

JULY 2022

Climate Resilient Burlington

A Plan for Adapting to Our Warmer, Wetter and Wilder Weather
2022-2032 Action Plan

VISION Through collective action, Burlington is a net zero carbon community and is prepared for warmer, wetter and wilder weather.

This project was supported by:



EXECUTIVE SUMMARY

Climate Resilient Burlington (CRB) is a climate adaptation plan identifying actions to manage the highest projected risks of warmer, wetter and wilder weather. The objectives of the CRB plan are:

1. Uphold a set of agreed-upon principles to guide the actions in achieving a long term vision.
2. Focus City efforts on the highest risks where the City can take the lead or play a significant role in managing the risks.
3. Align, augment or integrate climate actions into existing City initiatives.
4. Work collaboratively by identifying synergies, partnerships and opportunities for alignment with key community stakeholders.

Stakeholders including City of Burlington (City) staff and community organizations were integral to the creation of CRB, with 49 stakeholders contributing more than 660 hours of collective input. Stakeholders assessed the highest climate risks for Burlington, identified actions to manage these risks, and ultimately prioritized **32 actions** organized around **five themes**, shown at right. The themes align with Canada's National Adaptation Strategy.

CRB outlines City actions to focus on over the next 10 years, 2022-2032, to build resilience and prepare for a changing climate. These actions will continue to shift the City from reactive to more proactive measures with the goal of less damaging impacts to the City's infrastructure, services, environment, economy and the health and well-being of residents.

Ongoing monitoring and evaluation of CRB's implementation is key to ensuring its efficacy and success. A subset of indicators have been identified to measure the goals of CRB. Progress against these indicators will be assessed and reported on an annual basis to assist the City in determining the success of CRB, if additional resources are needed to achieve the goals, and where adjustments to CRB may be needed. The CRB plan will be reviewed in detail and updated as required by the City every five years.

1

Resilient Built and Natural Infrastructure



2

Thriving Natural Environment



Photo courtesy Conservation Halton

3

Health and Well-Being



4

Disaster Resilience



5

Strong and Resilient Economy





Ice storm, No. 8 Side Rd., December 2013, Burlington, Ontario

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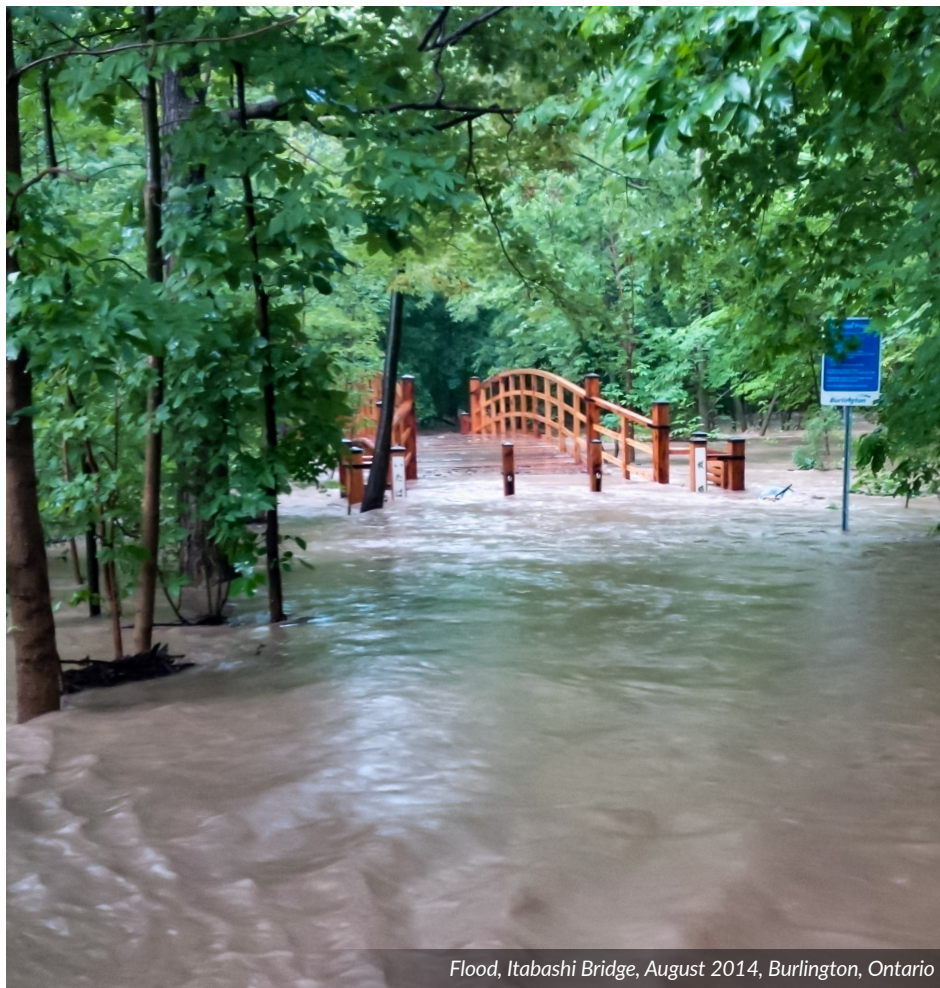
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GLOSSARY

Term	Definition
Acute Risks	Rapid onset or event-driven risks such as high wind or intense rainfall events.
Adaptation (to climate change)	Adjusting to actual or expected climate impacts to reduce negative effects on people, society, infrastructure, and the environment.
Chronic Risks	Slow onset risks and long-term shifts in climate patterns such as seasonal temperatures and precipitation changes, or species migration.
Climate	The weather of a place averaged over a period of time, typically 30 years.
Climate Change	Significant changes in global temperature, precipitation, wind patterns and other measures of climate that occur over several decades or longer.
Climate Drivers	Climate variables or indices that influence the hazard or opportunity, e.g. a high intensity, short duration rainfall event.
Climate Hazard	A special type of hazard that is (at least partially) caused by climatic drivers, e.g. urban flooding.
Climate Opportunity	An opportunity that presents itself due to changing climate drivers, e.g. a longer growing season.
Consequence	The result or effect from climate impacts to people, society, infrastructure or the environment.
Coping Capacity	The extent to which people, both public sector and private sector organizations, and natural systems exposed to a climate hazard, can successfully adjust, accommodate, and recover from the anticipated impacts in the short-term using existing institutional arrangements, and financial, human and social capital.
Extreme Weather Event	A meteorological event that is rare at a place and time of year, such as an intense storm, flood or heat wave that is beyond the normal range of activity.

Term	Definition
Global Covenant of Mayors (GCoM)	A global alliance of municipal leaders that serves cities and local governments by mobilizing and supporting ambitious, measurable and planned climate and energy action in their communities.
Greenhouse Gas (GHG)	A gas that absorbs and emits radiant energy causing the greenhouse effect, which warms the atmosphere and changes the climate. The primary greenhouse gases are water vapour, carbon dioxide, methane, nitrous oxide and ozone.
Hazard	A potential source of harm.
Impact	An estimate of the harm that could be caused by an event or hazard.
Likelihood	The probability or chance of a hazard occurring, and how this likelihood changes in the future due to climate change.
Mitigation (of climate change)	Human interventions to reduce the sources and enhance the sinks, or absorption, of GHGs.
Representative Concentration Pathway (RCP)	RCPs represent models that predict how concentrations of GHGs in the atmosphere will change in the future as a result of human activities. There are four RCPs (2.6, 4.5, 6.0 and 8.5) with a higher value representing higher GHG concentrations in 2100.
Resilience	The capacity of a system, community, or society exposed to hazards to minimize damages by responding or changing to reach and maintain an acceptable level of functioning and structure.
Risk	A combination of the vulnerability, likelihood and consequences of an adverse event or condition occurring.
Sensitivity	The degree to which people, assets, natural systems, or economic, cultural, or social resources might be affected by the climate hazard (or opportunity) to which they are exposed.

Term	Definition
Stakeholder	People who are, or perceive themselves to be, affected by a decision, strategy or process. A stakeholder can be an individual, an organization or a group within an organization. Stakeholders can change at different stages in a process.
Vulnerability	Derived from the interplay of sensitivity, coping capacity and existing non-climate stresses or pressures.
Weather	Short term day-to-day changes in atmospheric conditions like temperature and precipitation.



Flood, Itabashi Bridge, August 2014, Burlington, Ontario

LIST OF ABBREVIATIONS

AMP	Asset Management Plan
BARAAC	Burlington Agricultural and Rural Affairs Advisory Committee
BLT	Burlington Leadership Team
BYSC	Burlington Youth Student Council
CH	Conservation Halton
COB	City of Burlington
CRB	Climate Resilient Burlington
EICS	Environment, Infrastructure and Community Services
GIS	Geographic Information System
GHG	Greenhouse Gas(es)
HEN	Halton Environmental Network
HIRA	Hazard Identification and Risk Assessment
HR	Halton Region
ICLEI	International Council for Local Environmental Initiatives
IDF-CC	Intensity-Duration-Frequency curves for Climate Change
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
MNAI	Municipal Natural Assets Initiative
MTSA	Major Transit Station Areas
RBG	Royal Botanical Gardens
RCC	Recreation, Community and Culture
RCP	Representative Concentration Pathway
RPF	Roads, Parks and Forestry
SW	Stormwater
UFMP	Urban Forest Master Plan
VRA	Climate Change Vulnerability and Risk Assessment



ACKNOWLEDGMENTS

Climate Resilient Burlington was developed with the input and hard work of a diverse group of individuals and organizations. We appreciate the time, effort, and knowledge contributed to building a more resilient city.

In addition to the numbers in the graphic on this page, many of the stakeholders were involved in developing the climate impact statements, one-on-one discussions during onboarding and additional time to refine and review content after the workshops.

We would like to acknowledge the following City stakeholders that supported the development of Climate Resilient Burlington:

City of Burlington Departments

- Building and Bylaw
- Community Planning
- Corporate Communications and Engagement
- Corporate Legal Services
- Engineering Services
- Environment, Infrastructure and Community Services (EICS)
- Finance
- Fire
- Human Resources
- Recreation, Community and Culture (RCC)
- Roads, Parks and Forestry (RPF)
- Transportation

See the [Climate Resilient Burlington Engagement Report \(2022\)](https://www.burlington.ca/environment) at [burlington.ca/environment](https://www.burlington.ca/environment) for more information¹. See [Appendix A](#) for specific names of workshop attendees.

We would like to acknowledge the following community stakeholders that supported the development of Climate Resilient Burlington:

Community Organizations

Building Owners and Managers Association Canada (BOMA)
Burlington Agricultural and Rural Affairs Advisory Committee (BARAAC)
Burlington Economic Development
BurlingtonGreen Environmental Association
Burlington Hydro Inc.
Burlington Sustainable Development Advisory Committee
Centre for Climate Change Management at Mohawk College
Community Development Halton
Conservation Halton (CH)
Enbridge Gas
Halton Environmental Network (HEN)
Halton Region (HR)
Ministry of Transportation
Royal Botanical Gardens (RBG)
Sustainability Leadership
United Way Halton and Hamilton
West End Home Builders' Association

Halton Region used a one-window approach, providing a single representative to attend the workshops and then reach out to relevant staff to provide additional insight where appropriate.

The following organizations were invited to be involved in development of this plan but were unable to attend the workshops:

Halton Catholic District School Board
Halton District School Board
Metrolinx
407-ETR (invited but no response)



High Lake Ontario water levels, Beachway Park shoreline, June 2019, Burlington, Ontario

Between Sept. 2021 and Mar. 2022, City of Burlington staff participated in ICLEI Canada's Planning cohort of the Advancing Adaptation: Train the Trainer project, funded through the Ministry of Environment, Conservation and Parks alongside support from Environment and Climate Change Canada. COB staff attended workshops and ICLEI staff reviewed the draft plan.

INTRODUCTION

Climate Resilient Burlington (CRB): A Plan for Adapting to Our Warmer, Wetter and Wilder Weather outlines actions for the City of Burlington (the City) to focus on over the next 10 years to prepare for a changing climate and build community resilience. These actions focus the City's efforts on more proactive measures with the goal of less damaging impacts from extreme weather events and changing climate conditions to the built, natural, social and economic elements of the Burlington community.

Community Lens, City Focus

Stakeholders across multiple City departments and external community organizations provided extensive input to the CRB plan. Vulnerabilities and risks related to future climate conditions were assessed for the Burlington community, beyond just the impact to the City organization. However, the CRB 10 year action plan only identifies actions where the City can take a lead role.

Collective Action

Although CRB predominantly has a City focus, we all play a role in preparing for climate change. As such, partnerships and collaboration are essential to take collective action. Many opportunities for alignment between stakeholders have been identified through this process. Each City action in this plan has identified related initiatives such as projects or programs. Many of the actions are not starting from scratch, but rather building on work already underway and leveraging knowledge and experience from others.

Citizens also have a responsibility to build resilience to climate change but often don't know where to start. Actions at an individual level may feel insignificant compared to scale of the risk, but collectively it all builds resilience. A checklist of actions that citizens can take to reduce climate risk are provided in [Appendix C](#). Actions are separated into investments you can make around your home and actions focused around good habits and behaviours. The climate hazard(s) associated with each action has also been provided to explain the reason for taking the action.



City View Park, Burlington, Ontario

SCOPE

Climate change impacts are widespread in scope. However, for practical reasons – in terms of what the City can control and influence – the following boundaries were placed on the scope of the CRB plan.

Spatial Boundary:

Within the six wards that make up the City of Burlington

Climate Impacts:

Chronic (slow onset) and acute (rapid onset) climate impacts

Assessment Timeframe:

Climate risks in 2051-2080

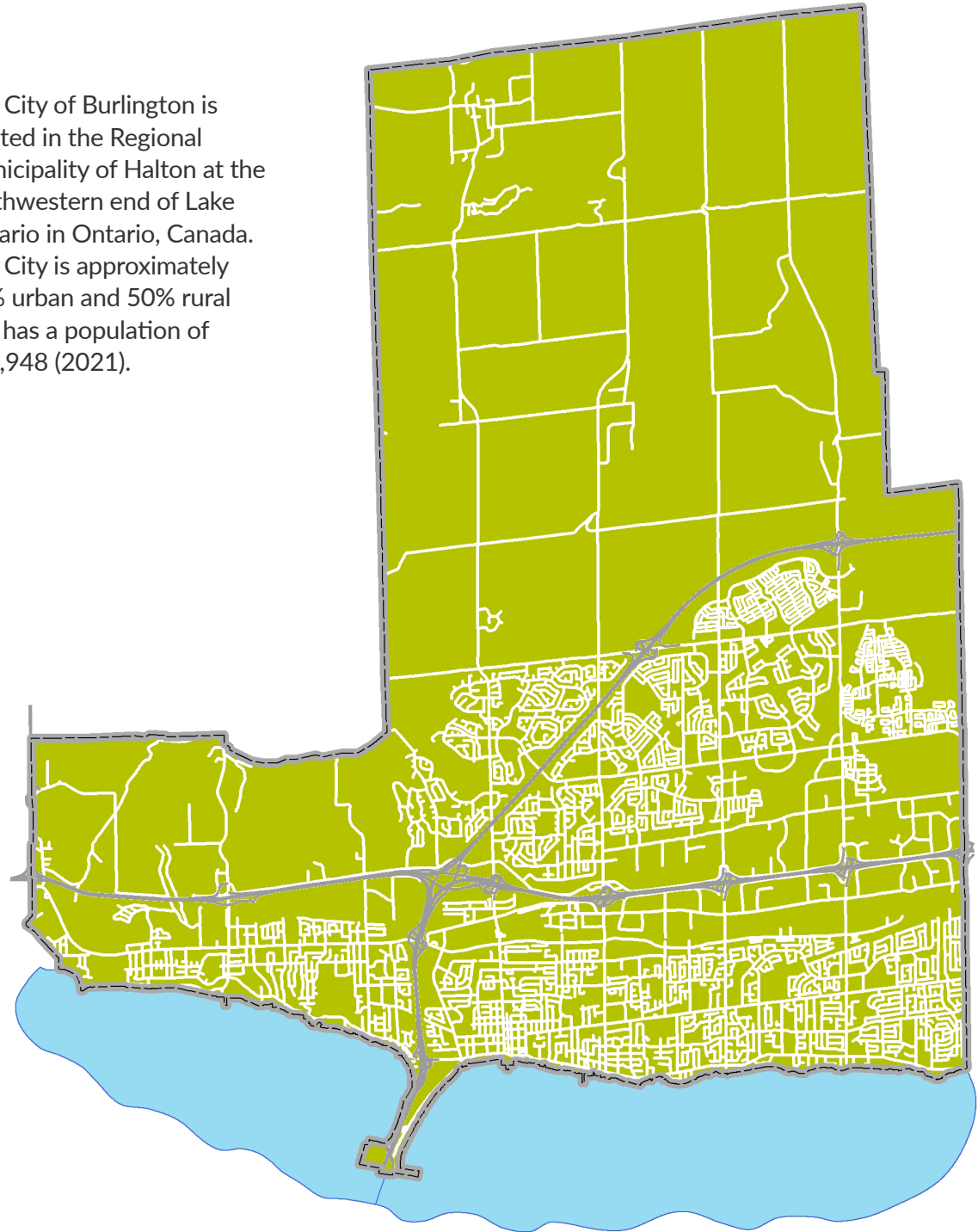
Climate Scenario:

Climate projections using a high emissions scenario with a representative concentration pathway (RCP) of 8.5

Action Timeframe:

Actions to implement in the next 10 years (2022-2032) by the City of Burlington

The City of Burlington is located in the Regional Municipality of Halton at the northwestern end of Lake Ontario in Ontario, Canada. The City is approximately 50% urban and 50% rural and has a population of 186,948 (2021).



UNDERSTANDING CLIMATE CHANGE

Climate Mitigation

Climate mitigation seeks to curb global warming by preventing or reducing greenhouse gas (GHG) emissions into the atmosphere. The more GHGs released, the hotter our planet gets. The City's Climate Action Plan and Corporate Energy and Emissions Management Plan: 2019-2024 address climate mitigation.

Sample climate mitigation actions: renewable energy, energy efficiency, sustainable and active transportation.

Connection to Extreme Events

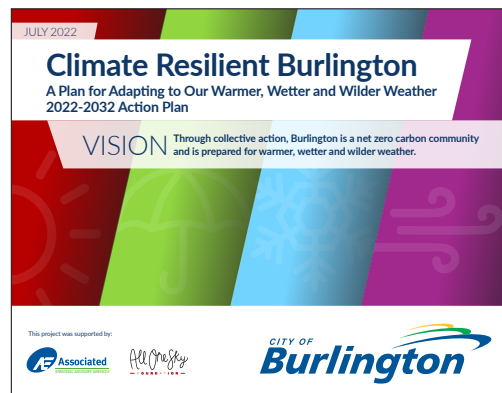
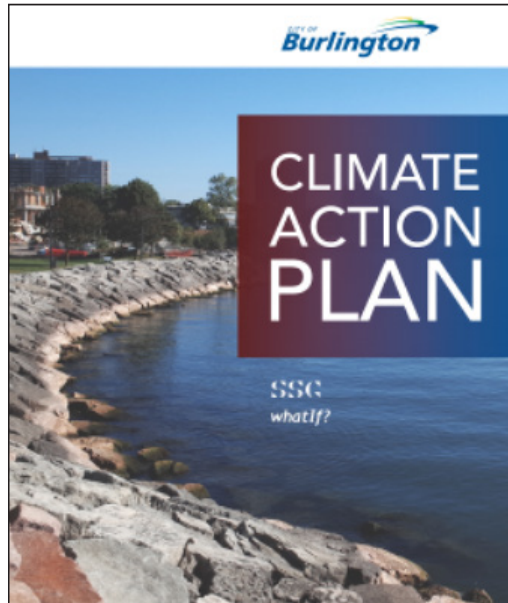
For every 1°C increase in temperature, the atmosphere holds 7% more water vapour.² A warmer atmosphere can also hold the water vapour longer. This is why we can expect periods of drought with longer, hotter, drier summers, but when it does rain, it will fall with more intensity.

The more GHG emissions are reduced, the less severe future climate change impacts will be.

Climate Adaptation

Climate adaptation is the process of planning for and adjusting to the current and future effects of climate change. Data show that the damages are increasing from more severe and frequent extreme events.³ Analysis also shows that it costs about six times more to respond to extreme events than to proactively adapt.⁴ Climate Resilient Burlington addresses climate adaptation.

Sample adaptation actions: flood protection, infrastructure upgrades, healthy tree canopy, disaster management and business continuity.



Weather

Short term day-to-day changes in atmospheric conditions like temperature and precipitation.



Climate

The weather of a specific region averaged over a long period of time, typically 30-year periods.



Climate Change

Significant changes in climate that occur over several decades or longer.



Mitigation

Actions to reduce emissions that cause climate change.



Adaptation

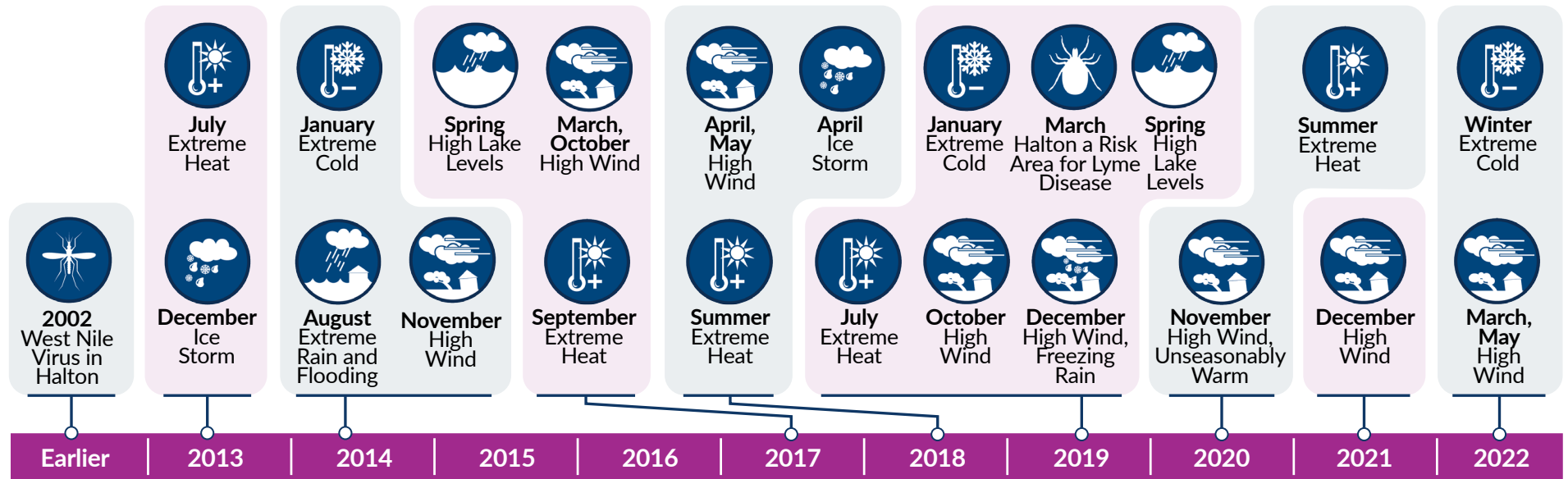
Actions to manage the risks of climate change impacts.

CLIMATE ADAPTATION TIMELINE

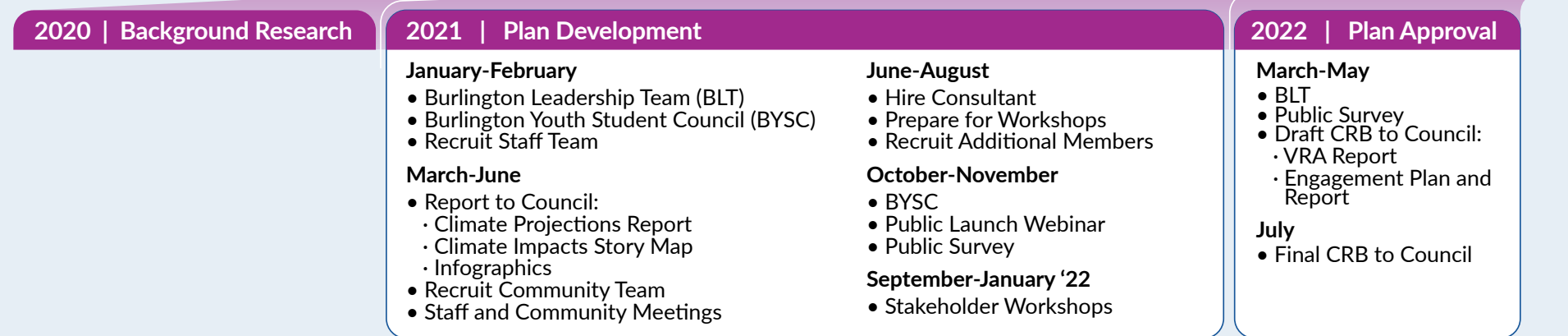
Weather and Climate Events Experienced

Similar to many other cities and citizens, Burlington has experienced impacts from extreme weather, most notably from the ice storm of December 2013 and the flood event of August 2014. Evacuation, power disruption, debris from broken trees, and compromised access to transportation routes, are a few factors City staff have had to navigate. Recovery activities following an emergency takes time and resources to address.

Additional information on events Burlington has recently experienced is available from the [Climate Change Impacts Story Map \(2021\)](https://www.burlington.ca/environment) at [burlington.ca/environment](https://www.burlington.ca/environment)⁵







CRB Plan Process



CLIMATE PROJECTIONS

The report [Climate Projections for Burlington Region \(2021\)](#) identifies warmer, wetter and wilder weather potentially leading to more frequent emergency response and recovery efforts.⁶ Climate change is a risk multiplier, meaning that although risks such as flooding already exist,

the severity and frequency of flooding will increase over time. Under a high emissions scenario (RCP 8.5), the future time frame of 2051-2080 was predominantly compared to a baseline of 1976-2005 to identify the following climate projections and impacts:

	Climate Projections	Example Impacts
	<p>WARMER SUMMERS</p> <ul style="list-style-type: none"> • 30°C days increase from 16 to 61 days • Greater than 20°C nights increase from 8 to 45 days • Average warmest maximum temperature increases from 34°C to 39°C 	<ul style="list-style-type: none"> • Heat-related morbidity (illness) and mortality (death) • Increased use of splash pads, pools, and greenspace • Increased vector-borne disease and invasive species migration and lifespan
	<p>WARMER WINTERS</p> <ul style="list-style-type: none"> • Average winter temperature increases from -3°C to 1°C • Average coldest mean temperature increases from -21°C to -13°C • Mild winter days (< -5°C) decrease from 67 to 27 days 	<ul style="list-style-type: none"> • Loss of winter recreation opportunities • Less cold-related morbidity and mortality • Decrease in snowfall accumulation and more mixed precipitation • Road network impacts due to more freeze/thaw action • Increased survival of invasive species
	<p>WETTER</p> <ul style="list-style-type: none"> • Annual precipitation increases 10% • Spring precipitation increases 17% • Winter precipitation increases 18% 	<ul style="list-style-type: none"> • Stress on the City's stormwater drainage network • Public and private property flooding and increased erosion • Transportation disruptions and damage to roadways from flooded roads
	<p>WILDER</p> <ul style="list-style-type: none"> • More intense and extreme rainfall events • Freezing rain increases 40% in 2050 • 70 km/h wind gusts increase 17% by 2046–2065 	<ul style="list-style-type: none"> • Power outages and property damage from downed trees • Disruption to transportation routes and outdoor recreation • More frequent, intense erosive events along watercourse and Lake Ontario

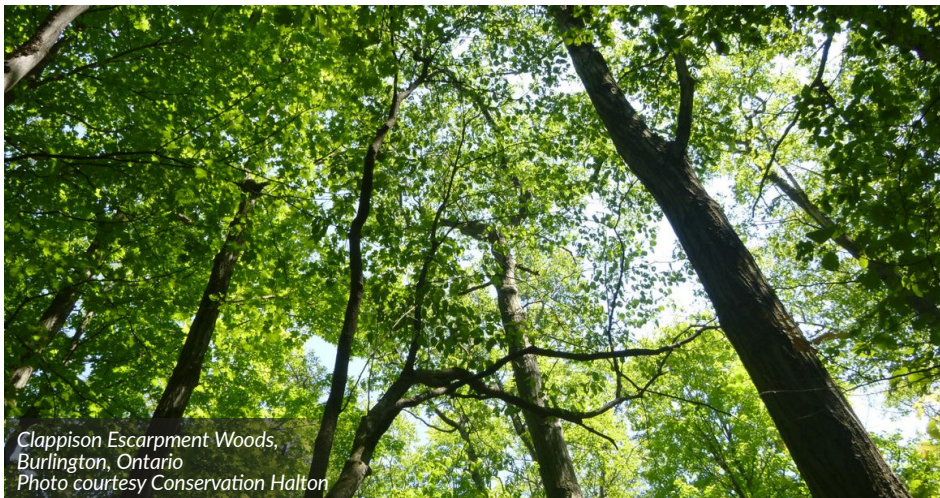
Access the full [Climate Projections for Burlington Region \(2021\)](#) report at burlington.ca/environment⁶

CLIMATE RESILIENT BURLINGTON ALIGNMENT WITH OTHER INITIATIVES

Tackling the issue of climate change requires a multi-faceted, holistic approach supported by policies, strategies, plans, programs and partnerships at all levels of government. The impacts of climate change reach beyond jurisdictional boundaries requiring cross collaboration.

Many initiatives by the City of Burlington and community stakeholders, such as Conservation Halton and Halton Region, as highlighted on this page, are already underway to manage climate-related risks. This plan does not seek to redirect resources away from existing initiatives, but rather to augment and build upon this work. Climate Resilient Burlington sought to:

- 1** Uphold a set of agreed-upon principles to guide the actions in achieving a long-term vision
- 2** Focus City efforts on best opportunities where the City can take the lead or play a significant role in managing the highest risks
- 3** Align, augment or integrate climate actions into existing City initiatives
- 4** Work collaboratively by identifying synergies with key community stakeholders



Clappison Escarpment Woods,
Burlington, Ontario
Photo courtesy Conservation Halton

Subset of Existing Initiatives Related to Climate Adaptation

Policies

- Official Plan Section 4.1 Climate Change and Air Quality
- Sustainable Building and Development Guidelines
- Stormwater Management Design Guidelines
- Working in Hot Weather, Health and Safety Standards
- Burlington Emergency and Continuity Management Bylaw

Strategies and Plans

- Vision 2040: Burlington's Strategic Plan 2015–2040
- 2018–2022 Burlington's Plan: From Vision to Focus
- 2021 Asset Management Plan and Financing Plan
- Urban Forest Master Plan (update underway)
- Parks, Recreation and Culture Assets Master Plan (update underway)
- Flood Vulnerability and Prioritization Mitigation Study
- Erosion Control and Flood Mitigation Environmental Assessments
- Major Transit Station Area - Area-Specific Planning

Programs

- HR Enhanced Basement Flooding Prevention Subsidy Program
- Plumbing Permit Fee Grant Program
- Home Flood Protection Assessment
- CH Floodplain Mapping
- Comprehensive and Interim Creek Inspection Program
- CH Healthy Neighboursheds Program
- CH Long Term Monitoring Program
- Warming and Cooling Centres

Partnerships

- Municipal Natural Assets Initiative: Grindstone Creek Project
- Cootes to Escarpment EcoPark System
- Bay Area Climate Change Council
- Halton Climate Collective

VISION AND PRINCIPLES

The vision and principles shape and provide guidance not only for the 10 year action plan, but throughout the long term journey to the 2051-2080 timeframe and beyond. They provide direction for prioritizing climate actions and approaches, establish consistent language and a common direction. A values-based approach was used where stakeholders identified what beliefs should guide or motivate actions.

Vision

Through collective action, Burlington is a net zero carbon community and is prepared for warmer, wetter and wilder weather.

Principles

City decision-making on climate action is equitable, transparent, and is able to pivot to leverage emerging opportunities.

Stakeholders work together and invest in proactive measures to reduce damage and impacts from future extreme weather events.

The City recognizes synergies by coordinating programs and tools for collective climate action.

Council decisions, City processes, and investments support climate-minded innovation.

The City is accountable for increasing resilience by measuring and reporting progress on climate action.

Community members are supported and empowered to take personal responsibility in preparing for future climate conditions inclusive of all age groups, cultures, and income levels.



The City first met with the Burlington Youth Student Council to get their thoughts on climate change. The word cloud below illustrates what they said when asked what they value most. Their comments helped inform the visioning exercise for the stakeholder workshop. It should be noted that the City of Burlington Community Survey 2021 asked 'What would you say you like best about living in Burlington?' and many similar words were also used.

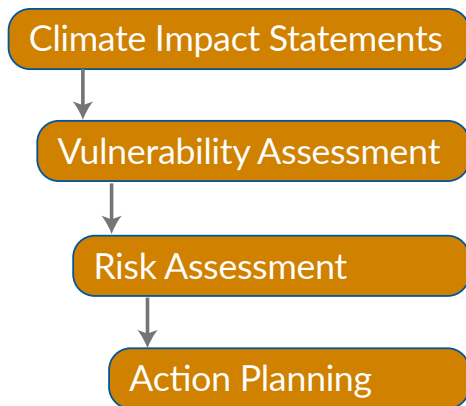


VULNERABILITY AND RISK ASSESSMENT

International Standards

The approach to vulnerability and risk assessment (VRA) is based on the Intergovernmental Panel on Climate Change’s (IPCC) latest conceptualization of climate risk and can be viewed as a risk assessment with an embedded vulnerability assessment component. It is consistent with the recently published International Organization for Standardization (ISO) guidelines for climate vulnerability and risk assessments (ISO 14091) and adaptation planning for local governments and communities (ISO 14092) and entails four activities shown below.

Adaptation Plan Process

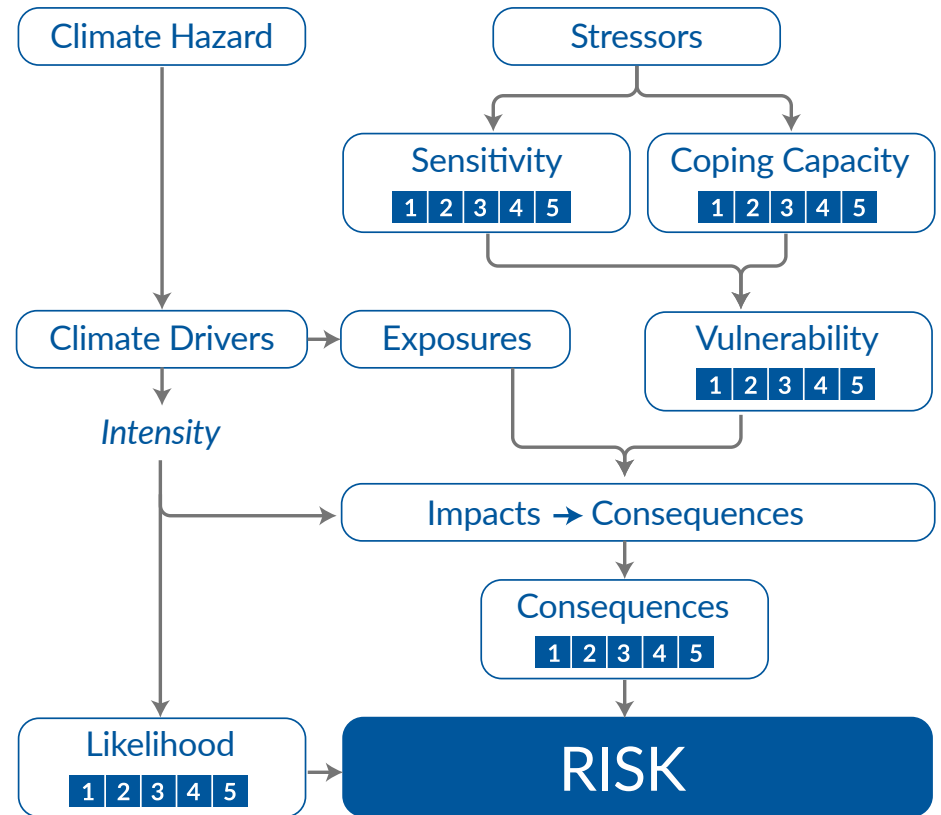


The [Climate Change Vulnerability and Risk Assessment Report](#) (2021) provides additional detail on the process used. Scoring for sensitivity, lack of coping capacity, vulnerability, consequence and likelihood are shown for each climate impact statement.⁷ The report is available from the [City of Burlington’s website](#) at burlington.ca/environment.

Bottom-Up Approach

The VRA was largely informed by a bottom-up, participatory approach that recognizes the skills and experiences of City staff and a range of community stakeholders, who are engaged throughout in the co-production of outcomes at each stage. This approach builds momentum for successful adaptation planning and implementation by including key stakeholders in all aspects of the development process. A detailed list of stakeholders involved throughout the process is provided in [Appendix A](#).

Vulnerability and Risk Assessment Process



ADAPTATION PLANNING PRIORITY

It is not practical to address all the impacts of climate change as part of this initial CRB adaptation plan. The value of the Vulnerability and Risk Assessment (VRA) is to focus the efforts of the CRB on the highest risks while recognizing the related initiatives already underway. Stakeholders provided input on existing initiatives and identified new actions required or enhancement of existing actions to integrate future climate risk. This does not mean that the lower priority risks should not be addressed, but rather that increased focus above and beyond existing initiatives may not be required at this time.

Multiple consequences were identified for each climate hazard or opportunity. Risk was assessed for each of the consequences. In some situations (shown with *), the overall risk score for the hazard was a lower risk, but some specific consequences of the hazard had a high risk score. These specific consequences were considered as part of the adaptation planning phase.

Discrete consequences of climate hazards taken forward to adaptation planning phase.

Although a climate hazard to prepare for, or a potential opportunity, these are a lower priority for this 10 year plan.

Extreme Risk

- High Winds
- Shifting Ecoregion
- Freezing Rain
- Wet Conditions
- Water Quality (algal blooms)

High Risk

- Heavy Snowfall
- Vector-Borne Disease
- Extreme Heat

Medium Risk

- Cooling Demand
- Freeze-Thaw Cycles
- Late Spring Frost
- High Water Levels (Lake Ontario)
- Stormwater Flooding
- Mismatched Timing of Plant and Animal Lifecycles

Lower Risk

- Air Quality*
- Invasive Species and Pests*
- Increased Water Demand
- Increased Heating Demand
- Drought
- Loss of Winter Recreation
- Creek Flooding*
- Low Water Levels
- Grass Fire
- Forest Fire

Climate Opportunities

- Increased Active Transportation
- Increased Summer Recreation Season
- Longer Growing Season

CLIMATE RESILIENT BURLINGTON 10 YEAR ACTION PLAN

This part of the CRB plan outlines the actions the City should implement from 2022 - 2032. Actions are grouped together by similar topics and aligned within one of five themes. Each theme is introduced by providing context for a topic, followed by a table outlining related actions as described on this page.

Action Themes

Themes are broad areas of focus and align with Canada's National Adaptation Strategy to support potential future monitoring and reporting requirements.

-  **Theme 1: Resilient Built and Natural Infrastructure**
-  **Theme 2: Thriving Natural Environment**
-  **Theme 3: Health and Well-Being**
-  **Theme 4: Disaster Resilience**
-  **Theme 5: Strong and Resilient Economy**

Monitoring and Reporting

Each grouping of actions are described by:

Goal: A longer term objective supported by the action grouping

Indicator: Measurable factors that show progress related to the goal

Target: Provides clarity of what should be achieved

Action Responsibility

Actions in this plan are the responsibility of City staff, however the role of climate adaptation extends beyond the City. Community connections have been identified for potential partnerships, synergies and alignment to external initiatives.

See [page iv](#) for abbreviations of City departments and community stakeholders. See [Appendix B](#) for a table showing which climate hazards each action addresses. Citizen actions are included in [Appendix C](#).

Action Type

To advance climate adaptation, the following types of actions may be used:

- **Assessment Actions:** Analysis or research to gather information
- **Partnership Actions:** New or strengthened existing partnerships
- **Planning Actions:** New or enhanced plans or strategies
- **Policy Actions:** New or updated rules and regulations
- **Procedural Actions:** New or updated operational procedures
- **Program-Specific Actions:** New or updated program with ongoing implementation
- **Project-Specific Actions:** New or updated project with shorter implementation

Public engagement is part of numerous actions and therefore was not specifically identified. Additional staff may be required to support the implementation of some of the actions. Staff resourcing has not been determined in this plan.

Action Timeline

The timeline for actions are for completion of the action but may start earlier than specified:

Ongoing: Occurs on a continual basis

1-2 years: Already in budget/work plan or as part of existing initiative

3-5 years: Include in next business cycle

5-10 years: Longer duration actions or starting in later business cycle

Action Cost

The estimated additional cost of implementing actions is based on the following:

\$: Low cost (\$0 to \$100,000)

\$\$: Medium cost (\$100,000 to \$500,000)

\$\$\$: High cost (>\$500,000)

THEME 1: RESILIENT BUILT AND NATURAL INFRASTRUCTURE

Infrastructure Design and Life Cycle Management

Infrastructure is a broad term that typically refers to built or engineered systems of assets that provide a service to the municipality such as roads, storm sewers and City-owned buildings. The term is evolving to include green infrastructure or natural assets, such as forests and wetlands, to recognize their multiple benefits. For example, the City has incorporated Urban Forestry into its Asset Management Plan (AMP) and it intends to include additional natural assets in the future following industry Best Management Practices and standards.

The City is also involved with local partners to understand, measure, value and manage natural assets in the Grindstone Creek watershed to address flood risk, erosion and other impacts. This project will help provide a framework for future incorporation of natural assets into the City's and other partners' existing corporate asset management plans.

The City's 2021 AMP acknowledges climate change as a risk to City infrastructure and services. The impact of climate change on different

types of assets throughout their lifecycle will be incorporated into future AMPs to provide more accurate estimates of long-term financing needs.

In 2021, the Financial Accountability Office (FAO) of Ontario released a report on public buildings in Ontario. They estimate a cost increase of 8.2–14.5% over current costs to maintain assets in a state of good repair when accounting for future climate conditions.⁸

The City should integrate climate-related standards, such as those being developed and enhanced by the Standards Council of Canada, where appropriate to improve Burlington's community and infrastructure resilience.

Goal: Manage infrastructure to prepare for future climate conditions and carbon neutral goals.

Indicator: Percentage of prioritized asset categories that have been assessed for future climate impacts

Target: 100% by 2032

Asset Life Cycle	Example Climate Change Impacts to Asset Management
Design Requirements	<ul style="list-style-type: none"> • Adjusting design storm events to reflect more frequent, severe storms. • Increased need for conservation of natural areas to provide shade, reduce surface runoff and maintain biodiversity.
Operation and Maintenance	<ul style="list-style-type: none"> • Increased maintenance to trees and transportation infrastructure due to more frequent and severe climate hazards. • More frequent removal of sediment from stormwater ponds may be required due to increased erosion from increased rainfall intensity.
Life Span	<ul style="list-style-type: none"> • More frequent replacement of exterior building materials, due to high wind, extreme heat and intense rain. • Shorter life span of roadway asphalt and concrete from increased precipitation, milder winters and extreme heat.

ID	Action	Action Type	Complete	Cost	City Lead	City Supporting	Community Connections
1-1	Expand natural asset data and include priority natural assets into Burlington's Asset Management Plan	Plan	3-5 years	\$\$	Engineering Services	All natural asset service areas	CH; HR
1-2	Integrate future climate impacts in Burlington's Asset Management Plan for prioritized asset categories and assess long-term infrastructure funding requirements	Plan	5-10 years	\$\$	Engineering Services	All asset services areas	
1-3	Review and if necessary update design standards for City infrastructure to account for future climate conditions in alignment with Federal and Provincial initiatives, and Burlington's net carbon neutral goals	Policy	Ongoing	\$	Engineering Services	All asset services areas	Federal and Provincial Governments; CH; HR

Related Initiatives for each action:

- 1-1: Halton Region (HR) Natural Heritage Strategy (Regional Council, early 2022); Municipal Natural Assets Initiative (MNAI) (Grindstone Creek project); Urban Forest Master Plan (UMFP)
- 1-2: Asset Management Plan (AMP); Asset Management Financing Plan
- 1-3: Burlington Stormwater (SW) Management Design Guidelines; Major Transit Station Areas (MTSA) Urban Design Guidelines; Downtown Urban Centre and Burlington GO MTSA Flood Hazards and Scoped SW Assessment; CH Floodplain Mapping; CH Flood Studies and Spill/Flood Hazard Policies; Sustainable Building and Development Guidelines; Climate Action Plan; Corporate Energy and Emissions Management Plan



Road Construction, Burlington, Ontario

Flood Management

There are different types of flood risk in Burlington including creek flooding, Lake Ontario shoreline flooding, localized flooding due to stormwater system capacity and basement flooding due to elevated groundwater levels or sanitary sewer backup. Improving our understanding of how these current risks will increase due to climate change should inform flood protection measures and emergency preparedness planning. This involves continued close collaboration with the City, Conservation Halton and Halton Region with support from many community stakeholders.

Conservation Halton, the City and the Region use flood hazard maps to show areas at risk for different sized floods and the extent of the flood hazard for regulatory decisions, land use planning and flood mitigation studies. These studies show the spatial extent and flood levels for a design flood, such as a 100-year flood event which has a 1% chance of occurring in any given year, as well as historical flood events, such as Hurricane Hazel. Inundation mapping shows areas at risk for different sized floods during real flood events. It may also be used for flood mitigation studies as well as flood forecasting and warnings and can be incorporated in emergency preparedness plans and support communication of the varying levels of risk. Both types of maps should be updated at regular intervals to be informed by climate change and not only reflect past storms and flooding.

Goal: Enhance resilience of infrastructure exposed to high flood risk.

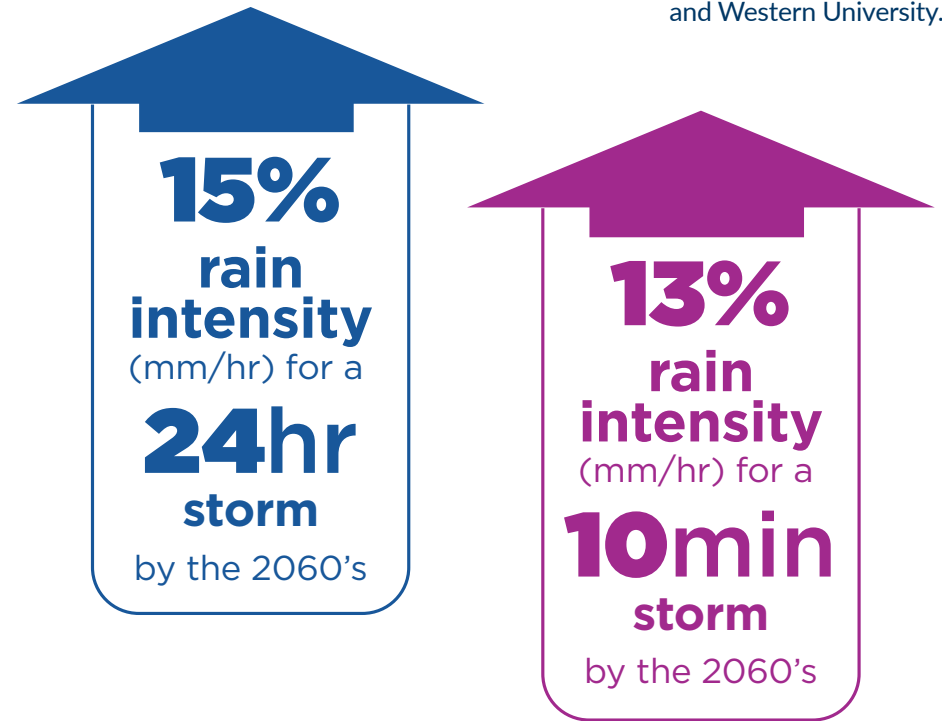
Short-term Indicator: Percentage of City with future climate informed flood mapping for creeks

Target: 95% by 2027

Indicator: Percentage of critical infrastructure exposed to high flood risk

Target: Decreasing long term

* Increased rainfall intensity determined using the IDF-CC tool by the Institute for Catastrophic Loss Reduction (ICLR) and Western University.



ID	Action	Action Type	Complete	Cost	City Lead	City Supporting	Community Connections
1-4	Develop lake shoreline flood management strategy augmenting existing plans to incorporate future climate projections and impacts to protect City assets (parkland and infrastructure)	Plan	5-10 years	\$\$	Engineering Services	EICS; RPF; RCC; Community Planning	CH; HR
1-5	Enhance creek flood protection plan <ul style="list-style-type: none"> Review and if necessary update regulatory flood hazard maps reflecting future climate risks and integrating the mapping in land use planning studies 	Plan	3-5 years	\$\$	Engineering Services	EICS; RPF; RCC; Community Planning	CH; RBG
1-6	Enhance emergency preparedness plans and public communication of flood risk with more detailed flood hazard information <ul style="list-style-type: none"> Develop emergency flood management procedures using predictive rainfall information for stormwater infrastructure 	Procedure	5-10 years	\$	Fire	Engineering Services; Corporate Communications and Engagement	CH; Intact Centre on Climate Adaptation; Red Cross
1-7	Enhance coordination with partner agencies and higher levels of government to ensure that flood hazard maps and protection measures are up to date to manage flood risks	Partnership	5-10 years	\$	Engineering Services	Community Planning; Fire	CH; Intact Centre on Climate Adaptation; Senior Levels of Govt.; Partner Agencies

Related initiatives for each action:

- 1-4: HR Burlington Beach Technical Studies; Lake Ontario Shoreline Management Program
- 1-5: COB, HR, CH Flood Studies and Spill/Flood Hazard Policies; CH Floodplain Mapping and Studies; Installation of additional climate and streamflow gauging stations through CH's real-time monitoring network
- 1-6: Annual Critical Infrastructure Mapping; Regional Flood Risk Program; COB Disaster Recovery and Rehabilitation Planning; Red Cross Disaster Risk Reduction Program; Grindstone Creek Project; CH Flood Forecasting Modernization Initiative
- 1-7: CH Floodplain Mapping

Service Disruption

Multiple climate hazards pose a risk to the reliability of critical infrastructure and continuity of services, such as:

- Residential and regional roadways
- Highways and rail
- Power and water supply distribution systems
- Access to public facilities including medical, parks, recreation or schools

Being prepared for disruptions includes:

- Backup power supplies for both public and private infrastructure and services
- Redundant or duplicate systems like sump pumps
- Flexible working arrangements such as working remotely or adjusting hours
- Emergency preparedness planning

Currently, City budgets account for cleanup activities following an extreme event. As climate events occur more frequently and inflict more damages, sufficient funding needs to be available for proactive and emergency measures.

Goal: Invest in proactive measures to prepare for increased extreme events to avoid post-storm reactive costs.

Indicator: Dollars spent on response and recovery of extreme events by type and severity

Target: Decreasing long term trend (depends on type, frequency and severity of event)

ID	Action	Action Type	Complete	Cost	City Lead	City Supporting	Community Connections
1-8	Develop tracking for post-storm assessment to inform recovery and future adaptation efforts including data on type and severity of event, type of damage, amount or cost of damage, debris management to improve debris pick-up, etc.	Procedure	3-5 years	\$	RPF	EICS; Fire; Finance; Engineering Services; applicable service areas	Burlington Hydro; CH; HR
1-9	Maintain level of service for tree pruning and enhance risk assessment protocol in areas with above-ground powerlines, near major roads, near fire stations, etc.	Procedure	3-5 years	\$\$	RPF	Fire	Burlington Hydro; HR
1-10	Invest in backup power for City infrastructure <ul style="list-style-type: none"> • Assess backup power needs to sustain critical services during a significant power outage including consideration of vulnerable populations • Develop a plan utilizing permanent and temporary backup power sources and partnering with community stakeholders 	Project	3-5 years	\$\$	EICS	Fire; applicable service areas	Burlington Hydro; HR; Community Groups

ID	Action	Action Type	Complete	Cost	City Lead	City Supporting	Community Connections
1-11	Develop wind risk and vulnerability mapping to communicate high risk areas, inform emergency response planning, prioritize maintenance activities and guide community planning	Assessment	3-5 years	\$	Fire	Engineering Services; EICS; RPF; Corporate Communications and Engagement	HR; CH; Red Cross
1-12	Assess snow management plan to ensure a climate lens is applied to incorporate increased frequency and severity of extreme events (e.g., heavy snow, freezing rain, wind) with consideration of impacts to vulnerable populations	Plan	3-5 years	\$	RPF	EICS; RPF; Transit; Transportation; Fire	HR; Community Groups; Red Cross
1-13	Assess the impacts of projected climate conditions on all recreation services offered by the City to determine adaptive measures for long term recreational needs, including consideration for impacts on vulnerable populations	Assessment	3-5 years	\$	RCC	Fire; EICS; Community Planning; Engineering Services	CH; HR; RBG; Community Development Halton; Province of Ontario

Related initiatives for each action:

1-8: Enterprise Asset Management System (EAMS); Automated Vehicle Locator (AVL); i-Tree; TreePlotter (CH); HR proposed Solid Waste Management Strategy; Disaster Debris Management Plan Emergency Support Function (Part of update to the Disaster Recovery and Rehabilitation Plan)

1-9: UFMP

1-10: Community groups that have mobile generation to coordinate during emergency; connection to action 4-3

1-11: Annual Hazard Identification and Risk Assessment (HIRA); Community Risk Assessment; Red Cross Disaster Risk Reduction Project

1-13: Proposed Parks, Recreation, and Cultural Assets Master Plan; Annual HIRA; CH Watershed Climate Change Resiliency Strategy

THEME 2: THRIVING NATURAL ENVIRONMENT

Tree Management

Healthy and well managed trees and urban forests provide significant benefits related to health and well-being, recreation, food, wildlife habitat, and the regulation of ecosystem processes like pollination, air and water quality, stormwater flow, shade and cooling. With climate change, trees play an increasingly important role in reducing extreme heat and flooding impacts.

Trees are also vulnerable to climate change. There will be a northward migration of tree species and habitats as they follow the shifting climate conditions. Assessing tree species that will be resilient to climate change and proactive planting of these species is important.

Tree damage and fallen branches from freezing rain, ice storms and high winds can lead to property damage, power outages, transportation disruptions and public safety concerns. Healthy and well managed trees improve the strength of the trees, and appropriate placement also helps to reduce damages from fallen trees.

Burlington's Urban Forest Master Plan (UFMP) provides an opportunity to align and incorporate several actions to manage multiple climate risks. Management decisions guided by the UFMP should be driven by maximizing co-benefits from trees.

Goal: Reduce damage to trees while increasing the value of the services they provide.

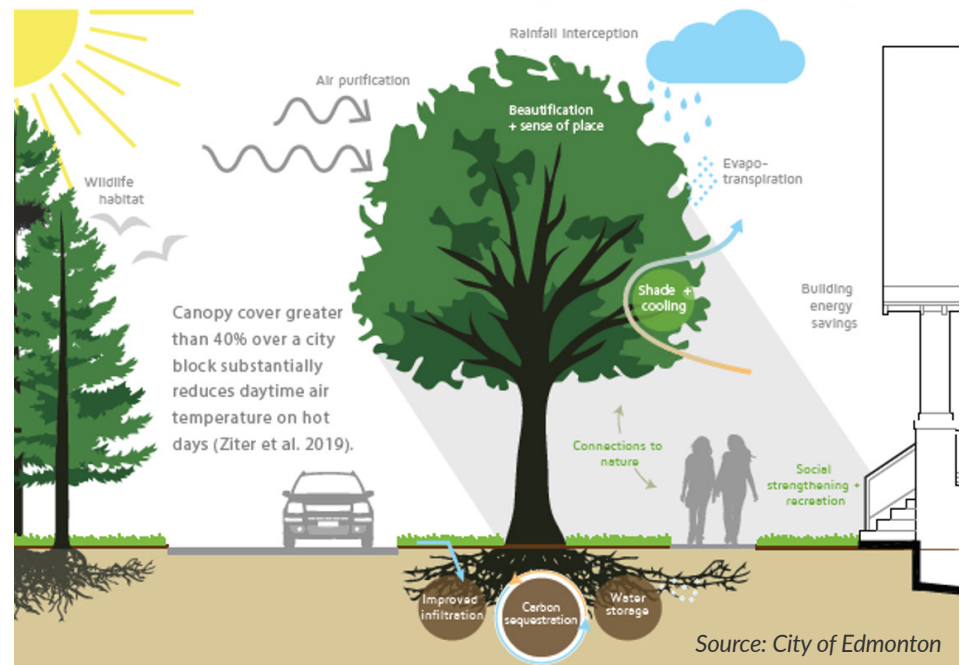
Indicator: Number of major limb failures and catastrophic tree failures per storm, per year

Target: Decreasing long term trend (depends on type, frequency and severity of extreme storms)

Indicator: Percentage of tree canopy cover

Target: 35% by 2041

Benefits of Urban Trees



ID	Action	Action Type	Complete	Cost	City Lead	City Supporting	Community Connections
2-1	Invest in full tree life cycle management balancing amount of planting and ongoing maintenance to improve tree survival outcomes: <ul style="list-style-type: none"> • “Training young trees” programming for stronger trees to withstand extremes • Forestry on-call program • Coordination with volunteers for tree maintenance • Enhanced pruning 	Program	Ongoing	\$\$	RPF	EICS	CH; HR; RBG; Community Groups and Volunteers; Schools
2-2	Incorporate a climate lens in recommendations of management decisions in the Urban Forest Master Plan (UFMP) to maximize co-benefits: <ul style="list-style-type: none"> • Research to determine tree canopy coverage and assess species vulnerable to climate change • Consider shade for extreme heat, water retention for stormwater management, supporting biodiversity and carbon sequestration • Consider rural areas, vulnerable populations and equity in prioritizing investments • Maximize ecosystem services 	Plan	3-5 years	\$	RPF	Engineering Services; EICS; Fire; Community Planning; RCC; Transportation	CH; HR; RBG; BurlingtonGreen
2-3	Invest and support implementation of the UFMP	Program	5-10 years	\$\$\$	RPF	Applicable service areas	CH; HR; RBG; BurlingtonGreen

Related initiatives for each action:

2-1: CH Guidelines for Landscaping and Rehabilitation Plans, June 2021; CH Seed Mixes October 2020; CH Native Species List, Aug. 2018

2-2: i-Tree analysis

2-3: COB Corporate Tree Protection and Enhancement Policy; CH Tree Planting Program

Natural Area Management

Natural areas are especially valuable as they can reduce risk from changing climate conditions (climate adaptation) and absorb and store greenhouse gases (climate mitigation). However, nature is also impacted by changing climate conditions and needs to be protected and supported.

Nature is an interconnected system. Biodiversity, which is the amount of variety of life within an ecosystem, is a fundamental building block upon which all benefits and ecosystem services depend. Negative biodiversity trends are evident in Canada, highlighting the need for an integrated approach across jurisdictions.

The City and its eight partners own or manage almost 1,900 hectares of natural lands within the Cootes to Escarpment EcoPark System. The City

will continue to participate in existing and planned biodiversity initiatives with partner agencies, neighbouring municipalities, and community organizations.

Goal: Value, conserve and enhance the multiple services that natural areas provide.

Indicator: Dollars spent on green infrastructure projects

Target: Increase

Indicator: TBD through Biodiversity Plan

Target: TBD

ID	Action	Action Type	Complete	Cost	City Lead	City Supporting	Community Connections
2-4	Invest in green infrastructure to reduce flood risk, enhance habitat connectivity and support other ecosystem services	Program	Ongoing	\$\$	Engineering Services	Applicable service areas	CH
2-5	Establish a City-Wide Biodiversity Plan that addresses: <ul style="list-style-type: none"> Local effects of climate change on wildlife and biodiversity Habitat connectivity and wildlife corridors Ecosystem resilience Invasive species management Urban and rural landscaping behaviours and operations and maintenance that can support plants and wildlife Integration of citizen science Habitat restoration Ecosystem services 	Plan and Partnership	5-10 years	\$\$	Community Planning; RPF	EICS; Engineering Services	CH; HR; RBG; BurlingtonGreen; Sustainable Development Committee; Hamilton Naturalists' Club

Related initiatives for each action:

2-4: Grindstone Creek MNAI Project; Halton Natural Heritage System; Halton Watershed Stewardship Program; CH Restoration Services; CH Watershed Climate Change Resiliency Strategy; CH Water Quality and Habitat Improvement Program

2-5: UFMP; Cootes to Escarpment EcoPark System; HR Natural Heritage System; Bird Friendly City Hamilton Burlington; Hamilton Biodiversity Action Plan; Oakville Strategy for Biodiversity; HR Biodiversity Plan; CH Effects of Climate Change on Biodiversity and Habitat Connectivity Modeling; CH Long-term Environmental Monitoring Program

THEME 3: HEALTH AND WELL-BEING

The health and well-being of vulnerable residents are already adversely affected by climate change, with the consequences projected to worsen with further climate change. Climate change impacts our health by altering exposures to extreme heat events, floods, droughts and other extreme events; vector-, food- and water-borne infectious diseases; changes in air and water quality; and stresses to mental health and well-being generally.

Extreme Heat and Health

High temperatures in the summer are linked with increased risk of a range of illnesses and death. Those particularly at risk include older adults, pregnant women, children, people with chronic health conditions, and populations with increased social vulnerability with less access to information, resources, healthcare, and other means to prepare for and avoid the health risks of high temperatures.

People living in built-up areas may experience higher temperatures because of the additional heat generated by “urban heat islands”, which increase health risks.

Actions to manage heat-related risks include heat warnings, air conditioning in buildings, cooling shelters, increased greenspace and shade in neighbourhoods.



Cooling Centre Information: Where to go in Burlington

- Central Library: 2331 New St. (905-639-3611)
 - Aldershot Library: 550 Plains Rd. E. (905-333-9995)
 - Alton Library: 3040 Tim Dobbie Dr. (905-634-3686)
 - Brant Hills Library: 2255 Brant St. (905-335-2209)
 - New Appleby Library: 676 Appleby Line (905-639-6373)
 - Tansley Woods Library: 1996 Itabashi Way (905-336-5583)
- Call or check website for hours.

Goal: Provide City services to support the community during extreme heat events.

Indicator: Number of aquatic facilities (pools, misters and splash pads) per 10,000 residents

Target: TBD through Parks Master Plan

Indicator: Percentage of community within walking distance to a public space cooling facility

Target: 100% by 2035

ID	Action	Action Type	Complete	Cost	City Lead	City Supporting	Community Connections
3-1	Develop program to support vulnerable populations in installing and maintaining cooling systems	Program	5-10 years	\$\$	EICS	Finance	HR; Local Funders; Community Service Organizations
3-2	Identify gaps in public space cooling by assessing utilization of current cooling facilities and identifying the type of cooling supports and accessibility needs of the community especially for vulnerable populations	Assessment	1-2 years	\$	RCC	Community Planning; Fire; EICS	HR; Community Services Organizations; Community Development Halton; Burlington Public Library
3-3	Conduct an Urban Heat Island assessment to inform infrastructure design guidelines, shade structures, cooling facilities and UFMP	Assessment	3-5 years	\$	EICS	Community Planning; RPF; Engineering Services	
3-4	Explore the feasibility of updating the Property Standards Bylaw to include requirements to keep indoor temperatures from exceeding a maximum threshold	Policy	3-5 years	\$	Building and Bylaw	Community Planning; EICS	HR; Housing Providers
3-5	Incorporate shade (natural and built) and opportunities for cooling with water play as well as water fountains and bottle filling stations for access to free hydration into park development	Procedure	Ongoing	\$- \$\$\$	Engineering Services	RCC	Citizens

Related initiatives for each action:

3-1: Energy Affordability Program; Home Energy Retrofit Program (not yet approved or funded)

3-2: Community Development Halton for Social Planning Mapping; UFMP and Tree canopy cover (GIS); AMP; Public Safety Protocols - Warming and Cooling Centres

3-3: UFMP; Tree canopy cover (GIS)

3-5: Proposed Parks, Recreation and Cultural Assets Master Plan

THEME 4: DISASTER RESILIENCE

Community Capacity Building

The City and community stakeholders have well established protocols for emergency notification and communication. The City can focus on enhancing social capital by implementing equity-centered measures considering the most vulnerable populations. Factors such as household income, age and the ability to understand communications in English could influence the capacity to adapt to climate change and the type of resources needed.

Numerous public education programs exist, typically targeted to a specific hazard such as flooding or actions such as landscape practices. A holistic program should be developed to help citizens understand the bigger picture around climate adaptation, connect the dots between the different types of actions and guide citizens to resources and funding opportunities.

The City could establish resilience hubs which involve community-serving facilities augmented to support residents and coordinate resource distribution and services before, during and after a natural hazard event. Resilience hubs can equitably enhance community resilience and build local community leadership. Local examples of climate resilience hubs include OakvilleReady, Climate Ready Hamilton and Brampton's Lighthouse Program.

Goal: Build capacity in the community to prepare for and respond to more extreme events and long-term climate stresses.

Indicator: Percentage of urban area connected to a resilience hub within walking distance (15 minutes)

Target: 100% by 2040

Indicator: Key locations for rural resilience hubs established

Target: Two by 2032



Downtown Burlington, Ontario

ID	Action	Action Type	Complete	Cost	City Lead	City Supporting	Community Connections
4-1	Enhance emergency notification and communications plan incorporating needs of vulnerable populations	Plan	3-5 year	\$	Fire	RCC; Corporate Communications and Engagement	Vulnerable Community Members; Community Groups; Burlington Hydro; HR; HEN; CH; Red Cross
4-2	Develop a Community Climate Resilience Education Program focusing on high climate risks <ul style="list-style-type: none"> Help residents understand climate science, risks, adaptation actions, funding opportunities and relevant City initiatives 	Program	1-2 year	\$	EICS	RCC; Fire; Corporate Communications and Engagement	HEN; RBG; CH; HR; Community Groups; Citizens; Burlington Public Library; Red Cross
4-3	Enhance funding and supports for community and neighbourhood social resilience programs in urban and rural communities <ul style="list-style-type: none"> Establish Resilience Hubs across the City Establish a help line to support vulnerable populations during and after extreme events Train residents in emergency preparedness Restart and increase funding for Community Support Fund Increase funding for Neighbourhood Community Matching Fund 	Program	3-5 year	\$\$	RCC	Finance; Community Planning; Corporate Communications and Engagement; EICS; Fire	Agricultural Community; Community Groups; HR; HEN; Town of Oakville

Related initiatives for each action:

- 4-1: HR Alerts (air quality, heat, cold, etc.); CH flood alerts; Civic Alerting Platform; Updating of Emergency Preparedness webpage; HR Emergency Preparedness Guidebooks; Public Safety Protocols under Emergency Management
- 4-2: OakvilleReady; Warming and Cooling Centre Partnership with Burlington Public Library; Red Cross Disaster Risk Reduction Program
- 4-3: Building Neighbourhood Connections (Burlington); OakvilleReady; Urban Eco-Farm Feasibility Study; Halton Food (HEN)

Citizen and Business Support Programs

The City and community stakeholders should continue to provide support to citizens and businesses targeting the most significant climate change risks.

Building retrofits provide a significant opportunity to manage both climate adaptation and climate mitigation. Site drainage and stormwater management is another critical action that citizens and businesses can take to reduce risk.

See [Appendix C](#) for a checklist of Citizen Actions.

Goal: Encourage climate adaptation actions from citizens and businesses.

Indicator: Uptake of citizen and business climate adaptation support programs

Target: Increase

ID	Action	Action Type	Complete	Cost	City Lead	City Supporting	Community Connections
4-4	Promote and augment existing programs for home and business climate resilience retrofits	Program	3-5 year	\$\$	EICS	Finance; Building and Bylaw; Community Planning; Corporate Communications and Engagement	CH; HR; Sustainability Leadership; BurlingtonGreen; HEN; RBG
4-5	Enhance existing policies, programs and education programming for private stormwater management practices <ul style="list-style-type: none"> Encourage increased permeability on public and private sites Continue existing program to encourage property owners to remove stormwater from the wastewater system Encourage ongoing inspection and maintenance of potential flood risks on property 	Program	3-5 year	\$\$	Engineering Services	Community Planning; EICS; Corporate Communications and Engagement	BurlingtonGreen; CH; HR; HEN; RBG

Related initiatives for each action:

4-4: Home Energy Retrofit Program (HERO) (under development and currently unfunded); MentorWorks (energy funding opportunities); Enbridge Home Efficiency Rebate; Home Flood Protection Program; Plumbing Permit Fee Grant Program; HR Enhanced Basement Flooding Mitigation Program

4-5: Depave Paradise; CH Healthy Neighboursheds Workshops; Unflood Ontario; CH Rainwater Conservation Fund

THEME 5: STRONG AND RESILIENT ECONOMY

Agriculture

The agricultural sector is a key part of the local economy and is particularly sensitive to weather and climate conditions. Climate change has the potential to adversely impact local agricultural productivity through changes in rainfall patterns, more frequent climate extremes (including high temperatures and drought), and increased stress from pests and disease. Risks arising from climate change depend on the ability of producers to adapt to projected changes.

Additional risks for the agricultural sector include:

- Changes to weather-dependent planting and harvesting cycles
- Damage to assets and infrastructure from wind, hail and other storm events

Below is a local example where too much rain at the end of the 2021 season prevented the farmer from finishing combining, missing the last hay cut and as a result couldn't plant the winter wheat.



Saturated Fields, 2021, Burlington, Ontario. Photo courtesy of North Aldershot Farmer

- Power outages from extreme weather resulting in inability to use some equipment and loss of communications
- Flooded roadways, fields and farm buildings
- Livestock welfare during extreme weather events and emergency situations

Goal: Support agricultural community in preparing for climate change.

Indicator: TBD through the Agricultural Action Plan

Target: TBD



Maple Park Community Garden, Burlington, Ontario

ID	Action	Action Type	Complete	Cost	City Lead	City Supporting	Community Connections
5-1	<p>Pursue approval to develop a Burlington Agricultural Action Plan that includes a climate lens and considers opportunities to complement partner agency initiatives. Consider actions such as:</p> <ul style="list-style-type: none"> • Supporting the agricultural community in implementing best management practices including improvements to rural drainage • Enhancing monitoring of, and implementing projects to improve water quality • Researching how climate change will impact food crops and other agricultural products and potential opportunities for new crops • Flood management and emergency response planning for livestock • Assessing the cumulative effects of non-agricultural development uses in prime agricultural areas, with respect to preserving agricultural system integrity 	Plan	3-5 years	\$	Community Planning	EICS; Burlington Agricultural and Rural Affairs Committee (BARAAC)	HR; CH; Universities such as U of Guelph; HEN/ Halton Food
5-2	Expand the opportunities to support local food production across the City of Burlington (such as community gardens, rooftop gardens, backyard gardening, etc.)	Partnership	Ongoing	\$	RCC	Engineering Services; Building and Bylaw; RPF	BurlingtonGreen; HEN/Local Food; Food Security Network; Faith Based groups; Community Groups

Related initiatives for each action:

5-1: HR Natural Heritage System; HR Rural and Agricultural Strategy; Halton Food; Urban Eco-Farm Feasibility Study (HEN); Halton Watershed Stewardship Program (CH) ; CH Water Quality and Habitat Improvement Program

5-2: Proposed Parks, Recreation and Cultural Assets Master Plan; Urban Eco-Farm Feasibility Study; Our Food Future Guelph-Wellington

Local Economy

All economies like Burlington’s have foundational building blocks: the workforce, built capital (buildings, infrastructure, equipment) and natural capital (land and raw materials). Climate change can adversely impact all three of these building blocks and in turn the local economy.

Weather and climate conditions can damage assets and infrastructure; present health and safety risks to workers and reduce their productivity; interrupt transport logistics, the supply of raw materials and finished products; disrupt power, fuel and water supply; hinder access to markets, reduce sales, and increase the cost of doing business; and create other indirect impacts that cascade across sectors and through the local, regional and national economy.

The local economy does not function in isolation – its success depends on a system of interrelated networks (workforce, transportation, supplies

and products) within and beyond Burlington that can be adversely affected by climate change increasing risks to businesses. Prosperous communities depend on a successful and stable local economy for goods, services and livelihoods. Communities become vulnerable when their economic base is damaged or disrupted by extreme weather events. Building a climate resilient economy and resilient communities thus goes hand in hand.

Goal: Support and develop resilient local supply chains to help withstand impacts associated with extreme climate events outside of Burlington.

Indicator: Number of new local supply chain partners

Target: 10 by 2032

Indicator: Number of new products piloted

Target: 10 by 2032

ID	Action	Action Type	Complete	Cost	City Lead	City Supporting	Community Connections
5-3	Assess the feasibility of sourcing and providing preference to local suppliers in contracts to increase resilience with supply chain disruptions	Assessment	3-5 years	\$	Burlington Economic Development	Finance	Halton Region
5-4	Investigate the feasibility to develop a business innovation ecosystem where locally developed products can be tested to encourage the development of local supply chains and innovative products	Assessment	3-5 years	\$	Burlington Economic Development	City Manager's Office; Finance	Burlington Chamber of Commerce; Invest Burlington; Halton Community Benefits Network; Sustainability Leadership

HOW WILL WE MANAGE THE CRB?

Implementation and Governance

Success of CRB will require the support of key stakeholders who helped shape the vision, principles, and actions. Visible sponsorship from the Strategic and Risk Team, Burlington Leadership Team and City Council will aid greatly in implementing the CRB plan.

Implementation of individual actions are the responsibility of the lead department identified. Environment, Infrastructure and Community Services (EICS) will play a coordination role, monitor data, and report on collective action and progress towards the goals of CRB. EICS will also support the integration of the CRB plan into future City strategic and corporate plans and initiatives.

Monitoring and Evaluation

Monitoring and evaluating CRB implementation is key to ensuring its efficacy and success. An initial list of indicators has been identified to measure the goals of CRB. Progress against these indicators will assist the City in determining the success of CRB, if additional resources are needed to achieve the goals, and where adjustments to the CRB may be needed.

Indicators will be assessed by EICS staff and, if necessary, modified with progress being publicly reported on an annual basis.

Plan Renewal

CRB will be reviewed and updated by the City every five years. This process will include:

- An update on progress to date;
- Revision or addition of actions as needed;
- Integration of any new or updated climate projections and risks; and,
- Alignment with updated City policies and guidance documents.

Funding

Adequate funding will need to be secured to implement the actions in CRB. Cost estimates have been provided in the action tables and will inform

future business planning. Additional staff to support overall coordination and implementation of CRB is likely required. Adaptation actions are not necessarily stand-alone actions, as many actions are part of other initiatives which may require incremental adjustments to budgets. Potential external funding sources should be leveraged where possible.

Citizen Action and Engagement

CRB is the City's first climate adaptation plan, which helps to frame and focus future citizen conversations. Many of the actions will include public engagement during implementation. In the spirit of collective action, a checklist of citizen actions is provided in [Appendix C](#).



HOW WILL WE MEASURE SUCCESS?

Monitoring of climate adaptation progress is critical but it can become overly complex involving diverse types of actions, multiple climate hazards, actions across all City departments and collaboration with many community stakeholders. Although indicators could be selected for each action, the City

has selected a subset of indicators that are realistic and manageable to report on annually while still providing an overall indication of their progress. The City should remain flexible to adjust the indicators to align with rapidly evolving national and international reporting requirements.

Theme and Goals	Indicators and Targets
Theme 1: Resilient Built and Natural Infrastructure	
<p>Manage infrastructure to prepare for future climate conditions and carbon neutral goals.</p> <p>Enhance resilience of infrastructure exposed to high flood risk.</p> <p>Invest in proactive measures to prepare for increased extreme events to avoid post-storm reactive costs.</p>	<ul style="list-style-type: none"> Percentage of prioritized asset categories that have been assessed for future climate impacts; Target: 100% by 2032 Percentage of City with future climate informed flood mapping for creeks; Target: 95% by 2027 Percentage critical infrastructure exposed to high flood risk; Target: Decreasing long term Dollars spent on emergency response and recovery actions from extreme events by type and severity; Target: Decreasing long term trend
Theme 2: Thriving Natural Environment	
<p>Reduce damage to trees while increasing the value of the services they provide.</p> <p>Value, conserve and enhance the multiple services that natural areas provide.</p>	<ul style="list-style-type: none"> Number of major limb failures and catastrophic tree failures per storm, per year; Target: Decreasing long term trend Percentage of tree canopy cover; Target: 35% by 2041 Dollars spent on green infrastructure projects; Target: Increase TBD through Biodiversity Plan; Target: TBD
Theme 3: Health and Well-Being	
<p>Provide City services to support the community during extreme heat events.</p>	<ul style="list-style-type: none"> Number of aquatic facilities (pools, misters and splash pads) per 10,000 residents; Target: TBD through Parks Master Plan Percentage of community within walking distance to a public space cooling facility; Target: 100% by 2035
Theme 4: Disaster Resilience	
<p>Build capacity in the community to prepare for and respond to more extreme events and long-term climate stresses.</p> <p>Encourage climate adaptation actions from citizens and businesses.</p>	<ul style="list-style-type: none"> Percentage of urban area connected to a resilience hub within walking distance (15 minutes); Target: 100% by 2040 Key locations for rural resilience hubs established; Target: Two by 2032 Uptake of citizen and business climate adaptation support programs; Target: Increase
Theme 5: Strong and Resilient Economy	
<p>Support agricultural community in preparing for climate change.</p> <p>Support and develop resilient local supply chains to help withstand impacts associated with extreme climate events outside of Burlington.</p>	<ul style="list-style-type: none"> TBD through the Agricultural Action Plan; Target: TBD Number of new local supply chain partners; Target: 10 by 2032 Number of new products piloted; Target: 10 by 2032

REFERENCES

- (1) City of Burlington (2022). [Climate Resilient Burlington Engagement Report](https://burlington.ca/environment) prepared by Associated Engineering and All One Sky Foundation. <https://burlington.ca/environment>
- (2) IPCC, Climate Change (2007). [Working Group I: The Physical Science Basis](http://www.ipcc.ch/publications_and_data/ar4/wg1/en/faq-3-2.html). http://www.ipcc.ch/publications_and_data/ar4/wg1/en/faq-3-2.html
- (3) Insurance Bureau of Canada (IBC) (2021). Facts Book, PCS, CatIQ, Swiss Re, Munich Re & Deloitte. [Image of insured catastrophic losses in Canada](http://www.abc.ca/on/resources/media-centre/media-releases/severe-weather-in-2021-caused-2-1-billion-in-insured-damage) from: <http://www.abc.ca/on/resources/media-centre/media-releases/severe-weather-in-2021-caused-2-1-billion-in-insured-damage>
- (4) McAllister, T.P. (2013). Developing Guidelines and Standards for Disaster Resilience of the Built Environment: A Research Needs Assessment, NIST TN 1795, National Institute of Standards and Technology, Gaithersburg, MD, 20899.
- (5) City of Burlington (2021). [Climate Impacts Story Map](https://burlington.ca/environment). <https://burlington.ca/environment>
- (6) City of Burlington (2021). [Climate Projections for Burlington Region](https://burlington.ca/environment) prepared with Town of Oakville and ICLEI Canada. <https://burlington.ca/environment>
- (7) City of Burlington (2021). [Climate Change Vulnerability and Risk Assessment Report](https://burlington.ca/environment) prepared by Associated Engineering and All One Sky Foundation. <https://burlington.ca/environment>
- (8) Financial Accountability Office (FAO) of Ontario (2021). [Costing Climate Change Impacts to Public Infrastructure](https://www.fao-on.org/en/Blog/Publications/cipi-buildings). Assessing the financial impacts of extreme rainfall, extreme heat and freeze-thaw cycles on public buildings in Ontario. <https://www.fao-on.org/en/Blog/Publications/cipi-buildings>



Brant Street Pier, Burlington, Ontario

APPENDIX A: STAKEHOLDER LIST

Stakeholder Engagement Workshop Summary

Name	Workshop	Description
Vulnerability and Risk Assessment	1A	Review draft impact statements and define climate drivers and thresholds for assessment.
	1B	Using the pre-defined scales, separately assess the City's sensitivity and coping capacity to each impact statement.
	2A	Introduce the risk assessment process and assess consequences of the impact statements.
	2B	Continue the assessment of consequences of the remaining impact statements.
Adaptation Strategic Direction	3A	Develop a vision statement and principles to guide the adaptation plan.
	3B	Develop a series of themes to group and focus actions. Determine goals and potential indicators for each theme.
Action Identification	4A	Infrastructure: action identification and alignment to existing initiatives.
	4B	Natural Environment: action identification and alignment to existing initiatives.
	4C	Energy and Water Supply: action identification and alignment to existing initiatives.
	4D	Community Services and Public Health: action identification and alignment to existing initiatives.
	4E	Operations and Maintenance: action identification and alignment to existing initiatives.
	4F	Business and Economy: action identification and alignment to existing initiatives.
Action Implementation	5A	Action prioritization using a multi-criteria framework (cost-benefit).
	5B	Further defining the priority actions including roles and responsibilities and order of magnitude cost estimates.
	5C	Develop implementation sequencing and timeframes for priority actions and develop monitoring and reporting requirements.

Stakeholder List

Name	Department	Workshop														
		1A	1B	2A	2B	3A	3B	4A	4B	4C	4D	4E	4F	5A	5B	5C
City Stakeholders																
Jackie Murphy	Building and Bylaw	•	•		•	•	•	•	•	•	•	•				•
Jeff Crowder	City Manager's Office			•	•	•		•		•		•	•	•		•
Alison Enns	Community Planning	•				•				•	•		•	•		•
Laura Ross	Community Planning		•	•	•										•	
John Stuart	Community Planning															•
Chitra Gowda	Conservation Halton, Planning and Watershed Management (external agency)	•	•	•	•	•	•	•	•		•		•			
Kim Barrett	Conservation Halton, Planning and Watershed Management (external agency)	•	•	•	•		•	•	•				•	•		•
Cecilia Essien	Corporate Legal Services	•														
Ingrid Vanderbrug	Engineering Services	•	•	•	•	•	•		•						•	•
Amy Daca	Engineering Services	•	•	•	•	•	•	•	•				•	•	•	•
Umar Malik	Engineering Services	•	•	•	•	•		•			•					•
Emily Linschoten	Engineering Services						•		•	•	•	•		•		
Ken Pirhonen	Environment, Infrastructure and Community Services (EICS)		•					•								
Paul Swioklo	EICS	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Fleur Storce-Hogan**	EICS (CRB Project Manager)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Lynn Robichaud	EICS	•	•		•	•	•	•	•	•	•	•	•	•	•	•
Ellen Chen	Finance	•	•					•						•		•
Amber Rushton	Fire				•		•	•	•							
Samantha Thompson	Halton Region, CAO's office (external agency)	•	•	•	•	•	•	•			•					
Lisa Kohler	Halton Region, CAO's office (external agency)															•
Matt Girodat	Human Resources		•	•	•	•	•		•	•	•		•	•	•	•
Denise Beard	Recreation, Community and Culture		•	•	•			•	•		•		•			•
Matt Koevoets	Roads, Parks and Forestry (RPF)			•		•	•									•
Steve Robinson	RPF	•	•		•			•	•	•	•				•	
Kyle McLoughlin	RPF			•												
Nadia Blackburn	RPF	•											•			
Kaylan Edgcumbe	Transportation	•														
Nicholas Pongetti	Transportation		•	•	•	•	•					•		•		
Steve Vrakela	Transportation											•				

** Project Manager for the Climate Resilient Burlington project.

Stakeholder List

Name	Department	Workshop														
		1A	1B	2A	2B	3A	3B	4A	4B	4C	4D	4E	4F	5A	5B	5C
Community Stakeholders																
Bala Gnanam	BOMA (Building Owners and Managers Association) Canada	•	•		•					•		•	•			
Kelly Cook	Burlington Agricultural and Rural Affairs Advisory Committee (BARAAC), staff liaison				•								•		•	
Anita Cassidy	Burlington Economic Development									•			•			
Marwa Selim	BurlingtonGreen Environmental Association	•	•	•	•	•	•	•							•	•
Amy Schnurr	BurlingtonGreen Environmental Association								•							•
Christine Hallas	Burlington Hydro Inc.	•		•	•		•	•		•					•	•
Paul Fletcher	Burlington Sustainable Development Advisory Committee								•	•	•			•		
Anne Hammill	Burlington Sustainable Development Advisory Committee					•	•								•	
Emily Vis	Centre for Climate Change Management at Mohawk College		•	•		•						•				
Kate Flynn	Centre for Climate Change Management at Mohawk College	•														
Mike Nixon	Community Development Halton	•	•					•	•			•			•	•
David Dyer	Enbridge Gas	•	•	•	•		•	•	•	•	•	•	•	•	•	•
Andrea Rowe	Halton Environmental Network															•
Stephanie Bush	Halton Environmental Network		•		•											
Lisa Kohler	Halton Environmental Network						•	•	•				•			
Kyle Perdue	Ministry of Transportation	•	•	•	•	•	•	•	•	•	•		•	•		•
Chris McAnally	Royal Botanical Gardens	•	•	•	•	•	•	•	•	•		•		•		•
Rafiq Dhanji	Sustainability Leadership	•	•	•								•	•			•
Vivien Underdown	United Way Halton and Hamilton	•	•	•	•		•		•	•	•					•
Michelle Diplock	West End Home Builders' Association	•		•	•	•	•			•			•	•		•
Tom Hilditch	West End Home Builders' Association		•													

APPENDIX B: CRB ACTION HAZARD SUMMARY

Theme	Subgroup, Action ID	High Winds	Shifting Ecoregion	Freezing Rain	Wet Conditions	Water Quality (algal blooms)	Heavy Snowfall	Vector-Borne Disease	Extreme Heat	Cooling Demand	Freeze-Thaw Cycles	Late Spring Frost	High Water Levels (Lake Ontario)	Stormwater Flooding	Mismatched Timing of Plant & Animal Lifecycles	Air Quality	Invasive Species and Pests	Creek Flooding	
Theme 1: Resilient Built and Natural Infrastructure	Infrastructure Design and Life Cycle Management																		
	1-1	✓		✓	✓		✓		✓	✓	✓		✓	✓		✓	✓	✓	
	1-2	✓		✓	✓		✓		✓	✓	✓		✓	✓		✓	✓	✓	
	1-3	✓		✓	✓	✓	✓		✓	✓	✓		✓	✓		✓		✓	
	Flood Management																		
	1-4	✓		✓		✓								✓	✓				✓
	1-5			✓															✓
	1-6			✓										✓	✓				✓
	1-7			✓										✓	✓				✓
	Service Disruption																		
	1-8	✓		✓	✓		✓					✓		✓	✓				✓
	1-9	✓		✓			✓		✓										
	1-10	✓		✓	✓		✓		✓	✓	✓				✓				✓
1-11	✓												✓						
1-12	✓		✓			✓				✓									
1-13	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓		✓	✓	✓	
Theme 2: Thriving Natural Environment	Tree Management																		
	2-1	✓	✓	✓			✓		✓				✓			✓	✓	✓	
	2-2	✓	✓	✓	✓		✓		✓				✓		✓	✓	✓	✓	
	2-3	✓	✓	✓	✓		✓		✓				✓		✓	✓	✓	✓	
	Natural Area Management																		
2-4		✓		✓	✓			✓	✓			✓	✓	✓	✓	✓	✓	✓	
2-5		✓		✓								✓		✓	✓	✓	✓	✓	

Theme	Subgroup, Action ID	High Winds	Shifting Ecoregion	Freezing Rain	Wet Conditions	Water Quality (algal blooms)	Heavy Snowfall	Vector-Borne Disease	Extreme Heat	Cooling Demand	Freeze-Thaw Cycles	Late Spring Frost	High Water Levels (Lake Ontario)	Stormwater Flooding	Mismatched Timing of Plant & Animal Lifecycles	Air Quality	Invasive Species and Pests	Creek Flooding	
Theme 3: Health and Well-Being	Extreme Heat and Health																		
	3-1 Cooling for vulnerable populations								✓	✓							✓		
	3-2 Public space cooling								✓	✓							✓		
	3-3 Urban heat island assessment								✓	✓							✓		
	3-4 Indoor temperature thresholds for hot weather								✓	✓							✓		
	3-5 Public shade, water play and hydration								✓	✓							✓		
Theme 4: Disaster Resilience	Community Capacity Building																		
	4-1 Emergency notification and communications	✓		✓	✓	✓	✓		✓	✓	✓		✓	✓		✓		✓	
	4-2 Community climate resilience education	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	4-3 Social resilience programs	✓		✓	✓		✓		✓	✓	✓			✓		✓		✓	
	Citizen and Business Support Programs																		
	4-4 Home and business retrofit programs	✓		✓	✓		✓		✓	✓				✓		✓		✓	
4-5 Stormwater management practices				✓	✓								✓					✓	
Theme 5: Strong and Resilient Economy	Agriculture																		
	5-1 Agriculture action plan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
	5-2 Local food production	✓		✓	✓				✓			✓		✓				✓	✓
	Local Economy																		
	5-3 Feasibility of preference to local suppliers	✓		✓	✓		✓							✓					✓
5-4 Feasibility of business innovation ecosystem		✓			✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

APPENDIX C: CITIZEN ACTION CHECKLISTS

Home Investment	Flooding/ Wet Conditions	High Winds	Freezing Rain	Extreme Heat/ Dry Conditions	Extreme Cold/ Heavy Snow	Reduced Biodiversity
<input type="checkbox"/> Obtain home and auto insurance for extreme events	✓	✓	✓	✓	✓	
<input type="checkbox"/> Install and perform regular maintenance on backup power equipment	✓	✓	✓	✓	✓	
<input type="checkbox"/> Install energy-efficient windows and shades to retain and block heat				✓	✓	
<input type="checkbox"/> Install windows with exterior screens to reduce fatal bird collisions with glass						✓
<input type="checkbox"/> Install and perform regular maintenance of air conditioning units				✓		
<input type="checkbox"/> Remove or trim existing trees that overhang houses, garages or sheds (check private tree bylaw first)		✓	✓			
<input type="checkbox"/> Install and perform regular maintenance on sump pump and backup sump pump and backup power source (in locations of high groundwater)	✓					
<input type="checkbox"/> Reduce risk of sanitary sewer backup by installing and regularly cleaning out a backwater valve as well as disconnecting downspouts and weeping tile from the sanitary sewer system and re-directing the weepers to a sump pump and discharging the sump pump overland	✓					
<input type="checkbox"/> Improve drainage on property without affecting neighbouring properties, such as ground sloping away from the house, downspouts and sump pump discharges 2 m away from the house	✓					
<input type="checkbox"/> Reduce hard surfaces such as driveways or decks and use alternate methods such as permeable pavement	✓					
<input type="checkbox"/> Move electrical and mechanical equipment/switches out of the basement (or elevate if in the basement)	✓					
<input type="checkbox"/> Install water-resistant basement flooring such as tile, concrete or vinyl	✓					
<input type="checkbox"/> Check floodplain/hazard mapping before purchasing a new home	✓					

Resources



Burlington.ca

Home Flood Protection Assessments
Plumbing Permit Fee Grant Program



Halton.ca

Guide to Flooding Prevention and Recovery
Enhanced Basement Flooding Prevention Subsidy Program



HomeFloodProtect.ca

Three Steps to Cost-Effective Home Flood Protection



ConservationHalton.ca

Natural Hazards
Climate Change
Stewardship

Good Habits	Flooding/ Wet Conditions	High Winds	Freezing Rain	Extreme Heat/ Dry Conditions	Extreme Cold/ Heavy Snow	Reduced Biodiversity
<input type="checkbox"/> Check on your neighbours to ensure that they are safe during extreme weather events	✓	✓	✓	✓	✓	
<input type="checkbox"/> Create a healthy and environmentally friendly yard by selecting the right plants for your garden and learning proper maintenance tips to attract pollinators				✓		✓
<input type="checkbox"/> Reduce outdoor water use by collecting and using rain water, choosing drought-resistant plant species, and directing downspouts on your property 2 m away from your foundation and towards your vegetated areas	✓			✓		✓
<input type="checkbox"/> Maintain landscaping and/or gardens to promote biodiversity such as keeping grass at least 2” long and leave grass cuttings/leaves on the lawn						✓
<input type="checkbox"/> Plant drought-resistant trees to provide shade but keep away (10-20 ft) from houses, garages, and sheds				✓		✓
<input type="checkbox"/> Check with a professional to see if your new tree needs to be supported in the early years based on the site (high wind area), the tree (bare root, loose root ball), etc.		✓	✓			✓
<input type="checkbox"/> Remember to water your new trees in times of drought				✓		✓
<input type="checkbox"/> Perform regular pruning of existing trees by removing damaged and weak branches and keeping away from houses, sheds and garages		✓	✓			✓
<input type="checkbox"/> Delay putting garbage/recycling containers outside until 7 a.m. on collection day		✓				
<input type="checkbox"/> Support vulnerable neighbours by assisting in snow/ice removal to allow for personal mobility and critical deliveries or pick-ups			✓		✓	
<input type="checkbox"/> Keep roadway catch basins near property free of debris/ice/snow	✓		✓		✓	
<input type="checkbox"/> Clear gutters to ensure proper drainage	✓				✓	
<input type="checkbox"/> Keep valuables out of the basement	✓					
<input type="checkbox"/> Store vehicles and outdoor items in the garage during extreme events		✓	✓		✓	

Resources



Burlington.ca

- Extreme Weather Alerts
- Cooling Centres – Burlington Public Libraries
- Emergency Preparedness



Halton.ca

- Today’s Air Quality
- Emergency Preparedness
- Woodlands Stewardship Program
- Beach Water Monitoring
- Cold Warnings and Heat Warnings
- West Nile Virus and Lyme Disease



weather.gc.ca/warnings/

“EC Alert Me” Extreme Weather Condition Notifications



conservationhalton.ca

- Healthy Neighboursheds
- Water Quality and Habitat Improvement Program