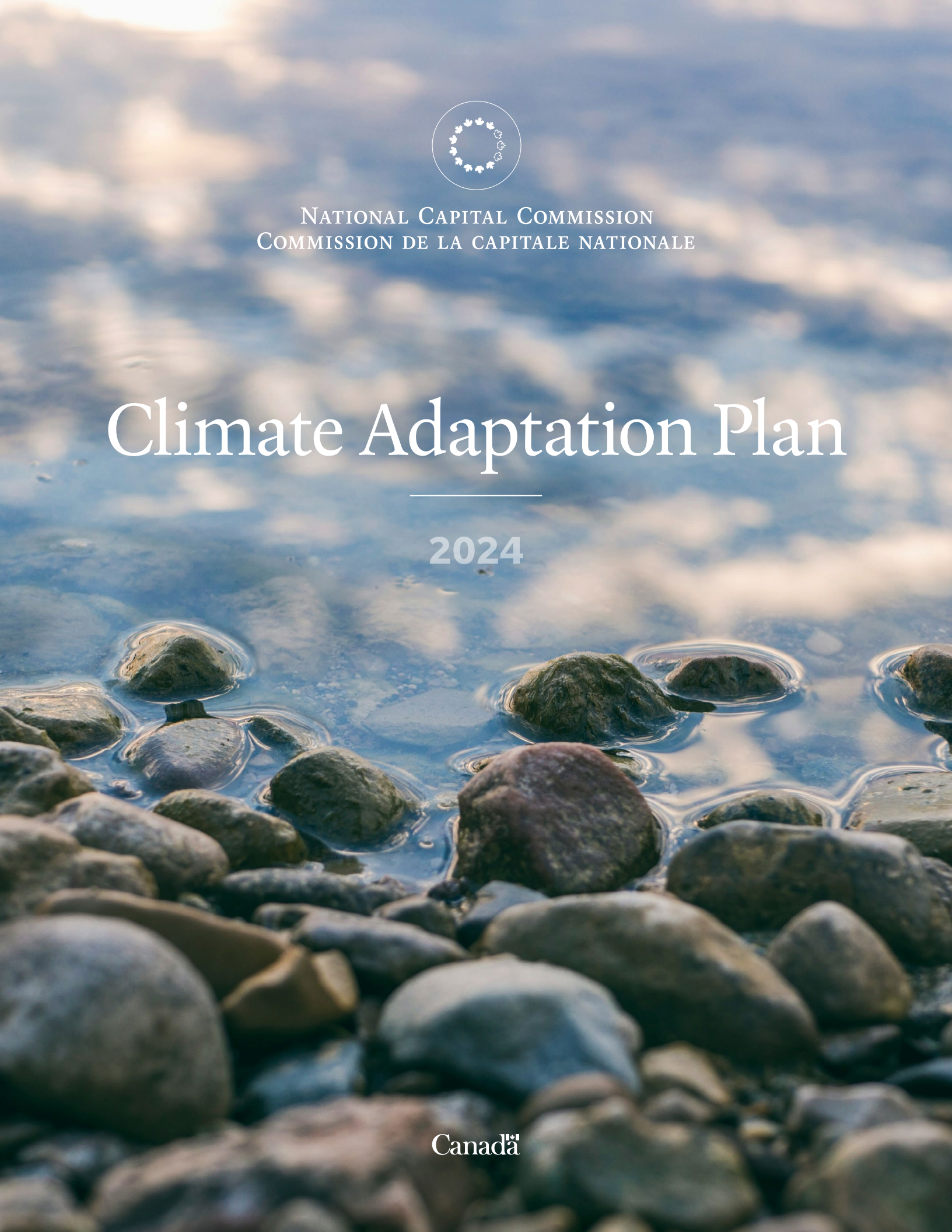


National Capital Commission
Commission de la capitale nationale

Climate Adaptation Plan

2024

Canada

Table of Contents

Figures

Executive Summary

Chaudières Bridge during the 2017 flood

People are feeling the impacts of climate change globally and locally. Research predicts these impacts will intensify and affect the National Capital Region for decades to come.[1] As such, the region will experience more extreme weather events like floods, wildfires, droughts, heatwaves, freeze-thaw spells and tornadoes. These hazards already magnify existing stressors or challenges, like aging infrastructure, and are expected to create new ones, as the risks of more frequent and severe climate-related hazards intensify over time. Without proactive action, the National Capital Commission's (NCC) exposure to the costs and disruptions related to climate change are expected to increase. This is the NCC's first plan to increase its resilience to climate risks.

This Climate Adaptation Plan (the Plan) is part of a three-phase project: climate projections study, climate vulnerability and risk assessment (CVRA), and action plan development. The first phase, completed in 2020, involved developing climate projections for the National Capital Region, which was done in partnership with the City of Ottawa and involved the Ville de Gatineau, Environment and Climate Change Canada's Canadian Centre for Climate Services, and conservation authorities. The second phase, completed in 2022, involved the completion of a climate vulnerability and risk assessment (CVRA) to identify the highest climate hazards and sectoral risks to the NCC. The CVRA identified hotter and more humid summers, short duration/high intensity and sustained precipitation events, and extreme events (e.g. windstorms, freezing rain) as the climate hazards that pose the greatest risk to NCC operations. It also identified several geographic risks, including flooding, shoreline erosion, urban heat islands and landslides. The third and final phase involved the development of this Climate Adaptation Plan to manage the greatest climate risks and identify risks shared by the NCC, the City of Ottawa and the Ville de Gatineau.

The development of the Plan involved two workshops with staff where the greatest risks across the eight sectors studied in the CVRA were presented. From this list of risks, a suite of potential actions were identified with staff and prioritized using six criteria: feasibility/complexity, policy alignment, foundation-setting, effectiveness, climate mitigation co-benefits and equity. The list of actions was further refined through extensive internal consultation, which has resulted in a total of 35 actions that are largely focused on internal decision-making processes and operations and to move the NCC towards a vision of the NCC being able to deliver its mandate despite climate disruptions.

[1] Climate projections for the National Capital Region

Of these 35 actions, 43% are focused on addressing many of the structural corporate vulnerabilities identified in the CVRA. Integrating consideration of climate risk into decision-making processes, or "mainstreaming," as well as capacity building, capital funding structures, and data collection, were identified as important strategies to address these vulnerabilities. The remaining actions (57%) are related to addressing the specific climate hazards and geographic risks identified in the CVRA. For example, there are actions related to stormwater management and the use of climate projections, reducing flood and extreme heat risks, improving emergency response, and mapping erosion, floodplains and extreme heat.

Overall, increasing the resilience of the NCC will require:

- embedding climate change and sustainable development considerations into all aspects of the organization (e.g. the requirement of climate risk assessments in capital funding decisions);
- adjusting internal structures to encourage long-term thinking and decreasing the number of assets with poor adaptive capacity;
- utilizing data and information to improve asset-level decision-making (e.g. linking asset management programs and climate change);
- working with stakeholders to understand how external vulnerabilities are being managed and reduced; and
- modifying financial and capital asset decision frameworks that realize the economic value of long-term investments under a changing climate.

In terms of updating the Plan, the NCC will be acquiring new climate projections at regular intervals, which will be followed by a new CVRA for the organization. The Plan will be reviewed based on this cycle and a halfway check will also be completed. Progress made as this Plan is implemented will be monitored as part of the NCC's Sustainable Development Strategy indicators and reported through its annual reports.

Derecho storm damage in the Greenbelt

1.0 Introduction

NCC River House

Climate impacts are already being felt globally and locally and are expected to continue to intensify and affect the National Capital Region for decades to come. This is the National Capital Commission's (NCC) plan to increase its resilience to climate risks.

At the local scale, the climate projections for the National Capital Region predict warmer winters, shorter snowfalls, hotter and drier summers, and more extreme heat events. Precipitation and rainfall intensity may increase, leading to more flooding. Conditions conducive to extreme weather phenomena such as freezing rain, tornadoes and forest or bush fires are likely to become more common.

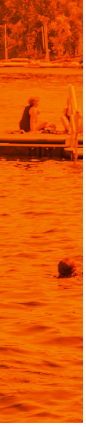
The NCC is committed to evaluating the risk of climate change impacts on NCC assets, programs and operations and to developing a Climate Adaptation Plan as a commitment under the NCC's Sustainable Development Strategy. As a designated entity under the *Federal Sustainable Development Act*, the NCC is required to contribute to and report on progress toward the Federal Sustainable Development Strategy. As a Crown corporation, the NCC is also encouraged to align with the Greening Government Strategy, and:

- take action to improve understanding of the risks posed by the impacts of climate change on federal assets, services and operations;
- take action to reduce climate change risks to assets, services and operations;
- apply climate-resilient building guidance being developed by National Research Council Canada; and
- increase training and support for public service employees on assessing climate change and impacts, undertaking climate change risk assessments and developing adaptation actions.

INDIGENOUS PEOPLES AND THE CAPITAL

The NCC acknowledges that the National Capital Region, in which it carries out its mandate, is situated on the unceded and traditional territory of the Algonquin Anishinaabeg People. The NCC values Indigenous heritage and knowledge and commits to continue working collaboratively with the Anishinabe Nation and other Indigenous communities to build a sustainable Capital Region.

Increasing the resilience of the NCC will require embedding climate change and sustainable development considerations into all aspects of the organization (e.g. the requirement of climate risk assessments in capital funding decisions), adjusting internal structures to encourage long-term thinking and decreasing the number of assets with poor adaptive capacity, utilizing data and information to improve asset-level decision-making (e.g. linking asset management programs and climate change), working with stakeholders to understand how external vulnerabilities are being managed and reduced, and modifying financial and capital decision frameworks that realize the economic value of long-term investments under a changing climate.



Like many proactive cities and organizations across Canada, the NCC has evaluated the risk of climate change to its assets, programs, and services by conducting a climate vulnerability and risk assessment (CVRA).

Through the completion of the CVRA, the NCC assessed the potential impacts of climate hazards for eight sectors:

1. Agriculture
2. Infrastructure and Operations
3. Natural Resources and Parks
4. Archaeology
5. Buildings, Housing and Real Estate
6. Corporate Services (IT, Security, HR, Procurement, Communications, Legal)
7. Recreation, Education, Tourism and Cultural Heritage
8. Land Use, Development and Planning

Based on the assessment, if no further adaptive actions are taken, the climate-related hazards associated with hotter and more humid summers, short duration/high intensity and sustained precipitation events, and extreme events (e.g. ice storms, freezing rain) are expected to present significant risks to NCC staff, residents and visitors, the construction, operation and maintenance of NCC infrastructure, the delivery of recreational programs and services and the natural function of ecosystems.

Climate hazards are likely to have the greatest number of priority impacts on the following NCC sectors:

- Natural Resources and Parks
- Infrastructure and Operations
- Buildings, Housing and Real Estate

The conclusion is that the NCC is highly vulnerable. In response to this CVRA, the NCC has developed this Climate Adaptation Plan ("Plan") to begin to reduce the consequences when climate events do occur and increase overall organizational resilience.

This Plan defines a new vision and objectives to build a resilient NCC that provides direction for future decision-making, as well as several line-item actions that can be initiated by NCC staff. It covers the lands managed by the NCC within the National Capital Region and is largely focused on internal decision-making processes and operations.

Impacts on natural resources and parks

The study has found that the NCC's assets within the 100-year flood plain are already at risk of extreme and long-duration precipitation events. This risk will increase as the probability of high-precipitation events increases. This will impact assets like shorelines, contaminated sites, and archeological sites.

We expect extreme heat, drought-like conditions and the cascading effects of seasonal changes to increase stress on ecosystems. These changes should make it increasingly difficult for the NCC to maintain tree canopy and achieve its tree-planting targets.

Impacts on infrastructure and operations

Heritage buildings and structures are at the greatest risk of extreme temperatures and precipitation as they were not designed to handle the projected climate conditions. Extreme heat, seasonal changes, heavy snow and long-duration precipitation events already impact them.

For at-risk infrastructures, intense and long precipitations are the most damaging and costly kind of hazard. Hotter summers and droughts speed up the degradation of infrastructure. They soften and rut asphalt roads and damage steel structures like bridges and rail systems. Winter freeze-thaw damages roads, sidewalks and shallowly buried infrastructure. They cause thermal cracks, frost heave, potholes and rutting.

These impacts can result in health and safety hazards, localized flooding and property damage. Many of the impacts have cascading impacts on operations, costs and users. With many of the NCC's pathways already in poor condition, this likely means more complaints, and slip, trip and fall-related liabilities.

Impacts on buildings, housing and real estate

Extreme heat can result in damaged or compromised buildings (e.g. mechanical systems not being able to keep buildings cool, or buildings without air conditioning), increased cooling demands on buildings and reduced indoor air quality, especially in older buildings. This can result in significant health and safety issues for the individuals that occupy the buildings – especially in cases where buildings do not have adequate insulation or air conditioning systems, which is often the case for heritage buildings.

Seasonal variability is expected to increase the number of winter freeze-thaw events, which can result in foundational damage, premature deterioration of concrete, damage to porous and masonry materials, damage to roofs due to ice dams (due to poor thermal insulation), moisture damage (due to poor moisture barriers), the freezing and breaking of pipes (due to poor thermal insulation) and hazards to building occupants (ice overhangs on copper and cedar roofs).

Electric heat pumps, like this one, have been installed on many NCC buildings. They provide climate mitigation co-benefits, including cooling to combat extreme heat and lower greenhouse gas emissions.

1.1 THE NCC'S ROLE IN CLIMATE CHANGE ADAPTATION

The NCC owns and manages over 11% of the lands in the National Capital Region (537 km^2) (Figure 1).

Figure 1. National Capital Region boundary and NCC-managed lands

It has custodial responsibilities that extend to a large and diverse portfolio of built and natural assets worth an estimated $2.2B.[2]

It also oversees natural assets that provide an average of $332M[3] worth of benefits yearly to the National Capital Region. Those natural assets include Gatineau Park, the Greenbelt, parkways, shorelines and urban green spaces. The value of the benefits of these natural assets is due mostly to the key climate regulation role they play and the ecosystem services they provide. These functions are critical to providing climate resilience as they adapt naturally to climate change. Other benefits of natural assets include their ability to improve air quality, improve water quality, provide a carbon storage solution, support wildlife habitat, and help control and minimize erosion.

The NCC's large portfolio also includes some of the most significant heritage, cultural and public assets in the country, many of which draw not only residents, but also over 10 million visitors annually. The NCC also offers programs and events including cross-country skiing, snowshoeing, ice skating, swimming, camping, hiking, trail running and cycling, among many others.

Because of the vast amount of land, the number of assets, and the breadth of programming and services offered to the public, the NCC is facing a strong climate change adaptation imperative as it becomes increasingly vulnerable to a range of climate hazards that include floods, wildfires, droughts, rising temperatures, winter freeze-thaw events, and more frequent and intense storms, like tornadoes. These hazards already magnify existing stressors or challenges, such as aging infrastructure, and are expected to create new ones, as the risks of more frequent and severe climate-related hazards intensify over time.

Rideau Canal Skateway

[2] *Summary of the Corporate Plan 2022–2023 to 2026–2027*

[3] *Natural Capital: The Economic Value of the National Capital Commission's Green Network*

1.2 CLIMATE RESPONSES

There are two general responses to climate change:

1. **Mitigation:** measures to reduce greenhouse gas (GHG) emissions and the impacts on climate change.
2. **Adaptation:** measures to prepare, protect and increase the resilience of infrastructure, assets, programming and people to the impacts and consequences of climate change.

Adaptation reduces an organization's vulnerability to the harmful effects of climate change by enabling an asset, sector, process or community to have a greater coping range for new or changing environments as represented in the blue box of Figure 2. This doesn't completely eliminate the risk, but increases the organization's ability to cope, resulting in an organization that is less vulnerable to a changing climate. Most importantly, climate adaptation is now an essential aspect of managing assets and infrastructure.

Climate change is already impacting NCC operations. For example, the floods of 2017 and 2019 had significant impacts on the multi-use pathway network. The emerald ash borer and the tornadoes in 2018 impacted trees on NCC-managed lands in Ottawa and Gatineau. The extreme heat episodes in the summer of 2018 impacted crops in the Greenbelt and increased energy demand to cool buildings. The 2022 derecho, estimated to cost the province of Ontario over $720M[5] in damages, resulted in significant tree and canopy loss within the NCC and closed parks and trails. Climate change has also disrupted winter activities, including popular programs such as cross-country skiing in Gatineau Park and skating on the Rideau Canal. The impact of these events ranged in economic magnitude but included service disruption to users, damage to, and loss of, physical and natural assets, reduced service life for asset components and assets themselves, and increased stress and reduced capacity of NCC staff and operations.

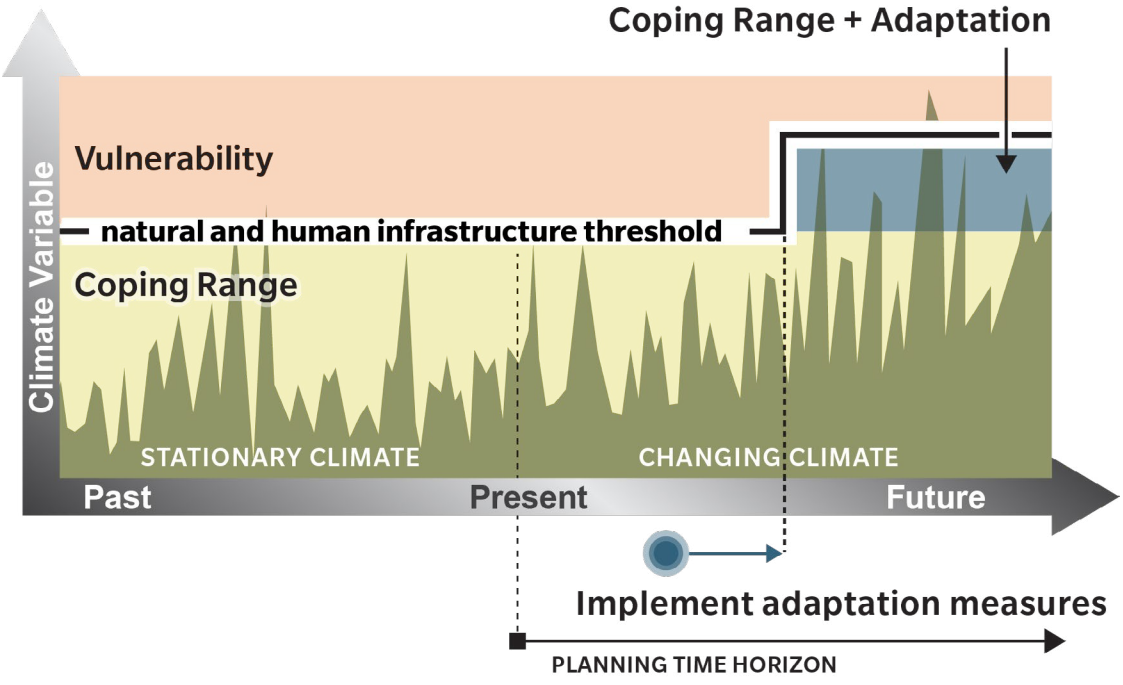
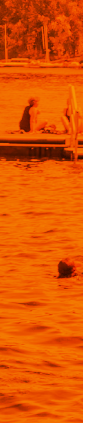


Figure 2. Adaptation aims to reduce vulnerability by increasing coping ranges[4]

[4] *Climate risk and business: Terminal Marítimo Muelles el Bosque Cartagena, Colombia*

[5] *Derecho Storm Ranks 6th Largest Insured Loss Event in Canadian History* (ibc.ca)



The cost of doing nothing to adapt to climate change is greater than the cost of climate damage. Failure to meet global GHG emissions targets could cost Canada $30 to $62B per year in adaptation costs by the 2050s and $74 to $319B by the 2080s.[6] The federal government could face annual costs of $3 to $8B by 2030, increasing to $6.2 to $13.5B if no proactive measures are taken.[7] The benefits of investing in adaptation measures are projected to outweigh the costs if the investments are made before 2030.[8] Under a high GHG emissions scenario (i.e. RCP 8.5), the National Round Table on the Environment and the Economy estimated that entities like the NCC could realize a benefit-to-cost ratio of 38:1; while under a lower GHG emissions scenario, the same benefit-to-cost ratio falls to 9:1.[9] Similar studies have also shown that every $1 proactively invested in resilient infrastructure could avoid $6 of losses resulting from climate change.[10]

As with proactively investing in infrastructure to increase its resilience, there is also a wide range of economic, social and cultural benefits that arise from maintaining and conserving high-quality green spaces that provide a vast range of ecosystem goods and services. Several recent studies show that the net economic value resulting from ecosystem conservation or restoration benefits (e.g. preventing and mitigating floods, erosion and landslides, mitigating effects of extreme heat, purifying groundwater, etc.) tend to outweigh the economic benefits from converting natural green spaces to other uses.[11] Restoration of degraded ecosystems can also have considerable climate resilience benefits; for example, a meta-analysis on restoration projects (>225 studies) found that the average benefit-cost ratio was 10, which means that every dollar invested results in a return of $10.[12] Another study estimated that by restoring 350 million hectares of degraded forest areas globally, $7 to $30 of economic benefits could be returned for every dollar invested. As the NCC protects more than 55,000 hectares of land, contributing an estimated average economic value of $332M per year in terms of ecosystem goods and services, it is critical to maintain and protect the high-value ecosystems in light of the impending threat posed by climate change.[13]

Adaptation and mitigation are not mutually exclusive and can sometimes result in co-benefits and synergies when carefully considered and planned for. For instance, green roofs can improve onsite stormwater management, increase biodiversity in the area, improve the thermal retention of the roof to reduce summer cooling energy use and reduce GHG emissions as a result. At the same time, resilience measures can increase GHG emissions. For example, increasing air conditioning to deal with extreme heat may increase GHG emissions, and so it is important to watch for these conflicts.

The NCC is in the process of developing a climate mitigation plan and in the future, this Climate Adaptation Plan and the Climate Mitigation Plan will be merged into a unified NCC Climate Action Plan. Identifying mitigation-adaptation co-benefits will be a key aspect of this combined plan.

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6 *Costs and Benefits of Climate Change Impacts and Adaptation*

7 Treasury Board of Canada Centre for Greening Government (2022). *Costing the Impacts of Climate Change to the Federal Government Phase 2 Study*

8 *Investing in Canada's Future: The Cost of Climate Adaptation at the Local Level*

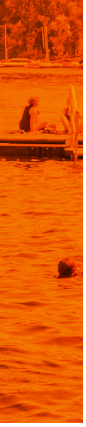
9 *Climate Prosperity – Paying the Price: The Economic Impacts of Climate Change for Canada*

10 *Natural Hazard Mitigation Saves–2019 Report*

11 *Opportunities for cost-effective restoration | Biodiversity: Finance and the Economic and Business Case for Action | OECD iLibrary (oecd-ilibrary.org)*

12 *Benefits of Investing in Ecosystem Restoration | Request PDF* (researchgate.net)

13 *Natural Capital – The Economic Value of the National Capital Commission's Green Network*



1.3 ADAPTATION HAS ALREADY BEGUN AT THE NCC

Even before this formal adaptation planning process began, the NCC had already taken several steps to increase the resilience of its infrastructure and programs to the changing climate. These actions include:

1. **Mapping:** The NCC has been mapping the tree canopy, urban heat, floodplains and socioeconomic status on the lands it manages to understand geographic risks that will be exacerbated by climate change. This information will help the NCC develop appropriate risk mitigation strategies.
2. **Forest strategy and tree planting goal:** The NCC has developed a forest strategy that includes a tree planting goal of 100,000 trees by 2026. The Forest strategy includes several actions that will contribute towards resilience, including determining species, varieties and cultivars or tree seed sources suitable for the future climate of the National Capital Region, for different types of terrain and functions.
3. **Better shoreline protection for key pathways:** The NCC has strengthened the construction on the Parliament and Voyageurs pathways following the floods of 2017 and 2019 to better withstand flooding.
4. **New adaptation lens in corporate processes:** The Multi-Year Capital Program (MYCP) funding and Strategic Environmental Assessment processes now include climate change adaptation as an evaluation metric.
5. **NCC's new headquarters:** The NCC's new headquarters at 80 Elgin Street was assessed for climate risk and measures have been integrated into the renovation design to improve the resilience of the site and building.
6. **Remediating Victoria Island:** The NCC is undertaking the remediation of Victoria Island, which was contaminated with hazardous materials from historical industrial activities. This initiative involves removing all contamination so none remains to wash downstream during flooding events and will help protect the final landscaping from erosion.
7. **Climate change and the Rideau Canal Skateway:** In 2022, the NCC partnered with Carleton University to address the impacts of climate change on the Skateway, with the aim of keeping this decades-long tradition alive.
8. **Capital Design Guidelines:** The Capital Design Guidelines are a reference tool for designers and decision-makers in the National Capital Region that sets out the NCC's expectations for the design of important places and buildings. The document provides guidance on several climate adaptation topics, including tree management, stormwater management, urban heat and flooding.
9. **Acknowledging corporate risk:** The threat to assets posed by climate change may limit the NCC's ability to effectively manage risks tied to asset deterioration and is already acknowledged in the NCC's Enterprise Risk Framework. The actions in the Climate Adaptation Plan are the primary strategy for mitigating this risk.
10. **Capital Pathway Strategic Plan:** The Capital Pathway Strategic Plan outlines a proactive approach to managing flood impacts on vulnerable pathway segments. For areas where frequent flooding is anticipated, seasonal detours will be planned. In areas where pathways are located within the 100-year flood plain, they will be designed to be resilient to major flood events through improved alignments, grading and construction methods. For low points within the 20-year flood plain, the Plan calls for redesign or relocation to mitigate flood impacts and adapt to recurring, yearly flood events.

11. **Sustainable agriculture:** the NCC Sustainable Agriculture Strategy articulates strategies to improve soil and crop quality and diversity on Greenbelt farms. When it is updated, climate adaptation will feature prominently.
12. **Archaeological map data:** Maps of known and potential archaeological sites have been added to the NCC's internal geomatics system so that the rescue of archaeological artifacts can be considered at the project level. Flooding and shoreline erosion are creating pressure to rescue artifacts before they wash away, and climate change is exacerbating this challenge.
13. **Changing how cross-country ski tracks are set:** The NCC has changed the equipment used to set cross-country ski tracks so that tracks can be groomed with very little snow.
14. **NCC's IT system:** The relocation of the NCC IT system's disaster recovery function to the cloud now guarantees the organization's operational continuity in the face of potential harm to NCC servers due to extreme events or extended power outages.
15. **Disclosing climate-related financial risk:** Per the 2021 federal budget, the NCC is required to disclose its climate-related financial risk by 2024. While this work is just beginning, the NCC's Sustainable Development Strategy aims to implement eight of the 11 recommendations of the Task Force on Climate-related Financial Disclosures standards by 2024–2025.

Overall, these steps taken by the NCC signal the organization's commitment to increasing the resilience of the lands it manages to the effects of climate change. By proactively planning for and responding to climate change, the NCC is setting an example for other organizations to follow.

Grooming of a cross-country ski trail in Gatineau Park

2.0 About This Plan

Bioswale at Champlain Bridge node parking lot

2.1 PLAN DEVELOPMENT PROCESS

The Plan is part of a three-phase project: climate projections study, climate vulnerability and risk assessment, and action plan development. The process of developing the Plan is depicted in Figure 3.

The first phase involved developing climate projections for the National Capital Region. This phase was completed in partnership with the City of Ottawa and involved feedback from staff and NCC stakeholders, such as the Ville de Gatineau, Environment and Climate Change Canada's Canadian Centre for Climate Services, and conservation authorities.

The second phase involved the completion of a CVRA to identify the highest climate hazards and sectoral risks to the NCC. The objective of the CVRA was to expand the NCC's understanding of its vulnerability to climate change within and across business lines and identify ways in which the organization can reduce its vulnerability and increase resiliency to the impacts of climate change. The development of the CVRA involved utilizing the climate projections developed in Phase 1, maps and asset management data, and engagement with staff to assess climate-related vulnerabilities and risks to NCC operations and built and natural infrastructure.

The third and final phase involved the development of this Climate Adaptation Plan to manage the greatest climate risks and identify risks shared by the NCC, the City of Ottawa and the Ville de Gatineau. The development of the Plan involved two workshops with staff, where the greatest risks across the eight sectors studied in the CVRA were presented. From this list of risks, a suite of potential actions was identified, and a prioritization list was completed.

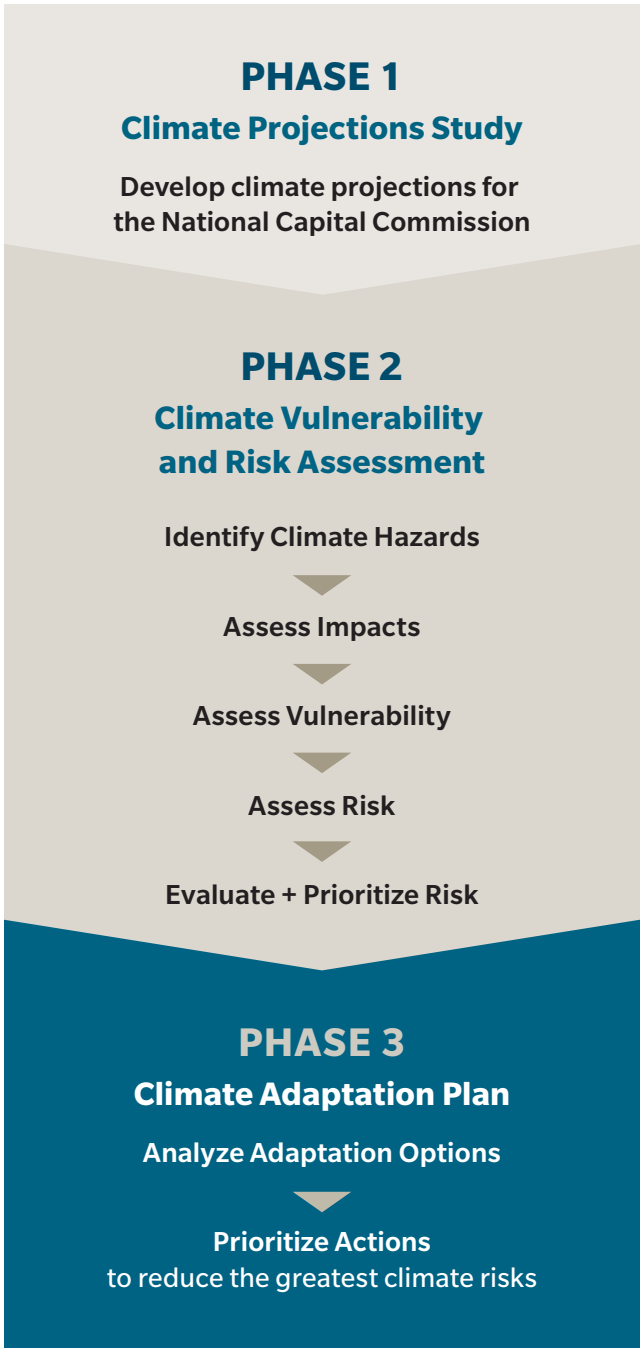
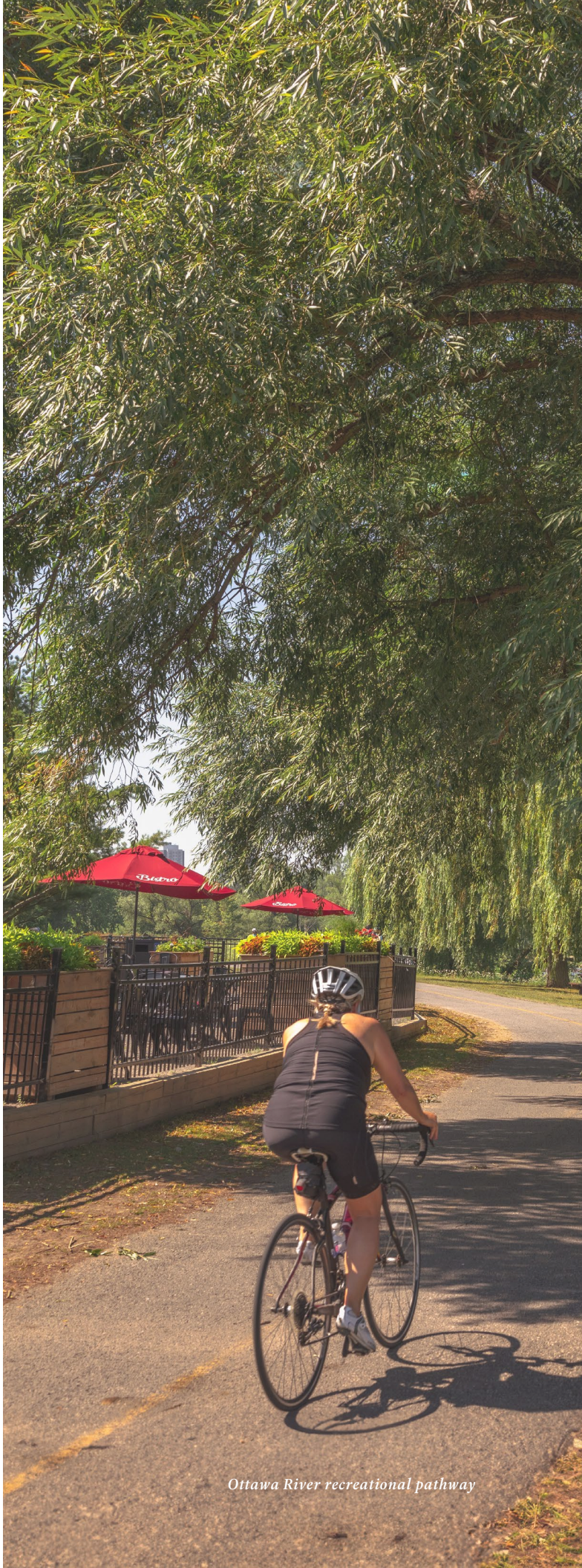


Figure 3. NCC Climate Adaptation Plan development phases

This list of actions was prioritized using the following six criteria:

- **Feasibility/complexity:** The adaptive and risk reduction measure is relatively straightforward to implement and maintain from an operations and maintenance perspective.
- **Policy alignment:** The adaptive and risk reduction measure is not in conflict with other adaptation efforts and is coherent with existing or planned NCC corporate priorities and policies.
- **Foundation setting:** The adaptive and risk reduction measure lays the foundation for other efforts/actions at the NCC, though by itself may not increase the resilience of the organization measurably.
- **Effectiveness:** The adaptive and risk reduction measure will achieve the intended outcome(s) of reducing or preventing climate change damage.
- **Climate mitigation co-benefits:** The adaptive and risk reduction measure has a neutral or net positive effect on GHG emissions.
- **Equity:** The adaptive and risk reduction measure benefits or does not cause harm to vulnerable populations.

The list of actions was further refined through extensive internal consultation, which has resulted in a total of 35 actions for inclusion in this plan.



Ottawa River recreational pathway

3.0 The Plan

Confederation Park

3.1 VISION

The NCC is thriving in its ability to deliver its mandate, despite climate disruptions, and contributes to building a resilient National Capital Region.

3.2 PRINCIPLES

The following principles have been developed for the Plan. They are meant to guide decision-making as the NCC implements the actions within this Plan and as new risks and opportunities emerge over time.

Principle 1 – Mainstream adaptation into existing processes, policies and decision-making mechanisms

Managing climate-related risks through adaptation requires that consideration of climate risk be integrated into key corporate processes, from policy development to project management. When plans, processes and projects are being updated or considered, it is necessary to evaluate vulnerabilities, gaps and risks and build in flexible adaptive measures that provide both short- and long-term benefits. This principle mirrors one of the principles of the Sustainable Development Strategy: to include sustainable development in decision-making processes, planning and operations.

Principle 2 – Protect green spaces

Green spaces support resilience in multiple ways. For example, they can mitigate flooding by absorbing rainfall onsite, support habitat, provide shade and improve air quality. Through its long-range planning functions, land use planning, maintenance and operations, the NCC looks to protect and enhance green spaces. When development sites are identified, ecological enhancements and compensation are considered and integrated into the planning exercise to ensure green spaces continue to play a key role in the National Capital Region.

Principle 3 – Prioritize climate mitigation co-benefits and avoid conflicts

Climate change adaptation measures may have GHG mitigation co-benefits and vice versa. Wherever possible, the co-benefits of actions should be used to prioritize actions. At the same time, actions that improve resilience can result in GHG emission increases, for example, air conditioning. Likewise, actions to reduce GHG emissions can worsen resilience. For example, "Compact urban development can hinder adaptation efforts as high-density locations lack enough green and open spaces and are more prone to heat stress due to the UHI effect."[14] It is important to watch for these conflicts.

[14] Pierer, C., Creutzig, F., 2019. Star-shaped cities alleviate trade-off between climate change mitigation and adaptation. Environ Res Lett 14(8).

Principle 4 – Prioritize health impacts and safeguard vulnerable populations

Considering health impacts, especially on vulnerable populations, is of the utmost importance when adapting to climate change. Climate change has far-reaching consequences on various aspects of human health, including increased risks of heat-related illnesses, infectious diseases, and danger during extreme weather events. Vulnerable communities, such as the elderly, children, low-income groups, and those with pre-existing health conditions, are particularly at risk. Therefore, adaptation strategies need to prioritize the health and well-being of the public, tenants and staff, so that we can build resilience, reduce disparities, and create sustainable and equitable solutions that protect and promote the health of all individuals.

Principle 5 – Partnerships for regional sustainability

Creating resilient communities requires collaboration across political and geographical boundaries, as well as knowledge and expertise from various disciplines. The NCC must collaborate with its partners at the City of Ottawa, Ville de Gatineau, adjacent municipalities and other levels of government to foster the exchange of ideas and tackle significant climate challenges in a coordinated way within the region. By implementing this strategy, the NCC will go beyond merely making its operations more resilient and will move toward a more resilient Capital Region.

Principle 6 – Adopt a long-term view

Increasing resilience to climate change is a long-term goal that requires:

- an ongoing commitment to proactive action;
- established governance processes and frameworks to assess and sustain progress;
- adequate and stable funding;
- planning and financial systems capable of measuring avoided costs and co-benefits;
- meaningful engagement with stakeholders;
- a culture willing to change and adapt when circumstances and the climate changes.

3.3 ACTIONS

A total of 35 actions have been identified and grouped according to six overarching goals:

- Corporate Policy and Guidelines
- Capacity Building
- Operational Planning and Management
- Emergency Response and Business Continuity
- Capital Investment and Funding
- Data Deployment

The following table presents the actions of this Plan, to be implemented over the following time periods to achieve the vision of a resilient NCC:

Continuous: action will continue or occur repeatedly throughout the life of the Plan.

Short term: action should be initiated within 0–4 years, matching the Sustainable Development Strategy renewal cycle.

Medium-to-long term: action should be initiated within 5–8 years.

Corporate Policy and Guidelines

Integrate the consideration of climate risk into the NCC's policies, guidelines and rulemaking processes.

1	Require a climate vulnerability and risk assessment before the design phase on applicable projects to ensure climate resilient project design.	**Short term**
2	Adopt climate adaptation guidelines to incorporate into NCC projects.	**Short term**
3	Enhance existing ecological corridors as part of the long-range planning functions to ensure ecological connectivity in the face of urban pressure on ecosystems.	**Short term**
4	Strengthen the Strategic Environmental Assessment process to integrate consideration of climate risks in the land use planning process.	**Short term**
5	Integrate an environmental pre-screening into the Process for Project Management at the statement of requirements stage to protect ecological functioning, including evaluation of species at risk, wetland and tree compensation, and invasive species.	**Short term**
6	Implement NCC stormwater management guidelines in projects to prevent flooding and update the policy based on climate projections.	**Short term**
7	Review gaps in occupational health and safety training programs for exposure to climate risks to protect employee health and safety.	**Short term**
8	Integrate resilience measures into every phase of development at LeBreton Flats, including infrastructure, buildings and parklands, to mitigate climate risks at the design stage.	**Short term**
9	Develop a policy to guide new development in the 1:20, 1:100 and 1:350 floodplains to limit future risk to the organization.	**Medium-to-long term**
10	New building designs and equipment upgrades will use NCC climate projection data that relates to the end of life, or the building codes, whichever is more stringent, as the basis of design to ensure building upgrades are suited to future climate conditions (applies to NCC-led projects).	**Medium-to-long term**

Capacity Building

Ensure that staff have the training, decision-support tools, and resources to ensure climate risks are considered when it comes to the management of climate risk across business lines.

11	Require all staff to complete a suite of mandatory climate mitigation and adaptation courses to increase capacity to reduce climate risks at the project level/design stage.	**Short term**

Operational Planning and Management

Integrate the consideration of climate risk into everyday operations and asset management and planning.

12	Collect data about ice formation and test ice-building technologies to maintain the skating season of the Rideau Canal Skateway in the near term.	**Continuous**
13	Explore options to adapt recreational offerings based on climate projections to manage climate risks to the sector in a coordinated manner.	**Continuous**
14	Lead a strategic assessment encompassing three archaeologically significant zones vulnerable to the impacts of climate change: Leamy Lake Park, Jacques Cartier Park and Rockcliffe Park.	**Short term**
15	Conduct a risk assessment of assets, including archeological resources, in high-risk areas, including the current (i.e. non-climate adjusted) 1:20, 1:100 and 1:350 floodplain and landslide zones, and identify options to reduce the impact of these hazards.	**Short term**
16	Update asset inspection checklists to include climate vulnerability and risk in order to prioritize improvements to assets.	**Short term**
17	Explore opportunities to move attractions/programming associated with the Rideau Canal Skateway (e.g. skate rentals, beavertails, washrooms, not the skating itself) to land locations to reduce disruptions to winter programming.	**Short term**
18	Complete a climate vulnerability and risk assessment for the Portage and Champlain interprovincial bridges to identify high-risk components.	**Short term**
19	Expand the existing summer volunteer first aid patrol program to mitigate a higher visitor vulnerability related to climate change.	**Short term**

20	Expand the Gatineau Park visitor experience agent program and include educational material on species at risk and invasive species. Create a volunteer park stewardship program that would operate in support of this program.	**Short term**
21	Explore the option of increasing the asphalt performance grade used to maintain asphalt lifespan.	**Medium-to-long term**
22	Complete a climate vulnerability and risk assessment for all non-interprovincial vehicular bridges that cross waterways to identify high-risk components and climate-resilient maintenance recommendations.	**Medium-to-long term**

Emergency Response and Business Continuity

Implement prevention and preparedness actions in advance of extreme weather events and streamline response and recovery processes.

23	Complete an emergency response gap analysis and clarify needs and responsibilities for communication during and following extreme events, and develop playbooks for a range of extreme weather events.	**Short term**
24	On a semi-annual/seasonal basis, conduct a scan of potential supply chain risks and stockpile supplies, particularly those related to health and safety and critical operations, as necessary.	**Short term**
25	Continue onsite server transition to an eco-friendly cloud solution to ensure business continuity during extreme events.	**Short term**
26	Replace the two-way radio communication system to bolster emergency response and coordination systems.	**Short term**
27	Increase standing offer agreement and call-up limits during emergencies to facilitate cleanup and recovery efforts.	**Short term**
28	Develop an emergency management Corporate Administrative Policies and Procedures (CAPP) that articulates the key components of emergency response and accountabilities.	**Medium-to-long term**
29	Conduct an annual emergency response dry run to ensure the reaction to extreme events is more coordinated.	**Medium-to-long term**

Capital Investment and Funding

Integrate the consideration of climate risk into capital, budgeting and financial decision-making processes.

30	Review language in the Multi-Year Capital Program (MYCP) prioritization matrix and new project form, on an ongoing basis, to ensure sufficient consideration for climate risk analysis and sustainability measures.	**Continuous**
31	Create a system to track operational, staff resource and capital costs resulting from extreme events to manage them effectively and better inform decisions on where to make investments.	**Short term**

Data Deployment

Improve the collection, deployment and utilization of relevant local climate data and information resources.

32	Update urban heat maps every five years to ensure that extreme heat is considered in land use and project planning.	**Continuous**
33	Update floodplain maps every five years to ensure that flooding is considered in land use and project planning.	**Continuous**
34	Develop a land cover layer in GIS. Add to GeoVu and remodel every five years to track changes in land use and loss of natural areas.	**Short term**
35	Add erosion hazard maps in GeoVu to manage climate risks during land use and project planning.	**Short term**

3.4 MATCHING ACTIONS TO CLIMATE VULNERABILITY AND RISK ASSESSMENT

The objectives and actions of the Plan address many of the 124 impacts as well as the underlying structural corporate vulnerabilities identified in the climate vulnerability and risk assessment (CVRA). Climate change is complex and touches all activities at the NCC; however, the actions included cannot address all of the risks all at once. The CVRA identified extreme heat, drought and humidity, seasonal variability and change, increased precipitation (volume and intensity) and extreme events (e.g. windstorms, freezing rain, etc.) as the climate hazards that pose the greatest risk to NCC operations. It also identified several geographic risks including flooding, shoreline erosion, urban heat islands and landslides. As can be seen in Figure 4, the Plan has actions (~57%) related to each of the four climate hazard themes to address these hazards and geographic risks. For example, there are actions related to stormwater management, reducing flood and extreme heat risks, improving emergency response, and mapping erosion, floodplains and extreme heat.

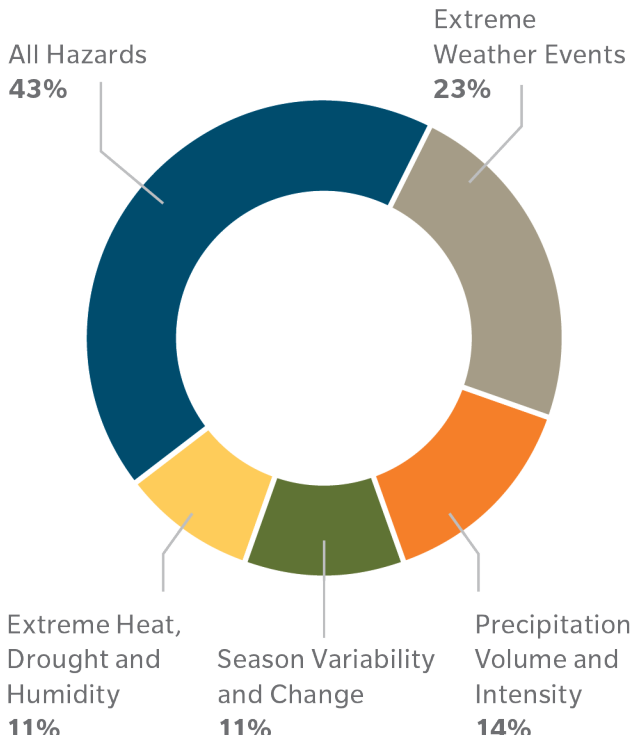


Figure 4. Breakdown of actions by climate hazard

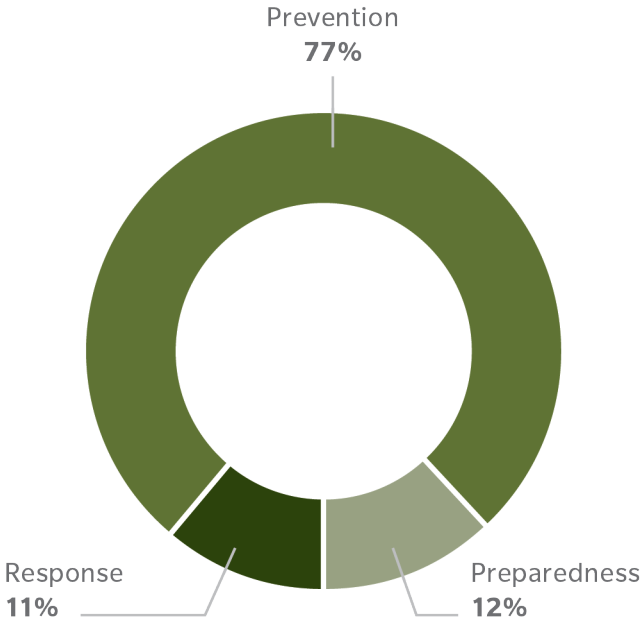


Figure 5. Breakdown of actions by disaster response function

The remaining "all hazards" actions (~43%) are focused on addressing many of the structural corporate vulnerabilities identified in the CVRA. Integrating consideration of climate risk into decision-making processes, or "mainstreaming," as well as capacity building, capital funding structures, and data collection, were identified as important strategies to address these vulnerabilities and there are therefore several objectives and actions related to these themes.

As part of the action plan development stage, actions were also mapped against the stages of disaster response (prevention, preparedness, response and recovery – see text box) and NCC sectors to make sure there were no gaps. By adding a climate risk and resilience lens into corporate processes, we can ensure that climate risk is considered in all aspects of the delivery of the NCC's mandate. In terms of disaster response, Figure 5 shows that more than 88% of actions are focused on prevention and preparedness, which is all about reducing structural vulnerabilities. There are few actions related to response and no actions related to recovery as the NCC is already adept at responding and recovering from events. The purpose of this plan is to build resilience to the effects of climate change so that there is less damage and disruption and less effort and time needed to recover.

Four Stages of Disaster Preparedness

Disaster preparedness is divided into four stages: prevention, preparedness, response, and recovery. It is a continuous cycle of planning, organizing, training and evaluating emergency actions and procedures. Each of the phases is described below:

- Prevention – Seeking opportunities and implementing actions to reduce the probability of emergencies occurring and reducing the consequences when they do.
- Preparedness – Taking actions to be prepared and ready for an emergency (e.g. organizing, training and evaluating emergency actions).
- Response – Protecting life and infrastructure during and immediately after an emergency.
- Recovery – Rebuilding and restoring services after an emergency.

Many actions (34%) in this Plan are designed to address the priority impacts on the three most at-risk sectors: Infrastructure and Operations, Natural Resources and Parks, and Building, Housing and Real Estate (Figure 6). For example, there are actions related to bridges, asphalt, building inspections, matching lifecycle planning to climate projections, emergency response structures, mapping land cover change, etc.

In addition to the priority impact areas identified above, land use and corporate services tend to also be largely impacted by the effects of climate change, and so a further 43% of the actions are related to these areas. By implementing actions in these sectors, the downstream impacts on recreation, education, tourism and cultural heritage, buildings, housing and real estate, agriculture and archaeology are lessened, and thus fewer resilience actions are required.

There are also policy and procedure-related actions that affect all sectors; while there are only a few actions (9%), they are strategic and impactful. Although there are no actions related to agriculture at this time, the next iteration of the Sustainable Agriculture Strategy will include some solutions to the risks posed to this sector. Not all impacts identified in the CVRA are addressed by actions in this plan; in some cases, addressing the impact is beyond the NCC's control or would be immensely costly and complex. At the same time, there are actions in this plan that are not directly connected to an impact or structural corporate vulnerability identified in the CVRA; these actions were identified through internal consultation and expert opinion following the completion of the CVRA.

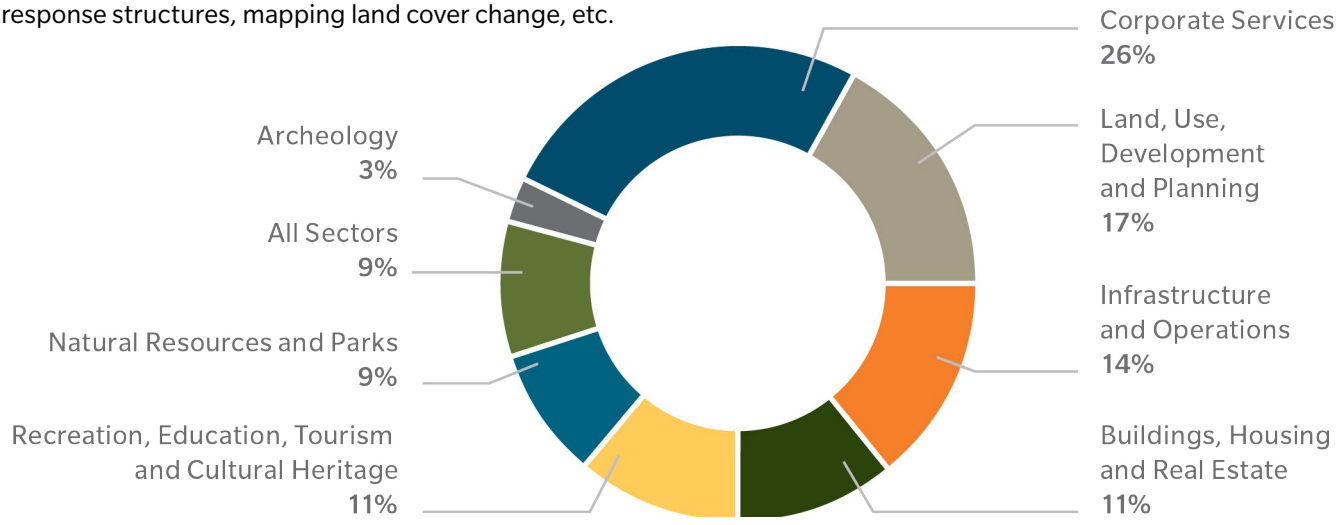


Figure 6. Breakdown of actions by NCC sector

3.5 TIME HORIZON

The NCC will be acquiring new climate projections regularly, followed by a new CVRA for the organization. The Plan will be reviewed based on this cycle and a half-way check will also be completed; see Figure 7.

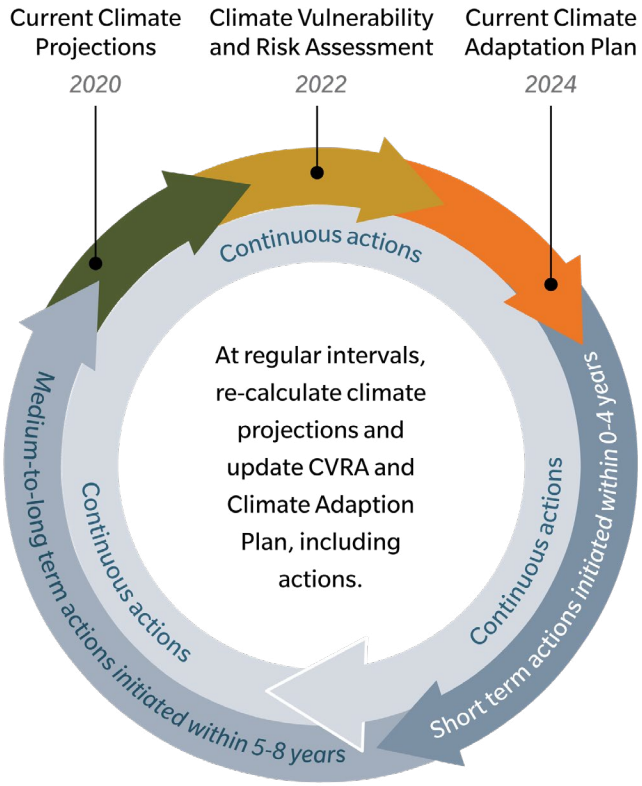


Figure 7. Plan horizon

3.6 COLLABORATION WITH REGIONAL STAKEHOLDERS

The NCC's geographic jurisdiction spans two cities and thus can play a leadership role in regional climate resilience by collaborating with both. The NCC has collaborated with both cities throughout all stages of this Plan's development and will continue to do so. Collaborating on the acquisition of regional climate data, such as urban heat, tree canopy, and climate projections presents an opportunity to acquire and work from shared consistent regional data in a fiscally efficient way. As all three jurisdictions will be developing similar assessments, guidelines and policies, there is a significant opportunity to collaborate and learn from one another when developing these resources, which will promote consistency across the three jurisdictions. The NCC and both cities will continue to reciprocally consult with each other regarding projects that may impact each other's plans or operations.

In addition to the two cities, there are several other regional stakeholders that share goals when it comes to climate change adaptation. The NCC hosted a regional sustainability workshop in December 2023, where regional stakeholders shared information on their sustainability initiatives and climate action plan development and progress.

Even though each stakeholder has slightly different priorities and plans that are at different stages of their development, it was clear that for certain initiatives, there was good alignment. Participants highlighted the need to collaborate, where possible, to leverage resources and knowledge for a more streamlined and regional approach. A key next step will be to identify areas of collaboration and outline a proposed governance framework to facilitate these conversations.

All participating regional stakeholders committed to continuing discussions to advance climate resilience in the National Capital Region.

4.0 Implementation

Retaining wall along the Kichi Zībī Mīkan

The Plan contains a list of recommended actions to be completed in the 2024–2032 timeframe. Implementation of the actions is likely to require dedicated resources and systems in place to ensure that the policies, programs and projects recommended are implemented and tracked so that resilience can be increased and gaps identified. Initial funding has been identified as outlined in Section 4.1 and the intention is that climate adaptation actions will be included into business planning going forward. The following are the core elements of the implementation framework for this Plan:

1. Resource and Budget Planning
2. Governance and Accountabilities
3. Monitoring and Reporting

4.1 RESOURCE AND BUDGET PLANNING

Funds to bridge projects currently underway and initiate short-term actions have been identified. The resources identified are early estimates and will be refined as implementation plans are developed. As actions are integrated into the NCC's planning and project cycle, project budgets will need to adequately account for adaptation assessments and measures. Funding for medium-to-long-term actions will be reviewed at the halfway point of this Plan (2027) alongside the development of the next cycle of NCC's Sustainable Development Strategy.

4.2 GOVERNANCE AND ACCOUNTABILITIES

Since 2018, sustainable development and climate action have been a corporate priority for the NCC. The Sustainable Development Strategy for 2023–2027 goes beyond the previous 2018–2023 strategy by including governance-related commitments that focus on establishing internal structures and processes that will further empower all staff to take responsibility for integrating sustainable development into the NCC's business lines. These commitments are:

1. Update the NCC's environmental sustainability policy.
2. Clearly define the roles, responsibilities and accountabilities for sustainable development, embed them into the NCC's governance structure and communicate them to staff.
3. Add sustainable development objectives into performance measurement, including executive and employee performance management.

The NCC has also adopted the Task Force on Climate-related Financial Disclosures (TCFD) standards. The NCC committed to disclose its climate-related financial risks and opportunities and integrate them into its strategic and operational plans and decision-making processes. The implementation of the TCFD standards and the disclosure of NCC climate-related risks and opportunities will clarify governance of sustainable development across the organization.

4.3 MONITORING AND REPORTING

This Plan will be monitored as part of the NCC's Sustainable Development Strategy. Progress towards the implementation of the short-term actions will be reported as part of the Sustainable Development Strategy annual reports. The following indicators, from the Sustainable Development Strategy 2023–2027, will be used to monitor and report on progress toward increasing NCC climate resilience:

- Percentage of applicable projects where a climate risk assessment was conducted before the design phase (100% of applicable projects by 2025).
- Number of trees planted on NCC lands since 2021 (target: 100,000 trees planted by 2026).
- Percent of tree canopy cover on NCC lands (target: maintain tree canopy cover at 74%).
- Number of new green spaces developed (target: three new green spaces developed by 2027).
- Number of existing green spaces enhanced (target: at least one green space enhanced by 2027).
- Economic value of the ecosystem services provided by NCC green spaces (target: maintain the economic value of the ecosystem services provided by NCC green space).
- Number of properties managed for nature conservation within identified corridors (target: a consistent increase in the number of properties managed for nature conservation, with a minimum of two conservation projects carried out annually).
- Percent of standing offers and contracts for the purchase of high-impact goods, services and construction that include green procurement criteria (target: 80% by 2027).

Tree planting on NCC lands

The work done through the disclosure of climate-related financial risks as per the TCFD standards (see Section 4.2) will also be a means to monitor and report progress made under this Climate Adaptation Plan.

At the halfway point of this Plan, the NCC will conduct a review of the actions. This will be an opportunity to add or modify actions to address emerging climate trends and opportunities to improve resilience or remove actions if they have been determined to be unfeasible or ineffective. This review will also determine the effectiveness of this Plan in improving the NCC's resilience and identify new strategies to manage climate risk. It is expected that additional indicators, specific to the actions, will be developed, if needed, as implementation plans are put in place.

Beaver dam management

5.0 Glossary

Mer Bleue Bog

adaptation: Acknowledgement that climate change is happening and adopting measures to respond to changes that are irreversible and already underway. [*adaptation*]

climate change: Long-term changes in climate variables, as measured by temperature, precipitation, and frequency of events, differ significantly from the normal range of extremes for a particular region. [*changement climatique*]

climate hazard: Potential source of harm. Hazard comprises slow-onset developments (e.g. rising temperatures over the long term) as well as rapidly developing climatic extremes (e.g. a heatwave) or increased variability. [*aléa du climat* or *danger climatique*]

climate impact: The resulting problem or opportunity to deal with a climate hazard (e.g. culvert failures, road washouts, flooding basements, etc.) [*incidence climatique* or *impact climatique*]

climate variability: Natural changes in climate that fall within the normal range of extremes for a particular region. Climate variability can range over time and space and result in thunderstorms, tornadoes, etc. [*variabilité climatique*]

enterprise risk management: The process of planning, controlling and acting on potential hazards and dangers to minimize their impact on an organization's operations and processes. [*gestion du risque d'entreprise*]

mitigation: A measure taken to reduce the probability of a risk occurring or the impact of negative consequences if it does occur; often referred to as a control measure. In the context of climate change, mitigation commonly refers to efforts to reduce greenhouse gas emissions at global, national, sub-national or organizational levels. [*atténuation*]

resilience: The capacity to respond to and recover from climate trends and shocks. [*résilience*]

risk: The effect of uncertainty. [*risque*]

risk assessment: The process of determining and evaluating risks. Assessments may be quantitative or qualitative and involve applying rating levels to prioritize risks needing mitigation. [*évaluation des risques*]

vulnerability: The propensity to be affected by change. Vulnerability encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt. [*vulnérabilité*]

National Capital Commission
Commission de la capitale nationale

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