



STAFF REPORT ACTION REQUIRED

Resilient City – Preparing for a Changing Climate

Date:	June 9, 2014
To:	Parks and Environment Committee
From:	Deputy City Manager and Chief Financial Officer
Wards:	All Wards
Reference Number:	P:\2014\Internal Services\E&E\Pe14002e&e – (AFS18868)

SUMMARY

The success of Toronto and its quality of life will be influenced by how resilient the City of Toronto, its residents and businesses are to the direct and indirect effects of a changing climate and associated extreme weather events.

Recent events, such as the July 8, 2013 rain storm, the many extreme heat alerts during the summer of 2013 and the December 2013 ice storm offer a number of lessons that identify the need to set a course of action that will help the City and its communities prepare for future eventualities and become more resilient to a changing climate. Toronto already has strategies and initiatives such as the Toronto Green Standard, Wet Weather Flow Master Plan, the Hot Weather Response Plan and the Strategic Forest Management Plan that are building up Toronto's resilience, but more work is required to:

1. support the integration of climate change resilience into decision making across all City operations;
2. further identify the changes required in Toronto's services and infrastructure to make them more resilient;
3. establish approaches for coordinating resilience action according to identified interdependencies of infrastructure and services and priority populations;
4. seek the engagement and assistance of the federal and provincial governments to address the impacts of the changing climate on the health and safety of residents;
5. partner with the private sector and broader public sector to coordinate the City's efforts with them to improve Toronto's overall resilience; and
6. support residents and businesses in taking actions that enhance their personal resilience.

The purpose of this report is to outline an approach that will see climate change resilience integrated into decision-making and co-ordination of City operations and services. This report proposes a *Climate Change Risk Management Policy* that defines roles and responsibilities for identifying and mitigating climate risks and proposes mechanisms for co-ordinating, resourcing and prioritizing actions. In addition, this report responds to the climate resilience directives made by City Council when it discussed how the City responded to the December 2013 ice storm.

It is important to note that this report focuses on improving Toronto's climate change resilience, while other reports being prepared by the City Manager and the Medical Officer of Health for presentation at the July 8, 2014 meeting of City Council address issues associated with being prepared for emergency events that occur as a result of extreme weather.

RECOMMENDATIONS

The Deputy City Manager and Chief Financial Officer recommends that City Council:

1. Adopt the "*Climate Change Risk Management Policy*", as outlined in Appendix A of this report, which establishes the necessary processes and controls for systematically identifying, assessing and taking action to mitigate risks arising from a changing climate and defines roles and responsibilities;
2. Require all City Agencies and request all City Corporations to adopt the City's *Climate Change Risk Management Policy* or a similar policy that is consistent with the one adopted by City Council and advise the Chief Corporate Officer when such policy has been adopted.
3. Request the Province of Ontario and the Government of Canada to prioritize the health and safety of residents resulting from a changing climate and extreme weather, with attention to the particular needs of large cities as a result of their density and the age of infrastructure, and the need for intergovernmental coordination among all governments, including municipalities; and direct the City Manager to continue to work with provincial and federal officials, the Federation of Canadian Municipalities and key municipal stakeholders to advance this intergovernmental priority.
4. Direct the Chief Corporate Officer in collaboration with the Executive Environment Team members to:
 - a) establish a process to manage across City Divisions and Agencies the interdependencies of infrastructure and services identified as being at risk to a changing climate; and

- b) to explore partnership opportunities with the private sector and broader public sector, such as telecommunication, private utility, healthcare, banking and insurance, in the implementation of collective action that increases Toronto's resilience to a changing climate and extreme weather.
- 5. Direct the Director of the Environment and Energy Division to:
 - a) lead the City's efforts to monitor and research how the climate is changing and when new information relevant to the City of Toronto becomes available, provide this to City Council, the City Manager, the Deputy City Managers and all Division Heads;
 - b) assist, where necessary, City Divisions and Agencies in undertaking climate change and extreme weather risk assessments of their operations and the identification of actions that could be taken to mitigate those risks;
 - c) coordinate annual reporting to City Council on the implementation of the "Climate Change Risk Management Policy" with the first report to be presented in the first quarter of 2016; and
 - d) collaborate with the Director of Strategic Communications and all relevant City Divisions, Agencies and Corporations, to establish a corporate-wide integrated approach to communicating, educating and engaging residents and businesses about the resources and supports available to them and the actions they can take to increase their resilience to a changing climate and extreme weather.
- 6. Request the Deputy City Manager and Chief Financial Officer and the Chief Corporate Officer to prepare a business case for consideration during the 2015 budget process and beyond that provides resources required to support implementation of the *Climate Change Risk Assessment Policy*;
- 7. Endorse the proposed letter of understanding, as outlined in Appendix C of this report, between the City of Toronto and Toronto Hydro for Collaborative Energy Planning ;
- 8. Direct the Deputy City Manager and Chief Financial Officer and the Chief Corporate Officer to identify proposals for consideration during the 2015 budget process and beyond for financing required increases in the electrical standby capacity in critical City-owned buildings operated by Facilities Management; and
- 9. Authorize the Director of the Environment and Energy Division the option to provide access to the Toronto Climate Risk Assessment Tool to the private sector and broader public sector at no financial cost and with the discretion to dispense with an indemnity.

Financial Impact

Recommendations in this report for additional resources could cost the City about \$1.350 million annually. This is a preliminary estimate and detailed funding requests based on Table 1 will be developed for consideration during the 2015 budget process and beyond.

As seen in recent extreme weather events, the City has experienced significant financial costs due to impacts on its infrastructure and services. For example, the direct costs to the City from the August 2005 rain-storm were \$47 million and the July 2013 rain-storm was \$70 million. While the City cannot predict nor prevent all impacts associated with the changing climate, it can make prudent investments in risk reduction that will yield cost savings in the long run for the City, its residents and businesses.

As risks and related mitigation actions are identified through the implementation of this report's recommendations, staff will bring forward associated proposals and financial impacts, for City Council's consideration.

Estimated Funding Request	Description
\$0.800 million annually	To provide the resources, in-house technical expertise and staffing required by affected City divisions and agencies to implement the Climate Change Risk Management Policy and other provisions as identified in this report. Staffing is currently estimated to be 5 to 7 full time equivalent positions annually, whose primary focus will be to assist City Divisions & Agencies in the identification of climate change risks and developing plans to manage and address those risks. The need for additional staffing will be reviewed annually and phased in as appropriate.
\$0.300 million annually	To fund expenses and external programs associated with a corporate-wide integrated outreach and engagement strategy that builds upon existing programs and makes it easy for residents and businesses to identify and access the resources, tools and information available to them to increase their personal resilience to a changing climate.
\$0.250 million annually	To access the necessary external expertise required to identify how Toronto's climate is changing and how it may affect our social, environmental and economic systems, to better inform decision-making.
Total: \$1.350 million annually	

This report identifies in Appendix B a number of actions being considered by City Divisions, Agencies and Corporations. Those actions may result in additional costs aside from the \$1.350 million per year as aforementioned. Any financial implications associated with those actions will be identified in the respective Divisions and Agencies'

budget submission and will need to be balanced against a variety of needs including competing priorities and affordability.

With respect to recommendation 8 addressing electrical standby capacity in critical City buildings, the Chief Corporate Officer and the Deputy City Manager and Chief Financial Officer will identify a financing proposal for consideration during the 2015 budget process and beyond. It is expected that this proposal will not introduce new budget pressures, because it will incorporate mechanisms such as:

- a) financial incentives available from the Ontario Power Authority;
- b) the City's recoverable debt financing model; and
- c) existing budgeted state of good repair funds.

The Deputy City Manager and Chief Financial Officer has reviewed this report and agrees with the financial impact information.

DECISION HISTORY

In 2007 City Council directed that a plan be established to reduce the negative impacts of unavoidable changes to climate that are already underway, including: extreme heat; more intense storms; floods and droughts; damaging insects; and newly introduced diseases. That plan was adopted in July 2008 (item #EX22.4).

<http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2008.EX22.4>

In August 2010, City Council endorsed the Staff Report, “*Climate Change Risk Assessment Process and Tool*”, which defined the authorities given to staff to negotiate and execute license agreements for sharing the Climate Change Risk Assessment Tool.

<http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2010.EX46.35>

In February 2013 City Council received a report entitled, “*Toronto’s Future Climate: Study Outcomes*”, which reported on research conducted to forecast likely climate conditions Toronto can expect to experience in 2040-2049. City Council directed that City Manager report back on what changes may be necessary to address the forecast change in climate (item #PE18.2).

<http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2013.PE18.2>

In response to this direction, in December 2013 City Council received a report entitled, “*Resilient City: Preparing for Extreme Weather*” from the Chief Corporate Officer that outlined existing policies, programs and initiatives, which are making Toronto a more resilient city. The report identified that additional time was required to further investigate cross corporate issues that are interdependent between many different City operations. This report responds to that directive.

<http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2013.PE24.3>

In addition, this report addresses City Council's directives 5l, 5cc, 5zi and 5zii that were made in response to the ice storm that occurred in December 2013. Those directives are:

- a) (5. l.) Identify the best practices of other major cities across the world which have developed effective ways to deal with extreme weather events;
- b) (5. cc.) Prepare an evaluation on the viability of embedded energy solutions to improve the reliability and security of Toronto's energy systems; and
- c) (5. z. i. & ii.) Prepare a list of actions that can be taken to enhance the resiliency of the City's infrastructure and services and the estimated costs for implementing those actions for potential inclusion in the 2015 budget.

<http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2014.CC46.1>

This report focuses on identifying how the City can integrate climate change resilience into its long-term decision-making. Related reports of significance that are also before City Council for its July 8, 2014 meeting and which are more focused on emergency preparedness and response are:

- a) a report from the City Manager to the Executive Committee meeting of July 2, 2014 which responds to the directives of City Council regarding the ice storm that occurred in December 2013;
- b) two reports from the Medical Officer of Health to the Board of Health meeting of June 30, 2014 which outline a strategy for preventing deaths during extreme heat events and review cold weather health impacts and related City protocols; and
- c) a report from the Medical Officer of Health to the Board of Health, being prepared for 2015, that provides a detailed climate and health vulnerability assessment for the City of Toronto.

This report was prepared with the engagement of the following City Divisions, Agencies and Corporations:

1. City Planning
2. Corporate Finance, Insurance and Risk Management
3. Engineering & Construction Services
4. Facilities Management
5. Office of Emergency Management
6. Parks, Forestry & Recreation
7. Purchasing & Materials Management
8. Shelter, Support & Housing Administration
9. Social Development, Finance & Administration
10. Toronto & Region Conservation Authority
11. Toronto Building
12. Toronto Hydro
13. Toronto Public Health
14. Toronto Transit Commission
15. Toronto Water
16. Transportation Services

In addition, as requested by City Council, GO Transit (representing Metrolinx) and Hydro One were invited to participate in the Resilient City Working Group and both organizations sent representatives to meetings.

Research support for this initiative was provided, under supervision of City staff, by 14 Graduate level students as part of their course on Urban Climate Change Adaptation at the University of Toronto, Department of Geography and Program in Planning.

ISSUE BACKGROUND

In 2011, the City commissioned a study to examine projected climate conditions that Toronto could experience in the period 2040-2049. That study, entitled "*Toronto's Future Weather and Climate Drivers Study*" predicts that Toronto can expect to experience higher average annual and maximum temperatures, more heat waves, and less frequent but much more intense rain events.

Recent extreme weather events highlight the financial, economic, social and environmental costs associated with a changing climate. For example, the estimated City of Toronto and Toronto Region Conservation Authority storm related expenditures and revenue loss from the July 8, 2013 was just over \$70 million. With respect to private property the Insurance Bureau of Canada has reported just under \$1 billion in insurance claims, from the July 8, 2013 storm.

Toronto Public Health has identified that potential health impacts associated with a changing climate include:

1. more illness and death from extreme heat, poor air quality and vector-borne disease;
2. more injury and illness arising from flooding of homes and businesses; and
3. impacts on mental health.

Toronto Public Health has also identified that a changing climate could have significant impacts on factors that indirectly affect health including food security, social networks, employment status, quality of housing, income and costs of recovery, and access to core services including electricity, transportation, and telecommunications. As directed by the Board of Health, Toronto Public Health is currently preparing a climate change and health vulnerability assessment for the City of Toronto.

A resilient city is one that is planning for and designing its infrastructure and services to reduce the impacts of a changing climate and extreme weather and setting itself up to quickly bounce back when extreme weather events occur. On December 6, 2013 a staff report was presented highlighting the climate change adaptation actions already in place or

Resilience Defined

Resilience is "the ability of a system, entity, community, or person to withstand shocks while still maintaining its essential functions and to recover quickly and effectively."

(Rockefeller Foundation)

underway. This report builds upon that work and proposes an approach for integrating climate change resilience into the City's decision-making and facilitating collaborative action.

COMMENTS

1. Proposed Short Term Adaptation Actions to Improve Toronto's Climate Resilience (Dec '13 ice storm motions 5. z. i. & ii)

In 2013, 14 City Divisions, Agencies and Corporations each conducted a half-day climate change vulnerability workshop. This helped identify potential risks, in-place adaptation actions, and potential short-term adaptation actions.

In its discussions regarding the ice storm that occurred in December 2013, City Council requested a list of actions that can be taken to enhance the resiliency of the City's infrastructure and services and the estimated costs for implementing those actions for potential inclusion in the 2015 budget (motion 5. z. i. & ii). Appendix B to this report outlines a set of short-term proposed adaptation actions.

The suggested actions are wide-ranging, varying from the review of existing policies, implementation tools and documents through a climate change/resilience lens (e.g., City Planning's policy assessment) to working cooperatively with other groups (e.g., TRCA's ongoing collaboration with the Office of Emergency Management with respect to emergency response planning related to flooding), to specific actions addressing technical concerns (e.g., TTC's inspection of high-priority culverts). These actions are being considered by the various City operations for inclusion in their 2015 work plans and where necessary operating and capital budget proposals.

2. How Other Cities are Managing and Planning for Climate Change Resilience (Dec '13 ice storm motion 5. I.)

In its discussions regarding the ice storm that occurred in December 2013, City Council requested a review of how other major cities are dealing with extreme weather (motion 5. I.). Five North American cities (New York City; Chicago; San Francisco; Vancouver; and Calgary) were examined as case studies.

A more comprehensive report entitled "*Best Practices in Municipal Climate Resilience*" is available on the City's website

<http://www1.toronto.ca/wps/portal/contentonly?vgnextoid=78cfa84c9f6e1410VgnVCM10000071d60f89RCRD&vgnextfmt=default&vgnextchannel=a201fbfa98491410VgnVCM10000071d60f89RCRD>. The following summarizes the key lessons learned from these municipalities:

1. Most cities have established a senior management steering committee or management panel that leads the overall resilience efforts. These committees are comprised of senior representatives of city departments and utilities. Often there is

a similar committee of external stakeholders made up of businesses and community organizations.

2. In New York City and San Francisco, there is a Director of Resilience or Chief Resilience Officer, respectively, overseeing the City's resilience actions. This position has responsibility for coordinating all of the City's resiliency efforts with the goal being to make the city as resilient as possible. This involves working with all relevant City operations but also working to ensure the City is collaborating with key stakeholders in the private sector and the broader public sector and with residents.
3. In all reviewed cities, the climate resilience organization or structures operate under the direction of the Office of the Mayor or the City Manager or a Deputy City Manager.
4. While the staff resources assigned to the resilience actions ranges from one full time equivalent in smaller cities to 50 in New York City, all cities had a dedicated team of staff assigned to conduct the necessary research and analysis plus manage the necessary cross corporate and community-wide coordination and collaboration.
5. For those issues that relate to the mandates of a number of City operations, inter-departmental working groups are established to coordinate the research and implementation of required actions. For those issues that are largely relevant to the mandate of a single City operation, that department is designated to lead the research and implementation and report back to the body or committee responsible for overall strategy development and coordination of implementation.
6. Outside of staff resources allocated to the Chief Resilience Office or equivalent, none of the examined cities have a budget established specifically for resilience action. They all build the budget requirements into the affected departments as part of the department's operational and capital budget. Any funding established specifically for resilience is usually allocated for recovery from an extreme weather event.
7. Extensive collaboration with key external stakeholders from the private sector and broader public sector and comprehensive engagement with residents and businesses is a common approach to the resilience planning and implementation efforts.
8. There is openness to innovation and policy making and program delivery is driven by well developed research and analysis.

In addition to this review of five cities, staff looked at other reports prepared by organizations that have examined in detail the resilience efforts of other cities around the world.

There is a solid foundation of good governance and decision-making systems, strategies and policies and programs that are directly or indirectly improving Toronto's resilience to a changing climate. For example:

- a) the existing Executive Environment Team lead by the Chief Corporate Officer is well positioned to formally assume the role of a "senior management steering committee" similar to what has been established in the North American cities reviewed;
- b) the existing cross corporate Resilient City Working Group is in alignment with the approach found in other leading cities;
- c) there have been initiatives to engage with key external stakeholders from the private sector and broader public sector through the WeatherWise Partnership initiative; and
- d) various City organizations have undertaken engagement with residents and businesses in support of resilience actions such as basement flood risk reduction, doubling the tree canopy and extreme heat response.

In addition to the governance and decision making systems listed above, the City is advancing efforts to build resilience in its infrastructure. For example, through the City's leading edge Basement Flooding Protection Program, the City is building resilience in its infrastructure by upgrading its storm drainage systems to address urban flooding during extreme storms. The Program is providing, where feasible, protection to a 1 in 100 year storm, in contrast to the existing systems which were designed typically to a 1 in 2 to a 1 in 5 year return storm.

The recommendations contained in this report serve to further advance the City's resilience efforts; the following sections discuss strategic actions that support the recommendations in this report.

Cities are increasingly recognizing that resilience to climate change and other stressors could become a strategic competitive advantage. From an economic development perspective, a recognized high level of resilience could become a factor in attracting and retaining investment and employment opportunities. London, England has identified the economic development opportunities tied to improved resilience to be a key pillar of its future development strategies.

3. Integrating Climate Resilience into the City's Decision Making

A common factor that was identified in the cities examined above was the need for clear designation of accountabilities and responsibilities. Climate change resilience must become part of the considerations in all infrastructure plans, service strategies, operational plans and major initiatives.

To create a culture of climate resilience, the City should establish the framework for requiring and facilitating the integration of climate change resilience considerations into decision-making by adopting a climate change risk management policy.

Once the policy is adopted, the City will need to ensure it has in place the mechanisms and tools required to facilitate and drive implementation of the policy and climate resilient related initiatives.

The recommended policy and implementation mechanisms are discussed in the following sections of the report.

3.1 Climate Change Risk Management Policy

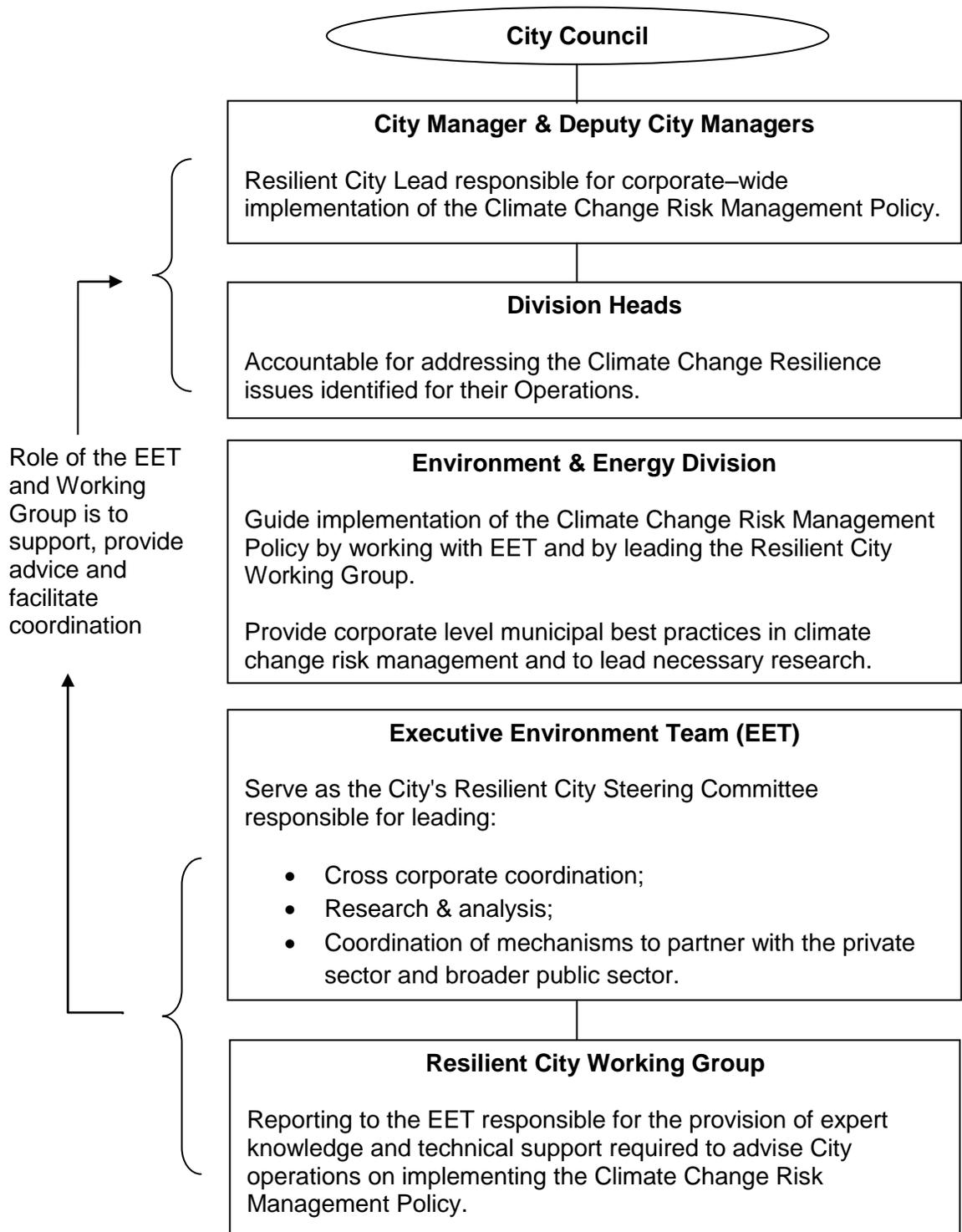
A climate change risk management policy should establish an ongoing approach for identifying risks, and clarify responsibilities, accountabilities, and approaches for managing these risks. The proposed policy statement outlined in Appendix A identifies the City's commitment to addressing resilience and provides guidance for the City of Toronto on identifying, assessing, monitoring, reporting and mitigating the risk associated with a changing climate and extreme weather events. The policy commits the City of Toronto to:

1. continue to monitor and research how the climate is changing to establish a common set of future weather assumptions that are used to identify, assess and manage risks that may impact Toronto;
2. mitigate risk to the City's assets and services by integrating identified risk information into decision making and utilizing this information to inform priorities for investment;
3. establish methods to evaluate initiatives undertaken by the City through the lens of climate change resilience;
4. Continue to reduce and manage risks to its employees and contractors resulting from a changing climate;
5. build awareness and establish meaningful partnerships with the community, residents, the private sector and the broader public sector; and
6. share knowledge and information with external organizations to promote engagement in enhancing extreme weather resilience on a broader scale.

3.2 Cross Corporate Coordination and Governance

The December 2013 Staff Report identified the importance of considering interdependencies of risks and mitigation measures across City Operations. A structured process is needed to ensure that cross corporate actions are prioritized and implemented in a coordinated manner. Diagram 1, below, provides an overview of the proposed Governance Structure for Climate Change Risk Management in the City of Toronto. This builds on existing City structures and takes into account how other large cities are organizing their efforts to become more resilient to a changing climate.

Diagram 1: City of Toronto Governance Structure for Climate Change Risk Management



The existing Executive Environment Team (EET), currently chaired by the Chief Corporate Officer, consists of senior staff from most of the City Divisions, Agencies and Corporations that are affected by extreme weather, and it currently functions as a forum for senior level cross corporate coordination. Therefore this committee is positioned to take on the role of continuing to coordinate the City's Resilient City efforts.

It is recommended that the mandate of EET be modified to include the provision of the operational support and coordination for city-wide resilience efforts. It will be expected to ensure cross corporate cooperation and avoided duplication by including all relevant City Divisions, Agencies and Corporations in various initiatives. EET will also serve as the point of contact to coordinate the City's actions to partner with key stakeholders in the private sector and broader public sector.

In order to succeed there is a need to ensure there are dedicated human resources. Therefore, it is recommended that the existing inter-division/agency Resilient City Working Group be formally established and that the staff participants of key Divisions be designated the responsibility of being the '*Resilience Lead*' for their operation. Depending upon the operation, this will entail the need for additional funding or a reallocation of funding priorities.

The Resilient City Working Group will function as a sub-committee of the EET and will become the hub of expertise for understanding how a changing climate affects people, neighbourhoods, communities and businesses in Toronto, who is most vulnerable, and how City operations can mitigate the magnitude and type of affects they experience. Reporting to the EET, the Resilient Leads and Resilient City Working Group will be responsible for:

1. Representing their home City Division, Agency or Corporation and communicating with that Operation's senior staff;
2. Supporting their home operation in defining and communicating responsibilities and accountabilities associated with climate;
3. Supporting their home operation in implementing climate change risk management processes;
4. Coordinating the development of operational and issue specific action plans identifying the efforts to be taken to manage and mitigate identified risks and thereby increase Toronto's resilience;
5. Identifying issues of interdependencies and vulnerabilities between operations and communicating those issues when their home operation is establishing organizational priorities and business plans;

6. Identifying and communicating any regulatory requirements and other potential liabilities associated with a changing climate;
7. Facilitating the provision of necessary training for staff on the issue climate change risk management;
8. Participating in cross corporate issue specific work groups, contributing to these groups as appropriate; and
9. Assisting in the monitoring and commenting on proposed provincial and federal legislative and regulatory changes from a climate change perspective.

Resources, in-house technical expertise and staffing are required to facilitate the integration of climate change resilience into the decision-making of the City. Therefore it is recommended that the Chief Corporate Officer prepare a business case seeking funding, for inclusion in the 2015 and subsequent budgets. These funds would be re-allocated by the Chief Corporate Officer in consultation with the Executive Environment Team, to the Divisions and Agencies engaged in the Resilient City Working Group enabling them to dedicate staff to the Working Group, while continuing the existing functions and work of those staff.

3.3 Systematic Risk Assessments

By undertaking a structured risk assessment against expected changes in climate and extreme weather, City operations can more accurately identify key vulnerabilities in their infrastructure and services that may require change to improve their resilience. It also helps inform priorities.

The City has developed a process and electronic tool known as the "Toronto Climate Risk Assessment Process and Tool". This process and tool was developed by Deloitte & Touche LLP consultants, in consultation with an external advisory panel and an internal staff committee. The process and tool is consistent with an enterprise risk assessment approach and ISO 31000, an international risk management standard.

Two City organizations have implemented the tool:

- a) Shelter, Support and Housing Administration (Pilot application only); and
- b) Transportation Services Division.

The climate change risk assessment completed by Transportation Services is very comprehensive and involved consideration of:

- a) Over 90 high priority asset and critical services;
- b) Seven different types of extreme weather events;
- c) Two time periods (2010 to 2020 and 2040 to 2050);
- d) Training for risk assessors; and
- e) 15 half-day workshops in various functional groups.

Transportation Services' climate change risk assessment has identified a comprehensive list of over 60 risk reduction actions already in place and 100 proposed risk reduction actions that will impact the Division's future capital and operating programs. Completion of the risk assessment process provides evidence of due diligence for the Division. Based on input from Transportation Services, some enhancements to the tool may be recommended. It has not yet been determined if these enhancements can be done by existing staff.

Similar general risk assessment processes are being used in other City operations such as Toronto Water and these efforts reinforce the value of a systematic approach to identifying, prioritizing and managing risks. Therefore it is recommended that the Resilient City Working Group support City operations in conducting a climate change risk assessment.

It is anticipated that as more detailed climate change risk assessments are conducted in more City operations, it will become possible to understand better how interdependent infrastructure and services may be at risk. It will also be possible to make more informed decisions on priorities for climate change risk reduction action. As these actions are identified over time, it may result in financial implications in the future. Conducting the climate change risk assessment is the critical first step.

3.3.1 Operational, Service and Infrastructure Standards, Guidelines, Best Practices and Codes

As the City of Toronto builds and replaces its infrastructure and plans its services, it is important that consideration be given to how the climate is changing and the resilience of that infrastructure and services to those changes. There are many examples within the City of where this is already occurring. For example, Toronto Water considers future weather in its design standards, Forestry has made changes in the species of trees it plants, and Transportation Services has revised its operational procedures around culvert maintenance and inspection.

As part of the systematic risk assessments, the Resilient City Working Group will assist City operations in a review of operational, service and infrastructure standards, guidelines and best practices to evaluate whether they incorporate consideration of climate change. In light of the latest climate change information and extreme weather events that have occurred, a checklist will be developed establishing key decision making points (or entry points) when consideration of resilience needs to occur.

Many of the standards, guidelines and codes utilized or enforced by the City are established under the authority of the Provincial or Federal Government or professional bodies. Where staff identify that the City has concerns that these standards, guidelines and codes do not adequately address the latest information about a changing climate, they will take appropriate actions to advocate for changes as they are developed or updated.

3.4 GIS Risk Assessment Project

Toronto has extensive capability in the field of geographical information systems (GIS) through the Geospatial Competency Centre and qualified staff working in divisions with responsibility for assets and services located across the City. Staff in the Social Development, Finance and Administration Division have initiated a review of risk management in the City in relation to vulnerable populations. A vital component of any such assessment is an examination of the datasets and information system that underlie decision-making about risk.

Geographic Information Systems are used by the City for planning and analysis of everything from transportation corridors to new real estate developments to social programs and grants. A GIS can be useful not just for analyzing existing data but also for modelling various phenomena to predict future behaviour.

The Social Development, Finance and Administration Division is coordinating initial efforts with other City operations and external organizations to put together a GIS that will consolidate a large set of geospatial information into one location. Examples of information that may be included are:

- a) socio-demographic characteristics of key populations (e.g., frail seniors, children, disabled);
- b) heat vulnerability maps from Toronto Public Health;
- c) locations of flood zones from Toronto and Region Conservation Authority;
- d) locations of previously flooded areas and electrical outages from Toronto Hydro;
- e) location of high-rises which have lost electrical power;
- f) areas of heavy tree damage from Parks, Forestry and Recreation; and
- g) locations of critical infrastructure.

This information, put into map format and analyzed, could provide valuable information to all stakeholders about areas of greatest need, greatest deficiency and/or highest resiliency, helping them to assess current risk, remediate it and improve overall resilience.

It is envisioned that outcomes of the climate change risk assessment results, as they become available, may be depicted in different "layers" on this GIS platform. This approach will facilitate understanding of the locational risk of various critical infrastructure and delivery of essential services as well as vulnerable populations. Further, this approach offers the potential for more advanced understanding of interdependencies and the possibility of cascade or domino style failures, which can be especially problematic.

To further facilitate this effort it is recommended that the Social Development, Finance and Administration Division coordinate preparation of a project proposal and associated resource requirements to implement a pilot project to test the use of GIS in identifying the spatial relationship between factors, such as, climate change risks, infrastructure interdependencies and the location of vulnerable populations.

3.5 Sharing of Toronto Climate Risk Assessment Tool

In August 2010, City Council endorsed the Staff Report, "Climate Change Risk Assessment Process and Tool." In this report the Director of the Toronto Environment Office was given authority to negotiate and execute license agreements for sharing the Climate Change Risk Assessment Process and Tool, at no cost, with interested government Ministries, academic institutions and not-for-profits within the Province of Ontario and with certain other groups identified.

Unfortunately no such agreement has been reached due to the legal barriers associated with the requirement to indemnify the City of Toronto for events arising out of, generally speaking, the Licensee's use or reliance on the Risk Assessment Tool. Over the last several years, two provincial agencies, Municipal Affairs and Housing and Metrolinx have expressed interest in the Tool, but they have found it problematic because they cannot enter into agreements containing an indemnity provision unless they receive permission from the Minister of Finance or in accordance with s.28 of the Financial Administration Act. As a result the Tool has not been shared with any provincial entities. This has been unfortunate because if sharing had occurred, Toronto would have benefited from understanding risks identified in other jurisdictions.

In the interest of co-operation and progress towards enhancement of the Tool, the Director of the Environment & Energy Office requires the authority to provide access to Toronto's Risk Assessment Tool on a significantly less restricted basis to associations and the broader public sector including interested government Ministries, academic institutions and not-for-profits within the Province of Ontario on a "use at your own risk basis", at no financial charge or liability to the City of Toronto. The Director should also be given authority to decide whether an indemnity is required in the particular circumstances.

The Tool was found to be very valuable, especially to Transportation Services in its climate change risk assessment. Now, the Transportation Association of Canada (TAC) has developed some insight into how a changing climate might affect transportation infrastructure and services, but are looking for a standardized approach to determine risks and possible solutions. Making the City of Toronto's Tool available to an organization such as TAC could be the basis for a national risk assessment and management tool for roads departments across Canada. This is unlikely to happen if an indemnification licence is required and if TAC has to pay for the Tool.

The advantage of working with TAC could result in the organization investing in the Tool, as part of their 'Pool Funded Projects', funded through its members, and further develop the Tool for its national members. Through this process the Tool could be made user-friendlier and Toronto, in return, would receive the enhanced Tool for free. Toronto staff would also have more peers working at an advanced level using the same language to identify and manage risks to our roads transportation system.

3.6 Partnering with the Private Sector and Broader Public Sector

Building up the resilience of Toronto is not something that can be done solely by the City and its Divisions, Agencies and Corporations. There are a number of services provided in the private sector and broader public sector that Toronto's residents and businesses are reliant upon and which are vulnerable to a changing climate and extreme weather. While many are recognizing the need and taking action, it is imperative that the City works with these services.

In 2011, the City in collaboration with CivicAction established a forum known as the "*WeatherWise Partnership*" with the goal to bring together large organizations operating critical infrastructure and major businesses in Toronto to reduce risks associated with climate change. A similar approach can be found in cities such as New York, London, Chicago and Barcelona. The WeatherWise Partnership has had success in bringing about collaboration between the major organizations involved in the provision and delivery of electricity to Toronto (i.e. Toronto Hydro, Hydro One, Ontario Power Generation, Ontario Power Authority, and the Ontario Ministry of Energy). Collectively these groups have engaged in initiatives that are evaluating risks to the City's electric systems from a changing climate.

It is recommended that the Executive Environment Team coordinate the City's efforts to partner with the private sector and broader public sector in identifying and taking collective actions to build up the overall climate change resilience of Toronto. These partnerships may be established through one-time discussions, re-engaging the WeatherWise Partnership or an ongoing forum depending upon the interest and direction of these key stakeholders.

The type of organizations that the City will look to further partner with include:

- key service providers, such as energy suppliers (i.e. Enbridge Gas);
- telecommunications suppliers;
- broader public sector groups, such as school boards, universities and colleges and health care services;
- community-based and faith-based organizations
- transportation services for both people and goods;
- organizations and associations representing the owners and operators of large commercial and residential buildings (e.g., BOMA, Financial Sector Business Improvement Area RealPac, Greater Toronto Apartment Association);

- representatives of key economic and business and industrial sectors in the city such as the banking and insurance sectors;
- neighbouring municipalities; and
- Provincial and Federal government organizations.

The experience of other cities, such as Barcelona, where the city has established a Resilience Board that includes 37 public and private infrastructure groups mandated to coordinate efforts, is that the equivalent of at least a full-time staff position is required to manage the external collaborations, including numerous sector-specific working groups supported by Barcelona city staff from different city departments. Therefore it is recommended that a detailed business case be prepared by the Chief Corporate Officer, seeking funding for inclusion in the 2015 budget proposal.

3.7 Monitoring and Reporting

Toronto already undertakes public reporting on matters that directly or indirectly pertain to resilience. There is however no consolidation or specific look at Toronto's resilience to climate change and associated extreme weather. Examples of existing reporting relevant to resilience include:

- Wet Weather Flow Master Plan Updates;
- Basement Flooding Protection Program reporting;
- Urban Forestry report: "Every Tree Counts: A Portrait of Toronto's Urban Forest";
- Greenhouse Gas and Air Quality Inventory;
- Environmental Sustainability Report; and
- Toronto's Heat Vulnerability Index.

Measurement of resilience of cities is an emerging field. Other jurisdictions have begun to explore this important area. There is no generally accepted set of resilience performance indicators established to allow comparability between cities. Resilience measures are not universal in nature because stress and shock factors will be different for every city. Also, the geographic, socioeconomic, built and natural infrastructure assets vary across cities.

The Resilient City Working Group will coordinate the development of performance measures and indicators of resilience in light of current knowledge about forecast changes in extreme weather. This work will be coordinated with Toronto's involvement as one of 15 cities piloting implementation of ISO 37120:2014, an international standard which defines and establishes methodologies for a set of indicators to steer and measure the performance of city services and quality of life.

The development of resilience measures and indicators will support regular reporting, starting in 2016, to City Council on the implementation of the Climate Change Risk Management Policy.

3.8 Research and Analysis

In order to provide responsible decision making in support of resilience to climate change, access to best available information is important when decisions on action or inaction may have serious financial, social and environmental implications.

Decision support information can most often be accessed through open sources. City staff make strong efforts to seek information from peer municipalities locally and globally. In the case of climate change, access to best available information on the probability and magnitude of local extreme weather events and combined extreme events is key and not necessarily available. In 2013 Toronto published its "Climate Drivers Study" prepared by SENES Consultants, which identified for Toronto expected changes in climate for 2040 to 2050.

If improved level of Federal and/or Provincial assistance with local climate information is not forthcoming, the City will need to continue to invest in pursuit of a higher reliability of climate projections for Toronto. Given the billions of dollars that will be spent on infrastructure construction, it would be prudent that the design and standards be informed by enhanced confidence in future weather projections.

In the coming years, staff also anticipate the need for Toronto-specific climate impact studies requiring external expertise in the science and social science fields. Although these studies have not yet been specifically identified, the need is highly probable. Therefore, it is recommended that the Chief Corporate Officer prepare a business case seeking funding not to exceed \$0.250 million annually for the next five years for inclusion in the 2015 budget proposal for climate information and additional impact studies.

3.9 The Insurance Bureau of Canada's Municipal Risk Assessment Tool

In December 2013, City Council requested that staff investigate the Insurance Bureau of Canada's (IBC) pilot of its Municipal Risk Assessment Tool (MRAT) and potential usefulness to Toronto. MRAT is a geographical information system (or electronic map based) tool under development to identify the probability of urban flooding. It uses dozens of information inputs to statistically predict the probability of flooding. It is not a hydraulic model, like what is used by Toronto Water already. One of the features of the MRAT is consideration of how the level of risk will change into the future as climate change and associated extreme weather is anticipated to get worse. MRAT is currently being piloted in three Canadian cities: Fredericton, Hamilton and Coquitlam.

Interviews with staff from these three communities were conducted and with staff from the Insurance Bureau of Canada. The Insurance Bureau of Canada (IBC) has advised that it is currently focussing its Municipal Risk Assessment Tool (MRAT) work with pilot municipalities, and is currently engaged in a process to determine the best way to share and implement the MRAT tool with Canadian municipalities going forward. The IBC is not currently providing any further details, but may be in a position to do so in the future, at which time staff can report back to Council.

While the MRAT tool may, in the future, provide the City with an additional tool to assist it in identifying and managing flood risks, it is important to note that:

- a. Toronto Water already has a variety of flood risk assessment technologies that are in place;
- b. Toronto Water plans to study the entire City as part of the Basement Flood Protection Program;
- c. The Toronto and Region Conservation Authority (TRCA) regularly updates watershed hydrology studies, hydraulic models and digital flood line mapping. TRCA plans to update Floodplain maps for Flood Vulnerable Areas incorporating new technologies (3-D modelling) with updated hydrology, hydraulics and future extreme weather projections. Additionally, TRCA intends to work with City staff to developing integrated riverine/urban drainage models incorporating future extreme weather. The first priority will be to identify study areas for development of these models.
- d. At TRCA, a Flood Protection and Remedial Capital Works Strategy was also completed in 2012, with some of the works occurring in the City of Toronto, in addition to other municipalities in the TRCA boundary area. The Strategy is being updated in conjunction with future flood line mapping updates. The strategy includes an analysis of flood mitigation options (including a cost-benefit analysis) in order to prioritize land areas or structures within the TRCA jurisdiction requiring remedial flood protection works and/or acquisition. The Toronto and Region Conservation Authority (TRCA) also monitors, maintains and operates small dams and flood control channels that help reduce flooding in flood vulnerable areas and provide recreational facilities. Maintenance inspections are completed annually and deficiencies identified are repaired as required (where funds are available). This program entails ongoing maintenance of City of Toronto flood control infrastructure.

The Director of the Environment and Energy Division in collaboration with the Insurance and Risk Management Unit, Legal Services and other relevant City Divisions will continue to monitor the development of MRAT and any other emerging trends and issues in insurance markets and liabilities associated with a changing climate and report to City Council when appropriate.

3.10 Collaboration with the Provincial and Federal Governments

Investing in the resilience of the City's infrastructure and services should be a joint effort of all orders of government.

The City should continue to advocate for the Provincial and Federal governments to:

- a) initiate and support research that helps municipalities identify how their local climate is changing and how it may affect our social, environmental and economic systems, to better inform decision-making;
- b) undertake, where necessary, a review of relevant codes, standards and guidelines utilized by all orders of government;
- c) provide financial support to municipalities that will allow them to design and replace infrastructure that is more resilient to a changing climate; and
- d) identify opportunities where they can influence the delivery of key services (e.g., telecommunications, natural gas supply and means to pay during a power outage) provided by the private sector, to improve their climate resilience.

3.11 Engaging Residents and Businesses in Becoming More Resilient

While this issue of climate change is often thought of in a global context, many climate adaptation actions are organized on a more local scale. Since every resident and business in Toronto is affected by a changing climate, public education and engagement in climate change adaptation is vital in creating a resilient city. In addition to reducing impacts on residents and businesses, greater self-reliance and resilience of residents and businesses may help reduce the burden on government resources.

The City of Toronto currently has resilience-oriented resources and programs residing within its Divisions and Agencies, ranging from issues such as tree canopy enhancement, basement flooding prevention and emergency preparedness to flood prevention. A coordinated outreach strategy could integrate all information to the public and the business community regarding:

- How the climate has changed and will continue to change;
- What impacts have occurred on Toronto, its residents and businesses;
- What the City is doing to increase resilience to climate change; and
- What residents, communities and businesses can do to be more resilient to climate change.

In addition to providing an integrated approach to accessing all information and supports available to residents and businesses, there may be an opportunity to coordinate the City's efforts with citizen and business groups. A growing number of citizen groups, community organizations and business associations have expressed an interest in finding ways to partner with the City in helping inform and support their communities on the actions they can take to increase their resilience to a changing climate.

It is recommended that the Environment and Energy Division and the Office of Emergency Management, in collaboration with Strategic Communications and the relevant City Divisions, Agencies and Corporations coordinate the development of this corporate-wide integrated outreach and engagement approach. Significant financial resources are already allocated as part of specific initiatives and strategies for outreach and engagement by other Divisions such as Toronto Water and Office of Emergency Management. These efforts and messages will continue and the focus of this effort is on coordination.

Additional financial resources are required to fund expenses and external programs associated with the development of this approach that will build upon existing efforts and make it easy for residents and businesses to identify and access the resources, tools and information available to them to increase their personal resilience to a changing climate. The estimated financial costs are \$0.300 million annually for five years. Therefore it is recommended that the Chief Corporate Officer prepare a business case seeking funding not to exceed \$0.300 million annually for the next five years for inclusion in the 2015 budget proposal.

4. Embedded Energy Solutions: Improving Energy Reliability and Reliance (Dec '13 ice storm motion 5. cc.)

In its discussions regarding the ice storm that occurred in December 2013, City Council requested the Director of the Environment & Energy Division in consultation with Toronto Hydro to conduct an evaluation on the viability of embedded energy solutions, including district energy, co-generation, and renewable power, to improve the reliability and security of Toronto's energy systems.

The premise of embedded energy solutions is the identification of opportunities to integrate energy solutions at the source of the demand. In addition, to district energy, co-generation, and renewable power, embedded energy solutions also include demand response and conservation and peak electricity demand reduction.

The City and Toronto Hydro and other local utilities and organizations have been actively pursuing these options for some time. In November 2009, City Council adopted "*The Power to Live Green: Toronto's Sustainable Energy Strategy*", which was prepared collaboratively with Toronto Hydro and endorsed by Enbridge Gas. That strategy established aggressive targets for energy conservation and local generation of renewable energy.

Some of the embedded energy solutions that have been established by Toronto Hydro and the City over the last few years include:

- a) facilitating by Toronto Hydro, the implementation of 700 solar photovoltaic systems totalling an estimated 50 to 60 MegaWatts of electricity;

- b) the Process and Systems Upgrade Initiative of Toronto Hydro, which is currently working to install 63 MegaWatts of combined heat and power with large industries;
- c) implementation by the City of a new district energy system with combined heat and power at Exhibition Place;
- d) potential expansion by Toronto Water and Enwave of the Deep Lake Water Cooling System, which already reduces peak electricity demand by 61 MegaWatts;
- e) the incorporation of improved environmental performance measures for new buildings, including improved energy efficiency in the City's Toronto Green Standard; and
- f) significant energy conservation and demand response programming by Toronto Hydro and by the City through programs, such as the Better Buildings Partnership.

Additional efforts that are being made to improve energy security and reliability include:

- a) development of the Toronto Regional Electricity Plan as part of the Ontario Power Authority's Integrated Regional Resource Plan;
- b) the inclusion of energy supply issues in the Downtown Infrastructure Study; and
- c) the completion and ongoing preparation of Community Energy Plans, which identify opportunities for energy conservation and peak electricity demand reduction, resilience to extreme weather and other high impact events and powering growth through locally planned and implemented solutions.

Examples of ongoing CEP work that could be expanded with additional resources and in partnership with Toronto Hydro and other parties include:

- a) developing minimum guidelines for existing and new buildings for improved resilience not currently addressed in existing policies and codes;
- b) working to develop Official Plan policies that may require developers to submit CEPs for medium and large development, with specific recommendations to implement embedded energy solutions; and
- c) considering the development of operational policies that may:
 - i. require new City facilities to be designed to Tier 2 of the Toronto Green Standard and have improved business continuity and resilience to power outages;
 - ii. encourage proponents buying City land to incorporate embedded energy solutions; and
 - iii. look for opportunities to leverage City facilities and land to support the development of embedded energy solutions.

Embedded energy solutions can help improve the climate change resilience of Toronto by reducing reliance on external energy sources. Toronto Hydro and the City are actively engaged in working to establish these types of solutions. To further these efforts it is recommended that City Council endorse the Letter of Understanding between the City and Toronto Hydro, as presented in Appendix C, for continued collaborative work in this area.

5. Demand Response and Backup Energy Systems

The Environment & Energy Division is currently leading implementation of the Province of Ontario's Demand Response Program. This Program pays companies and organizations willing to commit to undertaking actions that relieve pressure on the electricity distribution system during times of high demand. These companies commit to reducing peak demand by turning off non-essential loads (curtailment) and/or by generating electricity on-site through the use of back-up power generators.

Currently, 18 City-owned buildings are enrolled in this Program, providing the City with a source of revenue. Where generators are installed to provide electricity during times of peak demand, the City benefits by also establishing reliable backup power that is available in the event of power disruptions. Therefore, it is recommended that the Chief Corporate Officer develop the business case for financing the installation or replacement of back-up power generators at key City buildings operated by Facilities Management.

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ATTACHMENTS

Appendix A: City of Toronto Climate Change Risk Management Policy
Appendix B: Proposed Short-Term Adaptation Actions
Appendix C: Draft Letter of Understanding: City of Toronto and Toronto Hydro
regarding Collaborative Energy Planning

APPENDIX A: City of Toronto Climate Change Risk Management Policy

Date & Version Number: July 8, 2014 Version 1.0

Background

Toronto's climate has changed and will continue to change into the foreseeable future. Recent studies anticipate more variable weather including drought, extreme rain and wind storms and heat, which will have impacts on our residents, businesses, built infrastructure, services, food supplies and natural environment. The future of Toronto and its quality of life may be influenced by how resilient the City, its residents and businesses are to the direct and indirect effects of a changing climate. Vulnerable populations may be disproportionately impacted by extreme weather events and as such climate change risk management actions help support equity.

The City cannot prevent all disruptions due to a changing climate and extreme weather but by applying a systematic approach to identifying risks and setting priorities it can work to minimize disruptions and destructive forces and be more resilient.

Purpose

This policy establishes a process to systematically prioritize the identification, assessment, reduction, monitoring and reporting on the risks to the City of Toronto's infrastructure, finances, operations and liability due to a changing climate, including increased incidence of extreme weather events.

Scope and Application

This policy applies to all City of Toronto staff and management, as well as any contractors or consultants that are employed on behalf of the City.

It is effective as of the date indicated at the top of this document and remains so until a newer version is issued or the policy is cancelled.

Policy Statement

The City will:

1. Continue to monitor and research how the climate is changing and when new information relevant to the City of Toronto becomes available, provide this to City Council, the City Manager, the Deputy City Managers and all Division Heads;
2. Mitigate risk to the City's assets and services by integrating identified risk information into decision making and utilizing this information to inform priorities for investment;
3. Establish methods to evaluate initiatives undertaken by the City through the lens of climate change resilience;
4. Continue to reduce and manage risks to its employees and contractors resulting from a changing climate;

5. Build awareness and establish meaningful partnerships with the community, residents, the private sector and the broader public sector; and
6. Share knowledge and information with external organizations to promote engagement in enhancing extreme weather resilience on a broader scale.

Roles and Responsibilities

Position	Roles & Responsibilities
City Manager & Deputy City Managers	Resilient City Lead responsible for corporate-wide implementation.
Division Heads	Accountable for the climate change resilience of their operations.
Environment & Energy Division	To guide implementation of this Policy by supporting the EET and by coordinating and leading the Resilient City Working Group. To coordinate monitoring and reporting of progress of implementation. To provide corporate level municipal best practices in climate change risk management and to lead necessary research.
Executive Environment Team (EET)	To lead implementation of this Policy, cross corporate coordination, research and analysis, as well as coordination of mechanisms to partner with the private sector and broader private sector.
Resilient City Working Group	To provide expert knowledge and technical support and facilitate implementation of resilience actions within their respective operations.

Document Approval

This policy was adopted by City Council on July 8, 2014.

Policy Review Cycle

This policy will be reviewed as a minimum every year by the EET.

Definitions

- City, City of Toronto – the municipal corporation that provides public services across all municipal wards that comprise the geographic region of Toronto.
- Risk – the total concept of the likelihood of occurrence of a risk event and the severity of possible consequences.
- Resilience – the ability of a system, entity, community or person to withstand shocks while still maintaining its essential functions and to recover quickly and effectively".
- Extreme weather – when a weather event is significantly different from the average or usual weather pattern.

APPENDIX B: Proposed Short-Term Adaptation Actions

The following proposed short-term adaptation actions have been identified by the City Divisions, Agencies and Corporations currently involved in the Resilient City Working Group for potential inclusion in the their 2015 work plan and where necessary operating and capital budget proposals. This identification process was informed by the high-level weather vulnerability screening process conducted in mid-2013.

#	City Agency, Division or Corporation	Identified Proposed Adaptation Actions, Policies and Procedures	Rationale
1	City Planning	In 2015, City Planning will evaluate the impact of future weather (<i>Toronto's Future Weather & Climate Drivers Study</i>) on future built form including: buildings, infrastructure and landscapes, considering the areas we regulate and apply conditions of approval. A consulting study will be undertaken using a policy assessment methodology to complete the evaluation of some of City Planning's key policies, implementation tools and documents under a climate change/resiliency lens. The study will produce a set of priority actions that could be taken, that are most effectively implemented and addressed by City Planning.	City Planning prepares and stewards the City of Toronto Official Plan, a City Council adopted policy that manages growth and change. . In order to better manage development in ways that contribute to a well-functioning City, City Planning in concert with other divisions coordinates the consistent application of design standards and requirements from partner divisions through the development review and approvals process. The content of City Planning policy documents needs a more detailed assessment to determine their adequacy in the face of climate change and more severe weather.
2	Engineering and Construction Services	Support the development and delivery of assets that are resilient.	As a delivery agent for the City's water, road, and solid waste infrastructure, proposed adaption actions are included in these division's comments.
3	Facilities Management	a) Include evaluation of risk of basement flooding in Building condition Assessments (BCAs). b) Upgrade sewer backflow prevention valves to prevent contamination in case of overwhelming rain. A capital program to upgrade water supply backflow prevention valves.	a) There is a policy to conduct BCAs on 20% of buildings annually. This does not include consideration of future extreme weather. b) Prevents backflow, the undesired reversal of water flow against normal direction, which can cause contaminants to enter into the drinking water supply system.
4	Office of Emergency Management (OEM)	a) Continuous improvement to response structures, associated plans and linkages to Toronto Hydro in response to extreme weather events.	a) As identified in The Emergency Operations Centre After Action Report (July 8 th Flood).

#	City Agency, Division or Corporation	Identified Proposed Adaptation Actions, Policies and Procedures	Rationale
		<p>b) Continue to influence the public to be proactive (i.e. 72 hr kit and supplies) rather than reactive.</p> <p>c) Develop key preparedness messages for target populations (e.g., high-rise dwellers, small business, etc.).</p> <p>d) Conduct a risk assessment using the City of Toronto Climate Change Risk Assessment Tool.</p> <p>e) Work with Emergency Management Ontario to include extreme weather and cascading effects in their Provincial methodology.</p> <p>f) Obtain best available information on the probability and magnitude of extreme weather events to use in the HIRA.</p>	<p>b) Included in the Emergency Risk Communicators Network – EMCoN mandate.</p> <p>c) Operational Support Function – Emergency Human Services which includes the Vulnerable Populations Protocol. (Vulnerable Populations Working Group)</p> <p>d) Identify and document the risks associated with extreme weather events.</p> <p>e) Coordinate efforts with the Province to ensure a standardized approach to managing the risks associated to extreme weather events as a consequence of climate change.</p> <p>f) Hazard Identification and Risk Assessment (HIRA), which describes the natural, technological and human-caused events which can potentially impact the people, economy, environment, and infrastructure within the City of Toronto.</p>
5	Parks, Forestry and Recreation (PF&R)	<p>a) More communication with the public to care for city and privately owned trees.</p> <p>b) Conduct Analysis of Assets prone to flooding and vulnerable to damage, keeping in mind emergency shelter status of centre.</p> <p>c) Develop a sump pump list and maintenance program that includes backup power.</p> <p>d) In areas of known flooding vulnerability, new construction should be designed to be flood</p>	<p>a) "Sustaining & Expanding the Urban Forest: Toronto's Strategic Forest Management Plan" approved by Council in 2013, includes the objective of increasing tree canopy cover within the city from the current estimate of 26.6 - 28 % to 40 %. This can only be achieved by protecting the city's existing forest resource and successful establishment of numerous trees on an annual basis.</p> <p>b, c, d, e) In case of power failure, sump pumps do not operate leading to flooding of buildings. Some, but not all sump pumps have a second redundant backup pump running on regular electrical power in case the first pump breaks down.</p> <p>The consequences range from property damage (e.g., mold, mildew, electrical damage) and unavailability of buildings as emergency shelters to loss of use by</p>

#	City Agency, Division or Corporation	Identified Proposed Adaptation Actions, Policies and Procedures	Rationale
		<p>resistant and redundancy in building systems incorporated to prevent flooding.</p> <p>e) Investigate whether PV panels feeding to the grid could be diverted during power outages for use by the facility.</p> <p>f) Increase the current tree maintenance program.</p> <p>g) Refine tree watering programs</p> <p>h) Develop a preventative maintenance program for roofs.</p>	<p>public and revenue.</p> <p>f) Proactive maintenance reduces the risk associated with tree/limb failure and improves tree health.</p> <p>g) To respond to prolonged periods of drought that are anticipated in future.</p> <p>h) Capital Projects conduct condition audits of faculties on a 5-yr cycle and develop a remedial plan for roofing systems, within the State of Good Repair (SoGR) program.</p> <p>There currently is a SoGR backlog. Buildings envelop is considered a high priority for emergency repairs.</p>
6	Purchasing and Materials Management	<p>a) Upon expiry of warehouse lease where pandemic supplies are controlled, PMMD will, based on warehouse rationalization plan, determine optimal solution for pandemic supplies storage. Should pandemic supplies be relocated to suitable City owned warehouse(s), the measures to protect pandemic supplies and possibly warehouse(s), may have some financial implications for Facilities as they own all City warehouses that PMMD manages pandemic goods within on behalf of the Toronto Public Health Division</p>	<p>a) A current pandemic supplies storage solution is in place.</p> <p>Plans for future pandemic supplies storage is continually reviewed through general warehouse rationalization and efficiency reviews along with the direction from Pandemic Influenza Planning & Preparedness meetings.</p> <p>Key stakeholders are aware and support both the current pandemic supplies storage solution as well as the future pandemic supplies storage solution(s).</p> <p>Ongoing measures for future pandemic supplies storage include sourcing of a backup generator for one of the pandemic storage location(s), anticipated to be completed through the current relocation project ongoing through 2014.</p>

#	City Agency, Division or Corporation	Identified Proposed Adaptation Actions, Policies and Procedures	Rationale
7	Shelter Support and Housing Administration (SSHA)	<p>a) Engage in discussions with the Medical Officer Of Health to review the current temperature threshold and procedures for calling extreme cold weather alerts. Identify any required changes that would enhance responsiveness to vulnerable populations and improve services</p> <p>b) Assessment on backup power/building condition and cost associated with equipping/maintaining shelters.</p> <p>c) Development of a 10 year shelter asset management plan, in keeping with the Division's Planning framework, to address a number of issues with current shelter facilities including availability of backup power and resilience against extreme rain conditions.</p> <p>d) Reinstating a system of flex beds within the shelter system which allows for shelters experiencing complications from extreme weather to relocate residents to other locations. The shelter system has had this flexibility in the past and it is vital to re establish it for potential future events.</p> <p>e) Review staffing and operational costs under such conditions.</p>	<p>a) Potential changes would improve responsiveness of the Division to the unique needs of marginalized and homeless individuals during extreme weather situations.</p> <p>b) This assessment would allow for potential improvement in service responses during extreme weather emergencies, including increasing the capacity of locations to shelter in place, reducing the need for evacuations.</p> <p>d) The ability to access and staff additional flex space within the shelter system would greatly improve service responses and reduce demand on other services such as reception/warming centres</p>
8	Social Development, Finance & Administration	<p>a) Create a GIS tool that would consolidate data from City divisions such as the Office of Emergency Management, Transportation, Planning, Shelters (and others), Toronto Hydro, Hydro One, telecoms providers, TCHC, TDSB/TCDSB and community agencies to provide a more coherent map of which parts of the city contain critical infrastructure, vulnerable residents and available services.</p> <p>b) Determine the feasibility of</p>	<p>a) The data combined by the tool would increase response times during an emergency, cover more vulnerable persons and give responders a better picture of what is happening in various parts of the city.</p> <p>b) This will allow the City to identify</p>

#	City Agency, Division or Corporation	Identified Proposed Adaptation Actions, Policies and Procedures	Rationale
		<p>pooling lists or developing a new voluntary list of vulnerable persons (electrically-dependent, unable to move, cognitively disabled, etc.) in Toronto.</p> <p>c) Investigate the implementation of policies or requirements to improve the safety for residents of multi-residential buildings who remain in the building after the occurrence of a power outage related to an extreme weather event. Potential responses may include ensuring resident access to water via faucet in an accessible building common area.</p>	<p>those residents that will be at greater risk during emergencies and incorporate this information into building Toronto's resilience.</p> <p>c) The Social Development Finance and Administration –Tower Renewal Office – prepares and implements policies and programs to support the improvement of apartment buildings and communities in terms of social, economic and environmental performance. Developing responses to the impacts of climate change and extreme weather aligns with the Tower Renewal Office's objectives.</p>
9	Toronto and Region Conservation Authority (TRCA)	<p>a) Continue to work with the Toronto Office of Emergency Management in support to its emergency planning relating to flooding.</p> <p>b) Maintenance and repairs of City's flood control infrastructure.</p> <p>c) Maintenance and repair of erosion control structures to preserve structural integrity and public safety.</p> <p>d) Develop integrated riverine/urban drainage models incorporating future extreme weather. First priority will be to identify study areas for development of these models.</p> <p>e) Update Floodplain maps for Flood Vulnerable Areas incorporating new technologies (3-D modelling) with updates hydrology, hydraulics and future extreme weather projections. Location of critical infrastructure and vulnerable</p>	<p>a)TRCA provides critical and timely hydrometric information to support municipal response plans for flood events to achieve the goal of reducing the risks to loss of life and property damage caused by flooding.</p> <p>b) Key to help manage the impact on flood control infrastructure.</p> <p>c) Severe damage from July 2013 Storm is being addressed through enhanced funding from the City. Sites include Eerosion hazard sites where the original protection has completely failed, placing municipal infrastructure at risk, valley system, shoreline and private property.</p> <p>d) This will provide decision makers, system planners, and field responders with more granular, timely information on impacts and extent, and help address urban flooding issues. This work is contingent upon discussions with City staff (e.g., Toronto Water, OEM) and available funding.</p> <p>e) This will help determine high risk assets susceptible to riverine flooding. There is a fixed level of funding for routine floodplain map revisions and updates, and larger exercises require special budget asks.</p>

#	City Agency, Division or Corporation	Identified Proposed Adaptation Actions, Policies and Procedures	Rationale
		<p>populations will be taken into account.</p> <p>f) The Greenlands Acquisition Plan estimates 1,000 hectares acquired by 2015, should funding of a projected \$27.5 million be available.</p> <p>g) Complete a Natural Heritage risk assessment of Toronto's natural system to develop priority adaptation strategies</p> <p>h) Current gauging network is suitable for flood forecasting. However, additional flow gauging instrumentation could help comprehensively track the impacts of extreme weather on flows in valleys and ravines.</p> <p>i) Working in partnership with the WeatherWise Partnership Electrical Sector Core Project Team (facilitated by the Environment & Energy Division) TRCA initiated a risk and opportunity assessment project for the electrical transmission systems. This project is aligned well with Toronto Hydro's distribution system risk assessment. Cherrywood Transmission System is being considered for the pilot study. This system has a more significant impact on Toronto's electricity users, including many vulnerable populations in downtown and central Toronto.</p>	<p>f) Priority acquisitions include areas where erosion in ravines and along shorelines is threatening adjacent homes or businesses.</p> <p>g) It is important to increase the resiliency of natural systems to climate change regardless of the types of change that are experienced in the future.</p> <p>h) The data collected by hydrometric networks is crucial to coordinate contingency plans, issue flood warnings, operate flood control structures and provide technical assistance to the City with respect to flood control.</p> <p>i) Electricity supply can impact critical infrastructure and services, supporting public health and safety and economic activity. This dependency makes a strong case for improving our understanding of vulnerability of the electrical system to severe weather events and the potential influence of climate change.</p>
10	Toronto Hydro	<p>a) Conduct further studies to identify system needs investment to make it more resilient to extreme weather - results will drive investment portfolios to enhance system resiliency.</p> <p>b) A Climate Change Risk Assessment following Engineers Canada's PIEVC protocol will be conducted in 2014, thanks to NRCan funding. The protocol will be used to evaluate key pieces of equipment under future climate scenarios. The</p>	<p>a, b) There is an ongoing concern over the fact that only two major electrical transmission lines from Hydro One service the City of Toronto. This introduces a fundamental vulnerability in the event that both supply lines were to become inoperable. Most large modern cities have more transmission redundancy.</p> <p>Aging underground transformers are more susceptible to failure in the event of continued flooding.</p>

#	City Agency, Division or Corporation	Identified Proposed Adaptation Actions, Policies and Procedures	Rationale
		duration and geographic extent of worst case plausible outages will be assessed.	
11	Toronto Public Health (TPH)	<p>a) Toronto Public Health needs to conduct a more detailed assessment of the health and social impacts of climate change in Toronto (as recommended at the November 4, 2013 Board of Health meeting, HL25.4). This assessment would provide further details about the adequacy of existing procedures, policies and standards, recommend additional adaptation actions as needed and identify where additional resources are needed beyond existing budget.</p> <p>b) Explore new funding to support climate change activities, including</p> <ul style="list-style-type: none"> - Research and policy development to support proactive health risk prevention measures. - Co-ordination and dissemination of climate-related information and needs within TPH. - Public communications/health promotion to support resilient communities. - Partnership development and co-ordination with external partners including other City division, other levels of government, NGOs, professional associations, and the private sector. <p>c) Co-ordinate development of a Cold Weather Plan that considers the range of health impacts associated with cold weather</p>	<p>b) Currently, climate change is one priority among many for staff at Toronto Public Health. Having a dedicated staff role to support climate change adaptation at Toronto Public Health will ensure that TPH effectively supports resilience in communities and is prepared to respond to extreme weather events as they occur.</p> <p>c) Emerging research suggests that health impacts of cold weather affect not only homeless populations but also the general population and in particular those with pre-existing heat conditions. A warming climate may mean that Toronto becomes less acclimatized to cold weather, while more variable and extreme weather events means that extreme cold remains a health risk</p>
12	Toronto Transit Commission (TTC)	a) Study the installation of emergency generators for bus garages	<p>a) During localized power outages, these generators will be moved into position at impacted garages and connected to the bus fueling equipment.</p> <p>b) A study of each existing TTC facility</p>

#	City Agency, Division or Corporation	Identified Proposed Adaptation Actions, Policies and Procedures	Rationale
		<p>b) Study overland flooding at three subway stations (York Mills, Kipling and Union).</p> <p>c) Assessment and installation of emergency back-up power for the drainage pumps.</p> <p>d) Conduct inspections of Fir Valley Culvert, Massey Creek Box Culvert, Massey Creek Pipe Culvert, Dorset Twin Pipe Culvert and East Don River Bridge.</p>	<p>would be required to quantify the risks of overland flooding.</p> <p>c) Existing resource levels are budgeted based on the planned and scheduled preventative maintenance programs and not the resources required to respond to/restore service after an extreme weather event.</p> <p>Prior to investment in permanent emergency back-up power, further industry consultation is required to determine the anticipated future reliability of the Province/City's electrical grid during extreme weather events.</p> <p>d) Development of procedures and resource allocation is required to increase the frequency of culvert inspection so that further deterioration and deficiencies can be detected before they present a hazard to rail operations.</p>
13	Toronto Water	<p>Thirty-three out of 34 of the City's Basement Flooding Protection Program's (BFPP) current environmental assessment (EA) studies are to be completed by the end of 2014, and the remaining Study Area 34 is planned for completion by the end of 2015.</p> <p>The BFPP has been expanded to now include the entire city. Seven new EAs are to be initiated in 2015. Other studies will be prioritized based on the density of basement flooding complaints per sanitary sewer subwatershed for major storm events since 2000. The 10-year Capital Budget and Plan includes \$962M for the construction of BFPP over ten years.</p>	<p>In 2006, Council approved a work plan to address basement flooding in 31 priority areas. The work plan was subsequently increased to 34 areas.</p> <p>City Council, at its meeting on October 8-11, 2013, requested the General Manager, Toronto Water, to report back during the 2014 budget process on the capital and operating budget impacts of expanding the Basement Flooding Protection Program on a city-wide basis beyond the existing 34 priority study areas, including methodologies for setting priorities and resource implications, so that the program continues to address urban flooding risks in a fair, well-organized, and efficient manner.</p>
14	Transportation Services	<p>a) Mitigate the Risk of Flooding</p>	<p>a) The increasing severity and frequency of extreme weather requires the modification/expansion of existing programs and development of new projects and programs that can mitigate infrastructure damage and increase the</p>

#	City Agency, Division or Corporation	Identified Proposed Adaptation Actions, Policies and Procedures	Rationale
		<p>b) Develop and implement flood-related road closure notification</p>	<p>operational effectiveness and safety of critical transportation infrastructure when flooding occurs. There are number of mitigating and adaptive measures that should be considered that can manage the risk of flooding due to extreme weather:</p> <ul style="list-style-type: none"> i. Explore opportunities to undertake a municipal Environmental Assessment that identify various mitigating measures as well as undertake a cost/benefit analysis that would evaluate flooding in high priority transportation areas adjacent to the Lower Don River (i.e. Don Valley Parkway and lower Bayview Avenue), Lake Shore Boulevard, and other various locations; ii. Establish a comprehensive cross-ABCD's response to flooding; iii. Implement permeable and porous surfaces in the right-of-way; iv. Develop a communication and management plan for dredging and/or removing debris from waterways; obtain clarification on what approvals are required to remove debris and clean out the channels and provide an information session to all affected stakeholders and document the process. Often recommendations to clean out the channel do not get done due to the many time consuming approvals and consultation required from the following approval agencies E&CS, P&E, TRCA, MNR and Department of Fisheries and Ocean; and v. Bio-retention and Low Impact Development within the right-of-way; vi. Further studies are required to evaluate the hydraulic flows of waterways before and after implementation/modifications to the design of culverts (i.e. might improve one culvert, but create problems downstream) and the impact of upstream development. <p>b) Assess the flood prone areas of the transportation network and implement</p>

#	City Agency, Division or Corporation	Identified Proposed Adaptation Actions, Policies and Procedures	Rationale
		<p>c) Implement an Environmental and Climate Change Risk Management System</p> <p>d) Develop a Culvert Management System</p> <p>e) Conduct a engineering vulnerability assessments on performance of cameras and traffic signal controller cabinets</p> <p>f) Emergency back-up power supply</p>	<p>flood-related road closure notification including but not limited to the following: installation of traffic control warning signs, road closure devices, cameras, emergency detour routes (EDRs) and water pump systems.</p> <p>c) Implement an Environmental and Climate Change Risk Management System that focuses on building an integrated environmental and climate risk management program; Undertake a prioritization of adaptation actions for the division to mitigate the impacts of climate change for each of the business units and develop a short and long term action plan; Understanding interdependencies between the public and private sectors, such as energy, communication, insurance and financial sectors, which will be critical when assessing climate change risk and identifying adaptation action; Engagement and collaboration with these sectors will reduce the risk of economic disruption to the community and enable opportunities for well adaptive infrastructure systems to be realized.</p> <p>d) Develop a Culvert Management System that includes an inventory, training, develop an inspection program (evaluates channels are cleared of debris, culvert not collapsing, condition and strength of the earth around culvert), maintenance, communication and documentation programs that consider extreme weather events.</p> <p>e) Conduct more in depth cost/ benefit analysis and engineering vulnerability assessments on performance of cameras and traffic signal controller cabinets.</p> <p>f) Ensure emergency back-up power supply for Fire Halls; Emergency and Railroad signals; Install uninterrupted power supply for critical intersections located on emergency routes.</p>



APPENDIX C: Draft Letter of Understanding for Collaborative Energy Planning

June 9, 2014

Draft Letter of Understanding

between:

City of Toronto Environment & Energy Division (EED)

and

Toronto Hydro-Electric System Limited (THESL)
(Hereinafter referred to as the "Parties")

Re. Collaborative Energy Planning

The Parties recognize the value in energy planning collaboration and accelerating the implementation of embedded energy solutions in the city and commit to working together to increase energy efficiency in all market sectors, reduce electricity consumption and demand, improve reliability and security of supply, and as an integral component of Toronto's resilience to a changing climate and extreme weather.

The following actions will be undertaken by the Parties and are subject to THESL's legal and regulatory compliance requirements, including those set by the Ontario Energy Board, and available funding:

The Parties agree to collaborate on:

1. Reducing electricity consumption and demand in all market sectors by leveraging the next generation conservation programs for the period of 2015 to 2020, as per Minister of Energy directive and Ontario's new Long Term Energy Plan
2. Community Energy Planning as an area-focused approach to identify opportunities and implement embedded energy solutions.
3. Enabling the implementation of embedded energy solutions, supported by favourable business cases, including;

- a) projects to improve business continuity of key City operations during power outages; and
 - b) projects for improved resilience to high impact events.
4. Working with stakeholders on the new Independent Electricity System Operator (IESO) Demand Response program scheduled to commence in January 2015.
 5. Reporting progress of the items above in Environment and Energy Division Annual Report, and through other means as appropriate.

Signatures

City of Toronto

Josie Scioli
Chief Corporate Officer

Toronto Hydro

Chris Tyrrell
EVP and Chief Customer Care and Conservation Officer

References

1. City of Toronto and THES letter of input to the IESO/OPA's Regional Energy Planning consultation
2. City of Toronto letter of input to the Long Term Energy Plan consultation by Ministry of Energy
3. City of Toronto input letter to Conservation First consultation by Ministry of Energy
4. City of Toronto EED presentation entitled "Energy Crunch in the City"