

PRACTICE GUIDE

CLIMATE CHANGE ADAPTATION





The Ontario Professional Planners Institute (OPPI) is the recognized voice of Ontario's planning profession with over 5,000 members who work in government, private practice, universities, and not-for-profit agencies in the fields of urban and rural development, community design, environmental planning, transportation, health, social services, heritage conservation, housing, and economic development. Members must meet specific practice requirements and are accountable to OPPI and the public to practice ethically and to abide by a Professional Code of Practice. Only full OPPI members are authorized by the Ontario Professional Planners Institute Act, 1994, to use the title Registered Professional Planner (or RPP). This work is guided by public interest and includes considering where people live, work, go to school, and spend their free time. In Ontario, the planning process involves many professions, but Registered Professional Planners (RPPs) are the only experts with the training necessary to balance short-term and long-term public needs and are duty bound to advocate for the needs of the community. Their goal is to create communities where people want to live.

ontarioplanners.ca

info@ontarioplanners.ca



The Ontario Resource Centre for Climate Adaptation (ORCCA) supports Great Lakes communities and Ontario users in adapting to climate change and building resilience. As part of a national climate services network, ORCCA provides municipalities and leaders with information and supports to enhance climate resilience across the Great Lakes basin and Ontario. This pilot initiative, led by ICLEI Canada, is funded by the Ontario Ministry of the Environment, Conservation, and Parks and alongside financial support through the federal Department of Environment and Climate Change Canada.

orcca-craco.ca

orcca.craco@iclei.org



The Climate Risk Institute (CRI) is a non-profit, academically affiliated organization focused on advancing practice and delivering services related to climate change risk assessment, adaptation planning, policy evaluation and resiliency. We run programs and develop and coordinate projects to mobilize knowledge, improve capacity, and deliver results for climate resiliency. CRI works with all levels of government, Indigenous communities, and private sector organizations to support the consideration of climate change in various planning and management processes, including enterprise risk management, hazard identification and risk assessment, corporate planning, infrastructure renewal and official plan development. We were very pleased to work with ORCCA and OPPI in the development of this practice guide.

climateriskinstitute.ca

info@climateriskinstitute.ca





CLIMATE CHANGE ADAPTATION

PRACTICE GUIDE

This resource was developed by the Ontario Professional Planners Institute and the Climate Risk Institute through the Ontario Resource Centre for Climate Adaptation.

CONTENTS

6 INTRODUCTION

7 ABOUT THIS GUIDE

8 PRACTICE GUIDE STRUCTURE

9 KEY TERMS

10 CLIMATE CHANGE AND PLANNING

12 CLIMATE EQUITY

13 LEGISLATIVE REQUIREMENTS AND ENABLING POLICIES

15 CLIMATE HAZARDS AND ADAPTATION PLANNING

CLIMATE CHANGE IN ONTARIO

FLOODING

EXTREME HEAT

DROUGHT

SHORELINE IMPACTS

WILDFIRE

**23 PLANNING INTERVENTIONS SUPPORTING
CLIMATE ADAPTATION**

CLIMATE VULNERABILITY AND RISK ASSESSMENTS

CLIMATE ADAPTATION PLANS

OFFICIAL PLAN POLICIES

DEVELOPMENT REVIEW PROCESS

URBAN DESIGN GUIDELINES

GREEN DEVELOPMENT STANDARDS

SUSTAINABLE DEVELOPMENT CHECKLISTS

SHORELINE MANAGEMENT PLANS

FLOOD MAPPING

NATURAL ASSET MANAGEMENT

60 CONCLUSION

61 RESOURCE GUIDE

67 ACKNOWLEDGEMENTS



INTRODUCTION

Effective land use and community planning that integrates climate change considerations is essential for creating climate-resilient communities. Planning is a diverse field that spans government, the private sector, and academia, involving municipal departments, Conservation Authorities, public health organizations, research institutions, and more. Planners play a critical role in shaping communities that can withstand the impacts of climate change across Canada, as extreme weather events, flooding, heatwaves, and other climate-related threats are projected to intensify.

Across Ontario, municipalities and other actors, including Conservation Authorities and public health agencies, are already striving to build

climate-resilient communities and regions through land-use planning and development. Given the diverse needs and capacities of communities across Ontario, locally tailored approaches to climate change adaptation are required. While planners in larger or mid-sized cities like Mississauga or Kitchener focus on large-scale infrastructure and policy changes, rural and northern communities often invest in developing context-specific solutions that leverage natural features and local knowledge to address climate hazards.

Increasingly, various planning tools and interventions are being used to help address the impacts and reduce the risks of climate-related hazards.



ABOUT THIS GUIDE

This practice guide showcases a range of innovative planning tools and interventions designed to effectively reduce the risks posed by various climate hazards. It serves as a reference for inspiration and ideas.

The guide contains information and key concepts to support adaptation planning and interventions across various community and service area

contexts. It provides case studies highlighting the use of established planning methods to build climate resilience in ways that resonate with the priorities and needs of communities.

The highlighted interventions illustrate the adaptability of planning tools across diverse municipal, organizational, and agency contexts, emphasizing their relevance for planning professionals.

The guide contains information and key concepts to support adaptation planning and interventions across various community and service area contexts. It provides case studies highlighting the use of established planning methods to build climate resilience in ways that resonate with the priorities and needs of communities.



PRACTICE GUIDE STRUCTURE

This guide includes four main sections to help planners understand and apply planning interventions to foster more climate resilient communities:

- **Climate Change and Planning:** This section relates planning practices to climate change adaptation and identifies the legislative framework and enabling policies for adaptation planning in Ontario.
- **Climate Hazards and Adaptation Planning:** This section provides an overview of key climate hazards worsened by climate change and related adaptation planning measures that can be considered to manage associated risks.
- **Planning Interventions Supporting Climate Adaptation:** This section provides an overview of specific interventions planners can use to advance adaptation, including case studies that

illustrate how these interventions have been successfully implemented across Ontario.

- **Resource Guide:** This section includes a curated collection of resources intended to support planners in applying the information in this guide.

Using this guide, Ontario planners can draw valuable insights from climate actions undertaken elsewhere in the province. By analyzing how these strategies align with the local priorities, demographics, and environmental conditions, communities can build on existing successes while tailoring solutions to their specific challenges. This approach leverages the strength of established methods while empowering communities to create interventions that resonate with their values and needs, maximizing both impact and sustainability.



KEY TERMS

Adaptive Capacity: The ability of built, natural, and human systems to withstand climatic changes with minimal disruption or cost.

Climate Change: A persistent, long-term change in the state of the climate, measured by changes in the average conditions or variability. Climate change can result from natural processes, such as volcanic eruptions or solar activity, or from human activities, like greenhouse gas emissions and land-use changes.

Climate Change Adaptation: The process of adjusting to actual or expected changes in the climate and their impacts. Adaptation can involve actions like modifying behaviors, changing operations, using new technologies, redirecting investment, or updating policies to reduce risks and take advantage of opportunities created by a changing climate.

Hazards: A biophysical event (e.g., drought, rain, or wind) that could cause harm, damage, or adverse effects to people, property, or the environment.

Impacts: The effects of existing or forecast changes in climate on built, natural, and human systems, i.e., the effects of climate change on lives, livelihoods, health,

ecosystems, economies, societies, cultures, services, and infrastructure.

Resilience: The capacity of social, economic, and environmental systems to cope with and recover from disruptions caused by climate events or trends. Resilient systems maintain their essential functions and adapt, learn, and improve to better handle future challenges.

Risk: The combination of the likelihood of an event occurring and its negative consequences. What is considered risk can vary based on diverse values and perspectives, as different people and communities prioritize different assets, needs, or goals.

Social Determinants of Health: The social and economic factors that characterize and influence individual living conditions, such as income, education or employment, housing status, and the nature of the physical environment in which they reside.

Vulnerability: The degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change. Vulnerability depends on the character, magnitude, and rate of climate variation to which a system is exposed, and its ability to adapt.



CLIMATE CHANGE & PLANNING



CLIMATE CHANGE AND PLANNING

Climate change adaptation planning can augment existing policies, regulations, and strategic plans and be integrated across all sectors of development. This integration improves disaster risk reduction, ecosystem protection, infrastructure resilience, health outcomes, and equity concerns.

Good climate adaptation planning practices integrate a range of lenses, including:

1. Cross-sector collaboration with Indigenous rights holders, communities, and impacted parties for coordinated adaptation.
2. Equitable engagement, incorporating Indigenous ways of knowing and lived experiences of equity-denied groups to embed equity and ensure meaningful participation.
3. Minimizing risks by avoiding development in hazardous areas (e.g., floodplains) and investing in infrastructure and resources to support adaptation.

4. Fostering the development of climate-resilient infrastructure and urban form.
5. Supporting nature-based solutions and low-carbon development.
6. Ensuring access to essential services like emergency shelter spaces, clean water, and transportation in the event of a major climate event.

These actions align with OPPI's Professional Code of Practice, which states that planners have a responsibility to serve the interests of the public. Climate-resilient planning is crucial in reducing the negative impacts of climate change while improving community safety and quality of life.

CLIMATE EQUITY


Planners play a key role in the way that communities are designed and the experiences of people who live in them. Equity in planning requires us to consider the alignment of policy and process to ensure just and inclusive access to opportunities, power, and resources, regardless of age, ability, gender, income, education level, culture, or socioeconomic status.

No population or community is inherently more affected by the impacts of climate change than the next; rather, some will be more significantly impacted because of systemic and structural factors - like poverty, marginalization, racism, and colonialism - which can put them more in harm's way and make it more difficult to recover once affected.

Therefore, planners have a responsibility to leverage the latest information about climate change and work with communities to manage climate-related risks through collaborative and evidence-based adaptation planning that reflects the social and historical context we work in.

The Planning profession's historical practices, including exclusionary zoning and urban renewal projects, have created or exacerbated community inequities, resulting in segregated neighborhoods, displacement, and disproportionately high exposure to climate hazards. **Planners** have an opportunity to make meaningful change through the work of climate adaptation, which intersects with housing, transportation, infrastructure, public health, environmental conservation, and myriad other fields that planners work in.

When taking inspiration from the examples and case studies in this guide, planners should consider their role to serve the public interest and incorporate an equity-oriented approach to enhance outcomes and build towards greater community and interdisciplinary collaboration in all aspects of climate adaptation work. For more information and examples of frameworks to incorporate climate equity, please refer to the **Resource Guide** section.



READ

BEYOND INCLUSION: EQUITY IN PUBLIC ENGAGEMENT

(Simon Fraser University, 2020)

Beyond Inclusion details eight principles to guide the meaningful and equitable inclusion of diverse voices when planning and implementing public engagement initiatives to inform decision-making processes.

These principles can be utilized by planners undergoing adaptation work to enhance equitable access to public engagement and develop strategies that reduce vulnerability and strengthen adaptive capacity of equity-denied populations and communities.

To build equitable climate resilience, planners must recognize the historical inequities that have led to the disproportionate impacts of climate change on equity-denied populations and communities. Planners should actively engage with these diverse communities, listen to their needs, and incorporate their voices into the decision-making process. By prioritizing climate equity and sustainability, the planning profession can create tailored solutions and more equitable and resilient communities for all.



LEGISLATIVE REQUIREMENTS AND ENABLING POLICIES

In Ontario, a wide variety of provincial planning legislation, policies, and regulations play a critical role in addressing climate change by guiding land use planning and decision-making at all levels of government. The key legislation related to climate change in community development and planning is summarized below. Together, these Acts and policies provide a framework for integrating climate mitigation and adaptation to support sustainable, resilient communities.

Planning Act: Governs land use planning in Ontario and requires municipalities to integrate climate change considerations into official plans and decision-making processes.

Provincial Planning Statement, 2024: Replaces the Provincial Policy Statement and Growth Plan, focusing on sustainable development, climate resilience, and greenhouse gas emissions reduction.

Municipal Act, 2001: Establishes rules for municipalities in Ontario and grants them their authorities through this legislation. It codifies climate considerations within municipal legislative authority, allowing municipalities to pass bylaws for environmental protection and conservation and to participate in long-term energy planning.

Environmental Bill of Rights, 1993: Empowers citizens to participate in environmental decision-making and mandates the integration of environmental and climate change considerations in government decisions affecting the environment.

Ontario Climate Change Adaptation and Resilience Act, 2024: Establishes a provincial framework for addressing climate risks, including measures for adaptation and resilience in community planning.



Conservation Authorities Act, 1990: Enables Conservation Authorities to manage natural resources, protect watersheds, and implement programs addressing natural hazards management, including flooding, erosion, drought, and climate resilience.

Environmental Protection Act, 1990: Provides a framework for regulating activities that could harm the environment, including measures for mitigating and adapting to climate change impacts.

Clean Water Act, 2006: Protects drinking water sources, addressing vulnerabilities exacerbated by climate change, such as droughts and flooding.

Endangered Species Act, 2007: Protects biodiversity and ecosystems, which are critical for climate resilience.

Greenbelt Act, 2005: Establishes protected areas around urban centres to prevent sprawl, safeguard natural heritage, and support climate resilience.

It is also important for planners to consider the findings of the Ontario Human Rights Commission (OHRC) with regards to climate change, such as the OHRC statement on human rights, extreme heat waves and air conditioning (2022).

Together, these Acts and policies provide a framework for integrating climate mitigation and adaptation to support sustainable, resilient communities.



CLIMATE HAZARDS & ADAPTATION PLANNING



CLIMATE CHANGE IN ONTARIO

The climate is already changing in Ontario. For example, between 1948 and 2016, average temperatures increased by 1.3°C, and total precipitation increased by nearly 10%. Both measured and climate model data indicate increasingly frequent, variable, and severe extreme weather events, with impacts reflected in rising damages and losses tracked by organizations across Ontario and Canada. Ontario has already experienced significant climate impacts from flooding, wildfires, heat waves, ice storms, and many other types of hazard events. Flooding, in particular, has been a significant driver of damages and costs to both the public and private sectors.

The climate will continue to change. Based on historical greenhouse gas emissions alone, the impacts of climate change are expected to become more frequent and severe in Ontario, and globally, for many decades to come.

Effective land use planning plays a critical role in reducing climate-related risks and building resilience. Improved processes, such as incorporating Indigenous knowledge and engaging rights holders and impacted parties, help ensure the development of localized solutions.

The following sections provide an overview of key climate hazards in Ontario and related adaptation planning measures.

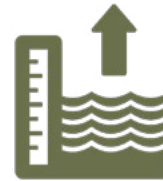
CLIMATE DRIVERS



Higher temperatures



Changing hydrologic patterns



Rising sea levels

HAZARDS



Flooding



Extreme heat events



Drought



Shoreline impacts and erosion



Wildfire

MAJOR IMPACTS



Public health events



Damage to property and infrastructure



Life-threatening events



Loss of biodiversity and impaired natural resources



FLOODING

Flooding, worsened by climate change, is impacting communities across Ontario, regardless of size or geography, through intensified rainfall, rising water levels, and increased storm surges. Planning that does not account for climate change—such as over-development in flood-prone areas or inadequate stormwater management—can amplify flood risk. In contrast, climate-resilient planning can mitigate these impacts by determining land use, infrastructure design, and development patterns that help reduce flood risk and alleviate the effects of flooding when it does occur.

Additionally, upgrading infrastructure to withstand extreme weather, incentivizing sustainable development, and embedding climate adaptation into all planning decisions are essential for creating a safer, more adaptable future.

Managing the increasing risks of flooding in Ontario requires communities, in collaboration with Conservation Authorities, public health agencies, and other relevant partners, to adopt integrated systems and policies, such as modernized stormwater management plans, climate-informed zoning bylaws, and flood mapping.

Adaptation Planning Strategies for Managing Flood Risk:

- Stormwater management plans
- Floodplain mapping
- Extreme weather and precipitation modelling
- Stormwater management upgrades (e.g., storm drains, culverts, retention ponds)
- Increased green coverage, rain gardens, bioswales, permeable pavement (Low Impact Development)
- Natural heritage conservation
- Land use policy and zoning regulations in floodplains and flood-prone areas
- Downspout disconnection
- Sump pump and backwater valve installation



EXTREME HEAT

In Ontario, extreme heat worsened by climate change poses significant challenges, including health risks, strain on energy systems, and diminished urban livability. Compact urban areas with minimal greenery and extensive heat-retaining materials exacerbate heat risks.

Managing the increasing risks of heat events in Ontario requires communities to adopt systems like urban heat mapping and heat-resilient infrastructure planning, along with proactive policies that promote green infrastructure and equitable access to cooling centres and public spaces (e.g., splash pads).

Adaptation Planning Strategies for Managing Extreme Heat Risk:

- Heat mapping
- Natural heritage conservation
- Increased green coverage and tree canopy
- Green development standards, such as climate-resilient materials, green roofs, and landscaping requirements
- Design standards related to building efficiency and heating, ventilation, and air conditioning (HVAC) requirements
- Enhanced public awareness of heat risks
- Improved access to public cooling centres

To adapt, communities must focus on updating building codes to include heat-resilient designs, integrating heat mitigation into zoning policies, implementing requirements for mechanical cooling to address inequities, and enhancing public awareness of heat risks.



DROUGHT

Drought conditions, worsened by climate change, can stress ecosystems, and pose challenges to water quality and quantity, agriculture, and wild-fire management across Ontario. Droughts have become more frequent and severe, particularly in the Great Lakes Basin, where lower water levels during dry periods have affected ecosystems, agriculture, and municipal water supplies. Practices such as over-reliance on limited water resources, inefficient irrigation and other water uses, and sprawling development increase the risks associated with drought.

Reducing the impacts of drought in Ontario requires a shift toward regional approaches, with policies and procedures that enforce conservation-focused planning, encourage sustainable land use, and support community-based water stewardship programs. By embedding climate adaptation into planning processes, Ontario communities can safeguard water resources and strengthen their capacity to thrive in a drier future.

Adaptation Planning Strategies for Managing Drought Risk:

- Water resource management plans
- Drought monitoring systems
- Rainwater harvesting
- Drought-resistant landscaping (xeriscaping)
- Strategies to reduce stormwater runoff, such as bioswales, increased green coverage, and Low Impact Development (LID)
- Community-based resilience initiatives, including rain gardens and tree planting initiatives
- Water reuse policies
- Urban forestry and agriculture plans



SHORELINE IMPACTS

Ontario has experienced significant shoreline impacts linked to climate change, including record-high water levels in the Great Lakes in 2019 and 2020, which caused severe flooding, erosion, and damage to coastal infrastructure. Increased storm intensity and fluctuating water levels, and shrinking ice coverage have exacerbated shoreline erosion, threatening ecosystems, properties, and public access along Lake Ontario and Lake Erie.

Managing the increasing risk of shoreline impacts requires proactive planning that prioritizes sustainable land use, adaptive zoning regulations, and climate-resilient design; to protect communities and ensure long-term ecological and economic stability along Ontario's shores.

Adaptation Strategies for Shoreline Impacts:

- Shoreline erosion and hazard mapping
- Shoreline protection measures (groynes, revetments, seawalls)
- Slope stabilization measures and natural heritage protection
- Zoning and building standards that establish shoreline hazard setbacks
- Managed retreat or realignment of infrastructure and assets

Managing the increasing risk of shoreline impacts requires proactive planning that prioritizes sustainable land use, adaptive zoning regulations, and climate-resilient design.



WILDFIRE

Wildfires fuelled by climate change threaten communities across Ontario by endangering lives, destroying property, and damaging ecosystems. Planning can significantly influence wildfire risks through land use decisions, infrastructure placement, and vegetation management.

Planning that does not consider wildfire risk, such as building near fire-prone forests without proper buffers, increases vulnerability.

Managing the growing risks of wildfire in Ontario requires improved wildfire risk assessments, updated building codes emphasizing fire safety, and land use policies that prioritize defensible spaces. Planning processes should integrate wildfire considerations into community design, enhance emergency response plans, and promote public awareness. Adopting adaptive planning practices will help ensure communities are better prepared to face increasing wildfire threats.

Adaptation Planning Strategies for Managing Wildfires:

- Fire risk mapping
- Official Plan and land use policy development
- Updated building codes, fire-resilient building materials and design
- Fire-resistant landscaping and buffers
- Green and Urban Design Standards
- Integrate Environmental Impact Assessments and wildfire risk assessments into development approval process
- Emergency preparedness planning and public communications

A black and white photograph of a group of cyclists riding away on a tree-lined street. The cyclists are wearing helmets and jackets, and the scene is captured from behind them. The background shows a row of trees and a building in the distance.

PLANNING INTERVENTIONS SUPPORTING CLIMATE ADAPTATION



PLANNING INTERVENTIONS SUPPORTING CLIMATE ADAPTATION

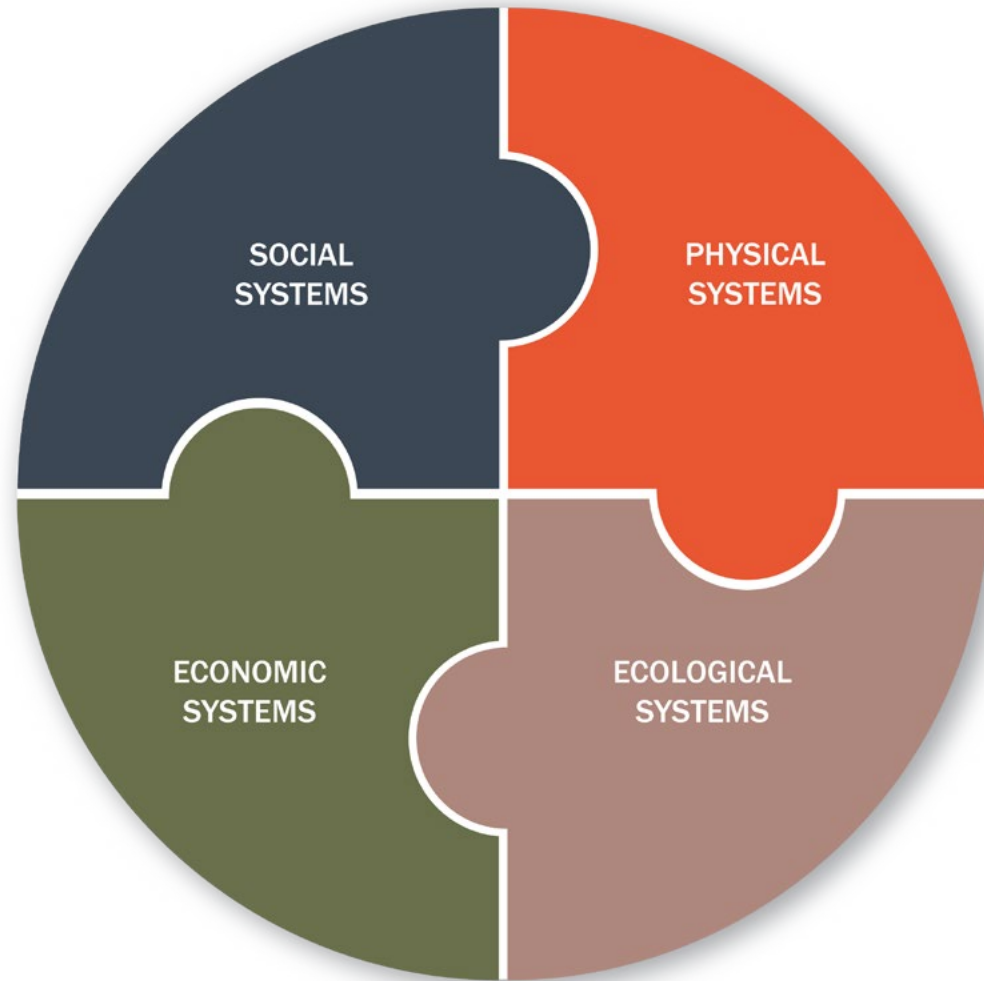
Effective community planning for climate adaptation relies on a strong foundation of data and analysis. Planners play a critical role in identifying the nature, location, and severity of climate-related hazards and assessing their potential impacts on residents, structures, and infrastructure. This information helps shape the development of actionable goals and policies that prioritize community safety and resilience.

Planners have several policy tools and other mechanisms to leverage this data, along with local insights, to craft adaptation strategies. This section of the guide highlights a series of these climate adaptation planning interventions. They can be used to identify critical issues, assess vulnerabilities, and uncover a range of responses across various sectors.

In total, 12 planning interventions are profiled, demonstrating the variety of planning tools that can contribute to adaptation actions. Some of these interventions are typical components of a planner's policy toolkit, such as Secondary Plans, while others are more specific to climate adaptation, such as climate change vulnerability and risk assessments.

Ontario case studies demonstrate how each intervention has been used to drive adaptation action, where applicable. These case studies provide details on how collaboration occurred at the local level, the timelines and resources required, the successes and challenges faced by planners, community impacts, and what's next for each intervention.

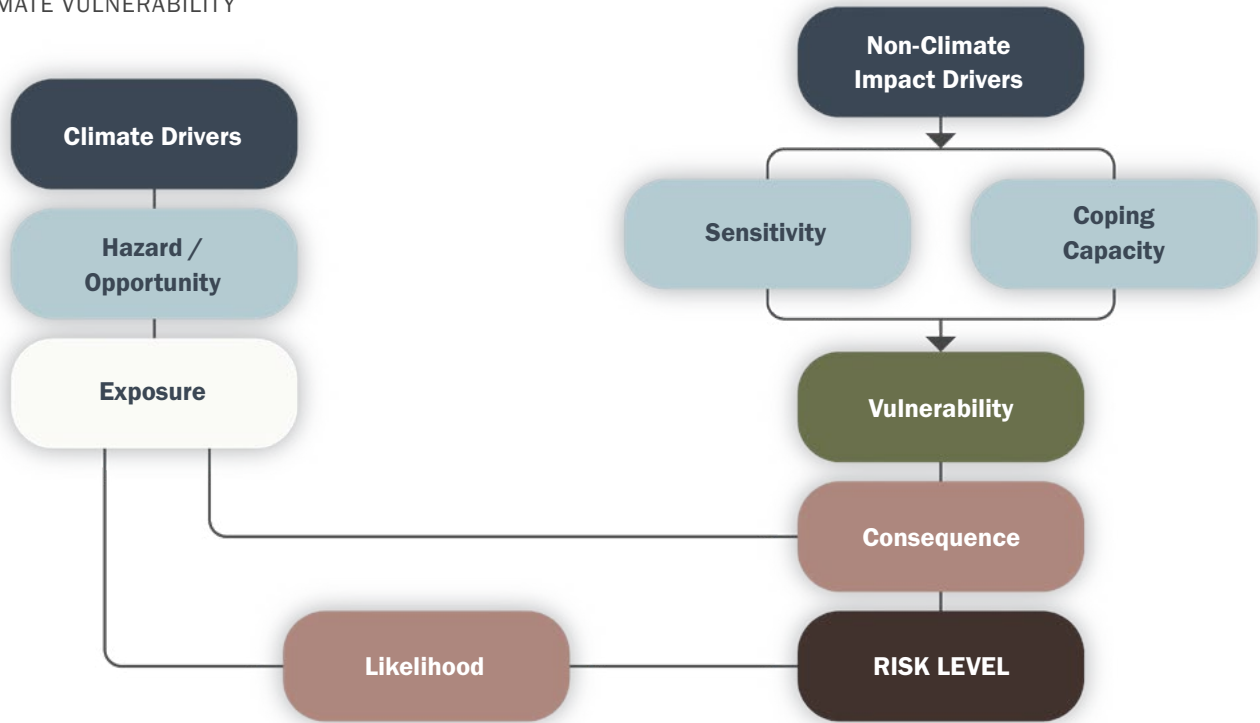
SYSTEMS THINKING



Source: adapted from icleicanada.org, 2019.

Systems thinking reveals the deep interconnections among social, physical, economic, and ecological systems. This holistic approach helps planners anticipate how disruptions in one area can trigger cascading effects across others while also identifying actions that can generate co-benefits across multiple systems. Collaborating with community partners across diverse sectors and groups can help to support systems-thinking by bringing together varied expertise, perspectives, and resources to address complex challenges more effectively and equitably.

PLANNING INTERVENTIONS
CLIMATE VULNERABILITY



“Based on concepts and aspects of ISO 31000: Risk Management – Principles and Guidelines (ISO, 2018); ISO 14091: Adaptation to climate change – Guidelines on vulnerability, impacts and risk assessment (ISO, 2021), as well as the IPCC’s latest conceptualization of climate risk in the AR6 report (IPCC, 2021).”

CLIMATE VULNERABILITY AND RISK ASSESSMENTS

A Climate Vulnerability and Risk Assessment (CVRA) is a tool that provides a localized perspective on climate risk. It generally incorporates both quantitative and qualitative data related to a range of climate hazards, considers the vulnerabilities of potentially exposed people and systems, and assesses the associated risks. CVRAs serve as the foundation for evidence-based approaches to climate change adaptation planning.

CVRAs help planners make informed decisions about where to prioritize action—based on which sectors, communities, or populations are most at risk—and determine which adaptation strategies may be most effective. *The Canadian Council of Ministers of the Environment’s Guidance on Good Practices in Climate Change Risk Assessment* reviews a range for CVRA methods and provides guidance for how to select among them.

Climate vulnerability and risk assessments can be scoped differently depending on the need. For example, they can focus on a site-specific asset or infrastructure, a single

Climate Hazards Addressed through Climate Vulnerability and Risk Assessments:

- Flooding
- Extreme Weather
- Increased Precipitation
- Increased Temperatures and Heat Waves
- Drought
- Shoreline Hazards
- Biodiversity Loss
- Invasive Species

natural asset, or a large natural system. They can also be scoped more broadly to assess risks at the community, municipal, or regional scale.

Identifying and engaging relevant, impacted parties is nearly always an integral step when undertaking a climate vulnerability and risk assessment.



CASE STUDY: DURHAM REGION FLOOD VULNERABLE ROAD AND CULVERT HYDRAULIC CAPACITY ASSESSMENT

Overview and Context

Flooding is an emerging challenge in Durham Region due to the increasing frequency and intensity of rainfall events. Durham Region partnered with TRCA in 2022 to develop a Flood Vulnerable Road and Crossing Hydraulic Capacity Assessment, designed to identify where roads were most vulnerable to flooding and develop recommendations to mitigate risk from future heavy rain events. Proactive planning interventions, such as those spearheaded by Durham Region in partnership with Conservation Authorities, aim to mitigate flood impacts to infrastructure, natural systems, and communities. These initiatives leverage methodologies like hydraulic capacity assessments to enhance resilience and safeguard resources.

A range of climate change risk assessment methodologies can be applied by planners to ground climate risk and impacts within their communities. These include:

- Ontario Climate Change and Health Toolkit
- ISO 31000:2018 Risk Management – Guidelines
- Climate Change Planning Tools for First Nations Framework
- Public Infrastructure Engineering Vulnerability Committee Engineering Protocol
- ICLEI Canada's BARC Framework

Each method considers distinct components and various scales at which climate risk is applied as part of a broader risk assessment framework.

PLANNING INTERVENTIONS

CASE STUDY: DURHAM REGION

Involvement and Collaboration

Impacted parties in Durham's flood mitigation efforts include Conservation Authorities and local area municipalities. The Region tasked a team comprising of GEI Consultants, the Climate Risk Institute (CRI) and the Toronto and Region Conservation Authority (TRCA) to help examine which roads are most vulnerable to flooding to better understand how to prepare for more frequent, intense, and longer-lasting rain events. Collaboration is central to these projects, with interdisciplinary expertise drawn from environmental science, urban planning, engineering and public works, and community organizations. These partnerships ensure holistic approaches to addressing flood vulnerabilities, combining technical assessments with best practices in community and Indigenous engagement and community-focused interventions.

Planning and Implementation

Data generation included creating geodatabases for crossing performance, road segment vulnerabilities, criticality rankings, with additional evaluation of socio-economic components applying an equity lens to identify infrastructure affecting at-risk neighbourhoods and communities.

The Region also worked with its partners to include a look at the impacts of climate change from a socio-economic perspective and consider nearby populations and community hubs that could potentially be more affected by these severe weather events.

The assessment highlights the importance of interdisciplinary collaboration in considering how climate change impacts communities, and how data can be leveraged to inform asset management and municipal investments in infrastructure that prioritizes communities that are disproportionately impacted by climate change.

Timeline and Resources

Updating floodplain mapping and models was funded in collaboration with the National Disaster Mitigation Program, regional partners such as Conservation Authorities and the Province, over the course of 2-3 years and is still on-going, with staff integrating findings into bridge and culvert design, renewal, and management.

Successes and Challenges

The project faced several major challenges, including managing the complexity and overlapping nature of data and uncertainty and questioning of the methodology, highlighting the importance of accuracy and clear assumptions. Building buy-in at the local and regional level, including organizing and integrating municipal departments and council was another significant challenge to be addressed to ensure the project's success.

There is a clear planning connection to Natural Heritage Assessments, which help identify system vulnerabilities, prioritize investments, and inform planning documents such as the Official Plan and Zoning.

The innovative approach was recognized with a 2024 Federation of Canadian Municipalities (FCM) Green Award in the Anti-racism, Reconciliation, Equity, and Inclusion (AREI) category.

Evaluation and Monitoring

The project underscores the importance of strategic, systems-based assessments that consider multiple hazard types and the geospatial aspects of risk and vulnerability. The outputs have been shared with the Ministry of Transportation with respect to climate risks and adaptation measures, as well as contributing to the analysis of development in North Oshawa, and guiding decision-making for capital investments. The wide utility of the project outputs highlights the value of such modeling and its contributions to various municipal and regional sectors.

Community Impact

To complement the risk assessment process, neighborhood health data was reviewed to incorporate a socio-economic perspective into risk scoring. This project has benefited the local community by enhancing asset management decision-making with the consideration of long-term impacts to communities.

What's Next?

The Region has extended collaboration with to other Conservation Authorities across the Region and is working to integrate socio-economic data layers into other regional initiatives such as the Durham Greener Homes program to inform sustainability and climate change related initiatives.

CLIMATE ADAPTATION PLANS

Climate Change Adaptation Plans establish a vision, identify adaptation goals and objectives, and detail the actions and implementation considerations for how a municipality or region will achieve climate resilience. They build off climate change and vulnerability assessments and focus action on prioritized climate risk, to reduce vulnerabilities, enhance resilience, and ensure that communities can thrive despite changing environmental conditions.

Adaptation plans are a holistic approach to identifying the physical, natural, social, and cultural impacts of climate change.

Collaboration is essential to long-term implementation success. By building on the relationships established through these processes, planners can support adaptation through identification of how and where departments and partners can support adaptation strategies, collecting and sharing climate data, mainstreaming, and monitoring climate action, and aiding in the communication of climate hazards and resilience.

Adaptation planning requires both incremental and transformational changes. Incremental changes might include upgrading infrastructure to withstand more intense weather. Transformational changes could involve significant changes to the municipal growth plans to avoid high-hazard areas (i.e., no growth on flood plains). Planners must assess the need for both types of adaptations depending on the severity of local climate risks.

Integrating climate change adaptation into community and regional planning allows municipalities to make short-, medium-, and long-term decisions that reduce vulnerability and build resilience. By using participatory planning approaches, planners can engage communities in the process, ensuring that adaptation strategies reflect local values and priorities. This approach is vital for creating adaptive, climate-resilient communities across Ontario, particularly as the province faces increasingly frequent and intense climate-related hazards.

Adaptation plans can integrate resilience in community and regional planning through:

Guiding Policy and Planning Frameworks:

- Official Plan policy
- Land use policies
- Zoning regulations

Environmental and Green Infrastructure:

- Heat and floodplain mapping
- Natural heritage protection
- Urban forestry

Community and Infrastructure Resilience:

- Asset management planning
- Infrastructure and building design standards
- Emergency preparedness plans

Public Health and Safety:

- Public health initiatives
- Public communications

Mainstreaming and Decision-making:

- Departmental and Council buy-in
- Corporate budgeting and implementation strategies



CASE STUDY: WINDSOR CLIMATE CHANGE ADAPTATION PLAN

Overview and Context

The City of Windsor's Climate Change Adaptation Plan, titled 'Degrees of Change', addresses the city's vulnerabilities to climate change. The Plan highlights key hazards, including rising temperatures, increased precipitation, and more frequent extreme weather events. A series of actions are identified to fulfill seven key objectives, which include integrating climate change thinking into municipal decision making, protecting public health, enhancing buildings and infrastructure, and community resilience.

Involvement and Collaboration

The development of the adaptation plan involved extensive collaboration among various city departments, local agencies, and impacted parties from the community. A Community Task Force, comprised of representatives from institutions such as the University of Windsor, Essex Region Conservation Authority, and Windsor-Essex County Health Unit, played a pivotal role in assessing vulnerabilities and formulating adaptation strategies.

The Plan highlights key hazards, including rising temperatures, increased precipitation, and more frequent extreme weather events. A series of actions are identified to fulfill seven key objectives, which include integrating climate change thinking into municipal decision making, protecting public health, enhancing buildings and infrastructure, and community resilience.

PLANNING INTERVENTIONS

CASE STUDY: WINDSOR

Planning and Implementation

The plan outlines a comprehensive approach to enhance Windsor's resilience to climate change. The implementation approach involves updating policies, enhancing public education, and investing in sustainable infrastructure.

Actions identified in the plan specifically relevant to planners include:

- Incorporate climate change language into the City's Official Plan, Zoning By-Law, and implementation guidelines.
- Integrate climate change considerations into Windsor's new and existing Plans and Policies.
- Identify vulnerable roads and areas prone to overland and extreme rain event flooding.
- Consider new design and replacement standards for building HVAC units.
- Incorporate climate change considerations into infrastructure design, development, maintenance, and renewal.
- Use the City's Zoning By-law and Site Plan Control process to limit hard surface areas in new developments.
- Promote and incentivize the use of low impact development to developers, private landowners, and the community.
- Encourage and implement more natural surface low impact development treatments instead of hard surfaces.
- Enhance landscaping and tree coverage in new public space and public right-of-way development.

Timeline and Resources

The original adaptation plan was adopted in 2012, with a significant update approved by City Council on June 15, 2020. The updated plan sets forth both immediate and long-term actions, with progress evaluations and plan reviews scheduled every five years to ensure ongoing relevance and effectiveness. Included in the update is a technical appendix outlining the potential social and financial costs to the community of delayed climate action.

Funding for the adaptation initiatives is sourced from municipal budgets, supplemented by external grants. Notably, the City of Windsor has secured over \$64 million

from the federal Disaster Mitigation and Adaptation Fund to support infrastructure projects aimed at mitigating climate-related flooding risks.

Successes and Challenges

A major success of the plan includes the development of the City's Sewer and Coastal Flood Protection Master Plan. Detailed computer modelling was used to estimate basement flooding potential under various rain events, and targeted improvements to infrastructure and community resilience were recommended. In addition, urban heat island awareness and mitigation planning in Windsor's parks and downtown has been a success of the adaptation plan. Challenges persist in securing sustained funding, coordinating among diverse stakeholders, and addressing the evolving nature of climate projections.

Evaluation and Monitoring

The plan incorporates a robust monitoring framework, utilizing high-level indicators to track progress. Regular assessments of climate projections and vulnerability analyses are conducted every five years, with periodic implementation updates presented to City Council and the Community Task Force to ensure transparency and accountability.

Community Impact

The adaptation plan has led to tangible benefits for the Windsor community, including reduced flood risks, improved public health outcomes during extreme heat events, and enhanced urban green spaces. These measures have collectively contributed to a more resilient and sustainable urban environment.

What's Next?

Moving forward, the City of Windsor aims to continue implementing the strategies outlined in the adaptation plan, with a focus on enhancing community resilience and reducing greenhouse gas emissions. Ongoing public education, policy updates, and infrastructure investments will be prioritized to address the dynamic challenges posed by climate change.

OFFICIAL PLAN POLICIES

Official Plans serve as the fundamental guiding policy document for planners at the local municipal level and are therefore a key tool for emphasizing commitment to climate action and mainstreaming climate adaptation.

Embedding climate adaptation strategies into Official Plan policies can enable proactive management of risks such as wildfires, flooding, and extreme weather events.

Adaptation and resilience can be included or directly to Official Plan policies in several ways:

Official Plans can include specific sections detailing how adaptation and mitigation will be addressed across the municipality or region.

Adaptation and mitigation can be included as principles throughout Official Plans, integrated into sections related to transportation, managing growth, the natural environment, and public health.

Specific aspects of adaptation and resilience can be addressed through Official Plan policies on parkland preservation, Green Development Standards, natural heritage protection, built asset enhancements or Secondary Plans.

Community Improvement Plans (CIPs), tools developed through Official Plan policy, can incentivize sustainable development and retrofits that enhance energy efficiency and reduce emissions. These tools provide a consistent yet flexible framework, aligned with the Provincial Planning Statement, that support safety, natural heritage protection, economic development, and environmental sustainability.

Where and how climate change adaptation strategies are integrated in Official Plan policy is specific to each region or municipality and depends on several factors including departmental buy-in, council direction, and public engagement.

Official Plans can integrate resilience in community and regional planning through:

Policy and Planning Frameworks

- Urban density and reducing automobile reliance
- Transit-oriented development
- Connecting policies to specific adaptation and mitigation targets
- Hazard mitigation such as floodplain regulations
- Sustainable food and agriculture policies
- Accessibility to public spaces and emergency shelters/resources
- Heat-resilient design to mitigate urban heat island effects
- Supporting community connectedness and social cohesion

Environmental and Green Infrastructure

- Watershed and subwatershed planning
- Natural heritage and urban green space policies
- Urban design and green development standards

Community and Infrastructure Resilience

- Asset management
- Emergency management preparedness
- Stormwater management

Public Health and Safety

- Public health initiatives
- Public communications



CASE STUDY: PRINCE EDWARD COUNTY OFFICIAL PLAN COMMUNITY IMPROVEMENT PLAN AND PARKLAND DEDICATION

Overview and Context

The Prince Edward County Official Plan, adopted in 2021, serves as a strategic guide for managing growth and development while addressing climate change challenges. Two key policy tools, parkland dedication and CIPs, are identified as mechanisms to promote sustainable, low-impact development and water conservation. These tools aim to mitigate potential climate change impacts, particularly drought conditions, and ensure the long-term resilience of the community.

Involvement and Collaboration

The Official Plan review began in 2013 with planning staff identifying key issues. The County hired a consulting team to facilitate community engagement, culminating in eight meetings with impacted parties representing 47 community organizations and two open houses. This

engagement identified topics important to the community, including maintaining a small-town lifestyle, shoreline protection and development, the management and preservation of natural heritage, biodiversity and habitat protection, and tourism.

Planning and Implementation

The County's Official Plan outlines how community improvement planning can address climate change mitigation and adaptation through building retrofits for energy efficiency, renewable and district energy systems, water conservation, and Low Impact Development strategies. The County can use several tools to implement Community Improvement policies, including the development of By-laws, the acquisition of land, or through funding mechanisms such as loans, grants, or reduced Development Charges.



The County is currently developing a Community Improvement Plan to set priorities for the municipality and inform strategic planning for council. A stated objective of engagement with the public and impacted parties is to respond to the climate emergency and reduce the challenges faced.

Parkland dedication policies require new developments to contribute land or funds for public green spaces. The Official Plan emphasizes the importance of these spaces in supporting sustainable development and addressing environmental concerns. CIPs can incentivize projects that align with environmental and community goals, including those related to mitigating climate change impacts like flooding, extreme heat, and drought.

The County requires parkland dedication as a condition of development and redevelopment, and is facilitated through Site Plan Control, consent, or subdivision applications. The County may consider the provision of sustainability features to address climate change in proposed developments in lieu of parkland conveyance where suitable lands are not available for establishing parkland. Such features may include green roofs, permeable surfaces, tree planting, renewable energy technologies, and water efficiency and conservation measures.

Timeline and Resources

The Official Plan sets a 25-year vision, with key milestones including periodic reviews every five years. These reviews allow the County to evaluate progress in implementing

parkland dedication and CIP-related initiatives, ensuring they remain effective in addressing emerging challenges due to climate change.

Consultation for the Community Improvement Plan began in 2021, concluded in 2023, and is currently under review before being submitted to Staff and Council for approval.

Evaluation and Monitoring

The County's Official Plan requires Community Improvement Plans to be reviewed every five years to monitor the uptake of any financial incentives and the effectiveness of programs in achieving their objectives.

Community Impact

By promoting low impact development and water conservation, the County may reduce vulnerability to extreme weather, flooding, and heatwaves and enhance the resilience of its ecosystems and infrastructure. Parkland designed with sustainable features can provide recreational and ecological benefits, while CIPs can help local businesses and residents adopt innovative energy and water-saving solutions, contributing to a more sustainable community.

What's Next?

By prioritizing these efforts, Prince Edward County can continue to build resilience against the impacts of climate change while fostering sustainable growth and development.



SECONDARY PLANS

Secondary Plans enable municipalities to develop area-specific policies that address climate-related risks, including those related to flooding, extreme weather events, heat waves.

Supported by climate change vulnerability and risk assessments, Secondary Plans provide a localized focus and emphasis on community engagement, ensure that adaptation strategies are tailored to the unique needs of the area promoting long-term sustainability and preparedness.

Secondary Plan tools to support climate change adaptation:

Apply community-level objectives and goals

Establish tailored direction on community priorities

Include area-specific resilience goals such as:

- Flood-resilient infrastructure
- Stormwater management planning
- Green infrastructure
- Parkland dedication
- Natural heritage protection
- Design guidelines



CASE STUDY: MUNICIPALITY OF BLUEWATER BAYFIELD SECONDARY PLAN

Overview and Context

The Bayfield Secondary Plan (BSP) for the Municipality of Bluewater addresses several climate impacts, including shoreline erosion and flooding. The development of the Secondary Plan provided Bluewater with an opportunity to establish tailored policies that guide future development applications, including Site Plan and Subdivision applications. The BSP also integrates the community's long-term vision and priorities, ensuring that local interests are reflected in planning decisions.

Involvement and Collaboration

The BSP draws on planning direction from the County of Huron Official Plan and Bluewater Official Plan, integrating existing adaptation and resilience policies. It was developed in collaboration with a Citizen Advisory Committee and local Conservation Authorities. Significant community consultation ensured that local perspectives were incorporated. Through the adoption of climate resilience

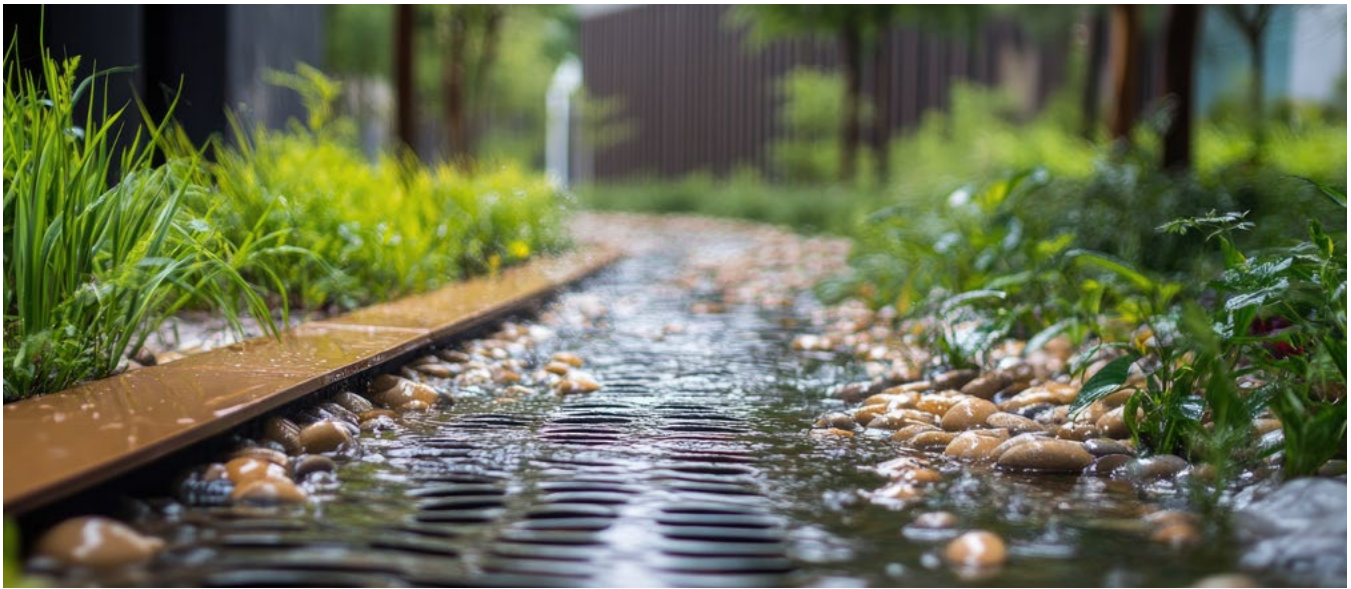
and sustainability as 'Guiding Principles', the BSP development process resulted in numerous actions to enhance the community's capacity to adapt to climate impacts.

Planning and Implementation

The BSP establishes long-range policy direction for land use, the protection of natural heritage, parks and open spaces, infrastructure coordination, transportation improvements, and urban design.

Specific actions in the BSP based on the Guiding Principle of climate resilience included:

- Amending the Parkland Dedication Bylaw to permit Urban Forests to be designated as parkland.
- Developing a Treescape Policy that requires enhanced tree planting along arterial and residential streets.
- Establishing minimum interior yard setbacks between buildings along Main Street to accommodate expanded tree canopies.



- Requiring 50% of front yards be maintained as landscaped open space to accommodate tree planting.
- Considering the impact to the water table when reviewing residential development.
- Encouraging high-performance building standards.
- Introducing bicycle parking requirements for commercial development.
- Supporting other localized resilience measures, such as rain gardens, active transportation, and rain barrels.

Timeline and Resources

During the 2016 to 2018 Five-Year Review of the Bluewater Official Plan, residents expressed growing interest in adopting a more detailed approach to urban design in Bayfield, as well as protecting cultural and natural heritage features. This provided an opportunity to integrate climate resilience into the BSP.

The first draft of the BSP was presented to the community in September of 2022. The BSP was approved by council in February 2023 and is now a key resource for updating municipal policies and reviewing development applications.

Successes and Challenges

The BSP successfully integrates a variety of resilience measures, especially by emphasizing the value of natural environments. It demonstrates how embedding climate resilience as a ‘Guiding Principle’ can lead to significant

advancements in municipal planning, by codifying it into policies and Zoning By-law provisions.

Challenges remain. Though sustainable and green design elements are encouraged, they cannot be enforced through the planning review process, posing limitations on implementation.

Evaluation and Monitoring

No specific evaluation or monitoring framework is outlined in the Secondary Plan.

Community Impact

The BSP demonstrates a holistic and focused approach to integrating climate considerations into municipal planning. By identifying and protecting natural heritage, enhancing urban green spaces, and establishing a framework to guide future development, the BSP supports both environmental and community resilience. Its emphasis on climate adaptation benefits current residents and helps Bayfield prepare to meet future challenges.

What’s Next?

The BSP will be incorporated into the Bluewater Official Plan, Zoning Bylaw, and other municipal tools, such as Subdivision Approval and Site Plan Control. This integration will allow the policies outlined in the BSP to shape future development in Bayfield.



DEVELOPMENT REVIEW PROCESS

The development review process is a structured procedure through which municipalities evaluate proposals for new developments or changes to existing properties.

This process ensures that proposed developments comply with local planning policies, zoning bylaws, and other regulatory requirements. Municipalities use the development review process to balance growth, community needs, environmental protection, and sustainable planning principles.

When adaptation and resilience policies are well integrated, such as through growth management, natural heritage, and land use policies, development reviews can require that development proposals identify and mitigate climate risks such as those related to extreme weather, flooding, and wildfires.

Integrating climate change adaptation into Ontario's development approvals process requires strategic actions and policy implementation, including:

Updating Municipal Planning Policies:

- Amend local Official Plans and land use policies to explicitly include climate change adaptation as a key consideration

Revising Development Application Submission Requirements:

- Include environmental or hazard impact assessments
- Require hazard buffers and setbacks
- Mandate stormwater management strategies

Promoting Resilience Measures:

- Encourage building efficiency and climate-resilient design
- Support the adoption of Urban or Green Development Standards

CASE STUDY: DEVELOPMENT REVIEW – DISTRICT OF MUSKOKA

Overview and Context

The District of Muskoka addresses wildland fire hazards through their official plan policies. Policies reflect the Provincial Policy Statement (2020) regarding hazardous areas, directing development away from unsafe forest types. Development within Extreme, High, and Needs Evaluation areas as identified in Appendix D of the Muskoka Official Plan requires a Wildland Fire Hazard Risk Assessment to verify risks and recommend mitigation measures. The Muskoka GeoHub, a public mapping system with internal components, integrates the Ministry of Natural Resources (MNR) mapping, which supplements the planning review process by identifying high-risk areas based on factors like forest type and vegetation.

Involvement and Collaboration

Impacted parties include the District of Muskoka, lower-tier municipalities, and the Ministry of Natural Resources. Community partners were engaged through policy alignment with the 2020 Provincial Policy Statement and ongoing emergency management planning. Development review processes incorporate wildfire hazard assessments and Environmental Impact Statement requirements to ensure risks are adequately addressed.

Planning and Implementation

The initiative employs planning tools like the Muskoka GeoHub, screening developments for natural constraints and wildland fire hazards. Development is directed outside of lands that are unsafe for development due to the presence of hazardous forest types for wildland fire, with municipal Official Plans incorporating these constraints. When development is proposed in a wildland fire hazard area (categorized as Extreme, High, or Needs Evaluation), the District of Muskoka requires the applicant to submit a Wildland Fire Hazard Risk Assessment Report and mitigation standards to evaluate wildland fire hazards and other relevant constraints. This assessment includes

recommendations such as setbacks, vegetation clearing guidelines, and development envelopes. The approval authority then uses these results to help make decisions on the proposed development.

Timeline and Resources

The wildfire hazard policies were introduced during the 2019 Official Plan update and aligned with the Provincial Policy Statement.

Successes and Challenges

The initiative successfully integrates wildland fire risk mitigation into planning processes, acceptance of impacted parties, which included acceptance of wildland fire assessments and mitigation standards in supplemental submission requirements for consent applications, official plan amendments and plan of subdivision/condominium applications, as required.

Additionally, the Muskoka GeoHub provides residents and visitors to the area up-to-date forest fire information, including fire ratings and bans, real-time updates of current fires in the province, thermal activity, smoke forecasting, the location of fire station and reception stations, and information on what to do in an emergency.

Challenges include addressing outdated wildland fire mapping and ensuring policies remain relevant with updated data.

Evaluation and Monitoring

There is no monitoring to assess the direct impact of policies on wildfire hazard mitigation.

Community Impact

The initiative promotes safety by directing development away from high-risk areas and ensuring preparedness for emergencies. Community acceptance has been strong, with recognition of the environment's role in Muskoka's economy and resilience.

What's Next?

Future steps include revisiting wildfire hazard mapping wherever possible to enhance data accuracy.



URBAN DESIGN GUIDELINES

Urban Design Guidelines are recommendations and standards developed by municipalities to guide the physical development and aesthetic quality of urban areas. They aim to create cohesive, attractive, and functional environments that enhance residents' quality of life.

Typically applied to new developments, renovations, and public spaces within specific areas like downtown cores or neighborhoods, these guidelines are integrated into the development approvals process. They can be paired with incentives, such as development charge or planning fee rebates, density bonusing, or expedited permitting, to encourage developers to go beyond the minimum design standards established by the municipality to support the design of public spaces and infrastructure capable of withstanding changing climate conditions, such as higher temperatures, increased precipitation, and more frequent storms.

Urban Design Guidelines can integrate climate change adaptation and mitigation measures such as:

- Resilient landscaping and green infrastructure
- Energy efficient and resilient building design
- Sustainable communities and transportation
- Ecosystem health and natural heritage protection
- Waste reduction and management



CASE STUDY: NORTH MARKHAM URBAN DESIGN GUIDELINES

Overview and Context

The North Markham Future Urban Area (FUA) Urban Design Guidelines represent a forward-thinking approach to sustainable urban development. Covering 1,300 hectares, the FUA is designed to support 45,000 residents and provide 16,000-18,000 jobs. As climate change intensifies, extreme heat events and the urban heat island (UHI) effect pose significant challenges to urban areas. These guidelines aim to mitigate these impacts through innovative strategies that prioritize environmental sustainability and climate resilience. The plan balances urban growth with ecological preservation, setting a benchmark for sustainable urban living.

Involvement and Collaboration

The development of the Urban Design Guidelines involved a collaborative effort between city planners, environmental experts, and the community. Public consultations and

engagement with impacted parties were instrumental in aligning diverse interests. Environmental consultants assessed the natural landscape to develop targeted strategies for mitigating the UHI effect, including preserving existing green spaces and integrating cooling elements into urban design. This collaborative process ensured that the guidelines reflect the needs of the community in the context of climate adaptation.

Planning and Implementation

The guidelines outline specific strategies to mitigate the UHI effect and enhance climate resilience:

- 1. Green Infrastructure:** Green roofs, walls, and tree-lined boulevards are encouraged to reduce ambient temperatures. Streetscapes are designed with permeable paving and bioswales to improve surface cooling and water management.

- 2. Urban Forest Enhancement:** The guidelines set minimum tree canopy requirements for public and private spaces. Native, drought-resistant species are prioritized to provide long-lasting shade and cooling effects. Green networks connect parks, streets, and open spaces to create continuous cooling corridors.
- 3. Parks and Open Spaces:** Strategically located parks are designed as cooling zones, featuring water elements, shaded paths, and dense vegetation to moderate microclimates.
- 4. Low-Impact Development (LID):** Rain gardens and retention ponds manage stormwater while cooling urban areas and enhancing biodiversity.
- 5. Building Orientation and Materials:** Guidelines recommend energy-efficient building materials with high solar reflectance and building orientation to maximize natural ventilation and minimize heat gain.

These measures form a comprehensive approach to addressing the challenges of urban heat in a warming climate.

Timeline and Resources

The planning process began with the City's 2014 Official Plan, which identified the FUA as a key area for future growth. Following this, the Conceptual Master Plan and supporting studies were developed to shape the guidelines. The Urban Design Guidelines were finalized in 2020 and continue to guide development. Resources include funding from municipal and provincial governments, as well as technical support from environmental experts and urban planners.

Successes and Challenges

The Urban Design Guidelines provide guidance for the development of high-quality design, ensure that the North Markham Area is sustainably designed and developed, and provide guidance to the development industry and City planners in the preparation and review of development applications.

Evaluation and Monitoring

No specific evaluation or monitoring framework is outlined in the publicly available Urban Design Guidelines document for the FUA.

Community Impact

The guidelines aim to enhance community well-being by reducing heat stress and improving access to green spaces. These features contribute to healthier living environments and support overall quality of life in the FUA.

What's Next?

Future steps include the development of detailed secondary plans for individual areas within the FUA. These plans will guide specific implementation efforts and address remaining challenges as the region develops. Continued collaboration with impacted parties and adherence to the Urban Design Guidelines will ensure that the FUA evolves into a sustainable, climate-resilient community.

Additionally, the City is developing both a Sustainable Development Checklist for the North Markham Area to further inform and streamline the implementation of the Design Guidelines, and City-wide Urban Design Guidelines.

These guidelines aim to mitigate these impacts through innovative strategies that prioritize environmental sustainability and climate resilience. The plan balances urban growth with ecological preservation, setting a benchmark for sustainable urban living.



GREEN DEVELOPMENT STANDARDS

Green Development Standards (GDS) are a set of voluntary or mandatory criteria and benchmarks established by municipalities to promote environmental, social, and economically sustainable practices in the planning and construction of new developments.

Applied at various stages of the development permitting process, GDS can be paired with incentives, such as development charge or planning fee rebates, density bonusing, or expedited permitting to encourage developers to go beyond the minimum design standards established by the municipality. By embedding sustainability into the planning and design of new developments, GDS ensure that communities are better equipped to adapt to changing climate conditions, protect natural ecosystems, and enhance the quality of life for residents.

Green Development Standards can encourage or require adaptation and resilience strategies to mitigate climate hazards and support GHG reductions:

Preserve and Enhance Green Infrastructure:

- Maintain or enhance existing tree canopy, natural heritage, and green spaces

Implement Sustainable Site Design:

- Set standards for green coverage and permeable pavement

Adopt Building Standards:

- Use cool or green roofs and climate-efficient, resilient building materials

Promote Water Conservation:

- Implement water conservation technologies



CASE STUDY: CALEDON GREEN DEVELOPMENT STANDARDS

Overview and Context

The Town of Caledon's Green Development Standards (GDS) aim to address the dual challenges of sustainable urban growth and climate resilience. A key focus of the standards is implementing adaptation measures to combat climate change impacts, such as reducing urban heat islands (UHIs), managing stormwater runoff, biodiversity loss, and drought. The standards encourage innovative practices like green roofs and sustainable landscaping to improve urban environments while aligning with the Resilient Caledon Community Climate Change Action Plan.

Involvement and Collaboration

The development of the Town's GDS involved a two-year process of engagement with impacted parties and research. This included focus groups with representatives from equity-deserving groups, workshops with the development industry, utilities, and conservation groups, a community survey, and collaboration with neighboring municipalities. The project

was guided by two groups that met regularly: a Project Advisory Committee consisting of Town staff, and a Technical Working Group composed of agency representatives, context and context experts, and development industry representatives.

These efforts ensured that the standards were tailored to meet Caledon's specific environmental and planning needs.

Planning and Implementation

On-site green infrastructure is a key focus of the GDS, and addresses several priorities outlined in the Official Plan reducing the UHI effect, managing stormwater run-off, and enhancing biodiversity. The standards set an overall target for green cover in development projects, encouraging the integration of green infrastructure elements such as green roofs, rain gardens, and permeable pavement into site designs, all of which contribute to managing the UHI effect and stormwater management. The Town's Green



Factor Tool provides flexibility in meeting green cover targets, allowing applicants to adapt to site-specific contexts.

The GDS also includes metrics to combat the UHI effect for building rooftops and pavement. Standards for building rooftops specify percentage coverage requirements for green or cool roof materials. Paving standards include a combination of high-albedo and permeable paving materials, canopy coverage, and shade from architectural structures.

These measures are incorporated into the planning approvals process applicable to Site Plan and Draft of Subdivision applications.

Timeline and Resources

The GDS pilot phase began on July 1, 2024, and was scheduled to run for one year to allow for testing and gathering feedback on the standards' implementation, with a focus on the practical application of adaptation measures such as green roofs.

Successes and Challenges

To facilitate compliance with the GDS, the Town provided detailed resources, including a GDS Guidebook, the Green Factor and Embodied Carbon Reporting tools, and Applicant a Site Plan Checklists for Site Plan, Draft Plan of Subdivision, and Industrial Site Plan. These documents emphasize the benefits of green roofs, their design requirements, and guidelines for incorporating landscaping solutions to

mitigate UHI impacts. They also outline best practices for maintenance to ensure long-term functionality.

Evaluation and Monitoring

During the pilot phase, the impact of green roofs and UHI-related adaptations are evaluated through performance monitoring and feedback from impacted parties. Metrics such as local temperature reductions, energy efficiency improvements, and stormwater retention will guide refinements to the standards, ensuring they remain practical and impactful.

Community Impact

By addressing urban heat islands and promoting green roofs, the GDS can contribute to an improved quality of life for residents. These measures contribute to cooler neighborhoods, reduced energy demands for cooling, and enhanced green spaces that promote mental and physical well-being. They also strengthen community resilience against extreme heat events, a growing concern under climate change.

What's Next?

After the pilot phase, the Town will review performance data and impacted party input to refine the GDS. Full implementation will aim to ensure that future developments in Caledon incorporate sustainable, climate-resilient features in alignment with long-term environmental goals.



SUSTAINABLE DEVELOPMENT CHECKLISTS

Sustainable development checklists are a set of voluntary or mandatory performance measures, evaluated through development permit review, to promote and contribute to sustainable land use and building design.

Sustainable development checklists can be paired with incentives such as planning fees and development charge rebates, density bonusing, or expedited permitting to increase uptake. By providing a clear framework for integrating climate adaptation strategies, these checklists help developers make informed decisions, reduce vulnerability to climate risks, and contribute to creating more resilient buildings and communities.

Sustainable development checklists can include measures to enhance building performance, resilience, stormwater management, water quality, ecology, biodiversity, and waste management:

Adopt Building Standard:

- Green and cool roofs
- LEED Certification
- Waste collection strategies
- Water conservation technology

Sustainable Site Design and Landscaping Requirements:

- Tree planting and soil volume
- Green coverage and permeable pavement
- Natural heritage enhancement and protection
- Bird friendly design and pollinator gardens

CASE STUDY: GUELPH SUSTAINABLE DEVELOPMENT CHECKLIST

Overview and Context

The City of Guelph has developed several key planning tools to promote sustainability and resilience in urban and community planning. These initiatives include the Sustainable Development Checklist, and the Official Plan (February 2024 Consolidation). These documents aim to support environmentally responsible development and address challenges like climate change, particularly regarding water management and urban resilience.

Involvement and Collaboration

The development of these strategies involved input from external stakeholders and municipal representatives, including planners. The Low Impact Development Implementation Strategy was shaped through collaborative workshops that informed its recommendations.

Planning and Implementation

The Sustainable Development Checklist provides developers with required minimum performance measures for new site designs, emphasizing resource efficiency and water management. Performance measures include design standards to improve air quality, building emissions, water quality and quantity, ecology and biodiversity, and waste collection and storage. The checklist applies to site plan approval applications and establishes clear expectations for sustainable practices.

The Low Impact Development Implementation Strategy outlines how features such as infiltration systems and permeable pavements can be integrated into urban design. It specifies permitted types and locations of these features, aiming to align urban growth with sustainable water management policies.

The Official Plan (February 2024 Consolidation) establishes long-term policy directions for land use and urban planning, including policies to enhance sustainability and climate resilience in development projects.

Timeline and Resources

The Sustainable Development Checklist is effective for site plan approval applications submitted on or after May 1, 2023. The Low Impact Development Implementation Strategy was finalized in early 2023. The Official Plan reflects updates consolidated as of February 2024. Supporting resources include the City's Infiltration Policy and other engineering and planning guidelines.

Successes and Challenges

The Sustainable Development Checklist and Low Impact Development Implementation Strategy highlight challenges in implementing sustainable development practices, including technical and compliance barriers, while seeking to promote effective integration of Low Impact Development features into urban areas.

Evaluation and Monitoring

The Low Impact Development Implementation Strategy includes recommendations for monitoring the performance of low impact development measures, although specific protocols are not detailed in the documents. Regular updates to the Official Plan ensure policies remain aligned with municipal goals.

Community Impact

The focus on sustainable water management and urban resilience aims to address environmental challenges and improve urban infrastructure's adaptability to climate conditions, including drought.

What's Next?

Future updates to the Sustainable Development Checklist and related policies are planned as part of Guelph's broader sustainability and resilience initiatives. The Official Plan and Low Impact Development Implementation Strategy will continue to evolve to address emerging challenges and ensure alignment with the city's goals.



SHORELINE MANAGEMENT PLANS

Shoreline Management Plans (SMPs) are strategic documents that provide a framework for managing coastal or shoreline areas sustainably.

SMPs are often developed through a collaborative process involving diverse impacted parties, including government agencies, local communities, environmental organizations, and industry representatives. These plans address issues such as coastal erosion, flooding, habitat conservation, and land use, aiming to balance environmental, social, and economic interests. SMPs outline policies and actions to protect and enhance shoreline environments, mitigate risks from natural hazards, and guide development and land-use decisions.

Shoreline management plans can support climate adaptation and hazard mitigation by promoting actions like:

- Shoreline and hazard identification and mapping
- Directing new development away from hazard lands
- Maintaining natural shorelines
- Mitigating the impacts of rising water levels and extreme weather
- Hazard-proofing existing infrastructure and buildings
- Identifying opportunities to retreat or re-align existing assets
- Public acquisition of high-risk or ecologically valuable lands



CASE STUDY: AUSABLE BAYFIELD CONSERVATION AUTHORITY SHORELINE MANAGEMENT PLAN

Overview and Context

The Ausable Bayfield Conservation Authority (ABCA) Shoreline Management Plan (SMP) addresses both existing and future development along the ABCA shoreline by incorporating policies for hazard zones to reduce erosion and flooding risks. The SMP seeks to minimize risk to human life and property over time by ensuring that buildings and structures are located outside shoreline hazard areas.

The approach of the SMP integrates key principles of robust adaptation planning, including through:

- Science-based methodology and commitment to ongoing hazard monitoring and identification.
- Prevention-first philosophy, encouraging proposed development to be located outside areas vulnerable to erosion, flooding, and dynamic beach hazards.

- Alignment with provincial policies to promote consistency and compliance.

Involvement and Collaboration

A Planning Group consisting of representatives from lakeshore communities, municipalities, and neighbouring Conservation Authorities was formed to update the ABCA's Development Guidelines (2000). Extensive public engagement was conducted to gather input on the updated guidelines, including surveys, open houses, newsletters, and media releases. This collaborative approach ensured that community perspectives were considered while developing policies to address shoreline hazards.

Planning and Implementation

The ABCA updated the SMP Development Guidelines to be consistent with the Provincial Policy Statement (2014), detailing minimum setback requirements for erosion, flooding, and dynamic beach hazards. The guidelines adhere to three provincial mandates for shoreline management:

1. No new hazards are created.
2. Existing hazards are not aggravated.
3. No adverse environmental impacts result.

To fulfill its responsibilities, the ABCA identified the following objectives:

- Minimize the potential loss of life or property damage along the shoreline.
- Direct development away from areas affected by natural shoreline hazards.
- Increase public awareness of natural hazards along the Lake Huron Shoreline.
- Reduce public expenditures related to damage and emergency operations caused by flooding, erosion, and dynamic beach hazards.

The approach recognizes existing development and provides a strategic process that looks to eliminate the risk to human life and property damage over time. Additional requirements mandate hazard assessments and permits to ensure sustainable development near shorelines.

Timeline and Resources

The ABCA initiated an update to the SMP in 2015, with community engagement occurring between 2015 and 2018. The updated Development Guidelines were finalized and approved in 2019, incorporating new data and metrics to better understand future shoreline hazards, including climate projections, 100-year flood levels, shoreline erosion mapping, and slope stability risks.

Successes and Challenges

The 2019 SMP builds on the 2016 draft and incorporates updated recommendations for Development Guidelines. This latest version provides valuable information on shoreline processes and shoreline management planning, emphasizing the importance of adapting policies to reflect current conditions.

Challenges have arisen during the update process. The 2016 Consultant Recommendation Report and regulatory mapping, which included updated shoreline recession rates, faced strong public opposition. The Board passed a resolution rejecting the recommended Shoreline Development Guidelines, including the principle of “managed retreat” and the prohibition of all shoreline protection works. As a result, the Board directed staff to re-engage the public and continue using the policies from the 2000 SMP while revising the plan.

Additional challenges stem from changes in land use along the shoreline. Many seasonal residences are now occupied year-round, and modern homes are often larger and more challenging to relocate compared to older structures. Despite these difficulties, the 2019 Development Guidelines incorporate valuable metrics, such as climate projections, 100-year flood levels, 25-, 50-, and 100-year shoreline erosion mapping, and slope stability risks, to better understand and manage future hazards.

Evaluation and Monitoring

The SMP commits to ongoing monitoring and identification of shoreline hazards. This includes regularly updating shoreline mapping and data on coastal processes and bluff recession to assess risks to people and property more effectively.

Community Impact

The SMP incorporates measures to protect the community from shoreline hazards while highlighting the importance of collaboration, public engagement, and tailored adaptation strategies. By involving residents in the planning process and providing accessible resources, such as shoreline hazard guides and a checklist for shoreline protection applications, the SMP empowers communities to make informed decisions and prioritize safety.

What’s Next?

The ABCA is continuing to keep residents informed about shoreline management through regular newsletter updates about shoreline management in the watershed. Moving forward, the ABCA will continue to update shoreline hazard data to monitor evolving risk.



FLOOD MAPPING

Flood mapping utilizes hydrological modelling to identify areas at risk of flooding, incorporating historical rainfall data as well as projected future rainfall amounts to improve public safety, minimize property damage, and protect natural heritage assets. By integrating future-projected rainfall amounts into flood mapping exercises, municipalities can assess and manage future flood risk more effectively.

Flood mapping can be used by planners to:

- Identify areas at-risk of overland and riverine flooding
- Guide land use policies and standards to inform growth and development
- Inform and improve asset management, storm-water management, and emergency preparedness planning
- Identify and protect natural heritage assets or areas that support flood mitigation

By integrating future-projected rainfall amounts into flood mapping exercises, municipalities can assess and manage future flood risk more effectively.

CASE STUDY: OTTAWA FLOOD MAPPING

Overview and Context

The City of Ottawa's floodplain mapping initiative addresses the increasing risks posed by climate change, ensuring land use and infrastructure decisions are grounded in robust data. Traditionally focused on the 1-in-100-year flood event, the city expanded its approach to include the 1-in-350-year flood event to better reflect the frequency and intensity of extreme weather events. This broader mapping framework enhances hazard assessment, enabling planners to prioritize public safety, resilient infrastructure, and sustainable development in high-risk areas.

Involvement and Collaboration

The City of Ottawa collaborated with local Conservation Authorities to update and create floodplain maps. These efforts included consultations with councilors, developers, and community members, ensuring transparency and broad engagement with impacted parties in the planning process.

Planning and Implementation

Floodplain mapping informs the City's Official Plan (OP) and Zoning By-law. Areas between the 1-in-100-year and 1-in-350-year floodplains are classified as Climate Change Flood Vulnerable Areas. New developments in these zones must incorporate mitigation measures such as elevated structures or safe access routes to reduce risks. The initiative emphasizes site-specific solutions, balancing flood risk management with Ottawa's priorities for intensification, redevelopment, and sustainable growth.

Timeline and Resources

The project started in 2014, and maps are updated as new data becomes available. Conservation Authorities collaborate with the City to prioritize mapping for growth areas and regions most at risk. These updates are integrated into existing planning frameworks and supported through funding allocated for municipal and regional resilience initiatives.

The 2023 budget included more than \$22 million of investments to continue floodplain mapping updates, develop a Wet Weather Management Plan, slope stabilization projects, integrated infrastructure renewal projects, and forestry and greenspace protection.

Successes and Challenges

The initiative has increased awareness of flood risks and integrated climate change considerations into planning. Updated maps have improved emergency preparedness, asset management, and informed decisions on critical infrastructure projects. However, challenges remain, including gaps in mapping coverage, particularly in historical urban areas, and the need for clearer provincial guidance on integrating climate change into flood management policies.

Evaluation and Monitoring

The City of Ottawa works with area Conservation Authorities to routinely update the floodplain maps as new data become available.

Community Impact

The updated floodplain maps have enhanced the City's capacity for emergency preparedness, asset management, and resilient development. These tools have also increased public awareness of flood risks and supported proactive planning measures.

What's Next?

The City is working to expand floodplain mapping to unmapped watercourses and urban systems, prioritizing areas experiencing redevelopment or growth pressures. The next Zoning By-law Review will further refine policies to reflect updated data while allowing flexibility for site-specific solutions. Additionally, upcoming vulnerability assessments will evaluate demographic and infrastructure risks, ensuring Ottawa's flood resilience efforts continue to evolve with climate challenges.



NATURAL ASSET MANAGEMENT

Natural asset management (NAM) is the process of identifying, evaluating, and managing natural resources and ecosystems to optimize their services for communities.

The approach recognizes natural features such as forests, wetlands, rivers, and green spaces as valuable assets that provide essential services, like engineered infrastructure. In certain contexts, natural assets can provide equivalent or better services than engineered assets, often at a fraction of the cost, while enhancing resilience to extreme weather events.¹

By valuing natural features and integrating them into planning and infrastructure decisions, NAM enhances climate resilience and offers cost-effective solutions to challenges like flooding, erosion, and extreme weather events. NAM supports scalable, context-specific strategies that adapt to diverse geographic and demographic needs, ensuring that natural assets continue to deliver critical services for current and future generations while reducing reliance on expensive, resource-intensive engineered infrastructure.

Natural asset management can support and enhance climate adaptation planning through:

- Informed and cost-effective decision making
- Natural heritage protection
- Enhanced flood control and stormwater management
- Improved water quality and quantity
- Increased carbon sequestration
- Support biodiversity and habitat connectivity
- Mitigate the Urban Heat Island Effect
- Erosion control and coastal protection

¹ Municipal Natural Assets Initiative: “What are Municipal Natural Assets: Defining and Scoping Municipal Natural Assets” (2019). Available [here](#).



CASE STUDY: GRINDSTONE CREEK NATURAL ASSET MANAGEMENT PLAN

Overview and Context

The Grindstone Creek watershed project was a multi-year initiative led by the Municipal Natural Assets Initiative (now Natural Assets Initiative, or NAI) with project partners. The project identified and quantified the value of natural assets and their ecosystem services, particularly in flood mitigation and stormwater management. By modeling various scenarios, it compared the economic value of these natural systems to the costs of traditional grey infrastructure. This work was done to support financial planning, asset management, and climate resiliency initiatives.

Involvement and Collaboration

Project partners included Conservation Halton, City of Hamilton, City of Burlington, Greenbelt Foundation, and the Royal Botanical Gardens. These project partners

contributed expertise, data, and funding. Engagement focused on technical inputs and promoting the final report, with minimal public involvement. NAI led modeling and analysis efforts, with Conservation Halton staff providing data, helping to develop the methodology, and reviewing draft reports.

Planning and Implementation

The project added a climate adaptation lens to natural heritage planning and watershed management, highlighting the interconnectedness of ecological restoration and urban resilience. It emphasized a shift from isolated decision-making to a broader, holistic approach that integrates water quality, forest cover, and biodiversity data. This can inform policy recommendations for reviewing how natural assets are managed and incorporated into planning frameworks. The initiative also demonstrated how ecosystem

services could be quantified and prioritized, helping to address both ecological and urban challenges.

Recommendations relevant to municipal planning practitioners include:

- Review policies to protect existing natural assets to ensure that future land use change considers the value of existing natural assets and their role in service delivery.
- Develop a collaborative watershed management strategy and plan. This is consistent with policy directives in the Provincial Policy Statement 2020 (now the Provincial Planning Statement 2024).
- Install Low Impact Development projects in priority areas and build them into asset management plans.
- Strengthen assessment of natural assets to include inventory and monitoring data, condition assessment, and risk identification.
- Develop integrated systems, and incorporate traditional ecological knowledge, modelling for stormwater and water quality.
- Develop a communications plan to communicate the value of services provided by the watershed to decision-makers and the broader community.

Timeline and Resources

Initially planned as a 14-month project, the initiative extended to three years due to delays caused in part by the COVID-19 pandemic. The project was funded through a combination of external contributions from the Greenbelt Foundation, Conservation Halton, and municipal support, totaling over \$200,000. Staffing and expertise came from NAI, which led the modeling and report writing, supported by Conservation Halton and other municipal and technical experts.

Successes and Challenges

One of the most significant successes was the ability to communicate the value of natural assets in monetary terms, broadening conversations about ecosystem services to include diverse stakeholders like accountants and planners. The table illustrates the value of co-benefits that natural assets provide the community within Grindstone Creek Watershed. This information can inform decisions about resources allocation, indicate the potential loss in value if action is not taken to protect



these assets, and highlight the potential improvement in value if restoration actions are taken.

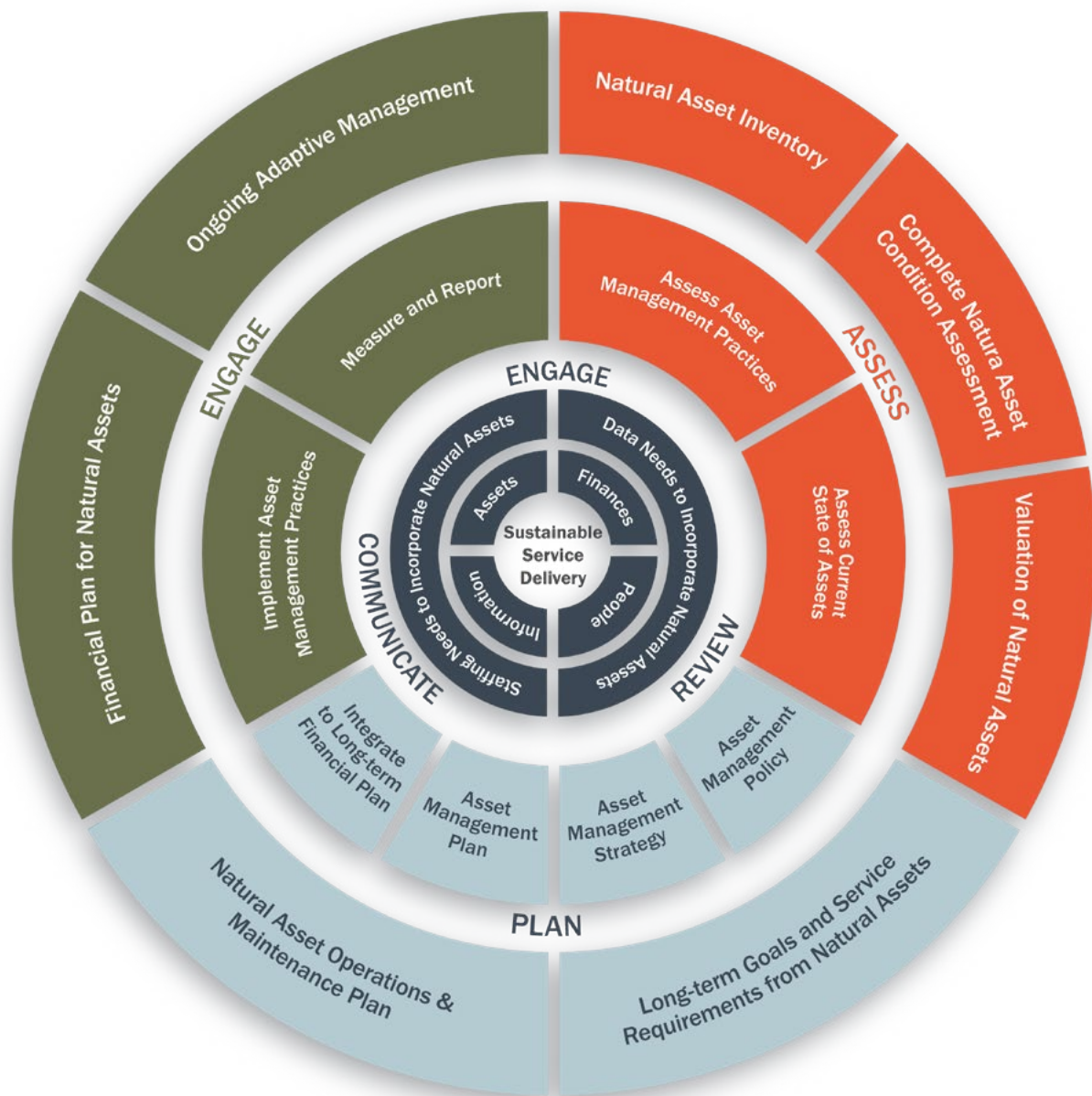
Engagement and collaboration with Indigenous communities highlighted the importance of incorporating traditional ecological knowledge into natural asset management strategies, to provide new perspectives on the importance of natural assets, understand the context of local Indigenous groups and who to engage, reframe and scope projects, and better understand and represent the role of natural assets in supporting Indigenous well-being.

Challenges faced by the project included the lack of standardized methods for natural asset assessment, the complexities of modeling ecosystem services, and variable data resolutions.

Evaluation and Monitoring

While no comprehensive monitoring program was established for the project, its recommendations are being implemented through watershed management planning. Conservation Halton is working with partners to develop collaborative monitoring plans, leveraging existing programs to ensure natural assets are managed and monitored effectively. This step is crucial for maintaining the levels of service these assets provide in the face of changing urban and ecological conditions and in a changing climate.

THE NATURAL ASSET MANAGEMENT CYCLE



Source: adapted from Asset Management BC, 2014.

SUMMARY: PARTIAL LIST OF CO-BENEFIT SERVICE VALUES FROM GRINDSTONE CREEK NATURAL ASSETS (\$/YEAR - INDICATIVE ESTIMATES)						
SERVICE	AGRICULTURE	FOREST	MEADOW SUCCESSIONAL	SWAMP	MARSH	ASSET AREA (HA)
Recreation and tourism	\$ 899,000	\$ 21,986,000	\$ 33,000	\$ 6,945,000	\$ 2,210,000	\$ 32,073,000
Erosion control	Not assessed	\$ 1,300,000	\$ 3,000	\$ 1,900,000	N/A	\$ 3,203,000
Carbon sequestration	\$ 397,000	\$ 254,000	\$ 53,000	\$ 623,000	\$ 198,000	\$ 1,525,000
Habitat Preservation values	Not assessed	\$ 220,000	\$ 55,000	\$ 321,000	\$ 48,000	\$ 644,000
Atmospheric regulation	Not assessed	\$ 218,000	\$ 10,000	\$ 318,000	\$ 10,000	\$ 556,000
Asset Area (ha)	\$1,296,000	\$23,978,000	\$154,000	\$10,107,000	\$2,466,000	\$ 38,001,000

Community Impact

The project benefited the local population by supporting future flood mitigation enhancement, improvements to biodiversity, and by emphasizing the importance of ecosystem services. The project’s findings highlighted the critical role natural assets play in urban resilience, contributing to the broader understanding of their value in supporting sustainable communities.

What’s Next?

Long-term plans include scaling the project to other watersheds within the jurisdiction and developing collaborative monitoring strategies to build upon existing programs. Conservation Halton is engaging with other Conservation Authorities to share lessons learned and expand natural asset management efforts regionally. These steps aim to solidify the integration of natural assets into planning frameworks and provide a replicable model for other communities.

RESIDENTIAL CLIMATE ADAPTATION PROGRAMS

Residential climate adaptation programs aim to equip homeowners with the knowledge and tools to adapt and build resilience.

These programs educate residents about practical measures, such as installing flood-resistant materials, improving drainage systems, and implementing energy-efficient retrofits to reduce vulnerability to extreme weather. By offering resources, financial incentives, and technical guidance, these programs empower individuals to make proactive changes, ultimately strengthening community resilience and reducing the overall costs of climate-related damages.



CASE STUDY: DURHAM RESIDENTIAL CLIMATE ADAPTATION PROGRAMS

Overview and Context

Durham Region's Flood Ready Durham is a resource hub designed to engage, inform, and protect residents from the impacts of flooding. This project provides valuable information and tools for residents, businesses, and local governments to understand flood risks and implement effective mitigation strategies. By fostering collaboration and informed decision-making, Flood Ready Durham aims to protect communities and infrastructure from the impacts of flooding.

Residential Climate Adaptation Programs may take a variety of forms but focus on building resilience at the community level and can include:

- Knowledge hubs and capacity building
- Community engagement and outreach
- Residential tree planting, rain gardens, and landscaping initiatives
- Home retrofit programs
- Small-scale funding programs

By fostering collaboration and informed decision-making, Flood Ready Durham aims to protect communities and infrastructure from the impacts of flooding.

PLANNING INTERVENTIONS

CASE STUDY: DURHAM

Involvement and Collaboration

Created in partnership between Durham Region, local municipalities, Conservation Authorities, and the Climate Risk Institute, Flood Ready Durham is part of a larger project comprised of several impacted parties to raise awareness and the climate-related impacts across the Region.

Planning and Implementation

Flood Ready Durham aimed to build on previous assessments by improving flood risk data and raising flood risk awareness amongst local government and the public. The project was comprised of four major phases of work:

- Consultation with impacted parties.
- Dataset preparation, collection, and flood risk assessment preparation.
- Flood risk assessment and synthesis to curate messaging.
- Public engagement and knowledge mobilization.

The hub contains several resources for residents to better understand the types of flooding they may be at risk of, resilience measures being integrated into regional planning, how they can protect their homes from the impacts of flooding, and emergency preparedness.

Timeline and Resources

The project was awarded funding through the National Disaster Mitigation Program in early 2021 to address a major component of Durham's Community Climate Adaptation Plan and went online in Spring of 2023. The hub is updated frequently as new floodplain data become available and as resources are created.

Successes and Challenges

The Flood Ready Durham webpage showcases several case studies documenting the success of flood mitigation strategies. These include Low Impact Development initiatives at the Ontario Institute of Technology, Rain Garden Retrofits, incorporating LEED standards at the Ganaraska Forest Centre, and the Rouge Beach Improvements Project.

Community Impact

The Residents Guide to Vulnerability outlines measures residents can take to floodproof their home such as eavestrough clearing and downspout locations, green infrastructure and Low Impact Development, and sump pump installation. The Guide also includes plain language information on climate change projections and expected impacts, as well as strategies for food security, waste reduction, health and wellness, water conservation, and transportation choices to reduce carbon emissions.

Flood Ready Durham's Floodplain Viewer provides residents with the latest available data mapped by Conservation Authorities, representing the regulatory floodplain. This tool helps residents understand which areas may be theoretically inundated with floodwaters during an extreme event, where emergency services may be needed, and where flood mitigation is necessary to protect existing communities and future development.

What's Next?

The Region continues to enhance data analysis, monitor flood risk in identified areas, and develop and update resources for residents.



CONCLUSION

In the face of escalating climate challenges, planners in Ontario are uniquely positioned to lead the charge in building resilient communities. This practice guide has been developed to offer insights and inspiration drawn from a diverse array of successful interventions across the province. By examining these examples, planners can identify strategies that align with their local contexts, enabling them to craft tailored solutions that address specific climate hazards while resonating with community values.

The guide underscores the importance of collaboration across sectors and jurisdictions, highlighting the critical roles played by municipal departments, conservation and public health authorities, Indigenous groups, and community organizations and impacted parties. By fostering partnerships and leveraging collective expertise, planners can drive equitable and widespread resilience, ensuring that all communities—regardless of size or location—are equipped to withstand the impacts of climate change.

As Ontario continues to face extreme weather events, flooding, heatwaves, and other climate-related threats, the need for innovative and adaptable planning solutions becomes ever more pressing. We hope this guide empowers planners to build on existing successes, adapt proven methods, and implement interventions that maximize both impact and sustainability. In doing so, planners can help create climate-resilient, safer, healthier, and more sustainable communities across Ontario.

In addition to the strategies and case studies presented above, this guide includes a selection of supplementary adaptation resources. These resources provide additional insights, tools, and frameworks that can be tailored to meet the unique needs of each community, enhancing their capacity to effectively address climate challenges.



RESOURCE GUIDE



RESOURCE GUIDE

The following resources and links are offered to support ongoing learning and climate change adaptation capacity for planners.

CASE STUDY REFERENCES

City of Windsor Climate Change Adaptation Plan (2022)

Prince Edward County Official Plan (2021)

Bayfield Secondary Plan (Municipality of Bluewater, 2023)

District of Muskoka Official Plan (2023)

North Markham Urban Design Guidelines (City of Markham, 2018)

Town of Caledon Green Development Standard Guidebook (2024)

RESOURCE GUIDE

City of Guelph Sustainable Development Checklist (2023)

Ausable Bayfield Conservation Authority Shoreline Management Plan (2019)

City of Ottawa Flood Plain Mapping

Grindstone Creek Watershed Natural Assets Management Project (MNAI, 2022)

Flood Ready Durham (Region of Durham)

GENERAL CLIMATE CHANGE BACKGROUND AND RESOURCES

General information on climate change including scientific reports, review of impacts, case studies, and educational information designed for a variety of audiences including planners, decision-makers, and the general public.

C40 Cities Knowledge Hub - Climate Action Guide for Urban Planners

Canada's National Adaptation Strategy (2023)

Canadian Institute of Planners Resource Library

Environment and Climate Change Canada's Map of Adaptation Actions

Environment and Climate Change Canada's Regional Perspectives Report, Chapter 3: Ontario (2022)

Federation of Canadian Municipalities

ICLEI Canada - Local Governments for Sustainability

Indigenous Climate Change Adaptation Toolkit

Institute for Catastrophic Loss Reduction

International Panel on Climate Change (IPCC)

Natural Resources Canada (NRCan) Adaptation Library

The Ontario Resource Centre for Climate Adaptation (ORCCA)

Policy on Climate Change Planning (Canadian Institute of Planners, 2023)

INDIGENOUS PERSPECTIVES

Research and guidance on Indigenous perspectives and knowledge on climate change and building healthy and resilient communities.

Canada in a Changing Climate - For Our Future: Indigenous Resilience Report

Climate Change and Indigenous Peoples' Health in Canada (National Collaborating Centre for Indigenous Health, 2022)

Indigenous Climate Hub

CLIMATE EQUITY

Reports and guidance to support the integration of an equity lens on climate adaptation planning and policy.

Climate Change and Health Vulnerability Assessment for Waterloo Region, Wellington County, Dufferin County, and City of Guelph (Region of Waterloo Public Health and Wellington-Dufferin-Guelph Public Health, 2022)

Disability-Inclusive Climate Action Research Programme (McGill University)

Equitable Climate Adaptation - Considerations for Local Governments (ICLEI Canada, 2023)

Health of Canadians in a Changing Climate (Health Canada, 2022)

Integrating Equity, Diversity and Inclusion into Municipal Climate Action (Partners for Climate Protection, 2022)

Ontario Provincial Climate Change Impact Assessment (Ministry of Environment, Conservation and Parks, 2023)

CLIMATE SERVICES

Links to downscaled climate data and guidance on how to interpret climate projections and scenarios.

Canadian Centre for Climate Services

Climate Atlas of Canada

Climatedata.ca (Environment and Climate Change Canada)

ClimateWest

CLIMAtlantic

Pacific Climate Impacts Consortium

CLIMATE VULNERABILITY AND RISK ASSESSMENT

Guidance and tools on undertaking climate change vulnerability and risk assessments at a range of scales.

Climate Change and Health Vulnerability Assessment for Waterloo Region, Wellington County, Dufferin County, and the City of Guelph (Region of Waterloo Public Health and Emergency Services, 2022)

Guidance on Good Practices in Climate Change Risk Assessment, (Canadian Council of Ministers of the Environment, 2021)

Indigenous Climate Change Adaptation Planning Toolkit (Centre for Indigenous Environmental Resources, 2020)

Ontario Climate Change and Health Toolkit (Province of Ontario, 2016)

Public Infrastructure Engineering Vulnerability Committee Engineering Protocol (PIEVC, 2021)

ISO 31000:2018 Risk Management - Guidelines

NATURAL ASSET MANAGEMENT

Getting Nature on the Balance Sheet: Recognizing the Financial Value Provided by Natural Assets in a Changing Climate (Intact Centre on Climate Adaptation, 2022)

Natural Asset Initiative (NAI)

CLIMATE RESILIENCY CODES AND STANDARDS

National standards and guidelines for climate resiliency of built and natural infrastructure

CLIMATE RESILIENCY TRAINING AND CREDENTIALLING PROGRAMS

Infrastructure and Climate Resilience Planning Micro-Credential

Infrastructure Resilience Professional Credentialling Program

ADDITIONAL CLIMATE HAZARD FOCUSED RESOURCES

Flooding

Municipal Flood Risk Check-Up for Canadian Municipalities: Tackling Flood Together (Intact Centre on Climate Adaptation, 2024)

Wildfires

Wildfire-Ready: Practical Guidance to Strengthen the Resilience of Canadian Homes and Communities (Intact Centre on Climate Adaptation, 2024)

Extreme Heat

Irreversible Extreme Heat: Protecting Canadians and Communities from a Lethal Future (Intact Centre on Climate Adaptation, 2022)

Drought

Canadian Drought Monitor (Agriculture and Agri-Food Canada)

The health impacts of drought in Canada (National Collaborating Centre for Environmental Health)

Shoreline Impacts

Ontario's Flooding Strategy (Ministry of Natural Resources)

Value-for-Money Audit: Climate Change Adaptation: Reducing Urban Flood Risk (Office of the Auditor General of Ontario)

ACKNOWLEDGEMENTS

The project team respectfully acknowledges that the work of their respective organizations take place on the traditional and treaty territories of many Indigenous Nations, Communities and Peoples across what is now called Ontario. This land has been—and continues to be—home to Indigenous Peoples since time immemorial. Currently, there are 46 treaties in Ontario, 133 distinct First Nations communities, as well as many other diverse First Nations, Inuit, and Métis populations across the province. We also recognize that truth and reconciliation requires ongoing learning, unlearning, reflection, and action. Together, we must all strive to work collaboratively in the spirit of partnership to plan for better, more inclusive, equitable and sustainable communities, for all our human and non-human relations, and for all future generations.

OPPI, CRI and ORCCA acknowledge that the creation of this practice guide would not be possible without contributions from a variety of dedicated, passionate professionals.

Ontario Professional Planners Institute

Ryan Des Roches, CD, OCT

Sarah Bradbury

Candace Metzgar

Advisory Group

Zahra Jaffer, Candidate Member

Barbara Veale, RPP

Lisa Prime, RPP

Megan Myles, Candidate Member

Climate Risk Institute

Erik Sparling

Megan Gereghty, RPP

Santinah Green-Mignacca

Stephanie Gagnon, RPP

Co-Authors

Megan Gereghty, RPP

Zahra Jaffer, Candidate Member

Aynsley Klassen

Robert Wilson

Stephanie Gagnon, RPP

Erik Sparling

Ontario Resource Centre for Climate Adaptation

Aynsley Klassen

Ewa Jackson

Haley Anderson

Project Management Team

Ryan Des Roches

Zahra Jaffer

Aynsley Klassen

Erik Sparling

Spruce Creative

Cindy MacBride

Paul Marconi

Amy Thompson



Ontario
**Professional
Planners
Institute**