



STAFF REPORT ACTION REQUIRED

Resilient City: Preparing for Extreme Weather Events

Date:	November 22, 2013
To:	Parks and Environment Committee
From:	Chief Corporate Officer
Wards:	All Wards
Reference Number:	P:\2013\Internal Services\E&E\Pe13006e&e (AFS 17444)

SUMMARY

The purpose of this report is to provide City Council with an update on the actions being taken to assess:

1. the adequacy of the City's infrastructure and services to accommodate future extreme weather events as predicted in "*Toronto's Future Weather and Climate Drivers Study*";
2. planned activities to enhance the City's assets and services to withstand future weather conditions; and
3. what more may need to be done to ensure the safety and security of assets and services under future extreme weather conditions.

This report also provides a status update about implementation of the City's 2008 Climate Change Adaptation Strategy and the development of the City's Climate Change Adaptation Toolkit.

In 2011, the City of Toronto completed a study to help predict future climate conditions. Key predictions from the "*Toronto's Future Weather and Climate Drivers Study*" were that Toronto might experience increasing average annual and maximum temperatures,

more heat waves, and less frequent but much more intense rain events. The storm of July 8, 2013, during which severe thunderstorms and heavy rains flooded many parts of the City caused damage to public and private property and infrastructure, stranded thousands of commuters, and left tens of thousands of residents and businesses without electricity, emphasized the reality of the study's prediction.

The Chief Corporate Officer has coordinated the development of this report with the engagement of 14 City Divisions, Agencies and Corporations and Metrolinx and with support from Legal Services, Corporate Finance and Accounting Services. Work completed to date, has identified that while City operations have in place numerous initiatives, policies and services that support extreme weather adaptation, there is a need for additional work to evaluate a number of corporate wide issues and, in particular issues associated with the interdependencies of critical City infrastructure and services.

RECOMMENDATIONS

The Chief Corporate Officer recommends that City Council direct:

1. The Chief Corporate Officer, continue to coordinate the work of City Divisions, Agencies and Corporations, to refine the effort of the Resilient City Working Group and prepare by the second quarter of 2014, a strategy that sees the City define the key interdependencies between the City's infrastructure and services and can be used to set priorities and actions to be taken to enhance the resilience of the interdependent infrastructure and services to extreme weather.

Financial Impact

There are no immediate and direct financial implications arising from this report. The Deputy City Manager and Chief Financial Officer has reviewed this report and agrees with the financial impact information.

DECISION HISTORY

In July 2008, City Council adopted the recommendations of the Climate Change Adaptation Strategy, Ahead of the Storm, which laid the foundation for City operations to begin to identify adaptation actions that would minimize the negative effects of extreme weather on City infrastructure and services. The Council decision is at:

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

The 2008 Climate Adaption Strategy, Ahead of the Storm is at:

<http://www.toronto.ca/legdocs/mmis/2008/ex/bgrd/backgroundfile-13842.pdf>

In August 2010, City Council adopted a report outlining a Climate Change Risk Assessment Tool, which was developed to provide a systematic method for the identification and evaluation of potential risks associated with an increase in extreme weather events. The Council decision is at:

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

In February 2013, City Council received a staff report entitled, *Toronto's Future Climate: Study Outcomes* (item #PE18.2). That report outlined the expected changes that may occur in Toronto's climate with a focus on identifying changes in extreme weather events that may have an effect on the City's infrastructure and services. In response, City Council directed that:

1. A working group of staff from City Divisions, Agencies and Corporations and Metrolinx be established to review the effects on the City and its residents of an increasingly wet and volatile climate with a focus on evaluating the adequacy of the City's infrastructure and services and report back on necessary actions to address the impact of potential changes and financial implications of climate change; and
2. Various City operations and Metrolinx report back as to what they have identified as key adaptation actions in their plans relating to core services and what their capital plans will be moving forward.

In addition, the Parks and Environment Committee, when it considered the same report in January 2013, requested a status report on the Climate Change Adaptation Toolkit and 2008 Climate Change Adaptation Strategy.

The Council decision is at:

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

A summary of the study "*Toronto's Future Weather and Climate Drivers Study*" is at:

<http://www.toronto.ca/legdocs/mmis/2013/pe/bgrd/backgroundfile-55150.pdf>

ISSUE BACKGROUND

Tracking and monitoring of record weather events as identified by Environment Canada between 2000 and 2012, suggest that Toronto is and will continue to experience a change in extreme weather events. In less than 12 years Toronto has experienced three one in 100 year storms (July 2000; August 2005; and July 2012). Table 1 highlights the increasing occurrence of record weather events between 2000 and 2012.¹

Table 1: Record Weather Events in Toronto by Year for 2000 to 2012	
Year	Record Events
2000	Wettest summer in 53 years, with 13% more precipitation than normal
2001	Driest growing season in 34 years; first ever heat alert; 14 nights with temperature above 20 C (normal is 5 nights)
2002	Driest August at Pearson Airport since 1937; warmest summer in 63 years; 5 th coldest spring
2003	Rare mid-Spring ice storm where Pearson Airport used a month's supply of glycol de-icer in 24 hours
2004	Year without a summer; May rainfall in Hamilton set an all-time record; all-time record 409 mm of rainfall was set at Trent University in July which was the equivalent to 14 billion litres of water in 5 hours (a one in 200 year event)
2005	Warmest January 17 th since 1840; January 22 nd blizzard with whiteouts; warmest June ever; number of Toronto days greater than 30°C was 41 (normal 14); August 19 th rainstorm washed out part of Finch Avenue
2006	23 tornadoes across Ontario (normal is 14); record year for major storms; record one-day power demand of 27,005 MegaWatts due to summer heat
2007	Protracted January thaw; 2 nd least snow cover ever in Toronto (half the normal amount); snowiest Valentine's Day ever; chunks of ice fell from the CN Tower; 2-3 times the number of hot days in the summer; record latest-in-season string of +30°C days around Thanksgiving
2008	Toronto's 3 rd snowiest winter ever; record for highest summer rainfall
2009	3 rd rainiest February in 70 years; Hamilton had a 100-year storm; one of the wettest summers on record; tornadoes hit Vaughan-Woodbridge area in late August; an unusually mild and storm-free November in Toronto; first snow-free November at Pearson Airport since 1937
2010	No records
2011	A new all time July record maximum temperature of 37.9°C was set at Pearson airport (previous July record was 37.6°C in 1988)
2012	Toronto's earliest ever official heat wave (June 19-21)

¹ Source: Environment Canada as referenced in the *Toronto's Future Weather and Climate Drivers Study*.

Recognizing that extreme weather patterns are changing, in 2011, the City commissioned a study to examine projected climate conditions that Toronto could experience in the period 2040-2049. The purpose of the study, entitled "*Toronto's Future Weather and Climate Drivers Study*" was to forecast probable changes in extreme weather conditions to guide the City in making investment and budgetary decisions regarding infrastructure and service provision responsibilities.

The study predicts that Toronto could expect to experience higher average annual and maximum temperatures, more heat waves, and less frequent but much more intense rain events. Table 2 presents a summary of the key study findings.

Table 2: Expected Extreme Weather for Toronto by 2049			
Weather Extreme	Parameter	Short-term (2000-2009)	Long-term (2040-2049)
Extreme Rain	Maximum Amount in One Day	66 mm	166 mm
	Number of Days with More Than 25 mm	19 days	9 days*
	Mean Annual Daily Maximum	48 mm	86 mm
Extreme Heat	Extreme Maximum Daily	37°C	44°C
	Number of Days with Temperature Greater than 30°C	20 days	66 days
	Number of Heat Waves (3 or more consecutive days with temperatures greater than 32°C)	0.57 (3-day events)	2.53 (3-day events)

*Modelling results show the **number of extreme rainfall events decreasing** (i.e., number of days with more than 25 mm decreasing from 19 to 9) but the **volume of total rainfall within an extreme rainfall event increasing** and therefore of potentially greater concern.

Future climate conditions are already being realized. Toronto's most damaging storm since Hurricane Hazel occurred on July 8, 2013. Very high rainfalls within a relatively short period of time resulted in flooding of rivers, creeks, ravines, and low lying areas.

The July 8 storm resulted in significant costs to City Divisions, Agencies and Corporations and the Toronto and Region Conservation Authority (TRCA). At its peak 300,000 customer were without power. The City Manager's report entitled, "*Follow-up on the July 8, 2013 Storm Event*" presented to the November 13 to 14, 2013 City Council meeting (item #EX35.1), estimated City of Toronto and TRCA storm related expenditures and revenue loss at just over \$70 million². In addition, damage from the July 8th storm generated almost 5,784 insurance claims against the City. The Staff Report is at: <http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2013.EX35.1>.

The Insurance Bureau of Canada has reported that \$850 million in insurance claims across the GTA have been received making the July 8th storm the third most costly weather related event in Canadian history. The most costly severe rainstorm event was the Calgary flood, which happened earlier in 2013. The Canadian insurance industry has seen insured losses as a result of extreme weather events at above or near \$1 billion nationally in each of the past five years with 2013 breaking all previous records.

The financial and economic costs of extreme weather are significant but so are the social and health effects. Associated with this report is a Board of Health report that provides an overview of potential health impacts associated with extreme weather and identified in the published research including: more illness and death from extreme heat, poor air quality, and vector-borne disease; more injury and illness arising from flooding of homes and businesses; and impacts on mental health. The Board of Health report also finds that increases in extreme weather 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. The report was presented at the November 4, 2013 meeting of the Board of Health (item #HL25.4)³ and is included in the agenda as an information item for the December 6, 2013, Parks and Environment Committee.

² Additional staff reports prepared for City Council about the July 8th storm are:

"*Impact from the July 8, 2013 Storm Event on the City of Toronto*" (item #EX34.4) prepared by the City Manager (the Council decision is at: <http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2013.EX34.4>); and

"*Impact of the July 8, 2013 Storm on the City's Storm and Stormwater Systems*" (item #PW25.7) prepared by the General Manager of Toronto Water (the Council decision is at: <http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2013.PW25.7>)

³ <http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2013.HL25.4>)

COMMENTS

The Chief Corporate Officer was tasked with coordinating the City's response to the directives of City Council, adopted at its meeting in February 2013 (item #PE18.2). A Resilient City Working Group (RCWG) was formed comprising of staff from the following 14 City Divisions, Agencies and Corporations:

1. City Planning
2. Engineering and Construction Services
3. Facilities Management
4. Office of Emergency Management (OEM)
5. Parks, Forestry and Recreation (PFR)
6. Purchasing and Materials Management
7. Shelter Support and Housing Administration (SSHA)
8. Toronto and Region Conservation Authority (TRCA)
9. Toronto Building
10. Toronto Hydro
11. Toronto Public Health (TPH)
12. Toronto Transit Commission (TTC)
13. Toronto Water
14. Transportation Services

The RCWG also included representation from Metrolinx.

The RCWG was tasked to:

- (i) Screen, at a high level, the adequacy of the City's infrastructure and services to accommodate future extreme weather by identifying actions that have already taken place or are in progress;
- (ii) Identify planned activities that will enhance the City's assets and services to withstand future weather conditions; and
- (iii) Identify what more may need to be done to ensure the safety and security of assets and services under future extreme weather conditions.

Existing Activities that Address Expected Extreme Weather

The high level screening identified that numerous adaptation actions are already in place or are underway. Some efforts have been in place since 2001 when Extreme Heat Alerts were implemented and 2003 when the Wet Weather Flow Master Plan was adopted. More recent examples include the Toronto Green Standard (TGS), which was recently updated in July 2013 and the Green Roof Bylaw adopted in 2010.

Specific adaptation actions varied from large-scale projects to small-scale, inexpensive operational steps. A few examples include:

- a. TTC's installation of direct fixation track systems which assists with maintenance costs/lifespan but also minimizes the impact of extreme heat on rails;
- b. Transportation Services' program to upgrade the quality of asphalt to better withstand heat and avoid deformation;
- c. Toronto Water's implementation of the Wet Weather Flow Master Plan, which comprises a significant number of storm-water management projects and development and administration of the Basement Flooding Protection Subsidy Program, which offers financial assistance to homeowners;
- d. Shelter, Support and Housing Administration's "shelter management information system" for notifying shelter providers about extreme weather via a web based system; and
- e. Purchasing and Materials Management's business continuity approach of having hard copies of pertinent documents, such as contracts and emergency supplier lists (that are updated periodically on a three to five year procurement business cycle) to continue limited business operations during non-digital/no-electricity occurrences.

Appendix A of this report provides a list of current actions, policies and procedures that were identified by the 14 City Divisions, Agencies and Corporations during the initial high level screening and a statement from Metrolinx about their efforts to identify and prepare for extreme weather. The information in Appendix A is not a complete summary of all adaptation actions across the City but rather an indication of the breadth and scale of existing adaptation actions.

Possible Future Actions to Address Extreme Weather

The initial high level screening identified that many approaches and systems are already in place. Many City initiatives are collaborations among a number of divisions, agencies and corporations; an illustrative example is the work to mitigate stream erosion which is being undertaken jointly by Forestry, Parks and Recreation, the TRCA and Toronto Water.

At the same time, the screening found there is a large degree of interdependency among City assets and services. For example, the potential risks identified by a number of divisions, agencies and corporations relate to power outages and the ability to maintain or quickly restore a service is dependent upon the resilience of the power systems.

The issue of interdependency, in particular, requires further evaluation to fully understand what is needed to collectively and efficiently ensure Toronto's assets and services can accommodate future extreme weather. An appropriate approach is the development of a corporate-wide strategy, which would ensure systems and processes are in place and adequately resourced to identify and manage corporate-wide issues.

The initial high-level screening also found that:

- a. There are opportunities to link actions that address future extreme weather with the City's emergency response and business continuity plans and initiatives. An example of this was identified by Purchasing and Materials Management, which has taken precautionary measures to limit disruption to specific warehouse(s) and critical contents by locating facilities high above the water table with good drainage, tracking the temperature inside storage areas, ensuring there is on-site emergency power generation, and delineating alternate routes to and from those specific warehouse(s);
- b. There is a need to raise awareness about the potential impacts of extreme weather among staff, including training in procedures, and providing suitable equipment and strategies for working under future conditions. For example, Engineering and Construction Services highlighted the need to ensure that frontline personnel are knowledgeable about the potential effects of extreme weather on infrastructure, and about the need to ensure construction projects are delivered according to procedural and material specifications that address future climate conditions;
- c. Many City assets and services are delivered based on guidance (i.e., standards, codes and regulations) from the Provincial or Federal governments, but the guidance may not adequately or appropriately account for future extreme weather. TRCA, for example, has identified the need for changes to Provincial technical guidelines for storm water management and river and stream systems: flooding hazard limit so as to promote more effective management and extreme weather responsiveness;
- d. Within most of the reviewed City operations there are opportunities to better integrate our knowledge about expected extreme weather events into existing operating policies and procedures. Facilities Management, for example identified that it has a target to conduct a building condition assessment on 20% of the City's building portfolio every year. The protocol or standards for conducting those building condition assessments would benefit from the inclusion of information about current and forecasted extreme weather events so that these City assets are maintained with resilience to extreme weather in mind;
- e. Screening of assets and services to accommodate future extreme weather should be expanded to encompass all divisions, agencies and corporations in order to ensure full coverage across the entire City. For example, it was identified that Fleet Services has responsibility for the provision of fuel for City vehicles and operations but was not included in this initial assessment;

- f. The adaptation actions outlined in this report speak primarily to City infrastructure and services. While these adaptation actions minimize disruptions to residents and businesses caused by extreme weather, a common concern raised during the development of the initial high-level screening revolved around engaging residents and businesses about the need to improve their own resilience to extreme weather events. In 2011, the City in partnership with CivicAction formed the WeatherWise Partnership, which consists of 70 business and community leaders. This is one available vehicle for engaging residents and businesses, but other approaches may be required and should be identified and implemented, where appropriate; and
- g. Based on research to date, there may be a need to identify legal and liability issues arising as a result of this work and that this may need to be investigated by the City Solicitor in consultation with appropriate City operations.

Increases in allocations or reallocations of resources may be needed to manage the pressure on services and stress on assets caused by extreme weather events. However, the high level nature of the RCWG screening did not provide the opportunity to assess the resource implications of future unplanned actions in detail.

Building upon the initial high level screening completed by the RCWG, senior management from key City operations will be working with the Chief Corporate Officer over the next few months to prepare, by the second quarter of 2014, a strategy for consideration by City Council. That corporate resilient city strategy will define the key interdependencies between the City's infrastructure and services and set priorities and actions to be taken to enhance the resilience to extreme weather of those interdependent infrastructure and services.

Climate Change Adaptation Toolkit - Update

The Parks and Environment Committee at its meeting in January 2013 requested an update on the development of a Climate Change Adaptation Toolkit.

The purpose of the toolkit is to outline internal risk management systems to prepare for predicted health and social impacts associated with climate change. It focuses on the improvement of internal processes that City Council can rely upon to make decisions and to ensure improved capacity to act upon the complex data involved with extreme weather protections and scenarios.

Established elements within the toolkit include a summary of highlights from "*Toronto's Future Weather and Climate Drivers Study*" and the City of Toronto's Climate Change Risk Assessment Tool. The Climate Change Risk Assessment Tool is a systematic process that guides identification of potential risks from extreme weather to assets, business processes and services and enables actions and investments to be prioritized to mitigate the risks.

The Climate Change Risk Assessment Tool has been applied by the Transportation Services and the Shelter, Support and Housing Administration Divisions. Transportation Services' detailed climate change risk assessment looked at all of their high priority assets and critical services. That work involved fifteen half-day workshops, which allowed extensive consideration of how seven types of extreme weather events (extreme rain, extreme heat, freeze/thaw, extreme freezing rain, extreme wind, extreme snow and extreme cold) were evaluated against 90 asset and service classes over two time periods (2010 to 2020 and 2040 to 2050). In total, 1,650 risk scenarios were identified, taking into account first, second, third and fourth order impacts (i.e., possible cascading failures). Future adaptation actions were identified to complement the actions already in place.

The Shelter, Support and Housing Administration Division and Toronto Community Housing Corporation (TCHC) performed detailed assessments on only a sample of its operations, which were two assets (TCHC apartments and shelters) and one program (Streets to Homes), based on four types of extreme weather and 25 risk scenarios. Numerous potential adaptation actions were identified, including notifying tenants of impending extreme weather events, acquiring backup generators, using infrared thermal scanning to identify building envelope weaknesses and formalizing a tenant buddy system to ensure vulnerable tenants are looked after during extreme weather events.

There are other tools available for conducting extreme weather/environmental risk assessments. For example, in the initial high level screening it was identified that:

- a. Toronto Region Conservation Authority has completed a detailed climate change risk assessment using the Engineers Canada's Protocol (i.e., Public Infrastructure Engineering Vulnerability Committee (PIEVC) protocol) for two of its flood control dams;
- b. Toronto Hydro is planning further climate change risk assessment work utilizing the PIEVC protocol as a part of its assessment; and
- c. Toronto Public Health is considering applying new climate change vulnerability assessment guidelines from the World Health Organization (WHO) and Pan-American Health Organization (PAHO) in Toronto.

Additional elements to be developed in 2014 for inclusion in the Toolkit are:

- a) Corporate Extreme Weather Risk Management Policy;
- b) Extreme weather resilience measures and targets, which will provide an indication of progress on resilience to extreme weather;
- c) Standardized reporting form to communicate progress on the resilience measures; and
- d) Training materials for City executives and elected officials.

Status of 2008 Climate Change Adaptation Strategy Recommendations

The Parks and Environment Committee at its meeting in January 2013 requested an update on the progress that has been or is being made on implementation of the Climate Change Adaptation Strategy adopted in July 2008 and the information is presented in Table 3.

Table 3: Update to the 2008 Climate Change Adaptation Strategy – Recommendations	
Council Directive	Status as of October 1, 2013
<p>1) in order to adapt to the long-lasting change in weather patterns due to climate change, City Council direct that climate change mitigation measures and explicit goals for adaptation of infrastructure and buildings be incorporated into Toronto's Official Plan and request that the Chief Planner report on the amendments appropriate to the Official Plan incorporating such measures;</p>	<p>City Planning is currently in the process of completing a review of the Official Plan and in 2014 is planning to present proposed policies that address predicted extreme weather for inclusion in the Official Plan.</p> <p>Since 2008, City Planning has taken the following actions, which considered future weather changes:</p> <ol style="list-style-type: none"> 1. Provincial Policy Statement (PPS) 5-year review draft policies now incorporate policy references to climate change mitigation, adaptation and strengthened policy basis for energy planning 2. Review and incorporation of climate change adaption policy basis within the 5-year review of Toronto's Official Plan (underway) 3. Adoption and comprehensive review and update of the Toronto Green Standard (TGS) including strengthened energy conservation, urban heat island reduction, shading, cooling and continued storm water infiltration requirements for new development. 4. Green Roof Bylaw assists with reducing urban heat island effect and on-site storm water infiltration. 5. Citywide Zoning Bylaw incorporates provisions for Renewable Energy and sloped driveways to reduce flooding.

Table 3: Update to the 2008 Climate Change Adaptation Strategy – Recommendations

Council Directive	Status as of October 1, 2013
<p>2) City Agencies, Boards, Commissions, Corporations and Divisions likely to be strongly affected by climate change also be requested to incorporate climate change mitigation measures and explicit goals for adaptation in their plans, programs, strategies and assessment procedures;</p>	<p>There are many initiatives being undertaken that support adaptation. This staff report highlights the actions in place for the City Agencies and Corporations that participated in the Resilient City Working Group.</p>
<p>3) City Council request all City Agencies, Boards, Commissions, Corporations and Divisions to incorporate climate change concerns into planning for 2009, and identify in their 2009 budget submissions specific actions and programs they plan to undertake regarding climate change mitigation and adaptation, including, but not limited to the Council direction provided through the adoption of the Climate Change, Clean Air and Sustainable Energy Action Plan;</p>	<p>In 2009 and 2010 City Divisions and Agencies identified in their budget submissions, actions that supported implementation of the City's climate change mitigation and adaptation priorities.</p>
<p>4) the Deputy City Manager and Chief Financial Officer report back on a funding strategy for climate change adaptation planning and actions, including the creation of an Extreme Weather Reserve, the purpose of which is to mitigate the expenditure impacts arising from extreme weather conditions by providing funding at the end of the year to offset wholly or partly a budget shortfall resulting from unbudgeted and uninsured extreme weather-related costs incurred during the year;</p>	<p>In March 2008, City Council adopted the following staff report, "<i>Funding Strategies to Mitigate Financial Impacts on the City Due to Extreme Weather Conditions</i>" (item# EX18.1), which established the Extreme Weather Reserve Group. The report is at: http://www.toronto.ca/legdocs/mmis/2008/ex/bgrd/backgroundfile-11747.pdf</p> <p>Two reserve accounts were established: one for Transportation Services and one for Parks, Forestry & Recreation. The balance of the two accounts as of October 8, 2013 was \$30 million.</p>

Table 3: Update to the 2008 Climate Change Adaptation Strategy – Recommendations

Council Directive	Status as of October 1, 2013
<p>5) the Director of the Toronto Environment Office support the work of the Deputy City Manager and Chief Financial Officer cited above in Recommendation No. 4, by establishing, in consultation with the Climate Change Adaptation Steering Group, a methodology to prioritize short-term Climate Change Adaptation actions recommended by City Divisions prior to the 2009 Budget Cycle process;</p>	<p>A methodology was developed for the 2009 budget process.</p>
<p>6) the Director of the Toronto Environment Office establish a process for the development of a longer-term, comprehensive adaptation strategy, that: identifies key vulnerabilities to climate change of the City, including financial vulnerability; prioritizes risks; identifies, assesses and implements adaptation actions that will reduce vulnerability; and takes advantage of opportunities presented by a changing climate; and</p>	<p>Progress includes: an international benchmarking study on climate change risk assessment; internal study on state of environmental risk management, training 30 staff on Toronto's Climate Change Risk Assessment Tool developed in 2011. Transportation Services and SSHA have performed detailed climate change risk assessments using the tool; City operations are or are in process of utilizing other risk assessment tools.</p> <p>This report identifies that a report will be presented to City Council in the second quarter of 2014 that maps out a corporate resilient city strategy for critical City infrastructure and services.</p>
<p>7) to support co-operation, communications and research among Federal, Provincial and Municipal governments, universities, colleges and non-governmental organizations on climate change mitigation and adaptation actions and strategies relevant to the City of Toronto and other urban centres, City Council authorize the Director of the Toronto Environment Office to co-ordinate City staff participation in</p>	<p>In 2009, the Urban Climate Change Network held a forum attended by a 110 stakeholders. This forum led to the establishment in 2011 of the WeatherWise Partnership, which consists of 70 businesses (e.g. banks, insurance, telecom, commercial real estate and other municipalities) and organizations. The objectives of the WeatherWise Partnership are:</p> <ul style="list-style-type: none"> • To understand extreme weather risks and interdependencies of infrastructure affected by extreme weather; • To prioritize risk reduction actions that will help

Table 3: Update to the 2008 Climate Change Adaptation Strategy – Recommendations

Council Directive	Status as of October 1, 2013
<p>the establishment and development of the proposed Urban Climate Change Network.</p>	<p>maintain service levels for customers; and</p> <ul style="list-style-type: none"> • To avoid costs for residents, businesses and shareholders. <p>The issue area of initial focus for the WeatherWise Partnership was the electrical sector. The Electrical Sector Core Project Team was formed in 2011 and includes representatives from Toronto Hydro, Hydro One, Ontario Power Generation, Ontario Power Authority, Independent Electricity Operator and the Ministry of Energy. This Project Team has:</p> <ul style="list-style-type: none"> • Conducted a survey of critical infrastructure providers' tolerance to an extended power disruption; • Conducted a pilot climate change engineering vulnerability assessment for Toronto Hydro and now planning a system wide assessment; and • Conducting a GTA climate change risk assessment. <p>Due to changing priorities and available resources, both CivicAction and the Environment and Energy Division have reduced their staff support for the Weatherwise Partnership, with the exception of allocating staff time in support of the Electrical Sector Core Project Team. The foundation is still there and the Weatherwise Partnership will serve as a useful forum for engaging in a discussion about how to better engage residents and businesses in taking action to improve their own resilience to extreme weather.</p>

CONCLUSION

Toronto is experiencing and will continue to experience a change in extreme weather events. Research completed by the City suggests that Toronto will see more frequent occurrences of extreme rain storm events and more heat waves.

Recognizing this, City Council directed that key City operations and Metrolinx report on potential impacts of the forecast changes in extreme weather and assess the adequacy of the City's infrastructure and services to manage these extreme weather events. An initial high level screening has been completed on 14 City Divisions, Agencies and Corporations and on Metrolinx and reported on through this report.

While this initial high level screening found numerous in place initiatives, policies and services that are adaptation actions, additional work is required to more thoroughly identify and assess the City's readiness for the forecast changes in extreme weather events. The Chief Corporate Officer will continue to coordinate with City Divisions, Agencies and Corporations this evaluation and preparation of a strategy for presentation in 2014 to City Council.

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SIGNATURE

Josie Scioli
Chief Corporate Officer

ATTACHMENTS

Appendix A: In Place Adaptation Actions and Programs

APPENDIX A: IN PLACE ADAPTATION ACTIONS & PROGRAMS			
#	City Agency, Division or Corporation	Identified Adaptation Actions, Policies and Procedures	Rationale
1	City Planning	<p>a) Toronto Green Standard</p> <p>b) Green-Roof Bylaw</p> <p>c) Renewable Energy Bylaw</p> <p>d) Reverse Slope Driveway requirements</p> <p>e) Provincial Policy Statement Review</p> <p>f) Review of Official Plan in 2014</p>	<p>a) Requires sustainable performance measures for new development to reduce on-site storm water runoff and the urban heat island effect.</p> <p>b) Bylaw created to implement section 108 of the City of Toronto Act to require and govern the construction of green roofs.</p> <p>c) Permits energy production and distribution using renewable energy devices and co-generation devices on properties thereby reducing demand on high greenhouse gas generating energy sources. Now replaced by the City-Wide Zoning Bylaw.</p> <p>d) Part of the City-Wide Zoning Bylaw, precludes construction of reverse slope driveways, thereby eliminating a pathway for stormwater to enter the property</p> <p>e) Five-year review draft policies now incorporate policy references to climate change mitigation and adaptation and strengthen policy basis for energy planning</p> <p>f) To address future extreme weather.</p>
2	Engineering and Construction Services	<p>a) Maintain concrete structures in State of Good Repair (SoGR)</p> <p>b) City has a CCTV inspection program to evaluate the condition of sewers/water courses.</p> <p>c) Rehabilitation of sewers and maintenance holes.</p>	<p>a) Through proper maintenance and rehabilitation that extends the useful life of the asset and reduces life-cycle costs. The science on how hot weather impacts concrete placement is known. Hot weather placement of concrete requires the finisher to take certain precautions to minimize the impact of higher temperatures.</p> <p>b) Blocked or damaged sewers/water courses can be cleared and repaired, respectively, to minimize flooding.</p> <p>c) Extends the life of the asset and reduces life-cycle costs and has been ongoing for the past 15-20yrs.</p>

APPENDIX A: IN PLACE ADAPTATION ACTIONS & PROGRAMS			
#	City Agency, Division or Corporation	Identified Adaptation Actions, Policies and Procedures	Rationale
		<p>d) Engineering & Construction Services recent reorganization.</p> <p>e) The hiring of consultants to assist with increase work load.</p>	<p>d) To position division to adapt to future demands.</p> <p>e) Service levels not jeopardized with growing demand.</p>
3	Facilities Management	a) Building Code has required upgrade of water supply backflow prevention valves.	a) 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)	<p>a) City of Toronto Emergency Plan</p> <p>b) Risk Specific Plan - Flood</p> <p>c) Risk Specific Plan - Power Disruption (Electricity)</p> <p>d) Operational Support Function – Damage Assessment</p> <p>e) Emergency Risk Communications Working Group (ERCWG)</p>	<p>a) Provide the framework within which extraordinary arrangements and measures can be taken to protect the health, safety, and welfare of the inhabitants of the City of Toronto when faced with an emergency.</p> <p>b) Provide a framework for the coordination of the municipal response to help ensure public safety and to minimize damage to property in the event of a major flood event.</p> <p>c) Identify the general roles and responsibilities that City divisions have in responding to a power failure event and, if necessary, to assist Toronto Hydro's efforts to coordinate a timely and effective response to a power failure event.</p> <p>d) Provides an overview of Toronto Building's plan to facilitate and coordinate inspection and remedial actions required to mitigate any potential threat to the safety and welfare of the impacted citizens.</p> <p>e) Strengthen working relationships among key communication stakeholders to facilitate effective communications before an emergency occurs, during an event and in the recovery phase of an emergency and messages are accurate, consistent and coordinated.</p>

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#	City Agency, Division or Corporation	Identified Adaptation Actions, Policies and Procedures	Rationale
		<p>f) Operational Support Function - Evacuation</p> <p>g) Operational Support Function – Emergency Human Services</p> <p>h) Vulnerable Populations Working Group</p> <p>i) Hazard Identification and Risk Assessment (HIRA)</p>	<p>f) Planning and preparing for a decision to evacuate an area in the event of an emergency or pending emergency.</p> <p>g) An organized response to the urgent needs of people and their pets once they are out of immediate danger of a disaster or emergency situation. The primary services include providing emergency accommodation, food, registration and inquiries, personal support services and operation of a Reception Centre for residents evacuated from their homes.</p> <p>h) Created to ensure that effective responses are provided to vulnerable residents during extended power outages, building evacuations or other declared and non-declared emergencies. Developed a plan to identify and assist vulnerable residents to access services.</p> <p>i) 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 (PRR)	<p>a) Sustaining & Expanding the Urban Forest: Toronto's Strategic Forest Management Plan</p> <p>b) Urban Forestry has implemented a newly planted tree maintenance program.</p> <p>c) Proactively prunes approximately 38,000 trees per year and inspects approximately 50,000 trees per year.</p> <p>d) Area Street Tree Maintenance Program, Urban Forestry</p>	<p>a) Increasing tree canopy cover within the city from the current estimate of 26.6 - 28 % to 40 %, thereby reducing on-site storm water runoff and the urban heat island effect.</p> <p>b) Visit trees planted within the last three years to access the tree performance and maintenance. Tree planting contracts include warranty periods and schedules for watering.</p> <p>c) Pruning reduces risk associated with tree and/or tree limb failure and improves tree health. Inspects in response to requests for service from the public and schedules remedial work accordingly.</p> <p>d) Perform proactive maintenance of City street trees, removing potentially hazardous trees and tree limbs prior to failure.</p>

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		<p>e) Forestry Service Plan set an objective of three months to address the backlog.</p> <p>f) Carry out emergency clean up and repairs of parks ravines and water courses, in cooperation with TRCA crews.</p> <p>g) Work with TRCA and Toronto Water to inventory, monitor, plan, and implement comprehensive watershed geomorphologic studies.</p> <p>h) Implementing bio-engineering solutions to watercourse rehabilitation projects and stormwater management projects, e.g., retention ponds, infiltration and recharge areas, porous pavements, etc.</p> <p>i) Monitor interior of facilities for water leaks.</p>	<p>e) In an effort to reduce 6 month tree maintenance backlog.</p> <p>f) To minimize blocked channels that would otherwise exacerbate flooding and potentially damage property.</p> <p>g) Understand ravines/water courses capacity and connectivity to predict behaviour during varying weather events.</p> <p>h) To minimize runoff, prevent flooding and downstream erosion and improve water quality.</p> <p>i) To determine proactive/corrective measures required to ensure integrity of roofing systems.</p>
6	Purchasing and Materials Management	<p>a) Warehouse of critical content (e.g., pandemic medication) located above water table with good drainage.</p> <p>b) Thermometer(s) tracking temperature inside warehouse of critical content.</p> <p>c) Warehouse of critical content equipped with on-site emergency power generation.</p> <p>d) Alternate routes to and from warehouse of critical content available.</p> <p>e) Hard copies of business continuity documentation including Emergency Supplier Listing and Emergency Management Staff Confidential Contact.</p>	<p>a) Prevents flooding of warehouse.</p> <p>b) Will provide alarm to monitoring staff to take appropriate actions to preserve content.</p> <p>c) Will provide power to maintain supplies within safe environmental control ranges.</p> <p>d) Mitigating disruption of accessing and delivering critical content.</p> <p>e) Will enable limited service during a power outage.</p>

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7	Shelter Support and Housing Administration (SSHA)	<p>a) Toronto Shelter Standards</p> <p>b) Shelter Management Information System</p> <p>c) Works in collaboration with the Medical Officer of Health (MOH) on Extreme Heat Alerts, which are issued by MOH.</p>	<p>a) Detail requirements of shelter/service providers regarding emergency planning and health and safety.</p> <p>b) Can notify & update shelter providers and community partners regarding extreme weather via the web, fax and email notifications.</p> <p>c) To alert those most at risk of heat-related illness that hot weather conditions are either imminent or currently exist and to take appropriate precautions.</p>
8	Toronto and Region Conservation Authority (TRCA)	<p>a) Lakes and Rivers Improvement Act</p> <p>b) Dam safety reviews regularly completed.</p> <p>c) Dam breach analyses completed.</p> <p>d) Climate Change Risk Assessment completed</p> <p>e) Channels are inspected regularly and assessed for competency.</p> <p>f) Emergency Preparedness Plans and emergency response planning</p> <p>g) Floodplain maps and models are maintained and updated regularly.</p> <p>h) Reviews outfalls as part of current regulation.</p>	<p>a) Sets out requirements for dam design, which take into consideration extreme conditions.</p> <p>b) Daily inspections and regular training in operations and maintenance carried out and take into consideration extreme conditions. Review completed in 2013 for G. Ross Lord Dam.</p> <p>c) Analyses completed for G. Ross Lord and Claireville dams to quantify the magnitude of impact.</p> <p>d) Using Engineers Canada Protocol for 2 dams.</p> <p>e) Keeping channels clean and technically stable to handle high flow during extreme rainfall events. Increased inspection frequencies and accelerated remediation plans are completed when need is identified.</p> <p>f) Initiated with Office of Emergency Management (OEM) to protect public safety and safeguard assets.</p> <p>g) Providing updated information to help predict and plan for extreme weather.</p> <p>h) Implement remediation measures, when needed, to maintain stormwater quality.</p>

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		<p>i) The Greenlands Acquisition Plan</p> <p>j) TRCA policies guide municipalities to construct effective stormwater management measures.</p> <p>k) Monitor the condition of terrestrial and aquatic ecosystems.</p> <p>l) Rehabilitation and reconstruction of damaged sections of urban stream.</p> <p>m) Management of existing forest.</p> <p>n) Ontario Regulation 166/06 reduces the number of new sites that may be potentially impacted by extreme weather.</p> <p>o) Working with Toronto Water and PF&R to find efficiencies.</p>	<p>i) Estimates 1,000 hectares acquired by 2015 should funding of a projected \$27.5 million be available. Priority acquisitions include areas where erosion in ravines and along shorelines is threatening adjacent homes or businesses.</p> <p>j) Measures mitigate the impacts of new development, which lead to increased impermeable surfaces, thereby increasing runoff.</p> <p>k) To minimize the degree of damage commonly experienced during significant rainfall events.</p> <p>l) Making urban streams more resilient to frequent high flows.</p> <p>m) To increase resiliency to insect and disease infestations, thereby maintaining the urban forest and subsequently reducing on-site storm water runoff and the urban heat island effect.</p> <p>n) Minimizes property damage and cost.</p> <p>o) By addressing large scale risks to existing infrastructure within valley corridors through collaboration projects in order to reduce overall project costs, and to accelerate completion times.</p>
9	Toronto Building	<p>a) Responsible for enforcement of Ontario Building Code Act and Ontario Building Code.</p> <p>b) In an extreme weather event, Toronto Building would respond, as it does currently, by assessing the safety of buildings where there is a potential public safety risk; and act accordingly under the Act and Code so that the hazard is remedied.</p>	<p>a) The building code sets out technical requirements for the construction (including renovation) and demolition of buildings.</p>

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10	Toronto Hydro	<p>a) Equipment designed to CSA overhead and underground</p> <p>b) System response and stand by crews respond to system failures.</p> <p>c) Critical infrastructure customer tolerance survey to power disruption was done in 2013.</p> <p>d) Equipment selected today is designed to operate under high ambient temperature (i.e., 45°C or above).</p> <p>e) Power line monitors installed</p> <p>f) Encourages customers to be resilient to power outages.</p> <p>g) Customer surveys and observations made on July 8, 2013.</p> <p>h) Applying to the Ontario Energy Board for funding requests to address aging infrastructure & maintenance needs.</p>	<p>a) CSA standards used across Canada and equipment selected as per internal specification and standards prepared and signed by internal Professional Engineers.</p> <p>b) Higher level of resources dedicated to extreme weather events through internal Emergency Management guidelines and procedures, recovering quickly from service disruptions.</p> <p>c) Although not conclusive, the study indicated potentially significant vulnerabilities of the Toronto Region in the event of an extended power disruption.</p> <p>d) Eliminating service disruptions caused due infrastructure exposure to extreme heat.</p> <p>e) Located in parts of the system to monitor conditions and to predict failures.</p> <p>f) Converses with the building maintainers about the condition/maintenance of their electrical equipment and ask that they ensure backup generators are working in their buildings.</p> <p>g) Revealed that there is opportunity for customers to adjust their demand for electricity during times when the grid is under stress.</p> <p>h) Future investments plans for system resiliency and climate adaptation plans need to be developed with Regulator recognition.</p>
11	Toronto Public Health (TPH)	<p>a) TPH employs an all hazards approach to emergency preparedness in coordination with the Toronto Office of Emergency Management. TPH reviews existing plans to ensure they meet the needs of extreme weather events. Additionally, TPH may exercise its own plan or participate</p>	<p>a) TPH's role is to protect the health of residents in the City of Toronto when faced with an emergency including emergencies resulting from extreme weather events such as power disruptions, flooding, evacuations, extreme heat. In the case of evacuations and reception centres, TPH is responsible for food safety, infectious disease control and</p>

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		<p>in exercises with extreme weather scenarios. To manage emergencies TPH has an emergency plan, an incident management system and provides emergency response training to staff.</p> <p>b) TPH works in partnership with Toronto Water to implement the Wet Weather Flow Master Plan to reduce flooding and sewage overflow into the Lake (see Table Entry 13).</p> <p>c) TPH helps protect the public from health impacts of flooding at beaches and in buildings:</p> <p>Beaches: TPH monitors beach water quality and advises the public on safety of swimming.</p> <p>Flooding: TPH is legally required to investigate flooding and sewage/water backups in homes and businesses to assess risks of mould and suitability for habitation. TPH response may include resident support and community meetings at request of MOH or Councillors.</p> <p>d) TPH coordinates the West Nile Virus Control Program – includes: 1. Coordinating larvaciding of City catch basins; 2. Conducting adult mosquito surveillance; 3. Investigating confirmed and suspected human cases of WNV illness; 4. Investigating standing water complaints that contribute to a mosquito breeding; 5. Issuing surveillance bulletins 6. Providing advice and information to residents.</p>	<p>psychosocial response. Provides psychological first aid and group interventions after a traumatic event such as an extreme weather event</p> <p>b) Toronto Water's Plan was approved in 2003 and its implementation will take 25 years. Once implemented it is expected to mitigate some of the climate change impacts related to increased numbers and intensities of such events.</p> <p>c) Beaches: Bathing in polluted waters may increase the risk of acquiring infections. E-coli levels could exceed safe levels which is an indication of human or animal fecal mass in the water.</p> <p>Flooding: Extreme rain can lead to overflow of sewage treatment plants and localized flooding and flood basements. This can lead to the presence of harmful bacteria and growth of toxic mould.</p> <p>d) Predicted extreme weather can lead to an increase in prevalence of the West Nile Virus. Heavy downpours can potentially flush both larvae and larvacide from catch basins. Larvacides are applied to roadside catch basins to inhibit the development of larvae into adult mosquitoes. Rain can also increase the amount of standing water (breeding areas) in the community, although heavy rainfalls will wash the larvae away.</p> <p>Warmer temperatures increase the rate at which mosquitoes develop from egg to adult and also increase the rate of viral replication within the mosquito itself. Mosquitoes also feed more often in hotter weather.</p>

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		<p>e) TPH co-ordinates Toronto's Heat Alert and Response Plan (HARS) which includes monitoring of the Heat Health Alert System, calling and terminating Heat Alerts, and activating the Hot Weather Response Plan.</p> <p>f) TPH operates a food safety program that includes food safety policies, procedures, protocols and position papers and regular review of food safety incidents.</p> <p>g) Toronto Food Strategy</p>	<p>In recent years, 2002 and 2012 had the highest numbers of mosquitoes testing positive and human confirmed cases of WNV.</p> <p>The WNV control program is designed to prevent immature mosquitoes (larvae) from developing into adult mosquitoes that can transmit West Nile Virus (WNV), thereby minimizing infections during hot days that are expected to increase.</p> <p>e) To protect residents from the negative impacts of extreme heat. The main objective is to alert those most at risk of heat-related illness that hot weather conditions are either imminent or currently exist and to take appropriate precautions.</p> <p>New work includes collaboration with federal, provincial and local partners on developing a heat alert harmonization strategy and collaboration with City Manager's Office on issues related to heat in multi-residential settings.</p> <p>f) Increased frequency of power outages and/or extreme heat will increase risk of improper food handling practices, food spoilage, food contamination and possible food shortages and place high demands on TPH service response.</p> <p>g) Encourages access to healthy food and community development through food, thereby decentralizing food supply and increasing community resilience and a healthy and sustainable food system. Specific projects address mobile vendors, healthy foods in corner stores, a locally grown world crop project, and co-ordination among community organizations to improve use of existing facilities for storing and transporting food, and encouraging broad scope.</p>

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		h) TPH collaborates with community partners to implement the Strong neighbourhoods strategy.	h) Strengthens social, economic and physical conditions in communities, thereby increasing community resilience. The Strategy is a joint project of the United Way and the City to support healthy communities by partnering with residents, businesses and agencies to invest in people, services, programs and facilities in specific neighbourhoods.
12	Toronto Transit Commission (TTC)	<p>a) Design Standards regarding fuel storage.</p> <p>b) Acquisition and placement of mobile generators.</p> <p>c) Onsite storage for 100 year storm at new TTC facilities.</p> <p>d) Small portable pumps</p> <p>e) Installation of direct fixation track systems.</p>	<p>a) Dictate that motive fuel storage be sized to provide a minimum of 2 days fuel supply, thereby minimizing disruption to service.</p> <p>b) Two additional mobile generators (for a total of 4) are being placed in strategic locations in the east and west end of the city. During localized power outages, these generators will be moved into position at impacted garages and connected to the bus fueling equipment.</p> <p>c) Is required and provided by depressions in parking lots, storm management ponds, underground storm water retention tanks and roof top storage.</p> <p>d) Pumps powered with small mobile generators are used in emergencies when electrical power is lost. These are primarily an aid to service recovery after flooding has already taken place and when power loss occurs in only isolated sections of the system.</p> <p>e) As mainline wood and tie and ballast track areas in open cut sections reach the end of their operational life, direct fixation track systems are being installed to help mitigate the effects of extreme temperatures. Other track technologies are also being examined.</p>
13	Toronto Water	a) Wet Weather Flow Master Plan,	a) A \$1 billion, 25-year undertaking to reduce and eliminate the adverse impacts of wet weather flow.

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		<p>b) Work plan to address basement flooding in 31 priority areas.</p> <p>c) Mandatory Downspout Disconnection program,</p> <p>d) The Toronto Water Strategic Plan 2010 – 2020</p> <p>e) The Toronto Green Standard</p> <p>f) Reverse Slope Driveway Bylaw</p> <p>g) Municipal catchbasins , local storm, sanitary, and combined sewers are cleaned on a regular basis.</p> <p>h) Closed circuit television (CCTV) inspections</p> <p>i) Operate wastewater treatment plants in full compliance with Ontario Ministry of the Environment Certificates of Approval.</p> <p>j) Drinking Water Quality Management System</p> <p>k) Documented emergency response program for the City's water system, titled Toronto Water Emergency Program.</p>	<p>b) The work plan was recently expanded to encompass the entire City.</p> <p>c) Intended to have downspouts across the entire City disconnected by 2016. This will slow and reduce the volume of runoff reaching storm sewers during a rain event.</p> <p>d) Identifies implementation of the Wet Weather Flow Master Plan as a strategic Continuous Service Delivery Improvement priority.</p> <p>e) Includes requirements that promote effective management of stormwater runoff.</p> <p>f) Precluding construction of reverse slope driveways, thereby eliminating a pathway for stormwater to enter the property</p> <p>g) Removing materials that settle or float thereby preventing contaminants from flowing into stormwater system and overflowing of catch basin.</p> <p>h) Ensure ongoing structure integrity of the sewers. Additional inspections are conducted after extreme storms.</p> <p>i) All operations staff are appropriately licensed in accordance with Ontario Regulation 129/04.</p> <p>j) Requires a risk assessment of the water system to be conducted every 36 months. The last assessment was completed between January 26th and Feb 23rd 2011.</p> <p>k) The Environmental Health and Safety Unit of Toronto Water's Business Operations Management Section oversees emergency preparedness and response. District Operations section staff conduct emergency response exercises on a regular basis.</p>

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		<p>l) Enhanced demand management to satisfy anticipated water consumption increases due to future higher temperatures and less frequent rain events.</p> <p>m) Sustainability of drinking water supply after extreme weather events that cause power failures.</p>	<p>l) Demand management is actively addressed on an ongoing basis through regular Joint Optimization Studies. Future extreme weather conditions are factors that are considered.</p> <p>m) Plans are in place for expanding back-up power generation at Toronto's water treatment plants.</p>
14	Transportation Services	<p>a) 5 RWIS (Road Weather Information System) stations.</p> <p>b) Communication capability: through communication-centre, teleconferencing, weather advisories and BlackBerrys.</p> <p>c) Standard Operating Procedures</p> <p>d) Weather Monitoring</p> <p>e) Business Continuity Plan</p> <p>f) Inventorying and mapping of culverts less than 3 metres in diameter (10% of system currently catalogued).</p>	<p>a) Provides forecasted and real-time pavement information to assist with snow and ice control decisions (i.e., deployment of salt/plow trucks).</p> <p>b) Ensures effectively and efficiently communication during extreme weather events.</p> <p>c) Ensuring health and safety of staff during extreme weather through: tailgate sessions, completed Hazard Identification Forms for each job, dissemination of information to staff regarding the Heat Stress policy, implementation of task rotations, work rotations and micro breaks.</p> <p>d) Provides staff with up-to-date information using, custom weather reports from the Weather Network; Global Positioning Systems (i.e., patrol vehicles equipped with GPS which provides data as to where/when patrolling occurred); infrared thermometers mounted on patrol vehicles allows monitoring of ambient air and pavement temperatures.</p> <p>e) To minimize service disruption to winter control due to pandemic influenza (i.e., potential for situation to worsen due to more temperate winters).</p> <p>f) Allows regular scheduling of inspection and maintenance regime to keep culverts clean and functioning properly to handle high flow during extreme rainfall events.</p>

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		<p>g) Engineering vulnerability assessment of major culverts (three major culverts examined in 2011).</p> <p>h) Transportation Road Operation staff perform visual inspections of bridges and culverts.</p> <p>i) Detailed visual inspection of all City culverts larger than 3 metres in diameter by Structures group.</p> <p>j) GIS enabled Bridge Management System (BMS).</p> <p>k) Removal of leaves from catchbasin tops and cleaning/maintenance of roadside ditches.</p> <p>l) Higher stone mastic content in asphalt.</p> <p>m) Replacement of asphalt with concrete pads at bus stops.</p> <p>n) Pavement Management System</p>	<p>g) Use of the PIEVC (Public Infrastructure Engineering Vulnerability Committee) protocol, a tool derived from standard risk management methodologies, allows one to assess the impacts of climate change on infrastructure and incorporate adaptation actions into design and development.</p> <p>h) All bridges inspected once a year, and culverts once a year and after each major rain event.</p> <p>i) Detailed inspection is once every 4 years, unless there is indication of a particular problem. Outcome of inspection program is maintenance and rehabilitation activities to ensure culverts function as designed.</p> <p>j) Mapping of bridges and culverts larger than 3 metres allows better management of the assets, thereby increasing resilience.</p> <p>k) Ensures better handling of drainage during extreme rainfall events.</p> <p>l) Improves strength under extreme heat conditions thereby increasing the durability of the pavement surface. Used in limited applications mainly on expressways where larger traffic volumes and heavier vehicles are common.</p> <p>m) Asphalt pavement surface, at bus stops, generally exhibit severe asphalt distortion (e.g., rutting) due to bus loads and extreme heat conditions. Replacement of asphalt stopping areas with concrete pads will improve the situation.</p> <p>n) Asset management system improves process for assessing the condition and life cycle of the pavements and for plan improvements to increase the resiliency of pavement due to extreme weather events.</p>

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		<p>o) Perform conflict monitoring</p> <p>p) Installation of new controllers</p> <p>q) Installation and maintenance of traffic control signals, devices and detector stations performed entirely through contracted services.</p> <p>r) All cameras have environmental controls (heaters and cooling fans).</p> <p>s) Winter Maintenance Program</p> <p>t) Cleaning low lying areas</p> <p>u) Street sweeping frequency</p>	<p>o) Freezing rain and extreme cold may cause failure of the pre-emptive signals at Fire Halls, Emergency Medical Services stations and railway level crossings. Contracted inspection allows for immediate identification and correction of problem.</p> <p>p) Increased resilience due to extreme heat or cold by installing cabinet heaters, cooling fans and using lighter coloured exterior paint on cabinets.</p> <p>q) Contracting out work ensures that service levels and performance of equipment is maintained at all times, thereby minimizing service disruption. This includes software maintenance for all traffic control systems and staffing for Traffic Centre Control Room, dispatchers and Road Emergency Services Communications Unit (RESCU) operations.</p> <p>r) To withstand heat and cold events with minimal service disruption.</p> <p>s) Program provides timely and effective winter maintenance to ensure the safety of road and sidewalk users, as well as minimize the impacts of extreme weather events.</p> <p>t) Low lying areas around catchbasins are cleaned prior to and after a rain storm event to ensure proper drainage.</p> <p>u) Maintain a relatively high sweeping frequency which mitigates the deposit of road dust and debris into catchbasins, which could otherwise impact drainage during extreme rain events.</p>

Metrolinx provided the following statement:

With safety and service as its top priorities, Metrolinx applies a risk-based approach in its business activities and decision-making to facilitate the identification of short, medium and long-term risks to our operations, associated with likelihood, impacts and the measures we are taking to address them.

Looking at international best practices, available extreme weather information and the potential impact on our infrastructure and services will continue to be part of Metrolinx's corporate risk profile. Our readiness and resilience of infrastructure, processes and protocols will continue to be evaluated and actions prioritized. This will be done in close collaboration with Provincial ministries, municipalities, conservation authorities, suppliers and other key stakeholders.

Examples of areas to be considered with respect to increasing frequency of extreme weather in the short, medium and long term:

- Continued safety of customers and staff;
- Integrity of essential infrastructure (e.g. roadways, bridges, tracks, signals, buildings);
- Emergency Service, staff and asset prioritization protocols;
- Emergency internal and external communication protocols;
- Reliability of energy, communications and other third-party systems; and
- Consideration of future weather in design standards.