WET INFRASTRUCTURE:

Building Blue and Green

A series of research based handbooks designed to offer accessible and practical information about blue-green infrastructure approaches.

Handbook 2:

Governance

A Study of Stormwater Management Governance Structure in Toronto and Ontario

WET INFRASTRUCTURE Building Blue and Green developed at:

Ryerson University

School of Urban and Regional Planning

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WET INFRASTRUCTURE: Building Blue and Green is a series of accessible informational handbooks about blue-green infrastructure and the opportunities for the City of Toronto. The intended use of this series is to educate and inform stakeholders on the design, monitoring, maintenance, and policy considerations for urban stormwater management. Urban stormwater refers to rainfall and snowmelt which falls on the built environment and infiltrates, evaporates or runs off into storm sewers, streams and lakes.[65]

As a part of this project, the team conducted site visits and best practice interviews with stormwater professionals in the Netherlands in October 2016. The Dutch are internationally recognized as world leaders in both hard-surface control-based engineering and soft-surface adaptive design approaches to flood management. With the majority of their economy situated at or below sea level, the Dutch have pioneered innovative stormwater solutions and established global benchmarks for engineering technology. This series draws from current stormwater management practices and related governance structures in the Netherlands, and grounds them in the Toronto context through a governance analysis and professional communications with involved stakeholders.

This project was undertaken by graduate students from the Ryerson University School of Urban and Regional Planning, under the academic guidance of Professor Nina-Marie Lister.


Grant Mason, 2016

WHY THIS? *Stormwater management is incredibly complex.*

Today, the majority of the world's population lives in an urban delta – an area at the mouth of a river, where land and water meet. Toronto is both a riverfront and lakefront city, and this holds particular planning and design challenges and opportunities for effective stormwater management. Blue-green infrastructure is an emerging set of design technologies, based on ecological functions, using landscape treatments to help meet today's stormwater management needs.

Stormwater management is closely connected to the various components of the urban environment: from transportation to waterfront development. Critical alignment between the policies and legislation, and the actions and interests of stakeholders at various scales - from homeowners to developers, regional governments to Aboriginal communities - is pivotal to effective and resilient stormwater management.

WHY US? *We are a multidisciplinary group.*

Our diverse academic and professional experiences, coupled with the professional communication and field research we have conducted during this study, provides us with a unique and extensive understanding of how problems are faced by various stakeholders involved with urban stormwater management.

WHY NOW? *The time to act is now.*

The increasing frequency and severity of storm events are linked to climate change, causing significant economic, social, and ecological impacts on Torontonians. Three major storms, between 2013 and 2016 alone, have resulted in over two billion dollars in damage. Adaptive and innovative approaches to stormwater management are imperative to building a resilient and sustainable future. A contemporary approach to climate resilience includes blue and green infrastructure.

Grant Mason, 2016

HOW SHOULD THIS BOOK BE USED?

The Governance handbook intends to stimulate a conversation for developing a comprehensive understanding of existing and potential governance structures related to blue-green infrastructure, bridging the gap between ideation and implementation. This handbook provides an overview of how decisions have been made, can be made with current regulations, and could be made through future opportunities. In looking at how decisions have been made and can be made, the first portion of this handbook considers the stakeholders involved in stormwater management and provides a broad overview of provincial, regional, and municipal plans, policies, and legislation that play a role in water governance in Ontario and more specifically, Toronto.

The remainder of this handbook turns to future opportunities for governance by exploring international case studies that address governing for resilience and planning at the watershed scale. In addition, strategies for consistent and effective data availability are considered, understanding that stormwater management and climate change planning hinge upon the collection and analysis of credible and standardized data. This handbook concludes with opportunities that are further explored and expanded upon in the third and fourth handbooks of the series, ***Best and Next Practices*** and ***Activation Plan***, addressing the need for a collaborative and integrated watershed management approach. Ultimately, the governance handbook acts not as a final, fixed review but rather a flexible and adaptable document where value lies in its ability to be updated and discussed.

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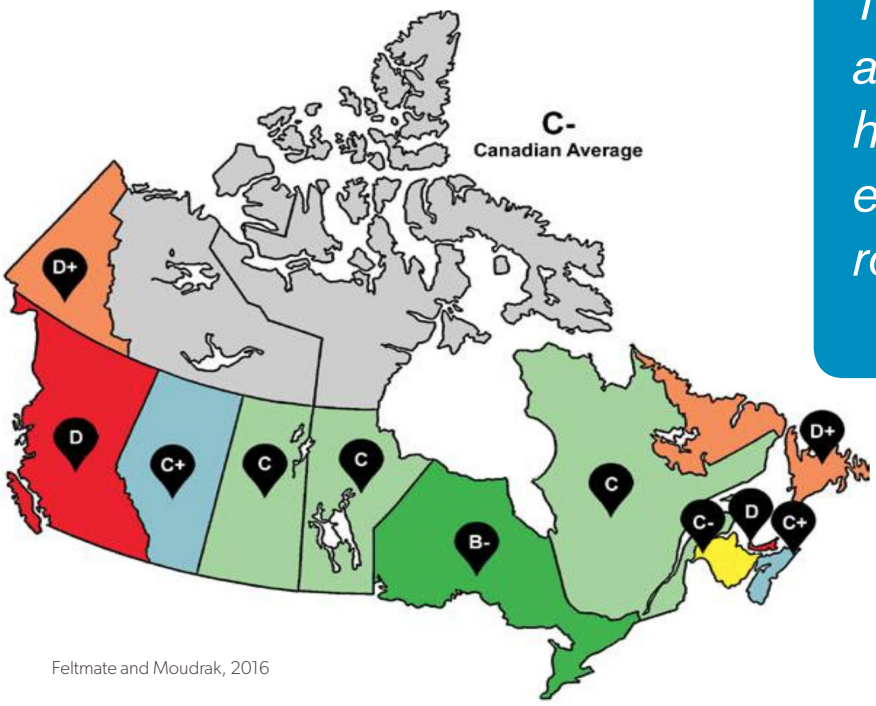
"Water management is facing enormous challenges both nationally and internationally. ***Climate change,*** *a* ***rapidly increasing population*** *and* ***economic developments*** *are putting immense pressure on water systems...****Governments have a clear responsibility*** *for the management of water resources and the safety of inhabitants from flooding. These tasks... not only require adequate funds, physical infrastructure and knowledge, but also a good institutional structure to be efficient and effective to engage stakeholders and to build trust.* ***That is good water governance."*** [51 p. 9]

A recent report by the University of Waterloo Intact Centre on Climate Adaptation, *Climate Change and the Preparedness of Canadian Provinces and Yukon to Limit Potential Flood Damage,* evaluated the readiness of governments to confront the effects of a changing climate.[60] Based on 12 factors, provinces and the Yukon territory were given a score from A to E, with A representing "high flood preparedness" and E representing "low flood preparedness".[45, p. iv] The factors for assessment include floodplain mapping, land-use planning, and action following an emergency. **Ontario achieved a score of B-**, leading the way in a **nation averaging a score of C-.**[45,97]

While lacking a strong preparedness for flooding, the province of Ontario and municipalities within have an opportunity to embrace a leadership role in climate change adaptation and strive to be highly prepared for flooding and other similar climate change shocks. Moving forward, Ontario and Toronto's leadership requires a governance system that is integrated, coherent and accountable. As the United Nations stated in their second report on World Water Development titled, *Water: a Shared Responsibility*, the incessant, severe, and evolving water calamity worldwide is primarily a governance crisis.[96]



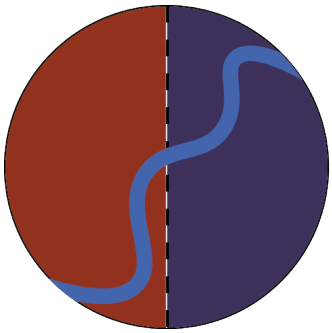
Feltmate and Moudrak, 2016

The Province of Ontario and municipalities within have an opportunity to embrace a leadership role in climate change adaptation.

CHALLENGES

There are several challenges that stem from the policies, programs, plans, and strategies that incorporate considerations or regulations for stormwater management, green infrastructure, and climate change resilience. These various challenges, are discussed throughout this review of Ontario's provincial policies and Toronto's municipal policies, and fall under the following three broad themes:

Watershed Boundaries VS. Political Boundaries

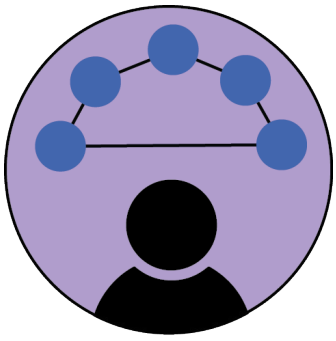


The complex and overlapping interactions between political boundary decision-making and watershed boundary decision-making. In particular when important decisions made in either realm affect, conflict, or repeat decisions made in the other.

Fragmented Nature of Policy

The multifaceted nature of stormwater management and legislation leads to challenges of coordination, audiences, and questions of who has what authority, influence, or power.

Complex Interdisciplinary Problems



The interdisciplinary nature of blue-green infrastructure is exacerbated by the compounding effects resulting from climate change, population growth, and new development. The interdepartmental requirements of blue-green infrastructure coupled with the unprecedented nature of climate change, requires collaboration to arrive at collective action and solutions.

STAKEHOLDER BREAKDOWN

A wide array of stakeholders are involved within and/or contribute to stormwater management, and particularly blue-green infrastructure, in Toronto. The variety of interests, responsibilities, and roles have the potential to conflict, resulting in reduced opportunities for meaningful and productive crossover between stakeholders.

Who is Responsible for Our City Streets?

The complexity of stakeholders involved and their diverse vested interests are evident when considering the implementation of blue-green infrastructure on the public right-of-way. The City of Toronto streets are serviced and maintained by a number of City divisions. For Example:

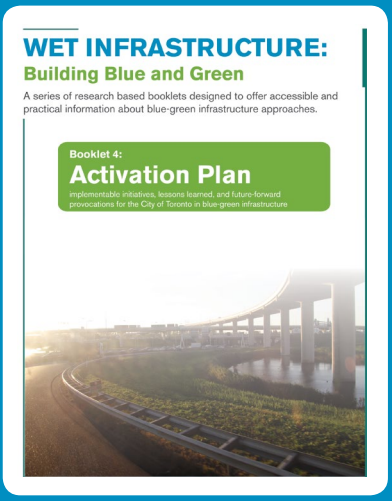
1) A selection of above ground departments involved:

Parks, Forestry & Recreation; Transportation Services; City Planning; Engineering and Construction Services

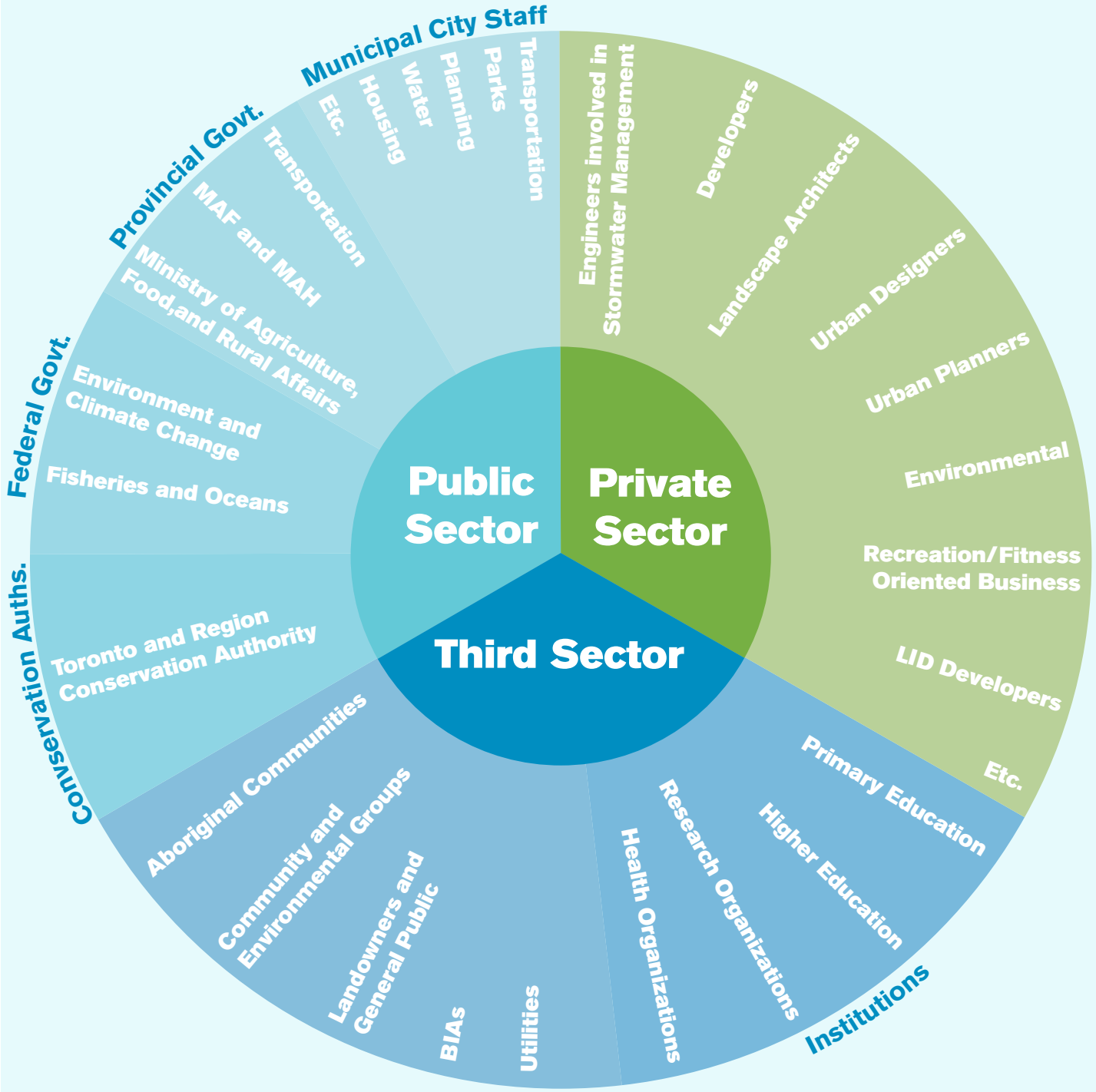
2)A selection of below ground departments involved:

Toronto Water; Utilities

It is critically important for the stakeholders involved to find common ground, so that wide-scale adoption of blue-green infrastructure is successful. With opportunities for the creation of multifunctional facilities, blue-green infrastructure provides multiple community benefits and serves the interests of varying stakeholder groups simultaneously.[7]



Look to the Community Engagement Strategy section of the ***Activation Plan*** for more information about stakeholder engagement and outreach, focused on effective communication across all those involved in blue-green infrastructure to help achieve buy-in.



A wide array of stakeholders are involved in blue-green infrastructure

CHAMPIONS

To advance the adoption of blue-green infrastructure in the City of Toronto, champions play a critical and necessary role. Our research in both the Netherlands and the Greater Toronto and Hamilton Area supports this conclusion.

The City of Mississauga, for instance, could be viewed as a champion in the field of blue-green infrastructure. Mississauga was the first municipality within Credit Valley Conservation's jurisdiction to implement blue-green infrastructure in road allowances. Planners executed a right-of-way retrofit project on Elm Drive in Mississauga which was one of the first green street retrofit projects in Ontario. The project uses low impact development practices, or blue-green infrastructure, to capture and treat stormwater through the use of bioretention planters and permeable pavement.[44] This project would not have been possible without the leadership of dedicated councillors and members of the Peel District School Board (PDSB). Many challenges emerged during the implementation process, including design issues, unfamiliarity with the technology, safety concerns, among others.

Blue-green infrastructure adoption requires early buy-in from stakeholders to ensure that the project succeeds despite the many challenges that may arise. Without early buy-in or champions the Elm Drive project may not have come to fruition. The Ward Councillor and local PDSB trustee were instrumental in facilitating dialogue and buy-in from the local government and public officials.[35] Ultimately, this project - a collaboration between the City of Mississauga, Credit Valley Conservation and the Peel District School Board - demonstrated how collaborative partners can lead to a successful project.

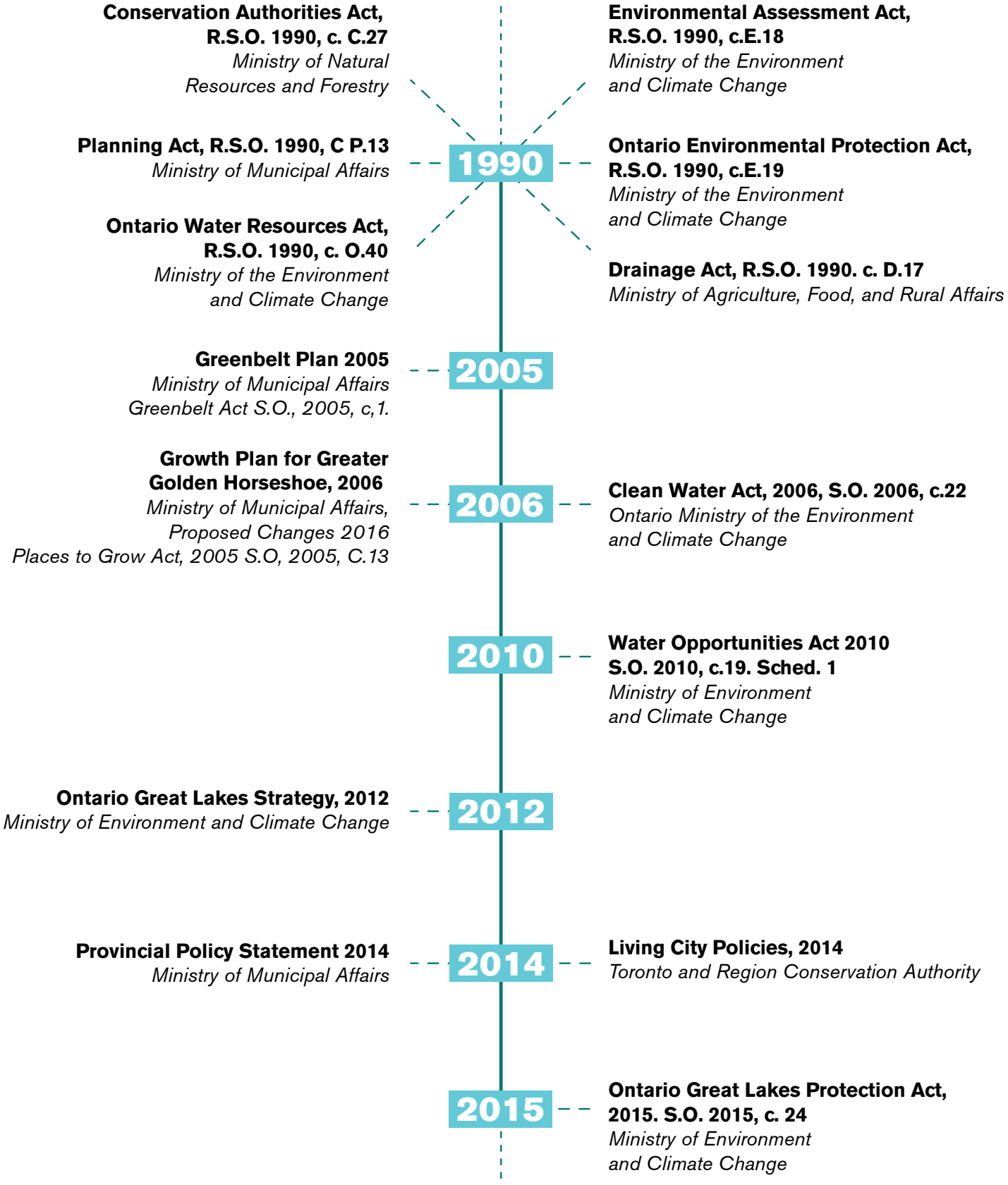
Since the Elm Drive retrofit project, Mississauga has become the home for many innovative demonstration projects on blue-green infrastructure. One such project is the demonstration site for blue-green infrastructure on industrial-commercial properties at the IMAX corporate head office. The parking lot has been retrofitted with permeable pavement and bioretention units to collect, hold, and filter pollutants from stormwater runoff and includes seven monitoring stations that allow the Credit Valley Conservation to monitor the performance of the site.[34] To be a leader requires risk. It also requires the development of partnerships and champions. The stakeholder visual on page 12 not only depicts the various groups who play a role in the transformation of blue-green infrastructure from ideation to implementation. Further it highlights potential opportunities for champions and partners in this endeavour to implement multifunctional and resilient stormwater infrastructure that benefits communities while minimizing environmental impact.

PROVINCIAL POLICY AND LEGISLATION

The review of provincial and municipal policies outlined in the following two sections embody the intent and spirit of the legislation. For specific terms, regulations, and policies please refer to the acts, plans, and strategies themselves.

This provincial policy review establishes the current legislation, policies, and plans developed by the provincial government of Ontario that pertains to stormwater management and climate resilience. Descriptions and applications of each act or strategy included in this section can be found in the Appendix of this handbook.

Grant Mason, 2017


Conservation Authorities Act, R.S.O. 1990, c. C.27
Ministry of Natural Resources and Forestry
Planning Act, R.S.O. 1990, C P.13
Ministry of Municipal Affairs
Ontario Water Resources Act, R.S.O. 1990, c. O.40
Ministry of the Environment and Climate Change
1990
Environmental Assessment Act, R.S.O. 1990, c.E.18
Ministry of the Environment and Climate Change
Ontario Environmental Protection Act, R.S.O. 1990, c.E.19
Ministry of the Environment and Climate Change
Drainage Act, R.S.O. 1990. c. D.17
Ministry of Agriculture, Food, and Rural Affairs
Greenbelt Plan 2005
Ministry of Municipal Affairs
Greenbelt Act S.O., 2005, c,1.
2005
Growth Plan for Greater Golden Horseshoe, 2006
Ministry of Municipal Affairs, Proposed Changes 2016
Places to Grow Act, 2005 S.O, 2005, C.13
2006
Clean Water Act, 2006, S.O. 2006, c.22
Ontario Ministry of the Environment and Climate Change
2010
Water Opportunities Act 2010 S.O. 2010, c.19. Sched. 1
Ministry of Environment and Climate Change
Ontario Great Lakes Strategy, 2012
Ministry of Environment and Climate Change
2012
Provincial Policy Statement 2014
Ministry of Municipal Affairs
2014
Living City Policies, 2014
Toronto and Region Conservation Authority
2015
Ontario Great Lakes Protection Act, 2015. S.O. 2015, c. 24
Ministry of Environment and Climate Change

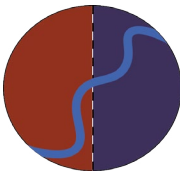
"This issue-based approach of dealing with individual water management problems rather than water resource systems has resulted in the accumulation of over 20 pieces of legislation that each deal directly or indirectly with some aspect of water resources. Responsibility for administering this body of legislation has been distributed among an array of agencies, including local and regional municipalities, several provincial agencies and the conservation authority, with no formal process for coordination." 101 p. 4

Conservation Authorities Act, R.S.O. 1990, c. C.27

Ontario Ministry of Natural Resources and Forestry

The *Conservation Authorities Act* is currently undergoing a review. The Ministry of Natural Resources and Forestry published a report containing proposed foci for the revision of the *Conservation Authorities Act* resulting from stakeholder feedback.[30] These include: an increase in accountability; further collaboration among stakeholders involved in resource management; and the establishment of clear functions, procedures, priorities and criteria for conservation authorities.[48]

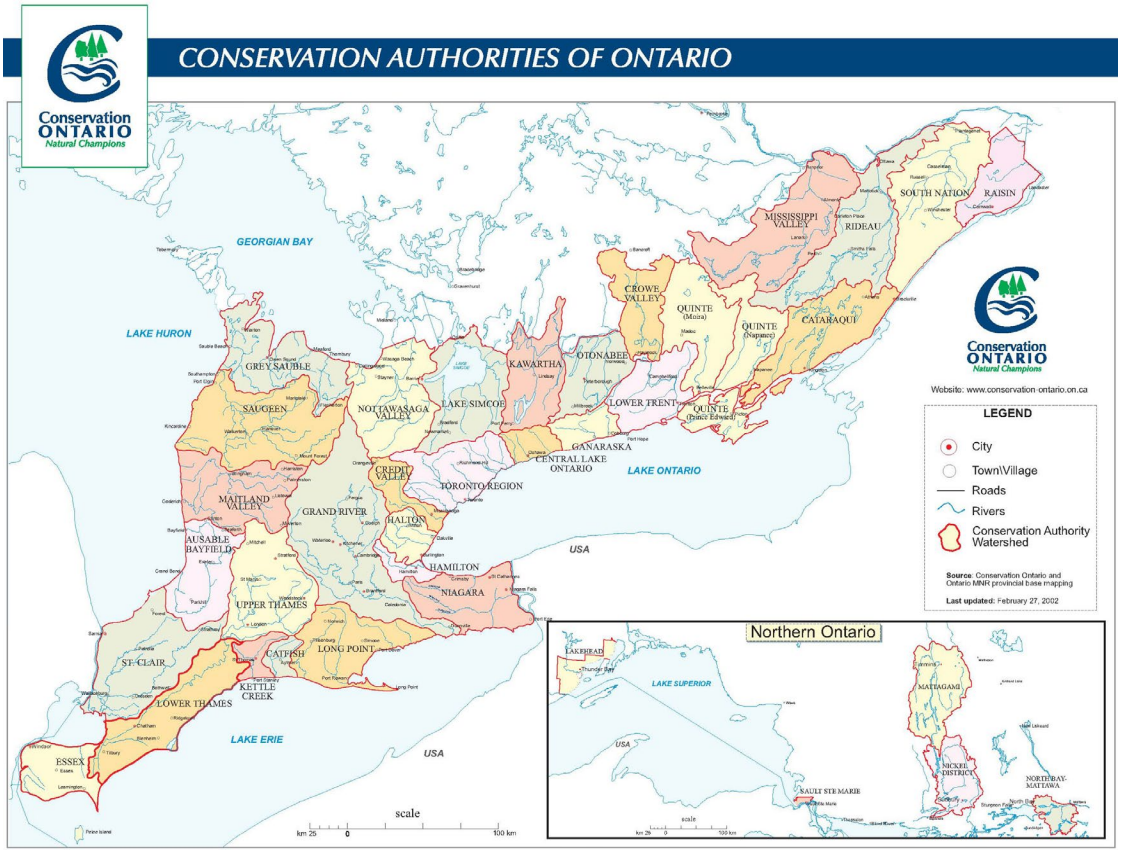
In response, Conservation Ontario highlighted five key topics on behalf of all the conservation authorities, one of which included integrated watershed management. Integrated watershed management "manages human activities and natural resources together, on a watershed basis taking into consideration environmental, economic, and human needs and interests".[30]



"Water does not respect political boundaries" [71 p. 272]

The main concepts of integrated watershed management focus on collective governance to establish goals and collaborate on decision making, as well as adaptive management model that highlights key actions, observations, and maintenance strategies.[30]

The Ontario Ministry of Natural Resources and Forestry acknowledges that it is crucial for conservation authorities to be well equipped to confront and address climate change.[48]

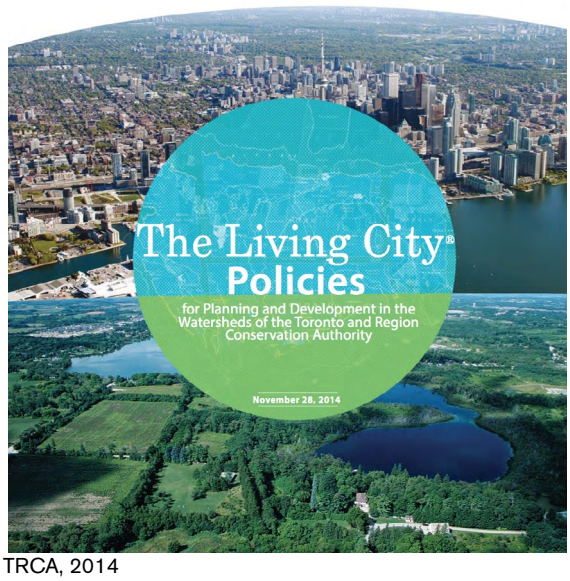


Living Cities Policies, 2014

Toronto and Region Conservation Authority

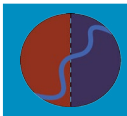
Section 6.7 of the *Living City Policies* identifies policies for green infrastructure including:

- Coordination with municipalities, developers, and other stakeholders to execute green infrastructure initiatives;
- Researching the practices and advantages of green infrastructure that focus on opportunities in ecosystem services, account for concerns of urbanization, and address the possible effects of a changing climate; and
- Cooperation with municipalities to preserve, improve, and grow the urban tree canopy.[93]



TRCA, 2014

Complexity of Decision-Making across Boundaries



Watersheds do not respect artificially imposed political boundaries. As a result, the interactions between watershed level and political level decision-making processes are multi-layered and complex. This complicated relationship between public entities is particularly noticeable when decisions which are in one at one level directly impact the other. This issue is particularly pronounced when dealing with global scale issues such as climate change, which require both watershed and political boundary level responses to work in conjunction with each other.

The most notable overlap between the watershed and political boundary is the population which reside in them. The Toronto and Region Conservation Authority (TRCA) is responsible for a watershed which has direct impacts on the lives of individuals across 18 municipalities.[93] TRCA management coordination and support on issues which may not evenly impact each municipality. Yet, municipalities are directly responsible for their own respective municipal areas. The public is thus caught between the jurisdictions of two authorities. Both require the cooperation of the public and seek to protect the environment and improve wellbeing.

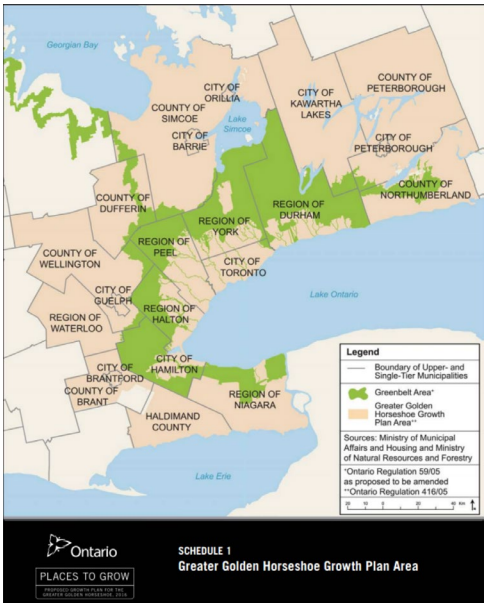
An overarching complexity relating to blue-green infrastructure stems from its connection to river systems and corresponding watersheds. The ongoing development of Toronto has resulted in issues such as increased runoff, rising water levels, watercourse erosion, and water quality concerns. As Toronto has urbanized, the amount of impermeable surfaces has increased, leading to polluted stormwater runoff directed to Toronto's rivers. These rivers are under the jurisdiction of the TRCA which is responsible for the city's watercourses and shoreline. While the City has taken a proactive role in addressing concerns regarding its aging infrastructure and instituting blue-green building standards, development continues to impact the watershed. Yet, the TRCA cannot intervene in the municipal level development approval process where proposed developments do not fall within its jurisdiction or regulated areas.[93] Even in situations where the TRCA can intervene they must coordinate and work alongside the City.

Where municipal infrastructure is not at risk, the TRCA is responsible for assessing, documenting, and prioritizing repairs for watercourses and then handing responsibility for the organization and cost of repairs onto the municipality and property owner. Often repairs for low and medium term risks take over 10 years to complete.[56] While there are instances where the TRCA can have a direct influence over watercourses and stormwater management, they must ultimately deal with the ramifications of decisions which fall outside of their jurisdiction.

Growth Plan for the Greater Golden Horseshoe, 2006
Ministry of Municipal Affairs, Proposed Changes 2016*
Places to Grow Act, 2005 S.O, 2005, C.13

Under the Co-ordinated Land Use Planning Review, proposed changes within the *Growth Plan for the Greater Golden Horseshoe* now place strong emphasis on the fact that climate change and resilience must be taken into consideration in land use and growth planning.[69]

The province has proposed that stormwater management plans and a watershed management planning approach are to be required by municipalities. This demonstrates that in comparison with the current *Growth Plan Greater Golden Horseshoe of 2006*, provincial interests are proposing to be more focused on stormwater management and climate change resiliency, further emphasizing the importance of effective water management techniques.[69]



The *Greenbelt Plan* is also included in the 2016 Co-ordinated Review conducted by the Ministry of Municipal Affairs. The proposed changes place strong emphasis on further integration and mitigation of climate change as well as, more effective water management planning through the requirement of watershed planning and a cross-jurisdictional approach.[68]

Who is Responsible for What?

"[The Growth Plan for the Greater Golden Horseshoe] must be read in conjunction with other provincial plans as defined in the Planning Act that may apply within the same geography. Within the GGH [Greater Golden Horseshoe], this includes the Greenbelt Plan, the Oak Ridges Moraine Conservation Plan and the Niagara Escarpment Plan, as well as the Parkway Belt West Plan and the Central Pickering Development Plan. Other plans including the Lake Simcoe Protection Plan under the Lake Simcoe Protection Act 2008, and some source protection plans under the Clean Water Act, 2006 also apply within the GGH." [68 para 21]

The responsibility of stormwater management and blue-green infrastructure is inherently fragmented with a wide range of ministries, divisions, conservation authorities and organizations involved in the implementation, operations, and maintenance of blue-green infrastructure. As there is a large array of stakeholders involved, the roles they play, and their respective responsibilities can be perceived as ambiguous.

From a provincial standpoint, the main responsibility is to outline provincial interests which relate to stormwater management through the issuing of policy statements and provincial plans to legislate those interests through provincial acts. However, these policies and acts are not intended to stand alone rather, they are intended to work in conjunction with the multitude of policies and acts which consider stormwater and blue-green infrastructure. Here lies the challenge; the proposed changes to the *Greenbelt Plan (2016)*, for example, specifically outline stormwater management and resilient infrastructure policies yet, it differs from the *Growth Plan (2016)* proposed changes in terms of further direction related to the implementation of green infrastructure and stormwater management practices.

From a municipal standpoint, the City of Toronto is primarily responsible for the implementation, operations and maintenance of blue-green infrastructure while also considering each provincial policy that discusses and outlines stormwater management practices.[10] However, the fragmented municipal governance structure directly influences the ability for the City of Toronto to successfully implement blue-green infrastructure. Various divisions have specific responsibilities which can create issues of conflicting mandates and repetitive planning and decision-making.[80]

*Proposed Changes through the Co-ordinated Review have been used in this section.

Ontario Great Lakes Strategy, 2012

Ministry of Environment and Climate Change

Great Lakes St. Lawrence River Basin

SeaWiFS Project, NASA/Goddard Space Flight Center, and ORBIMAGE, 2000

Within the *Ontario Great Lakes Strategy*, stormwater management is highlighted in terms of volume reduction and improvements to the quality of runoff by assisting municipalities, the insurance industry, and local stakeholders.

The *Strategy* encourages the demonstration of innovative green infrastructure projects, highlighting the need to monitor their performance and effectiveness, and then share results to a wider audience.

The removal of barriers was identified in the *Strategy* to facilitate greater use of low impact development and green infrastructure. To achieve this the province and non-governmental groups are suggested to work with municipalities on innovative and cost-effective strategies These strategies are intended to focus on the control of rain and snowmelt volumes and quality at the source.

One of the main challenges with stormwater management is that it is often regarded as an afterthought during the site plan and development stages. The *Strategy* explicitly states that the use of green infrastructure and low impact development must be incorporated in the early stages of municipal planning decisions.

The *Strategy* also outlines the need for government action in minimizing the negative impacts of stormwater. For example, government action could include providing direction and advice regarding source control operations and thus, encouraging the inclusion of environmental impact in the early stages of municipal planning and decision making (e.g. low impact development).[67]

Environmental Assessment Act, R.S.O. 1990, c.E.18

Ontario Ministry of the Environment and Climate Change

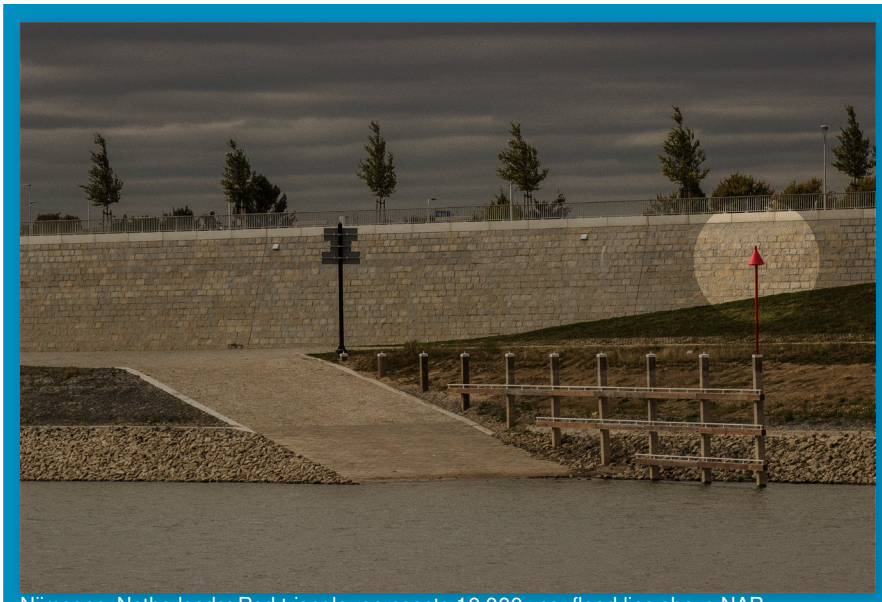
The 2007-2008 Annual Report of the Environmental Commissioner of Ontario, *Getting to K(no)w,* critically analyses Ontario's Environmental Assessment process. The report highlights a number of pivotal issues with Ontario's Environmental Assessment process including:

- The insufficient tracking of, and adherence to, the terms and conditions of environmental assessments;
- The disjointed nature of decision-making for environmental assessment approval that hinders significant participation from the public; and
- The ineffective incorporation of environmental assessments in land use planning.[63]

In the Netherlands, the 1 in 10,000 year flood line is displayed on public infrastructure.[57]

Undertakings requiring environmental assessments must often comply to two formal assessment criteria as well as various regulatory procedures. While accounting for the effects that an undertaking may have on the environment is a complex process (that involves consideration of potentially unforeseen cumulative effects), it is important for various jurisdictions or authorities to coordinate on decision-making, share information, and pinpoint challenges.[71]

Prioritizing Blue-Green Infrastructure



Nijmegen, Netherlands: Red triangle represents 10,000 year flood line above NAP
Grant Mason, 2016

The implementation of blue-green infrastructure experiences ongoing challenges associated with: buy-in, coordination between organizations with varying mandates, and the fundamental prioritization of this approach by stakeholders. In the Netherlands, blue-green infrastructure has gained significant attention and investment due to the looming threat of catastrophic flooding and the severe impacts of climate change.

This threat is visualized as a constant reminder to all stakeholders through the Amsterdam Ordnance Datum (NAP) initiative, where the 1 in 10,000 year flood line is displayed on public infrastructure.[57] As flooding is not currently perceived as a major threat to the Toronto population, how can the priority of blue-green infrastructure be elevated for the City of Toronto and private developers? Current policy standards such as the Environmental Assessment Act provide prescriptive measures, rather than creating goal-oriented action that can invoke concern about urban flooding, thus prioritizing the implementation of blue-green infrastructure.

Water Opportunities Act 2010 S.O. 2010, c.19. Sched. 1

Ontario Ministry of Environment and Climate Change

The *Act* places strong emphasis on the fostering of innovative water management practices. This highlights the objective of the provincial government in continuing to promote the protection of Ontario's water.

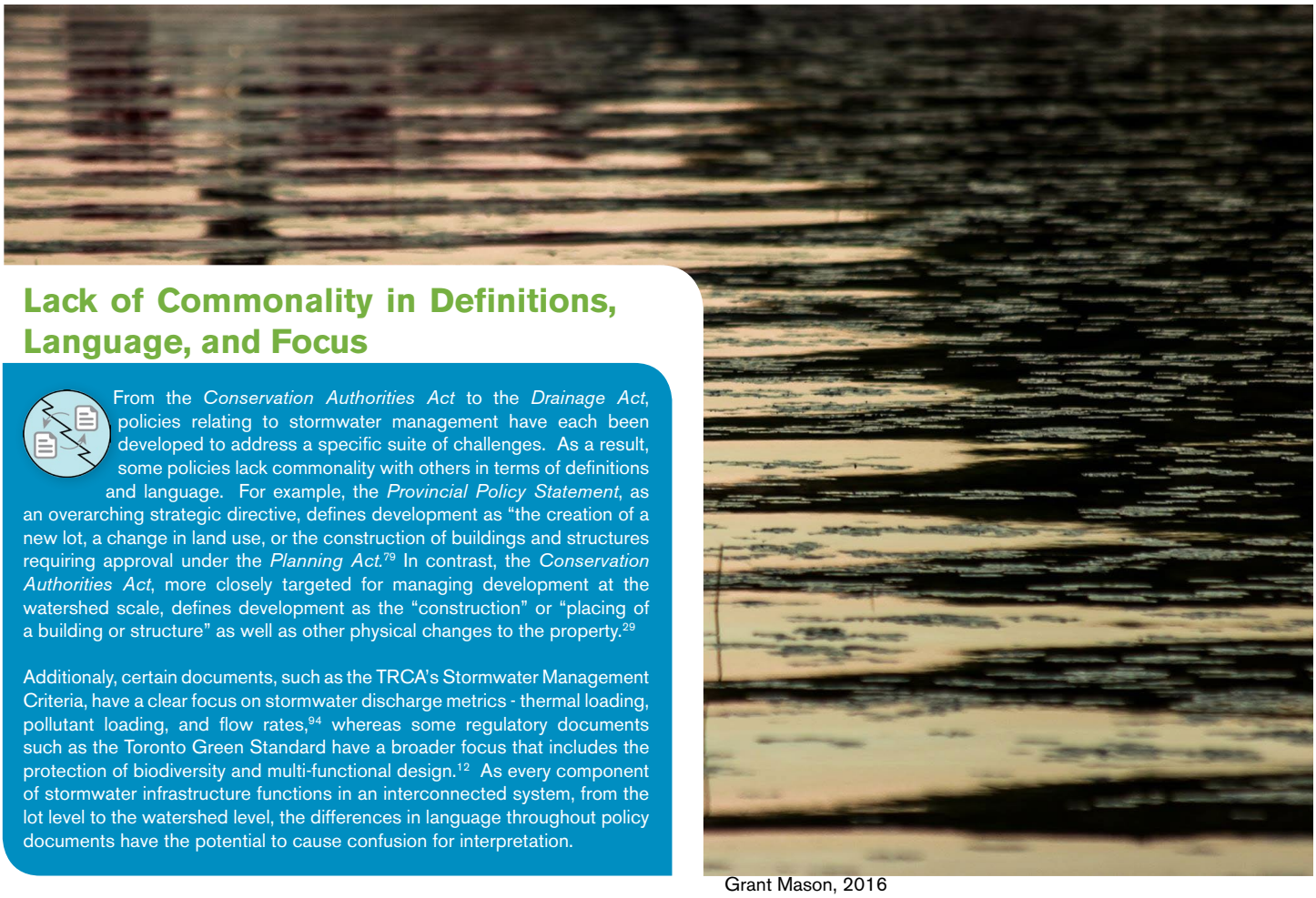
The *Water Opportunities Act* requires Ontario's municipalities to think innovatively about how they can better conserve and manage water.[98]

Definitions may vary among legislative acts. For instance, development is defined differently in the *Planning Act* and the *Conservation Authorities Act*.[93]

Policies and Regulation have Different Audiences

Stormwater management is inherently an interdisciplinary issue, requiring cooperation from private landowners to infrastructure engineers to land-use planners. Some pieces of legislation appear to be targeted for interpretation specifically by the engineering profession. For example, the *Drainage Act* specifies the duties and responsibilities of the engineer, and identifies standards that must be followed during engineering assessment work.[41]

Conversely, the *Water Opportunities Act* appears to be targeted for use by municipal governments, stipulating the responsibilities of municipalities to create conservation plans, risk assessments, and assess the potential impacts of climate change.[98] In an environment where specialized policy and regulations target specific audiences, we face the challenge of ensuring that stakeholders of all levels have a shared understanding of stormwater issues.



Grant Mason, 2016

Lack of Commonality in Definitions, Language, and Focus

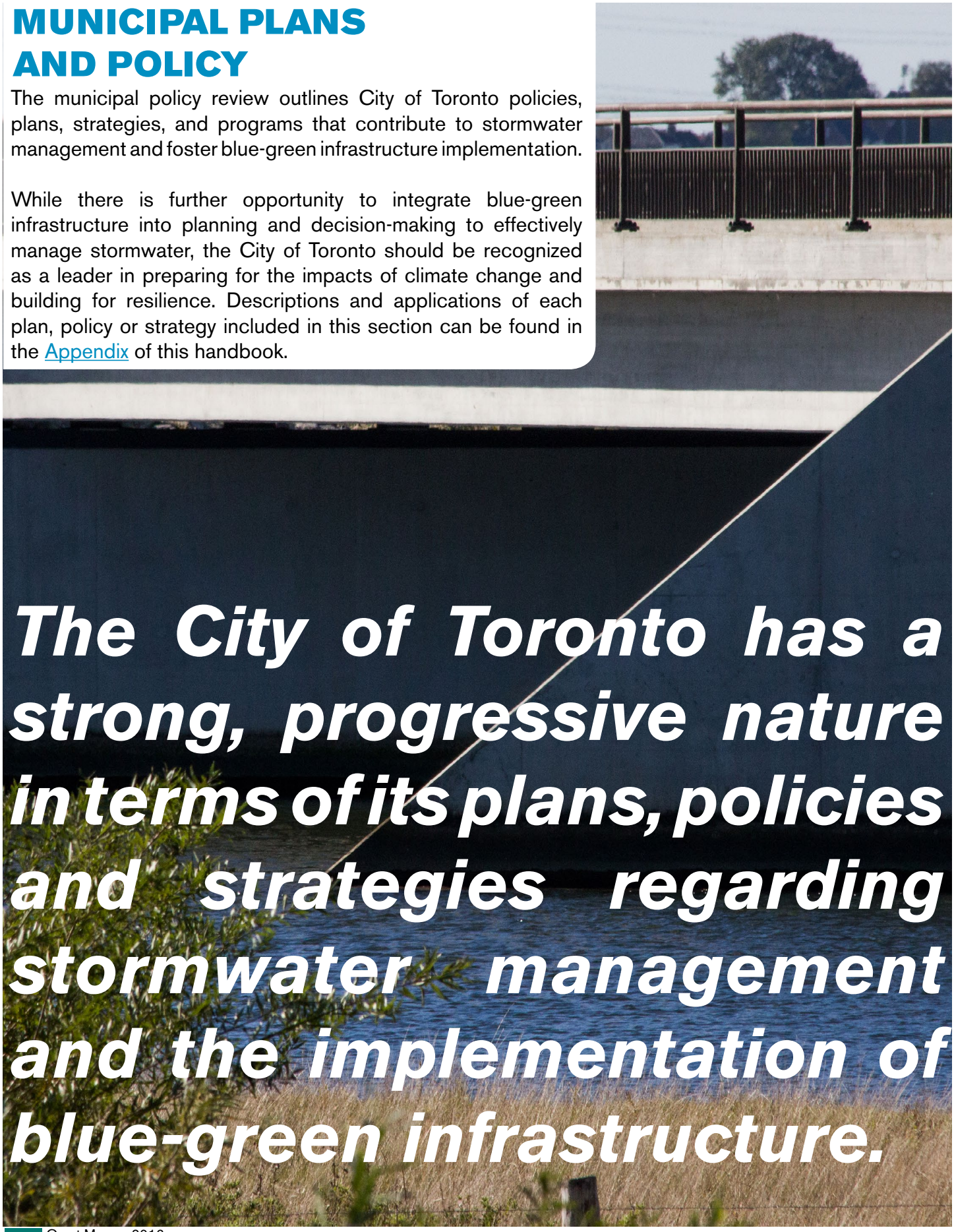
From the *Conservation Authorities Act* to the *Drainage Act*, policies relating to stormwater management have each been developed to address a specific suite of challenges. As a result, some policies lack commonality with others in terms of definitions and language. For example, the *Provincial Policy Statement*, as an overarching strategic directive, defines development as "the creation of a new lot, a change in land use, or the construction of buildings and structures requiring approval under the *Planning Act*."[79] In contrast, the *Conservation Authorities Act*, more closely targeted for managing development at the watershed scale, defines development as the "construction" or "placing of a building or structure" as well as other physical changes to the property.[29]

Additionaly, certain documents, such as the TRCA's Stormwater Management Criteria, have a clear focus on stormwater discharge metrics - thermal loading, pollutant loading, and flow rates,[94] whereas some regulatory documents such as the Toronto Green Standard have a broader focus that includes the protection of biodiversity and multi-functional design.[12] As every component of stormwater infrastructure functions in an interconnected system, from the lot level to the watershed level, the differences in language throughout policy documents have the potential to cause confusion for interpretation.

MUNICIPAL PLANS AND POLICY

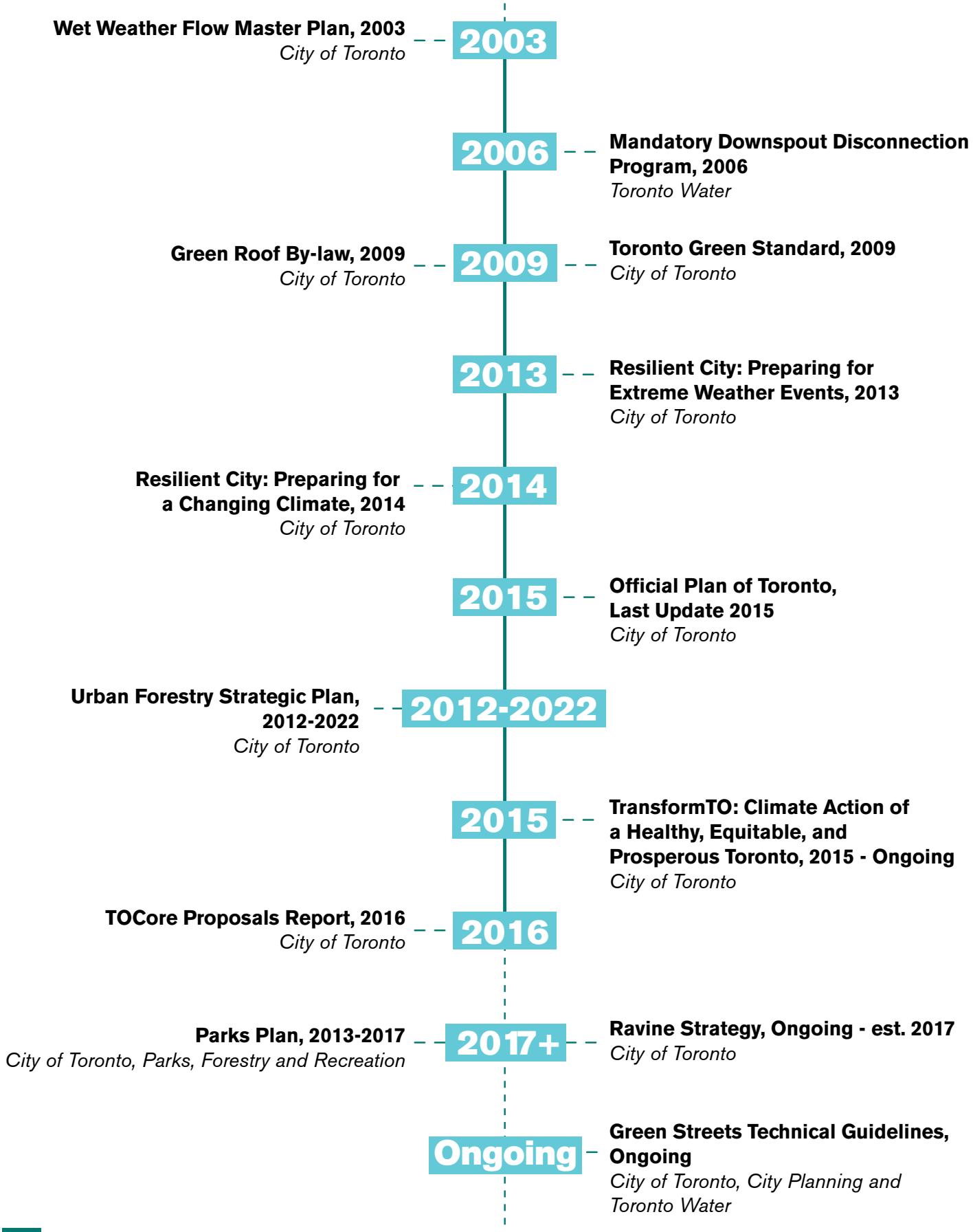
The municipal policy review outlines City of Toronto policies, plans, strategies, and programs that contribute to stormwater management and foster blue-green infrastructure implementation.

While there is further opportunity to integrate blue-green infrastructure into planning and decision-making to effectively manage stormwater, the City of Toronto should be recognized as a leader in preparing for the impacts of climate change and building for resilience. Descriptions and applications of each plan, policy or strategy included in this section can be found in the Appendix of this handbook.



The City of Toronto has a strong, progressive nature in terms of its plans, policies and strategies regarding stormwater management and the implementation of blue-green infrastructure.

Grant Mason, 2016


Wet Weather Flow Master Plan, 2003
City of Toronto
2003
2006
Mandatory Downspout Disconnection Program, 2006
Toronto Water
Green Roof By-law, 2009
City of Toronto
2009
Toronto Green Standard, 2009
City of Toronto
2013
Resilient City: Preparing for Extreme Weather Events, 2013
City of Toronto
Resilient City: Preparing for a Changing Climate, 2014
City of Toronto
2014
2015
Official Plan of Toronto, Last Update 2015
City of Toronto
Urban Forestry Strategic Plan, 2012-2022
City of Toronto
2012-2022
2015
TransformTO: Climate Action of a Healthy, Equitable, and Prosperous Toronto, 2015 - Ongoing
City of Toronto
TOCore Proposals Report, 2016
City of Toronto
2016
Parks Plan, 2013-2017
City of Toronto, Parks, Forestry and Recreation
2017+
Ravine Strategy, Ongoing - est. 2017
City of Toronto
Ongoing
Green Streets Technical Guidelines, Ongoing
City of Toronto, City Planning and Toronto Water

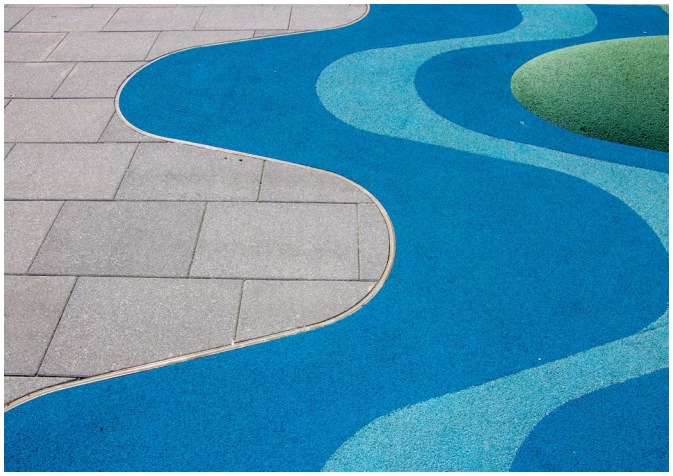
Wet Weather Flow Master Plan, 2003

City of Toronto

The *Wet Weather Flow Master Plan* focuses on the management of water at the regional watershed scale with a focus on a multi-step solution approach that begins with source water capturing, followed by conveyance controls and concluding with end of pipe strategies.

In order to manage stormwater effectively, enhance the health of the natural hydrological system, and improve the quality of runoff, it is essential for municipalities to collaborate with the general public, regional authorities, provincial governments, and the federal government. Public awareness is essential in order to improve stormwater runoff, pollution and improve stream habitats.[16]

The *Plan* presents a comprehensive overview of how to address stormwater management from a regional hydrological perspective to site specific considerations.[16] It is regarded as an innovative piece that provides performance metrics for City divisions which reflects Toronto's progressive, on-the-ground strategies and actions to address climate change.[80]



Grant Mason, 2017

Accounting for Uncertainty

To effectively meet not only the city's current needs but also take into account the potential impacts of climate change, stormwater management practices must be developed despite uncertain projections and risks. This can be challenging.

For example, the *Wet Weather Flow Master Plan* heavily relies on the 100-year flood as a standard for flood protection, yet this standard is based on historical records instead of future projections.[16] A forward-looking precautionary approach would incorporate the uncertainties regarding future increases in the frequency and severity of storm events.

Grant Mason, 2017

Resilient City: Preparing for A Changing Climate, 2014

City of Toronto

Resilient City: Preparing for a Changing Climate suggests increased coordination among different orders of government, partnerships involving both the private and public sector, and further integration of climate change resilience priorities in planning and decision-making.[27]

The City's Resilient City Steering Committee, described in the Resilient City plan, would be responsible for "cross corporate co-ordination, research and analysis, and coordination of mechanisms to partner with the private sector and broader public sector".[27 p.12] The report confronts the complex nature of monitoring and reporting on measures of resilience and thus, sets tasks of creating a set of performance indicators for resilience which are based on the current understanding and forecasts of climate change.[27]

As a member of the World Council on City Data (WCCD), Toronto is involved in the integration of ISO 37120 in municipal decision-making and planning. ISO 37120 is a new international standard for cities that outlines procedures for the implementation of indicators to assess city services and quality of life. The performance indicators created for measuring resilience at the City of Toronto as part of Resilient City: Preparing for a Changing Climate, will consider and build upon the international standard.[27]

The City of Toronto has achieved "Platinum" status for their indicator data by the WCCD. Further, the Resilient City Status Update and Next Steps report indicates that City staff will follow updates from WCCD.[24] See page 39, Data Availability for more information about the World Council on City Data and ISO 37120:2014.

Announced in the Resilient City Status Update and Next Steps report, in executing the Climate Change Risk Management Policy, the City has conducted a Thematic High Level Risk Assessment (HLRA). The HLRA system, which was created by the inter-divisional team that comprises the Resilient City Working Group, explores 10 identified Thematic Areas. Water, which includes stormwater management, is one of the first Thematic Areas that has been assessed.[24]

The Resilient City Status Update and Next Steps report also notes the creation of the Extreme Weather Portal, which is an online education tool informing residents about how they can become more resilient and better understand the risks they face in light of extreme weather.[24]

"Ours is the first generation that can end poverty, and the last that can take steps to avoid the worst impacts of climate change."
- Ban Ki-moon[70]

Toronto Green Standard, 2009

City of Toronto

Several of the criteria categories in the *Toronto Green Standard* pertain to stormwater management and blue-green infrastructure including:

- Stormwater retention - incorporating the water quality and runoff criteria outlined in the *Wet Weather Flow Master Plan* (WWFMP);
- Urban Forest for the protection and creation of a larger tree canopy; and
- Urban heat island pertaining to reduction at grade and on the roof.[12]

City of Toronto, 2015

Green Roof By-law, 2009

City of Toronto, Municipal By-law


Keira Webster, 2016

In addition to reducing impermeable surfaces in the city, Green roofs also foster habitats and improve biodiversity in the city.

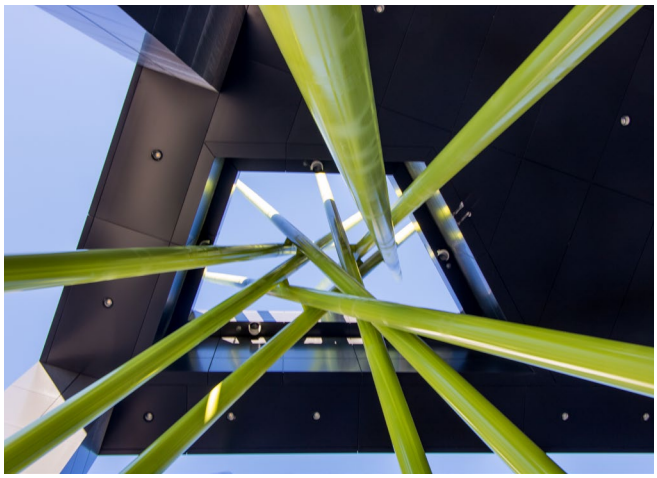
The Eco-Roof Incentive Program puts payments from developers toward the construction of green roofs.

From 2009 to 2015, the Eco-Roof Incentive Program reduced the amount of stormwater that would have otherwise ended up in the city's sewers by 8.9 million litres.[11]

Official Plan of Toronto 2015 Update

City of Toronto

The *Official Plan* highlights that Toronto will work with regional neighbours in addressing stormwater management based on watershed principles. Structured growth must address the need for effective management of stormwater before it enters the Great Lakes basin. The *OP* highlights that source control of stormwater is required for new developments to ensure it does not increase net runoff (rain and snow). Site Plan Control, now under the *OP*, specifically outlines the need for rainwater management infrastructure through the implementation of low impact development.[10]



Grant Mason, 2017

Mandatory Downspout Disconnection Program, 2006

City of Toronto, Toronto Water; Municipal By-Law

TRCA, n.d.

Disconnecting downspouts minimizes the quantity of stormwater that reaches the city's sewers. The program also lessens the threat of basement flooding.[11] See ***Setting the Context,*** p 25 to learn more.

Bieslousov, A. 2011

Need for Coordination at Watershed Scale

The range of adopted stormwater management legislation conclude that planning and decision-making should be enforced at either the watershed or municipal scale. This difference in scale creates conflicts and can be complicated for professionals to comprehend. Currently, the *Clean Water Act, Conservation Authorities Act*, and the *Great Lakes Strategy* are the only pieces of legislation that explicitly state all planning should be based on watershed boundaries determined by the conservation authorities. Planning at this scale is unfamiliar to municipalities and can be difficult to facilitate and enforce. To overcome this challenge, watershed scale planning has been included within the *Wet Weather Flow Master Plan*, the proposed changes for the *Growth Plan* and *Greenbelt Plan*, and a recently approved amendment (262) within the *City of Toronto Official Plan*.

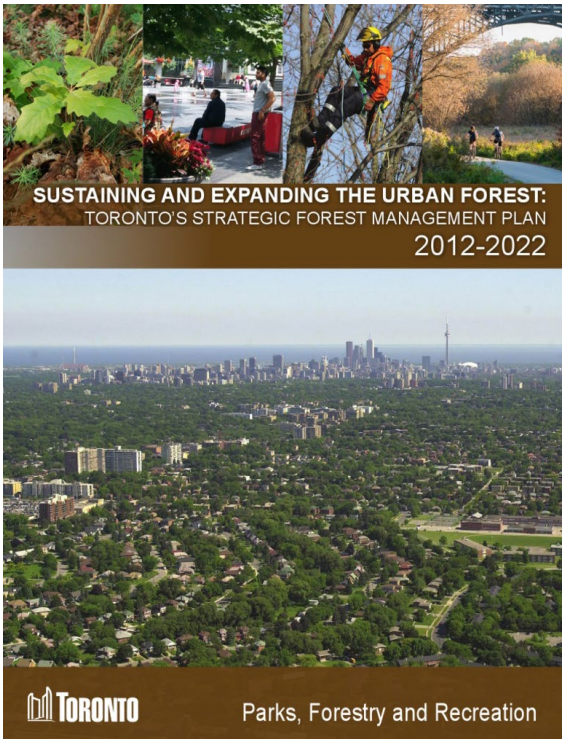
Strategic Forest Management Plan, 2012-2022

City of Toronto

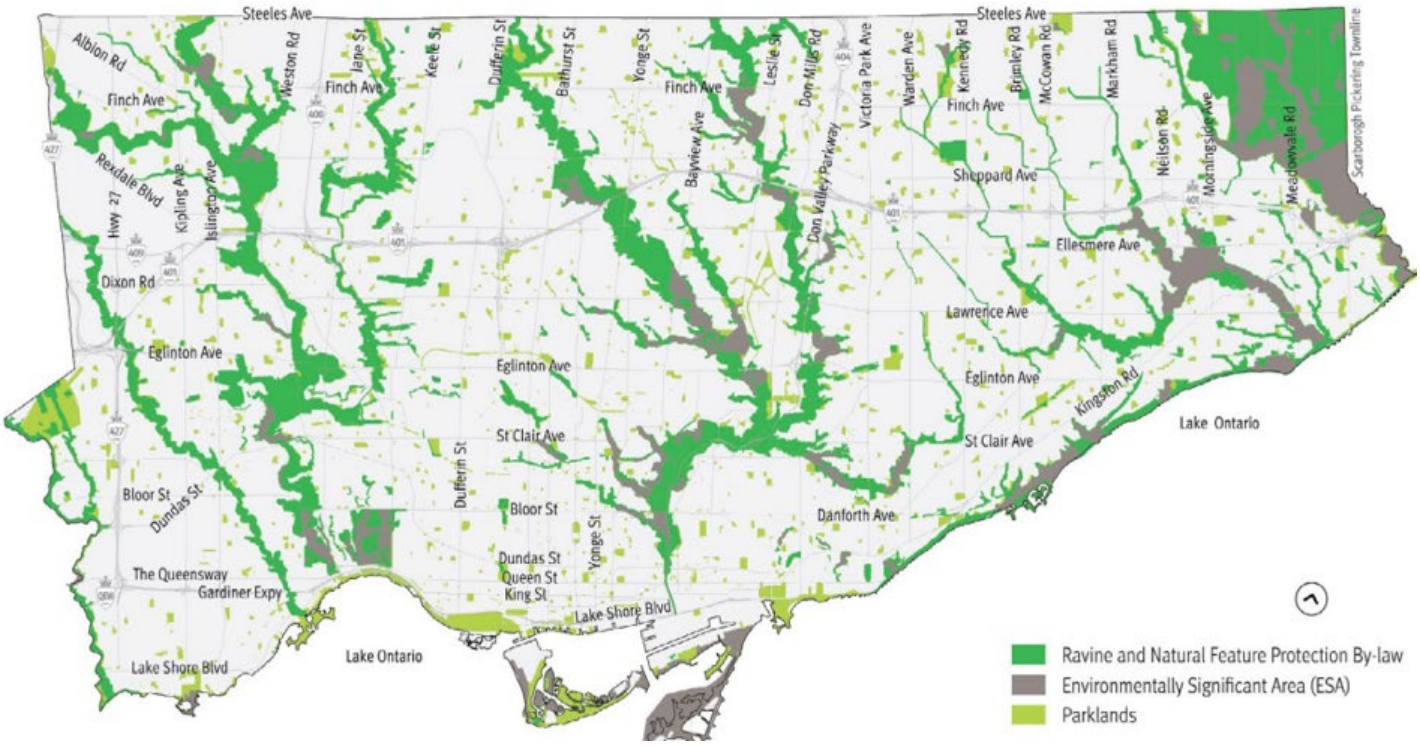
The *Strategic Forest Management Plan* outlines the need for further collaboration with Toronto Water and Toronto Transportation Services to find and utilize more suitable areas for stormwater management.

The impacts of climate change are directly felt by Toronto's urban forests; the health of the forests is impacted by stormwater runoff both in terms of quantity and quality of rain and snowmelt.

Faced with increased densification and climate change impacts, Toronto's forests are facing heightened pressure. Appropriate coordination among stakeholders and City divisions, policies and practices can ensure limited stormwater runoff, and continued urbanization can be accommodated successfully.[14]



City of Toronto, 2016



City of Toronto, 2016

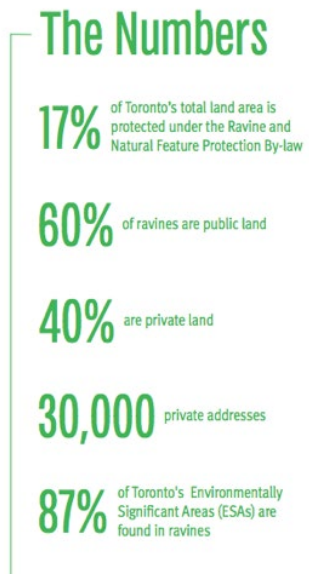
Toronto's Ravine Strategy, Expected Completion 2017

City of Toronto

The *Ravine Strategy* addresses the need for a comprehensive strategy that consolidates the plans, regulations, and bylaws applicable to the ravines.[22]

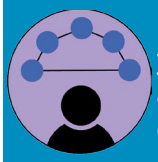
The development of the *Ravine Strategy* stems from the uncertainty of, and stress on, the health of Toronto's ravine system due to population growth, recent development, and a changing climate.[22] The expected effects of climate change on the ravines include flooding and erosion. Maintenance, monitoring, and protection of the ravine system is thus crucial to combat the negative impacts of these factors.[9]

The ravine system contains 30,000 private properties and the total land area is 60% public and 40% private. As a result, the ravine system is comprised of a variety of land uses from industrial areas, to railways, to parks.[22] The draft principles and actions of the *Ravine Strategy* strive for the collaboration and partnership of multiple stakeholders including property owners, utilities, Aboriginal communities, academic institutions, and the Toronto and Region Conservation Authority. These stakeholders contribute to either the improvement, conservation, or commemoration of the ravine system.[9]



City of Toronto, 2016

Compounding Effects affecting Stormwater Management



Integration of action on climate change regarding both mitigation and adaptation is complicated yet necessary. Through its plans and policies such as the *Toronto Green Standard*, *Resilient City*, and the *Wet Weather Flow Master Plan*, Toronto is seen as a progressive leader in addressing climate change head-on. Yet climate change and the involvement of blue-green infrastructure in achieving climate action is inherently complicated.

The Toronto and Region Conservation Authority's *Living City Policies states*:
"Overall, the compounding potential effects of climate change with those of urbanization, make it more important than ever for TRCA and its partners to take a precautionary and adaptive approach to the management of our watersheds". [91 p. 40]

The *Ravine Strategy* aims to tackle the compounded and interconnected nature of building a resilient ravine system in acknowledging that the stresses placed on ravines are coupled and interrelated stemming from population growth, urbanization, and climate change.[24]

Green Streets Technical Guidelines, Ongoing

City of Toronto, City Planning and Toronto Water

The development of the *Green Streets Technical Guidelines* requires collaboration from a range of departments including Engineering and Construction Services, Economic Development, and Parks, Forestry, and Recreation.

Collaboration with an advisory group is also taking place involving utilities, non-governmental organizations, and conservation authorities.

Environmental considerations influencing the need for the Green Streets Technical Guidelines include the following factors: stormwater, climate, and urban heat island.[5]

The recently released TOCore Proposals Report, which is the initial outline of the proposed downtown secondary plan, outlines that the downtown core is vulnerable to impacts from extreme rain and snowfall events. In order to mitigate these impacts and incorporate resilience planning within the core, policy "J" directs staff to require the public realm to meet the *Green Streets Technical Guidelines* while also incorporating green infrastructure to better absorb stormwater.[8]

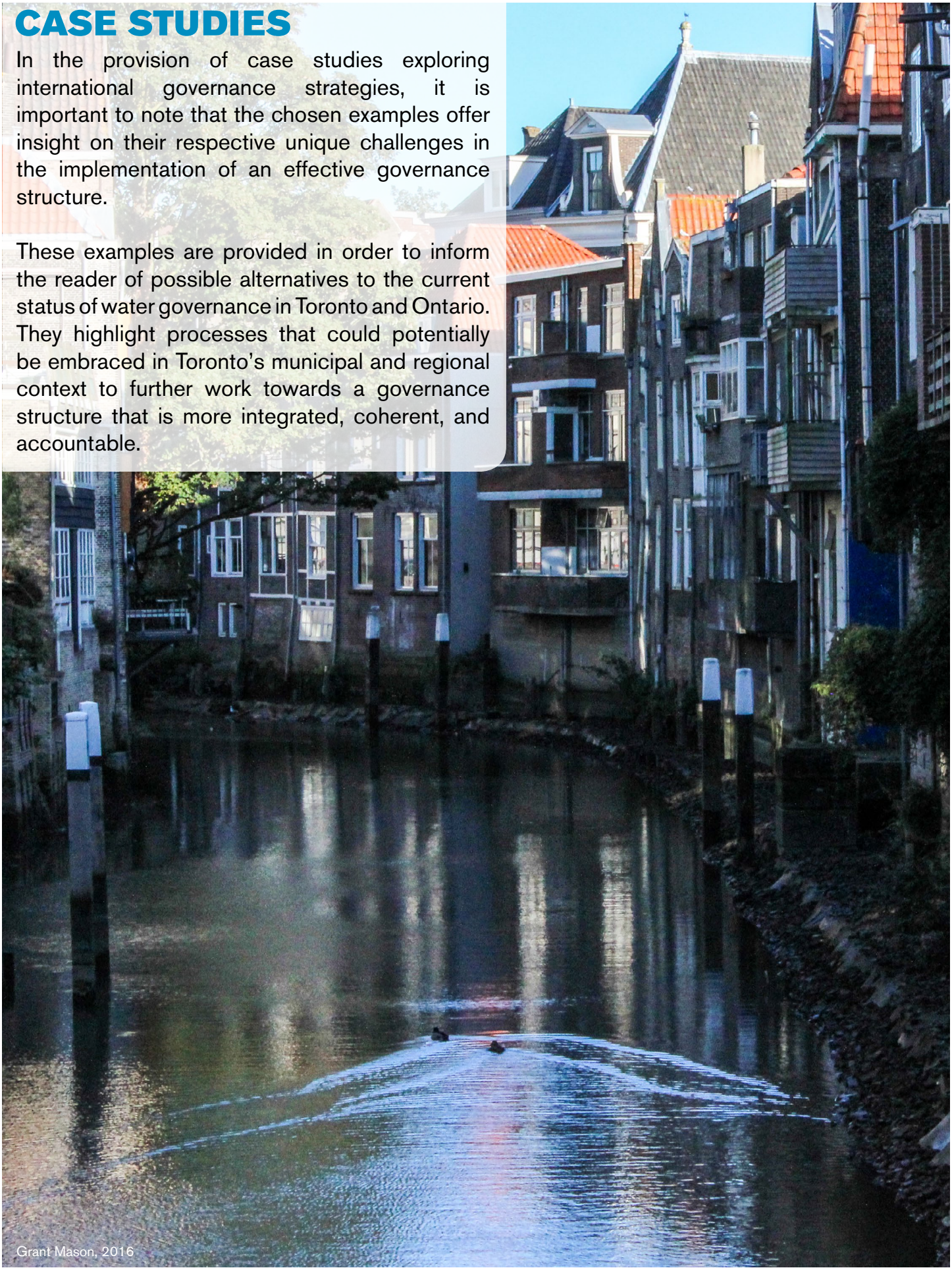
In order to incorporate resilience planning within the core, policy "J" directs staff to incorporate green infrastructure in the public realm to better absorb stormwater.[8]

Alex Butler, 2017

CASE STUDIES

In the provision of case studies exploring international governance strategies, it is important to note that the chosen examples offer insight on their respective unique challenges in the implementation of an effective governance structure.

These examples are provided in order to inform the reader of possible alternatives to the current status of water governance in Toronto and Ontario. They highlight processes that could potentially be embraced in Toronto's municipal and regional context to further work towards a governance structure that is more integrated, coherent, and accountable.



Grant Mason, 2016

Rockefeller Foundation, n.d.

ROCKEFELLER FOUNDATION'S 100 RESILIENT CITIES AND THE CHIEF RESILIENCE OFFICER

The 100 Resilient Cities (100RC) movement, initiated by the Rockefeller Foundation, is a non-profit initiative which intends to aid international cities in building resilience to the effects of natural disasters and climate change. Further, the 100RC aims to building resilience to the inherent shocks and stresses that emerge through incapacities within municipal governance and infrastructure.[88] The Rockefeller Foundation defines urban resilience 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 and acute shocks they experience".[87]

Thousands of cities applied to the 100RC initiative, and were evaluated based on their mayor's ability to innovate, their history in building partnerships, and their ability to collaborate with a diverse range of stakeholders. 100RC member cities receive financial and logistical support to develop a resilience strategy, employ a Chief Resilience Officer (CRO) for the municipality, and provide education opportunities to a wide variety of stakeholders in order to implement resilience strategies.[86]

If stakeholders - including urban planners, government officials, and the general public - are to understand what resilience entails and how to better prepare for the impacts of climate change, a standard evaluation tool is required worldwide. The task in formulating such a governance model, that accurately reflects the diversity and complexity of cities around the world, is extremely challenging.[86,72] The Rockefeller Foundation's City Resilience Framework (CRF) model, as part of their 100 Resilient Cities initiative, is robust yet broad, with the goal to ensure that the diversity and complexity of the respective cities are captured and achieved through the use of a multitude of goals and indicators. The CRF model has been developed in order to provide cities with the ability to develop effective strategies to measure and monitor multiple factors that contribute to a city's resilience, and thus, identify their respective strengths and weaknesses.[88]

The measurement framework has been developed using a four dimensional approach. Two are highly relevant to Toronto's context in becoming resilient:

(Continued from previous page)

Infrastructure & the Environment and Leadership & Strategy. These four dimensions use a total of 12 overarching drivers that when combined form the 100 Resilient Cities Index Indicator model, discussed further below.[86] These measurement tools are intended to develop a comparison model across all cities that are part of the 100 Resilient Cities movement, with the goal to exchange and enhance information sharing, including benchmark indicators and best practices - across all member cities.

Governance Structure

1. The City Resilience Framework Index

The 100 Resilient Cities Index Indicator model has been developed using the four dimensional approach encompassing the following dimensions: Health and Wellbeing, Economy and Society, Infrastructure and Environment, and Leadership and Strategy.

The CRF intends to address the diverse shocks and stresses facing cities through an integrated governance structure approach.[83]

These four dimensions outline the necessary capacities, actions, and outcomes to build a resilient community.[72] The critical application of these indicators is through the interconnected action needed when a city faces a severe shock and/or stress, and how that stress contributes to wide-scale risk.[86] When these shocks and stresses occur through a catastrophic event, the impacts become exacerbated. However, when normal stressor events, such as a subway line facing brief infrastructure failure, are studied to understand how impacts from these strains can be mitigated on a routine basis, cities are then more informed. This can make cities better prepared to limit impacts and address problems, albeit at a larger magnitude, therefore they are better equipped to respond to catastrophic events.[43]

The CRF intends to address the diverse shocks and stresses facing cities through an integrated governance structure approach.[86] In order for an integrated and effective municipal governance structure to function at its highest capacity when building resiliency, it must be cross-sectoral and non-fragmented.[86] This integrated approach is informed by assessing a city's resilience through quantitative, and largely qualitative metrics, which are determined based on the review and measurement of a city's present day performance and future trajectory.[88] Municipal staff review the respective indicators and develop a holistic resilience profile through consideration of the index indicator questions. This provides an overview of the current state of a city's interconnected systems - a key step towards preparation for shocks, and subsequent aftershocks, from a major disruption.

Rockefeller Foundation - Bridgett-Jones, 2016

Building, achieving, and governing for resilience are not without challenges, requiring consideration of context-specific issues that can be persistent, sudden, and unforeseen.[3,62] As defined by Lister (2015):

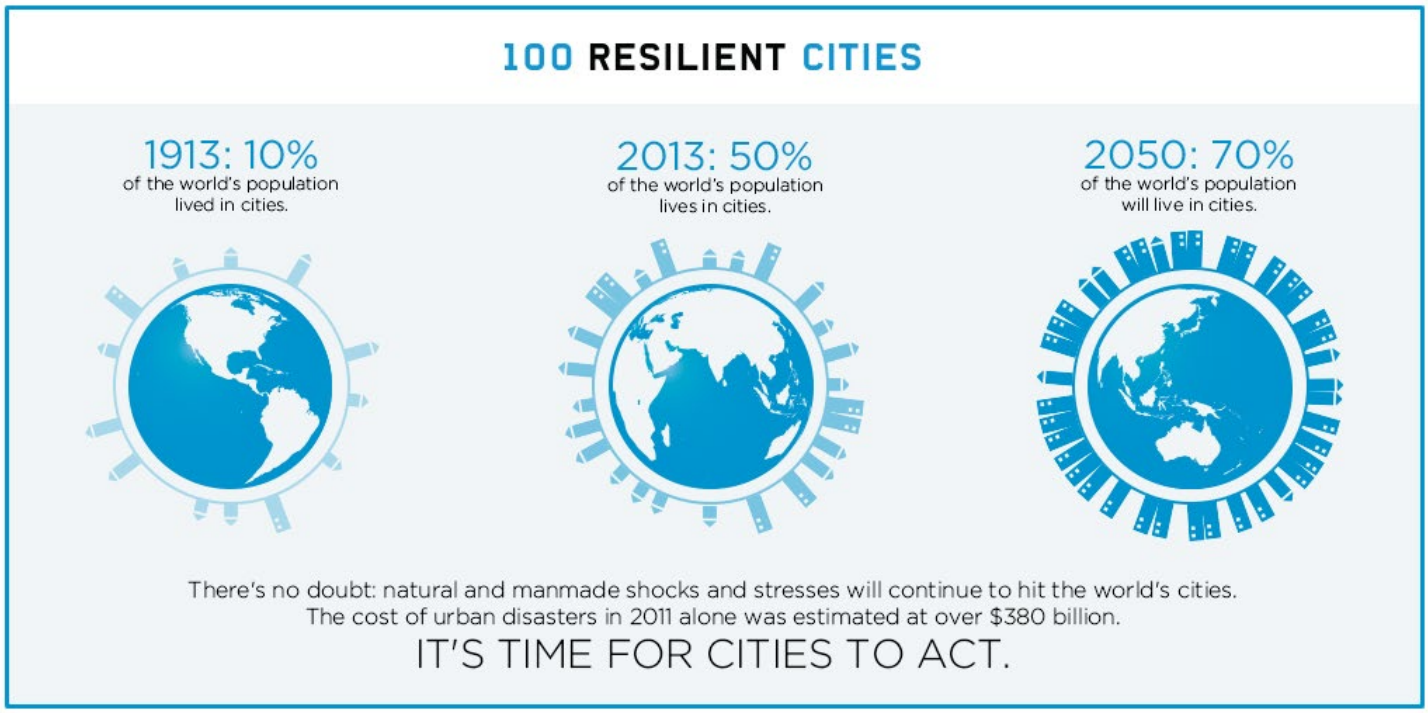
> "Resilience refers generally to the ability of an ecosystem to withstand and absorb change to prevailing environmental conditions; in an empirical sense, resilience is the amount of change or disruption an ecosystem can absorb and, following these change events, return to a recognizable steady state in which the system retains most of its structures, functions and feedbacks." [58 p.14]

While the concept of resilience is becoming increasingly prominent in planning and decision-making around the world, it has diverse interpretations, making it difficult to establish a shared focus and set of goals. It is important to consider the intricate nature of defining what resilience means for a given place in realizing resilience from ideation to practice.[3]

2. Chief Resilience Officer (CRO)

A key aspect of the 100RC framework is the process of deconstructing political fragmentation to foster the creation of an integrative and collaborative governance structure. One of the most influential tools in accomplishing this objective is the employment of a Chief Resilience Officer (CRO). The CRO provides the municipal government with an individual to lead and coordinate the development and implementation of a three-phased municipal resilience strategy. The first phase includes undertaking and guiding a formal review of a city's strengths and weaknesses based upon the Index Indicators. The second phase focuses on developing a multi-iterative resilience strategy built through collaboration across municipal divisions and stakeholders. The third phase aims to aids and direct the implementation of the developed resiliency plan over a one year period.[86]

Integral to this position is the ability for the CRO to work with a cross-sectoral approach; facilitating internal communication in the development of divisional plans and projects.[4] Further, a crucial aspect of achieving urban resilience, in a municipal context, is educational awareness among stakeholders regarding the persistent challenges facing a municipality in light of systemic shocks. The CRO acts as a catalyst for change by fostering a collective discussion with stakeholders involved in city-building as the main focus for the initial phase of the CRO's tenure. CROs are fully funded through the Rockefeller Foundation's 100RC initiative for the entirety of two years, which allows them to gain a strong understanding of the challenges a municipality faces in terms of resilience preparation.



Rockefeller Foundation, n.d.

The Index Indicators Framework Phase One, informs the municipalities' overall strengths and weaknesses. Phase Two and Three address the implementation of a municipal resilience strategy. This task is directly supported by the Resilience Steering Committee through a series of resilience building initiatives, meant to identify gaps in addressing climate change adaptation challenges within the municipality.[86,43]

For more information on the 100 Resilient Cities Governance Model visit: 100resilientcities.org

Grant Mason, 2016. Oosterscheldekering

THE NETHERLANDS CONTEXT

With more than half the country, and almost half the population at or below sea level the Dutch have a long history of water management.[61] From 800 BCE when residents of The Netherlands lived on terps - human-made mounds - to protect themselves from flooding, the Dutch have implemented a wide range of practices, over the years, to maintain 'dry feet' and eventually learn to 'live with water'.[55,61,40]

These practices range from large-scale infrastructure including Oosterscheldekering, a 3km long storm surge barrier at the North Sea born from the Delta Works initiative, to Room for the River, a flood risk management strategy to increase the discharge ability of and space for the country's major rivers.[61,89] The success and effectiveness of the Dutch water management strategies are directly linked to the capacity of their governance structure to facilitate and influence the country's approach to and management of water.

Governance Structure

Rijkswaterstaat

In 1798, the Rijkswaterstaat was created as a component of the Dutch Ministry of Infrastructure and the Environment, previously known as the Ministry of Transport, Public Works and Water Management. Their mandate (translated to English) is "the national agency that provides dry feet, clean and sufficient water, and a quick and safe flow of traffic".[40 para 2] Comprised of 10 regional, 6 specialist, and 2 special services, the Rijkswaterstaat is responsible for the implementation of public works and water management. In this role, they develop and maintain waterways and roads and safeguard against and mitigate flooding.[40] The Rijkswaterstaat uses integrated water management which incorporates flood protection, water quality,

and practical information. In 2009, through the framework of integrated water management, the Rijkswaterstaat collaborated with a diverse array of stakeholders including:

- Dutch Association of Regional Water Authorities,
- Research institute - Deltares, international committees (e.g. EU Interreg, European Commission Joint Research Centre),
- Municipalities, provinces ad environmental organizations,
- Government Service for Sustainable Rural Development
- Private sector.[85]

This collaboration was intended to inform the integrated water management process to "achieve the most efficient and flexible construction, management and maintenance of the main water systems in the Netherlands." [85 para 2]

Marvin Jansen, 2016

Grant Mason, 2016

Dutch Regional Water Authorities

In addition to the Rijkswaterstaat, the Netherlands has regional water authorities that are responsible for the development, monitoring, and maintenance of water infrastructure. From water quality to water levels they deal with flood protection, infrastructure and climate change adaptation.[40] They are independent authorities that operate alongside the State as well as provincial and local governments.[51]

While 23 regional authorities govern water management across the country today, the first regional water authority was established in the 13th century, approximately 800 years ago.[51,39] From a legal perspective, the regional water authorities are part of the democratic organization of the Netherlands. The authorities are given the power to collect their own taxes, amounting to 2.7 billion Euros in 2016.[39] Each water authority is coordinated by an internal structure containing a governing board, an executive committee and a chairperson. The governing board is made up of stakeholders including residents, property owners of open land (e.g. farmers), businesses, and property owners of natural sites. The executive committee is then appointed by the governing board and is responsible for implementing the daily activities of the water authority. Further, with an emphasis on integrated water management, the regional water authorities facilitate collaboration and coordination with other orders of government and non-governmental organizations.[51]

DUTCH AND ONTARIO WATER AUTHORITIES

Described as a "global reference" by the OECD, the Dutch water governance structure offers valuable direction and lessons for the international community.[51 p. 3] The following three key features attributed to the success of the Dutch regional water authorities, could be informative and applicable to water governance structures worldwide including Ontario's Conservation Authorities.

For more information, check out Water Governance: The Dutch Water Authority Model at: dutchwaterauthorities.com **(PDF)**

Key Feature	Dutch Regional Water Authorities	Ontario Conservation Authorities
Functional Authority [51 p. 58]	Regional Water Authorities are incorporated within the Dutch Constitution (e.g. Article 133). Legal influence, tax collection, and governing board are mandated under *Regional Water Authorities Act, Water Act*, and by-laws outlined by the authorities. Thus, water authorities are separate from the political influence of governments and can concentrate solely on water management.[51]	Conservation Authorities develop and implement local resource management programs at the watershed scale incorporating the priorities of the provincial and municipal governments.[49] Mandated under *Conservation Authorities Act*. Section 28-30 of the Act outlines the regulations that can be made by an authority.[29]
Stakeholder Democracy [51 p. 59]	Members of governing board are from different interest groups including residents, businesses, farmers, property owners of natural areas, etc. Seats for the residents are decided through elections, while the seats for the specific interest categories are appointed by the class organizations. The stakeholder democracy ensures representation of people that are affected by and attentive to water management.[51]	Board members are appointed by local communities. Most of the board members are elected municipal officials.[31] For example, the TRCA has 28 board members comprising the executive committee and budget/advisory board, 14 of which are from Toronto as appointed by the City Council. Nine are City Councillors and five are Citizen Appointees.[21]
Financially Autonomous	Collect their own taxes through a water system levy, wastewater treatment levy, and surface water pollution levy.[51]	Funded through multiple sources where 48% is through municipal levies, 40% through own-source revenue, 10% through provincial grants and special projects, and 2% through federal grants and contracts.[31]

Grant Mason, 2016

Jocey K, 2013

NEW ZEALAND: WATERSHEDS AS GOVERNANCE BOUNDARIES

New Zealand is one of the first countries in the world to incorporate a watershed management governance structure in their legislation.[83] New Zealand, during the mid 20th century faced extreme impacts from flooding events which led to the formation of the *Soil Conservation and Rivers Control Act* in 1941.[74] Under this *Act*, an established governance structure was formed through the creation of Catchment Boards. The Catchment Boards were granted broad powers in order to accomplish goals within the *Act* including flooding control and mitigation, promotion of soil conservation, and erosion prevention.[74] In 1991, the *Resource Management Act* was enacted, which created a new legal framework in terms of watershed governance, and ultimately, changed the current status of the institutionalization of watershed management.[83]

The *Resource Management Act* (RMA) was developed in response to an identified need to make governmental agencies more coherent in terms of the management of natural resources and the management of the environment. A large disconnect had emerged between land use planning and water planning.

The realignment of New Zealand's governance structure granted more autonomy to local and regional governments to establish visions, and develop policy, that reflected the goals of the *RMA.*[47,83] 16 regional councils were formed on the basis of general watershed boundaries as part of the *RMA,* which were given direct authority on all matters relating to water management within their respective jurisdiction. Further, the regional councils are elected bodies and are granted the ability to generate taxes within their

watershed in order to implement the *RMA.*[74,83] Key Differences between New Zealand's Watershed Management and Dutch Water Governance:

- The *RMA* governance structure is completely part of national government; regional councils are not separate, independent boards.
- Elected board members are politicians, not stakeholders, general public members, etc.
- The *RMA* focuses on the further protection and governance of the natural environment, as opposed to only water management.

For more information on the *Resource Management Act* and Watershed Governance in New Zealand visit: legislation.govt.nz

"The 21st century water manager needs to manage the flow of data and information as well as the flow of water. Our future depends on it."[52 p. 9]

DATA COLLECTION

In 2010, the MOECC conducted a review of policies, acts, and regulations to explore how to address Ontario's municipal stormwater management systems when faced with climate change. As part of their key findings, the MOECC stresses the significance of data collection and information management systems to monitor the collection, state, and effectiveness of stormwater systems. Data collection, availability, and processing is pivotal to determining the province and municipalities' resilience to a changing climate and further assisting in adaptive decision-making to ensure that effective measures are taken in a proactive manner.[64] A governance structure that considers data management and availability is necessary to not only prove the reasoning for blue-green infrastructure initiatives, but also to generate grounded and evidence-based decisions.

The Global Facility for Disaster Recovery and Reduction's Open Data for Resilience Initiative (OpenDRI) strives for collaboration and partnerships among governments and global organizations. They strive to use open data to disseminate information on vulnerability, risk, and threats for the development of initiatives in climate change adaptation and disaster risk management. OpenDRI notes that in order to effectively reach a diverse and broad population and to establish a common goal and shared understanding, data availability and understanding of how to process, analyze, and use the data is crucial.[46]

While there are many benefits that green infrastructure provides for the urban landscape (see ***Setting the Context*** handbook for more details), there are difficulties. A common challenge pertains to data availability, and information that describes the advantages, costs, and performance of green infrastructure initiatives.[33] This section turns to the World Council on City Data, Deltares and their iD Lab, and crowdsourcing and citizen science as precedents to foster a discussion on the need for, and effective incorporation of, data collection, analysis, and proliferation in green infrastructure, stormwater management, and more broadly, climate change resilience.

World Council on City Data

The World Council on City Data (WCCD) is a global organization that focuses on using standardized city data to realize smart, sustainable, resilient, and prosperous cities.[100]

A network of cities stem from the WCCD, aiming to enhance their services and quality of life using open city data and standardized urban performance measures.

Further, WCCD acts as a medium in which partnerships and collaboration occurs among cities, international organizations, corporations, and academia to develop creative initiatives considering the future longevity of cities.[100]

WCCD, n.d.

As part of executing the standardization of city data, the WCCD is applying ISO 37120 Sustainable Development of Communities: Indicators for City Services and Quality of Life. ISO37120, created in May 2014 by the International Organization for Standardization, is the first international standard for cities. It contains 46 core indicators, and 100 indicators in total, that are then implemented using the provided descriptions and methodologies to measure the effectiveness, and adequacy, of city services and quality of life. The indicators fall under 17 themes, some of which directly relate to blue-green infrastructure and climate change resilience, including environment, fire and emergency response, governance, wastewater, urban planning, and water and sanitation.[100]

A standard for city indicators allows for global accountability and comparability from year to year. Indicators can vary in methodologies and measurements incorporating qualitative and quantitative data (ISO/TC 268 Sustainable cities and communities, 2014). Toronto is one of the 20 Foundation Cities of the WCCD's pilot for the ISO 37120 standard.[100] In creating standardized methodologies to measure the performance of city services and quality of life, ISO 37120 facilitates a comprehensive and knowledgeable decision-making process.[54]

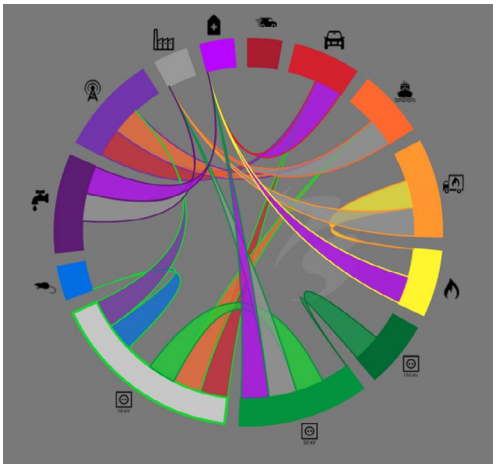
For more information on the World Council on City Data, visit dataforcities.org

Deltares: CIrcle Tool

The Deltares iD-Lab is an "interactive data research laboratory" that explores disaster risk management through the combination of models, data, visualization processes, and expert understanding.[36 title] Within the iD-Lab, Deltares has created the CIrcle tool standing for "Critical Infrastructures: Relations and Consequences for Life and Environment". The tool is designed to measure and relate "cascading effects" or the indirect impacts that result from extreme weather events.[36 para 1] In addressing the common difficulty of data collection usually resulting from concerns of privacy or confidentiality, the CIrcle tool combines identified "causal links", open data, and flood models to explore the cascading effects.[36 para 3] The visualizations of the cascading effects are then shown to the participants and experts for additional feedback and evaluation.[36] A key component of the CIrcle tool is the use of qualitative data to indicate impacts or causal links between various facilities, activities, or uses. While this adds a subjective component to the decision making, planning, or

emergency response process, it also facilitates the sharing and understanding of data.[75]

Learn more in the ***Activation Plan***

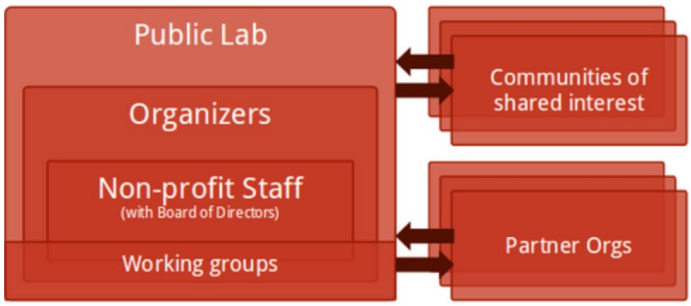


Deltares, n.d.

Crowdsourcing and Citizen Science

Crowdsourcing and citizen science are cost-effective and collaborative means of collecting local information, improving data availability, and broadening the scope to determine a community's resilience to climate change.[42,82,53] The National Geographic Society defines citizen science as "the practice of public participation and collaboration in scientific research to increase scientific knowledge".[73 para 1] In this role, residents have the ability to contribute to data collection, monitoring, and proliferation.[73] For citizen science and crowdsourcing to be effective, it is important that volunteers are diverse and committed, data is collected over time and over a series of events when looking at climate change, and is also coupled with additional evidence-based data.[73,53]

In terms of blue-green infrastructure, crowdsourcing and citizen science may be useful to address the need for data regarding the monitoring and maintenance of initiatives. Public Lab for instance, is a medium in which the general public can acquire skills in examining environmental issues. Public Lab uses cost-effective, do-it-yourself strategies and an open network, comprised of researchers, teachers, and community facilitators, to explore and develop tools and techniques with the goal to track and solve issues related to air, land, and water.[82]



"It's a missing scale of environmental data that has not been collected about urban events before." [84]

The Public Lab community fosters improved access to open source methods for data collection.[81] Moreover, the staff at Public Lab assist individuals who wish to explore an environmental problem or question but lack the sufficient tools needed - whether it be money, skills or social capital - to confront the problem or question on their own.[84] As such, Public Lab provides the opportunity for enhanced public education and awareness, and also allows for community involvement and contribution to local issues and initiatives, while simultaneously addressing the need for data availability and monitoring of environmental issues.[82]

For more information on the Public Lab and crowdsourcing, visit: publiclab.org

Bottom-Up Environmental Action and the Rise of the Smart Citizen

Public Lab gained prominence in April 2010 following the BP oil spill. Volunteers gave residents of the Gulf Coast DIY balloon mapping kits to determine the actual degree of the oil spill as authorities would not allow for aerial photography. Public Lab is currently working on a flood sensing project in New Orleans exploring the length and location of flooding occurrences as well as the current plans for flood mitigation, protection, and control. The project, while still in the initial stages, is considering the effectiveness of the City's drainage facilities and water management models and programs. The Public Lab flood sensing project has hosted several workshops and hackathons and started investigating public plans.[84]

Balloon Mapping: Jeff Warren, 2010.

MOVING FORWARD

There are three overarching opportunities or next steps which confront the challenges discussed in the review of Ontario's and Toronto's plans, policies, and legislation. These stem from the 100 Resilient Cities movement, Dutch governance structure, New Zealand watershed management structure, and the need for comparable and thorough data. The next steps, described in further detail in the ***Activation Plan*** handbook, act as future provocations that build on and channel the progressive spirit of Toronto while integrating global lessons in wet infrastructure, to arrive at credible and effective solutions for stormwater management. The overarching opportunities or next steps are:

A method to solve problems which no individual agency owns

Drawing on the Rockefeller Foundation's 100 Resilient Cities Framework, how can collaboration be legitimized to confront a deeply fragmented decision making process? Is it the role of the Chief Resilience Officer to tackle this challenge and design a collaborative structure, incorporating the diverse stakeholders involved that is efficient and productive?

An autonomous and financially independent governance structure for watershed management

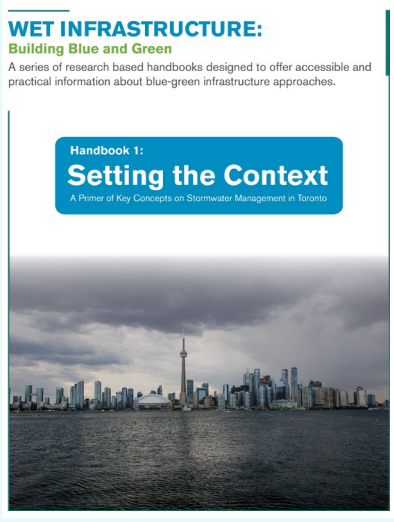
Drawing on the watershed management and governance practices of New Zealand and the Netherlands, autonomous, financially independent authorities allow for water management practices that can dedicate resources solely to water-based issues. Could Ontario's conservation authorities potentially become autonomous, financially independent bodies that have the authority and capital to realize resilient and integrated watershed management practices?

A standardized & action-oriented set of performance measures

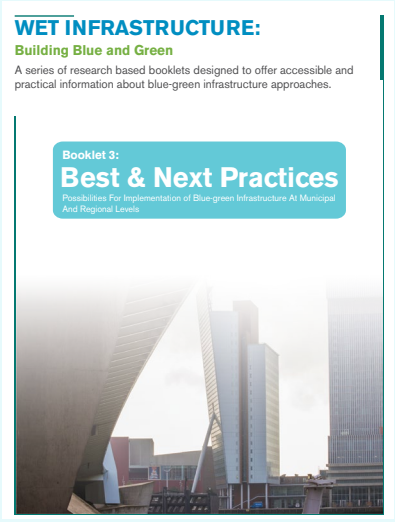
Drawing on the World Council on City Data, the Deltares CIrcle tool, and Public Lab, there is a need to foster data collection processes which incorporate standardized and comparable indicators, involving both quantitative and qualitative interpretations, and merging open data with expert information.

The intent of this Governance handbook is to provide a foundational understanding of Ontario's and Toronto's current legislative context as it relates to blue-green infrastructure. It seeks to highlight the challenges pertaining to public policy and legislation and stimulate discussion regarding their future roles and opportunities. This handbook does not suggest potential remedies and panaceas for the discussed challenges, rather it informs the potential short, medium, and long-term future-forward provocations outlined within the ***Activation Plan's*** *Section: 3 Governance and Capacity Development.*

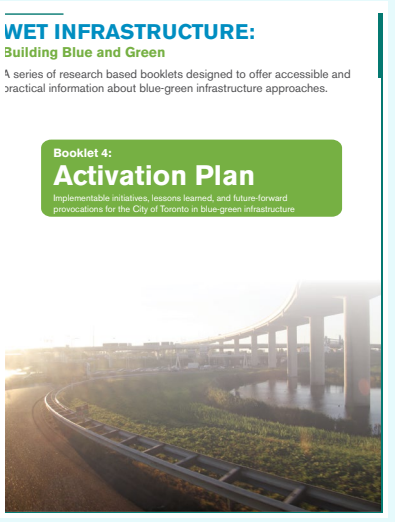
Nextvoyage, nd.



Setting the Context
A Primer of Key Concepts on Stormwater Management in Toronto



Best and Next Practices
International Opportunities and Approaches in Stormwater Management



Activation Plan
Implementable Initiatives, Lessons Learned, and Future-Forward Provocations for the City of Toronto in Blue-Green infrastructure

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APPENDIX

Provincial

Ontario Environmental Protection Act, R.S.O. 1990, c.E.19

Ontario Ministry of the Environment and Climate Change

The *Ontario Environmental Protection Act* "provides for the protection and conservation of the natural environment" (Ministry of the Environment and Climate Change, 2015, p.2).

Ontario Water Resources Act, R.S.O. 1990, c. O.40

Ontario Ministry of the Environment and Climate Change

The *Ontario Water Resources Act's* purpose is to "provide for the conservation, protection and management of Ontario's waters and for their efficient and sustainable use, in order to promote Ontario's long-term environmental social and economic well-being." (*Ontario Water Resources Act*, 1990, Section 0.1). Section 53(1) states that "no personal shall use, operate, establish, alter, extend or replace new or existing sewage works except under and in accordance with an Environmental Compliance Approval" (*Ontario Water Resources Act*, 1990, Section 53(1)). The definition of sewage in the Act includes stormwater and drainage (*Ontario Water Resources Act*, 1990).

Environmental Assessment Act, R.S.O. 1990, c.E.18

Ontario Ministry of the Environment and Climate Change

Description

Passed in 1975 and later amended in 1996, the Ontario *Environmental Assessment Act* details the legislative requirements for addressing and examining an "undertaking" to determine the definite and possible effects on the environment. 'Undertaking' refers to policies, plans, programs, and projects and 'environment' incorporates social, economic, cultural, and biophysical effects and their inter-relations. The Ontario *Environmental Assessment Act* requires proponents conducting an environmental assessment to explore the benefits and issues related to the environment resulting from the undertaking itself, alternative procedures to the development of the undertaking, and alternatives to the undertaking (Muldoon et al, 2015).

Application

Ontario's *Environmental Assessment Act* pertains to public plans and projects conducted by the provincial and municipal governments except for those that are exempt. The private sector may also be required to conduct environmental assessments for some undertakings such as waste discard or electricity proposals (Muldoon et al, 2015).

Planning Act R.S.O. 1990, C P.13

Ontario Ministry of Municipal Affairs

Description

The Ontario *Planning Act* sets an overall framework in terms of land use for the entirety of the Province of Ontario. Specifically for context of southern Ontario, the *Planning Act* distinguishes municipal governance structure by outlining land use authority based upon single, lower and upper tier municipalities. The *Planning Act* is provincial legislation mandated through the Ontario Legislature (Ministry of Municipal Affairs, 2016).

Application

The *Planning Act* reflects land use policy pertaining to a provincially led framework where municipal land use decisions shall be consistent with provincial interests as outlined in the 2014 *Provincial Policy Statement* (Ministry of Municipal Affairs, 2016). These land use decisions are made through the focus of local based autonomy such as a municipality.

Key Considerations

- The *Planning Act* is an overarching provincial planning document that sets outlines for provincial interests through the *Provincial Policy Statement* for the 444 municipalities in Ontario.
- The *Act* provides the basis for municipal official plans, municipal planning tools, to make local planning decisions with guidance from the provincial government when required (*Planning Act*, 1990).

- Essentially, it sets the democratic framework for land use planning.

Conservation Authorities Act, R.S.O. 1990, c. C.27

Ontario Ministry of Natural Resources and Forestry

Description

The *Conservation Authorities Act* was passed in 1946, due to issues - raised by a number of stakeholders including farmers and naturalists - of environmental destruction resulting from insufficient land, water and forestry activities. The *Act* has led to the creation of 36 conservation authorities that now reside over watersheds and municipalities in southern and central Ontario. The *Conservation Authorities Act* outlines planning and decision-making at the watershed scale acknowledging both that water does not flow along political boundaries and that pollution and use of natural environments from human activities have impacts that affect an entire watershed (Muldoon et al, 2015). Section 21 of the *Conservation Authorities Act* highlights the powers that a conservation authority has to meet its goals and mandate. Included in Section 21 are the powers to examine the watershed, obtain land, make agreements, collect fees for services, and construct facilities (Government of Ontario: Ministry of Natural Resources and Forestry, 2015, p.7). Ultimately, the objective of a conservation authority is to implement and facilitate a local resource management initiative that accounts for provincial and municipal needs and opportunities at the watershed scale (Government of Ontario: Ministry of Natural Resources and Forestry, 2015). While conservation authorities vary in their priorities, general functions include the creation of programs to address flooding and erosion, the management, protection, and maintenance of Ontario's water bodies, and facilitation of situations in which the general public can explore, experience, and admire the natural environment of Ontario (Conservation Ontario, n.d.b.).

Application

The *Conservation Authority Act* outlines the manner in which the Province of Ontario and municipalities can work together to create a conservation authority (Conservation Authority, n.d.a.). Conservation Authorities are governed by an executive committee and advisory boards appointed by the local municipalities (*Conservation Authorities Act*, 1990; Government of Ontario: Ministry of Natural Resources and Forestry, 2015). The funding from Conservation Authorities is provided through multiple sources where 48% is through municipal levies, 40% through own-source revenue, 10% through provincial grants and special projects, and 2% through federal grants and contracts. Conservation Ontario is the non-profit organization that embodies the conservation authorities across the province (Conservation Ontario, n.d.b.).

Drainage Act, R.S.O. 1990. c. D.17

Ontario Ministry of Agriculture, Food, and Rural Affairs

Description

The *Drainage Act* is used to enable neighbouring landowners in coordination to achieve appropriate drainage. The *Drainage Act* is a technical document with an audience primarily comprised of engineers (*Drainage Act*, 1990).

Application

Primarily focused on rural considerations of drainage in agricultural zones, this *Act* stipulates that drainage is a communal process and places strong importance on landowners' legal rights to drainage (*Drainage Act*, 1990).

Key Considerations

- Neighbouring land owners are now given the right to effective drainage and municipalities are responsible to aid in the development of the appropriate drainage construction (*Drainage Act*, 1990).

Growth Plan for Greater Golden Horseshoe, 2006

*Ministry of Municipal Affairs, Proposed Changes 2016**

Places to Grow Act, 2005 S.O, 2005, C.13

*Proposed Changes through the Co-ordinated Review have been used in this section.

Description

The *Growth Plan* outlines provincial interest in developing communities through a framework which supports

strong, prosperous, and managed growth within the region under its jurisdiction, in this case the Greater Golden Horseshoe. This framework places strong emphasis on the building of complete communities through outlined priorities such as intensification, mixed-use development, and an integrated planning process. The integrated planning process places importance on planning and land use which reflects integration with infrastructure developments and public service facilities (Growth Plan, 2016).

Application
The current *Growth Plan* 2006, is placed under authority of Section 7 of the *Places to Grow Act*, 2005 and applies to the Greater Golden Horseshoe region of Ontario and the corresponding upper, lower, and single tier municipalities. At the municipal level, official plans and zoning by-laws act as policy and tools for the implementation of the *Growth Plan* (Ministry of Municipal Affairs, 2016a).

Greenbelt Plan, 2005
*Ministry of Municipal Affairs, Proposed Changes 2016**
Greenbelt Act S.O., 2005, c,1.
*Proposed Changes through the Co-ordinated Review have been used in this section.

Description
The *Greenbelt Plan* builds off of the *PPS* in outlining provincial interests in specific areas such as the protection of continued agricultural landscape, natural heritage, and water resource systems which covers 1.8 million acres of Southern Ontario (Ministry of Municipal Affairs, 2016).

Application
Intended to work as a collective in terms of organizing and implementing the *Greenbelt Plan*, the Greenbelt is governed by planning policy of various levels of government. Together with the *PPS* and *Growth Plan*, the Greenbelt is intended to be used through the implementation of municipal policy such as official plans and zoning by-laws (Ministry of Municipal Affairs, 2016).

Key Considerations
- Similar to the *Growth Plan* in terms of outlined proposed policy changes under the 2016 Co-ordinated Review, the *Greenbelt Plan* makes specific references to how municipalities are to undertake stormwater management, climate change, and resilience through land use planning.
- Specific policies in the *Greenbelt Plan*, such as Section 3.3 Natural Systems, under the proposed changes now require municipalities to undertake watershed planning (Ministry of Municipal Affairs, 2016b).

Clean Water Act, 2006, S.O. 2006, c.22
Ontario Ministry of the Environment and Climate Change

The *Clean Water Act* protects "existing and future sources of drinking water" (*Clean Water Act*, 2006). As is the case with the *Conservation Authorities Act*, the *Clean Water Act*, manages water at the watershed scale through source protection committees. Various stakeholders including municipalities, agricultural, commercial, and industrial fields, environmental organizations, health facilities, and the general public work together in these committees to develop plans that address concerns regarding drinking water sources in their region. Conservation authorities are tasked with creating the source water protection committees and managing the creation and implementation of source water protection plans, as outlined in the *Act* (Muldoon et al, 2015).

Water Opportunities Act 2010 S.O. 2010, c.19. Sched. 1
Ontario Ministry of Environment and Climate Change

Description
The main purpose of this *Act* is to foster innovative water, wastewater and stormwater technologies within public and private sectors (*Water Opportunities Act*, 2010).

Application

The *Act* stipulates that municipalities may be required to develop a municipal water sustainability plan that is implemented through performance indicators established by MOECC. These performance indicators and targets specifically focus on stormwater management through innovative green infrastructure. Municipalities may also be required to submit water conservation plans, risk assessments, potential impacts of climate change, and strategies for improving municipal services. These recommendations may ensure future demands on water infrastructure are met while considering new methods of efficient water use for the conservation of Ontario's water resources (*Water Opportunities Act*, 2010).

Ontario Great Lakes Strategy, 2012

Ministry of Environment and Climate Change
Great Lakes St. Lawrence River Basin

Description

The *Ontario Great Lakes Strategy* outlines how provincial ministries, municipalities, and local non-governmental organizations, along with the general public can improve the biodiversity of the Great Lakes. The *Strategy* also stresses the need for climate change adaptation (Ministry of the Environment and Climate Change, 2012).

Application

The *Great Lakes Strategy* pertains to Ontario as a whole but makes specific reference to the further collaboration, education, and engagement for stewardship of the Great Lakes. The *Strategy* states that a partnership with conservation authorities, environmental agencies and the general public is needed for effective water protection (Ministry of the Environment and Climate Change, 2012).

Living City Policies, 2014

Toronto and Region Conservation Authority

Description

The *Living City Policies* (*LCP*) for Planning and Development in the Watersheds of the TRCA comprise the priorities, objectives, and policies outlining the "legislated and delegated" functions of the TRCA as part of planning and development approvals (TRCA, 2014a; TRCA, n.d.b, para 1). The Toronto and Region Conservation Authority (TRCA), created after Hurricane Hazel in 1954 (TRCA and ThinData, n.d.), is responsible for nine watersheds and components of or the entirety of eighteen municipalities (TRCA, n.d.a; TRCA, 2014a). The *LCP* now serves as the TRCA's primary policy document, expanding upon the *Valley and Stream Corridor Management Program* created in 1994 (TRCA, 2014a).

Application

The *Living City Policies* indicate the initiatives of the TRCA and the Authority's actions as a "public commenting body, service provider, resource management agency, representative of the provincial interest for natural hazards, regulator, and landowner in the context of the planning and development process" (TRCA, 2014a, p.6). Section 5.3 of the *LCP* outlines a series of strategic objectives of the TRCA, moving forward, including:

- "Sustainable Communities";
- "Greenspace and Biodiversity";
- "Business Excellence"; and
- "Healthy Rivers and Shorelines" (TRCA, 2014a, p.36 and 37).

For more information on the TRCA Stormwater Management Criteria, see http://sustainabletechnologies.ca/wp/wp-content/uploads/2013/01/SWM-Criteria-2012.pdf

Provincial Policy Statement 2014

Ontario Ministry of Municipal Affairs
Authority granted under Planning Act Ontario

Description

The 2014 *Provincial Policy Statement (PPS)*, outlines provincial interests in terms of planning policy and land use planning. The *PPS* makes specific reference to resiliency, climate change and stormwater management with the overarching goal to build strong, healthy, and resilient communities (*Provincial Policy Statement*, 2014).

Application
The *PPS* is an important planning policy document that highly influences planning policy and land use decisions at the municipal level. The province is granted authority whereby municipalities shall conform to outlined provincial interests which are clarified in the *PPS* (*Provincial Policy Statement*, 2014).

Key Considerations
- The *PPS* highlights the importance of planning that considers stormwater runoff where decisions shall utilize effective best practices which re-use rainwater and snowmelt at its source, utilize low impact development (LID), minimize volumes and contaminants, and promote the use of permeable surfaces.
- The *Provincial Policy Statement* outlines and emphasizes the importance of stormwater management as determined by the province, encouraging the use of appropriate planning decisions and best practices (*Provincial Policy Statement*, 2014).

Ontario Great Lakes Protection Act, 2015. S.O. 2015, c. 24
Ministry of Environment and Climate Change
Great Lakes- St. Lawrence River Basin

Description
The *Great Lakes Protection Act* is intended to protect and restore the ecological health of the Great Lakes Basin (Ontario Great Lakes Protection Act, 2015).

Application
The 2012 *Ontario Great Lakes Strategy* is the application of this *Act*. The *Act* is built upon outlined goals of the *Great Lakes Strategy* and thus, supports the *Strategy's* goals through legislative authority (Ontario Great Lakes Protection Act, 2015).

Key Considerations
- The province has outlined the importance of the Great Lakes both in terms of ecological health and biodiversity as well as human health. The protection of the Great Lakes is of great concern due to the impacts of climate change, urbanization, agricultural runoff, pollution and invasive species with three out of the four Ontario Great Lakes in decline in terms of ecological health (Ontario Great Lakes Protection Act, 2015).

Municipal
Wet Weather Flow Master Plan, 2003
City of Toronto
Description
The *Wet Weather Flow Master Plan* (*WWFMP)* focuses on the six regional watersheds that encompass Toronto and the lake-based watersheds which drain directly into Lake Ontario. In contrast, the TRCA's *Living City Policies (*2014) includes 9 watersheds. The plan provides goals in terms of the reduction and eventual elimination of the impacts of wet weather flow in order to protect, sustain, and improve the rivers, streams and watersheds that lie within and pass through Toronto (City of Toronto, 2003).

Application
The WWFMP is intended to be applied through a hierarchy of solutions. The most relevant solution to this project is the use of source control. Source control is a solution that aims to capture water where it falls through the implementation of green infrastructure and low impact development methods. Source control applies directly to the Toronto Green Standard and Green Roof By-Law and are implemented through policies outlined in the City's *Official Plan* (City of Toronto, 2003).

Wet Weather Flow Gudelines
The City of Toronto also created the Wet Weather Flow Management Guidelines in conjunction with the WWFMP (City of Toronto, 2006). The intention of the guidelines is to aid in the review and approval of stormwater management plans as well, inform stakeholders of the technical requirements for all new development and infill development in relation to the WWFMP (City of Toronto, 2006). Performance objectives are also outlined which

focus on peak flow and runoff management as well as, water quality.

Mandatory Downspout Disconnection Program, 2006

City of Toronto, Toronto Water

Description

The Mandatory Downspout Disconnection By-law orders property owners to disconnect their downspouts in a series of phases beginning in 2011 (City of Toronto, n.d.e; City of Toronto, 2015a).

Application

Property owners living in areas with combined sewers must disconnect their downspouts by November 20th, 2011. Phase 2, completed by December 3rd, 2013, targeted downspout disconnection for residents in basement flooding study areas. The final phase requires the remaining property owners in Toronto to disconnect their downspouts by December 3rd, 2016 (City of Toronto, 2015a).

Toronto Green Standard, 2009

City of Toronto

Description

Created in 2010 and later updated in 2014, the Toronto Green Standard (TGS) outlines performance criteria and suggestions for sustainable site and building design. The criteria outlined in the TGS aims to enhance the quality of air and water, minimize greenhouse gas emissions, improve urban ecology, and limit the amount of solid waste (City of Toronto, 2015b).

Application

The Toronto Green Standard is implemented in the preliminary steps of planning through site plan control (City of Toronto, 2015a; City of Toronto, 2015b). The standard is organized into two tiers whereby Tier 1 applies to all new development and Tier 2 is a more thorough, voluntary set of criteria that results in a 20% reduction in development charges at the 2014 rate (City of Toronto, 2015b). While completion of the Tier 1 requirements is evaluated by City Planning through development approval, Tier 2 completion is subject to the consideration of a third party (City of Toronto, 2015b).

Green Roof By-law, 2009

City of Toronto

Description

Adopted by City Council in 2009, the Green Roof Municipal By-law outlines criteria for the inclusion of green roofs in new developments (City of Toronto, n.d.d).

Application

The Green Roof By-law applies to new developments of residential, commercial and institutional buildings larger than 2000m^2 (City of Toronto, 2015a).

Resilient City: Preparing for Extreme Weather Events, 2013

City of Toronto

Description

The City of Toronto has released a number of plans to build resilience to climate change and prepare for extreme weather events. *Change is In the Air: Climate Change, Clean Air and Sustainable Energy Action Plan* was adopted in 2007 followed by the *Climate Adaptation Strategy*, and *Ahead of the Storm: Preparing Toronto for Climate Change*. The most recent reports for climate change adaptation are *Resilient City: Preparing for Extreme Weather Events* and *Resilient City: Preparing for a Changing Climate* which were adopted by City Council in December 2013 and July 2014 (City of Toronto, n.d.a). *Resilient City: Preparing for a Changing Climate* is discussed below. *Resilient City: Preparing for Extreme Weather Events* builds upon *Toronto's Future Weather and Climate Drivers Study*, evaluating the preparedness of the City's infrastructure and services for extreme weather events (City of Toronto: Chief Corporate Officer, 2013).

Application

Resilient City: Preparing for Extreme Weather Events was created in collaboration with 14 City Divisions, Agencies and Corporations as well as Metrolinx. The report yields a recommendation to expand upon the operations of the Resilient City Working Group and develop a strategy that details priorities and actions to build resilience of "the interdependent infrastructure and services to extreme weather" (City of Toronto: Chief Corporate Officer, 2013, p.2).

Resilient City: Preparing for a Changing Climate, 2014

City of Toronto

Description

Resilient City: Preparing for a Changing Climate, building on the City's previous plans and policies such as the *Toronto Green Standard* and *Wet Weather Flow Master Plan*, provides a strategy to build resilience to climate change as part of the City's decision-making and operations (City of Toronto: Deputy City Manager and Chief Financial Officer, 2014).

Application

Resilient City: Preparing for a Changing Climate responds to the recommendation made in *Resilient City: Preparing for Extreme Weather Events*, acting as a strategy that provides a series of recommendations and proposed short-term adaptation actions. Among the recommendations is a proposal to adopt the *Climate Change Risk Policy* that specifies procedures, roles, responsibilities, and actions for mitigating the risks associated with a changing climate (City of Toronto: Deputy City Manager and Chief Financial Officer, 2014). The *Climate Change Risk Management Policy* was adopted in 2014 and a staff report highlighting status updates and implementation was released on November 2nd, 2016 (City of Toronto: Chief Corporate Officer, 2016a).

Official Plan of Toronto, Last Update 2015

City of Toronto

Description

The recently updated *Official Plan* through the Environmental Policies Amendment 262, reflects the progressive spirit of Toronto's planning policy. The Amendment calls for effective implementation of green infrastructure to build climate change resiliency. This amendment to the *Official Plan* also highlights the necessity of stormwater management and climate change mitigation efforts throughout Toronto (City of Toronto, 2015c).

Application

The *Official Plan* acts as a visionary framework for how the entirety of Toronto will develop in the present and future. It is a cohesive policy document which provides planners, stakeholders, and politicians with strong requirements for land use planning on a multitude of scales, enacted through zoning by-laws (City of Toronto, 2015c).

Parks Plan 2013-2017

City of Toronto

Description

The vision of the *Parks Plan* focuses on how Toronto's parks can continue to function and improve while accommodating population growth and development that impact the health of the City's green space. The *Plan* also outlines potential impacts from climate change, specifically, impacts from stormwater runoff that can damage park systems (City of Toronto, 2013).

Application

The *Parks Plan's* foundation is built upon municipal policy outlined within Toronto's *Official Plan*. Further, Parks, Forestry, and Recreation's *Parks Plan* functions alongside the *Urban Forestry Strategic Plan* and the *Recreation Service Plan* (City of Toronto, 2013).

Key Considerations

- The City of Toronto Parks, Forestry, and Recreation division plays an important role in climate change adaptation with stormwater mitigation outlined as an integral part of Toronto's stormwater management system (City of Toronto, 2013).

TransformTO: Climate Action of a Healthy, Equitable, and Prosperous Toronto, 2015 - Ongoing

City of Toronto

Description

TransformTO was established in 2015 as a "community-wide, cross-corporate initiative" aimed at meeting the Toronto's long-term goal of an 80% reduction in greenhouse gas emissions to 1990 levels by 2050 (City of Toronto: Chief Corporate Officer, 2016b, para 12. The initiative focuses on engaging residents, stakeholders and City Divisions, Agencies and Corporations to collaborate on meeting this goal and achieving a low-carbon outcome that is favourable for all stakeholders (City of Toronto: Chief Corporate Officer, 2016b).

Application

TransformTO began with a series of stakeholder sessions involving the participation of 2000 residents from March 2015 to July 2016. Also in March 2015, a Subcommittee on Climate Change Mitigation and Adaptation stemming from the Parks and Environment Committee was established to assist and direct the project. *TransformTO* is a joint project organized by the Environment and Energy Division and the Toronto Atmospheric Fund (City of Toronto: Chief Corporate Officer, 2016b). The intention of *TransformTO* is to develop two independent but interconnected reports. The first report outlining a short-term strategy (2017-2020) for Toronto to achieve a 30% reduction in greenhouse gas emissions by 2020. The second report is a long-term strategy to reach the 2050 goal of reducing greenhouse gas emissions by 80% from 1990 levels and thus fostering a healthy, vibrant, and fair city (City of Toronto, n.d.f).

Key Considerations

- On November 2nd, 2016, a report by the Chief Corporate Officer was released outlining the short-term strategies for TransformTO. The short-term strategies include building upon the creative financing tools such as the Toronto Atmospheric Fund's Energy Savings Performance agreements and the Home Energy Loan Program. Another short-term strategy highlights the need to engage and work with stakeholders including community residents, utilities, and other levels of government (City of Toronto: Chief Corporate Officer, 2016c).
- As part of the November 2nd, Report - *Transform TO: Climate Action for a Healthy, Equitable, and Prosperous Toronto*, the Chief Corporate Officer recommends that coordination be made with the provincial and federal governments to emphasize the need for program funding, co-deliver possibilities, as well as policy and regulatory that contributes or promotes the execution of the short-term strategies and facilitates the City of Toronto in reaching their 2050 target (City of Toronto: Chief Corporate Officer, 2016b).

TOCore Proposals Report, 2016 - Project Ongoing

City of Toronto

Description

The recently published TOCore Proposals report outlines challenges that Toronto's downtown core is facing due to unprecedented, high-density growth (City of Toronto, 2016b). The proposal report is intended to act as an initial release of potential policy that will be incorporated into the downtown core's secondary plan. Section "J" specifically outlines the challenges the downtown core is facing in terms of climate change and building a resilient community.

Application

Policy proposals outlined within the report are meant to promote discussion amongst stakeholders, planners and the general public in regard to development of the downtown core's forthcoming secondary plan. At the moment, these guidelines are simply ideas and have no current application through planning policy or plans (City of Toronto, 2016b).

Key Considerations

- The proposal report emphasizes the fact that Toronto's downtown core and the population inhabiting the core, particularly residents of high-rise developments, are vulnerable to the impacts of climate change. It outlines that the core needs to be better prepared in order to deal with stormwater runoff and calls for planners to potentially require the public realm to meet the Green Streets Technical Guidelines as well as, encourage new development to utilize blue-green infrastructure in order to mitigate stormwater (City of Toronto, 2016b).

- The TOCore initiative and development of the downtown secondary plan are ongoing and could be subject to change as planners, stakeholders and the public provide input (City of Toronto, 2016b).

Ravine Strategy, Ongoing - est. 2017

City of Toronto

Description

The *Ravine Strategy*, expected to be completed in April-May 2017, builds upon current plans, regulations and by-laws to realize a common vision and provide a series of principles and actions to direct further policy and planning of the ravine system (City of Toronto, n.d.c.; City of Toronto, 2016). The *Ravine Strategy* is a joint initiative of City of Toronto's Parks, Forestry, and Recreation, City Planning, and Toronto Water (City of Toronto, n.d.c).

Application

A draft of the *Ravine Strategy* has been published depicting the current status of the principles and actions addressing, simultaneously, the protection and use of the City's ravines. It is intended that the document's fundamental themes and concepts, as outlined in the principles, will direct policy, investment, and stewardship pertaining to the ravine system as well as future decision-making (City of Toronto, 2016).

Green Streets Technical Guidelines, Ongoing

City Planning and Toronto Water

Description

In October 2013, Toronto City Council adopted a motion directing Toronto Water, Transportation Services, Engineering and Construction Services, and City Planning to create a set of standards for green infrastructure to be applied to the public right-of-way and incorporated in the development of capital projects (City of Toronto, 2015a; Boudreau and Cheung, 2015).

Application

The creation of the Green Streets Technical Guidelines is still in progress. The guidelines are anticipated to act as a Toronto Green Standard for the public right-of-way (Boudreau and Cheung, 2015).

Urban Forestry Strategic Plan, 2012-2022

City of Toronto, Parks, Forestry and Recreation

Description

The *Urban Forestry Strategic Plan* envisions a healthy, sustainable tree canopy for the entirety of Toronto stressing the need for an increased canopy, the improvement of biodiversity, increased awareness and education, and equitable distribution of the forest canopy. The *Plan* highlights that there are specific challenges affecting Toronto's tree canopy, such as the effects resulting from climate change and increased storm events. These storm events unload greater amounts of precipitation thus creating larger amounts of stormwater runoff which directly impacts the health of soil and thus, the urban trees along roadways and within parks (City of Toronto, 2012).

Application

The *Urban Forestry Strategic Plan* was created through approved policies such as the *Official Plan* in Section 3.4.1(d) which focus on the need to preserve and enhance the urban forest. Other policies outlined within Toronto's *Official Plan* focus on the protection of the natural environment and heritage systems, green spaces, clean air and freshwater. The *Urban Forestry Strategic Plan* works in conjunction with provincial planning policy, strategic municipal plans, guidelines and zoning by-laws in order to aid in the development of municipal environmental initiatives (City of Toronto, 2012).