



# **Niagara-on-the-Lake Climate Change Adaptation Plan**

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**Niagara**  
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# Contents

<b>Foreword</b>	<b>1</b>
<b>Acknowledgments</b>	<b>2</b>
Project Team	2
Environmental Advisory Committee	2
Senior Management Team	3
Brock University (Niagara Adapts Collaboration)	3
External Stakeholders and Community Involvement	3
Future Green Team	4
<b>Message from The Lord Mayor &amp; CAO</b>	<b>5</b>
<b>Climate Change, Extreme Weather and Local Trends</b>	<b>6</b>
Town of Niagara-on-the-Lake Climate Change Projections	8
<b>Climate Change Adaptation</b>	<b>10</b>
Adaptation vs. Mitigation	10
Provincial and Federal Direction on Climate Change	11
Town of Niagara-on-the-Lake's Commitment to Climate Change	12
Planning Process	13
<b>Climate Change Vulnerability and Impact Identification</b>	<b>14</b>
Vulnerability Assessments	14
Climate Change Impact Identification	16
<b>Vision, Goals and Actions</b>	<b>17</b>
Vision Statement	17
Goals	17
Actions	18
Resident Engagement Vision and Goals Survey	20
<b>Implementation</b>	<b>21</b>
Implementation Schedule	21
Implementation Tools	22
Monitoring and Review	23
Indicators and Measuring Plan Progress	23
Next Steps	25
<b>Appendices</b>	<b>26</b>
Glossary	27
Vulnerability Ranking Chart	30
Impact Statements	31
Indicators	34
Implementation Schedule	36
References	47





# Foreword

The purpose of a Climate Change Adaptation Plan (CCAP) is to prepare the Town to adapt to climate change, extreme weather and to minimize the results of climate impacts. This will be accomplished by:

- Creating a vision statement to support the Town's position on climate change.
- Identifying potential impacts related to climate change on infrastructure, assets, services and operations.
- Prioritizing adaptation actions to reduce risk and vulnerability.
- Developing a detailed plan of implementation including cost estimates, funding sources, responsibilities, timelines and evaluation framework.

The impacts of climate change will be felt across the entire region and will continue into the future. Adaptation planning enables the Town to develop a guideline and evaluate vulnerabilities, manage the impacts, risks and opportunities presented by changing climate. While efforts to combat climate change are necessary at all levels, municipalities are on the frontline of planning for climate change adaptation and engaging stakeholders.

The CCAP includes twenty-seven actions that the municipality will undertake to adapt to climate change. These actions contribute to six overarching goals that the Town will strive towards as it implements the CCAP. The goals are as follows:



**Integrate Climate Change into Plans, Policies, By-Laws and Standards**



**Build Urban Forest Resiliency**



**Reduce Flooding Risks**



**Incorporate Climate Change in Design and Construction**



**Minimize Health and Safety Risks to Community Members**



**Support Public Awareness and Education**



# Acknowledgements

The Town of Niagara-on-the-Lake Climate Change Adaptation Plan was developed as a collaboration between the Environmental Advisory Committee (EAC), Brock University, municipal staff and many community stakeholders. The Project Team would like to thank all those who contributed their time, expertise and support.

## Project Team

Victoria Steele, Executive Assistant & Communications Officer to the CAO & Lord Mayor  
Rob Andrea, Engineering Technologist

## Environmental Advisory Committee

To ensure the CCAP reflects local context, community priorities and industry expertise, the Town's Environmental Advisory Committee (EAC) assisted in the development of the plan. The planning process included a series of workshops, meetings and surveys to evaluate and consult on the adaptation plan process and the draft plan.

Members of the committee include:

Councillors	Citizen Representatives	Staff
Norm Arsenault (Chair)	Christine Earl (Vice Chair)	Victoria Steele
Sandra O'Connor	Marco Brunato	Rob Andrea
Gary Burroughs	Kyra Simone	Brett Ruck
	William Rapley	Sheldon Randall
	Paul Jurbala	
	Dylan Wiens	
	Owen Bjorgan	
	William Roberts	



## Senior Management Team

The Project Team would like to thank the Town of Niagara-on-the-Lake Senior Management Team (SMT). Their ongoing support, input and expertise were influential in the development of the CCAP and championing climate action in Niagara-on-the-Lake.

## Brock University (Niagara Adapts Collaboration)

Adaptation is well-suited for a collaborative approach because of the wide range of expertise and experience required. 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 also recognizing and supporting the uniqueness of each partnering 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

## External Stakeholders and Community Involvement

To ensure the CCAP reflects local context and community priorities, external stakeholders were consulted and the Project Team would like to acknowledge these stakeholders and their ongoing support.





## Future Green Team

To ensure the plan reflects staff expertise and corporate priorities, a future “Green Team” will be considered as an additional measure to ensure the success of the adaptation plan. The “Green Team” will be multi-departmental and comprise individual Town staff with diverse expertise and experience with the Town’s communities, infrastructure, assets and services. The team will be expected to attend workshops to identify and evaluate risks and vulnerabilities and to facilitate the implementation of the plan. Ownership for each department’s adaptation plan will live with the department.



# Message from the Lord Mayor & CAO



On behalf of the Council and Staff of the Corporation of the Town of Niagara-on-the-Lake, it is our pleasure to present the Climate Change Adaptation Plan.

Climate change has become abundantly apparent in the Niagara Region in recent years. We have witnessed warmer, wetter and wilder weather that has severely impacted shorelines and infrastructure. The physical, social and financial impacts of changing weather patterns in our community are evident, and the Town is committed to becoming a leader in climate change adaptation.

The vision, goals and actions presented in this strategy will guide the Town as we prepare for, respond to, and recover from the impacts of climate change. This plan will provide guidelines to ensure the Town is prepared to respond to an uncertain future of a changing climate.

We thank everyone involved in completing this project; Town Council and Staff, the Environmental Advisory Committee, Brock University's Environmental Sustainability Research Centre and the community.

With extreme weather events becoming increasingly common, the Town recognizes the need to commit to action. The Town of Niagara-on-the-Lake is preparing for the future and is becoming a strong community by acting now.



*Betty Disero*

Betty Disero  
Lord Mayor



*M. Cluckie*

Marnie Cluckie  
Chief Administrative Officer





# Climate Change, Extreme Weather and Local Trends

In 2019, Environment and Climate Change Canada published Canada's Changing Climate Report, which reviews the evidence that the Earth has warmed during the Industrial Era. The report documents widespread evidence that the main cause of this warming is human influence, specifically industrial activity and greenhouse gas emissions from fossil fuel burning. The data included in the report shows:

- Increases in near-surface and lower-atmosphere air temperature, sea surface temperature and ocean heat content.
- The shift toward a warmer global climate on average has been accompanied by an increase in warm extremes and unpredictable winter conditions.
- 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>1</sup>

The steady change in average temperature, precipitation and rising sea level will be accompanied by changes in intensity and frequency of extreme weather events.

The vulnerability of Canadian communities and infrastructure can also be realized by the impacts of extreme weather and climate change. Over the past 15 years, the costs resulting from extreme weather events in Canada have been greater than all previous years combined. These costs include property damage and disruptions in the production and flow of goods and services associated with flooding, wind, hail, ice storms, hurricanes, tornadoes and wildfires. With continued climate change, projected increases in the frequency and intensity of extreme weather will also affect the cost and availability of insurance and impact governments that serve as insurers of last resort.<sup>2</sup>

Locally, climatic and extreme weather trends are outlined in a 2012 report<sup>3</sup> from the Regional Municipality of Niagara including:

- An increase in annual average temperature
- More days with temperatures over 30° C
- Heat waves lasting 3 or more days
- Increase in average number of frost-free days
- Increase in annual precipitation (mostly in the winter months)
- Increase in summer droughts
- Increase in heavy rain events



Climate scientists project the following for the Niagara Region over the next 30 years:

- Increase in average annual temperatures of 3–4°C by the 2050s
- Increase in frost-free days by as much as 30 days by 2050
- A significant decrease in rainfall in the summer by 2050
- An increase in freeze-thaw cycle frequency
- Increase in extreme weather events including high winds, heavy rains, hailstorms and tornadoes.

The Town is likely to be affected by a range of climate change impacts including basement flooding, damaging storms, power outages, heat stress and damage to infrastructure. These impacts will reach all aspects of the Town, including residents, business owners, tourists, agriculture and wildlife.







## Town of Niagara-on-the-Lake Climate Change Projections

Climate change continues to put significant pressure on both natural and built environments and will be felt locally in terms of both extreme events and incremental change. Projections for Niagara-on-the-Lake are largely focused on changes in temperature and precipitation patterns, but also provide insight into extreme weather events.

These climate projections for the Town of Niagara-on-the-Lake are based on climate modelling data from [Climatedata.ca](http://Climatedata.ca), a project undertaken with the financial support of Environment and Climate Change Canada, the Computer Research Institute of Montréal, Ouranos, the Pacific Climate Impacts Consortium, the Prairie Climate Centre and Habitat Seven.

Projections are based on high-emission scenarios for future outcomes using historical data and current science. A summary of projected changes can be found below.

Temperature	
Annual Average Temperature (Under high emissions scenario)	1951-1980: 8.9° C 1981-2010: 9.4° C 2021-2050: 11.3° C 2051-2080: 14.7°C
Warming	Trends show an increase in warm days and fewer cold days across all seasons.
Freeze-Thaw Cycles	Projections suggest an increase in frequency of freeze-thaw cycles between 2021–2080
Hot Days	The number of hot days (days above 30°C) is expected to increase from a baseline (1981-2010) of 10 days to 13 days by the 2020s, 48 days by the 2050s and 85 days by the 2080s.
Cold Days	The number of cold days (days below -15°C) is expected to decrease from a baseline of 21 days to 10 days by the 2020s, 6 days by the 2050s and 3 days by the 2080s.





## Precipitation

Average Annual Precipitation	1951–1980: 810 mm 1981–2010: 860 mm 2021–2050: 890 mm 2051–2080: 925 mm
Intensity	Trends show precipitation events will become more intense and extreme.
Wet Days (Above 10mm Precipitation)	Projections suggest an increase in wet days by 10–20%.

## Extreme Weather Events

Rainfall	Increase in intensity, duration and frequency of extreme rainfall events.
Wind	Severe winds to increase in both magnitude and frequency by the end of the century.
Snowfall	Annual snowfall is projected to decrease but freezing rain events are predicted to increase.

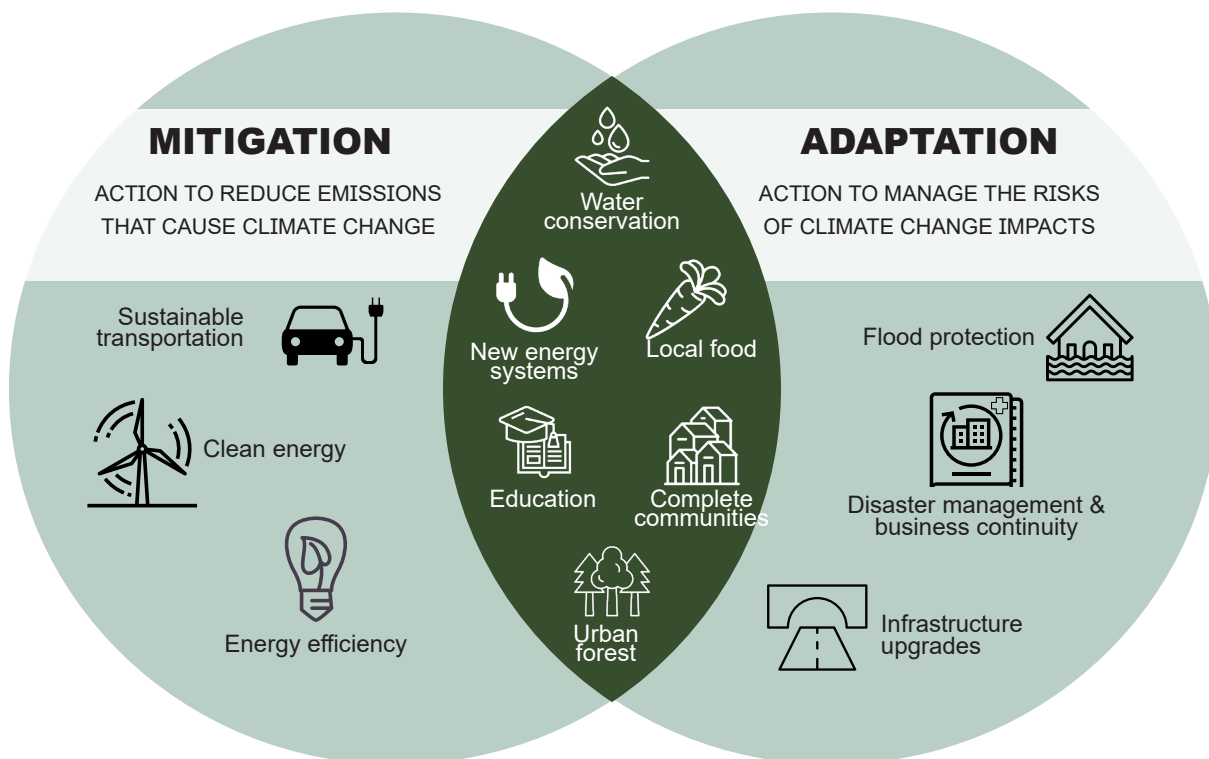
While we acknowledge that there is inherently some uncertainty in the exact number of days or specific temperature measurements, the overall climate change trends projected by these mathematical models provide the best possible prediction of future conditions for the area. However, use of these tools must be informed by an understanding of their limitations. the understanding of their limitations.



# Climate Change Adaptation

In terms of dealing with climate change there are two harmonious and intersecting approaches.

## Adaptation vs. Mitigation



Adaptation refers to actions taken to respond to the impacts of climate change by taking advantage of opportunities or reducing the associated risks, while Mitigation refers to ongoing attempts to prevent significant climate change through reductions in greenhouse gases in the atmosphere. Examples of adaptation actions include updating operating procedures, increasing stormwater management system capacities and increasing the urban tree canopy coverage. In contrast, mitigation examples include improving energy efficiency of buildings and using low-emission vehicles.

Mitigation and adaptation are not mutually exclusive, with many actions overlapping both goals. For example, planting trees will contribute to adaptation to extreme heat by providing shade, while also mitigating greenhouse gas emissions and lowering energy consumption.





## Provincial and Federal Direction on Climate Change

Evidence of the rising cost of climate change in Canada is shown by the increase in government-sponsored disaster relief payments. The importance of adaptation in reducing those costs becomes very evident as confirmation develops for actual and predicted costs of climate change. The Office of the Auditor General's 2016 report on federal government support for mitigating the effects of severe weather notes the potential cost effectiveness of disaster mitigation measures for government and society, citing Public Safety Canada's estimate that every dollar invested in mitigation saves \$3 to \$5 in recovery costs.<sup>4</sup>

In terms of federal direction, Canada was one of the 195 countries to sign the Paris Agreement in December of 2015. The Agreement intends to maintain the increase in global average temperature to below 2°C and to drive efforts to limit the temperature increase even further to 1.5°C above pre-industrial levels. Additionally, the Agreement aims to strengthen resilience, enhance adaptive capacity and lessen vulnerability to global climate change.

Furthermore, the 2019 report, Canada's Changing Climate, released by Environment of Climate Change Canada, documented the latest evidence of climate change and the severity of the impacts on our economy. The report concluded that public infrastructure is particularly vulnerable to the impacts of climate change and Canadian municipalities are struggling to maintain these crucial assets.<sup>5</sup>





## **Town of Niagara-on-the-Lake's Commitment to Climate Change**

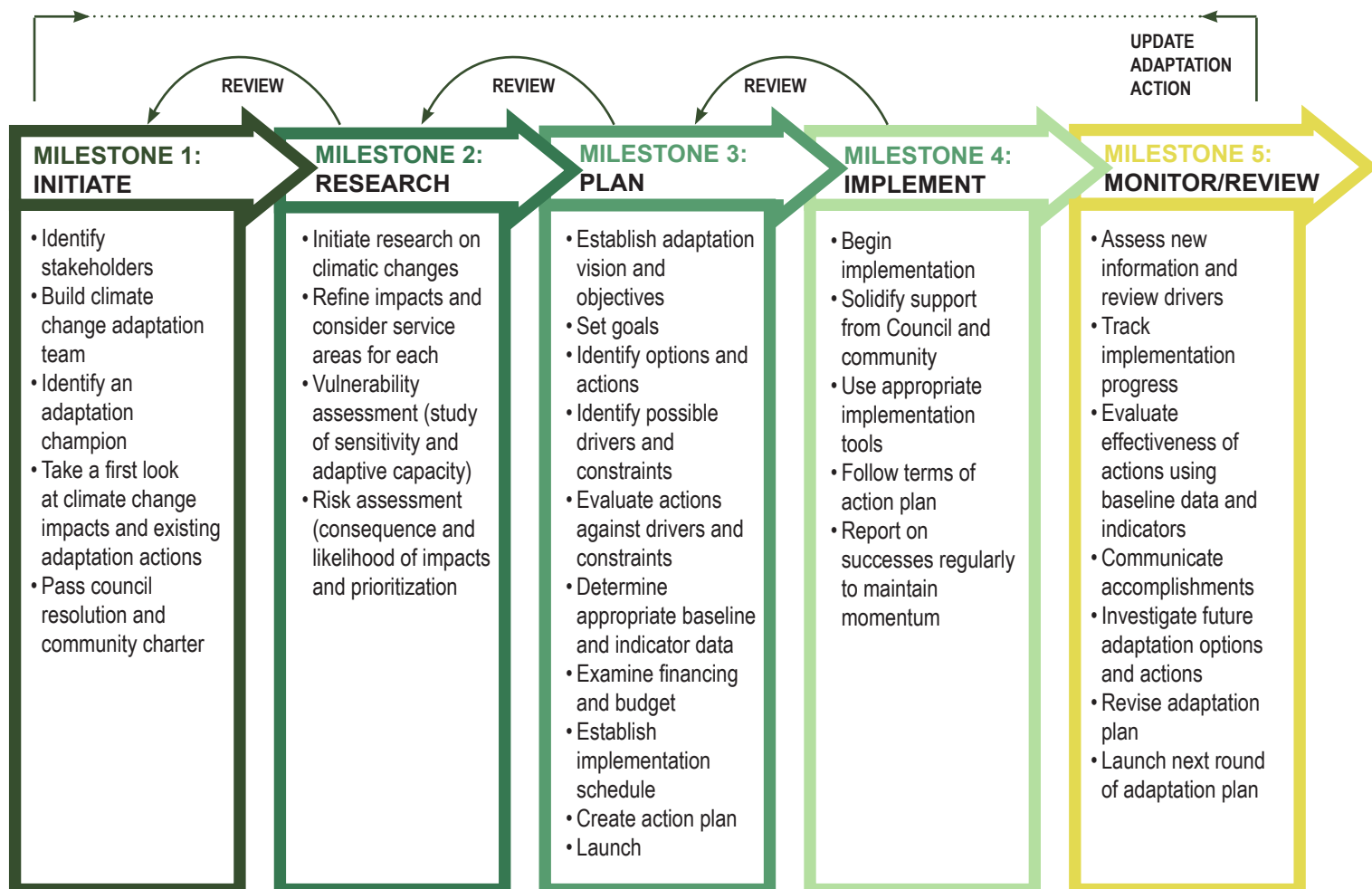
The Town of Niagara-on-the-Lake is committed to providing residents with opportunities to enjoy an improved and protected quality of life in a prosperous and ecologically sustainable community. This commitment is reflected in several measures the Town has already taken to become more sustainable in the face of climate change. For example, in November of 2020 the Town of Niagara-on-the-Lake developed the Environmental Advisory Committee (EAC) to offer a collaborative approach to environmentally sensitive issues and climate change adaptation and mitigation. Additionally, the group relies on strategic advice and expertise among members of the community, other volunteer or official environmental organizations, additional key stakeholders, external experts and other levels of government to provide information and advice to promote environmental sustainability, stewardship and protection within the Town. The EAC will coordinate information and strategic advice on how to integrate an environmental lens for future projects and initiatives to foster sustainability.

Overall, the Town of Niagara-on-the-Lake understands that collaborative action must be taken now to help our communities become more resilient to climate change impacts. The development of the Climate Change Adaptation Plan will help coordinate decision-making and planning efforts to reduce vulnerabilities to climate change, while building resilience across Town operations.



## Adaptation Planning Process

The development of the plan utilized Building Adaptive and Resilient Communities BARC Framework that was developed by the International Council for Local Environmental Initiatives Canada (ICLEI) following the release of Changing Climate, Changing Communities: Guide and Workbook for Municipal Climate Adaptation in 2010. The BARC framework provides a structured approach to adaptation planning. This is accomplished by working through a series of five (5) progressive milestones including impact identification, risk assessment, goal setting, action identification, action prioritization and implementation monitoring.





# Climate Change Vulnerability and Impact Identification

## Vulnerability Assessments

Vulnerability refers to the susceptibility of a given region, municipality, social group or sector to harm arising from climate change impacts. Vulnerability is understood as a function of exposure, sensitivity and adaptive capacity to climate change impacts.

Town staff completed a risk and vulnerability indicator ranking exercise. Based on an extensive literature review and expert opinion, Brock University's Environmental Sustainability Research Centre developed a set of 50 indicators specific for the Niagara Region.

To ensure that the 50 indicators were highly relevant to Niagara-on-the-Lake, Town staff prioritized the indicators, from most to least important, using the QSort method. These rankings were then used to develop weights which were applied during the vulnerability survey analysis. The completed Ranking Chart can be found in Appendix B.

In the fall of 2019, a vulnerability assessment was issued to residents of Niagara-on-the-Lake. Primary and secondary data were collected from multiple sources including Statistics Canada, Niagara Region Public Health, municipal input by Niagara Adapts partners and a community survey. For Niagara-on-the-Lake, 104 members of the public completed the survey.

The results from the survey provided critical insights into how people in the region were experiencing climate change as well as their potential capacity to adapt. For example, 78% of respondents believe climate change is creating impacts in their community, and 84% of respondents support municipal resources going towards adaptation planning in Niagara-on-the-Lake.

Findings from the analysis revealed a final vulnerability index value of 0.332 for Niagara-on-the-Lake, where 0 represents highly vulnerable and 1 represents highly robust.





## Exposure to climate change in Niagara-on-the-Lake

**78%**

of respondents believe climate change is impacting their community

**82%**



of respondents have experienced community flooding

**51%**



of respondents have experienced extreme heat

**20%**



of respondents have experienced extreme cold

**27%**



of respondents have experienced severe weather

Only **20%** of respondents feel that Niagara-on-the-Lake is prepared to adapt to climate change

## Opportunities for adaptation



**90%** of respondents believe humans have the capacity to address climate change



For **58%** of respondents, adapting to climate change is a top priority for their households



**84%** of respondents support municipal resources being used for climate change adaptation

### Household Flood Preparedness

**20%**



of respondents have experienced household flooding

**61%**



of respondents have a sump pump

Only **22%**



of respondents use rain barrels

**55%**



of respondents have household flood insurance

Note: Percentages reported on this page reflect the 104 people who completed surveys from Niagara-on-the-Lake.



## Climate Change Impact Identification


The impacts of climate change will affect a variety of physical systems in the Town of Niagara-on-the-Lake including the built environment, parks, transportation, irrigation/drainage and energy systems. The frequency and extremes of weather events will increase maintenance requirements, replacement costs and the potential damage of assets throughout the community. An increase in precipitation will have a direct impact on Town infrastructure such as stormwater pond capacity and road washouts. Freezing rain and more frequent freeze-thaw cycles present challenges to the physical and green infrastructure in Niagara-on-the-Lake. Additionally, historic and cultural sites are also at risk of damage and deterioration due to extreme storms, wind, erosion and flooding.

Extreme weather events, air quality concerns, extreme heat and cold, as well as the spread of vector and rodent born disease will directly impact Niagara-on-the-Lake residents.

The Town's ecosystems are already under stress because of human activities including the migration of native and non-native species and the spread of insects and disease, which have been intensified by climate change. Warmer winters, longer summers and decreased annual precipitation have led to lower water levels, warmer water temperatures and reduced availability of soil moisture in forests and agricultural land. <sup>6</sup> These changes are impacting the shoreline, species distribution, erosion, water quality, fish and wildlife habitats and the spread of invasive species.

Although, the extent of these impacts is difficult to predict, the effect of extreme weather and long-term changes in temperature and precipitation is irrefutable. Economic losses from extreme weather events, changes to the production, price, and demand for goods and services, as well as impacts to several economic sectors, such as energy, agriculture, tourism, recreation, freshwater fisheries, and transportation, are all likely to occur within the short and medium term. <sup>7</sup> Residents will also be impacted, resulting in increased insurance premiums and damage to properties as a result of extreme weather events. Local businesses will experience operational losses, business continuity issues and disruptions to essential services.

A list of impact statements can be found in Appendix C. The impact statements incorporate a variety of areas including infrastructure, the natural environment, public health and safety and communications.








# Vision, Goals and Actions

## Vision Statement

*“Niagara-on-the-Lake will demonstrate leadership and innovation to protect the community’s natural beauty, charm and heritage against the impacts of climate change today and into the future.”*

## Goals

Six goals were developed by the Project Team and Environmental Advisory Committee. The overarching goals include the following:

-  **Integrate Climate Change into Plans, Policies, By-Laws and Standards**
-  **Urban Forest Resiliency**
-  **Reduce Flooding Risks**
-  **Incorporate Climate Change in Design and Construction**
-  **Minimize Health and Safety Risks to Community Members**
-  **Support Public Awareness and Education**





### **Integrate Climate Change into Plans, Policies, By-Laws and Standards**

- Update Official Plan to align with climate change adaptation goals.
- Review and update by-laws to incorporate climate change.
- Develop a policy for regular interval updates to infrastructure design standards to reflect climate change projections and green infrastructure technologies.
- Incorporate climate change projections into Engineering Design Standards.



### **Urban Forest Resiliency**

- Develop an Urban Forestry Management Plan.
- Canopy coverage mapping to establish measurable goals.
- Include trees as a part of the Town's asset management plan.
- Mapping of invasive species.
- Promote planting of native vegetation along creeks, ravines and lakes.
- Consider partnership with local Colleges, Universities and research centres



### **Reduce Flooding Risks**

- Engage a Stormwater Management Plan.
- Review and update floodplain mapping.
- Create a flood preparedness and evacuation plan with flood alerts and mapping.
- Increase public awareness of clearing of catch basins.



### **Incorporate Climate Change in Design and Construction**

- Incorporate climate change considerations into the Town's Asset Management Plan.
- Ensure climate change impacts are incorporated into project risk management framework.
- Explore projects suitable for Low Impact Development (LID).
- Create a Stormwater Management Inspection Program (High Risk Infrastructure).
- Leverage available grants for both built infrastructure and asset management.



### **Minimize Health and Safety Risks to Community Members**

- Increase shade coverage in urban areas.
- Investigate ways to improve storm water discharge to creeks, streams, rivers and lakes. Both quantity and quality.
- Promote active transportation and improve the safety of bike lanes.
- Implement warming and cooling centers.



### **Support Public Awareness and Education**

- Engage Town Staff and Public to develop a Natural Assets Plan.
- Educate Public and Town Staff of standing water concerns and develop a guide for remediation.
- Develop a social media campaign to target climate change initiatives.
- Utilize Town website to convey climate change and adaptation information.



## **Resident Engagement: Vision and Goals Survey**

The results from the climate vulnerability survey, combined with information gathered through the workshop with the Town's Environmental Advisory Committee, were used to develop the draft vision and goals for Niagara-on-the-Lake's Climate Adaptation Plan.

Prior to the Town sharing the draft vision and goals with the public and garnering their feedback, the survey was first issued to Town Staff to allow for feedback and adjustments to the survey, as required. Town Staff was asked to consider the draft vision and goals from the perspective of a Town employee and, wherever possible, in light of their specific work. This approach allowed for the evaluation of the Staff's support for specific goals and consider the ways in which a Climate Change Adaptation Plan may impact the work and service that is provided as a municipality. Surveys were issued to Senior Management and staff from a variety of departments. Overall, there was an enthusiastic level of support for the draft visions and goals.

After reviewing the results of the Staff survey, it was then issued to the public on June 1, 2021 for further engagement. The survey was promoted on the Town's website, social media and issued to the EAC for further promotion within the community. A selection of residents completed the survey and exhibited an overwhelmingly positive support for the draft vision and goals. The qualitative responses were quite informative and offered a variety of suggestions of actions that could be promoted under each category.

The project team is satisfied with the results and achieved the desired amount of support from the community and staff for the draft vision and goals.





# Implementation

The Town of Niagara-on-the-Lake has made improvements in adaptation through the development of the Climate Change Adaptation Plan. However, it is through implementation of the Plan overall that the Town will improve its adaptive capacity. To ensure the implementation is effective, the Town in collaboration with the EAC developed a preliminary implementation schedule.

The Implementation Schedule is intended to be a living document and will be further refined as actions progress and are completed. Updates may include modifications to policies, staff or financial resources, grant opportunities and unexpected extreme weather events. Allowing for flexibility will ensure the Town is not constrained to certain parameters should new opportunities for implementation arise.

## Implementation Schedule

The preliminary Implementation Schedule was developed to identify and allocate resources required to implement priority actions. Alongside every priority action, the Implementation Schedule includes:

Detailed description of each action item including opportunities to integrate actions into existing municipal plans, policies and plans.

- Identification of potential risks and how they may impact the overall success of each action item.
- Identification of practices that are currently in place at the Town in relation to the action item.
- Timeframes for implementation of each action.
- Reference to similar action items where synergies exist.

The preliminary Implementation Schedule is presented in Appendix E.



## Implementation Tools

To ensure the likelihood of success and foster long-term sustainability, the Town will utilize a variety of tools to successfully implement each action.

### Implementation tools may include the following:

- **Communications and Marketing:** The Town will use a variety of communication channels including visual advertisements, written media, social media and verbal communication.
- **Municipal Policy Tools:** To provide policy framework and generate new compliance requirements that are supportive of adaptation actions, the Town may use land-use planning tools, by-laws and subsidy programs.
- **Training and Education:** The Town will utilize both internal and external training public education sessions for selected adaptation actions. Additionally, the activities will help support implementation by increasing the knowledge and deepening/enhancing public collaboration.
- **Demos and Pilots:** Some action items will require the use of a pilot or demonstration site, prior to implementing at a larger scale and across the municipality. Smaller scale initiatives will help determine the viability of the action and the overall level of success moving forward.





# Monitoring and Review

Monitoring and review is a critical part of the adaptation planning process. It not only provides an opportunity to assess the lessons learned throughout the development and implementation of the adaptation actions, but also allows for the evaluation of potential risks and opportunities. The review of these processes can then be integrated into future adaptation strategies and planning.

In addition, tracking development is also an essential part of the monitoring and review process, as it allows the Town to assess the rate of success and whether the actions outlined in this plan are producing the desired results. Tracking also provides an opportunity to communicate accomplishments and celebrate the successes of the Town's adaptation efforts.

The Town is committed to formally reviewing the CCAP every five years and to present an annual update to Senior Management and Council.

## Indicators and Measuring Plan Progress

To ensure the successful implementation of the Town's CCAP, a series of indicators are included and will be useful in tracking progress over time. These indicators are outlined in Appendix D and will measure the overall success of the CCAP and provide insights into how the Town is preparing and responding to the impacts of climate change.

Indicators are quantitative or qualitative factors that provide a method to describe an issue and track trends over time relative to a baseline. Indicators will be most effective when they follow SMART criteria:

- **Specific:** Focus on a specific area for improvement.
- **Measurable:** Ability to quantify the progress of the indicator.
- **Assignable:** Specify the resources required for each indicator.
- **Realistic:** Identify the results that can realistically be achieved.
- **Time-related:** Specify when the results can be reached.

Indicators will measure the degree to which the Town is implementing the actions outlined in the Plan, but not measure if the actions have succeeded in reducing vulnerabilities to climate change. Therefore, it will be essential to develop outcome-based and action-specific indicators as implementation progresses.



## Plan Review

The Town of Niagara-on-the-Lake intends to review and assess the CCAP on an annual basis with a comprehensive update every five years. The assessment schedule may be modified to less than five years in the event of a change to a significant climate change impact, Federal, Provincial and/or Regional policy updates. It is anticipated that a report to Council will occur on a yearly basis, with a progress report submitted every six months. This will also include a review of the 2022 budget to identify any potential opportunities to incorporate the newly adopted goals and actions.

### **The annual review and progress report will include the following:**

- Synopsis of any observed changes in climate change impacts.
- Review of successful implemented actions.
- Review of obstacles and amendment of actions to enable successful implementation.
- Reassessment of scheduling timelines as information on funding is updated.
- Review of planning programs or initiatives that provide opportunity for climate adaptation actions or that may be impacted by climate change.
- Identification of potential new funding options.

### **The five-year update and review will include:**

- A thorough review by a designated Climate Change Adaptation Team appointed by the Chief Administrative Officer. The inclusion of at least one member of the original plan development team is encouraged.
- New development in Federal, Provincial and/or Regional climate science and impact assessments.
- Analysis of impacts identified and prioritized in the original plan. Specifically, the review of any gaps arising from new climate science or observed impacts. New actions to mitigate these impacts will be detailed.
- A review and revision of all actions to account for actions completed, deferred, removed or updated.
- Evaluation of any changes in risk or to leverage new programs, policies or plans.
- Incorporation of new indicators to measure adaptation progress.
- Review by the appropriate departments prior to a final plan update being presented to Council for adoption.





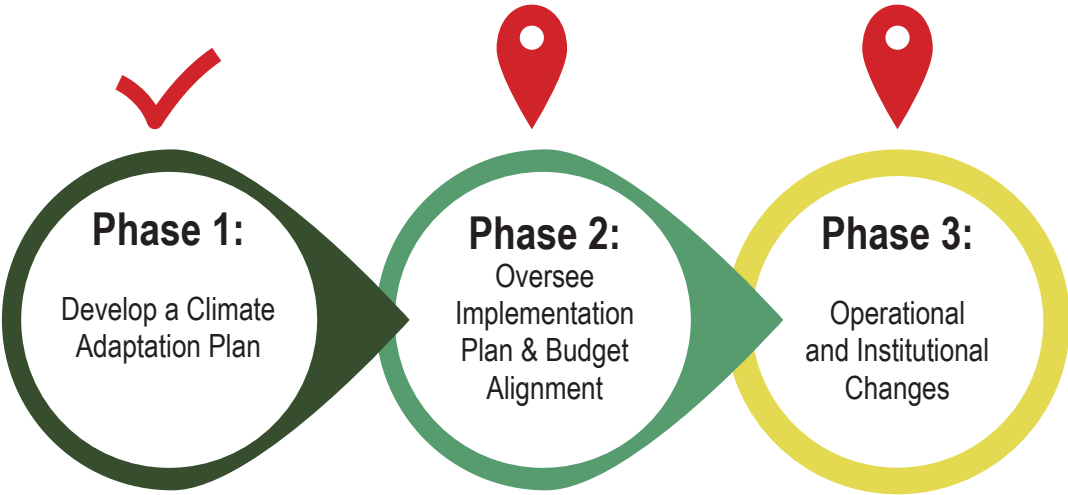
# Next Steps

The implementation of the CCAP will commence upon Council approval and adoption of the final plan. The Town of Niagara-on-the-Lake is dedicated to working with staff, residents, the Niagara Peninsula Conservation Authority, the Region of Niagara, Brock University, Council and other community stakeholders to successfully implement the Plan’s vision, goals and actions.

Additionally, the Town will explore options to create a Mitigation Plan to address the greenhouse gas (GHG) emissions in relation to the Town’s services, assets, operations and infrastructure. Examples may include active transportation, green fleets or sustainable energy projects.

The Town will consider joining 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.

Next steps for the Town will include executing the CCAP as outlined in the implementation schedule and aligning budget items. Specifically, short-term action items will commence if included in the budget and detailed planning for mid-to long-term actions will be forecasted. This will also include the re-engagement of staff and the formation of the internal employee Green Team to align the implementation schedule within each department.





# **Appendices**

**Appendix A - Glossary**

**Appendix B - Vulnerability and Risk Assessments**

**Appendix C - Impact Statements**

**Appendix D - Indicators**

**Appendix E - Implementation Schedule**

**Appendix F - References**



## 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 0°C</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 -15°C</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 -25°C</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 30°C</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.
<b>Extreme Events</b>	A meteorological event that is rare at a place and time of year, such as an intense storm, tornado, hailstorm, flood, or heat wave, and is beyond the normal range of activity. An extreme weather event would normally occur very rarely or fall into the tenth percentile of probability

## Appendix A - Glossary

<b>Frost Days</b>	Number days when daily minimum temperature is less than 0°C and indicates when conditions are below freezing, usually overnight.
<b>Frost-Free Days</b>	Average duration interval between the last frost day of the spring and the first frost day of the autumn season.
<b>Growing Degree Days 10°C</b>	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.
<b>Growing Degree Days 5°C</b>	The number of days in which the daily temperature exceeds the threshold temperature (temperatures that support plant growth). For example, a threshold temperature of 5°C is generally used for forage crops and canola.
<b>Heating Degree Days</b>	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.
<b>Hottest Day</b>	This is the highest maximum temperature value in this time period.
<b>Impact</b>	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).
<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.

## Appendix A - Glossary

<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>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 - Vulnerability Ranking Chart

Least Important

Neutral

Most Important

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

# Appendix C - Impact Statements

Increase in Temperature			
Impact ID	Climatic Change	Impact Statement	Impacted Service Area
1.1	Increase in days above 30° C	Increase in frequency and duration of days above 30°C, leading to an increase of energy use at Town owned facilities and buildings.	Community Services Emergency Response Parks and Recreation
1.2	Increase in days above 30° C	Increase in frequency and duration of hot days above 30°C, resulting in higher demand for cooling centres outside of regular business hours.	Parks and Recreation Emergency Response
1.3	Increase in days above 30° C	Increased need for additional canopy coverage and shaded areas.	Engineering (GIS) Parks and Recreation Planning
1.4	Increase in summer temperatures	Warmer temperatures leading to an increase in demand for aquatic facilities, splash parks and wading pools.	Parks and Recreation
1.5	Increase in summer temperatures	Increase in dry periods, resulting in loss of vegetation and increase in wildfires.	Fire and Emergency Services Drainage and Irrigation
1.6	Increase in summer temperatures	Increased health and safety risks to the public and vulnerable populations.	Emergency Response Communications
1.7	Increase in annual temperatures	Increase in vector-borne illnesses as a result of warmer temperatures (e.g. Lyme Disease).	Environmental Services Parks and Recreation
1.8	Increase in annual temperatures	Increased spread of invasive species due to longer growing season (e.g., Phragmites).	Environmental Services Drainage and Irrigation Parks and Recreation
1.9	Increase in annual temperatures	Increase in rapid snowmelts, impacting stormwater infrastructure.	Engineering Environmental Services Roads
1.10	Increase in volatile temperatures	Increase in freeze and thaw cycles, leading to damage to Town infrastructure and buildings.	Roads Water/Wastewater Engineering Environmental Services Parks and Recreation
1.11	Increase in volatile temperatures	Increase in salt use, resulting in accelerated deterioration of Town assets (fleet and infrastructure).	Roads Fleet Management Environmental Services Parks and Recreation

# Appendix C - Impact Statements

Changes in Precipitation Patterns			
Impact ID	Climatic Change	Impact Statement	Affected Service Area
2.1	Increase in heavy rainfall events	Increase in overland flooding due to overburdened storm water management facilities and storm sewer infrastructure.	Roads Water/Wastewater Engineering Environmental Services Parks and Recreation
2.2	Increase in heavy rainfall events	Increase in basement flooding and backups caused by inflow and infiltration in sanitary sewers.	Water/Wastewater Engineering Environmental Services
2.3	Increase in heavy rainfall events	Increase in erosion leading to damage to creeks, parks, shoreline trails and Town infrastructure.	Water/Wastewater Environmental Services Parks and Recreation
2.4	Increase in heavy rainfall events	Increase in closures of parks and sports fields, leading to temporary loss of facilities and increased maintenance requirements.	Parks and Recreation
2.5	Increase in frequency of rainfall events	Increase in damages to agricultural lands resulting in lower crop yields.	Agriculture and Tourism Economic Development
2.6	Increase in frequency of rainfall events	Increase in cancellations of outdoor programming and public events, leading to a decrease in tourism.	Parks and Recreation Tourism and Culture Community and Development
2.7	Increase in frequency of rainfall events	Increase in insurance claims from homes adjacent to lake and river.	Finance Legal
2.8	Increase in frequency of rainfall events	Increase in public emergency events and evacuations.	Emergency Response Communications
2.9	Increase in freezing rain events	Increase in power outages and service disruptions caused by freezing rain events.	Emergency Response Facilities Hydro Services
2.10	Increase in freezing rain events	Safety risks for public and Town staff are increased as a result of winter rain events.	All Staff and Residents



# Appendix C - Impact Statements

Extreme Weather Events			
Impact ID	Climatic Change	Impact Statement	Affected Service Area
3.1	Extreme cold temperatures	Increase in watermain breaks and frozen services leading to emergency repairs and service disruptions.	Water/Wastewater Engineering Environmental Services
3.2	Extreme cold temperatures	Increase in required maintenance for Town-owned equipment, leading to increased stress on operations and decreased service levels.	Fleet Management Roads Water/Wastewater
3.3	Extreme temperatures	Increased health and safety risks to outdoor workers during extreme temperatures.	Roads Water/Wastewater Engineering Environmental Services Parks and Recreation By-Law
3.4	Increase in extreme windstorms	Increase in damage to Town assets and infrastructure including trees, signs, streetlights, buildings, sidewalks and roads.	Roads Parks and Recreation Engineering
3.5	Increase in extreme windstorms	Increase in fallen trees and branches causing blockages of creeks, rivers and streams.	Drainage and Irrigation Parks and Recreation
3.6	Increase in extreme weather	Increase in impacts to tourism leading to a decrease in tourism and economic development.	Tourism Community and Development Economic Development
3.7	Increase in extreme weather	Increase in impacts to urban forests and green spaces resulting in increased maintenance and remediation.	Parks and Recreation Community and Development

## Appendix D - Indicators

Goal # 1 - Integrate Climate Change into Town’s Plans, Policies, By-laws and Standards		
ID	Indicator	Potential Source
1.a	Number of plans, policies, procedures, strategies and projects that include climate adaptation considerations.	All Departments
1.b	Number of Environmental Advisory Committee initiatives.	Environmental Advisory Committee
1.c	Number of Future Green Team initiatives.	Green Team
1.d	Number of 27 CCAP actions that are in progress and/or have been completed.	All Departments
1.e	Number of external funding opportunities. Both applied for and awarded.	All Departments

Goal # 2 - Urban Forest Resiliency		
ID	Indicator	Potential Source
2.a	Percentage of total tree canopy.	Parks and Recreation Planning and Development
2.b	Number of work orders for invasive species management.	Parks and Recreation Environmental Services Roads
2.c	Percentage of native and non-native plants.	Parks and Recreation
2.d	Number of diverse species planted on Town owned properties.	Parks and Recreation
2.e	Percentage of new landscaping that includes climate change considerations.	Parks and Recreation
2.f	Number of natural assets and value of ecosystem services.	Parks and Recreation

Goal # 3 - Reduce Flooding Risks		
ID	Indicator	Potential Source
3.a	Number of reported properties experiencing flooding.	Operations
3.b	Number of Green Infrastructure or Low Impact Development installations within the Town.	Public Works Planning and Development
3.c	Percentage of Inflow and Infiltration in the sanitary system.	Engineering Environmental Services
3.d	Flow monitoring results.	Engineering Environmental Services
3.e	Number of insurance claims related to water incurred losses.	Legal
3.f	Number of Combined Sewer Overflows.	Engineering Environmental Services
3.g	Percentage of permeable ground in relation to total ground coverage.	Engineering Planning and Development

# Appendix D - Indicators

Goal # 4 - Incorporate Climate Change in Design and Construction		
ID	Indicator	Potential Source
4.a	Number of Capital Projects that include climate change considerations.	Public Works
4.b	Number of Green Infrastructure or Low Impact Development installations located on Town owned properties.	Public Works Planning and Development
4.c	Number of Green Infrastructure or Low Impact Development installations within new development.	Public Works Planning and Development
4.d	Percentage of Inflow and Infiltration (I&I) derived from flow monitoring results.	Environmental Services Engineering
4.e	Number of rain events that exceed design standards in a given period.	Public Works
4.f	Percentage increase in annual costs for road, sewer and watermain maintenance, repairs and new construction.	Public Works

Goal # 5 - Minimize Health and Safety Risks to Community Members		
ID	Indicator	Potential Source
5.a	Number of road closures including severity of incident.	Public Works
5.b	Number of accident or incidents reported by staff and community.	Public Works Human Resources Fire and Emergency Services
5.c	Warming and cooling center attendance records.	Parks and Recreation Fire and Emergency Services
5.d	Number of days that warming and cooling centers are required.	Parks and Recreation Fire and Emergency Services
5.e	Number of residents reached during emergency preparedness campaign.	Communications Fire and Emergency Services
5.f	Number of municipal staff provided relevant training.	Public Works Human Resources
5.g	Average response time for municipal staff to respond during extreme weather events.	Public Works Fire and Emergency Services
5.h	Number of beach closures per year.	Public Health Environmental Services
5.i	Number of times freshwater tests are above maximum contaminant level.	Public Health Environmental Services

Goal # 6 - Support Public Awareness and Education		
ID	Indicator	Potential Source
6.a	Number of residents utilizing municipal communications tools	Communications
6.b	Emergency preparedness engagement campaign	Communications
6.c	Flood preparedness engagement campaign	Communications
6.d	Climate Change awareness engagement campaign	Communications
6.e	Green infrastructure and permeable surfaces engagement campaign	Communications Public Works
6.f	Number of Town businesses that have included climate change considerations into business continuity plans.	Chamber of Commerce Business Associations
6.g	Number of Green Infrastructure and Low Impact Development demonstrations and/or pilot projects throughout the Town.	Public Works Planning and Development



## Appendix E - Implementation Schedule

Goal # 1 - Integrate Climate Change into Town's Plans, Policies, By-laws and Standards						
ID	Action	Description of Action (Scope)	Potential Risks	Current Town Practice	Timing	Link to Actions
1.1	<b>Update Official Plan to align with climate change adaptation goals.</b>	General alignment opportunities could include the following: <ul style="list-style-type: none"> <li>Identifying gaps, conflicts, and synergies. Where gaps exist, strengthen policies and develop new practices to reduce vulnerability and risk. Where conflicts exist, modify policies to build resiliency</li> <li>Identifying approaches that address both adaptation and greenhouse gas mitigation.</li> <li>Include policies specifying adaptive approaches.</li> </ul>	<ul style="list-style-type: none"> <li>Approval difficulties.</li> <li>Risk of not acting decisively.</li> </ul>	<ul style="list-style-type: none"> <li>Official Plan in process of approval.</li> <li>To satisfy provincial requirements of including climate change policies in the new Niagara Official Plan.</li> </ul>	2022 onwards	
1.2	<b>Review and update by-laws to incorporate climate change.</b>	Town staff will incorporate climate change considerations into its by-laws to ensure it is represented and formalized at the decision-making level. This may include: <ul style="list-style-type: none"> <li>A comprehensive review of existing bylaws.</li> <li>Enforcement review and implementation.</li> <li>Revising bylaws to preserve or normalize an environmentally sustainable perspective.</li> </ul>	<ul style="list-style-type: none"> <li>Tree by-law lacking strength.</li> <li>Intensification's impact on environment and Storm Water Management.</li> <li>Opposition to change.</li> <li>Failure to act decisively.</li> </ul>	<ul style="list-style-type: none"> <li>No plan currently in place.</li> </ul>	2022/2023 onwards	
1.3	<b>Develop a policy for regular interval updates to infrastructure design standards to reflect climate change projections and green infrastructure technologies.</b>	The Town will develop a process for reviewing and obtaining localized climate projections on a regular basis. This will ensure that Town decisions are based on up-to-date projections. This may include the following: <ul style="list-style-type: none"> <li>Aligning climate projection updates with release of future IPCC Assessment Reports.</li> <li>Forming partnerships with local municipalities and organizations (e.g., Brock University, Niagara College) to receive or share up to date climate projections.</li> <li>The Official plan and zoning bylaw will reflect infrastructure technologies being developed to align with climate change. This may include green infrastructure such as green roofs, solar roofs and LID technology.</li> <li>Consultation with the building industry for policy development.</li> </ul>	<ul style="list-style-type: none"> <li>Funding for studies.</li> <li>Training of staff for implementation.</li> </ul>	<ul style="list-style-type: none"> <li>No plan currently in place.</li> </ul>	2022/2023	
1.4	<b>Incorporate climate change projections into Engineering Design Standards.</b>	Town staff will continue to update the Engineering Design Standards on a yearly basis. As a part of this process, climate change practices and projections will be considered. Collaboration will be considered with other local area municipalities, the Region of Niagara and Niagara Peninsula Conservation Authority.	<ul style="list-style-type: none"> <li>Not capturing all scenarios.</li> <li>Risk of overextending.</li> <li>Risk of incorporating untested technologies.</li> </ul>	<ul style="list-style-type: none"> <li>Updated on a yearly basis.</li> </ul>	2022 onwards	4.3

## Appendix E - Implementation Schedule

Goal # 2 - Urban Forest Resiliency						
ID	Action	Description of Action (Scope)	Potential Risks	Current Town Practice	Timing	Link to Actions
2.1	<b>Develop an Urban Forestry Management Plan.</b>	<p>An Urban Forestry Management Plan will provide Town staff with tools for growing and maintaining a healthy and resilient urban forest and natural landscape. This includes street trees, parks, and natural areas. The strategy will provide direction on all aspects of the maintaining an urban forest and identify challenges and opportunities for improvement. This may include the following:</p> <ul style="list-style-type: none"> <li>Identifying tree species for planting that are highly resilient to invasive species and changing climatic conditions.</li> <li>A re-planting program for trees lost during extreme</li> <li>Overall connectivity of the natural system.</li> <li>A replanting program to replace the hundreds of trees lost to the ash borer.</li> <li>Stricter penalties for tree removal, and requirement to replant any trees lost.</li> <li>Identifying tree species with biological value to the ecosystem.</li> <li>Ensuring an optimal mix of canopy and understory species.</li> <li>Protection of wildlife corridors within the forest.</li> <li>Identifying species resistant to infestation.</li> <li>Development of a database using GIS.</li> <li>Minimize the destruction of mature healthy trees.</li> <li>Engage cooperatively with other organizations and work with volunteers from the community.</li> </ul>	<ul style="list-style-type: none"> <li>New developments.</li> <li>Lack of Funding.</li> <li>Inventory gaps and inefficiencies.</li> <li>Monitoring of implementation.</li> <li>Responsibility.</li> </ul>	<ul style="list-style-type: none"> <li>No plan currently in place specific to an Urban Forestry Management Plan.</li> </ul>	2022-2024	5.1 2.2
2.2	<b>Canopy coverage mapping to establish measurable goals.</b>	Town staff to develop a mapping tool to establish the Town's canopy coverage. This will include collaboration with the NPCA, Niagara Region and assistance from the public. This initiative may also benefit from the use of students from local Colleges and Universities.	<ul style="list-style-type: none"> <li>Funding.</li> <li>Private and Public lands.</li> <li>Substantial resources required for this initiative.</li> </ul>	<ul style="list-style-type: none"> <li>Current mapping does not cover a large range of tree canopy coverage.</li> </ul>	2022/2023 onwards	5.1 2.1
2.3	<b>Include trees as a part of the Town's asset management plan.</b>	<p>Town staff to develop an inventory of Town owned trees to be incorporated into the asset management plan. This may include the following:</p> <ul style="list-style-type: none"> <li>Use of a tree inventory software.</li> <li>Leverage community partnerships.</li> <li>Use of NPCA and Niagara Region mapping.</li> </ul>	<ul style="list-style-type: none"> <li>Funding.</li> <li>Town lands only.</li> <li>Substantial resources required for this initiative.</li> </ul>	<ul style="list-style-type: none"> <li>Current mapping does not cover a large range of tree canopy coverage.</li> </ul>	2022/2023	5.1 6.1 2.1 2.2

## Appendix E - Implementation Schedule

Goal # 2 - Urban Forest Resiliency						
ID	Action	Description of Action (Scope)	Potential Risks	Current Town Practice	Timing	Link to Actions
2.4	<b>Mapping of invasive species.</b>	<p>Town staff to develop a mapping tool to identify areas containing invasive species. This may include collaboration with the NPCA and help from the public. This may include developing a communications campaign to inform homeowners of planting best practices. Invasive species may include, but not limited to the following:</p> <ul style="list-style-type: none"> <li>• Phragmites</li> <li>• Emerald Ash borer</li> <li>• Garlic mustard</li> <li>• Buckthorn</li> <li>• Japanese Knotweed</li> </ul>	<ul style="list-style-type: none"> <li>• Weighing the good versus the bad.</li> <li>• Not acting soon enough.</li> <li>• Risk of identifying species as invasive when they are successfully adapting to climate change (migrating species).</li> </ul>	<ul style="list-style-type: none"> <li>• Mapping of phragmites in certain areas of Town.</li> </ul>	2022/2023 onwards	
2.5	<b>Promote planting of native vegetation along creeks, ravines and lakes.</b>	<p>Town staff to develop a plan on how to better promote planting of native vegetation along creeks, ravines and lakes for sediment control and the promotion of biodiversity. This will also include identifying tree species for planting that are highly resilient to invasive species and changing climatic conditions. This may include private landowners with property along creeks, ponds, and planting of a wide diversity of trees.</p>	<ul style="list-style-type: none"> <li>• Cooperation of private property owners needed.</li> <li>• Education campaign needed.</li> <li>• Resistance to cost.</li> </ul>	<ul style="list-style-type: none"> <li>• No plan currently in place.</li> </ul>	2022 onwards	5.1 5.2 2.1
2.6	<b>Consider partnership with local Colleges, Universities and research centres</b>	<p>Town staff will seek opportunities with local educational facilities to enhance the Urban Forest Resilience overarching goal. This may include volunteer planting programs, community workshops, student mapping exercises and research projects specific to the Town. This may include working with the following:</p> <ul style="list-style-type: none"> <li>• Niagara College</li> <li>• Brock University</li> <li>• Local elementary schools</li> <li>• Local High schools</li> <li>• Students skills and training specific to grant reporting.</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of volunteers.</li> <li>• Lack of resources.</li> </ul>	<ul style="list-style-type: none"> <li>• Currently working with Brock University (Niagara Adapts).</li> <li>• No standard policy or procedure for future partnerships.</li> </ul>	2022 onwards	



Appendix E - Implementation Schedule

Goal # 3 - Reduce Flooding Risks						
ID	Action	Description of Action (Scope)	Potential Risks	Current Town Practice	Timing	Link to Actions
3.1	Engage a Stormwater Management Plan.	<p>The Stormwater Management Master Plan will provide the Town with a preferred stormwater management strategy to identify, protect, and enhance natural features, ecological roles, and biophysical integrity. The plan will assist staff in appropriately managing risks through the establishment of environmental targets for water quality, water quantity, erosion, infiltration and guidance with respect to the protection of natural features. The plan will also address infrastructure issues, such as flooding, and form part of the overall asset management program. The plan will establish a stormwater management policy and address stormwater infrastructure to identify and prioritize remedial work. This may include the following:</p> <ul style="list-style-type: none"><li>Community Engagement.</li><li>Hiring of a Consultant.</li><li>Regional and/or Provincial Funding.</li><li>Critical review of low-lying areas.</li></ul>	<ul style="list-style-type: none"><li>Integration with the irrigation plan and municipal drains.</li><li>Budget.</li><li>Rate payer resistance to enhancement of natural features adjacent to properties.</li><li>Once established, the Town will have an obligation to follow the recommendations.</li><li>Remediation could be quite costly.</li></ul>	<ul style="list-style-type: none"><li>The Town currently does not have a SWM plan for the Town as a whole.</li><li>Some small scale SWM plans exist.</li></ul>	2022-2024	5.2 4.3 4.4
3.2	Review and update floodplain mapping.	<p>Regulatory floodplain mapping shows the area that would be subject to flooding and is based on standards set by the province. The Town will work with the Niagara Peninsula Conservation Authority to review existing regulatory floodplain mapping and prioritize areas to update. This could include consideration of the following:</p> <ul style="list-style-type: none"><li>Relative hazard level.</li><li>Relative risk level.</li><li>Age of existing modelling/mapping.</li><li>Working with the Region of Niagara.</li></ul>	<ul style="list-style-type: none"><li>1:100-year storm not adequate.</li><li>Niagara River international control of the waterway.</li><li>Ratepayers push back.</li><li>Potential liability from previous land use approval.</li><li>Ability to secure overland flood insurance.</li><li>Risk of being under resourced.</li><li>Risk of having an additional system to be managed internally.</li></ul>	<ul style="list-style-type: none"><li>Town currently uses the information supplied by the NPCA. However, the Town does not have their own stand-alone mapping.</li></ul>	2022/2023 onwards	

## Appendix E - Implementation Schedule

Goal # 3 - Reduce Flooding Risks						
ID	Action	Description of Action (Scope)	Potential Risks	Current Town Practice	Timing	Link to Actions
3.3	<b>Create a flood preparedness and evacuation plan with flood alerts and mapping.</b>	<p>The Town will develop mapping of areas prone to urban flooding and model scenarios to determine the impact of various rainfall events, complete with alerting systems. This may include:</p> <ul style="list-style-type: none"> <li>Working with Niagara Region.</li> <li>Leveraging the NPCA flooding notifications.</li> <li>Integrate Provincial alert systems to Town residents.</li> <li>Create emergency plans for extreme weather events which might cause extensive flooding.</li> </ul>	<ul style="list-style-type: none"> <li>Risk of not reaching all residents using various types of platforms.</li> <li>Insurance impacts.</li> </ul>	<ul style="list-style-type: none"> <li>Currently, no plan in place.</li> </ul>	2022/2023	
3.4	<b>Increase public awareness of clearing of catch basins.</b>	<p>The Town will generate awareness on the importance of clearing catch basins, as leaves, snow, and other debris can block catch basins and prevent rain from entering the storm sewer system. This may include consideration of creating a website or social media content, developing messaging, and placing it in strategic locations and working with community partners. This may include the following considerations:</p> <ul style="list-style-type: none"> <li>Consider delineating curbs where catch basins are located to assist with clean up measures in the winter months.</li> <li>One-time property tax credits for property owners who show they have invested time and money in various urban conservation and/or clean-up activities.</li> </ul>	<ul style="list-style-type: none"> <li>Risk of not getting to people not using social media.</li> <li>Risk of misunderstanding between public and Town.</li> <li>May have a bad public perception.</li> </ul>	<ul style="list-style-type: none"> <li>Current practice is to clean the catch basins once a year through our catch basin maintenance program. Normally, in the spring or early summer.</li> </ul>	2022/2023 onwards	6.2

## Appendix E - Implementation Schedule

Goal # 4 - Incorporate Climate Change in Design and Construction						
ID	Action	Description of Action (Scope)	Potential Risks	Current Town Practice	Timing	Link to Actions
4.1	<b>Incorporate climate change considerations into the Town's Asset Management Plan.</b>	<p>The Town will incorporate climate change considerations into its asset management planning to improve the resilience and adaptive capacity of assets, which may include the following:</p> <ul style="list-style-type: none"> <li>Integrating climate change into risk management.</li> <li>Implementing a cost analysis for investment decision-making processes, considering the change in lifecycle events based on climate change and environmental factors.</li> <li>Assessing the financial impacts of climate change on levels of service.</li> <li>Reviewing these actions through asset management groups and discussions.</li> <li>Incorporate nature-based solutions in asset management.</li> <li>Implement low-energy solutions where possible.</li> </ul>	<ul style="list-style-type: none"> <li>Ensure plan is comprehensive and fully implemented.</li> <li>Ensure budget is available for implementation.</li> </ul>	<ul style="list-style-type: none"> <li>No plan currently in place.</li> </ul>	2022/2023 onwards	6.1 2.3
4.2	<b>Ensure climate change impacts are incorporated into project risk management framework.</b>	<p>Staff to be trained on how to incorporate climate change considerations into the Town's risk management framework. This can be found in the Project Management manual (updated version) regarding climate change and risk assessments.</p>	<ul style="list-style-type: none"> <li>Ensure budget for implementation.</li> <li>Ensure this is a priority.</li> <li>Need mechanism to resolve conflicts.</li> </ul>	<ul style="list-style-type: none"> <li>This is incorporated into other policies (i.e., Drinking Water Quality Management Standards)</li> </ul>	2022/2023	
4.3	<b>Explore projects suitable for Low Impact Development (LID).</b>	<p>The Town will continue to investigate suitable locations for LIDs for Town owned properties. This may include newly proposed subdivisions and/or existing storm water discharge locations in streetscapes. The Town will continue to work with local conservation authorities to develop and implement LID's as they evolve and become more widely used. This may include the following:</p> <ul style="list-style-type: none"> <li>A comprehensive LID strategy to be developed to include all future developments.</li> <li>Consider international examples.</li> <li>Consider implementing private property standards for LIDs.</li> <li>Consideration to incorporate LIDs into subdivision agreements.</li> </ul>	<ul style="list-style-type: none"> <li>Not enough promotion.</li> <li>LIDs are not widely known.</li> <li>Opposition to change.</li> <li>Risk of changing standards and guidelines.</li> <li>Risk of not working.</li> </ul>	<ul style="list-style-type: none"> <li>The Town does not have any policies or standards in relation to LID.</li> <li>Town has LID located at Simcoe Park. Installed in 2020.</li> </ul>	2022 onwards	5.2 1.4



Appendix E - Implementation Schedule

Goal # 4 - Incorporate Climate Change in Design and Construction						
ID	Action	Description of Action (Scope)	Potential Risks	Current Town Practice	Timing	Link to Actions
4.4	Create a Stormwater Management Inspection Program (High Risk Infrastructure).	The Town will review and develop protocols to ensure they are adequate to address changing climatic conditions. As precipitation events are projected to become more frequent and intense, the need for inspecting creeks and stormwater infrastructure on a regular basis will ensure systems are functioning normally and are not in need of repair.	<ul style="list-style-type: none"><li>• Lack of emphasis on SWM natural infrastructure.</li><li>• Cost and staff time.</li><li>• Land ownership.</li><li>• Risk of not completing the inspections on time.</li><li>• Risk of not completing remediation on time.</li></ul>	<ul style="list-style-type: none"><li>• Inspections completed on an annual basis.</li></ul>	2022-2024	3.1 5.2
4.5	Leverage available grants for both built infrastructure and asset management.	<p>Town staff will seek available grants that are specific to climate change for both built infrastructure and asset management. The creation of a Corporate Climate Change Adaptation Plan is normally a prerequisite for many of the climate change related grants. Therefore, the completion of this document will serve as a guide and have the ability to leverage suitable grants based on the recommendations within. This may include shovel-ready projects and planning for the following:</p> <ul style="list-style-type: none"><li>• Solar panels.</li><li>• Power Storage.</li><li>• Electric Vehicle Chargers.</li><li>• Infrastructure.</li><li>• Asset Management.</li></ul>	<ul style="list-style-type: none"><li>• Risk of not being adequately prepared for the grant process.</li><li>• Risk of cost-benefit, where the time and effort put into grant applications doesn't get adequately rewarded with success.</li><li>• Grant processes can be laborious and slow and need internal continuity and persistence.</li></ul>	<ul style="list-style-type: none"><li>• Town Staff consistently seeking new grant opportunities.</li><li>• Further attention will be given to align with the Corporate Climate Change Adaptation Plan.</li></ul>	2022 onwards	

## Appendix E - Implementation Schedule

Goal # 5 - Minimize Health and Safety Risks to Community Members						
ID	Action	Description of Action (Scope)	Potential Risks	Current Town Practice	Timing	Link to Actions
5.1	<b>Increase shade coverage in urban areas.</b>	<p>The Town will review the current canopy coverage to identify opportunities for improvement and will create mapping to identify tree deficit areas. The identification of deficit areas can be used to inform planting and programming efforts. This may include the following:</p> <ul style="list-style-type: none"> <li>Review canopy coverage/tree planting from erosion control and storm water management perspective.</li> <li>Develop a comprehensive plan with homeowners, farmers, Town, Region of Niagara and NPCA.</li> <li>Incorporate volunteers from the community.</li> <li>Potential use of tree mapping software.</li> <li>Strengthen and review tree by-laws to reflect both Public and Private tree canopy coverage and provide educational seminar to Council and Staff.</li> <li>Consider rural versus urban canopy coverage.</li> </ul>	<ul style="list-style-type: none"> <li>Essential for mitigation against high temperatures, flooding and wildlife habitat loss.</li> <li>Not acting quickly enough.</li> <li>Requires buy-in from Town and Council to make this a priority item for the long term.</li> <li>Development.</li> <li>Resistance to cost of tree planting.</li> </ul>	<ul style="list-style-type: none"> <li>Minimal tree planting program.</li> </ul>	2022 onwards	Goal 2
5.2	<b>Investigate ways to improve storm water discharge to creeks, streams, rivers and lakes. Both quantity and quality.</b>	<p>The Town will work with the Niagara Peninsula Conservation Authority to investigate ways to ensure that protocols are in place to for storm water discharge. This may include:</p> <ul style="list-style-type: none"> <li>Water quality studies.</li> <li>Low Impact Development.</li> <li>New product technology.</li> <li>Research the use of permeable surfaces in future development.</li> <li>Promote and encourage use of rain barrels.</li> <li>Storm water end treatments.</li> <li>Use of landscaped swales, rain gardens and permeable pavers for both private properties and public properties.</li> <li>Storm Water Management.</li> </ul>	<ul style="list-style-type: none"> <li>Extended efforts do not produce acceptable results.</li> <li>Maintenance.</li> <li>Risk of doing nothing.</li> <li>Flooding and erosion.</li> <li>Industry push back due to additional costs.</li> <li>Lack of interest from homeowners to invest in permeable products.</li> <li>Community acceptance/resistance.</li> </ul>	<ul style="list-style-type: none"> <li>Town performs investigations on a case-by-case basis.</li> </ul>	2022-2025	1.4 3.1 5.2

## Appendix E - Implementation Schedule

Goal # 5 - Minimize Health and Safety Risks to Community Members						
ID	Action	Description of Action (Scope)	Potential Risks	Current Town Practice	Timing	Link to Actions
5.3	<b>Promote active transportation and improve the safety of bike lanes.</b>	<p>The Town will review the existing bike lanes to ensure they are designed in accordance with the current standards and guidelines. Additional consideration will be given for upgrades, improvements and newly proposed bike lanes to assist with the promotion of active transportation. This may include the following:</p> <ul style="list-style-type: none"> <li>• Recommendations of the Transportation Master Plan.</li> <li>• Consideration to set aside a portion of the incoming Municipal Accommodation Tax (MAT) for active transportation upgrades. This may include completing missing links or wayfinding especially for tourists that may not be familiar with the Town.</li> <li>• Aim to get locals to opt for active transportation measures for running errands around Town to assist with reducing emissions and congestion.</li> <li>• Develop social media and communications campaigns promoting active transportation to locals.</li> <li>• Provide secure bike parking areas at hubs and intermodal links (e.g., bus-bike, car-bike).</li> <li>• Incorporate bike friendly community standards town-wide.</li> <li>• Develop more on road and off-road cycling clubs for community connection and promotion.</li> </ul>	<ul style="list-style-type: none"> <li>• Alcohol consumption.</li> <li>• Use of full lane.</li> <li>• Budget restrictions.</li> <li>• Lack of political will to set aside MAT tax.</li> <li>• Risk of not doing anything.</li> <li>• Risks of not implementing bike lane safety measures, increasing the likelihood of cyclist-automobile collisions.</li> <li>• Risk of delays dealing with outside organizations.</li> <li>• Cost of construction</li> <li>• Regional Roads are out of scope for Town.</li> </ul>	<ul style="list-style-type: none"> <li>• Being reviewed as part of Master Transportation Plan.</li> </ul>	2022 onwards	6.4
5.4	<b>Implement warming and cooling centers.</b>	<p>To investigate the feasibility of providing spaces for extreme temperature relief outside of normal business hours. This could include consideration of the following:</p> <ul style="list-style-type: none"> <li>• Extending pool and splashpad hours when required.</li> <li>• Identifying buildings that could serve as warming and/or cooling centres.</li> <li>• Identifying accessibility, capacity, and staffing considerations.</li> <li>• Reviewing non-municipal venues.</li> <li>• Collaboration with Region of Niagara.</li> <li>• Working with existing natural features to optimize cooling effects (e.g., shaded areas and greenspace).</li> <li>• Consider enhancing backup power generators.</li> </ul>	<ul style="list-style-type: none"> <li>• Liability / Insurance.</li> <li>• Cost.</li> <li>• Staffing.</li> <li>• Inefficient / Expensive energy use.</li> <li>• Capacity considerations.</li> <li>• Staff availability to oversee extended hours.</li> <li>• Acceptance by owners of non-municipal venues.</li> </ul>	Courthouse and Community Centre offered as a cooling center in the summer months.	2022 onwards	



## Appendix E - Implementation Schedule

Goal # 6 - Support Public Awareness and Education						
ID	Action	Description of Action (Scope)	Potential Risks	Current Town Practice	Timing	Link to Actions
6.1	<b>Engage Town Staff and Public to develop a Natural Assets Plan.</b>	<p>Town staff will develop a Natural Assets Plan with the assistance of the Public. Under Ontario Regulation 588/17, green infrastructure is defined as assets consisting of natural or human-made elements that provide ecological and hydrological functions and processes and includes natural heritage features and systems, parklands, stormwater management systems, street trees, urban forests, natural channels, permeable surfaces and green roofs. This may also include the following:</p> <ul style="list-style-type: none"> <li>Potential use of Parks Canada land on Lakeshore to develop a marshland using storm water run-off.</li> <li>Look at potential linkage of storm water with the irrigation system.</li> <li>Consider signage identifying green infrastructure to sensitize public to ecological importance of various features. e.g., how the feature protects property from damage.</li> </ul>	<ul style="list-style-type: none"> <li>Lack of Public interest.</li> <li>Lack of defined limits.</li> <li>Ensure plan is comprehensive and fully implemented.</li> <li>Lack of promotion.</li> <li>Clear definitions are required.</li> <li>Lack of standards/enforcement to protect green infrastructure from destruction.</li> </ul>	<ul style="list-style-type: none"> <li>No plan currently in place.</li> </ul>	2022-2024	3.1 5.1 2.1
6.2	<b>Educate Public and Town Staff of standing water concerns and develop a guide for remediation.</b>	<p>Recognizing that standing water can have a negative impact to the residents and environment, the Town will create awareness on the importance of removing standing water and development of a guide to assist with this initiative. This could include consideration of the following:</p> <ul style="list-style-type: none"> <li>Creating website or social media content.</li> <li>Developing messaging and placing it in strategic locations.</li> <li>Working with community partners.</li> <li>Inclusion of churches and faith groups for whom water is extremely symbolic and precious.</li> <li>Include clear messaging to distinguish between the types of concerns e.g., mosquito's vs storm water management.</li> </ul>	<ul style="list-style-type: none"> <li>Risk of not sending the right message.</li> <li>Resources required.</li> </ul>	<ul style="list-style-type: none"> <li>The Town does not currently have a plan in place to educate and remediate.</li> </ul>	2022/2023	3.4
6.3	<b>Develop a social media campaign to target climate change initiatives.</b>	<p>Town staff will research and develop social media campaigns to help share the message about climate change. This may include the following:</p> <ul style="list-style-type: none"> <li>Staff to follow up on climate initiatives in other areas including world climate events such as COP26.</li> <li>Dedicated landing page for climate change initiatives.</li> <li>Work with Science Communicators to ensure messaging is effective and posts are accessible (potential internship role).</li> <li>Include a section for Environmental Advisory Committee (EAC) achievements.</li> </ul>	<ul style="list-style-type: none"> <li>Reaching people not on social media.</li> <li>Funding.</li> <li>Messaging needs to be carefully executed.</li> </ul>	<ul style="list-style-type: none"> <li>Website, Facebook and Newspaper</li> </ul>	2022/2023 onwards	Goal 6 2.4 2.5 2.2 3.4

# Appendix E - Implementation Schedule

Goal # 6 - Support Public Awareness and Education						
ID	Action	Description of Action (Scope)	Potential Risks	Current Town Practice	Timing	Link to Actions
6.4	Utilize Town website to convey climate change and adaptation information.	<p>Town staff to update the Town website to reflect climate change information. Updates could include notices of road closures, cancellations, news alerts, public notices, and more. The Town will also consider the following:</p> <ul style="list-style-type: none"><li>To reduce the “psychological distance” of the issue and remind residents that the impacts are tangible, current, and nearby.</li><li>Include news about the initiatives being taken by the Town, so that residents may be kept informed of these efforts.</li><li>Development of a digital alerting system.</li></ul>	<ul style="list-style-type: none"><li>Website needs to be user friendly and intuitive.</li><li>Ease of access.</li><li>Misinformation.</li></ul>	<ul style="list-style-type: none"><li>No plan currently in place.</li></ul>	2022/2023 onwards	6.3

## Appendix F - References

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