GREEN MUNICIPAL FUND
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# PLANNING FOR CLIMATE-RESILIENT INFRASTRUCTURE

## WHAT IS CLIMATE-RESILIENT INFRASTRUCTURE?

Climate-resilient infrastructure refers to infrastructure systems and assets that are designed, constructed, operated and maintained to allow them to withstand and adapt to climate change impacts. This type of infrastructure encompasses a wide range of physical and non-physical components, including buildings, transportation networks, water and sanitation systems, energy grids, communication systems and other essential infrastructure.

## WHAT MAKES AN INFRASTRUCTURE PROJECT CLIMATE-RESILIENT?

An infrastructure project with climate resilience is typically one that is designed to be physically robust and durable—one that is capable of withstanding climate-related hazards and stresses.

Here are some characteristics of climate-resilient infrastructure projects:

- adaptable and flexible, can respond to changing climate conditions and future uncertainties
- incorporate redundancy measures (e.g., backup systems)
- use climate data, projections and assessments to inform decision-making, design and planning
- involve collaboration and engagement with various stakeholders
- often include nature-based climate solutions

## WHY DOES CLIMATE RESILIENCE MATTER?

As local governments across Canada aim for transformative change and deploy net-zero solutions, they cannot subject their investments to unmitigated climate risk that may undermine infrastructure integrity and/or design life. **There is no smooth transition to a net-zero future without enhancing resilience as we go.**

Building infrastructure to minimum climate-resilience standards is crucial for several reasons:

- ✓ **Protection against climate risks:** Climate-resilient infrastructure is designed and constructed to withstand and adapt to the expected impacts of climate change—increased temperatures, changing precipitation patterns, rising sea levels, and more frequent and intense extreme weather events. Building with resilience in mind means infrastructure can better withstand these climate-related risks, reducing the potential for damage, disruption and costly repairs.
- ✓ **Cost savings:** Investing in climate-resilient infrastructure from the outset can lead to long-term cost savings. Considering climate risks and incorporating appropriate design features, materials and construction techniques results in infrastructure that's better equipped to withstand future climate-related challenges. This reduces the need for frequent repairs and retrofits, minimizing maintenance costs and the financial burden on governments, communities and individuals.
- ✓ **Continuity of services:** Climate-resilient infrastructure ensures the continuity of essential services even in the face of climate-related disturbances. Infrastructure built to withstand climate risks is less likely to fail or experience disruptions during extreme weather events or other climate impacts. This means that critical services (e.g., water supply, energy distribution, transportation networks and communication systems) can continue to function, ensuring well-being and safety while minimizing economic disruptions.
- ✓ **Safeguarding human lives:** Climate-resilient infrastructure plays a crucial role in protecting human lives. Infrastructure that incorporates safety measures and design standards that account for climate risks can make us less vulnerable to climate-related hazards. For example, buildings constructed to withstand high winds or floods can provide safe shelter during severe weather events, reducing the risk of injury or loss of life. Similarly, infrastructure systems designed to manage and mitigate climate-related risks, such as effective drainage systems or early warning systems, can help prevent or minimize harm to individuals and communities.

- ✓ **Climate adaptation and futureproofing:** Building infrastructure to minimum climate-resilience standards acknowledges the reality of climate change and proactively prepares for its impacts. By integrating climate resilience into infrastructure planning, design and construction, communities can better adapt to changing conditions, lessen vulnerabilities, and ensure the long-term viability and sustainability of infrastructure systems.
- ✓ **Advancing equity and reconciliation:** Building climate-resilient infrastructure offers opportunities to engage, involve and support equity-deserving groups in our communities. Climate-related hazards disproportionately impact vulnerable individuals, including people in low-income or racialized communities.[1] First Nations, Inuit and Métis peoples also experience greater challenges from climate change compared to non-Indigenous people. When planning, designing and building infrastructure, consider how to work with local Indigenous communities and other vulnerable populations to incorporate their perspectives, lived experience and knowledge[2] into the project.

For more information about taking an equity-centered approach to climate adaptation work read GMF's factsheet, **Why equity matters in municipal climate adaptation**.

## WHAT DOES AN INFRASTRUCTURE CLIMATE RISK ASSESSMENT INVOLVE?

A climate risk assessment is an important element of risk management because it helps us prioritize risks and best understand where to focus our resilience efforts.

Climate risk assessments consider vulnerabilities and exposure to climate change hazards, and the likelihood and consequences of those hazards, to identify appropriate ways to respond to risks.[3] This factsheet focuses on infrastructure projects, but climate risk assessments can be undertaken at community- or system-wide levels.

Infrastructure-based climate risk assessments are usually carried out by engineering consulting firms, planning consulting firms, and other professionals working in the infrastructure planning and construction fields. Asset-level assessments can range in cost depending on the size and scope of the project but are often around $10,000.

1 See **Who is most impacted by climate change**, Health Canada

2 See, for example, **Indigenous knowledges and climate change**, Climate Atlas of Canada

3 See **Guidance on good practices in climate change risk assessment,** Canadian Council of Ministers of the Environment

An infrastructure-based climate risk assessment includes the following steps:

1. Gather climate data from reliable sources, including publicly available sources such as **Climate data for a resilient Canada**, **Climate atlas of Canada**, the **Design value explorer** and the Government of Canada's **Flood hazard identification and mapping program.** Climate data should include historical climate records, such as temperature, precipitation, wind patterns and extreme weather events. It should also include future climate projections for the project area.
2. Analyze the climate data (with the help of infrastructure design specialists) to identify the specific climate risks and vulnerabilities that the infrastructure may face. This includes assessing the potential impacts of climate change, such as increased temperatures, changing precipitation patterns, rising sea levels, or more frequent and intense extreme weather events.
3. Assess the likelihood and consequences of climate hazards to evaluate the infrastructure's vulnerability to climate risks and identify areas where adaptation measures are needed. This assessment should consider specific design requirements, potential exposure to climate hazards, and the criticality of the infrastructure's function.
4. Use the climate data and projections to determine the appropriate design parameters for the infrastructure. These may include factors like temperatures, rainfall intensities, wind speeds or storm surge levels.
5. Develop adaptation strategies and design features to address the identified climate risks, if required. This may involve incorporating protective measures, such as flood-resistant structures, increased drainage capacity or heat-mitigation strategies.

Here are some suggested resources on conducting infrastructure climate risk assessments:

- **Infrastructure Canada climate lens**
- **Climate-ready communities assessment tool**
- **ISO 14091:2021 (Adaptation to climate change)**
- **PIEVC High level screening guide** (or equivalent)

## STRATEGIES FOR FLOOD-RESILIENT INFRASTRUCTURE

The following approaches can help to ensure that new infrastructure projects are situated and designed to provide environmental and community benefits throughout their lifespans.[4]

- ✓ At a minimum, all infrastructure projects should consider flood exposure through a climate risk assessment. When siting new projects, select a location that is outside the 100-year floodplain on the most recent floodplain map. If this is not possible, design the project to mitigate flood risk and provide evidence of the protections in place.
- ✓ For high-value projects (e.g., assets valued over $2 million), assess project design parameters against future climate conditions. The future climate conditions should coincide with the 30-year climate period during the end of the infrastructure's design life.
- ✓ If the climate risk assessment identifies enhanced risk of flooding due to climate change, build to floodproof standards, defined as:
  - Elevation above the most recent floodplain map's 200-year floodplain level, or inclusion of structural interventions (such as the placement of critical components) that would allow a rapid resumption of service following a 200-year flood; or
  - Elevation above the 100-year flood level during the 30-year climate period associated with the last decade of the asset's design life, where hydrological modelling has factored in downscaled climate change projection, unless evidence can be provided of structural floodproofing to this level.

All applicable structures should follow the **federal** or the provincial or territorial equivalent.

GMF sets out specific resilience requirements for the capital projects that it funds, in line with the recommendations in this factsheet. For more information on the requirements for GMF's different funding offers, review our **funding opportunities** and associated application guides.

4 These recommendations align with Infrastructure Canada's 2019 **Climate lens** for projects funded under the Investing in Canada Infrastructure Program (ICIP), Disaster Mitigation and Adaptation Fund (DMAF), and Smart Cities Challenge.

## ADDITIONAL RESOURCES

Flood-resilience:

- CSA standards for **flood resilient design of new residential communities** and **site preparation, foundation, and installation of buildings**
- The Intact Centre for Climate Adaptation has numerous resources on **flooding**:
  - **Preventing disaster before it strikes (standard for flood-resilient residential communities)**
  - **Ahead of the storm (flood resilience for commercial real estate)**
  - **Under one umbrella (practical ways to reduce flood risks)**
- **International guidelines on natural and nature-based features for flood risk management**
- Communities located in coastal regions may also have relevant provincial/territorial or regional resources available to support adaptation to storm surge and coastal flooding due to sea level rise, for example:
  - **Coastal floodplain maps (British Columbia)**
  - **Coastal flooding and erosion (Nova Scotia)**

Wildfire risks:

- If the climate risk assessment identifies **enhanced risk due to wildfires**, facilities and infrastructure constructed in at-risk areas (wildland–urban interface regions) should follow the **National guide for wildland–urban interface fires**.
- **FireSmart Canada** offers training and resources to increase resilience to wildfires in Canada
  - **Wildfire-resilience best-practice checklist for home construction, renovation and landscaping**

Situated on permafrost:

- If the infrastructure project **will be situated on permafrost**, follow standards such as:
  - CSA S501:21 (**Moderating the effects of permafrost degradation on existing building foundations**)
  - CSA PLUS 4011:19 (**Infrastructure in permafrost: A guideline for climate change adaptation**)
  - CAN/BNQ 2501-500 (**Geotechnical site investigation for building foundations in permafrost zones**)

Follow these other useful standards and guidance for different types of infrastructure projects:

- **Wastewater treatment plants** should follow CSA S900.1:18 (**Climate change adaptation for wastewater treatment plants**), where possible.
- **Affordable housing projects** should consider resilience to extreme heat in building design and operations, given the likelihood of working with vulnerable populations at greater risk from extreme heat events. See the Intact Centre for Climate Adaptation's report, **Irreversible extreme heat: Protecting Canadians and communities from a lethal future**.
- **Building projects** may also consider CSA S478:19 (**Durability in buildings**) for guidance on improving building durability as a climate change adaptation strategy.