and labour costs
<b>More cooling degree days</b>	Increased breaks required for staff for safety resulting in decreased productivity time.
<b>More frequent/severe droughts</b>	Limited water resources and extreme temperatures resulting in crop failure, lower yields, and economic impacts.
<b>More frequent/severe droughts</b>	Water resources are more vulnerable resulting in increased irrigation needs and/ impacts to municipal water supply/usage
<b>More frequent/severe extreme weather events</b>	More frequent extreme weather and icing resulting in poor travel conditions, leading to increased safety concerns throughout community, on rural roads (i.e. visibility with snow drift, etc.) leading to increased emergency response costs and labour
<b>More frequent/severe extreme weather events</b>	Increased flood risk, storm water velocities and storm water volumes resulting in increased storm sewer infrastructure maintenance, repair, and capacity building costs.
<b>More heavy rainfall events</b>	Increased flooding, erosion (creeks, valley lands, shoreline) leading to changes in land uses and where new development can occur (change in floodplain areas, erosion hazard setbacks, etc.)
<b>More hot days &gt;30C</b>	Increased energy consumption leading to increased cooling costs for Town-owned facilities



<b>Climatic Threat</b>	<b>Impact Statement</b>
<b>More hot days &gt;30C</b>	Decreased use of outdoor recreation areas and facilities and increased demand for indoor/aquatic facilities leading to increased maintenance costs (cooling and water quality)
<b>Winter precipitation changes (more ice vs. snow)</b>	Increased injury risks/liability claims resulting in higher insurance premiums, impacts to service delivery, and more frequent communications
<b>⚠ Impact Priority: Medium</b>	
<b>Fewer frost days</b>	Ice wine crop damage, lower yields, and economic impacts.
<b>Increased annual temperatures</b>	Increased incidences of vector-borne illness due to longer exposure periods
<b>Increased annual temperatures</b>	Thawing permafrost resulting in infrastructure damage leading to increased maintenance, labour, and material costs
<b>Increased annual temperatures</b>	Increased incidents of foodborne outbreaks leading to increased public communication
<b>Increased annual temperatures</b>	Decrease in water quality resulting in increased flushing to retain chlorine residuals leading to increased operational costs for labour, facility closures, and water loss
<b>Increased extreme weather and temperatures</b>	Higher demand for public transit services leading to increased transit and communications costs (need updated digital info, redo brochures, change scheduling and messaging)
<b>Increased extreme weather and temperatures</b>	Increased heat or cold stress for firefighters and equipment leading to additional equipment and labour costs (ex. firefighters required per incident)
<b>Increased extreme weather and temperatures</b>	Increase in heat stress and cold stress injuries (medical response) leading to increased need for emergency services and public health resulting in increased labour and equipment costs
<b>Increased extreme weather and temperatures</b>	Increase in heat stress and cold stress leading to increased health and safety risks to the public, especially vulnerable populations (e.g. elderly, socially isolated, etc.).
<b>Increased extreme weather and temperatures</b>	Increased heat and smog alerts resulting in decreased productivity due to modified working days leading to health and safety and economic impacts
<b>Increased extreme weather and temperatures</b>	Increased tourism impacts leading to increased injury risks, loss of product, and decreased tourism resulting in higher insurance premiums, impacts to economic development
<b>Increased temperature variability in shoulder seasons</b>	Extended maintenance seasons and issues hiring students as seasonal staff
<b>Increased temperature variability in shoulder seasons</b>	Less confidence in past weather patterns leading to increase of road patrol requirements and costs.



<b>Climatic Threat</b>	<b>Impact Statement</b>
<b>Increased variability in temperatures and precipitation</b>	Increased manufacturing and transportation costs (high lake levels affecting shipping routes, need for refrigerated transport, trucks affected by icy and poor road conditions) and difficulty getting product to markets, leading to economic impact.
<b>Milder winter temperatures</b>	Increased insect/pest survival rates leading to impacts on ecological habitats and increased tree and vegetation maintenance requirements.
<b>More cooling degree days</b>	Increased energy consumption resulting in costs for cooling to cool businesses, residents, and private properties.
<b>More cooling degree days</b>	Increased energy consumption resulting in more power outages and service disruptions
<b>More frequent/severe droughts</b>	Water resources are more vulnerable resulting in possible usage restrictions leading to costs and distribution impacting residents and businesses
<b>More frequent/severe droughts</b>	Water resources are more vulnerable resulting leading to less healthy ecological habitats impacting aesthetics and environment in Town
<b>More frequent/severe droughts</b>	Increased risks of grass fires leading to increased public health and fire emergency costs, or implementation of fire bans
<b>More frequent/severe droughts</b>	Decrease of water supply (dry hydrants/ponds) for firefighting
<b>More frequent/severe droughts</b>	Lowered water table resulting in increased watermain breaks leading to increased maintenance and labour costs
<b>More frequent/severe extreme weather events</b>	Increased costs for internal and external emergency response planning, processes, and alerts.
<b>More frequent/severe freezing rain events</b>	Poor travel conditions leading to increased labour and equipment costs (ex. delays in maintenance, scheduling)
<b>More frequent/severe freezing rain events</b>	Poor travel conditions leading to increased risk of hazardous material spills and more frequent activations of the emergency response plan
<b>More growing degree days</b>	Longer growing seasons resulting in increased spread of invasive species (e.g. Phragmites, Giant Hogweed)
<b>More growing degree days</b>	Longer growing seasons, leading to increased issues optimizing Town fleet (e.g. leaf pick up equipment vs. snowplows)
<b>More heavy rainfall events</b>	Increased site-specific flooding resulting in private infrastructure damage leading to economic loss and increased costs to rehabilitate
<b>More heavy rainfall events</b>	Increased erosion/sedimentation of SWM ponds and increased contamination risks to private wells leading to increased public health and safety costs
<b>More heavy rainfall events</b>	Increased erosion/sedimentation of SWM ponds and increased contamination risks to private wells leading to increased labour, and maintenance/capital costs.
<b>More heavy rainfall events</b>	Increased stormwater inflow into sanitary sewer system leading to increased discharge to environment
<b>More heavy rainfall events</b>	Increased crop damage leading to lower yields, and economic impacts



<b>Climatic Threat</b>	<b>Impact Statement</b>
<b>Winter precipitation changes (more ice vs. snow)</b>	Increased material usages, maintenance, and labour costs (equipment fatigue, rust, corrosion, salt, sand)
<b>Winter precipitation changes (more ice vs. snow)</b>	Increased ecological damage (higher sodium concentration in surface and ground water)
<b>Winter precipitation changes (more ice vs. snow)</b>	Increased time for firefighters to respond to an emergency incident thereby requiring standby duties resulting in increased labour costs.
<b>Winter precipitation changes (more ice vs. snow)</b>	More frequent extreme weather and icing resulting in poor travel conditions, leading to increased injury risks and decreased pedestrian/cycling tourism resulting in higher insurance premiums, and impacts to economic development
<b>! Impact Priority: Low</b>	
<b>Extreme cold temperatures</b>	Decreased effectiveness of road salt resulting in increased costs for more expensive liquid de-icing usage
<b>Increased annual temperatures</b>	Decrease in water quality resulting in increased flushing to retain chlorine residuals leading to increased costs for internal and external communications with public health and public works (closures, boil water advisories)
<b>Increased annual temperatures</b>	Decrease in water quality resulting in increased flushing to retain chlorine residuals due to increased green algae blooms
<b>Increased annual temperatures</b>	Decrease in water quality resulting in increased chlorine added by Region leading to increased labour to investigate taste and odour complaints
<b>Increased extreme weather and temperatures</b>	Decreased use of active transportation and increasing transportation-associated emissions
<b>Increased variability in temperatures and precipitation</b>	Decrease of stability of ice on lake and ponds resulting in increased likelihood of water and ice rescue responses
<b>Milder winter temperatures</b>	Decreased risk of frozen water services leading to decreased maintenance and labour costs
<b>More growing degree days</b>	Extended growing seasons leading to positive economic impact



# Appendix G: Action Prioritization Assessment

Actions were prioritized by the Adaptation Steering Committee using the below 8 criteria. A score from 1-5 was assigned in each category. The sum of each action's scores determined the priority.

Criteria	Description	Supporting Questions
<b>Importance and effectiveness</b>	An option is considered important and effective when it prevents or reduces significant economic, ecological, or social damage (especially in relation to human health and welfare) or can generate benefits. The consideration here includes both monetarily quantifiable damage/benefits and damages/benefits that cannot be expressed monetarily and, at worst, may be irreversible (e.g., fatalities or the destruction of ecosystems and their functionality).	<ul style="list-style-type: none"> <li>• Can the option prevent significant damage or create opportunities?</li> <li>• Will irreversible damage be avoided by implementing the option?</li> <li>• Does the option have a broad (protective) impact on the population?</li> </ul>
<b>Urgency</b>	Urgency is differentiated from importance through the time factor. An option is considered as urgent when it could have prevented damage that has already occurred, thereby highlighting an adaptation deficit. Such options are useful and/or necessary for the current climate. In the planning of these options, it should be noted that (depending on the lifespan of the option) they are also designed to improve the future climate. In addition, it is essential to remember that a number of options (for example, in the forestry sector) require very long lead times, which may increase the urgency of long-term forward-looking options.	<ul style="list-style-type: none"> <li>• Are extensive damages already occurring that could be prevented or reduced through the option?</li> <li>• How much time will pass from the planning stage through implementation until the option becomes effective? Does the option have a long lead time or development phase before coming into effect?</li> </ul>





Criteria	Description	Supporting Questions
<b>Robustness and flexibility</b>	Despite recent advances in climate modelling and the development of climate projections, climate projections are still subject to uncertainty. Therefore, adaptation options should be carefully examined for their suitability to the widest possible range of future climate developments. There are very few adaptation options that should be 'set in stone'.	<ul style="list-style-type: none"> <li>• Can the option contribute to adaptation even if climate change takes place more rapidly and more radically, or if there are unforeseeable changes?</li> <li>• Can the option be adjusted to meet greater or different protective needs?</li> <li>• Can the option be removed as needed (applies only to structural options)?</li> </ul>
<b>Synergies with other policy objectives</b>	Adaptation options that not only entail a sector-specific benefit but also support adaptation in other sectors are considered as especially valuable (win-win) in terms of climate policy. This applies to adaptation options that can make a positive contribution to climate change mitigation (e.g., reduction of electricity consumption peaks during summer heat waves or reforestation of protective forests). Furthermore, many adaptation options make a valuable contribution to other policy fields. For example, the creation of retention ponds through the preservation/renaturation of riparian forests also contributes to the conservation of biodiversity, and the sustainable use of resources can be supported by the application of modern irrigation technologies.	<ul style="list-style-type: none"> <li>• Can the option be easily integrated with existing policies?</li> <li>• Will greenhouse-gas emissions be sustainably reduced through the implementation of the option?</li> </ul>
<b>Environmental consequences</b>	Some adaptation options can involve significant environmental impacts. This applies in particular to so-called 'grey'/structural options (e.g. infrastructure options). It is important to consider whether the outcomes of an action justifies interference in an ecosystem, or whether there are alternative options (generally less invasive planning options or ecosystem-function strengthening options) that might offer slightly less protection but involve no negative environmental impacts. Such options often demonstrate additional advantages over structural options - they can be more cost-effective, more flexible, and generate fewer reservations among the population.	<ul style="list-style-type: none"> <li>• Does the option help to strengthen the functions/services of the natural ecosystem?</li> <li>• Can the adaptation or protective objectives of a 'grey'/structural option also be achieved through a less invasive 'soft' or 'green' option?</li> <li>• Does the option avoid negative impacts on ecological systems ?</li> </ul>



Criteria	Description	Supporting Questions
<b>Social consequences</b>	<p>In addition to environmental impacts, adaptation options should also consider social aspects. For example, during a heat wave in France in 2003, the fatalities were primarily among people who had no access to air-conditioned spaces. Among the most vulnerable population segments are those with the lowest income levels and pre-existing health conditions. In the planning and implementation of adaptation options, it is therefore especially important to make sure that social inequalities will not be exacerbated; rather, if possible, a reduction in inequality should be the goal.</p>	<ul style="list-style-type: none"> <li>• Does the option contribute to a fair distribution of climate risks or create protective advantages for as many people as possible, fostering the welfare and health of the entire population?</li> <li>• Has it been ensured that they will bring advantages to the widest possible range of population groups?</li> <li>• Does the option entail benefits for particularly vulnerable segments of the population (elderly, chronically ill, poor)?</li> </ul>
<b>Economic efficiency</b>	<p>Adaptation options should be both effective and efficient. An option is effective when it achieves a defined protective goal for the widest possible range of potential future developments; an option is efficient when the benefits of the option exceed its costs. The costs of adaptation options can be difficult to determine. The benefits of an option can depend on many (uncertain) factors, such as the future climate or exposed assets and people. Thus, benefits can sometimes only be estimated, and there are many (in particular, 'green') adaptation options that restore or protect ecosystem functions (e.g., groundwater recharge for drinking water production) whose benefits cannot be adequately expressed in monetary terms. This is one reason why purely monetary cost-benefit analyses fall short or are not viable for the prioritization of adaptation options; instead, they should be part of a multicriteria analysis. Importantly, new research suggests that the costs of not adapting will be far greater than that cost of adaptation (FCM 2020). For calculations as part of a cost-benefit analysis, the time horizon of no earlier than 2020/2050 should be considered.</p>	<ul style="list-style-type: none"> <li>• Does the investment in the option pay off in terms of the potentially prevented damage?</li> <li>• Does the option achieve a certain protective objective in the most cost-effective manner (in comparison to other options with the same protective/adaptation objective)?</li> </ul>



Criteria	Description	Supporting Questions
<b>Feasibility</b>	The feasibility of an adaptation option does not necessarily have to be a prioritization criterion, but it should be carefully considered. Often adaptation options fail because too many decision-makers are involved, the option does not seem politically opportune, or it is not socially accepted. Consequently, for successful implementation, an analysis of those involved with the option is indispensable. Particular attention should be devoted to the possibility that options can be integrated into ongoing processes (e.g., in the area of spatial planning or in the course of the implementation of certain provisions/regulations).	<ul style="list-style-type: none"> <li>• Is the option politically opportune – that is, does it correspond with the political objectives of decision-makers?</li> <li>• Is the option socially accepted, or should considerable resistance from the population be anticipated?</li> <li>• Is the option easy to implement, in that it involves a manageable number of decisionmakers?</li> <li>• Can the option be integrated into other policy areas?</li> </ul>

Overall Score	Overall Priority
<b>36-40</b>	Extreme
<b>31-35</b>	Very High
<b>26-30</b>	High
<b>21-25</b>	Medium-High
<b>16-20</b>	Medium
<b>11-15</b>	Medium-Low
<b>6-10</b>	Low
<b>5</b>	Very Low



# Appendix H: References

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