CLIMATE RESILIENCE FRAMEWORK

AND RECOMMENDATIONS REPORT

CITY OF TORONTO // MARCH 2019

FOREWORD

This report was developed by Sustainability Solutions Group as a resource to support and inform the development of the City of Toronto's Resilience Strategy (RS). It was developed over the course of several months from Mar 2018 to Jan 2019, concurrent with the longer development period of the Resilience Strategy (Jun 2017 - Mar 2019).

Based on scope and timeline, the primary purpose of the work undertaken and this resulting report was to inform concepts, content and a set of recommendations (within the context of the wider Resilience Strategy process) for consideration and potential inclusion as actions in the Resilience Strategy. As a result, the actions outlined in the Resilience Strategy do not necessarily align perfectly with the recommendations in this report, neither are all the recommendations in this report included in the Resilience Strategy. Additionally, the Resilience Strategy includes many actions that were informed by several other parallel [non-climate specific] pieces of work.

In addition to a set of recommendations, this report includes a framework, made up of a foundation, set of principles and focus areas, to guide the City of Toronto in preparing for the impacts of climate change. It is intended to be applied in the implementation of climate resilience actions, and could be applied by the City more broadly when developing policy, plans, and in decision-making.

The preparation of this plan was carried out with assistance from the Government of Canada and the Federation of Canadian Municipalities. Notwithstanding this support, the views expressed are the personal views of the authors, and the Federation of Canadian Municipalities and the Government of Canada accept no responsibility for them.

Prepared for the
City of Toronto by:

SSG

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INTRODUCTION

WHAT IS THE CLIMATE RESILIENCE FRAMEWORK?

Failure to adapt to and mitigate climate change has been ranked in the top 5 risks globally over the last three years. Impacts from climate change are already being felt around the world and they will become more severe as global average temperature increases. Climate change impacts are felt at the neighbourhood and city level and preparing for and responding to these impacts is a difficult challenge facing cities around the globe. Climate change is a 'wicked' problem due to its intrinsic complexity and the breadth of its impacts.

The City of Toronto (City) has developed the Climate Resilience Framework (CRF) to guide climate resilience planning and action at the City. The framework is designed to be relevant over planning cycles as action plans are implemented and monitored.

The "framework" is a roadmap to guide the City of Toronto in preparing for the impacts of climate change. It provides a clear structure to the challenges presented by a changing climate and the pathways forward ensuring City staff, partners, stakeholders and community members all have a common starting place for collaboration. The framework outlines the priority pathways where there is the greatest need for adaptation through collective action planning. It also provides a lens that can be applied to new and existing projects to ensure climate resilience shapes the outcomes.

The framework includes a **foundation**, set of **principles** and **focus areas**. The foundation outlines the ideas that form the basis of the approach to climate resilience and should be applied throughout climate resilience work. The five principles guide integration of climate resilience into all practices and activities, and the three focus areas introduce themes for setting priorities in the framework.

A set of **recommendations** attached to the framework identifies a set of early opportunities to advance climate resilience in the City of Toronto over the next five years.

The framework and recommendations build upon foundational work and key policies that have guided climate adaptation work at the City of Toronto, including Ahead of the Storm in 2008 and the Climate Change Risk Management Policy in 2014.

HOW WAS THE FRAMEWORK DEVELOPED?

The framework and recommendations were developed using a multiple step process that included a literature review, development and analysis of best practices by cities from around the world, and a stakeholder engagement process. For more details on the method, see Appendix I.

HOW IS THE FRAMEWORK APPLIED?

The Framework supports the embedding of climate resilience at the City for different purposes (Table 1) and by different user groups (Table 2).

Table 1. Uses cases of the Climate Resilience Framework.

USE CASE	APPLICATION OF THE FRAMEWORK
POLICY DEVELOPMENT	The Framework can be applied to the development of new policies, plans and strategies to ensure that climate resilience is embedded in these efforts.
DECISION-MAKING	The Framework can be used as a decision-making lens by the City for budget development and the approval of projects, plans, strategies and policies.
ACTION PLANS	The implementation of the Framework will be supported by actions, which are developed by different entities within the City of Toronto on an ongoing basis to address resilience priorities.
EVALUATION	The principles in the Framework will be used as a lens to evaluate the City's overall progress and the effectiveness of specific policies, plans, initiatives and departments.
APPLIED RESEARCH	The Framework can be applied to inform a research agenda and research priorities among numerous stakeholders (e.g., academics, non-profits, conservation authorities, etc.)

Table 2. Users groups of the Climate Resilience Framework.

USER GROUPS	APPLICATION OF THE FRAMEWORK
PUBLIC	The Framework can be used by community members to better understand the challenge of climate change and to guide citizenship activities.
BUSINESSES	The approach and principles can be adapted by businesses in order to embed climate resilience into their organizations.
NON-PROFITS	The approach and principles can be used to evaluate existing programs and services and to support the development of new offerings or advocacy efforts.
STAFF	The Framework can be used to embed consideration of climate resilience into existing and new programs and initiatives and support advocacy to higher levels of government.
COUNCIL	The principles will be used as a checklist to assess how proposed policies, projects and initiatives enhance the City's climate resilience.
OTHER CITIES	The Framework can serve to guide other cities and contribute to global knowledge on city climate action.

HOW DOES IT CONNECT TO TRANSFORMTO?

The City of Toronto has set an emissions reduction target of 80% below 1990 levels by 2050, and has developed an ambitious emissions reduction plan, known as TransformTO to achieve this goal. TransformTO is primarily a GHG emissions reduction plan, and considers and identifies co-benefits for health, economy, social equity and climate resilience from mitigation action.

Pioneering adaptation work has also been undertaken by the City, including the development of the Climate Change Adaptation Strategy in 2008, a Climate Change Risk Assessment Tool in 2012, and the adoption of the Climate Change Risk Management Policy in 2014. Additionally, Toronto has contributed significantly to the global discourse on the interdependencies of urban infrastructure systems in the context of climate change. Due to a number of barriers however, adaptation work, specifically investments in adaptation, have not been fully implemented or resourced. The City currently does not a have an identifiable, approved or funded climate adaptation plan.

This work is intended to partially fill this gap. The framework and recommendations in this report build upon the pioneering adaptation work to date, outlining a pathway and opportunities to further advance climate adaptation efforts at the City. The climate-related [adaptation] actions identified in the Resilience Strategy (informed by this report), are intended to complement TransformTO's significant effort on climate mitigation action and further elevate and increase adaptation effort at the City.

At this juncture, and based on momentum afforded by the development of the Resilience Strategy and the 100RC initiative, these actions are to be implemented through delivery of the Resilience Strategy. However, it is a recommendation of this report that in the future, when TransformTO undergoes its first major update, that climate resilience/adaptation [components of the Resilience Strategy] be brought together more systematically with mitigation into a combined climate mitigation and adaptation plan to maximize efficiencies and cost-effectiveness.

CLIMATE ADAPTATION AND RESILIENCE

CLIMATE RISK AND VULNERABILITY

The study of climate change adaptation borrowed from the area of disaster risk reduction at its inception and applied risk management approaches. Climate-related hazards create risks to someone or something, which then create the imperative for risk mitigation options. Climate change cannot solely be managed in relation to external climatic systems, but requires instead an understanding of the complex interaction among societies, ecosystems and hazards arising from climate change. This perspective stresses the importance of considering the concept of vulnerability.[1]

The figure alongside illustrates a schematic representation of the interaction among the physical climate system, exposure, and vulnerability, as defined in the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) report.[2] Climate-related hazards interact with the exposure, sensitivity and adaptive capacity of human and ecological systems to determine changing levels of risk.

Key to understanding the impacts and risks that Toronto confronts (both now and in the future), and how they may be addressed, requires consideration of not just the changing climatic system, but how other physical, natural and socio-economic systems in Toronto will change over the coming decades as well. This is discussed in more detail in the **Changing Climate, Changing City** section.

ADAPTATION AND CLIMATE RESILIENCE

ADAPTATION is referred to as the **process** of adjustment in natural or human systems in response to actual or expected climatic change and its effects. The process of adaptation aims to moderate or avoid harm or exploit beneficial opportunities.[3]

URBAN RESILIENCE refers to the **ability** of urban centers and the systems on which they depend to anticipate, reduce, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner[4], or as the **capacity** of individuals, communities, institutions, businesses, and systems within a city to survive, adapt and grow no matter what kinds of chronic stresses or acute shocks they experience.[5] In this context, climate resilience is synonymous with the definitions above, but is more specific in that the hazardous events, shocks or stresses are those that are climate related.

Climate resilience is often used interchangeably with adaptation. For the purposes of the Framework however, **CLIMATE RESILIENCE** is viewed as a state, ability, or capacity, and adaptation is the process by which to accomplish this ideal; in other words, **increasing climate resilience through the process of adaptation.**

CLIMATE HAZARDS refer to the potential occurrence of climate-related physical **EVENTS**, such as extreme weather (heat wave or flood), or climate change **TRENDS**, such as increasing temperatures, that result in an impact for natural, built or human systems.

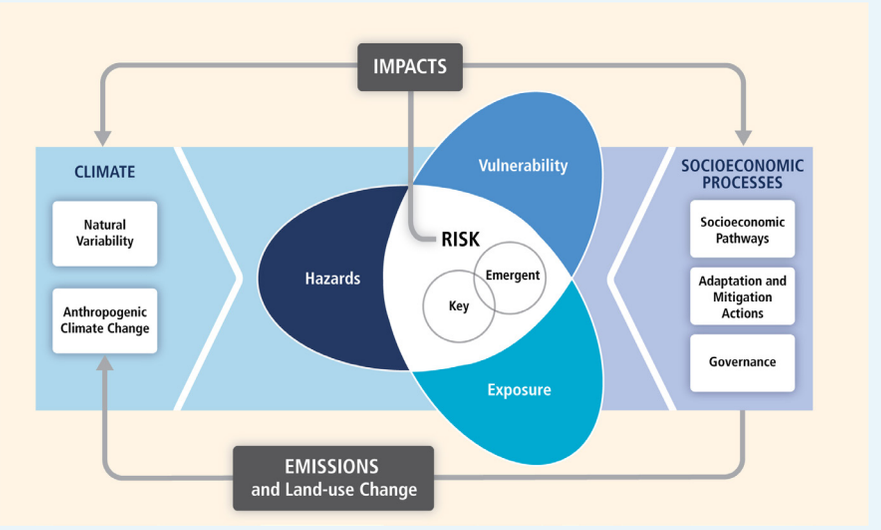
RISK results from the interaction of vulnerability, exposure, and hazard, and in this context, the term primarily refers to the risks of climate-change impacts. Risk is also referred to as the potential for consequences where something of value is at stake and where the outcome is uncertain; it is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. This mathematical approach, however, requires the consideration of vulnerability and exposure.

IMPACTS, also referred to as consequences or outcomes, refers to the effects on natural, built, and human systems of climate hazards; this includes the effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services, and infrastructure. Impacts generally manifest in some form of damage, disruption, or complete (irretrievable) loss, and can be generally categorized as physical, social, or economic. Impacts result due to the interaction of climate events or trends (occurring within a specific time period) and the vulnerability of an exposed society or system. Additionally, impacts can be considered direct (damage to a building) or indirect (loss of a job or income as a result of damage to a building).

EXPOSURE refers to the presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected; for example, assets located in a flood plain, or people living in poor quality housing.

VULNERABILITY refers to the propensity or predisposition to be adversely affected, and refers to characteristics of human or social-ecological systems that are exposed to hazardous climatic events or trends; it is a function of sensitivity and adaptive capacity. **SENSITIVITY** or susceptibility to harm, refers to the degree to which a system or species is affected; while **ADAPTIVE CAPACITY** refers to the ability to adjust or to respond to impacts. Ecosystems, geographic areas, assets or humans (amongst other) can be classified as vulnerable; this is of particular concern if vulnerability in one area (eg. humans) increases as a result of potential impairment or increased vulnerability in other areas (eg. assets).

Lastly, **STRESSORS** refer to events and trends, which are often not climate-related, that have an important effect on the system exposed and can increase vulnerability to climate-related risk. For example, growing income inequality is a stressor that is pushing already low income families to their financial limits; this further increases these families' vulnerability, as they have less resources (and therefore decreased capacity) to respond to the impacts major climate event.



CHANGING CLIMATE, CHANGING CITY

HOTTER, WETTER, WILDER

Toronto has experienced a number of climate hazards with major impacts over the last decade, including major flooding in July 2013, an ice storm that wreaked havoc in December 2013, the flooding of the Toronto islands in the spring of 2017, and a significant heat wave in late summer 2017. These events have significant impacts for people, infrastructure, natural systems and economies, including health impacts, damage to property, disruption in critical infrastructure systems, business and service interruptions, and inhibiting mobility access to services.

Many of these climate hazards are projected to increase in variability, frequency, and intensity; Toronto's weather is becoming "hotter, wetter and wilder".

The City of Toronto's Future Weather and Climate Drivers Study found that the city can expect, amongst other changes, higher average annual and maximum temperatures, more heat waves, and less frequent but much more intense rain events, particularly in the summer.[6]

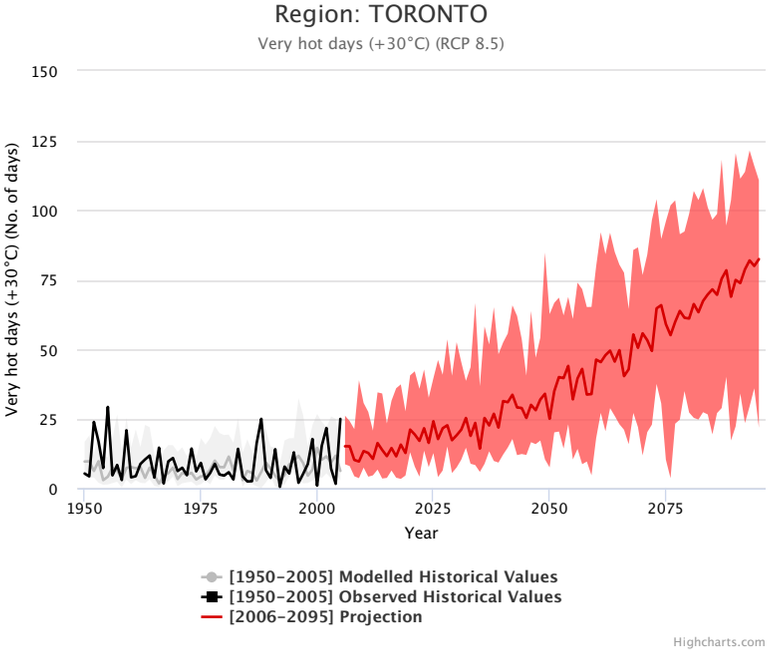


Figure 1. Projected increase in very hot days (+30°C), Toronto.[7]

Flooding and extreme storms cause significant negative impacts, including flooded basements and damage to property, disruptions in transportation and power outages, and increased insurance premiums. These impacts impose a disproportionate burden on people who are more vulnerable to these types of impacts, for example those in sub-standard living conditions, who are uninsured, or those who don't have access to financial resources to repair damage.

Heat waves have negative health impacts ranging from heat stress to heat stroke and death. The elderly are particularly vulnerable, along with those who are in substandard living conditions or housing that is susceptible to extreme heat, and those who may not be able to access needed services. Heat has a major impact on the natural environment and food production, and poses risks to infrastructure, such as the damage to rail tracks that can warp in extreme heat. Extreme heat also increases demands for emergency services, as well as other cooling services, such as cooling centres, splash pads and pools.

A study estimated higher temperatures and poorer air quality attributable to climate change would result in an additional five to ten additional deaths per 100,000 people by the 2050s and seven to seventeen by the 2080s in Toronto.[8] Over the next 20-30 years, Toronto is expected to see a tripling of high temperature days, from an average of 12 in the years 1976-2005 to an average of 55 by 2050.[9]

As Toronto becomes "hotter, wetter and wilder" over the coming decades, these types of impacts are expected to increase in both frequency and magnitude.

WITHOUT ADDITIONAL EFFORTS TO REDUCE RISKS, THE INCREASED FREQUENCY AND SEVERITY OF EXTREME WEATHER EVENTS COULD LEAD TO INCREASED HARDSHIP FOR MANY CANADIANS AND POTENTIALLY UNSUSTAINABLE LOSSES FOR GOVERNMENTS AND THE FINANCIAL SECTOR.

- Government of Canada, Working Group on Adaptation and Climate Resilience (2016)

GROWING CITY, AGING CITY

Toronto is growing rapidly. Currently home to just over 2.9 million people, the city is projected to grow to approximately 3.4 million by the 2040s. In the context of climate change, this presents both new challenges and opportunities.

This growth will increase demand on existing infrastructure, infrastructure that in many cases is already at or over capacity, is aging rapidly, and is currently experiencing impacts of extreme climate events. It will also require significant investments in new infrastructure.

The City of Toronto owns physical assets (buildings, transportation and water infrastructure) valued at more than $84 billion. This infrastructure is aging, and a variety of factors makes it challenging to sufficiently upgrade this infrastructure to meet the daily needs of Torontonians. The City currently has a state-of-good-repair backlog of some $5.5 billion.

As climate events become more extreme and occur more frequently, disruption and damage to infrastructure, and the subsequent costs needed to maintain a state of good repair will increase. Already aging infrastructure may age faster than designed for, requiring new investment for replacement ahead of its anticipated lifespan, further exacerbating the infrastructure deficit. In the absence of significant action and investment, the risk to existing and future infrastructure will continue to increase.

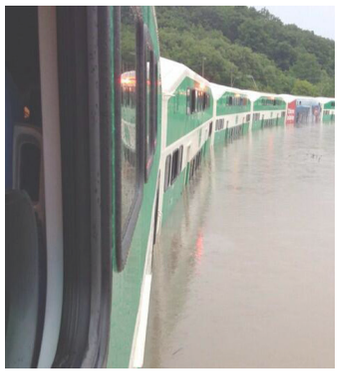
The City's infrastructure systems and services it provides is also highly dependent upon one another, and upon the infrastructure and services from the private sector (e.g. natural gas, electricity, telecoms, food distributers); damage and disruption in one leads to cascading impacts in others. Working in partnership with these key private sector service providers is vital.

The population of Toronto, while growing rapidly, is also aging. The Ontario Ministry of Finance projects a 75-100% increase in the number of seniors in Toronto between 2017 and 2041[13], a group which is more vulnerable to the impacts of climate change.

Lastly, urbanization is associated with elevated surface and air temperatures (the urban heat island effect), due to presence of heat absorbing materials, reduced evaporative cooling caused by lack of vegetation, and production of waste heat, as well as increased flooding as a result of the increase in impervious surfaces and decrease in vegetation. As Toronto grows, the City will need to ensure that this condition is not being exacerbated with the increase of built form in the city.

TORONTO FLOOD, JULY 2013

During a severe rainstorm on July 8, 2013, 97mm of rain fell in the city under two hours resulting in widespread flooding. Over 750,000 people lost power, more than 4,700 homes were flooded, and 1,400 GO Train commuters were stranded as a result of flooding of the foot of the Don Valley Parkway. The flooding led to $1 billion in insurance claims[12] and $70 million in costs to the city.[13]

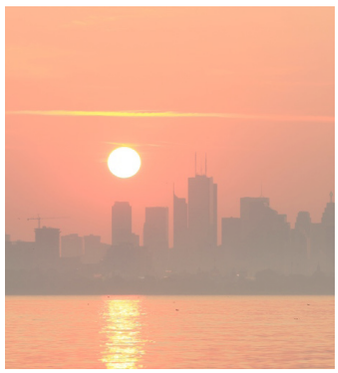


ONTARIO ICE STORM 2013

An extreme ice storm in December 2013 resulted in widespread power outages – more than one million people were without power, with some areas going without electrical power for almost a week in the middle of winter. There was also significant damage to public and private property, the displacement of thousands of Torontonians from their homes, and the disruption of City services. The City and associated agencies incurred approximately $94 million in damages, emergency response and hazard clean-up, while the electrical distribution company, Toronto Hydro, incurred approximately $13 million.[14]

HEAT WAVE 2017

In September 2017, where the city experienced a record breaking heat wave where temperatures exceeded 25˚C for nine consecutive days, followed directly by five consecutive days of temperatures between 30˚C and 34˚C, prompting Toronto Public Health to issue an extreme heat alert.



GROWING INEQUALITY

While Toronto is prosperous and growing, it is also an economically divided city.[14] These divisions manifest in different ways and are expressed in the physical layout of the city. Some neighbourhoods enjoy higher incomes, better health, and better access to a mix of housing, transit, and public services. In other parts of the city, poverty is more concentrated, health outcomes are poorer, services like transit are more sparsely located and people face barriers that prevent them from accessing everything Toronto has to offer.

In addition to this existing socio-spatial inequality, income polarization in Toronto is increasing. Research led by Dr. David Hulchanski from the University of Toronto showed that the areas of the city where people's income matched closely with the average income for the Census Metropolitan Area have been shrinking over time. As this inequality grows, the disparities in the geography of the CIty are also increasing.[15]

Not all people will be affected equally by climate change. Certain groups, communities, or populations, referred to as climate vulnerable populations, will be disproportionately affected due to their increased exposure and sensitivity to climate risks, or lack of adaptive capacity to deal with the impacts. The degree to which certain people are vulnerable to climate is driven by a variety socio-economic characteristics or factors, including income, housing and living conditions, and ability to access services (including infrastructure and support services). Climate vulnerable populations are discussed in more detail in the Principles section, and Appendix II.

In the context of climate change, growing inequality is a major concern, as it exacerbates the vulnerability to climate of those who are already vulnerable.

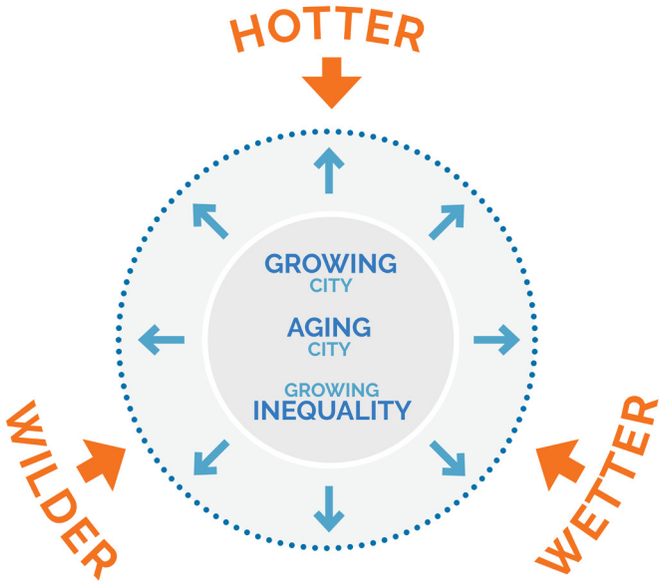


Figure 2. Schematic representing Toronto's climate context.

SECTION 02

FRAMEWORK

- FOUNDATION
- PRINCIPLES
- FOCUS AREAS

02

FOUNDATION

- Mitigation & Adaptation
- Transformational Change

5 PRINCIPLES

- Consider Climate Vulnerability and Social Equity
- Take a Multi-Hazard Approach
- Balance Risk Reduction with Community Enhancement
- Engage Deeply and Collaboratively
- Climate-Aligned Financial Management

3 FOCUS AREAS

- People & Neighbourhoods
- Built and Natural Infrastructure
- City Leadership

FOUNDATION

The foundation outlines two overarching concepts that form the basis of the approach to climate resilience and should be applied throughout climate resilience work.

- Mitigation & Adaptation
- Transformational Change

CLIMATE MITIGATION AND ADAPTATION

Climate change policies aim to "manage unavoidable changes and avoid unmanageable ones", and in this context, responding to climate change requires aggressive action on both climate mitigation and adaptation. Adaptation and mitigation are closely bound: mitigation efforts to reduce emissions will help moderate climate impacts in the future; investing in mitigation today can lower the costs of adaptation in the future. However, despite mitigation efforts, climate impacts are a growing threat, and will require action not only now, but for generations to come.

Adaptation and mitigation policy decisions in the near-term will affect the risk from climate change throughout the 21st century. The City of Toronto is investing in mitigation in the near-term to reduce the impacts and cost of adaptation in the long-term, but there is also an imperative to invest in adaptation now in order to reduce further impacts and costs both immediately and down the line.

Reducing GHG emissions will require major effort and investment in Toronto's buildings, transportation system, energy systems, and waste management. In parallel the City needs to adapt to the impacts of current and future climate.

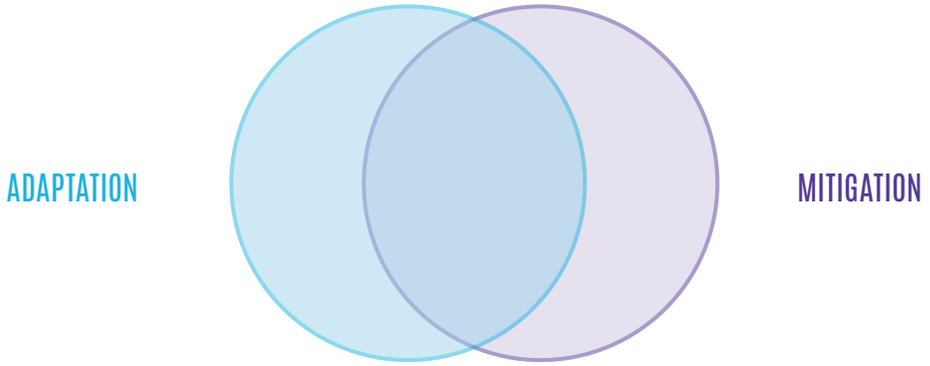
As Toronto sets forth to both reduce its emissions and adapt to climate change, there is an opportunity to integrate this effort and investment to maximize efficiency and cost-effectiveness, and minimise risk. This includes identifying, understanding and making informed decisions about synergies, trade-offs, mal-investment, and piggybacking opportunities between mitigation and adaptation action (see breakout box on pg 20). This also includes the integration or mainstreaming of mitigation and adaptation considerations holistically across all City decision-making.

ADAPTATION

Actions to moderate or avoid harm to actual or expected climatic change and its impacts

MITIGATION

Actions to reduce or prevent greenhouse gases emissions



TYPES OF ADAPTATION-MITIGATION INTERACTIONS

Mal-investment

Actions that can be undone or rendered less effective by the effects of climate change if they are not sufficiently resilient.

> building new infrastructure in an area prone to storm surge

Piggybacking

Actions that are complementary when designed and/or implemented together

> adding additional mitigation or adaptation actions at a marginal cost

Trade-off

Actions with contrary effects on mitigation and adaptation

> diesel back-up power or air-conditioning

Synergies

Actions that reduce both carbon emissions and climate risk

> green infrastructure

RESPONDING TO A WICKED PROBLEM: TRANSFORMATION AND ADAPTIVE MANAGEMENT

Climate change is a symptom of a medley of many other problems, ranging from the combustion of fossil fuels, to cultural norms and the structure of the economy. As a result, adapting to climate change joins a cadre of other societal challenges, such as alleviating poverty and reducing inequality, that are described as a **wicked problem**. Wicked problems cannot be solved by engineering or science alone.

Approaches to adapting to climate change can be incremental or transformational. In general, governance processes, policies and initiatives are developed by adjusting current practices, informed by historical experience. This approach, which can be characterised as one step at a time, is known as incremental change. The breadth and rate of climate change renders this one step at a time approach to climate adaptation ineffective.

Transformational adaptation, in contrast, involves a broader and more systemic look at the root causes of the vulnerability of the a city to the impacts of climate change, and considers the implementation of fundamentally different approaches to preparing for and responding to climate risks.

Approaches that incorporate transparency, integration, flexibility, monitoring, continual learning and knowledge sharing support transformational adaptation. At the heart of this approach is cultivating and embracing uncertainty, enabling honest dialogue and learning from doing.[16]

Adaptive management is a method that will enable the City of Toronto to manage the "wickedness "of climate change. Characterised as "learning to manage by managing to learn," adaptive management relies on strategic planning, encouraging innovation, experimentation, and decision-making processes that join learning with action.[17] A description of the application of adaptive management in practice is shown on page 22.

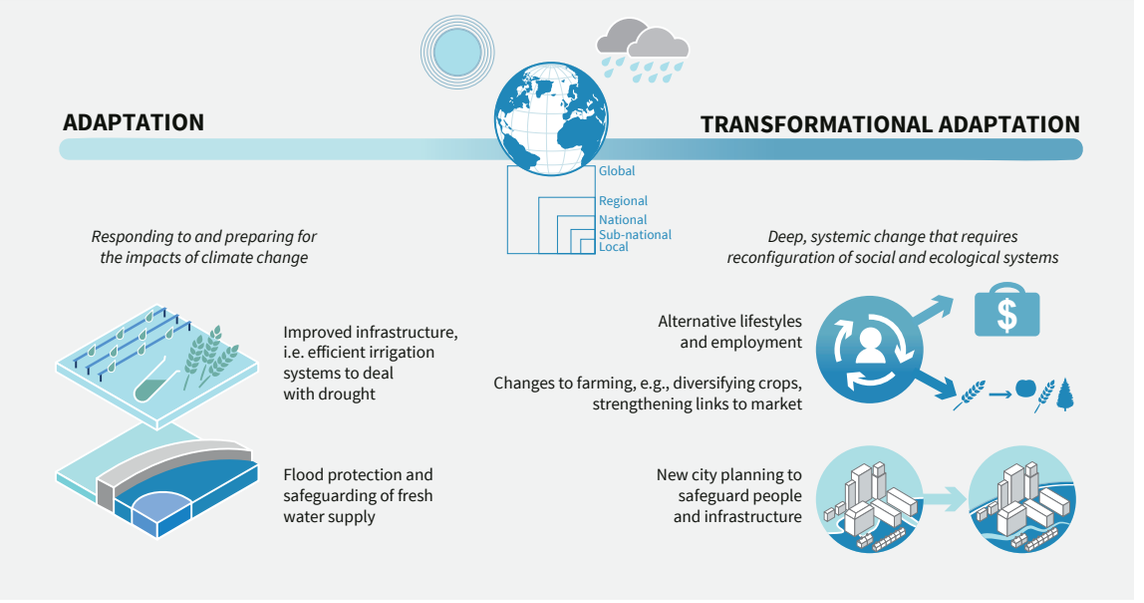


Figure 3. Example of transformational adaptation.[18]

COMPARING INCREMENTAL AND TRANSFORMATIONAL CHANGE PARADIGMS

DIMENSION	INCREMENTAL	TRANSFORMATIONAL
DEPTH OF CHANGE	Existing practices are improved in the same direction without altering existing assumptions.	New paradigms, values, and worldviews are introduced.
SCOPE OF CHANGE	Focussed on specific aspects of the system; for example, the size of pipes in stormwater management.	Large scale, macro, system-wide interventions; for example, abandons pipes in favour of green infrastructure.
SPEED OF CHANGE	Slow, step by step.	Quick, big jumps.

ADAPTIVE MANAGEMENT IN APPLICATION

ASPECTS OF ADAPTIVE MANAGEMENT[20]	APPLICATION
INTEGRATED AND FORWARD-LOOKING ANALYSIS	Identify key factors that affect policy performance; identify scenarios for how these factors might evolve in the future; develop policies that are robust to a range of anticipated conditions; develop indicators that trigger policy adjustments.
MULTI-STAKEHOLDER DELIBERATION	Apply a collective and collaborative effort to examine an issue from different points of views; build common values and shared commitment; provide a comprehensive understanding of causal relationships.
AUTOMATIC POLICY ADJUSTMENT	Monitor key indicators to trigger policy adjustments.
ENABLING SELF-ORGANIZATION AND SOCIAL NETWORKING	Ensure that policies do not undermine existing social capital; create forums that enable social networking; facilitate the sharing of good practices and remove barriers to self-organization.
DECENTRALIZATION OF DECISION-MAKING	Enable the authority and responsibility for decision-making at the lowest effective and accountable unit of governance, whether existing or newly created, to increase the capacity of a policy to perform successfully when confronted with unforeseen events.
PROMOTING VARIATION	Implement a variety of policies to address the same issue to increase the likelihood of achieving desired outcomes. A diversity of responses also forms a common risk-management approach, facilitating the ability to perform efficiently in the face of unanticipated conditions
FORMAL POLICY REVIEW AND CONTINUOUS LEARNING	Review regularly and use well-designed pilots to test assumptions related to performance and to address emerging issues and trigger adjustments.

PRINCIPLES

The five principles guide integration of climate resilience into all practices and activities at the City and will be applied throughout the development of climate resilience action planning.

- Climate Vulnerability and Social Equity Are Linked
- Take a Multi-Hazard Approach
- Balance Risk Reduction with Community Enhancement
- Engage Deeply and Collaboratively
- Climate-Aligned Financial Management

CLIMATE VULNERABILITY AND SOCIAL EQUITY ARE LINKED

Understanding social vulnerability to climate and considering social equity at all levels of decision-making and implementation.

The success or failure in preparing for the impacts of climate change will be measured by how well we fare as these emerge. Not all people will be affected equally by climate change. Certain groups, communities, or populations, referred to as climate vulnerable populations, will be disproportionately affected due to their increased exposure and sensitivity to climate risks, or lack of adaptive capacity to deal with the impacts.

Given limited resources, it is therefore imperative to prioritize action for the most vulnerable and affected members of our communities, many of whom are already suffering from a range of challenges. These include, amongst others, those who live or work in hazard-prone areas, persons who experience homelessness or live in poor quality housing or living conditions, the elderly and very young, and those with disabilities and pre-existing illnesses.[20] [21]

Exposure, sensitivity, and adaptive capacity are not static, and in many cases are inextricably linked. Low income persons, racialized groups, immigrants and refugees, non-english speakers, and Indigenous peoples (amongst others) face physical, social and structural barriers in accessing services and social supports, and frequently face discrimination;[22] this directly influences their ability to seek and receive help, in addition to influencing health and income.

Both historic and growing social and economic inequalities, and continued systemic and institutional inequity, exacerbate underlying drivers of vulnerability to climate change. For example, for racialized groups, structural and institutional racism negatively influence income, living conditions and health, all of which increase vulnerability to climate change.[23] Similarly, racialized and low income communities are frequently underfunded, which can

result in inadequate green space or community resources, increasing exposure to climate impacts.[24]

It is imperative for Toronto, in its efforts to address climate change, that it prioritize action for climate vulnerable populations, and consider social equity at all levels of decision-making and implementation. This will also support addressing the social inequities that are driving this vulnerability.

What does this mean? The City, in identifying, prioritizing and implementing actions that reduce risk for the city as a whole, will ensure the equitable distribution of resources and prioritize those most vulnerable to climate. At the same time, the City will address the systemic drivers of social inequity that are increasing social vulnerability, designing policies and programs that seek to eliminate inequities that contribute to climate vulnerability.

The City of Toronto currently employs an **Equity Lens** to address barriers faced by different people in relation to City policies, programs, practices and allocation of resources; the lens considers the impact of plans, policies and actions on equity seeking groups,[1] and requires solutions to minimize barriers and encourage positive outcomes.[25]

Applying the equity lens in climate related decision-making will ensure equitable outcomes for climate action. Due to barriers faced by equity seeking groups (as defined in the lens) they are considered more vulnerable to climate change; however, climate vulnerable populations, as defined in the literature, extend beyond those considered in the equity lens. Further details on the overlap between these specific climate vulnerable populations and equity seeking groups in Toronto is included in Appendix II.

For the purposes of this framework, the Toronto equity seeking groups are considered a subset of climate vulnerable populations that should be prioritized within climate vulnerable populations; while as a whole, climate vulnerable populations are prioritized in the context of the City's wider population.

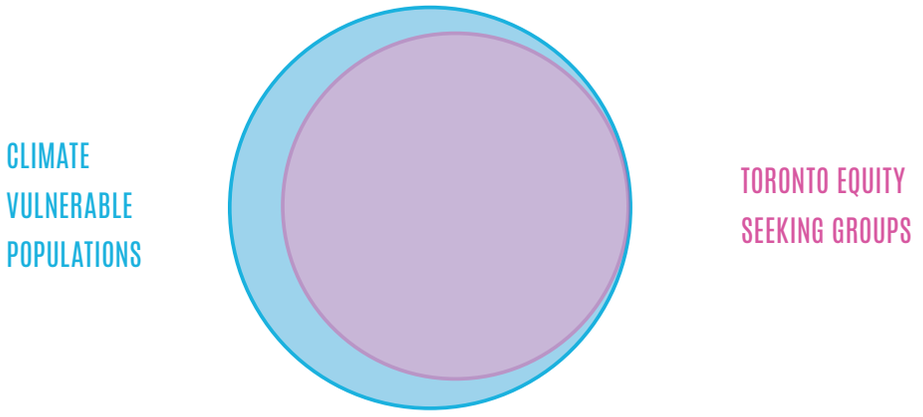


Figure 4. Climate vulnerable populations and Toronto equity-seeking groups.

1 Discrimination and exclusion are key barriers that can limit the success of equity seeking groups. Equity seeking as defined by the City includes: Aboriginal peoples, persons with disabilities, racialized groups, women, LGBT2QS, undocumented individuals, immigrants and refugees, persons with low income, youth, victims of violence, persons who are homeless or under-housed, and residents in neighbourhood improvement areas.

TAKE A MULTI-HAZARD APPROACH

Identifying solutions that improve resource efficiency and avoid unintended consequences.

Toronto faces a variety of climate hazards and risks, including extreme heat and extreme cold, heat waves and cold snaps, flooding from heavy rain, rivers and Lake Ontario, blizzards, and storms, in both winter and summer.

As discussed in Changing Climate, Changing City, Toronto is project to get “hotter, wetter, and wilder”. However, the city is still very much a winter city, where snow and cold temperatures are experienced over several months of the year.

A multi-hazard approach identifies and supports the implementation of solutions that address more than one hazard simultaneously. Through this approach, the City of Toronto will be able to more efficiently use its resources to address the diverse array of climate hazards it is facing. A prime example of this is in the implementation of green infrastructure, which reduces the impact of both flooding and heat, in addition to providing community benefits, such as improved air quality and access to green space.

Taking a multi-hazard approach also includes considering the interaction of hazards and solutions more holistically, rather than independently, to avoid unintended consequences. .For example, if in dealing with flooding, a system is designed exclusively to move water into pipes and away as fast as possible, this could potentially impact the availability of groundwater during dry periods if infiltration and groundwater recharge are restricted. Or in another case, shading structures intended to alleviate the impacts of extreme heat during the summer may create shading that exacerbates extreme cold in the winter.

BALANCE RISK REDUCTION WITH COMMUNITY ENHANCEMENT

Identifying no-regret measures that consider wider social, environmental and economic benefits.

Adaptation action planning often focuses on the identification and prioritization of actions that deliver the greatest risk reduction. However, climate risk can and will change based on other mitigation efforts, and changes in physical, human and natural systems over time. For many practical reasons, risk cannot be completely eliminated; successful adaptation does not mean that negative impacts will not occur, only that they would be less severe than would be experienced had no adaptation occurred. Additionally, a primary focus on risk reduction may result in missed opportunities, that is, the exclusion of no-regret measures that consider wider social, environmental and economic benefits.

To illustrate this, if the identification of actions to address flooding were only to focus on risk reduction, it is likely that larger pipes would be the resulting outcome. Similarly, the expansion of air conditioning may be identified to address extreme heat. By explicitly including social, environmental and economic considerations (in addition to risk reduction), alternative solutions may emerge for addressing climate risk. For example, green infrastructure reduces the risk of heating and flooding, contributes to increased biodiversity, improves air quality, and provides access to green space, which can contribute to improved health outcomes; this contributes further to reduce risk for certain climate vulnerable populations, such as those with pre-existing health conditions.

Additionally, it is also worth considering the cumulative impact of small measures. For example, one green roof, or one tree, while providing the benefits discussed above, will not necessarily by itself have a significant contribution in reducing flooding or heat impacts; but the impact becomes significant with the mass deployment of green roofs, or the significant increase in tree canopy cover, specifically in areas more prone to flooding and the heat island effect.

ENGAGING DEEPLY AND COLLABORATIVELY

Engaging deeply and collaboratively to harness a diversity of worldviews and perspectives.

Climate adaptation is a “wicked” problem that cannot be addressed by one or even a few perspectives. It requires a diversity of worldviews and perspectives, including Indigenous Knowledge Systems, to develop novel approaches and diverse ways of thinking in order to address the urgency and complexity of the issue. In this regard, Toronto has a significant asset to confront this complexity - Toronto is an exceptionally diverse city. Harnessing this diversity to address climate change provides a great opportunity for Toronto.

Broad, deep and collaborative engagement is fundamental for the City in addressing climate change. Those affected by climate decisions should not only be directly engaged in shaping those decisions, but in collaboratively identifying the solutions. Deciding with, not for, is at the foundation of this equitable and community driven approach, which is particularly relevant for climate vulnerable populations.

Inclusivity in the process, whereby a wide range of communities and stakeholders are engaged, ensures that a broad range of perspectives are applied. The process needs to be supported by inclusivity in the resulting policy, program and impact; ensuring fairness and accessibility in design and delivery, and the equitable distribution of benefits.

CLIMATE ALIGNED FINANCIAL MANAGEMENT AND INVESTMENT

Considering the impact of climate in financial decision-making.

Climate change is having and will continue to have a financial impact on the City. As climate events become more extreme and occur more frequently, it disrupts and damages infrastructure, driving up repair costs and shortening asset lifetimes. The needs to maintain a state of good repair (SOGR) are expected to increase, and new investment for replacement may be needed sooner than anticipated as already aging infrastructure ages faster than designed for, reaching the end of its useful lifetime earlier than planned.

Adaptation to climate change will require significant investment, and mobilizing funding commensurate with the challenge will be a struggle at many levels. But the cost of inaction will only grow over time. Every dollar invested proactively can save as much as four[26] to six[27] dollars on recovery. Many policy makers do not yet recognize the choice they face between paying predictable costs today for mitigation and adaptation, compared to delaying action and paying higher and unpredictable costs later to try and cope with the impact of climate change on non-resilient infrastructure.[28]

The City of Toronto owns physical infrastructure assets valued at more than $84 billion, and has a SOGR backlog of over $5.5 billion. Embedding climate resilience considerations into financial decision-making for both new infrastructure and in the delivery of SOGR, will be key to ensuring these investments are not “malinvested”, that they result in infrastructure that is more climate resilient, that meets the needs of the growing city, and that is able to withstand the climate changes that are coming. In doing so, the City is investing in resilience now to avoid future costs, reducing the burden on future generations.

FOCUS AREAS

Three focus areas introduce themes for setting priorities in this framework. Each includes high level objectives outlining what "we need to be doing and thinking about" in the delivery of climate resilience work, and are further intended to guide the identification and development of climate actions.

These focus areas can also be seen as "layers". Action across all areas to build resilience in Toronto's people, neighbourhoods, infrastructure and government will collectively build the resilience of the city as a whole through multiple layers of protection and preparedness.

- People & Neighbourhoods
- Built and Natural Infrastructure
- City Leadership

PEOPLE & NEIGHBOURHOODS

This area focuses on the need to build capacity to strengthen residents, businesses, and communities, at home and in their neighbourhoods, to make Toronto more resilient to climate change.

> Protect, prepare and strengthen those most vulnerable to climate impacts.

The success or failure in preparing for the impacts of climate change will be measured by how well we protect and strengthen the most vulnerable and affected members of our communities, many of whom are already suffering from a range of challenges. We need to hold those most vulnerable paramount.

> Empower neighbourhoods to take action and achieve their self-identified resilience goals.

More resilient neighbourhoods make a more resilient city. Neighbourhoods that invest in connections, capacity, and resources on a sustained basis are not only better able to withstand times of crises, but also address many of the chronic socio-economic stresses that increase climate vulnerability. We need to build capacity at the neighbourhood level to empower neighbourhoods to take action and build their own resilience, their own way.

> Be ready to respond to climate-related events.

The ability of residents, businesses, communities, and the City to withstand and respond to climate shocks will largely depend on the collective capacity to be ready for these events. As climate change becomes more severe, we need to keep building this capacity.

BUILT AND NATURAL INFRASTRUCTURE

This area focuses on the need to make Toronto's built and natural infrastructure more resilient to climate, and to use this infrastructure to make the city more resilient as a whole.

> Protect and strengthen our most critical infrastructure.

For the city to thrive, it is fundamental that its critical infrastructure is able to withstand the expected impacts of climate change, both in the near and long term. We need to proactively protect and strengthen infrastructure to ensure it can withstand the shocks and stresses that come with climate change.

> Build new, and rebuild better. Plan and build for future climate, not the past.

When communities plan and build for historical climate conditions that no longer exist, they make themselves more vulnerable to current and future climate risks, and increase the potential for malinvestment. We need to plan and build a city for a new climate reality.

> Expand city-wide built and natural systems to reduce risk and enhance community benefits.

While ensuring that infrastructure is able to withstand the impact of climate change, we need to actively maintain and expand physical and natural systems that directly address flooding and heat, but that also enhance community benefits, specifically green and blue infrastructure[2].

CITY LEADERSHIP

This area focuses on the need to build capacity and take leadership at the City of Toronto on climate resilience, working with and for its residents, businesses, communities, and partners.

> Establish governance for collaborative, flexible, and distributed action on climate resilience.

The challenges of climate change the City faces can neither be addressed by one division, nor through incremental change. Transformational adaptation and collective action, achieved through collaborative, flexible, and distributed action, necessitates a change in governance and how the City thinks about and addresses the issue.

> Develop human and technical resource capacity to support action.

To be a leader, the City needs more than just a champion. It needs the support and know-how of its staff, who are on the front lines of implementation, and defensible, data-driven technical resources to make climate-informed decisions.

> Actively work with partners and other institutions

Climate change affects everyone, and effectively preparing for it requires cooperation and collaboration throughout the community, and beyond. The City needs to take a leadership role in working with and learning from its local partners and institutions, engaging with neighbouring municipalities and regions, other municipalities provincially and nationally, and participating in international networks.

2 A combination of natural and human-made blue (water) and green (nature, parks, bioswales etc.) infrastructure to address stormwater management, heat stress, air quality and biodiversity.

SECTION 03

RECOMMENDATIONS

- RECOMMENDATIONS FOR THE RESILIENCE STRATEGY
- AREAS FOR FURTHER RESEARCH

03

RECOMMENDATIONS FOR THE RESILIENCE STRATEGY

RECOMMENDATIONS SUMMARY

1. Develop and deliver a neighbourhood capacity building program.
2. Integrate climate considerations into City emergency management planning.
3. Train local residents to plan for and respond to an emergency.
4. Integrate climate resilience into tower retrofitting initiatives and accelerate implementation.
5. Conduct a detailed spatial risk and vulnerability assessment for critical infrastructure.
6. Update existing codes and standards for future climate.
7. Integrate climate resilience into Land Use Planning policy and processes.
8. Integrate climate resilience into Asset Management.
9. Develop and apply a climate resilience lens for Capital Planning.
10. Develop a coordinated and comprehensive city-wide strategy to significantly expand blue and green infrastructure.
11. Bring together climate mitigation and adaptation into one Climate Action Plan.
12. Integrate Indigenous Knowledge Systems and collaborate more meaningfully with Indigenous peoples in climate action planning.
13. Establish a Resilience Office at the City of Toronto to institutionalize climate resilience.

NEIGHBOURHOOD RESILIENCE

1. Develop a deliver a neighbourhood capacity building program.

Community resilience refers to a community's ability to recover quickly and function well in the wake of a major shock. It goes beyond the two traditional elements of disaster resilience—preparedness and response—to include mitigation and recovery. The underlying logic behind the goal of community resilience is that if a community invests in connections, capacity, and resources at the individual, organizational, and community levels on a sustained basis, its overall resilience will increase.[29] This in turn, will increase the resilience of the city as a whole. This community resilience, which plays a critical role during acute shocks or times of crisis, also plays a role in addressing wider chronic community stressors.

Achieving community resilience requires investing in the capacity of neighborhood-level leadership to create and nurture local networks rich in trust and reciprocity. Such networks will have the ability to serve the needs of vulnerable residents before, during, and after times of stress.[30]

Communities that work together through a "bottom-up" approach to make informed decisions about how to invest in their neighborhood's physical and social infrastructure are better able to contribute actively to successful response and recovery during times of stress. Additionally, by putting communities at the centre of identifying their own resilience goals and actions to take, it increases the likelihood of sustained participation by key local stakeholders, and the implementation of action at the neighborhood level.

Through this type of engagement, community members build trust not only in one another, but also in the city agencies and first responder organizations critical to achieving their crisis management goals . This elevated trust is essential for ensuring the highest level of cooperation across all sectors at the times when neighborhoods need it most.[31]

It is in this context that it is recommended that the City adopt a "bottom-up community resilience approach" to enhance and build the capacity of its communities to become more resilient to climate impacts. More specifically, it is recommended to implement this through the **development and delivery of a neighbourhood (scale) capacity building program** that focuses on the City's most climate vulnerable neighbourhoods.

The use of "neighbourhood", rather than community, is intentional. This type of approach, or more specifically the deployment thereof, is necessarily place-based. Given the diversity of populations and their socio-economic drivers across neighbourhoods, bundled with geological, climatic, and infrastructural features, each neighbourhood is different and as a result, will require unique and context-informed neighbourhood-specific strategies.

EMERGENCY MANAGEMENT

2. Integrate climate considerations into City emergency management planning.

The impacts of climate change are expected to affect the emergency management sector's capacity to support preparedness, response and recovery efforts. As extreme events increase, so will the demands on full-time and volunteer emergency service personnel and non-government organisations. Emergency management responses are likely to increase for both slow (chronic stresses) and rapid onset (acute shocks) events, along with decreased recovery times as events happen more frequently and or concurrently. It is important to recognize that coping and response mechanisms, and planning for such events based on past vulnerabilities will no longer suffice for what is to come.

For Toronto, extreme events are projected to increase in both frequency and magnitude, in addition to exacerbating other non-climate related hazards. While adaptation efforts in other sectors to reduce risk and vulnerability will play a role, demands on emergency management services are expected to increase. Ensuring that emergency management has the capacity, through training and resourcing, to respond is critical.

It is recommended to **integrate climate considerations into City emergency management** planning in two main ways:

- By **taking stock of the impact that increased frequency and severity of climate-related events will have on emergency management operations** in order to inform decision-making and planning for the future in order to identify gaps and/or changes that may be needed for operations, including resourcing, training, tools and financing;
- By **integrating climate risk and vulnerability mapping with climate vulnerable population information** to better understand and identify locations, groups and individuals who are more at risk or more vulnerable to climate-related events, and may require additional or special assistance.

It is important to note that there is a direct connection between putting in place infrastructure and services that reduce the risk of an emergency occurring from extreme weather events, and the level of emergency services needed. While emergency management needs to plan for an increase in extreme climate events, ongoing investment to increase the resilience of infrastructure and provide supportive service is needed alongside to help alleviate these demands.

3. Train local residents to plan for and respond to an emergency.

As noted above, extreme climate events are projected to increase along with demands on emergency management services. In many cases, emergency management will not be enough. Residents and business owners need to be better prepared to respond during emergencies and extreme climate events. Training that builds and enhances emergency management capabilities will allow residents and business owners to become more self-sufficient, to provide support to fellow residents, and to provide additional support to first responders.

Increasing the number of Torontonians with emergency management training, specifically in neighbourhoods that are more vulnerable to extreme climate events, will help build much needed capacity in those neighbourhoods, and in turn will enhance the city's capacity to be more resilient to extreme events.

The City currently offers many workshops and training programs that are available to all Toronto residents, including first aid training focused on skills to support paramedics in medical emergencies. The City could **extend its training program to include an extreme events preparedness training program**, such as CERT3, **and/or include this in a neighbourhood capacity building program** (see Neighbourhood Resilience above); **focussing its efforts on the most vulnerable neighbourhoods**.

3 The Community Emergency Response Team (CERT) program educates volunteers about disaster preparedness for the hazards that may impact their area and trains them in basic disaster response skills, such as fire safety, light search and rescue, team organization, and disaster medical operations. CERT is intended to provide training to non-professional responders such that they can be better equipped to support professional responders.

TOWERS

4. Integrate climate resilience into tower retrofitting initiatives and accelerate implementation.

In the city of Toronto, there are roughly 1,200 apartment towers of eight or more storeys that were built before 1985 and house over 500,000 people. These towers were purpose-built rental housing, remain the largest stock of private rentals in Toronto, and represent a critical component of Toronto's affordable market rental stock.

Underinvestment over time has led to the decline of many of these buildings; as a group these towers are aging, and some are already in an advanced stage of disrepair. In response, initiatives such as the City of Toronto's Tower Renewal Program, and The Tower Renewal Partnership (TRP)[4], have been established to address this issue.

During extreme climate events, specifically heat waves, tower residents are particularly vulnerable. In addition to an overall decline in building condition, the majority of towers do not have central air conditioning, which leads to significant increases in indoor air temperatures, particularly on the upper floors. During power outages, residents can become stranded without elevator access. Additionally, towers house a higher portion of lower-income, visible minority, and immigrants compared to other housing types; groups that are more vulnerable to climate impacts and are equity seeking.

A key area of the tower renewal initiative includes building improvements and "deep retrofitting"; retrofits that are primarily focused on reducing energy consumption and greenhouse emissions, while providing comfortable and high-quality housing. In applying a core foundation of the CRF, it is fundamental to consider mitigation and adaptation efforts and investments in an integrated way to maximize efficiencies and cost-effectiveness.

There is an immediate opportunity to **integrate climate resilience within ongoing tower retrofitting initiatives through including resilience to heat, flooding and extreme events as a core component of the retrofit design objectives**.

Additionally, climate resilience considerations should be included in the prioritization process. While towers have been identified as particularly climate vulnerable, this vulnerability is not uniform within the tower stock. Building location, condition and the socio-economic factors of residents all play a role. Identifying, understanding and considering climate risk and social vulnerability will be important in the prioritization process to identify which buildings are tackled first. Additionally, this should be holistically considered alongside mitigation objectives, whereby towers with the highest climate risk and vulnerability, and those with high energy and emissions are prioritized.

There is a significant opportunity to increase resilience to climate in Toronto by undertaking widespread retrofits to these towers. While some pioneering work has been done, significant underinvestment and disrepair remain; accelerating the deep retrofttting of towers is critical .

4 TRP is a multisectoral collaboration working to establish a framework through which Tower Neighbourhood Renewal can be scaled across Canada; the City of Toronto is a supporting Partner.

CRITICAL INFRASTRUCTURE RISK & VULNERABILITY

5. Conduct a detailed spatial risk and vulnerability assessment for critical infrastructure.

Toronto depends upon a complex network of urban infrastructure; systems that function to produce and deliver a reliable flow of services that are critical to support economic prosperity and social well-being. This includes energy, telecommunications, transportation, water supply, wastewater treatment, solid waste management, buildings, and food systems. These systems are complex, interconnected, do not always work as foreseen, and have weaknesses.

Rapid growth in Toronto is increasingly putting pressure on existing infrastructure systems, which are in many cases already at or over capacity and are aging. As climate events become more extreme and occur more frequently, increases in disruption and damage to these infrastructure systems are expected, along with cascading consequences on the environment, society, and economy that are triggered by failure in these systems. For example, if a storm event causes significant damage to a major transportation facility (e.g., a bridge), and alternative transit options are limited, this can impact commuter and freight activity as well as emergency services, particularly if repairs to the facility are time-intensive.

Investments will be required to ensure that Toronto's existing critical infrastructure is able to withstand the impacts of both extreme climate events and longer-term climate trends. By improving the resilience on infrastructure now, the reactive resources needed for event or emergency response are reduced.

Understanding where, what, how, and by how much action and investment is required to build resilience in Toronto's infrastructure requires a better understanding of the risks and vulnerabilities these systems face in in a changing climate.

In 2010, the City of Toronto developed the Toronto Climate Change Risk Assessment tool to help prioritize actions in a consistent and robust manner across City divisions; the tool, in its full form, was used by Transportation Services, and Shelter, Support and Housing Administration. Later, a streamlined version of the tool was developed and used during a City-led High Level Risk Assessment (HLRA) exercise in 2016; three HLRA out of ten identified thematic areas were completed, namely utilities, transportation, and water.

The HLRA process was very successful in raising awareness and catalyzing dialogue among participants about specific climate change and extreme weather related risks, sectoral interdependencies, and the potential for cascading impacts on key infrastructure service providers. It also resulted in the identification of a preliminary list of risk reduction activities. However, participants indicated that there is a need for a better understanding of specific, localized flooding risks across the city and a more detailed and hazard-specific scenario analysis to allow for detailed site specific needs.

In order to better understand, identify and prioritize specific action and investment for critical infrastructure, it is recommended that, as a first step, the City **undertake a more detailed, spatial (specifically for flooding) risk and vulnerability assessment, including interdependencies analysis, for critical infrastructure systems**. This analysis will build upon the foundational work completed to date to identify and prioritize solutions to reduce risk for critical infrastructure, while considering climate vulnerable populations.

CODES AND STANDARDS

6. Update existing codes and standards for future climate.

The City's **existing codes and standards should include forward-looking climatic information to ensure that infrastructure is designed and built to be more resilient,** ensuring that it will be able to perform safely and efficiently under future climate conditions. This is particularly important for infrastructure with a longer design life or that performs a critical purpose, such as bridges or hospitals. Codes and standards that are based on historical weather records urgently need updating for the weather that is coming.

With the exception of the Toronto Green Standard, which applies to new construction of all private and City-owned buildings, and includes some requirements for climate resilience, there are no other known existing codes and standards that have been updated for future climate, or that have explicitly considered or incorporated future climate in their development; this includes the City's *Standards for Designing and Constructing City Infrastructure* and *Development Infrastructure Policy and Standards*.

This is not to say that there has not been any effort in developing codes, standards or guidelines that are intended to contribute to reducing the impacts of climate change. There is for example the Green Streets Guideline that provides guidance, standards and selection tools for the planning, design, integration and maintenance of a range of green infrastructure options appropriate for the City's street types and conditions; green infrastructure that will contribute to reducing the impact of flooding in the city.

Rather, this is intended to ensure that all codes and standards, whether directly intended to reduce climate impacts or not, include climate considerations. For example, while the Green Streets Guideline may be followed, do the standards that govern road materials to be used include specifications to ensure they are able to withstand the increasing temperatures and storm runoff of the future?

In 2011, the City of Toronto completed Toronto's Future Weather and Climate Drivers Study, a study to project anticipated future climate conditions. Since then, significant advances have been made in establishing downscaled and localized climate projections data. Most recently in 2018, The Climate Atlas of Canada was released. It uses the Pacific Climate Impacts Consortium's (PCIC) statistically downscaled data (Bias Corrected Spatial Disaggregation; BCSD) derived from 12 Coupled Model Intercomparison Project (CMIP5)[5] global climate models, for two emissions scenarios (RCP4.5 and RCP8.5).[32] Data is available at a 10km resolution for all of Canada, including Toronto. The Climate Atlas provides an updated and common set of future climate projections upon which the City can update its codes and standards.

Where the City relies on codes and standards that are developed by external standard-setting organizations (such as the Province), the City should work through the relevant professional organizations to advance the updating of these from a climate perspective. While the updating of existing codes and standards seek to set a new and higher bar for the construction of climate-resilient infrastructure, they remain nonetheless a baseline. Moving forward, these codes and standards should strive for continuous improvement, being frequently updated as new information and knowledge about the climate develops.

5 The CMIP5 models are those upon which the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) relies.

LAND USE PLANNING

7. Integrate climate resilience into land use planning policies and processes.

Toronto is growing rapidly. The city is currently home to just over 2.9 million people, and is expected to grow to approximately 3.4 million by the 2040s. Significant new and renewed housing, infrastructure and services will be needed to support this growth; growth that will take place in a new climate context.

When communities plan for historical climate conditions that no longer exist, they make themselves more vulnerable to current and future climate risks. It is imperative for the City to ensure that climate considerations are integrated into land use planning decisions to reduce this risk and vulnerability, and to ensure this growth is more resilient to the impacts of climate change.

Land use planning tools are one of the most effective processes to facilitate local climate resilience. For example, local governments have used land use planning tools – official plans, zoning, development permits and others – to minimize risks to communities from floods, wildfires, landslides and other natural hazards.[33] For the City of Toronto, this is no more apparent than when looking at Toronto's ravine system, which was largely created after the significant flooding experienced during Hurricane Hazel. The ravines are now one of Toronto's greatest assets, providing a wide range of benefits.

In general, planning tools can be used to reduce climate risks, or increase climate resilience, through: limiting development in hazard-prone or high-risk areas; ensuring that the built environment can withstand a range of climate hazards; protecting natural environments, and enabling the expansion of natural and human-made environments (eg. green infrastructure); and, educating stakeholders and decision-makers about risks and opportunities and fostering dialogue about climate resilience.

The City of Toronto has been a leader in many of these aspects, including the adoption of the Green Roof Bylaw (the first in North America) and the development of Toronto Green Standard; but continued and ambitious leadership and action is still needed.

To explore further how this may be achieved, the City of Toronto's Planning Division (Planning) co-hosted a full-day *Climate Resilience and Land Use Planning Workshop* with the City's Resilience Office in December 2018 to identify gaps and opportunities in key policy and implementation tools where climate resilience can be further advanced. Key findings and next steps from the workshop are included *Summary Report: Climate Resilience and Land Use Planning Workshop*.

Drawing from this workshop, it is recommended that **climate resilience be integrated into land use planning and policies** by undertaking the following:

- Establish a clear set of goals and objectives for climate resilience within Planning and integrate these from "top to bottom", from the Official Plan through secondary plans to zoning, translating these into into targets and requirements appropriate at each level;
- Undertake a thorough review of all existing Planning policies and implementation tools, to further identify areas where climate resilience can be further integrated and advanced;

- Augment the Toronto Green Standard and Green Roof Bylaw to include more stringent and mandatory climate resilience requirements;
- Develop climate risk and vulnerability maps, and integrate these into City Planning to inform policy and planning decisions;
- Develop a neighbourhood scale standard or guideline, (e.g. a scaled-up Toronto Green Standard for neighbourhoods), to apply to large development sites and guide climate resilience considerations in secondary planning, and include or require climate resilience considerations in the planning/application process;
- Include climate resilience as an organizing principle in the next update of the Official Plan.

ASSET MANAGEMENT

8. Integrate climate resilience into Asset Management.

The City of Toronto owns physical assets (buildings, transportation and water infrastructure) valued at more than $84 billion. This infrastructure is aging, and a variety of factors makes it challenging to sufficiently upgrade this infrastructure to meet the daily needs of Torontonians. The City currently has a state-of-good-repair backlog of some $5.5 billion.

In the context of climate change it is anticipated that the needs to maintain a state of good repair (SOGR) will increase. Already aging infrastructure may age faster than planned for as it is impacted by a greater number of and more extreme events. Maintenance and repair costs are expected to increase, with implications for long term preventative maintenance programs. Additionally, through increased damage and disruption, climate will have an ongoing and increasing impact on the ability of the City to meet current and future levels of services. Lifecycle costs for infrastructure are shifting with the climate.

Integrating climate resilience into asset management through understanding the impacts future climate will have on the state and longevity of assets, and integrating these considerations is key to ensure investments to repair, rebuild and maintain assets are not "malinvested", that is, they are made with future climate in mind, not the past, and that they contribute to increasing the resilience of infrastructure throughout the city. Upfront investment will contribute to reducing operating, maintenance and repair costs into the future, thereby reducing the total cost of ownership for the City.

The City is currently undertaking an *Integrated Asset Planning and Management (IAPM)* project to develop a corporate wide Asset Management Framework and Integrated Asset Management Plan to align with Ontario Regulation 588/17: Asset Management Planning For Municipal Infrastructure. There is a key opportunity at this juncture to integrate climate resilience into this process. The regulation requires the City to consider climate change in the development of its AM Policy and AM Plan, but is not prescriptive on how to undertake this.

It is within this context that it is recommended to **integrate climate resilience into asset management through developing a guideline for "how to consider climate" in the development of asset management to be applied to the IAPM project.**

CAPITAL PLANNING

9. Develop and apply a climate resilience lens for Capital Planning.

While existing infrastructure will need to be upgraded and managed for the evolving climatic conditions, there is a significant amount of new infrastructure that will need to be built to support the rapid growth of Toronto. It is critical that these infrastructure investments carefully consider and integrate climate resilience.

Upfront resilience investments will contribute to reducing operating, maintenance, repair and disruptions costs into the future. It is equally important that these investments are being implemented equitably. Investments could easily be squandered through maladaptive planning or projects that increase risk and vulnerability, or increase inequality, if climate-resilient infrastructure planning, policies and guidelines are not put in place today. Integrating climate into capital decision-making is fundamental to addressing this.

While codes and standards act as a baseline for the design and construction of new infrastructure, and upgrading these with climate considerations will be effective, they are only one component. Delivering resilient infrastructure requires an integrated and holistic approach that applies climate change thinking in the capital planning process; this is sometimes referred to as applying a "climate lens". To be effective however, guidance on what a climate lens is and how is it applied is needed.

With this in mind, it is recommended that as a first step, the City **develop a comprehensive guideline for applying a climate lens in the capital planning process**; essentially a "how to consider climate" in decision-making for all City capital projects.

The guidelines are intended to accomplish two main objectives: firstly, to ensure that while existing codes and standards are being updated, that in the interim, the City makes climate-informed capital decisions; and secondly, to include climate considerations in capital decision-making that are not otherwise covered by codes and standards. Essentially, the guidelines will provide a method and ask a set of questions to guide decision-making that results in more resilient infrastructure.

In 2018, Infrastructure Canada started requiring the application of a *Climate Lens* assessment for certain projects applying for funding under Infrastructure Canada's Investing in Canada Infrastructure Program (ICIP), Disaster Mitigation and Adaptation Fund (DMAF) and Smart Cities Challenge. Assessments are required to include two components: a GHG mitigation assessment, which measures the anticipated GHG emissions impact of an infrastructure project; and, a climate change resilience assessment, which employs a risk management approach to anticipate, prevent, withstand, respond to, and recover from a climate change-related disruption or impact. A guidance document for how to carry out these assessment has been published by Infrastructure Canada.

Infrastructure Canada's climate lens guidance provides a foundation from which to develop guidelines for the City of Toronto. It is recommended that the guidelines seek to build upon this guidance by including the consideration of the *foundation* and *principles* outlined in the Climate Resilience Framework, namely the consideration of climate mitigation and adaptation, climate vulnerable populations and social equity, balancing risk reduction with community enhancement, and climate-aligned financial management.

This could include, for example:

- Applying spatial risk and vulnerability mapping when deciding where to locate new infrastructure and in the process of design;
- applying climate resilience design considerations; asking how the project itself is more resilient to climate impacts, whether is it being designed to be adaptive, so that it does not lock-in decisions that limit future adaptation;
- considering equitable distribution of infrastructure and climate vulnerable populations, asking what type of infrastructure investment, and where, can most reduce climate vulnerability and inequality and increase opportunity, and how it is contributing to the resilience of the community or city more broadly; and,
- considering the full lifecycle costs of infrastructure in the context of the impacts of future climate in business case development.

GREEN AND BLUE INFRASTRUCTURE

10. Develop a coordinated and comprehensive city-wide strategy to significantly expand blue and green infrastructure.

Through urbanization, cities create unique micro-climates that affect climatic variables, including temperature. The urban heat island effect is a key example, where elevated surface and air temperatures result from the mass of buildings and heat absorbing materials, replacement of pervious vegetated surfaces with impervious built surfaces which reduce evaporative cooling, and the emission of heat from other human activities.

This urbanization, specifically the increase in impervious surfaces and decrease in vegetation, is also contributing to flooding risk in cities, as less rainwater is able to infiltrate into the ground, increasing runoff. Projected increases in average temperatures and heat waves, as well as precipitation and extreme rainfall events are expected to further intensify these effects.

Average temperatures in Toronto are increasing, as are the number and intensity of heat waves. Toronto's Future Weather and Climate Drivers Study[34] found that, by the 2040's, the city can expect: higher average annual temperatures, increasing by 4.4˚C; a higher number of hot days per year (days with >30˚C), increasing from 20 to 66; and four times as many heat waves. Simultaneously, rainfall is also projected to increase; by the 2040s, the daily rainfall maximum is projected to increase from 66mm to 166mm, with a threefold increase in the size and intensity of extreme rain events.

Many cities across the world are grappling with these challenges, and are looking to green and blue infrastructure as a solution. In the context of an urbanized environment, green and blue infrastructure includes all natural or human-made elements that provide or perform some form of ecological or hydrological function or process. This includes, but is not limited to, parks, trees, shrubs, urban forests, green roofs and walls, gardens, bioswales, natural channels, watercourses, ponds, and constructed wetlands.

From a climate perspective, green and blue infrastructure plays a significant role in reducing both heat and flooding impacts, primarily through increasing infiltration and reducing runoff, reducing the heat island effect, and providing shading and areas for reprieve. In this context, green and blue infrastructure is a front-runner under a "multi-hazard" approach.

The additional social and environmental benefits of green and blue infrastructure, however, particularly for health, are what make it so appealing when compared with other "grey" strategies to address heat (eg. expansion of air conditioning) or flooding (extensive hard stormwater infrastructure systems). Amongst others, green and blue infrastructure contributes to improving air quality, providing space for recreation, physical activity and social interaction, improving water quality, reducing noise pollution, reducing energy demand for cooling, providing habitat and enhancing biodiversity, growing food, and generally beautifying a city. Many aspects of green and blue infrastructure are no-regret measures that can significantly enhance communities.

Toronto's existing green and blue infrastructure, is helping to combat the impacts of climate change. This is particularly true for the city's extensive ravine system and tree canopy. There are currently many City plans, strategies, and initiatives that are collectively contributing to protecting or increasing green and blue infrastructure in the city, including the Ravine Strategy, the Strategic Forest Management Plan, the Parkland Strategy, the Biodiversity Strategy, the Toronto Green Standard, the Green Roof Bylaw, and the Green Streets initiative.

The city is nonetheless still experiencing climatic impacts, which are only projected to grow. Amongst other adaptation efforts, the **significant expansion of green and blue infrastructure is needed to address heat and flooding in the city**. What makes this particularly challenging is that Toronto is expected to grow rapidly over the next two decades, while the climate is also changing.

Addressing this challenge will require a multi-faceted approach. Firstly, to continue to protect and enhance the green and blue infrastructure that already exists. Secondly, to undertake some level of "retrofitting" to add in, patch, or increase, green and blue infrastructure within the existing built form. Lastly, to actively plan for green and blue infrastructure as the city grows, taking advantage of opportunities created by densification and changing land uses to add in and make space for green and blue infrastructure..

Many of the plans, strategies, and initiatives noted above are already contributing to this approach, but often in disparate and uncoordinated ways.. The planning and implementation of green and blue infrastructure requires a city-wide systematic and holistic view to ensure that opportunities for efficiencies and benefits across departments can be identified. For example, overlapping potential street tree planting and new park areas with the Wet Weather Flow Master Plan (WWFMP) to identify opportunities where green infrastructure can be better leveraged to achieve objectives for flood risk reduction. Achieving this will require significant cross-coordination between City departments.

It is within this context that it is recommended that the City **develop a coordinated and comprehensive city-wide strategy to significantly expand blue and green infrastructure**; one that builds upon the plans and initiatives already underway, and that integrates heat and flooding objectives in a more holistic and systematic way.

CLIMATE ACTION PLANNING - ADAPTATION AND MITIGATION

11. Bring together climate mitigation and adaptation into one Climate Action Plan.

The City of Toronto has set an emissions reduction target of 80% below 1990 levels by 2050, and has developed an ambitious emissions reduction plan, known as TransformTO to achieve this goal. TransformTO is primarily a GHG emissions reduction plan, and considers and identifies co-benefits for health, economy, social equity and climate resilience from mitigation action.

Pioneering adaptation work has also been undertaken by the City, including the development of the Climate Change Adaptation Strategy in 2008, a Climate Change Risk Assessment Tool in 2012, and the adoption of the Climate Change Risk Management Policy in 2014. Additionally, Toronto has contributed significantly to the global discourse on the interdependencies of urban infrastructure systems in the context of climate change. Due to a number of barriers however, adaptation work, specifically investments in adaptation, have not been fully implemented or resourced.

The framework and recommendations in this report build upon the pioneering adaptation work to date, outlining a pathway and opportunities to further advance climate adaptation efforts at the City, and are intended to complement TransformTO's significant effort on climate mitigation action and further elevate and increase adaptation effort at the City.

At this juncture, mitigation focused action is currently being implemented through TransformTO, and climate resilience/adaptation actions (as recommended in this report) are to be implemented through the Resilience Strategy. However, **it is recommended that in the future, climate resilience/adaptation [components of the Resilience Strategy] be brought together more systematically with mitigation into a combined climate mitigation and adaptation "Climate Action Plan"**. A timely opportunity to accomplish this would be when TransformTO undergoes its first major update.

As discussed in the framework, there are many synergistic opportunities that reduce both carbon emissions and climate risk, for example green infrastructure, and resilient local energy systems that diversify energy sources and reduce the risk of system failure during a stress or shock situation; local energy systems are a key focus of the City's existing efforts in developing community energy plans. It is, and will continue to be fundamental to consider mitigation and adaptation efforts and investments in an integrated way in order identify interdependencies and synergies that maximize efficiencies and cost-effectiveness, and minimise risk.

To systematically achieve this objective, it is recommended that over the course of the next few years ahead of TransformTO's first major update, the City work to bring together its existing climate mitigation work/actions (under TransformTO), and its existing and new adaptation work/actions (in the Resilience Strategy) into one "Climate Action Plan".

INDIGENOUS KNOWLEDGE

12. Integrate Indigenous Knowledge Systems and collaborate more meaningfully with Indigenous peoples in climate action planning.

Broad and deep engagement that brings together diverse perspectives and worldviews is required to develop novel approaches and diverse ways of thinking in order to address the urgency and complexity of climate change. Integrating Indigenous Knowledge systems and collaborating more meaningfully with Indigenous peoples is fundamental to this approach. Additionally, climate action planning that is equitable and community-driven can improve policy outcomes for those who may be more vulnerable to climate impacts; this inclusivity requires meaningful engagement of a wide range of communities and stakeholders in the planning process.

The City's Environment and Energy Division and the Resilience Office partnered with Indigenous Climate Action, an NGO, to host a workshop in October 2018 to start a collaboration that seeks to integrate Indigenous Knowledge Systems and more meaningfully engage with Indigenous people in Toronto in climate planning. Moving forward, it is fundamental for the City to continue these efforts in its climate planning work.

INSTITUTIONALIZING CLIMATE RESILIENCE

13. Establish a Resilience Office at the City of Toronto to institutionalize climate resilience.

Ensuring that the City continues to be a leader in taking action on climate both locally and globally, and makes investments and decisions that make Toronto more resilient, requires a sustained and broad approach; one that focuses on **institutionalizing climate resilience through** integrating and embedding [**mainstreaming**] climate resilience thinking throughout the organization, building human and technical resource capacity in the field of climate resilience [**building capacity**], driving climate resilience action at the City through the implementation of the Resilience Strategy [**action implementation**], and engaging with and working alongside external partners [**engagement**]. This approach is both focused in intent, while broad in application.

To facilitate this institutionalization [mainstreaming, building capacity, action implementation and engagement], a coordinated, collaborative and distributed effort is required. Fundamentally, there needs to be an entity responsible and accountable for this delivery.

The establishment of a **Resilience Office (or similar entity) with a distributed network of coordinated support** is well suited to this role. It would directly support City divisions and decision-makers to integrate climate resilience into their work; actively build staff and technical capacity; implement the actions in the Resilience Strategy; and, participate and work more collaboratively with external partners, including industry, academia, non-profit organizations, community groups, other levels of government regionally, provincially and nationally, and other international city networks.

In this context, a Resilience Office would act as the focal point for Climate Resilience at the City, while also facilitating, coordinating and driving climate resilience action within Toronto more broadly.

With specific reference to Recommendation 11, it is recommended to bring together mitigation and adaptation into a combined climate mitigation and adaptation “Climate Action Plan”, ideally when TransformTO undergoes its first major update. In the interim, a Resilience Office (or similar entity) is needed to drive and be accountable for the implementation of the climate resilience actions in the Resilience Strategy. During this period, it will be vital that this entity stay directly connected with the Energy and Environment Division and others who are delivering TransformTO.

AREAS FOR FURTHER RESEARCH

Through the course of undertaking this work, a number of areas emerged that are integral to climate resilience that would benefit from further research. It was identified that some of these are currently being explored by others within the City. Due to limited scope and time, along with trying to avoid unnecessary duplication of effort with other entities, these were not fully explored and integrated within this report. Moving forward, additional resources should be assigned to research these further and how to integrate them more systematically within climate resilience work at the City.

LOCAL FOOD AND FOOD SYSTEMS RESILIENCE

There is a direct connection between climate change and food. During the development of this report in 2018, the City undertook a high-level vulnerability assessment of Toronto's food system to identify the most significant risks climate change would pose to food distribution and access within Toronto and make recommendations that would increase the resilience of the city's food system. Findings are documented in Resilient Food Systems, Resilient Cities, and have been considered in the the Resilience Strategy.

COMMUNITY AND PUBLIC HEALTH

There are numerous impacts and risks for health and wellbeing from climate change, such as heat stroke, injury, vector-borne diseases, and mental health, along with impacts for health services and community support systems, and food systems (noted below). Toronto Public Health (TPH) developed and is currently implementing a five year (2015-2019) Climate Change and Health Strategy for Toronto identifying specific actions to better understand and respond to the health effects of climate change. The strategy recognizes that while the approach to addressing climate change health risks is broad, different assessment, analysis and engagement techniques need to be applied to specific health risks to address each one effectively.

CLIMATE FINANCE AND ECONOMIC DEVELOPMENT

- Investigate the role economic development plays in the implementation of climate resilience action, including innovation funding, green jobs creation, workforce development and new opportunities for social entrepreneurs.
- Quantify (in more detail) the projected economic impact of the physical impacts of extreme climate events playing out into the future (for the City and Toronto as a whole) to demonstrate the economic importance of concerted and ongoing investment in adaptation both now and over time.
- Investigate opportunities to use green bonds to fund climate resilience implementation
- Explore applying the Task Force for Climate-Related Financial Disclosures (TCFD)

reporting to the City

- Explore how [City] investments in climate resilience, and mechanisms like TCFD, could further influence costs of borrowing and insurance premiums for the City and residents/businesses more broadly, attract private investment needed for resilient infrastructure, and establish Toronto as preferred hub for sustainable finance and clean technology.
- Explore the integration of climate resilience with Enterprise-wide Risk Management and at the City.

APPENDIX I: DEVELOPMENT OF THE CRF & RECOMMENTATIONS

CONTEXT

The Climate Resilience Framework and set of recommendations was developed over the course of several months from March 2018 to January 2019, and formed part of the broader process of developing Toronto's Resilience Strategy, which was concurrently being developed over a longer period from June 2017 to March 2019.

To date (and prior to this work), pioneering adaptation work has been undertaken by the City, including the development of the Climate Change Adaptation Strategy in 2008, a Climate Change Risk Assessment Tool in 2012, and the adoption of the Climate Change Risk Management Policy in 2014. Additionally, Toronto has contributed significantly to the global discourse on the interdependencies of urban infrastructure systems in the context of climate change. Due to a number of barriers however, these efforts have not been fully implemented or resourced.

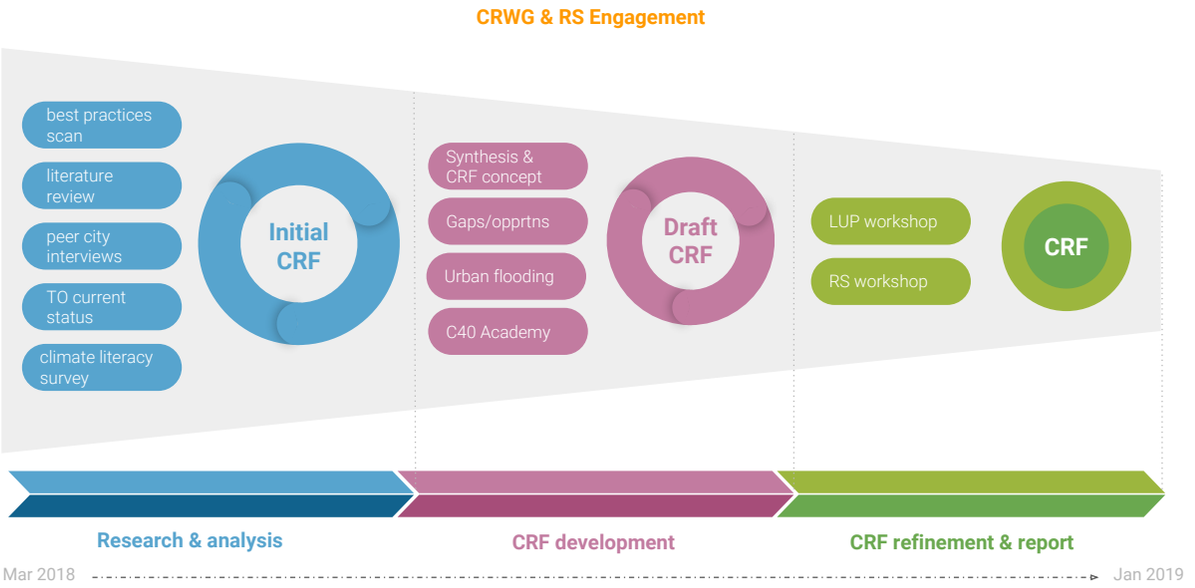
The primary purpose of the work undertaken and this resulting report was to inform concepts, content and a set of recommendations for consideration and potential inclusion as actions in the Resilience Strategy, to further advance climate adaptation efforts at the City within the context and momentum afforded by the Resilience Strategy.

To build upon the adaptation work to date and meet the needs of the substantive scope of the Resilience Strategy, a process was designed (outlined below) that focused on understanding the context of Toronto and the climate impacts its faces, defining the issues holistically, understanding existing City policy and work, and establishing a set of priority areas of action to advance climate resilience work at the City. Notably this process differs from that used in many other jurisdictions, which bases adaptation planning on detailed risk and vulnerability analyses. This process was designed to economise on limited time and financial resources, and to leverage both the existing adaptation work and the parallel work and engagement undertaken as part of the wider Resilience Strategy process.

PROCESS

The process involved a multiple step process including an initial research and analysis phase, followed by the development of the framework and set of recommendations, and finalization and integration with Toronto's Resilience Strategy. This process was accompanied by direct engagement with a Climate Resilience Working Group and in parallel with broader engagement undertaken through the development of the Resilience Strategy (refer to the Resilience Strategy for further details on engagement).

The Climate Resilience Working Group (CRWG) was established to guide and support the development of the Climate Resilience Framework. It was made up of 14 members from within the City and from external organizations, and met formally in 3 workshop sessions over the course of the CRF development. Members included: City of Toronto Environment & Energy Division (EED); Financial Planning, Analysis & Reporting Systems (FPARS); City Planning; Parks, Forestry & Recreation (PFR); Toronto Public Health; Toronto and Region Conservation Authority (TRCA), Community Resilience to Extreme Weather (CREW), Clean Air Partnership, and Toronto Environmental Alliance.



The initial research and analysis phase included:

- Preliminary Resilience Assessment review: review of work to date on Resilient Toronto;
- Climate data review: review of climate projections and impacts for the City of Toronto.
- Best practices research and jurisdictional scan: research of climate resilience and adaptation approaches and actions being undertaken by other cities (nationally and internationally); over 25 cities were looked at in detail
- Peer city interviews: interviewing front line staff from peer cities on how they are thinking about and undertaking climate adaptation planning and action; cities included Boston, New York City, Seattle and Portland;
- Literature review: grey and academic literature review on climate adaptation planning and governance in cities and more broadly, including governance, transformational change and integrated policy.
- Current Toronto status review: review of current climate-related City policy and policy more broadly, and previous and current climate adaptation action work at the City, including interviews with City adaptation staff.
- Climate literacy survey: a survey of over 280 City staff to better understand the level of staff literacy on climate change

The second phase of the project involved synthesis and analysis of the the initial findings to better understand and frame the character of change underway in the City of Toronto, the gaps in action, and the opportunities to advance adaptation and resilience. This informed an initial climate resilience framework concept and development of potential actions within the Toronto context. This phase was less linear in fashion; further analysis, research, concept development and engagement became iterative. This allowed for new findings, ideas and opportunities to emerge from and be further integrated into the process, along with parallel integration with the Resilience Strategy process.

This phase involved deeper collaboration with other Resilience Strategy working teams, specifically urban flooding, towers, and neighbourhood resilience. It also included participation in C40's Climate Adaptation Academy; much of what was learnt was integrated to further develop a draft framework and consolidated list of recommendations for consideration.

The final phase involved refinement of the framework and recommendations, along with integration into the Resilience Strategy, informed by engagement activities on the Resilience Strategy. Additionally, a full-day *Climate Resilience and Land Use Planning Workshop* was held with the City of Toronto's Planning Division during this final phase to further detail potential opportunities for action within land use planning.

APPENDIX II: CLIMATE VULNERABLE POPULATIONS AND SOCIAL EQUITY

Climate change will impact us all, but not all people will be affected equally; certain groups, communities, or populations will be disproportionately affected by the impacts of climate change due to their increased exposure and sensitivity to climate risks, or lack of adaptive capacity. Communities that are highly exposed or sensitive to climate risks, or have less capacity to respond to these risks are often referred to as "climate vulnerable populations". Table A-1 below includes (but is not limited to) those considered to be more vulnerable to climate change in the literature.

While illustrating the variables that contribute to climate vulnerability, Table A-1, does however present a static interpretation of these concepts and runs the risk of oversimplifying this analysis. Exposure, sensitivity, and adaptive capacity are not static, and in many cases are inextricably linked. Income is closely tied with living conditions and occupation, while health is frequently tied to age. Both historic and growing social and economic inequalities, and continued systemic and institutional inequity, are linked to and exacerbate underlying drivers of vulnerability to climate change.

Physical, social and/or structural barriers in accessing services and social supports, and frequent discrimination, directly influences the ability of a person or groups of persons to seek and receive help, in addition to influencing health and income.[35] For example, for racialized groups, structural and institutional racism negatively influence income, living conditions and health, all of which increase vulnerability to climate change.[36] Similarly, racialized and low income communities are frequently underfunded, which can result in inadequate green space or community resources, increasing exposure to climate impacts.[37]

The intent of this table and analysis is less about classifying these groups according to climate vulnerability, and more about demonstrating the link between climate vulnerability and social equity.

Table A-1. Climate vulnerable populations.

CLIMATE VULNERABILITY AS A FUNCTION OF >	EXPOSURE (Physical/geographic)	SENSITIVITY (Physical/social)	ADAPTIVE CAPACITY (Socio-ecenomic)
CLIMATE VULNERABLE POPULATIONS	-Location (eg. in a hazard area -Poor quality housing/ living conditions -Homeless or under-housed -Outdoor occupation	-Elderly -Young children -Persons with pre-existing illnesses/bad health -Persons with disabilities -Pregnant women	-Low Income -Racialized groups -Immigrants & refugees -Person without access to insurance -Homeless or under-housed -Non-english speakers -Aboriginal peoples -Women -Single-headed households -Public housing residents -Undocumented individuals -Socially isolated persons -Residents in neighbourhood improvement areas

The City of Toronto's Equity Lens identifies several groups considered as "equity seeking' within Toronto. These include:

- Indigenous Peoples
- Persons with disabilities
- Racialized groups
- Women
- LGBT2QS
- Undocumented individuals
- Immigrants and refugees
- Persons with low income
- Youth
- Victims of violence
- Persons who are homeless or under-housed
- Residents in neighbourhood improvement areas

When these equity seeking groups are over-layed with climate vulnerable populations in the literature, there are many commonalities, but also a few exclusions:

- Majority of the equity seeking groups are also considered more vulnerable to climate change in the literature; these are shown in purple in Table A-2;
- Some equity seeking groups are not considered more vulnerable to climate change in the literature, this includes LGBT2QS, youth, and victims of violence.
- Many climate vulnerable populations as defined in the literature, are not identified as equity seeking groups in Toronto; these are shown in blue in Table A-2.

Table A-2. Climate Vulnerability and Toronto equity-seeking groups.

CLIMATE VULNERABILITY AS A FUNCTION OF >	EXPOSURE (Physical/geographic)	SENSITIVITY (Physical/social)	ADAPTIVE CAPACITY (Socio-ecenomic)
CLIMATE VULNERABLE POPULATIONS	-Location (eg. in a hazard area -Poor quality housing/ living conditions -Homeless or under-housed -Outdoor occupation	-Elderly -Young children -Persons with pre-existing illnesses/bad health -Persons with disabilities -Pregnant women	-Low Income -Racialized groups -Immigrants & refugees -Person without access to insurance -Homeless or under-housed -Non-english speakers -Aboriginal peoples -Women -Single-headed households -Public housing residents -Undocumented individuals -Socially isolated persons -Residents in neighbourhood improvement areas

While some groups, such as LGBT2QS, youth, and victims of violence are not necessarily identified as a group more vulnerable to climate change in the literature, they nonetheless face barriers and/or discrimination in Toronto that may further influence income, health, living conditions and other factors that contribute to climate vulnerability, making these groups inherently more vulnerable.

In general, all equity seeking groups face historic or current physical, social and structural barriers that contribute to greater vulnerability. For this reason, and for the purposes of this framework, Toronto's equity seeking groups are considered a subset of climate vulnerable populations (Figure A-1), and as a group, should be prioritized within climate vulnerable populations; while as a whole, climate vulnerable populations are prioritized in the context of the City's wider population.

It is also worth noting that across the spectrum of climate vulnerable populations, some will experience climate impacts disproportionately. Those who experience multiple, overlapping factors of vulnerability are more likely to experience disproportionate affects compared with those who may only experience one factor. For example a racialized, low income, non-english speaking, elderly person in bad health, will be significantly more affected compared with someone who is a non-english speaking person, but otherwise in good health and does not face other barriers.

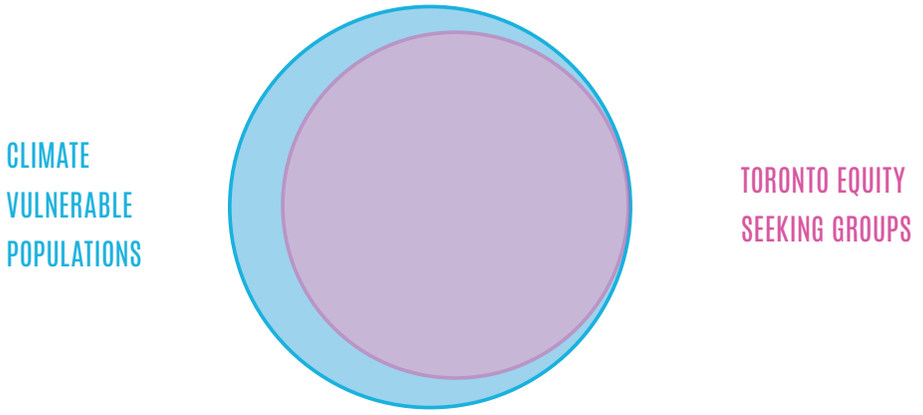


Figure A-1. Climate vulnerable populations and Toronto equity-seeking groups.

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CLIMATE RESILIENCE FRAMEWORK

CITY OF TORONTO