

## MISSISSAUGA STORMWATER MASTER PLAN – BUILD BEAUTIFUL

### DRAFT ACTIONS

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## A. Understand Its Nature (Studies)

Theme A: *Understand Its Nature (Studies)* is comprised of the following Actions:

- A.1 Prepare Dual Drainage Models in Older Neighborhoods (Capacity-Based) – Existing Action
- A.2 Map Groundwater (City-wide) – Future Action
- A.3 Economic Consideration for Environmental Decision-Making Process – Future Action
- A.4 Pursue System-wide ECA – Future Action
- A.5 Water Sustainability Plan – Future Action (New to Fill Gap from Checklist)

## A.1 Prepare Dual Drainage Models in Older Neighborhoods – Existing Action

Action A.1	Prepare Dual Drainage Models in Older Neighborhoods (Capacity-Based)
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
<b>Description</b>	<ul style="list-style-type: none"> <li>Integrated mapping of sanitary and storm sewer flood risks for older residential neighborhoods (i.e. Pre-1970s) through the preparation of dual drainage models (capacity analyses). <ul style="list-style-type: none"> <li>The historic villages of Mississauga include: Clarkson, Cooksville, Dixie, Erindale, Lakeview, Lorne Park, Malton, Meadowvale Village, Port Credit and Streetsville.</li> </ul> </li> <li>Use data to Prioritize flood risk studies which would be completed on the basis of known sanitary backup/basement flooding issues. <ul style="list-style-type: none"> <li>Studies to include hydrologic / hydraulic analysis (i.e., dual drainage capacity analyses) to identify stormwater system capacity and level-of-service (LOS).</li> </ul> </li> </ul> <p><b>Examples of past and on-going City of Mississauga Studies:</b></p> <ul style="list-style-type: none"> <li>Cooksville Creek – Dual Drainage (CVC, 2014) &amp; Vulnerability Assessment (CVC, Phase I 2014 &amp; Phase II 2018) <ul style="list-style-type: none"> <li>In partnership with CVC, a detailed hydrologic/hydraulic dual drainage (i.e. minor/major system) model was developed for the Cooksville Creek watershed using the PCSWMM software.</li> <li>The objective of the modelling assessment was to establish, <i>overland flow routes (major system), hydraulic grade lines and the capacity of existing storm sewers (minor system), as well as to assist with master planning and historical event analysis.</i></li> <li>The results of the hydrologic/hydraulic modelling were then used as inputs to the subsequent phases of the Vulnerability Assessment, including identification of risks, evaluation of alternatives, and financial analyses (further discussion in Action A4).</li> </ul> </li> <li>Malton – Flood Characterization Study (Matrix Solutions, March 2018) <ul style="list-style-type: none"> <li>Prepared under the leadership of TRCA in partnership with City of Mississauga and Region of Peel.</li> <li>Characterized flood risk and identify flood mechanisms through dual drainage modelings and development of a flood mitigation plan.</li> </ul> </li> <li>Port Credit Storm Drainage Master Plan (ongoing) <ul style="list-style-type: none"> <li>The City is currently completing a dual drainage assessment in the community of Port Credit, to assess the stormwater system's capacity (LOS), respective performance and identify the need for infrastructure improvements.</li> </ul> </li> </ul>
<b>Rationale</b>	Capacity-based modeling of sewer networks supports the mapping of wet risks (storm and sanitary sewers), which helps to identify unique problem areas exposed to risks associated with both the sanitary and storm systems across the City; data used to prioritize future flood risk studies to assess

<b>Action A.1</b>	<b>Prepare Dual Drainage Models in Older Neighborhoods (Capacity-Based)</b>
<b>Service Delivery</b>	<b>Plan/Program/Policy/Partnership/Procedure/Project</b>
	mitigation options and minimize flood risks associated with storm and sanitary sewer systems.
<b>Department/Division/Section</b>	T&W/IPES/ES
<b>Partnerships</b>	<ul style="list-style-type: none"> <li>Region of Peel – Mapping of Sanitary Risks (Inflow/Infiltration) particularly in locations with direct connections of foundation systems/weepers to sanitary system</li> <li>Conservation Authorities – riverine-based mapping of older residential neighborhoods and hydrologic modelling (watershed)</li> </ul>
<b>FTEs</b>	Approx. 0.2 FTE
<b>Equipment</b>	<ul style="list-style-type: none"> <li>Modelling Software (Hydrologic/Hydraulic) – platforms vary</li> <li>Mapping Software (ArcGIS), etc.</li> </ul>
<b>Annual Budget (Capital budget, O&amp;M, Year)</b>	Approx. \$100K per Individual Study. Currently as of 2020 – 1 study per year No O&M.
<b>Relevant Legislative/Policy /Emerging Practices</b>	<a href="#">Wood – will be an output from the Legislative Checklist (TBC)</a>
<b>Industry Best Practices</b>	<p><b>Dual Drainage Modelling (Capacity-Based Assessment):</b></p> <ul style="list-style-type: none"> <li>Capacity-based assessments of the stormwater management system can be completed through major/minor system modelling (or dual drainage modelling) in coupled hydrologic and hydraulic modelling software, such as PCSWMM which is based on US EPA-SWMM platform.</li> <li>This type of modelling allows for the design and analysis of urban drainage systems based upon computed surface runoff from modelled catchment areas (hydrology component), where surface water flows are then routed over the land surface via hydraulic elements representing the major system (such as roads, swales, street sags and storage areas) as well as simultaneously within the subsurface hydraulic conveyance system (minor system, such as storm sewer pipes).</li> <li>Both hydraulic systems can be interconnected in the modelling to simulate the inlet capacity of the storm sewer inlets (i.e. catch basins, ditch inlets, etc.) and can simulate conditions such as backwater, surcharging, surface ponding, etc. which may occur under certain flow regimes (ref. PCSWMM – Dual Drainage System Design).</li> <li>This type of modelling study can ultimately be used as a valuable tool to assess the performance of both the major and minor systems, which can be used in long-term capital planning for infrastructure and community improvements.</li> </ul> <p><b>City of Toronto – Basement Flooding Protection Program (BFPP)</b> (ref. 2017 Wet Weather Flow Master Plan Implementation Status Update, April 2017)</p>

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Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>• The BFPP was initially established in the City of Toronto in 2006; at which time, it included 31 priority study areas which had experienced flooding issues from previous major storm events (known issues).</li> <li>• Since 2006, there have been several other severe storm events in the City (notably, the July 8, 2013 event), which resulted in additional study areas being added to the priority list, resulting in a total of 67 study areas to be assessed (including the initial 31 at the start of the program).</li> <li>• Basement Flooding Environmental Assessments (EAs) began in 2007 to assess the capacity of all City owned drainage / sewer infrastructure, including storm, sanitary and combined sewer systems, as well as overland flow routes during severe storms.</li> <li>• <i>A preliminary schedule for undertaking the Basement Flooding EA studies in the study areas was developed in 2015, which estimated that two (2) to three (3) EA studies every two (2) to three (3) years, with the completion of all EA studies for all 67 study areas expected in 2028.</i> <ul style="list-style-type: none"> <li>○ <i>As of the end of 2016, 31 Basement Flooding EA studies (including 29 of the original areas) had been completed.</i></li> <li>○ Note: in the fall of 2019, the City initiated Basement Flooding Capacity Assessment engineering studies for the remaining 21 of the 67 study areas; this is part of the City-wide sewer infrastructure improvement capital program (accelerated process to develop sewer improvement plans within the City's right-of-way) (ref. <a href="https://www.toronto.ca/community-people/get-involved/public-consultations/infrastructure-projects/basement-flooding-investigation-environmental-assessment-studies/">https://www.toronto.ca/community-people/get-involved/public-consultations/infrastructure-projects/basement-flooding-investigation-environmental-assessment-studies/</a>).</li> </ul> </li> <li>• <i>The implementation of the recommended projects from completed Basement Flooding EA studies is prioritized based on a \$32,000 per benefiting property threshold, which was adopted by City Council in 2011 to protect the greatest number of properties as soon as possible, within approved budgets, and in coordination with other capital projects in the area. Recommended projects that meet the \$32,000 cost per benefiting property threshold at the EA stage and preliminary design stage can proceed to detailed design and construction.</i> <ul style="list-style-type: none"> <li>○ <i>As of the end of 2016, an estimated \$1.659 billion of infrastructure improvements have been recommended from the 31 completed Basement Flooding Protection EA studies.</i></li> <li>○ <i>These include approximately 29 kilometers of storm sewer upgrades and 8.2 kilometers of sanitary sewer upgrades.</i></li> </ul> </li> <li>• Basement Flooding Protection Subsidy Program (BFPSP) – offers residential property owners financial assistance of up to \$3,400 per property to install flood protection devices (i.e. backwater valve, sump pump, pipe severance/capping, etc.).</li> </ul> <p><b>Other Best Practices to Consider (under development):</b></p> <ul style="list-style-type: none"> <li>• City of Markham Flood Control Program</li> </ul>

<b>Action A.1</b>	<b>Prepare Dual Drainage Models in Older Neighborhoods (Capacity-Based)</b>
<b>Service Delivery</b>	<b>Plan/Program/Policy/Partnership/Procedure/Project</b>
	<ul style="list-style-type: none"> <li>Halton Region partnership with local Municipalities</li> </ul>
<b>Recommendations</b>	
<b>a. People</b>	Not required.
<b>b. Equipment</b>	<ul style="list-style-type: none"> <li>Modelling Software (hydrologic/hydraulic) to provide City staff with access and use of the models built as part of the studies.</li> </ul>
<b>c. Policy</b>	Not required.
<b>d. Program</b>	<ul style="list-style-type: none"> <li>Prioritize study areas and determine desired frequency of study to establish a schedule for neighborhood assessments.</li> </ul>
<b>e. Methodology</b>	<ul style="list-style-type: none"> <li>Prioritize study areas through ROP partnership for identified sanitary sewer areas with known / identified issues:               <ul style="list-style-type: none"> <li>Building from the ROP Inflow / Infiltration (I/I) Reduction Program, which has prioritized sections of the Region into various “blocks” for individual and in-depth study and assessment of the sanitary sewer system. Prioritization is based upon the severity of potential issues associated with I/I (i.e. flood risks, limiting development growth, risks to the environment and infrastructure, etc.).</li> </ul> </li> <li>Primary focus on older neighborhoods (pre 1970s) with Streetsville as next on the list to-do.</li> <li>Conduct capacity-based assessments of drainage networks (i.e. through dual drainage modelling studies).</li> <li>Training for City staff on software – modeling can be used for other City purposes subsequent to study completion.</li> </ul>
<b>f. Other</b>	
<b>City Commentary</b>	<ul style="list-style-type: none"> <li>Primary focus on areas with identified sanitary sewer/ backup issues / known impacts to residents (i.e. basement flooding):               <ul style="list-style-type: none"> <li>Based upon analyses completed by the City and CVC, urbanized areas with storm sewers can be less resilient than rurally serviced areas to major storm events → indicates potential management impacts as a result of urban site plan designs, including directly connected impervious area and grading to one point (storm sewer), which may lead to more issues of adverse overland flow compared to older rurally serviced neighborhoods (i.e. road side ditches).</li> <li>Review of ROP mapping/issues for I/I and existing backup issues will provide further direction regarding which areas to conduct additional / in-depth studies.</li> </ul> </li> <li>Consider using these models to inform development review team on implementing protective measures. For example, connections are not allowed if the basement elevation is below the 100 year HGL – or no connections are allowed at all in specific areas and sump to grade is the only option.</li> <li>Emerging Changes:               <ul style="list-style-type: none"> <li>Potential upgrades in software – larger scale modelling required</li> </ul> </li> </ul>

<b>Action A.1</b>	<b>Prepare Dual Drainage Models in Older Neighborhoods (Capacity-Based)</b>
<b>Service Delivery</b>	<b>Plan/Program/Policy/Partnership/Procedure/Project</b>
	<ul style="list-style-type: none"> <li>○ Prioritizing risk areas for a proactive approach as opposed to watershed-based studies – focusing detailed assessments on at-risk areas.</li> </ul>

## A.2 Map Groundwater (City-wide) – Future Action

Action A.2	Mapping Groundwater (City-Wide)
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
<b>Description</b>	<ul style="list-style-type: none"> <li>Improving the data/mapping for the groundwater levels across the City will provide a geographic database (mapping) of areas of the City which are at higher risk (high and/or susceptible groundwater levels) and thereby inform decision-making on land development, management practices and infrastructure renewal.</li> <li>Initial project would build from existing database of boreholes (City, ROP, Province) and from this establish estimated first order water levels (seasonally varying where available) followed by site-specific program of gap filling and updating, including strategic field work and GIS.</li> </ul>
<b>Rationale</b>	<ul style="list-style-type: none"> <li>Groundwater levels (seasonally based) can influence the effectiveness and viability of Stormwater infrastructure particularly source-based BMPs, as well as infill/intensification re-builds (i.e. particularly those with deeper basements)</li> <li>Not currently used for municipal planning and development purposes – data would be beneficial to integrate/inform recommendations and restrictions within infill/intensification areas and associated infrastructure renewal.</li> </ul>
<b>a. Best Practices</b>	<p><b>Oak Ridges Moraine (ORM) – Groundwater Program</b></p> <ul style="list-style-type: none"> <li>The ORM is a partnership-based groundwater program, initiated in 2001, involving thirteen (13) agencies and municipalities across the Oak Ridges Moraine; this includes the City of Toronto, regional Municipalities of York, Peel and Durham, and nine (9) local conservation authorities.</li> <li>The ORM program developed a robust database including hydrologic and hydrogeologic data related to legacy boreholes, monitoring wells, water-level measurements, streamflow gauges, climate stations, groundwater pumping, research studies, numerical modeling etc., in order to develop a database to support <i>Data Driven Decision Making</i> for all of its partners.</li> <li>In addition to the database, the ORM partnership produces data mapping and analysis tools including mapping of geology, data stations, and plotted water table and depth to water table, among others.</li> <li>The ORM data sharing has been divided into a “Public” component, with limited data accessible online to everyone, and a “Partner” side which includes additional mapping, analysis, document history, etc.</li> <li>Based on the publicly available mapping, the borehole/well data logs and resulting maps (water table and depth to water table) currently include all of the City of Mississauga.</li> </ul> <p><b>General Procedure</b></p> <ul style="list-style-type: none"> <li>Based on the availability of some existing data through the ORM, the following steps would be reasonable for such a project:</li> </ul>



Action A.2	Mapping Groundwater (City-Wide)
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>Groundwater elevation mapping (potentiometric surface mapping) can be created by plotting the static water levels measured through wells within unconfined and confined aquifers. These water levels can then be used to plot contour lines and determine the pattern/direction of groundwater flow (recharge/discharge).</li> <li>Utilizing existing monitoring networks for initial data gathering to identify available data and the associated gaps is the first step. The sources of data may include: <ul style="list-style-type: none"> <li>Oak Ridges Moraine Database (boreholes, monitoring wells, etc.)</li> <li>Other partnership opportunities for data and analysis may be available through monitoring conducted by the Conservation Authorities (CVC, TRCA), as well as the Region of Peel, through Source Water Protection initiatives.</li> </ul> </li> <li>Groundwater monitoring data can be supplemented based upon borehole data (not necessarily active monitoring stations) <ul style="list-style-type: none"> <li>As part of various geotechnical and structural work completed within and/or by a municipality, subsurface investigation methods including boreholes are often required.</li> <li>These borehole measurements often include observations such as depth to the water table and/or noting of saturated soils; these types of measurements and/or recordings can be used in conjunction with known ground surface elevations (through topographic survey and/or digital elevation models (DEM)) to determine the approx. elevation of the water table at the time of measurement.</li> <li>These water table elevations can then be processed in mapping software (such as ArcGIS) to produce water table maps, infer groundwater flow directions, and can be utilized to identify areas of high susceptibility and/or vulnerability. <ul style="list-style-type: none"> <li>It should be noted that the water table fluctuates both seasonally and over several years, therefore the data would need to be processed against a specified threshold to ensure either the most recent and/or the most conservative depth to water table is utilized in the mapping process.</li> </ul> </li> </ul> </li> </ul> <p><b>Municipal Uses for Data</b></p> <ul style="list-style-type: none"> <li>The resulting Water Table Mapping, can be applied to potential Building Code Amendments to consider Basements Above Groundwater Table (GWT) and limit any potential risks to homeowners: <ul style="list-style-type: none"> <li>Existing Areas – Intensification in Residential Areas <ul style="list-style-type: none"> <li>Basements in redeveloped areas are increasingly deeper- (e.g. 9 ft.) – resulting in buildings at risk/within the groundwater table/Seasonally</li> <li>Potential solution/considerations are OBC refinements to build higher to avoid groundwater – however this presents</li> </ul> </li> </ul> </li> </ul>

Action A.2	Mapping Groundwater (City-Wide)
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<p>different challenges with OBC for height / structural requirements, limiting building height.</p> <ul style="list-style-type: none"> <li>City may be able to, at least, manage risk by warning applicants about implications of deeper basements and possibly put on title to warn future owners.</li> <li>Can also utilize water table mapping for subsurface infrastructure issues (dewatering, mitigation practices) and problem areas relating to high water table elevations, impacting storm sewer capacity and sanitary infiltration.</li> </ul> <p><b>Other Best Practices to Consider (under development):</b></p> <ul style="list-style-type: none"> <li>TBD</li> </ul>
<b>b. Relevant Legislative/Policy /Emerging Practices</b>	Wood – will be an output from the Legislative Checklist (TBC)
<b>Suggested Department and Partnerships</b>	<ul style="list-style-type: none"> <li>Oak Ridges Moraine Groundwater Program</li> <li>MECP – PGMN and Borehole/Well Records</li> <li>Conservation Authorities <ul style="list-style-type: none"> <li>Watershed Monitoring &amp; Modelling</li> </ul> </li> <li>Region of Peel: <ul style="list-style-type: none"> <li>Oak Ridges Moraine Groundwater Program Partner</li> <li>Source Water Protection (Quantity/Quality) – Data/Models</li> <li>Water Level Mapping can support I/I Reduction Programs and Infrastructure Management</li> </ul> </li> <li>Potential Internal City Partnerships: <ul style="list-style-type: none"> <li>City departments which require geotechnical boreholes – development and infrastructure renewal</li> <li>Geotechnical reviews</li> </ul> </li> </ul>
<b>Resource Needs</b>	<ul style="list-style-type: none"> <li>Monitoring / Data Collection</li> <li>Licensing with ORM for use of data as Partner</li> <li>Modelling / Data Processing</li> <li>Mapping</li> <li>Staff and/or Consultants support</li> </ul>
<b>Estimated Costs</b>	Initial Study to compile data, analyze, establish gaps, and define at risk areas is expected to cost <\$250K. follow-on gap filling and plan maintenance costs are not yet known

### A.3 Economic Consideration for Environmental Decision-Making Process – Future Action

Action A.3	Economic Considerations for Environmental Decision-Making Process
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
<b>Description</b>	<ul style="list-style-type: none"> <li>The use of economic tools (e.g. Risk and Return on Investment Tool (RROIT) developed by CVC) can be helpful to evaluate flood and environmental risk mitigation options based on cost-benefits to support environmental assessments and infrastructure feasibility studies.               <ul style="list-style-type: none"> <li>Important to assess feasibility prior to commencing EA studies</li> </ul> </li> <li>Note: This new Action (process development) has been revised from the specific use of the CVC RROIT to a more generic objective related to Economic Considerations for Environmental Decision-Making Process – with an increased focus on Triple Bottom Line factors (broader, increased focus on sustainability); the intent is to allow the City to review multiple forms of integrated economic assessments (including the CVC RROIT) which consider all co-benefits of projects. Through this Action the City will be able to develop its own holistic “made-in-Mississauga” Decision Making Tool, building from the knowledge of others.</li> </ul>
<b>Rationale</b>	<ul style="list-style-type: none"> <li>Environmental projects which address stormwater management needs typically have far reaching impacts to many systems related to the natural and social environment. To systematically and equitably consider the benefits of these projects, in terms of fulsome economics, it is necessary to conduct comprehensive cost-benefit analyses to assess the feasibility of mitigation options and encourage sustainability within the City. The City requires a standardized process to allow it to consider all of the potential economics associated with its stormwater management projects.</li> </ul>
<b>a. Best Practices</b>	<p><b>Risk and Return on Investment Tool (RROIT), Sustainable Technologies, CVC</b></p> <ul style="list-style-type: none"> <li>With support from the National Disaster Mitigation Program, CVC and partners have developed a Risk and Return on Investment Tool (RROIT) to assist municipalities and conservation authorities in the assessment of water infrastructure projects to evaluate cost-effective decisions to reduce flood risks and meet funding requirements.               <ul style="list-style-type: none"> <li><i>Disaster Mitigation Action Fund (DMAF) and Infrastructure Canada’s Climate Change Lens require climate change risk assessments and return on investment analyses as prerequisites for infrastructure funding.</i></li> </ul> </li> <li>The RROIT will perform the following key functions:               <ul style="list-style-type: none"> <li><i>Regional climate change projections</i></li> </ul> </li> </ul>

Action A.3	Economic Considerations for Environmental Decision-Making Process
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>○ Assess baseline flood &amp; erosion risks associated with extreme rainfall events and quantify the potential damages to private and public infrastructure, and vulnerable populations under current and future climate.</li> <li>○ Evaluate and compare risk-reduction achievable by management options (e.g. grey and green stormwater infrastructure, land acquisition, flood proofing etc.)</li> <li>○ Perform a financial assessment of the return on investment associated with each or combination of management options by comparing life cycle costs to the benefits (i.e.: cost savings) achieved by reducing flood risk under various climate change scenarios.</li> <li>○ Identification of high-risk areas that considers social, health, infrastructure and environmental vulnerabilities.</li> </ul> <p><b>City of Calgary – Renfrew Integrated Stormwater Management Pilot Study (September, 2019)</b></p> <ul style="list-style-type: none"> <li>• Integrated Stormwater Management (ISWM) planning is a holistic approach used to identify, evaluate and select cost-effective stormwater management approaches and capital improvement projects to meet multiple goals. This includes a review of alternatives based upon a broad range of economic, environmental and social benefits or damages.</li> <li>• The study examined key capital improvement drivers within the Renfrew community such as flooding, deteriorating water quality and increasing erosion impacts on the receiving stream for existing conditions (2015) and predicted future redevelopment conditions through infill/intensification (2076).</li> <li>• This project included a concurrent and equitable comparison between traditional grey infrastructure, green infrastructure, as well as hybrid grey-green approaches to meet multiple objectives and provide benefits for the pilot study area. <ul style="list-style-type: none"> <li>○ A hydrologic/hydraulic model (PCSWMM) was developed under both existing and future (2076) land use conditions. A 50-year continuous simulation, as well as design storm simulations were completed to characterize the study area.</li> </ul> </li> <li>• The most cost-effective solutions were selected using an optimization and a triple bottom line (TBL) evaluation process: <ul style="list-style-type: none"> <li>○ The application of optimization software objectively identified the type, size and spatial distribution of water management systems that cost-effectively maximize the benefits of these investments.</li> <li>○ The optimization evaluates thousands of alternatives using lifecycle costs and monetized co-benefits to determine the</li> </ul> </li> </ul>

Action A.3	Economic Considerations for Environmental Decision-Making Process
Service Delivery	Plan/Program/Policy/Partnership/ <b>Procedure</b> /Project
	<p>most cost-effective management solutions that meet the defined objectives.</p> <ul style="list-style-type: none"> <li>○ Additional advancements included further evaluation of the optimal scenarios by using a TBL cost evaluation assessment that considered a broad range of economic, environmental and social benefits and damages.</li> <li>• The Triple Bottom Line (TBL) Assessment Approach Included the following aspects: <ul style="list-style-type: none"> <li>○ Economic Factors: <ul style="list-style-type: none"> <li>▪ Life-Cycle Capital Costs</li> <li>▪ Life-Cycle Maintenance Costs</li> <li>▪ Flooding Costs</li> <li>▪ Flood Reduction Benefits</li> <li>▪ Property Value Enhancement</li> </ul> </li> <li>○ Environmental Factors: <ul style="list-style-type: none"> <li>▪ Water Quality Benefits</li> <li>▪ Runoff Volume Reduction Benefits</li> <li>▪ Peak Flow Reduction Benefits</li> <li>▪ Water Reuse Benefits</li> <li>▪ Air Quality Improvements with Bioretention Systems</li> <li>▪ Construction Impacts – Air Emissions Due to Traffic Delays</li> <li>▪ Carbon Sequestration</li> </ul> </li> <li>○ Social Factors: <ul style="list-style-type: none"> <li>▪ Downstream Recreational Value</li> <li>▪ Health Benefits due to Improved Air Quality (Trees and Bioretention)</li> <li>▪ Construction Impacts – Lost Productivity due to Traffic Delays</li> </ul> </li> </ul> </li> <li>• A total of seven (7) different scenarios were assessed, including focus on grey infrastructure only, green infrastructure only and a hybrid between green and grey infrastructure practices.</li> <li>• The alternative scenarios were ranked based upon their net present value (NPV) of life cycle costs and benefits for economic, environmental and societal lenses. The results found that: <ul style="list-style-type: none"> <li>○ The green infrastructure only scenarios had the highest benefit to cost ratio, followed by the hybrid green and grey infrastructure scenarios, and grey infrastructure only having the least benefit to cost ratio.</li> </ul> </li> </ul> <p><b>Other Best Practices to Consider (under development):</b></p> <ul style="list-style-type: none"> <li>• City of Markham – An Economic Analysis of Green and Grey Infrastructure Benefits and Costs, TRIECA Conference 2019</li> </ul>

Action A.3	Economic Considerations for Environmental Decision-Making Process
Service Delivery	Plan/Program/Policy/Partnership/ <b>Procedure</b> /Project
<b>b. Relevant Legislative/Policy /Emerging Practices</b>	Wood – will be an output from the Legislative Checklist (TBC)
<b>Suggested Department and Partnerships</b>	<ul style="list-style-type: none"> <li>• Conservation Authorities <ul style="list-style-type: none"> <li>◦ Riverine Flood Risk Management</li> </ul> </li> <li>• ROP – Input on potential co-benefits related to water and wastewater/One Water opportunities</li> <li>• Sustainable Technologies <ul style="list-style-type: none"> <li>◦ Case Studies to use the RROIT</li> </ul> </li> </ul>
<b>Resource Needs</b>	<ul style="list-style-type: none"> <li>• Hydrologic / Hydraulic Modelling</li> <li>• Financial Modelling and Assessment (i.e. RROIT)</li> </ul>
<b>Estimated Costs</b>	<ul style="list-style-type: none"> <li>• Process Development – research RROIT and others; test in Mississauga setting; advance recommendations - &lt;\$100K</li> </ul>

## A.4 Pursue System-wide ECA – Future Action

Action A.4	Pursue System-Wide ECA
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
<b>Description</b>	<p>In 2020, the MECP proposed to implement a Consolidated Linear Infrastructure Permissions Approach which would adopt system-wide Environmental Compliance Approvals (ECAs) for low-risk municipal sewage works, modelled after the existing permissions framework for municipal drinking water systems (est. 2009).</p> <p>According to the July 2020 proposal, <i>the new consolidated linear infrastructure ECAs will:</i></p> <ul style="list-style-type: none"> <li>• <i>incorporate all the requirements for a municipality's entire sanitary collection system and stormwater management works</i></li> <li>• <i>include updated conditions that will pre-authorize municipalities and prescribed persons (e.g. developers) to make future specified alterations in accordance with the proposed new design criteria</i></li> <li>• <i>include other updated conditions to improve environmental protection and ensure quality and consistency in new construction</i></li> </ul> <p><i>Under the proposed approach, a municipality will no longer need to submit individual pipe by pipe ECAs for future alterations provided that the future alterations are built in accordance with new design criteria and all other ECA conditions. Also, under certain circumstances, and only with municipal approval, other persons such as developers may be able to construct works under the municipality's consolidated linear infrastructure ECA. This will eliminate the need for developers to prepare and submit individual ECAs for sewage works that eventually will be owned by the municipality.</i></p>
<b>Rationale</b>	<ul style="list-style-type: none"> <li>• The pursuance of a system-wide ECA procedure will help to save time and resources of both municipalities and developers through low-risk municipal sewage works (reducing to single city-wide approval as opposed to hundreds in current pipe by pipe approach).</li> <li>• Enhanced environmental protection at the province level through greater understanding of all sewage works province wide. Consistent permission process and design standards applied to all Ontario municipalities.</li> </ul>
<b>a. Best Practices</b>	<p><b>Pilot Study for Stormwater Management LI ECA were completed by Barrie (2016) and Region of Peel (2019).</b></p> <ul style="list-style-type: none"> <li>• In 2018, the Regional Municipality of Peel submitted an application for Environmental Compliance Approval for System-Wide Municipal and Private Sewage Works to MECP using the streamlined Consolidated Linear Infrastructure Permissions framework.</li> <li>• The following information/supporting documentation were submitted in support of the ECA application:</li> </ul>

Action A.4	Pursue System-Wide ECA
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>○ A detailed description of the stormwater management works including identification of storm sewers, ditches/swales, the total length of the system in km and pipe diameters of sections, stormwater management facilities by type including oil and grit separators, lot level, conveyance control and LID facilities and stormwater pumping stations including asset IDs for all works.</li> <li>○ A storm infrastructure map containing the following information: <ul style="list-style-type: none"> <li>▪ Existing municipally owned stormwater works including information regarding storm sewer lengths, diameters, stormwater management facilities, oil &amp; grit separators, LID facilities, Pumping stations.</li> </ul> </li> <li>• The ECA contained conditions, including others, related to the operation and maintenance, reporting, and source water protection. <ul style="list-style-type: none"> <li>○ The Owner shall: <ul style="list-style-type: none"> <li>▪ undertake inspection of condition of the system Works, at least once a year;</li> <li>▪ maintain a logbook to record the results of these inspections and any cleaning and maintenance operations undertaken and keep the logbook at the owner's administration office for inspection by the Ministry;</li> <li>▪ prepare an operations manual for facilities within (12) months of the issuance of date of Approval;</li> <li>▪ prepare and submit a performance report to the District Manager on an annual basis, within ninety (90) days following the end of the period being reported upon;</li> <li>▪ ensure for the Works located within Wellhead Protection Areas (WHPAs), Intake Protection Zones (IPZ), Highly Vulnerable Aquifers (HVA) and Significant Groundwater Recharge Areas (SGRAs), where this activity has been identified as a Significant Drinking Water Threat, there is an operation and maintenance program in place.</li> </ul> </li> </ul> </li> </ul> <p><b>Environmental Compliance Approval for Municipal Stormwater Management Systems – Consultation (Summer 2020)</b></p> <ul style="list-style-type: none"> <li>• In Summer of 2020, MECP carried out consultation to seek input from stakeholders about the CLI ECA framework. The presentation delivered as part of the consultation efforts provided some valuable information about the process and the efforts municipalities will have to undertake to obtain the ECA and terms and conditions that they can expect to be stipulated in the ECA.</li> <li>• The ECA should include the following information:</li> </ul>



Action A.4	Pursue System-Wide ECA
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>○ A summary description of the works that comprise the Municipal Stormwater Management System <ul style="list-style-type: none"> <li>▪ Identification of components of the stormwater management system, including storm sewers, ditches/swales, and the total length of the system in km</li> <li>▪ Identification of stormwater management facilities by type including oil and grit separators, wet/dry stormwater management ponds, LID facilities and pumping stations.</li> </ul> </li> <li>○ A map containing the following information: <ul style="list-style-type: none"> <li>▪ Existing municipally owned stormwater works (including asset IDs);</li> <li>▪ Identification of main tributaries and receiving water bodies that the works discharge to (including asset IDs);</li> <li>▪ Delineation of municipal watershed and subwatershed boundaries as available;</li> <li>▪ Identification of storm sewersheds for each outlet;</li> <li>▪ Identification of any source protection vulnerable areas;</li> <li>▪ Identification of any stormwater works that receive sanitary overflows.</li> </ul> </li> <li>• The inspection requirements that the municipalities can expect include the following: <ul style="list-style-type: none"> <li>○ All SWM facilities pre-authorized are to be inspected at least once a year</li> <li>○ All existing SWM facilities and outfalls to receivers to be inspected within three years</li> <li>○ Inspection records shall at a minimum include: <ul style="list-style-type: none"> <li>▪ Name of the inspector;</li> <li>▪ Asset ID of the Works inspected;</li> <li>▪ Date and time of each inspection;</li> <li>▪ Relevant observations, depending on the type of Stormwater Management works</li> </ul> </li> <li>○ Inspection requirements for erosion and sediment control measures during construction</li> </ul> </li> <li>• There will be monitoring requirements as well including the following: <ul style="list-style-type: none"> <li>○ Develop a monitoring plan, within 1 year of ECA issuance <ul style="list-style-type: none"> <li>▪ Peer-reviewed by a third-party qualified person</li> <li>▪ Can be jointly developed in partnership with owners of other municipal stormwater systems within the same watershed</li> </ul> </li> <li>○ Monitoring Plan includes: <ul style="list-style-type: none"> <li>▪ Identification of works and key receivers to be monitored</li> <li>▪ Consideration of relevant municipal land use and environmental planning documents</li> <li>▪ Monitoring program that includes water quality/quantity characterization; water quality and quantity goals;</li> </ul> </li> </ul> </li> </ul>

Action A.4	Pursue System-Wide ECA
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<p>parameters (hydrological, chemical, physical, biological); methodology</p> <ul style="list-style-type: none"> <li>Implementation plan: describe if works are monitored on a rotational basis</li> <li>Adaptive management: how will the monitoring data inform decisions</li> </ul> <ul style="list-style-type: none"> <li>There will be a requirement to submit within 3 years of issuance of the ECA, an inventory of the storm sewersheds and including the classification according to stormwater management level: <ul style="list-style-type: none"> <li>Level A - Treatment for water quality and quantity prior to environmental discharge</li> <li>Level B - No treatment for water quality prior to environment discharge</li> </ul> </li> </ul> <p><b>Transfer of Review (TOR) Program:</b></p> <ul style="list-style-type: none"> <li>An integral component of this transition to CLI ECA approach is the phase out of the TOR Program which used current pipe by pipe approach. Region of Peel currently participates in the Transfer of Review program for stormwater management works in the City of Mississauga only (Type C).</li> <li>The Ministry will work with TOR municipalities to ensure a smooth transition to the proposed LI ECA framework and will be open to discussions regarding continuation of TOR Program for private non-industrial works within municipal boundaries.</li> </ul> <p><b>Other Best Practices to Consider:</b></p> <ul style="list-style-type: none"> <li>City of London – LI ECA</li> </ul>
<b>b. Legislation/Policy Existing</b>	<p>Wood – will be an output from the Legislative Checklist (TBC)</p> <ul style="list-style-type: none"> <li>Regulation 208/19 - Environmental Compliance Approval Regulation In Respect Of Sewage Works Regulation.</li> <li>Use the authority of the "Prescribed Persons Regulation" (O. Reg. 208/19)</li> </ul>
<b>Suggested Department and Partnerships</b>	<ul style="list-style-type: none"> <li>MECP – regulatory agency</li> <li>ROP – dual tiered municipality</li> </ul>
<b>Resource Needs</b>	<ul style="list-style-type: none"> <li>Continue to develop detailed database and mapping of watersheds, sewersheds, watercourses, storm sewer infrastructure, SWM facilities, levels of control, inspection history, etc.</li> <li>Continue to advance asset management (GIS inventory) in preparation for City-wide summary</li> </ul>
<b>Estimated Costs</b>	<ul style="list-style-type: none"> <li>Based upon the MECP Presentation for the LI ECA application, there is a \$100 application fee associated with obtaining a LI ECA.</li> </ul>

Action A.4	Pursue System-Wide ECA
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>○ <i>Administrative consolidation of existing works, ministry technical review not required.</i></li> <li>• Additional costs associated with database preparation are reflected in other City actions and programs.</li> </ul>

A.5 Water Sustainability Plan – Future Action (New to Fill Gap from Checklist)

Action A.5	Water Sustainability Plan
Service Delivery	Plan/Program/Policy/Partnership/Procedure
Description	
Rationale	
a. Best Practices	
b. Legislation/Policy Existing	
c. Legislation/Policy Emergency	
Suggested Department and Partnerships	
Resource Needs	
Estimated Costs	

## B. Create Solutions (Design & Implementation)

Theme B: *Create Solutions (Design & Implementation)* is comprised of the following Actions:

- *B.1 Strategic Land Acquisition of Flood Vulnerable Lands (Riverine) – Future Action*
- B.2 Low Impact Development for Roads Program – Existing Action
- *B.3 City-Wide Flood Control Retrofit Project – Future Action*
- *B.4 Open Ditch Management Strategy – Future Action*
- B.5 Groundwater Management – Existing Action
- *B.6 Cooling BMPs – Future Action*

*B.1 Strategic land acquisition of flood vulnerable lands (riverine) – Future Action*

Action B.1	Strategic Land Acquisition of Flood Vulnerable Lands (Riverine)
Service Delivery	Plan/ <b>Program</b> /Policy/Partnership/Procedure/Project
<b>Description</b>	<ul style="list-style-type: none"> <li>Program to acquire land in flood vulnerable areas, including easement acquisition through development and/or for capital project delivery (e.g. erosion control, flood mgmt)</li> <li>The City currently has a parkland acquisition initiative in Cooksville Creek watershed – this is primarily focused on creating park land where lands are currently known to be at-risk of flooding, which inherently supports stormwater management objectives (risk-abatement). <ul style="list-style-type: none"> <li>Despite experiencing flooding, some residents still refusing City buy-out</li> </ul> </li> <li>Current approach is not proactively or strategically searching for land acquisition on a programmed basis – rather potential surplus lands are evaluated when for sale, internal process to declare if surplus or not.</li> <li>No dedicated funding source or realty arm at City to acquire land for express purpose of flood mitigation. <ul style="list-style-type: none"> <li>Realty acquisitions are more typically focused on project lands, encroachments, easements.</li> </ul> </li> </ul>
<b>Rationale</b>	<ul style="list-style-type: none"> <li>Systematic and informed approach required to consider/acquire lands at risk of flooding consistently across its jurisdictional area, measure against defined parameters to remove subjectiveness, as currently the approach is mostly reactionary <ul style="list-style-type: none"> <li>Consider areas where acquisition may be more palatable, e.g. second choice rather than last. Consider stakeholder meetings/consultation in-advance.</li> <li>Establish prioritization based on flood risk frequency, e.g. areas with 5-year flooding frequency are more impacted than 100-year flood frequency, easier to communicate risks where documented evidence is available as opposed to theoretical predictions.</li> <li>Include a rigorous and supportable cost-benefit process</li> </ul> </li> </ul>
<b>a. Best Practices</b>	<ul style="list-style-type: none"> <li>Collectively, Mississauga is aligned with other municipalities regarding challenges with land acquisition (e.g. legal issues associated with expropriation, no guaranteed resolution, public opposition).</li> </ul> <p><b>Managed Retreat from High-risk Flood Areas: Design Considerations for Effective Property Buyout Programs (Thistlethwaite, Henstra, Ziolecki, April 2020)</b></p> <ul style="list-style-type: none"> <li>This policy brief conducts a review of property buyout programs in the United States and Canada, in order to provide recommendations for future property buyout programs in an effort to manage flooding in Canada with increased risk due to climate change.</li> <li>This brief outlined <b>five (5) key considerations</b> for the design of successful property buyout programs:</li> </ul>

Action B.1	Strategic Land Acquisition of Flood Vulnerable Lands (Riverine)
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>○ <b>Timing</b> – Most buyout programs in the US and Canada are initiated after a flooding event, when the damage has already occurred; this can lead to an emotionally charged atmosphere making it difficult to have meaningful engagement with stakeholders. Additionally, there are often large time gaps between the flood event and the compensation (5 plus years to complete transactions). <ul style="list-style-type: none"> <li>▪ Programs initiated before flood damage occurs can allow for significant stakeholder engagement as part of the initial program design stages, to have stronger social acceptance in the effected communities. If proposed buyout programs are embedded as part of local climate change adaptation strategies, they can become more politically supported as part of long-term community planning.</li> </ul> </li> <li>○ <b>Coerciveness</b> – There are two (2) different methods for property buyout programs, namely voluntary programs, where the homeowner ultimately decides, or mandatory property acquisition, where the government takes over the property through its legal powers. Most buyout programs in the US and Canada are voluntary, whereas an example of mandatory acquisition includes the aftermath of Hurricane Hazel in 1954, when the Government of Ontario purchased over 200 properties impacted by the flood events; this program is considered “one of the most effective buyout programs in Canadian history”. <ul style="list-style-type: none"> <li>▪ Voluntary buyouts are considered to be more politically feasible and socially acceptable, however these are often less effective in reducing the evident flood risk. As an example, <i>less than 40 percent of eligible property owners agreed to buyouts from the Alberta government after flooding in 2013 (McGillivray 2017), resulting in isolated homes separated by vacant lots that cost approximately \$80,000 annually to maintain (Rieger 2018).</i> Governments will have to continue to fund for flood protection measures for the homeowners who remain in the flood risk areas.</li> </ul> </li> <li>○ <b>Compensation</b> – The level of compensation has a significant impact on the participation and effectiveness of the buyout program; these are namely focused on either providing compensation based upon pre-flood market value, or post-flood market value. <i>Pre-flood market values are typically higher, so programs designed in this way are more expensive, but they are also more socially acceptable. Offering post-flood market value lowers the costs of the program, making it more politically feasible and economically efficient, but reduces social acceptability and therefore threatens participation rates (Siders 2019).</i> <ul style="list-style-type: none"> <li>▪ Research suggests compensation must be adequate for property owners to replicate their current quality of life in another area.</li> </ul> </li> </ul>

Action B.1	Strategic Land Acquisition of Flood Vulnerable Lands (Riverine)
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<p><i>Decisions about pre- or post-flood valuations often fail to consider that the value of properties in areas suitable for relocation can exceed those in areas targeted for acquisition (Binder and Greer 2016). For example, New York State's program to buy out properties affected by coastal flooding from Hurricane Sandy included incentives ranging from five to 15 percent above pre-flood market appraisal, with the most generous incentives given to property owners who relocated to low-risk areas protected from future flooding (Contant 2019)</i></p> <ul style="list-style-type: none"> <li>○ <b>Eligibility</b> – Defining the eligibility of a property within the property buyout program is a critical element in program development. Cost-benefit analyses are often used to determine if the future disaster losses/damages exceed the cost of acquiring a property. Other criteria which have been applied in other Canadian provinces including Quebec, New Brunswick and British Columbia include applying damage thresholds (i.e. damages exceeding 50% of the property value) and geography within the flood zone (i.e. properties within the 50-year floodplain). <ul style="list-style-type: none"> <li>▪ Transparency regarding the eligibility requirements and criteria defining the buyout zone is required in order to maintain trust and understanding among the community. Lack of transparency can result in less confidence in the program and thereby being undermined if decisions are regarded as arbitrary (Binder and Greer 2016).</li> </ul> </li> <li>○ <b>Governance</b> – Local municipalities are typically initiating buyout programs, as they are responsible for land-use planning and regulating development; there are potential conflicts of interest involving local governments, as they also rely heavily on property taxes and particularly those of high-value properties along shorelines. <i>Moreover, many local governments lack the financial resources and administrative capacity to design and implement an effective buyout program.</i> <ul style="list-style-type: none"> <li>▪ Local governments are encouraged to explore partnerships with provincial and federal governments for property buyout programs; given the provincial government's superior fiscal capacity and legal authority, and the federal government's nationwide mandate and policy commitment to disaster risk reduction, they can both provide support to local governments.</li> </ul> </li> <li>• Based upon the policy review, this brief outlined three (3) recommendations which can assist Canadian municipalities in managing climate change flood risk (fluvial – riverine flooding): <ul style="list-style-type: none"> <li>○ <b>Identify priority areas for managed retreat</b> – Identifying areas most at risk of flooding (hazard exposure) as well as vulnerability to the flooding impacts, which includes social, economic and</li> </ul> </li> </ul>



Action B.1	Strategic Land Acquisition of Flood Vulnerable Lands (Riverine)
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<p>demographic indicators which may indicate the capacity to cope with and recover from these flood hazards.</p> <ul style="list-style-type: none"> <li>○ <b>Document experiences with property buyout programs to aggregate knowledge on best management practices.</b> – Past records of buyout programs in the US are maintained by FEMA and has allowed for detailed research regarding the associated strengths and weaknesses for lessons learned. There is currently no comparable database for Canadian examples, indicating the lack of available information for what has been successful or reasons for failure.</li> <li>○ <b>Build partnerships to support managed retreat.</b> – Partnerships with common goals/interests in managing high-risk flood areas should be formed to combine knowledge and resources for the common cause; these may include all three (3) levels of government, private sector partners (i.e. insurers and risk modelers) and non-government organizations which work with flood-prone communities could all offer knowledge, expertise and advice on how to properly execute buyout programs.</li> </ul> <p><b>Other Best Practices to Consider (under development):</b></p> <ul style="list-style-type: none"> <li>• City of Calgary (post 2013 flood events)</li> <li>• City of Ottawa &amp; City of Gatineau (post 2017 flood events)</li> </ul>
<b>b. Relevant Legislative/Policy /Emerging Practices</b>	Wood – will be an output from the Legislative Checklist (TBC)
<b>Suggested Department and Partnerships</b>	<ul style="list-style-type: none"> <li>• Conservation Authorities – access to riverine modelling and floodplain mapping and identification of riverine flood vulnerable areas for consideration.</li> <li>• Provincial and Federal Government for disaster assistance.</li> <li>• Public / Stakeholders/Neighbourhood Associations</li> <li>•</li> </ul>
<b>Resource Needs</b>	Initial consultant led studies to establish flood risk areas based on fluvial and pluvial systems. Based on outcomes, establish flood risk lands acquisition priorities using a systemic approach including cost-benefit analyses. Coordinate property appraisals in key areas. Initiate neighbourhood based consultation. Develop funding for multi-year buy-out program.
<b>Estimated Costs</b>	Initial costs will be limited to City-wide investigations leading to a recommended buy-out program; Study < \$250K; Buy-outs - \$TBD

## B.2 Low Impact Development for Roads Program – Existing Action

Action B.2	Low Impact Development for Roads Program
Service Delivery	Plan/ <b>Program</b> /Policy/Partnership/Procedure/Project
<b>Description</b>	<ul style="list-style-type: none"> <li>Retrofit program with conveyance controls (LID BMPs), coordinated with road rehabilitation program (i.e. resurfacing) to identify opportunities to implement LID BMPs throughout the City as part of Road Right-of-Ways (ROWs).</li> <li>Program has become more formalized for the ES group since 2015, including a regular review program.</li> <li>Approx. 14 LID BMP retrofits completed as of 2020, projects typically 100m or less, assessed as opportunities with road projects</li> <li>Currently selection process is more intuitive than systematic; manual review of servicing, grades, profiles, outlets etc. – Opportunistic approach to identify maximum or optimum benefits (e.g. 100m of 1km project, or determine not worthwhile) <ul style="list-style-type: none"> <li>Staff has interest in the process to be more formalized, i.e., standardized selection/evaluation criteria and decision framework</li> </ul> </li> <li>LID BMP design completed by separate consultant (not roadway consultant, typically sub or WRS consultant)– concepts brainstormed with City, then incorporated into road project. Road rehabilitation design package, LID BMPs are specified and made part of road tender.</li> <li>No standard or defined runoff capture/treatment goal (i.e., volume/surface area) – based on what ever the maximum benefit can be achieved through these opportunities.</li> </ul>
<b>Rationale</b>	Roadway rehabilitation works offer an excellent opportunity to improve stormwater management in areas that are currently underserved. Through the City's Road Retrofit program, LID BMPs are increasingly being designed / implemented as a standard SWM practice completed as part of City roadway projects; this leads to stormwater management benefits of LID BMPs as a SWM measure, as well as increased public education and awareness through LID BMP capital projects. Developing a formalized decision framework for LID BMP project sites would improve the structure and transparency of the program, and lead to defined Standards of Practice (SOPs) for retrofit LID BMP design and implementation, in road ROWs.
<b>Department/Division/Section</b>	T&W/IPES/ES
<b>Partnerships</b>	<ul style="list-style-type: none"> <li>Internal: Roads group, WOM (maintenance requirements), Capital Works</li> <li>CVC monitoring partnerships of effectiveness of LID BMPs (infiltration, temperature mitigation, based on performance data) <ul style="list-style-type: none"> <li>E.g. - CVC is currently conducting a three-year monitoring program to assess the performance of various LID facilities in the City. Five (5) facilities have been identified for monitoring, and works include water quality (i.e. soil sampling), water quantity (i.e. precipitation monitoring), and data analysis tasks. This program will also develop long-term monitoring plans for each facility.</li> </ul> </li> </ul>

<b>Action B.2</b>	<b>Low Impact Development for Roads Program</b>
<b>Service Delivery</b>	<b>Plan/Program/Policy/Partnership/Procedure/Project</b>
<b>FTEs</b>	Two (2) Individuals – approx. 0.30 FTE
<b>Equipment</b>	N/A
<b>Annual Budget (Capital budget, O&amp;M, Year)</b>	<p>Annual recurring budget:</p> <ul style="list-style-type: none"> <li>\$250,000 every year for design/construction capital</li> <li>Part of overall city-wide O&amp;M – premium costs due to specific maintenance needs not clearly definable.</li> </ul>
<b>Relevant Legislative/Policy/ Emerging Practices</b>	<ul style="list-style-type: none"> <li>Should MECP implement mandatory runoff volume control guidelines (LID SWM Guidance Manual (DRAFT), MECP 2017), City considers it well positioned to implement, acknowledging large volume that will need to be managed</li> </ul>
<b>Industry Best Practices</b>	<p><b>City of Toronto – Green Streets Technical Guidelines &amp; the Green Infrastructure (GI) Selection Tool and Vegetation Selection Tool</b> (ref. Green Streets Technical Guidelines, Toronto, November 2017)</p> <ul style="list-style-type: none"> <li><i>Toronto's Green Streets Technical Guidelines (GSTG) provides direction for the planning, design, integration and maintenance of a range of green infrastructure (GI) options appropriate for Toronto street types and conditions.</i></li> <li><i>The Guideline document was developed on behalf of the City of Toronto to assist City staff, developers and consultants to better understand planning, design, operations &amp; maintenance and monitoring requirements for GI solutions.</i></li> <li><i>GI and Vegetation Selection Tools that accompany the document are designed to first identify site specific GI options that are viable for implementation as part of a street retrofit or reconstruction project and then determine plant species that would be context appropriate (where applicable).</i></li> <li>The GSTG has outlined numerous GI options/solutions appropriate for the City of Toronto based upon previous study. These GI options have been organized into four (4) categories relating to the Toronto Green Standard (TGS) primary priorities / objectives. Recognizing that there will be various co-benefits to GI solutions, the four (4) categorized priorities and associated examples of the types of GI solutions, include the following: <ul style="list-style-type: none"> <li><i>Ecology</i> – i.e. urban forest cover, native plantings, ecopassages, etc.</li> <li><i>Air Quality</i> – i.e. green walls, street trees, planter boxes, etc.</li> <li><i>Greenhouse Gas (GHG) &amp; Energy Efficiency</i> – i.e. LED lighting, solar panels, solar roads, cool pavements, etc.</li> <li><i>Water Quality, Quantity &amp; Efficiency</i> – i.e. bioretention, rain gardens, swales, green gutters, underground infiltration systems, etc.</li> </ul> </li> <li>The GI Selection Tool is an MS Excel-based system which allows the user to assess either new or retrofit projects against a variety of</li> </ul>

Action B.2	Low Impact Development for Roads Program
Service Delivery	Plan/ <b>Program</b> /Policy/Partnership/Procedure/Project
	<p>selection parameters and specific site criteria in order to generate a refined list of relevant GI options.</p> <ul style="list-style-type: none"> <li>• The selection criteria imbedded in the tool include the following categories: <ul style="list-style-type: none"> <li>○ <i>Street Types</i>: The street type is critical in determining the types of applications and design objectives, as well as the form and aesthetics of potential GI options. As such, this is the first parameter assessed by the tool. The street types are consistent with the TGS manual, including sixteen (16) different street types such as: <ul style="list-style-type: none"> <li>▪ Civic Streets, Downtown &amp; Centers Main Streets, Park Streets, Neighborhood Residential Streets, etc.</li> </ul> </li> <li>○ <i>Applications</i>: The Applications selection parameter refers to the areas within a typical right-of-way where GI practices are suitable and/or proposed (if known at the time of design). These applications include twenty-one (21) different areas, such as: <ul style="list-style-type: none"> <li>▪ Frontage and Marketing Zones, Curbside Space, Medians / Raised Islands, etc.</li> </ul> </li> <li>○ <i>Physiography</i>: Site descriptions relating to physiography, biophysical and hydrologic conditions are important in determining the possible GI options as well as their functionality in providing a solution. The tool utilizes reference maps based upon City GIS data to establish site conditions for the following parameters: <ul style="list-style-type: none"> <li>▪ Topography, Depth to Water Table, Depth to Bedrock, Soil Permeability, and Contamination.</li> </ul> </li> <li>○ <i>Open Space Context</i>: This selection parameter considers the relationship between the ecological benefits of the GI options and the Natural Heritage System (NHS). The GI Selection Tool incorporates the connections to adjacent Natural Areas (i.e. Ravine) as well as Open Space (i.e. Park, Hydro/Utility Corridor).</li> <li>○ <i>Storm Sewer Infrastructure</i>: This selection parameter identifies if the storm sewer infrastructure includes combined sewers, or separated sewers; this differentiation will allow for the GI option to potentially be focused on differing priorities (i.e. quantity control focus in combined sewer areas).</li> <li>○ <i>Transit Infrastructure</i>: The tool incorporates known transit infrastructure, referring to all fixed transit routes above and below grade (i.e. Subways and LRT lines) which might impact and eliminate certain GI options.</li> <li>○ <i>Infrastructure Utilities</i>: Utilities are one of the greatest barriers to the implementation of GI options, as utilities often comprise a large and complex part of the ROW. The GI Selection Tool identifies any potential considerations for various GI options in close proximity to a variety of utility operations, including:</li> </ul> </li> </ul>

Action B.2	Low Impact Development for Roads Program
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>▪ Natural Gas, Hydro / Electrical, Bell Canada, Rogers, Enwave, Oil, Water, Sanitary Sewer, Street Lights, Service Laterals</li> <li>○ <i>Known Flooding</i>: Identifying known flood risks is a critical step in the selection of GI options. The GI Selection Tool evaluates the site's "Proximity to Basement Flooding" (Within, Outside or Contributing to a Flood Prone Area), in order to determine if runoff attenuation and quantity control should be optimized in the GI selection and design.</li> <li>○ <i>Urban Forest</i>: The GI Selection Tool identifies the existing level of Urban Forest canopy within a study area. In areas where existing Urban Forest canopy is low, tree planting is a priority, versus when existing Urban Forest canopy is high, priorities for GI options may shift.</li> <li>○ <i>Watershed Context</i>: The Watershed Context selection parameter is related to identifying erosion vulnerability in a receiving watercourse. If erosion vulnerability is found to be high, the GI option will be focused on quantity control through attenuation and infiltration.</li> <li>○ <i>Operations &amp; Maintenance</i>: The GI Selection Tool includes considerations for existing operations and maintenance regimes which may impact the selection and siting of potential GI options. These include considerations for: <ul style="list-style-type: none"> <li>▪ Garbage/Solid Waste (i.e. cannot obstruct access for garbage removal), and Winter Maintenance Protocols (Salt or Sand applications).</li> </ul> </li> </ul> <p><b>Other Best Practices to Consider:</b></p> <ul style="list-style-type: none"> <li>• City of Kitchener – Integrated Stormwater Management Master Plan – LID Road Retrofit &amp; Green Street Projects</li> <li>• City of Nashville – Green and Complete Streets</li> <li>• City of Ottawa – Low Impact Development Screening/Selection Tool</li> <li>• CVC – Low Impact Development Road Retrofits: Road Right-of-Way</li> <li>• City of Guelph – Road ROW example as part of Clair Maltby greenfield development</li> </ul>
Recommendations	
<b>a. People</b>	<ul style="list-style-type: none"> <li>• Confirm the need for additional staff with the City – possibility to combine with other actions</li> </ul>
<b>b. Equipment</b>	<ul style="list-style-type: none"> <li>• Selection tool / decision framework to be developed via software, database gathering, City policy, etc.; City staff training in use of tool to conduct standardized assessments</li> </ul>
<b>c. Policy</b>	<ul style="list-style-type: none"> <li>• Develop formalized documentation – Standard Operating Procedure (SOPs) for the program (i.e. site selection criteria, LID options based upon site, construction procedure, monitoring requirements, etc.)</li> </ul>

Action B.2	Low Impact Development for Roads Program
Service Delivery	Plan/ <b>Program</b> /Policy/Partnership/Procedure/Project
<b>d. Program</b>	<ul style="list-style-type: none"> <li>Continue program with developed decision framework/selection tool to formalize process, proactively assess feasible locations requiring additional quality control improvements.</li> <li>Training for staff for use of the tool and LID construction/monitoring</li> </ul>
<b>e. Methodology</b>	<ul style="list-style-type: none"> <li>Build upon the work/tools developed by others (i.e. City of Toronto, TRCA, CVC)</li> </ul>
<b>f. Other</b>	<ul style="list-style-type: none"> <li>Continue working with partners (i.e. CAs) for monitoring, performance reporting, fact sheet development, public education and outreach, etc.</li> <li>Could be combined with efforts for research and development of cooling BMPs (Action B.6)</li> </ul>
<b>City Commentary</b>	<ul style="list-style-type: none"> <li>Implement a formalized decision framework for selection/evaluation criteria of roadways to assist in planning for Green Street implementation.</li> <li>Document further – SOPs to develop/formalize the program</li> <li>Standard road ROW Cross-Sections – LID BMPs not included as part of standard requirement in Cross-Sections, therefore can be difficult to incorporate/find sufficient space after all other mandatory elements are addressed– ideal solution would be incorporating LID as a standard requirement.</li> </ul>

**B.3 Flood Control Retrofit Projects (City-wide) – Future Action**

Action B.3	Flood Control Retrofit Projects (City-wide)
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
<b>Description</b>	<ul style="list-style-type: none"> <li>Project to determine location and feasibility for flood control retrofits in largely uncontrolled watersheds (e.g. Cooksville Creek) – conceptual example provided for a SWM pond in the downtown core (Square One area) which could be designed as a community/recreational feature and thereby provide multiple co-benefits to the community in addition to SWM benefits.</li> <li>Important to consider the land value and ownership of lands being impacted by flood control storage as part of feasibility review, as the economics may favour maintaining urban development zoning over flood control uses. [Note: The open space land area in the downtown core which originally sparked the idea is privately owned and proposed for development.]</li> <li>Broader-based, systematic review required for “storage” solutions (surface and subsurface) on private and public lands.</li> <li>Retrofit opportunities are expected to arise as part of “re-development” over next decade plus. Note that Retrofit opportunities have been reviewed and explored for Cooksville Creek, Little Etobicoke Creek and Malton</li> </ul>
<b>Rationale</b>	<ul style="list-style-type: none"> <li>Several parts of the City are at-risk of flooding (fluvial and pluvial); a comprehensive project is required to assess the potential to remediate this flood risk (either fully or partially) by retrofitting lands and facilities by providing system storage. Multi-functional benefits of spaces dedicated to flood control should also be considered in the value assessment.</li> <li>At the time of this writing, accepted modeling practices do not account for storage facilities for floodplain reduction. In other words, capital investments in flood storage may not reduce floodplains. Despite this, municipalities are not discouraged from implementing flood storage due to actual benefits offered in-situ as a result of flow reduction.</li> </ul>
<b>a. Best Practices</b>	<p><b>Cooksville Creek Vulnerability Assessment (Phase II), Nodelcorp, RSI and CVC, April 2018</b></p> <ul style="list-style-type: none"> <li>Risk and Financial Analysis Methodology (RSI, January 2018) <ul style="list-style-type: none"> <li>Through the study of Cooksville Creek, eleven (11) new stormwater management facilities are planned and/or have been constructed in an effort to provide runoff attenuation during the 2- through 100-year design storm events (quantity control). <ul style="list-style-type: none"> <li>Of these facilities, three (3) are expected to be above ground ponds (open ponds), with the remainder being underground storage facilities.</li> </ul> </li> <li>The resulting quantity control and reduction of peak flows discharging to Cooksville Creek can reduce the severity and extent</li> </ul> </li> </ul>

Action B.3	Flood Control Retrofit Projects (City-wide)
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<p>of riverine flooding, riverine erosion, and the associate risks of damages and to public safety.</p> <ul style="list-style-type: none"> <li>Conceptual Modelling of Causal and Risk Mitigation Pathways (2018) <ul style="list-style-type: none"> <li>Financial analysis was completed for various SWM options considered for the Cooksville Creek watershed, including the installation of the planned SWM ponds.</li> <li>The financial analysis was completed for both Historical and Future Climate Conditions, to demonstrate the cost-benefits under both climatic conditions; the results demonstrated that the installation of ponds is significant and financially viable under both climate scenarios.</li> <li>The impact of the proposed SWM ponds in reducing riverine flooding within the Cooksville Creek watershed was reflected in the financial analysis through very positive cash flows, yielding very strong Internal Rate of Return (IRR) and Net Present Value (NPV) values: <ul style="list-style-type: none"> <li><i>Payback periods of between nine (9) and twelve (12) years.</i></li> <li><i>The IRR for the Future Climate is 29.9% while the IRR in the Historical Climate is 10.6%.</i></li> <li><i>The NPV in the Future Climate is \$260.9M and in the Historical Climate \$69.3M.</i></li> </ul> </li> <li>These financial results demonstrate the significant cost-benefit relationship for the SWM pond design and construction in mitigating the riverine flood risks within a watershed.</li> </ul> </li> </ul> <p><b>Other Best Practices to Consider (under development):</b></p> <ul style="list-style-type: none"> <li>Cooksville Creek Flood Evaluation Study, Aquafor Beech, July 2012</li> <li>Fourteen Mile Creek &amp; McCraney Creek Flood Mitigation Opportunities Study, Amec, 2014</li> <li>Town of Oakville Flood Prioritization Study, Phillips Engineering, 2008</li> </ul>
<b>b. Relevant Legislative/Policy /Emerging Practices</b>	Wood – will be an output from the Legislative Checklist (TBC)
<b>Suggested Department and Partnerships</b>	<ul style="list-style-type: none"> <li>Conservation Authorities <ul style="list-style-type: none"> <li>Riverine Flood Risk Management</li> <li>Risk and Return on Investment Tool (RROIT)</li> </ul> </li> <li>City's Community Services (CMS) department (Culture, Fire and Emergency, Library, Parks, Forestry and Environment, Recreation).</li> </ul>
<b>Resource Needs</b>	<ul style="list-style-type: none"> <li>Modelling – hydrologic / hydraulic to identify flood vulnerable watersheds lacking traditional SWM (quantity / quality)</li> <li>Mapping – floodplain delineations, land uses for planning purposes and potential site selections.</li> <li>Use of RROIT in other watersheds to determine areas which would benefit most from retroactive SWM</li> </ul>



<b>Action B.3</b>	<b>Flood Control Retrofit Projects (City-wide)</b>
<b>Service Delivery</b>	<b>Plan/Program/Policy/Partnership/Procedure/Project</b>
<b>Estimated Costs</b>	<ul style="list-style-type: none"> <li>Costs for retrofit facilities will vary on location, type, size and function of the proposed SWM facility.</li> <li>&lt; \$250K for Study</li> </ul>

*B.4 Open Ditch Management Strategy – Future Action*

Action B.4	Open Ditch Management Strategy
Service Delivery	Plan/ <b>Program</b> /Policy/Partnership/Procedure/Project
<b>Description</b>	<ul style="list-style-type: none"> <li>Develop program(s) to prioritize and maintain urban areas of the City with a rural servicing standard (i.e. roadside ditches) and culvert assets within the City; activities would include: <ul style="list-style-type: none"> <li>re-ditching, culvert replacement/rehab, headwall/ endwall repairs or replacement.</li> </ul> </li> <li>Incorporate the program more thoroughly into Stormwater AM plan (i.e. valuation, risk assessments etc.)</li> </ul>
<b>Rationale</b>	<ul style="list-style-type: none"> <li>The ditch and culvert network provides stormwater conveyance in older neighbourhoods of the City. It's essential this system is maintained in a SOGR to mitigate local flooding in the road network and on private lands</li> </ul>
<b>c. Best Practices</b>	Best Practices Under Development: <ul style="list-style-type: none"> <li>Town of Oakville – Stormwater Master Plan – under development</li> </ul>
<b>d. Relevant Legislative/Policy /Emerging Practices</b>	Wood – will be an output from the Legislative Checklist (TBC)
<b>Suggested Department and Partnerships</b>	<ul style="list-style-type: none"> <li>Roads (TAM), WOM, Capital Works</li> </ul>
<b>Resource Needs</b>	<ul style="list-style-type: none"> <li>Staff time related to: <ul style="list-style-type: none"> <li>Minor Ditch/Culvert network needs to mapped properly in GIS (e.g. assign asset IDs)</li> <li>Need to develop formal inspection/ condition assessment program in Stormwater group (Stormwater co-op student?)</li> <li>Surveying, Headwall repair/ replacement, Culvert Replacement (WOM-internal or contracted out)</li> </ul> </li> </ul>
<b>Estimated Costs</b>	<ul style="list-style-type: none"> <li>Existing City Operating Budget Cost for Ditch &amp; Culvert Repairs &amp; Construction" is ~\$233K/year; including \$50K for contractor.</li> </ul>

## B.5 Groundwater Management – Existing Action

Action B.5	Groundwater Management
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
<b>Description</b>	<p>Currently, the City allows proponents to discharge groundwater from development sites to the storm sewer system under two scenarios:</p> <ul style="list-style-type: none"> <li>• <i>Scenario 1 - Temporary Discharge</i> (i.e. construction activities, dewatering) – well defined process. <ul style="list-style-type: none"> <li>○ This requires a dewatering plan to be submitted and reviewed for approval.</li> <li>○ Once it has been confirmed that groundwater will not negatively affect system, the City provides the applicant with conditions of the dewatering plan – i.e. sampling requirements, allowable flow rate, etc.</li> <li>○ Currently, the City is not charging any fees for a temporary discharge.</li> <li>○ Not currently following up with applicants to ensure compliance of the agreement due to staffing constraints. When possible, inspect once during startup phase to confirm setup as agreed to in the application. <ul style="list-style-type: none"> <li>▪ The applicants will send data to the City in accordance with agreement → The City will review and accept/follow-up based on the guidance/direction offered in the data – notwithstanding due to limited staff resources there are few onsite compliance checks completed by the City.</li> <li>▪ Noted that City of Toronto has a much more involved process – demands a lot more from its applicants, and more resources for inspections, etc. Mississauga does not have a comparable development history.</li> </ul> </li> </ul> </li> <li>• <i>Scenario 2 - Permanent Discharge</i> – this includes groundwater discharge for new buildings (high-rise condos, underground parking). <ul style="list-style-type: none"> <li>○ Foundation drains are constantly draining the groundwater system.</li> <li>○ Permanent discharge needs to go to storm sewer system – ROP sanitary system may allow temporary discharge, but not permanent. ROP could foreseeably have issues with temporary discharge in the near future.</li> <li>○ City began reviewing approx. 2 years ago (2017/8), dealing with numerous files at present (2020), none are currently in construction phase.</li> <li>○ QUANTITY: The volume of discharge allowed from the site depends upon the greater constraint of the available downstream storm sewer capacity or the subwatershed quantity control criteria. <ul style="list-style-type: none"> <li>▪ Allowable release rate into the downstream storm sewer = stormwater runoff (+ groundwater discharge) <ul style="list-style-type: none"> <li>• i.e., combined targets.</li> </ul> </li> </ul> </li> </ul> </li> </ul>

Action B.5	Groundwater Management
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>▪ If a permanent discharge condition is known based upon FSR/SWM reports/plans, there needs to be sufficient onsite storage to hold the groundwater in advance of a storm – cannot have surcharging storm sewers due to groundwater.</li> <li>▪ Quantity control criteria are part of the development approval process for development review, however there is currently no advance notice through current City guidelines that groundwater is included in the allowable release rate / volume, which is dependent upon capacity / subwatershed criteria.</li> <li>▪ Applicants currently not proactively aware about the inclusion of groundwater quantity limitations, until applications submitted and reviewed by a Storm Drainage Technologist at the City. As of Jan 2021 any application coming through DARC (Development Application Review Committee) and rezoning, subdivision or Site Plan are requested to include a Hydrogeological report in their submittals if they have a basement/underground parking garage structure proposed.</li> <li>○ QUALITY: Applicants are required to submit reporting, with requirement that wells be installed near the locations of foundation drains to conduct monitoring/sampling for comparison against the Storm Sewer Use by-law (0259-2005) requirements. <ul style="list-style-type: none"> <li>▪ If the groundwater quality does not meet the requirements (i.e. limits/criteria for temperature, pH, E.Coli, metals, biochemical oxygen demand, total phosphorous, total suspended solids, etc.), quality treatment required at sump pump/before property line.</li> <li>▪ Not currently asking for long-term monitoring/reporting of treatment system.</li> </ul> </li> <li>• Issues in water quality testing include naturally occurring metals in groundwater (manganese and zinc) which often exceed the current by-law standards limits.</li> </ul>
<b>Rationale</b>	The management of groundwater discharge (quantity and quality) into the City's storm sewer system (temporary and permanent) is required in order to control the quality and quantity of water discharging to the municipal storm sewer system and ultimate watercourse receivers. Documenting clear guidance related to quality and quantity limitations, including design criteria and compliance monitoring for groundwater discharge scenarios will improve the overall industry-based understanding of requirements at the time of application and through any post-approval monitoring (compliance).
<b>Department/Division/Section</b>	T&W/IPES/ES
<b>Partnerships</b>	<ul style="list-style-type: none"> <li>• MECP – applicant applies through MECP for a permanent permit to take water (for 50,000+ liters per day), the City is informed, and the</li> </ul>

Action B.5	Groundwater Management
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<p>applicant will contact the City via the environmental inquiries email to determine their City requirements.</p> <ul style="list-style-type: none"> <li>• ROP – specific instances where ROP will accept temporary stormwater discharge (into the sanitary system) - largely based upon the industry/contaminants occurring from the site, which cannot go to the storm sewer system (e.g. meat processing plant). <ul style="list-style-type: none"> <li>○ ROP will make some surcharge agreements (i.e. if indoor wash-water is already approved, addition of outdoor runoff may be allowed) – OGS and flow gauge can monitor the incoming flow and calculate the fee/surcharge.</li> </ul> </li> </ul>
FTEs	<ul style="list-style-type: none"> <li>• Coordinator reviews for quality considerations (FTE 20%), Storm Drainage Technologists review for quantity requirements (as part of development review).</li> </ul>
Equipment	N/A
Annual Budget (Capital budget, O&M, Year)	No cost to the City except for staff time. All requirements for monitoring, sampling, BMPs, etc. passed along to applicant.
Relevant Legislative/Policy/Emerging Practices	<p>Wood – will be an output from the Legislative Checklist (TBC)</p> <p>Emerging Changes:</p> <ul style="list-style-type: none"> <li>• Previous assumption was that foundation drains were primarily capturing the downward infiltration of surface water – but with deeper buildings and parking areas, the issue is becoming more prevalent and in need of more sophisticated groundwater management. No longer viable to apply a standard estimate of infiltration quantities for all sites.</li> <li>• SOP goals and objectives required for groundwater quantity management in permanent discharge situations, clearly stating the monitoring/reporting requirements, compliance program.</li> </ul>
Industry Best Practices	<p><b>City of Toronto – Private Water Discharge Approval Application (2016)</b></p> <ul style="list-style-type: none"> <li>• The City of Toronto requires a sewer discharge permit / agreement for all private water (water not purchased from the City – i.e., groundwater, surface water, construction dewatering, rainwater/stormwater (mixed with construction material) which is discharged into the City's sewer system. These conditions are approved through two different scenarios: <ul style="list-style-type: none"> <li>○ Short Term Private Water Discharge Approval (By way of Permit or Agreement) <ul style="list-style-type: none"> <li>▪ <i>This type of approval is intended for discharge activities, such as site remediation and construction dewatering, which are to be completed within a relatively short period of duration (generally, 1 year or less).</i></li> </ul> </li> <li>○ Long Term Private Water Discharge Approval (By way of Agreement):</li> </ul> </li> </ul>

Action B.5	Groundwater Management
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>▪ <i>This type of discharge approval is intended for discharge activities which are long term in nature, such as where the premises will have a PWDS discharging to a municipal sewer connection for an extended duration (e.g. lifetime of the building). This type of approval is granted for terms of up to one (1) year and may be renewable.</i></li> <li>• Detailed information, sampling and studies relating to the quality, quantity and flow rate of the proposed discharge must be provided to the City prior to an approval for Private Water discharge to a municipal sewer and/or connection will be considered.</li> <li>• Sanitary / Combined Sewer discharges will be subject to fees based on the volume of private water being discharged (through monitoring). <ul style="list-style-type: none"> <li>○ No fee for discharging to a storm sewer, however discharges must adhere to the Sewer By-law quality limits.</li> </ul> </li> <li>• Information / Actions required as part of application / approval: <ul style="list-style-type: none"> <li>○ Project / Site Description – Drawings, Plans, Description of Works</li> <li>○ Flow Meters – outlining equipment, calibration methods, discharge information for the site.</li> <li>○ Sump Pump Information (if applicable) – pump schedule, capacity, volume, etc.</li> <li>○ Water Quality Information – sampling and analysis completed to demonstrate discharge meets quality requirements (within 9 months prior to application).</li> <li>○ Long-Term Sampling Access Point – exclusively monitor the quality, quantity and flow rate of the Private Water discharge into the City sewer, must be separate from any other discharge, and accessible at all times (24/7) by Toronto Water's Environmental Monitoring &amp; Protection staff ("EMP&amp;P").</li> <li>○ Pre-treatment (if required) – details of pre-treatment system (design, performance, sampling, etc.)</li> <li>○ Hydrogeological report (if required) – depends on volume.</li> </ul> </li> </ul> <p><b>City of Calgary – Drainage By-Law (ref. Bylaw Number 37M2005)</b></p> <ul style="list-style-type: none"> <li>• (8) Retention and Treatment - <i>The Director, Water Resources may permanently or temporarily require the owner or occupant of a Parcel to treat, restrict, impound, manage or otherwise retain Water on such Parcel:</i> <ul style="list-style-type: none"> <li>○ <i>if Prohibited Materials are likely to directly or indirectly enter the Storm Drainage System from the Parcel; or</i></li> <li>○ <i>(b) if the Water from the Parcel is likely to directly or indirectly cause erosion, damage or other Adverse Effect to property owned or occupied by the City; or</i></li> <li>○ <i>(c) in order to: (i) control the volume; or (ii) ensure the water quality; of Water directly or indirectly entering the Storm Drainage System</i></li> </ul> </li> </ul>

Action B.5	Groundwater Management
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<p><b>City of Vaughan – Sewer Use By-law (ref. Bylaw 087-2016)</b></p> <ul style="list-style-type: none"> <li>(4.2) Request and Approval of Special Discharge into Storm Sewers <ul style="list-style-type: none"> <li>Written request to the City for the proposed discharge which includes, <ul style="list-style-type: none"> <li>a. the reason for the need for special discharge;</li> <li>b. the volume, rate and duration of water to be discharged;</li> <li>c. the location of the water source;</li> <li>d. the address of the location where the water is being discharged; and</li> <li>e. the details of the proposed discharge plan to include sampling, monitoring and contingency plan;</li> </ul> </li> <li>2. a copy of a valid Permit to Take Water issued by the Ministry of the Environment and Climate Change in respect of the taking of the water that would be discharged, where such Permit to Take Water is required by the Ontario Water Resources Act;</li> <li>3. a copy of approval from other appropriate government agencies if applicable; and</li> <li>4. payment for any application fees for reviewing a request for a discharge under this section that may be imposed by the City from time to time.</li> </ul> </li> <li>City considering updates to two documents: Sewer Use By-law to account for naturally occurring parameters (increasing limits to account for these situations), and the Development Manual to include criteria for quantity limits / discharge criteria; additionally, the City is reviewing the Development Manual to include the requirement for Hydrogeological Reports, which will dictate the groundwater conditions.</li> </ul> <p><b>Other Best Practices to Consider (under development):</b></p> <ul style="list-style-type: none"> <li>TBD</li> </ul>
<b>Recommendations</b>	
<b>a. People</b>	<ul style="list-style-type: none"> <li>Additional staff – 1 Technologist (full-time) to support staff. <ul style="list-style-type: none"> <li>Staff could assist with outfall monitoring (Action C.1) and could also provide support for development/compliance review. Anticipate this will become a bigger issue as the downtown is continually built up along with larger / deeper buildings.</li> </ul> </li> </ul>
<b>b. Equipment</b>	N/A
<b>c. Policy</b>	<ul style="list-style-type: none"> <li>Sewer Use By-Law Refinements – increase concentration limits for naturally occurring parameters in groundwater discharge (i.e., magnesium and zinc).</li> <li>Development Manual Refinements – include quantity limits / discharge criteria for groundwater discharge to storm sewer infrastructure based</li> </ul>

Action B.5	Groundwater Management
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<p>upon current development review process. Include reference to Sewer Use By-Law for discharge quality requirements.</p> <ul style="list-style-type: none"> <li>• Refine Permit / Agreement application - explicitly outline monitoring &amp; compliance reporting requirements for temporary / permanent discharge situations. <ul style="list-style-type: none"> <li>○ Sampling Port Required for Both Discharge Conditions to monitor and report quality and quantity of private water discharge to City infrastructure: <ul style="list-style-type: none"> <li>▪ Temporary (i.e. Short-Term) – <i>Permit</i></li> <li>▪ Permanent (i.e. Long-Term) – <i>Agreement</i> <ul style="list-style-type: none"> <li>• Valid for up to one (1) year – renewable application to ensure compliance and function long-term.</li> </ul> </li> </ul> </li> </ul> </li> </ul>
<b>d. Program</b>	N/A
<b>e. Methodology</b>	<ul style="list-style-type: none"> <li>• Develop SOP goals and objectives required for groundwater quantity management in permanent discharge situations, clearly stating the monitoring/reporting requirements and compliance program.</li> </ul>
<b>f. Other</b>	N/A
<b>City Commentary</b>	<ul style="list-style-type: none"> <li>• Not currently following up with applicants to ensure compliance of the agreement for temporary discharge due to staffing constraints.</li> <li>• Updates to the development manual for inclusion of groundwater quantity can improve/streamline the communication between the City and proponents.</li> <li>• Anticipated potential long-term issues for the quality treatment requirements – if the treatment system is not being maintained, it will likely not be functioning as required over time. Consider how the City can implement a system and requirement for on-going monitoring/reporting that is not too onerous for application but confirms the system is working over the long-term.</li> <li>• Refinements to the by-law should be considered to increase the allowable limits for natural contaminants, to avoid a Risk Assessor letter each time this issue is encountered.</li> </ul>



**B.6. Cooling BMPs – Future Action**

Action B.6	Cooling BMPs
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
<b>Description</b>	<ul style="list-style-type: none"> <li>• Known need to have Temperature mitigation for selected creeks (i.e. for those with proven sensitivities) – CVC completed a long list of thermal mitigation practices (BMPs)</li> <li>• Examples of existing Cooling BMPs in the City:             <ul style="list-style-type: none"> <li>○ Pilot Cooling Trench applied at SWMF outfall – was not constructed properly (not functioning correctly)</li> <li>○ SWMF outfall (retrofit)</li> <li>○ Floating islands – few pilot projects implemented for qualitative benefit, one remains in place (Lake Wabukayne)</li> <li>○ SW Balls in Ponds</li> </ul> </li> <li>• No proactive implementation of cooling BMPs completed to date nor standards for guidance</li> <li>• Pond clean outs / retrofits have included works to reduce discharge temperatures             <ul style="list-style-type: none"> <li>○ Retrofits have been completed for thermal mitigation (i.e., Fletcher's Creek sensitivity / fish habitat), including the use of bottom-draw outlet pipes.</li> </ul> </li> <li>• Potential for pilot projects – planning, design, construction, post-construction monitoring             <ul style="list-style-type: none"> <li>○ End goal for formulated process to provide to proponents as part of development.</li> <li>○ Need to review types of LID BMPs and their performance related to thermal mitigation to confirm benefit and develop recommendations.                 <ul style="list-style-type: none"> <li>▪ Potential for thermal budgeting of traditional systems as well – cooling effect of concrete pipes.</li> </ul> </li> </ul> </li> </ul>
<b>Rationale</b>	Through temperature mitigation research and/or pilot projects, clear guidance and process regarding the planning, design, implementation and monitoring of cooling BMPs can be provided to proponents and City departments in locations where it is important to protect and enhance the habitat for natural systems. Knowledge of specific sensitive systems requiring enhanced thermal mitigation is also needed.
<b>a. Best Practices</b>	<p><b>Study Report: Thermal Impacts of Urbanization including Preventative and Mitigation Techniques, CVC, 2011</b></p> <ul style="list-style-type: none"> <li>• Through various case studies and literature review, CVC developed a summary list of recommended mitigation techniques for reducing thermal impacts. These include the following:             <ul style="list-style-type: none"> <li>○ <i>Zone 1: Up-Gradient of the Pond</i> <ul style="list-style-type: none"> <li>▪ <i>Low Impact Development</i></li> <li>▪ <i>Shading of Impermeable Surfaces</i></li> </ul> </li> </ul> </li> </ul>

Action B.6	Cooling BMPs
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>○ Zone 2: Inlet Structure <ul style="list-style-type: none"> <li>▪ Buried Pipes (Inlet/Outlet)</li> <li>▪ Cooling Trench (Inlet/Outlet)</li> </ul> </li> <li>○ Zone 3: Stormwater Pond <ul style="list-style-type: none"> <li>▪ Bottom Draw Outlet</li> <li>▪ Permanent Pool Depth</li> <li>▪ Cooling Tower</li> <li>▪ Pond Orientation</li> <li>▪ Pond Shape</li> <li>▪ Vegetated Floating Islands</li> <li>▪ Shading</li> </ul> </li> <li>○ Zone 4: Outlet Structure <ul style="list-style-type: none"> <li>▪ Buried Pipes (Inlet/Outlet)</li> <li>▪ Cooling Trench (Inlet/Outlet)</li> </ul> </li> <li>○ Zone 5: Riparian Corridor <ul style="list-style-type: none"> <li>▪ Shading</li> </ul> </li> <li>• Recommendations for temperature monitoring programs include conducting measurements of water temperatures at various locations within and downstream of existing SWM ponds/treatment systems; this could occur continuously, or at prescribed intervals (i.e. 2, 5, 10, 20 years) during and post-construction to assess the effectiveness of the mitigation techniques over time. <ul style="list-style-type: none"> <li>○ Temperature monitoring could be required through the approvals process, such as Municipal (subdivision or site plan agreements), MECP (ECA for stormwater), etc.</li> </ul> </li> <li>• This study also suggested a variety of potential key pilot studies / research topics which could be undertaken through joint partnerships between federal (DFO) and provincial (MECP, MNRF) agencies, Conservation Authorities, municipalities, development industry and the academic community. Some of the topics and/or pilot studies identified include the following: <ul style="list-style-type: none"> <li>○ Gravel Wetland Design – add-on system or retrofit option.</li> <li>○ Cumulative Impact Studies – extensive monitoring program for watercourses with established ponds in-series to provide insights to the cumulative effects of watershed/subwatershed scale development. Including temperature monitoring of SWM ponds and watercourses, fisheries investigations and benthic sampling.</li> <li>○ Decision Support System – building on previous frameworks for aiding planners and engineers in the selection of site-specific mitigation techniques.</li> <li>○ Low Impact Development – implement/monitoring of LID BMPs which includes temperature mitigation performance component.</li> </ul> </li> </ul>

Action B.6	Cooling BMPs
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>○ Optimizing Pond Design for Temperature Mitigation – cooling trenches, bottom draw structures, depth of pond, orientation etc.</li> <li>○ Vegetated Floating Islands – installation of vegetated islands within an existing SWM pond (variables include shape, size, percent of pond surface, plant species, etc.).</li> <li>○ Analysis of Existing SWM Facility(s) – monitoring from installation to age 5, 10, 15 and 25 years (approved design/planting plans) for vegetation (type, density, maturity/health), aquatic plants, pond orientation/shape, wind direction, water quality (salinity temperature monitoring) and municipal maintenance practices.</li> <li>• Monitoring of night-time release – pilot a night time release study using real time controls to mitigate thermal impacts.</li> </ul> <p><b>Other Best Practices to Consider (under development):</b></p> <ul style="list-style-type: none"> <li>• TRIECA Webinar – Ground Source Cooling of Stormwater Pond Outflows: New Research on a Cost and Space Efficient Method to Mitigate the Thermal Impacts of Stormwater Ponds on Aquatic Life</li> <li>• Northwest Brampton – Subwatershed Study for the Huttonville and Fletcher's Creeks, Amec 2011 <ul style="list-style-type: none"> <li>○ Summary/Literature Review of Thermal Impact Mitigation Strategies</li> </ul> </li> </ul>
<b>b. Relevant Legislative/Policy /Emerging Practices</b>	Wood – will be an output from the Legislative Checklist (TBC)
<b>Suggested Department and Partnerships</b>	<ul style="list-style-type: none"> <li>• CA's (CVC), MECP and DFO – for sensitivities / fish habitat / BMP research</li> <li>• Potential partnership with Colleges/Universities to establish research projects (partnering with students) – UTM, Sheridan, etc.</li> </ul>
<b>Resource Needs</b>	<ul style="list-style-type: none"> <li>• Selection of temperature sensitive watersheds (or highly urbanized) – identify existing SWM practices in watershed,</li> <li>• Develop thermal monitoring program as part of existing SWMF monitoring.</li> </ul>
<b>Estimated Costs</b>	<\$50,000 for Pilot

## C. Celebrate Its Value (Engagement & Partnerships)

Theme C: *Celebrate Its Value (Engagement & Partnerships)* is comprised of the following Actions:

- C.1 *Cost Effective Artist in Residence program – Future Action*
- C.2 Stormwater Outreach (Contemporary/Effective/Innovative) – Existing Action

*C.1 Artist in Residence Program – Future Action*

Action C.1	Cost Effective Artist in Residence Program
Service Delivery	Plan/Program/Policy/Partnership/Procedure
<b>Description</b>	<p><b>Past Artist in Residence Program</b></p> <p>The City operated an Artist in Residence program in 2016 which provided opportunities for two artists to create new responsive artworks, exhibitions and programs. Artists worked closely with members of various Mississauga-based communities to respond to local conditions, histories and contexts. Each residency is completely unique and takes place at various sites across the city.</p> <p>The City is looking to re-establish its Artist in Residence program, with a focus on stormwater.</p> <p><b>Related City Art Initiatives</b></p> <ul style="list-style-type: none"> <li>- The City's Poet Laureate and Youth Poet Laureate positions promote poetry and literary arts within the City, raise the profile of writers in Mississauga and create artistic legacies.</li> <li>- The City's Public Art Program includes a Public Art Collection of 20 permanent public art pieces, as well as ongoing temporary art.</li> <li>- A Public Art map is available online and allows the public to search for permanent and temporary public art pieces, accompanied by photos and information about the pieces.</li> <li>- The Public Art Master Plan (2016) establishes the strategic framework (guiding principles, priority public art zones, criteria for selection) and the operating and implementation framework (opportunities for permanent and temporary public art, funding strategy, acquisition strategy, and maintenance and conservation strategy).</li> <li>- The City Acquired Art Policy and Procedure (2013) establishes suitable locations for various types of art and identifies responsibilities for managing the City's Art.</li> <li>- The City has graphic artists on staff, but also temporarily employed three cartoonists from Sheridan College in 2020, who supported the City's communication efforts among other initiatives.</li> </ul>
<b>Rationale</b>	<p>Artist in Residence programs increase artworks of many forms in our communities, improving the public realm by building beautiful spaces, and providing opportunities for artworks which can raise awareness to important issues to Mississauga residents. Notably in relation to stormwater, an Artist in Residence program provides the opportunity to raise awareness to stormwater management projects and processes, which are often "out of sight, out of mind".</p>
<b>d. Best Practices</b>	<p><b>City of Guelph Artist in Residence 2021 (Ongoing/upcoming)</b></p> <ul style="list-style-type: none"> <li>• Overview: <ul style="list-style-type: none"> <li>○ Residency period from July 1 to September 30, 2021</li> </ul> </li> </ul>

	<ul style="list-style-type: none"> <li>○ Create one project, with process as important as delivery</li> <li>○ Virtually engage throughout</li> <li>○ Budget: \$6,500</li> <li>• <i>Program goals:</i> <ul style="list-style-type: none"> <li>○ <i>creatively animate public space(s) – indoor, outdoor and online</i></li> <li>○ <i>provide opportunities for artists to engage virtually with the public to showcase their creative practices</i></li> <li>○ <i>broaden the community's experience of the arts</i></li> <li>○ <i>contribute to placemaking and civic pride</i></li> </ul> </li> <li>• <i>The City of Guelph will provide:</i> <ul style="list-style-type: none"> <li>○ <i>assistance with any necessary permits for public space(s) (as appropriate);</i></li> <li>○ <i>limited access to municipal facilities and venues;</i></li> <li>○ <i>an opportunity for presentation and celebration at the end of the residency;</i></li> <li>○ <i>a budget which includes artist fees and funding to cover other costs directly related to the project;</i></li> <li>○ <i>promotional support (coordination of media releases, social media and promotional materials such as posters, postcards, signage, boosted Facebook posts etc.); and</i></li> <li>○ <i>recognition of the artist as the official City of Guelph Artist in Residence.</i></li> </ul> </li> <li>• <i>The selected artist will:</i> <ul style="list-style-type: none"> <li>○ <i>commit to engaging community members in creative experiences;</i></li> <li>○ <i>deliver the selected project within the program's timeline and budget;</i></li> <li>○ <i>provide regular progress updates to staff;</i></li> <li>○ <i>be available to speak with the media; and</i></li> <li>○ <i>attend a debriefing session at the end of the residency period.</i></li> </ul> </li> <li>• Two-step application process: <ul style="list-style-type: none"> <li>○ Stage 1: Expression of Interest</li> <li>○ Stage 2: Request for Proposals, criteria: <ul style="list-style-type: none"> <li>▪ Qualifications and experience 20%</li> <li>▪ Quality of Proposal 40%</li> <li>▪ Realization of Proposal 40%</li> </ul> </li> </ul> </li> </ul> <p><b>Seattle Public Utilities (SPU) – Drainage and Wastewater (DWW) Art Master Plan (2017)</b></p> <ul style="list-style-type: none"> <li>• 1% of eligible city capital improvement project funds for Art investments related to drainage and wastewater work</li> <li>• Two volumes: Book 1, the Vision for Public Art in Drainage and Wastewater, provides the framework for public art to and guidance on execution of public art projects and programs. Book 2 presents a catalogue of Opportunities for Public Art.</li> </ul>
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	<ul style="list-style-type: none"> <li>• The Vision document provides a guide for engineers, project managers and other staff regarding the application of the Art Master Plan, including answers to the following:</li> <li>• How are 1% of funds allocated? <ul style="list-style-type: none"> <li>○ The program specifies that 1% of eligible city capital improvement project funds be set aside for the commission, purchase and installation of artworks in a variety of settings. SPU's 1% for Art funds are pooled by fund source. Through conversations between SPU leadership and the Office of Arts &amp; Culture, guided by documents such as this Art Master Plan, funds are allocated to public art projects which are then listed in the Municipal Art Plan.</li> </ul> </li> <li>• How are art projects scoped and conceived? <ul style="list-style-type: none"> <li>○ The Art Master Plan provides suggested scopes of work for artists in the PROJECT OPPORTUNITIES section. The scope of work for the artist is further refined in the development of a Call for Artists to select the artist and then in the selected artist's contract. The Call for Artists and artist's contract are written and managed by the Office of Arts &amp; Culture.</li> </ul> </li> <li>• How does a project get started and proceed? <ul style="list-style-type: none"> <li>○ Once a project is scoped and a budget determined, a timeline for selecting an artist and the development of their work is determined based on project schedules and other factors.</li> <li>○ Artists are selected by a competitive process administered by the Office of Arts &amp; Culture. Typically, a Call for Artists is developed by Arts office staff, and then a selection panel comprised of art and design professionals, staff and stakeholders reviews the submitted qualifications. Artists can also be selected from a roster, invitational list, or in some cases by direct selection. Selection typically takes place in two phases: a review of qualifications and an interview of finalists. Artist selections are subject to approval by the Public Art Advisory Committee of the Seattle Arts Commission.</li> </ul> </li> <li>• How do project managers work with an artist? <ul style="list-style-type: none"> <li>○ The project manager in the Office of Arts &amp; Culture administers the artist selection process, handles the artist's contract and deliverables, and facilitates the design process and meetings. SPU provides the artist with details of site design, community process and project background, and often SPU will help integrate the artist's work into the design of a project. 1% for Art funds pay for the design, fabrication and installation of the artwork. In many cases, a permanent public art project will be installed at the time of construction. In others, work is temporary, performance based, or added after construction is complete. The Public Art Collection is managed and maintained by the Office of Arts &amp; Culture.</li> </ul> </li> <li>• Book 2 Opportunities for Public Art in SPU DWW identifies a diverse set of project opportunities to incorporate art into a major</li> </ul>
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	<p>infrastructure project to improve water quality in the Ship Canal, including:</p> <ul style="list-style-type: none"> <li>○ Curated Construction: Art for Fences and Sound Walls: The elements of construction projects, such as fencing, conveyors, and sound walls, are all possible sites for art. Art can tell the story of the project, communicate about water quality, and contribute to the aesthetic qualities of the neighborhood during construction. Budget Range: \$15,000-\$50,000 per site per year for a curator to program fences and walls with rotating artwork.</li> <li>○ 24th Ave NW Pier: An artist will design inlays for the pier, to be integrated during construction. The artist will develop artwork that references the maritime history of the site. Budget Range: \$40,000</li> <li>○ Roadside Bioretention Kit of Parts: The selected artist will design a kit of parts of artistic elements that may be incorporated into roadside bioretention responding to community input. The artist will work with staff and engineers to produce specifications for incorporating the designs. The artist will also fabricate or work with a fabricator to produce the elements such as inlays. Kit of Parts may include: Inlays that can be added to adjacent sidewalks, visual elements for inlets such as inlays or patterns, ideas for edges, railings, signage, stepping stones and benches.</li> </ul>
<b>e. Legislation/Policy Existing</b>	<ul style="list-style-type: none"> <li>- City's Art Master Plan (2016)</li> <li>- City Acquired Art Policy and Procedure (2013)</li> </ul>
<b>Suggested Department and Partnerships</b>	<p>City Partnerships</p> <ul style="list-style-type: none"> <li>- Culture Division</li> <li>- T&amp;W/IPES/ES</li> </ul> <p>Potential Community Partnerships:</p> <ul style="list-style-type: none"> <li>- Sheridan College</li> <li>- University of Toronto Mississauga</li> <li>- Peel District School Board Secondary Schools located in Mississauga</li> </ul>
<b>Resource Needs/Program</b>	<p>Resources and Policy needed to support the Artist in Residence Program are dependent on the City's preferred Option:</p> <ul style="list-style-type: none"> <li>- Option 1: Artist in Residence Program based on upcoming capital works, where artists incorporate public art into capital works project(s) based on 1% funding. Pre-defined projects and funding.</li> <li>- Option 2: Artist in Residence Program based on annual residency. More flexibility in the format of artworks, such as visual, literary, spoken word, with ability to respond to current events.</li> <li>- Option 3: Artist(s) in Residence of graphic/visual artists (e.g. from Sheridan College) to support exclusively with online</li> </ul>



	<p>engagement. Consider recurring partnership with Sheridan College or other Post-Secondary Education Institute.</p> <ul style="list-style-type: none"> <li>- Option 4: Prepare Stormwater Art Master Plan, or update the City's Art Master Plan, to identify stormwater project opportunities. Artists can then prepare proposals on previously identified opportunities, aligned with the capital works schedules.</li> <li>- Option 5: Youth Artist in Residence Program, or Art Competition, aimed at Secondary Schools in Mississauga to engage younger audiences in building beautiful spaces and increasing understanding of stormwater. Includes one project that will be funded by the City.</li> </ul>
<b>Estimated Costs</b>	Estimated costs associated with the Artist in Residence Program are dependent on the City's preferred Option above.






## C.2 Stormwater Outreach (Contemporary/Effective/Innovative) – Existing Action

Action C.2	Stormwater Outreach
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
<b>Description</b>	<p>The City's Stormwater Outreach Program includes a cross-section of communication and engagement initiatives, both virtually and in-person:</p> <ul style="list-style-type: none"> <li>• Stormwater By-law</li> <li>• Stormwater 101</li> <li>• YouTube Videos <ul style="list-style-type: none"> <li>○ The City has created a number of educational videos on the City's Youtube Channel, addressing topics such as the Stormwater Charge, Stormwater Management Ponds, Watercourses and Low Impact Development. Videos less than 90 seconds have resulted in the most views.</li> </ul> </li> <li>• Digital Engagement: <ul style="list-style-type: none"> <li>○ Increased use of social media since 2017. Continuation anticipated post COVID restrictions.</li> <li>○ The City's stormwater web pages are currently being migrated to the new WordPress platform, with completion anticipated for 2021. This has included markets being broken down to specifically address Residential customers, Business customers and youth. The new platform supports a variety of engagement tools that were not available on the previous ATG platform.</li> <li>○ Regular Instagram posts</li> <li>○ Council corner articles.</li> <li>○ Webtalks – Ask the Expert</li> <li>○ Education is not sufficient, City requires more feedback from public, why Engagement HQ is important.</li> <li>○ Interactive mapping available online that identifies ongoing projects, including construction maps, basic project management information, construction schedules, etc. Would be useful to incorporate project profiles and consult with IT to add QR codes so people know where there is "invisible" infrastructure</li> </ul> </li> <li>• Yellow Fish Road (YFR) Program / Youth Education (Program has been discontinued, included for background): <ul style="list-style-type: none"> <li>○ Reasons for program discontinuation: City and TRCA found that continuing the YFR program had become unworkable with new insurance and delivery policies adopted by the program founder Trout Unlimited (TU) Canada. Earlier program executives had supported the adoption of free insurance for participating volunteers, but with the change to this policy, only larger organizations are able to participate. Also, for municipalities who require permits for activities on municipal right-of-ways, TU was no longer obtaining the required permits leaving volunteers to also shoulder this burden</li> <li>○ Program Purpose: Focused on awareness of water quality. Included brief talk by City staff, and small community groups (e.g. Scouts) hosted event where children painted yellow fish on roads.</li> </ul> </li> </ul>


Action C.2	Stormwater Outreach
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>○ Program Uptake: While the program was active, the City tracked the number of groups, number of delivered flyers, number of catchbasins painted and the numbers of students and teachers involved. Numbers were steadily growing until the policy changes instituted by TU.</li> <li>• Youth Education Program:             <ul style="list-style-type: none"> <li>○ In-class presentations were completed for years, as schools are a natural entry for stormwater education. Water is in the Ontario curriculum starting in Grade 2. A teacher was previously on staff, who prepared material to feed into the curriculum, which helped teachers achieve their curriculum objectives and laid the groundwork for more advanced discussions in later years. Important to meet Ontario curriculum; if meets board requirements, easy to implement/schools will uptake. Requires staff with education background. Often, presentations were given to entire grades within the same week.</li> <li>○ City 311 now directs volunteers/inquiries regarding the YFR Program to TRCA Rain to Runoff online and classroom program.</li> </ul> </li> <li>• Business Education:             <ul style="list-style-type: none"> <li>○ Education needed for businesses, break the information by sector. Should be based on where the sector specifically goes for information, e.g. LinkedIn, trade journals, radio. 2020 FORUM data indicates that business prefer email communication. City is exploring the potential of an e-newsletter.</li> <li>○ Multi-cultural radio works great, requires sufficient repetition to get message across. Staff heavy, requires multi-lingual staff.</li> </ul> </li> <li>• Event Outreach:             <ul style="list-style-type: none"> <li>○ Notable events: Family fishing day, clear connection with water quality.</li> <li>○ 60 events held in 2018.</li> <li>○ Peel Water Children's Festival (1,000 kids a day)</li> </ul> </li> <li>• In-Person Engagement:             <ul style="list-style-type: none"> <li>○ Workshops in support of stormwater charge</li> <li>○ Door-to-door campaigns (no digital substitute)</li> </ul> </li> <li>• City stressed the importance of:             <ul style="list-style-type: none"> <li>○ One-on-one interactions</li> <li>○ Tracking of information</li> <li>○ Tagging onto other community events to broaden audience, rather than "usual suspects" at stormwater focused events.</li> </ul> </li> </ul>
<b>Rationale</b>	<p>Stormwater management infrastructure is largely out of site out of mind, therefore public education regarding the role the City and the public (residents, stakeholders, business) play in stormwater management is critical to building understanding and support for City initiatives, as well as increasing application of LID BMPs on private property. Stormwater outreach includes two-way communication, providing an avenue for the</p>

Action C.2	Stormwater Outreach
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<p>public to provide feedback and improve the stormwater program and outreach initiatives themselves. Primary messaging continues to focus around water quality and quantity aspects of stormwater. Public has little interest in stormwater unless it has impacted their lives or businesses directly. Unfortunately, much about stormwater is best undertaken preventatively. With hundreds of thousands of properties and customers in Mississauga using the stormwater system, it's not feasible to engineer away the impacts of improper use. The public simply must understand their role and how their actions and choices either make the system work or fail. Stormwater education is essential to this process.</p>
Department/Division/Section	T&W/IPES/ES
Partnerships	<p>City participates in a number of partnerships with external agencies and will continue to seek out collaborative opportunities.</p> <ul style="list-style-type: none"> <li>City of Brampton, Town of Caledon, ROP, CAs, Province: <ul style="list-style-type: none"> <li>Regional Salt Working Group (Peel Operations)</li> <li>Region of Peel education team</li> <li>Western Lake Ontario Partnership</li> <li>Coordinate with partners to have common language, web type interface, refer public to appropriate partner</li> </ul> </li> <li>CVC: 2021-2022 collaborative funding from multiple sources</li> <li>CVC's Greening Corporate Grounds Program <ul style="list-style-type: none"> <li>Help businesses to implement sustainable landscaping practices on site</li> <li>Potentially increase the intake of Stormwater Credit Program</li> <li>City financial support to continue this program</li> </ul> </li> <li>Internal partnerships: <ul style="list-style-type: none"> <li>311 Information Sheets</li> <li>Climate Change</li> <li>Forestry and Parks</li> <li>Youth Outreach Community Services</li> <li>Animal Services (pet waste connection)</li> <li>Emergency Management</li> <li>WOM Works Operations</li> </ul> </li> </ul>
FTEs	<p>Currently 1 FTE and 1 Coop student for 8-month duration Previous peak capacity of 3 FTEs in 2018 (MC &amp; 2 support staff).</p> <ul style="list-style-type: none"> <li>Ideal team, allowed for staff with different skills to be available for any community event and to have specialized skills (e.g. Digital design, web writing, teaching) within the team.</li> <li>Council did not think 3 FTEs was required following the enforcement of the stormwater charge – changed focus to digital engagement.</li> </ul>
Equipment	One outreach minivan, stormwater neighbourhood diorama model, information booth and supplies

Action C.2	Stormwater Outreach
Service Delivery	Plan/ <b>Program</b> /Policy/Partnership/Procedure/Project
<b>Annual Budget (Capital budget, O&amp;M, Year)</b>	<ul style="list-style-type: none"> <li>2020 first year with dedicated operating budget, previously limited to relying on project budgets.</li> <li>\$25,000 annual project budget moving forward.</li> </ul>
<b>Relevant Legislative/Policy/ Emerging Practices</b>	<p>Wood – will be an output from the Legislative Checklist (TBC)</p> <p>Emerging Practices:</p> <ul style="list-style-type: none"> <li>Expanded emphasis on digital and online delivery in the coming years to follow trend to greater online engagement. Especially during Covid restrictions. Some in-person interaction is still recommended for specific market segments going forward. Most effective tool for customer satisfaction. Digital must mimic in-person interactions and real life as much as possible to be effective.</li> </ul>
<b>Industry Best Practices</b>	<p><b>City of Vancouver Adopt a Catchbasin Program, Green Streets Program (Volunteer Gardener Program)</b></p> <ul style="list-style-type: none"> <li>Adopt a catch basin program: Volunteers adopt and name a catchbasin, and keep it clear from leaves and debris.</li> <li>Green Streets Program: Began as a pilot project with 15 volunteer gardeners. Program now has hundreds of gardeners caring for planted traffic circles and street corners across Vancouver.</li> <li>Green Streets gardens enhance public space, help manage rainwater, and provide wildlife habitat.</li> <li>Volunteers provide year-round care for gardens, and receive benefits such as compost, advance notice of plant giveaways, newsletter subscriptions, invitation to Green Streets Garden Party where the City celebrates the achievements of the program and volunteers, and access to mentor gardeners.</li> </ul> <p><b>City of Vancouver One Water Engagement Strategy</b></p> <ul style="list-style-type: none"> <li>Community Open House and Workshop</li> <li>Large-Site Developments Industry Workshop</li> <li>Small-Site Developments Industry Workshop</li> <li>12 Industry Sectors represented in workshops</li> <li>Designed potential solutions and discussed challenges for sites</li> <li>17 speaking engagements</li> <li>38 public events</li> <li>12 university partnerships</li> <li>Surveys (1500 responses)</li> </ul>

Action C.2	Stormwater Outreach
Service Delivery	Plan/ <b>Program</b> /Policy/Partnership/Procedure/Project
	<p data-bbox="548 275 1209 302"><b>Baltimore Public Awareness Campaign for Floatables</b></p>  <p data-bbox="570 804 993 827"><i>Trash removing water wheel in the Baltimore Harbor</i></p> <p data-bbox="548 888 1256 915"><b>Storm Drain Branding / Awareness – Various Proponents</b></p> <div data-bbox="561 940 959 1283">  <p data-bbox="561 1304 878 1323"><i>Similar catch basin medallions are used in Lincoln, NE</i></p> </div> <div data-bbox="987 940 1385 1283">  <p data-bbox="987 1304 1187 1323"><i>Catch basin casting in Boston, MA</i></p> </div> <div data-bbox="561 1356 959 1661">  <p data-bbox="561 1682 878 1701"><i>Storm drain art near the James River in Richmond, VA</i></p> </div> <div data-bbox="987 1356 1385 1661">  <p data-bbox="987 1682 1333 1701"><i>Child participating in storm drain marking in Baselburg, KY</i></p> </div>



Action C.2	Stormwater Outreach
Service Delivery	Plan/ <b>Program</b> /Policy/Partnership/Procedure/Project
	<p><b>Japan Manhole Cover Art, Public Awareness Campaign</b></p> 
<b>Recommendations</b>	
<b>a. People</b>	To be determined based on preferred options.
<b>b. Equipment</b>	N/A
<b>c. Policy</b>	N/A
<b>d. Program</b>	<p><b>Public Awareness Campaign- Manhole Cover/Catchbasin Branding:</b></p> <ul style="list-style-type: none"> <li>Engage the public, particularly youth (both primary and secondary schools) in designing manhole covers and/or catchbasin branding (e.g. plaques). This will increase public awareness, support attractive built form (build beautiful), and serve as an educational opportunity, serving the same purpose as the YFR Program.</li> <li>Manhole Cover/Catchbasin branding may reference receiving waterbody (watercourse or Lake Ontario) to highlight the One Water connection and that runoff is not treated prior to entering receiving systems.</li> <li>Consider partnering with TRCA Rainfall to Runoff program.</li> <li>Consider including Manhole Cover/Catchbasin Branding as a stormwater project as part of the Artist in Residence Program (Action C.1).</li> </ul> <p><b>Business Community Engagement – Workshops and Materials</b></p> <ul style="list-style-type: none"> <li>Hold (virtual) workshop(s) for business community to provide overview of Stormwater Charge and Credit Program, highlighting the following benefits to businesses: <ul style="list-style-type: none"> <li>Customers increasingly “voting with their dollars”, and choosing to shop at businesses with sustainable practices (i.e. LID BMPs evident on site, business mandate/communications identifying pollution prevention practices).</li> </ul> </li> </ul>

Action C.2	Stormwater Outreach
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>○ LID BMPs/onsite stormwater management can create attractive outdoor seating areas, increasing appeal to customers and creating better spaces for employees, something increasingly prioritized by the workforce.</li> <li>• Communicate the information above in newsletters tailored to specific businesses. Prepare newsletters in multiple languages.</li> <li>• Partner with CVC's Greening Corporate Grounds Program.</li> </ul> <p><b>Residential Engagement – Expanding Partnerships – Workshops</b></p> <ul style="list-style-type: none"> <li>• Expand partnerships with Peel's Fusion Landscaping and CVC's Your Green Yard programs. Highlight benefits to residents through attractive landscapes, water efficient landscapes, improved water quality/environmental benefits, financial support (e.g. grants, free compost, plant giveaways).</li> </ul> <p><b>Residential Engagement – Digital Engagement</b></p> <ul style="list-style-type: none"> <li>• Increase sense of ownership with residents regarding role private property plays in managing stormwater through: <ul style="list-style-type: none"> <li>○ Videos, VR/AR, presentations providing education on extent of underground infrastructure, amount of area/runoff generated from private versus public property, etc.</li> <li>○ Social Media (Facebook, Youtube, Instagram): Short educational videos (less than 90 seconds)</li> <li>○ Partnering with City Councillors, Environmental Groups to further message reach through newsletters</li> </ul> </li> </ul>
<b>e. Methodology</b>	N/A
<b>f. Other</b>	N/A
<b>City Commentary</b>	<ul style="list-style-type: none"> <li>• Challenges: <ul style="list-style-type: none"> <li>○ People largely do not plan ahead. Most stormwater messaging is pro-active and preventative. A paradox. Refining messages into 'hacks' may offer some advantages in the new digital age.</li> <li>○ People are largely not motivated to do things for the City or to assist the City or neighbours.</li> <li>○ People largely do not see their home as connected when services are delivered underground. We're looking into VR and AR tech to help with this disconnect.</li> <li>○ People generally regard themselves as independent and able to do what they prefer. Messaging must focus on what is in it for the customer.</li> <li>○ People seem to regard catchbasins in the same way they see drains in their home despite the fact that these two systems are not connected and that catchbasins are connected to a system with no treatment. People therefore routinely use catchbasins for disposal.</li> <li>○ Using exclusively English for text communications is not effective.</li> </ul> </li> </ul>



Action C.2	Stormwater Outreach
Service Delivery	Plan/ <b>Program</b> /Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>○ Challenge as residents pay taxes and the stormwater rate and expect the City to manage entirely, lack of ownership. Challenge with basic understanding of how stormwater system works.</li> <li>○ Messaging should not focus on myths, saying myths enough times cements myths, even when refuting.</li> </ul>

## D. Protect Quality (Monitoring & Maintenance)

Theme *D: Protect Quality (Monitoring & Maintenance)* is comprised of the following Actions:

- D.1 Outfall Monitoring (Water Quality) – Existing Action
- D.2 Pollution Prevention Plans – Existing Action
- D.3 Asset Management: Watercourses – Existing Action
- D.4 Asset Management: Pipes – Existing Action
- D.5 Asset Management: SWMF's – Existing Action
- *D.6 Culvert/Bridge Assessments – Future Action*
- D.7 Integrated Rainfall Monitoring Program (with CA's) – Existing Action
- *D.8 Shoreline Management – Future Action (New to Fill Gap from Checklist)*
- D.9 City-Wide Water Quality Retrofit Program – Existing Action

## D.1 Outfall Monitoring (Water Quality) – Existing Action

Action D.1	Outfall Monitoring (Water Quality)
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
<b>Description</b>	<p>There are approximately 1,200 existing City-owned storm sewer outfalls (as of 2020). Two (2) primary types of Outfall Monitoring for water quality– Reactionary (complaint driven) and Proactive (current (2020) in a pilot stage):</p> <ul style="list-style-type: none"> <li>• <b>Reactionary Program</b> – site visits, monitoring and investigation completed for all reported spills/exceedances until the issue has been resolved. <ul style="list-style-type: none"> <li>○ Respond to approx. 70 storm sewer violation incidents per year which equates to monitoring approx. 50 outfalls per year (on average) based upon reactionary program (currently monitoring 8-10 as part of on-going investigations).</li> <li>○ Approx. 600 site visits completed per year based upon received complaints/notifications – this can include weekly, monthly, etc. visits to the same outfall and/or source property depending upon the severity of the spill / WQ threat.</li> </ul> </li> <li>• <b>Proactive Program</b> – pilot project initiated 2020 to complete dry weather monitoring of outfalls within two (2) city zones (chosen at random) which do not have known water quality problem areas previously identified through the Reactionary Program. <ul style="list-style-type: none"> <li>○ Monitoring completed in the 2020 Fall season at 23 outfalls (19 samples collected due to dry weather base flow) located within the pilot study area – lab analysis has been received and report is currently underway.</li> <li>○ Issues are being found at previously unknown sites (i.e., E.coli, metals, etc.)</li> <li>○ Encouraged to find that less than half of the outfalls sampled revealed issues requiring further investigation. Follow up sampling and investigation are being planned and will occur in 2021.</li> </ul> </li> </ul>
<b>Rationale</b>	Outfall monitoring throughout the City aims to protect the quality of runoff to the City's natural systems; this is done through the identification, investigation and remediation of issues to ensure compliance with the City's Sewer Use By-Law and protection of natural features.
<b>Department/Division /Section</b>	T&W/IPES/ES
<b>Partnerships</b>	<ul style="list-style-type: none"> <li>• WOM – important internal partnership for materials (booms/pads) and work completed through service requests.</li> <li>• MECP important stakeholder/partner through enforcement and corrective actions – Incident numbers filed with Spills Action Center <ul style="list-style-type: none"> <li>○ Good relationship between City staff and abatement officers within Peel/Halton through resolving issues – trust that City is working to resolve the issues.</li> </ul> </li> <li>• ROP – approx. 90% of the public complaint calls go to ROP first through the 24/7 OnCall environmental control section, as ROP acts as the first</li> </ul>

Action D.1	Outfall Monitoring (Water Quality)
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	responders. ROP then informs the City when city infrastructure is involved.
FTEs	Involved in both Reactionary/Proactive Program: In 2020, Coordinator (30%), Co-op Student (70%)
Equipment	<ul style="list-style-type: none"> <li>• Sampling bottles (grab samples)</li> <li>• Auto-samplers</li> <li>• Lab testing (through contract)</li> <li>• Temperature and pH meter, turbidity meter</li> <li>• City vehicle, City cell phone, camera</li> <li>• Excel database</li> </ul>
Annual Budget (Capital budget, O&M, Year)	<p><b>Reactionary Program:</b></p> <ul style="list-style-type: none"> <li>• Approx. \$1-3K spent on lab analysis annually through Reactionary Program – samples are tested for contaminants based upon the field investigation and visual inspection of any floatables or evident chemical contaminants rather than a generic suite of contaminants (leads to cost savings).</li> <li>• Additional spending may arise when investigating complex issues – for example, additional \$60-70K approved for auto-sampler investigation and additional expertise (combined space entry) to further investigate and resolve problem areas.</li> </ul> <p><b>Proactive Program:</b></p> <ul style="list-style-type: none"> <li>• Approx. \$7K spent on lab analysis for pilot project – sampling suite primarily based on Sewer Use By-law (Part 4) which outlines the known contaminants/limits. Research done on the drainage area can eliminate certain contaminants that are not expected based upon the contributing land use, which can save costs on lab tests.</li> </ul>
Relevant Legislative/Policy/Emerging Practices	Wood – will be an output from the Legislative Checklist (TBC)
Industry Best Practices	<p><b>City of Toronto – Outfall Monitoring Program (OMP):</b></p> <ul style="list-style-type: none"> <li>• Outfall Monitoring Program (OMP) by the Environmental Monitoring &amp; Protection Unit (EM&amp;P) to ensure compliance with the Sewers By-law and proactively identify and rectify water quality issues. The Objectives included: <ul style="list-style-type: none"> <li>○ To locate and survey all outfalls within Toronto</li> <li>○ To sample all outfalls with a dry weather flow</li> <li>○ To identify contaminated stormwater flows</li> <li>○ Initiate remedial and/or enforcement action to eliminate the sources of contamination under authority of the Sewers By-law.</li> <li>○ Update City maps.</li> </ul> </li> <li>• The OMP includes the following actions:</li> </ul>

Action D.1	Outfall Monitoring (Water Quality)
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>○ <i>Inspection and sampling (dry weather flow) of every storm sewer outfall discharging into Lake Ontario and Toronto's watercourses (e.g. stream, river).</i></li> <li>○ <i>Frequent monitoring of known Priority Outfalls (outfalls known to have intermittent yet frequent contaminated discharges).</i></li> <li>○ <i>Actively investigating Priority Outfalls to locate and eliminate the source of contaminated flows.</i></li> <li>• There are 6 key steps in the OMP (ref. Sewers By-law (Toronto Municipal Code Chapter 681) and Outfall Monitoring Program, EM&amp;P Toronto Water Presentation, 2013):             <ul style="list-style-type: none"> <li>○ <i>Step 1: Surveying and Sampling</i> <ul style="list-style-type: none"> <li>▪ <i>Outfalls are the exit points of the storm sewer system for drainage of surface runoff (i.e. rain, snowmelt).</i></li> <li>▪ <i>Each individual watershed is surveyed for all Outfalls – defined as pipes greater than 10 cm.</i></li> <li>▪ <i>Each surveyed outfall with dry weather flow is sampled at least twice (during this phase, 2 rounds of samples).</i></li> <li>▪ <i>Sampling parameters may include: E. coli, TSS, pH, BOD, Metals, Total Phosphorus, TKN and Phenols – others can also be sampled and tested, at the discretion of the investigating officer.</i></li> </ul> </li> <li>○ <i>Step 2: Classification of Outfalls</i> <ul style="list-style-type: none"> <li>▪ <i>Outfalls are classified as either "Priority, Concern or Interest" based on sample results.</i></li> </ul> </li> <li>○ <i>Step 3: Investigate Priority Outfalls</i> <ul style="list-style-type: none"> <li>▪ <i>Priority outfalls are actively investigated and sampled.</i></li> <li>▪ <i>Pollution source tracing is done from the outfall, upstream throughout the storm sewer.</i></li> <li>▪ <i>Strategic storm manhole points are inspected and compared – areas of higher pollutant concentration indicate proximity to the source (i.e. between two manholes).</i></li> </ul> </li> <li>○ <i>Step 4: Pollution Source Inspections</i> <ul style="list-style-type: none"> <li>▪ <i>Property inspections begin once the source has been narrowed down in between two manholes.</i></li> <li>▪ <i>All properties within the area of inspection are flagged for inspection and are issued due test letters.</i></li> <li>▪ <i>Pollution sources can come from cross connections or through illegal dumping/discharge into catch basins, other potential sources include sewer infrastructure problems.</i></li> <li>▪ <i>Main test methods include non-toxic dye testing the property and video testing of the storm sewer lines.</i></li> </ul> </li> <li>○ <i>Step 5: Enforcement</i> <ul style="list-style-type: none"> <li>▪ <i>Stepwise enforcement (cross connected properties).</i></li> <li>▪ <i>Verbal warnings to property owners to not use the cross-connection fixtures until the problem is rectified.</i></li> <li>▪ <i>Property owners are issued written Notices of Violation by mail, indicating they are in breach of the Sewers By-law.</i></li> </ul> </li> </ul> </li> </ul>

Action D.1	Outfall Monitoring (Water Quality)
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>▪ <i>Legal actions / fines issues, if necessary.</i></li> <li>○ <i>Step 6: Delisting Priority Outfalls</i> <ul style="list-style-type: none"> <li>▪ <i>After Priority Outfalls are thoroughly investigated, they can be delisted to Outfalls of Interest, if the water quality has improved.</i></li> <li>▪ <i>This requires obtaining 3 clean samples from routine monitoring and sampling at the outfall – a clean sample is defined as having the attributes of an Outfall of Interest.</i></li> </ul> </li> <li>• Each year, the EM&amp;P unit publishes a summary report (ref. Sewers and Water Supply By-laws Compliance and Enforcement Annual Report) which is available to the public, and contains updates/summaries of the year's efforts in each of the major program areas / activities – this includes: <ul style="list-style-type: none"> <li>○ The OMP, Pollution Prevention Program, Reports of Spills, Sewers By-law Compliance, Grease Issues, etc.</li> <li>○ The OMP reporting includes summaries of the yearly: <ul style="list-style-type: none"> <li>▪ Cross connections found, cross connections corrected, priority outfalls, outfalls of concern, de-listed priority outfalls, number of inspections, number of sampling events, number of laboratory analyses, notices of violations issued.</li> </ul> </li> </ul> </li> </ul> <p><b>Other Best Practices to Consider (under development):</b></p> <ul style="list-style-type: none"> <li>• TBD</li> </ul>
Recommendations	
<b>a. People</b>	<ul style="list-style-type: none"> <li>• Additional staff – 1 Technologist (full-time) to support staff, to help provide support for development/compliance review for groundwater management (Action B.5).</li> <li>• Assess the need to develop on-call position for emergencies –possibility to combine with <i>Storm Sewer Emergency/ Failure response</i>.</li> <li>• Evaluate the need for an additional co-op student in the summer/fall seasons for the proactive monitoring program – assess based on the priority watersheds, schedule and new problem areas.</li> <li>• Over the course of the program (additional watersheds monitored), more problem areas requiring frequent monitoring may be required – requiring additional staff for the monitoring period.</li> </ul>
<b>b. Equipment</b>	N/A
<b>c. Policy</b>	No updates required.
<b>d. Program</b>	<ul style="list-style-type: none"> <li>• Maintain the existing <i>reactionary program</i> – assess the need with ROP to develop an on-call City position for spills / quality issues (potential to be combined with the <i>Storm Sewer Emergency/ Failure responses</i>)</li> <li>• Expand the <i>proactive program</i> into other watersheds to identify unknown quality issues.</li> </ul>
<b>e. Methodology</b>	<ul style="list-style-type: none"> <li>• Proactive Program:</li> </ul>

Action D.1	Outfall Monitoring (Water Quality)
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>○ Continue the focus on watersheds not currently monitored as part of the reactionary program – Identify all watersheds within the City of Mississauga which fit these criteria.</li> <li>○ Using the existing City infrastructure mapping database, identify the number of known storm sewer outfalls based on City selected criteria (i.e. diameter &gt; 0.10 m (City of Toronto)).</li> <li>○ Based on the number of outfalls per individual watersheds, develop a targeted priority list, and targeted schedule for City-wide monitoring completion <ul style="list-style-type: none"> <li>▪ i.e. City of Toronto achieved its goal or survey/sampling at all City outfalls (&gt;2,500 outfalls) over an approx. 9 year period (2005 to 2014).</li> </ul> </li> </ul>
<b>f. Other</b>	
<b>City Commentary</b>	<ul style="list-style-type: none"> <li>• Evaluate proactive management program established in 2020 (reporting currently being completed) – concern regarding finding new issues which may overwhelm existing staff/resources.</li> <li>• Potential for making an on-call position part of the City program (currently only ROP has 24/7 ability) – would require additional staff.</li> <li>• Working with geomatics to create an ESRI based GIS platform that would allow easy visual access to all the information that the city has for a particular property while in the field with a tablet.</li> </ul>

## D.2 Pollution Prevention Plans – Existing Action

Action D.2	Pollution Prevention Plans
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
<b>Description</b>	<ul style="list-style-type: none"> <li>Pollution Prevention (P2s) Plans are requested/enforced for businesses/properties that have a recurring contaminant issue related to the Sewer Use By-Law – P2 Plans are issued to ensure that the problems will be/are resolved (i.e. Compliance Tool).</li> <li>P2 plans are completed according to Schedule A of the Sewer Use By-Law – which contains the required format for P2s.</li> <li>Currently the City issues/enforces approx. 5-10 P2 plans per year for larger issues/major contaminators.</li> <li>Difficult to enforce because the current P2 format in the By-Law is quite extensive and costly for small or medium sized businesses to produce.</li> </ul>
<b>Rationale</b>	P2 plans are an important pollution planning measure to avoid and/or minimize the overall risk to the environment and/or human health through preventative measures.
<b>Department/Division / Section</b>	T&W/IPES/ES
<b>Partnerships</b>	<p>Important partners/stakeholders include MECP, which helps with enforcement and conditions for P2 plans to be completed. MECP relies on the City for the investigation, however, will help the City with enforcement including restitution.</p> <p>Conservation Authorities – CVC has published numerous P2 Case Studies and fact sheets raising community and industry awareness.</p>
<b>FTEs</b>	Coordinator (10%)
<b>Equipment</b>	N/A
<b>Annual Budget (Capital budget, O&amp;M, Year)</b>	N/A
<b>Relevant Legislative/ Policy/Emerging Practices</b>	Wood – will be an output from the Legislative Checklist (TBC)
<b>Industry Best Practices</b>	<p>The City completed a Pollution Prevention jurisdictional scan/review which summarized and assessed P2 strategies of other jurisdictions/countries – ref. "Cost-Benefit Analysis of P2 Planning: Literature Review", 2018.</p> <ul style="list-style-type: none"> <li>This literature review was focused on answering the following research question: <i>whether or not there is a net benefit for businesses who engage in P2 planning</i>. Supplementary to the overarching question, an evaluation of P2 programs and opportunities for the City of Mississauga to improve its P2 program were evaluated.</li> <li>The key findings included: <ul style="list-style-type: none"> <li><i>There is a net benefit for facilities/industries that participate in P2 planning.</i></li> </ul> </li> </ul>



Action D.2	Pollution Prevention Plans
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>○ <i>Firms who participate in P2 activities enjoy financial and non-financial benefits. Low-cost and easy to implement P2 projects have immediate financial benefits.</i></li> <li>○ <i>Smaller businesses benefit less from P2 planning than larger ones.</i></li> <li>○ <i>Barriers often outweigh the benefits to P2 planning.</i></li> <li>○ <i>Regulation and P2 planning are proven to reduce pollution, but ISO may not be the best option for reducing water pollution.</i> <ul style="list-style-type: none"> <li>▪ <i>A study of 138 countries from 1991-2005 found that while a 1% increase in ISO adoption was associated with a statistically significant reduction in sulfur dioxide, a 1% increase in ISO was not associated with a statistically significant reduction in biochemical oxygen demand. The researchers hypothesize that due to the visibility of air pollution compared to water pollution ISO certified firms may strategically invest more resources in reducing air pollution than water pollution.</i></li> <li>▪ <i>In addition, a study of 37 pulp and paper plants in Quebec found that only three of eighteen ISO adopters reduced BOD or TSS, and that reductions were minimal and comparable to reductions that occurred in the non-ISO control group.</i></li> </ul> </li> <li>● The recommendations include: <ul style="list-style-type: none"> <li>○ <i>Shift communications strategy from P2 planning as a legal requirement to a way to improve business.</i> <ul style="list-style-type: none"> <li>▪ The City should consider developing a pamphlet / fact sheet (similar to Environment Canada) with case study examples, and facts including payback periods, cost savings and improved working conditions, as well as helpful links to federal / provincial guidance tools.</li> </ul> </li> <li>○ <i>Address resource disparity in P2 planning between large and small facilities.</i> <ul style="list-style-type: none"> <li>▪ The City should consider developing a document which would outline the methods of calculating payback periods and how to assess the value or pollution/waste reduction. Reference is made to Washington State's Cost Analysis fact sheet which details methods of payback period calculation, list of typical costs to consider, and determining if a project is economically feasible.</li> <li>▪ It was also recommended for the City to create a survey to assess the barriers small to medium manufacturing (SMEs) face within the municipality, and then use the findings to further refine and update the program.</li> </ul> </li> <li>○ <i>Focus on immediate financial benefits from low-cost P2 projects.</i> <ul style="list-style-type: none"> <li>▪ Focus informational tools on low-cost projects and their financial outcomes to help overcome the assumption that all P2 activities are high in cost and an economic risk. Utilizing local case studies from Bloom (formerly OCETA) and/or CVC</li> </ul> </li> </ul> </li> </ul>

Action D.2	Pollution Prevention Plans
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<p>can provide further information regarding low-cost options and financial benefits.</p> <ul style="list-style-type: none"> <li>○ <i>Utilize proven tools such as workshops and consultation to promote P2 planning.</i> <ul style="list-style-type: none"> <li>▪ The City should consider organizing local P2 workshops in partnership with Bloom, CVC and the Mississauga Business Enterprise Centre to improve and promote public awareness.</li> <li>▪ Following the lead of the University of Nebraska's Partners in Pollution Prevention Program, the City could utilize and develop partnership connections to local Post-Secondary schools (such as Sheridan College, UTM and others) which include programs such as Chemical Engineering Technology and Environmental Technician programs, whereby the students could provide P2 planning consultation for local small businesses as part of a co-op / extracurricular program.</li> </ul> </li> <li>○ <i>ISO exemptions to P2 planning requirements may not be appropriate in stormwater by-law.</i> <ul style="list-style-type: none"> <li>▪ The ISO programs are not as effective in reducing water pollution, therefore exemptions for ISO accreditation should not be credited in relation to water P2 planning.</li> </ul> </li> <li>○ <i>Continue to increase public awareness of water pollution.</i> <ul style="list-style-type: none"> <li>▪ Continue public education and outreach to increase awareness regarding the causes, effects and mitigation measures for water pollution in Mississauga.</li> </ul> </li> </ul> <p><b>Other Best Practices to Consider (under development):</b></p> <ul style="list-style-type: none"> <li>• Brantford, ON Pollution Prevention Program</li> <li>• City of Kitchener – Integrated Stormwater Master Plan, , 2016 – Pollution Prevention Checklist integrated with Region of Waterloo's Risk Management Plans</li> </ul>
<b>Recommendations</b>	
<b>a. People</b>	<ul style="list-style-type: none"> <li>• Additional staff (as part of Outfall Monitoring) can help support existing staff for review of P2 submissions.</li> </ul>
<b>b. Equipment</b>	N/A
<b>c. Policy</b>	None required.
<b>d. Program</b>	<ul style="list-style-type: none"> <li>• Development of P2 checklist for low-cost options based upon specified business type (low-risk and/or non-compliance P2 industries).</li> </ul>
<b>e. Methodology</b>	<ul style="list-style-type: none"> <li>• Utilize local case studies (CVC and Bloom) to develop Mississauga fact sheets for P2 planning, explore the economics and cost-saving benefits.</li> </ul>
<b>f. Other</b>	N/A
<b>City Commentary</b>	<ul style="list-style-type: none"> <li>• Opportunity to work with the City's licensing department to require P2s to be completed to achieve business licenses – this would help to minimize risks and future issues.</li> </ul>

Action D.2	Pollution Prevention Plans
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>○ Would likely be push-back from business owners although there is a proven advantage to being proactive e.g. recycling/having proper disposal methods in place.</li> <li>○ Current view of business owners would be the additional costs associated with preparing P2s, P.Eng requirement, considered undue burden for inspections, etc.</li> <li>• Discussions regarding the lack of BMPs which could be implemented – suggestions raised to review work being completed in the US and other jurisdictions.</li> <li>• Discussions regarding improvements required to the SW Charge for businesses – currently providing a 5% credit for P2s (adhering to Schedule A in By-law) – cost benefit analysis completed by CVC found that the P2 credit would take approx. 20+ years to pay back the costs of generating a P2 – room for improvement in order to encourage involvement.</li> <li>• Discussions regarding a “P2 light” program – more of a checklist and/or quick wins which could be applied in simplified scenarios (i.e. standard lists for certain business types) to encourage involvement and PP (i.e. give them the 5% credit, if business meets all the checklist requirements). <ul style="list-style-type: none"> <li>○ Compliance P2s (Schedule A) would still be required for existing/proven issues.</li> </ul> </li> <li>• Potential involvement of CVC in order to incorporate green landscaping as part of checklist initiatives.</li> </ul>

## D.3 Asset Management: Watercourses – Existing Action

Action D.3	Asset Management: Watercourses
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
<b>Description</b>	<p>Watercourse management/monitoring for erosion control is a long-established program at the City, whereas formal asset management planning is comparatively new – history/lifespan of engineered assets is new and in development.</p> <p>Current program was initiated in 2009</p> <ul style="list-style-type: none"> <li>• Prior to 2009, monitoring/site visits were generally issue/complaint based.</li> <li>• Current program documents the condition/assessment of all City—maintained watercourse reaches on a 5-year cycle <ul style="list-style-type: none"> <li>○ Each City reach is visited at least once every 5 years (minimum)</li> <li>○ Most reaches are monitored on a more frequent schedule (e.g. every 0.5 years, 1-year, 2-years, etc.) <ul style="list-style-type: none"> <li>▪ The monitoring frequency is established based upon risk (i.e. surrounding lands, properties) and/or condition found at the time of assessment in comparison to previous monitoring.</li> <li>▪ There is a condition database, which tracks inspection frequencies.</li> </ul> </li> <li>○ Standardized method of assessing each watercourse reach – urban channel assessment (modified version of common rapid channel assessment or RCA), slightly modified based upon the urban conditions the City observes.</li> <li>○ Categorization of the monitored reach – “in regime”, “stressed” or “in adjustment”.</li> <li>○ 200 +/- reaches (segments) of 30 +/- different watercourse within the City.</li> </ul> </li> <li>• Storm (STM) outfall inspection / monitoring: <ul style="list-style-type: none"> <li>○ Primarily inspect outfalls for blockages</li> <li>○ Significant signs of erosion (structural integrity of outfall)</li> <li>○ Outfalls vs outlets – pipe outlet projecting from bank (projecting pipe), outfall includes larger infrastructure (i.e. headwall/wing walls/apron/spillway)</li> </ul> </li> <li>• Culverts – erosion/structural integrity (major issues)</li> <li>• Notes areas of water quality concern (discolorations, spills, etc.) – communicated to City staff as part of outfall monitoring (Action C.1) (alerting to issues)</li> <li>• Additional elements of watercourse monitoring program can include the following data at localized erosion or problem sites: <ul style="list-style-type: none"> <li>○ Velocity measurements</li> <li>○ Erosion Pin monitoring</li> <li>○ Channel cross-sections measurements</li> <li>○ Monitoring capital improvement projects (post-construction)</li> <li>○ Localized risk assessment score (separate from reach assessment)</li> </ul> </li> </ul>

Action D.3	Asset Management: Watercourses
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>The outcomes of watercourse monitoring program help to identify areas of risk and/or issues in the watercourse network across the City, which can be addressed through either capital works planning for large scale issues (e.g. re-alignments, outfall replacements, erosion protection, etc.) and/or in-house services/contracts addressed by the City for localized erosion issues.</li> </ul>
<b>Rationale</b>	Asset management of watercourses includes both monitoring and capital improvements which are both important for the management and protection of the City's engineered and natural open water features and those public/private lands in the surrounding areas. Scheduled and continuous monitoring of watercourses allows for the preventative identification of at-risk areas and mitigation planning through capital works; additionally serves as input for long-term municipal planning.
<b>Department/Division /Section</b>	T&W/IPES/ES
<b>Partnerships</b>	<ul style="list-style-type: none"> <li>Internal City Partnerships:               <ul style="list-style-type: none"> <li>WOM – often completes/contracts maintenance work</li> <li>Parks/Forestry – involved in all capital projects (watercourses frequently flow throughout parks and woodlots)</li> <li>Roads/ Asset Management Group – bridges/culverts (stability issues, replacements, etc.)</li> </ul> </li> <li>Conservation Authorities:               <ul style="list-style-type: none"> <li>Information sharing for annual reach assessments (only when requested)</li> <li>Capital projects/planning for works will require input for permitting.</li> <li>Strong partnership with the CVC – room for improvement for coordination efforts.</li> </ul> </li> </ul>
<b>FTEs</b>	<ul style="list-style-type: none"> <li>Monitoring program – 1 FTE, 1.4 Coop FTE (4 co-op students per year, 2 in the summer, 2 in the fall)</li> <li>1 FTE for localized erosion projects</li> </ul>
<b>Equipment</b>	<ul style="list-style-type: none"> <li>Field Camera</li> <li>Measuring equipment (ruler, tape measure)</li> <li>Erosion pins</li> <li>Software – MS Access Database</li> </ul>
<b>Annual Budget (Capital budget, O&amp;M, Year)</b>	<ul style="list-style-type: none"> <li>Capital – 10-year forecast for Watercourse projects (2019-2028 Capital Program) = \$93M (+/-) erosion projects               <ul style="list-style-type: none"> <li>Annual – \$9M (+/-) for Watercourse erosion projects                   <ul style="list-style-type: none"> <li>Approx. 3-5 projects a year – includes re-alignment, outfalls, erosion protection works, etc.</li> <li>Some forecasted projects are from separate/external studies not sourced from monitoring program</li> </ul> </li> </ul> </li> </ul>

Action D.3	Asset Management: Watercourses
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>○ Localized erosion projects – smaller scale maintenance/restoration budgets – Approx. \$350K per year for localized issues (in-house)</li> <li>• Annual Operating Budget (2019) = \$3.4M (+/-) watercourse program               <ul style="list-style-type: none"> <li>○ Maintenance – Minor maintenance goes to WOM (City dept)</li> </ul> </li> </ul>
Relevant Legislative/Policy /Emerging Practices	Wood – will be an output from the Legislative Checklist (TBC)
Industry Best Practices	<p><b>City of Toronto &amp; TRCA Partnership – Watercourse Management (ref. 2017 Wet Weather Flow Management Plan (WWFMP) Implementation Update):</b></p> <ul style="list-style-type: none"> <li>• <i>The City's Watercourse Management Program, delivered by Toronto Water in coordination with TRCA, is an ongoing WWFMP program to reduce the erosion impacts of wet weather flows on (i) the city's watercourses to protect Toronto Water sewer and watermain infrastructure, and (ii) valley land erosion that impacts private property, and also to address (iii) riverine flooding in Toronto's flood plains. This program supports WWFMP objectives including the reduction of erosion impacts on habitat and property, reducing flooding impacts to life and property, enhancement and restoration of natural features, achieving healthy aquatic communities, and improving water quality in the city's watercourses and Lake Ontario.</i> <ul style="list-style-type: none"> <li>○ The City takes the lead in prioritizing stream restoration works where City infrastructure is at risk (assessed through Stream Geomorphic Master Plan EAs)</li> <li>○ TRCA takes the lead in "Protection of Private Property from Valley Land Erosion" and "Riverine Flooding in Flood Plains" with support from the City through the "Coordinated Watercourse Management Plan" (2014) – some relevant excerpts include:                   <ul style="list-style-type: none"> <li>▪ <i>Design and construction of erosion control works should be carried out in collaboration with other potentially affected Divisions and costs for such work can be shared among Divisions where there are mutual benefits. The TRCA, Parks Forestry and Recreation, Toronto Water, and Transportation Services meet quarterly (or more frequently as required) in a variety of issue specific technical groupings to review new hazards identified, discuss proposed projects and workplans, address permitting and natural feature protection requirements, and promote ongoing collaborative decision-making and efficient use of public funds. Capital repair plans of PF&amp;R (such as erosion of pathways) and Transportation Services (such as road crossings) and TRCA (such as erosion hazard sites) are the respective responsibility of these departments, but co-ordinated with Toronto Water through the capital co-ordination process. Where stream erosion poses</i></li> </ul> </li> </ul> </li> </ul>

Action D.3	Asset Management: Watercourses
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<p><i>a risk to more than one owner group (department), the groups will continue the present practice of bundling of works (including through Engineering and Construction Services) to minimize impacts on the flora and fauna of valley lands; this may, in addition, cause the acceleration of some lower priority works in order to address the mutual needs of the owner groups.</i></p> <ul style="list-style-type: none"> <li>▪ <i>TRCA will be responsible for assessing erosion hazard sites affecting private property and designing, constructing and maintaining erosion control works affecting one or more property owners, on a priority basis, in order to protect public safety and to stabilize and limit further damage. This is a continuation of TRCA's present procedure under their Waterfront and Valley Erosion Control plan.</i></li> <li>▪ <i>Costs for design, construction and maintenance of such erosion control works will be shared between the benefitting property owners and TRCA (as per TRCA's Private Landowner Contribution Policy). TRCA will address such costs on a case by case basis and develop a cost sharing arrangement and any needed easements between the benefitting property owner(s) and TRCA, prior to commencing works.</i></li> </ul> <p><b>Industry Knowledge – Data Collection</b></p> <ul style="list-style-type: none"> <li>• The City of Mississauga has expressed interest in improving its digital inventory of watercourse assets; this can be achieved in technology upgrades including some of the following: <ul style="list-style-type: none"> <li>○ GPS Cameras – photos taken in the field can be imported directly into a mapping software (i.e., ESRI ArcMap) as georeferenced point shapefiles, which can then be supplemented with additional attributes for naming/identification, inspection information (such as findings and recommendations), etc.</li> <li>○ Digital Notetaking in the field – supplementing pen/paper note taking with digital notes (i.e. on a portable tablet) linked with mapping software (i.e. Google Earth) provides the ability to “pin” locations in mapping software directly – can help to confirm locations of assets and/or problem areas which are difficult to identify via aerial photos only. Incorporating digital note taking in the field can also reduce the time/effort of digitizing hard copy notes post-inspection.</li> </ul> </li> <li>• The City's watercourse monitoring program is highly photograph dependent, therefore georeferenced images and field notes can help supplement the digital inventory and have a more fulsome database and mapping of assets to continue building and refining the City's asset management.</li> </ul> <p><b>Other Best Practices to Consider (under development):</b></p>

Action D.3	Asset Management: Watercourses
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>Town of Oakville – Watercourse Monitoring Program</li> <li>City of Burlington – Watercourse Monitoring Program</li> <li>City of Kitchener – Integrated Stormwater Management Master Plan, – Watercourse &amp; Erosion Restoration</li> </ul>
<b>Recommendations</b>	
<b>a. People</b>	<ul style="list-style-type: none"> <li>Involve CA's through annual meetings? Discuss primary problem areas, property owners, risk severity, connect with CA related projects.</li> </ul>
<b>b. Equipment</b>	<ul style="list-style-type: none"> <li>Upgrade field equipment for georeferenced photography / field notes – better linking to existing GIS based inventory and improving accuracy and categorization of assets.</li> </ul>
<b>c. Policy</b>	TBD
<b>d. Program</b>	<ul style="list-style-type: none"> <li>City has a strong program for monitoring watercourses (frequencies and identification of issues)</li> <li>Improvements to be had regarding CA involvement in identification of issues/solutions (restoration) and for data management post inspections</li> </ul>
<b>e. Methodology</b>	<ul style="list-style-type: none"> <li>Improvements to the asset inventory through GIS database – can continue to develop and link to other stormwater infrastructure to produce a more cohesive asset inventory.</li> </ul>
<b>f. Other</b>	
<b>City Commentary</b>	<ul style="list-style-type: none"> <li>Improvement required for partnerships – inter governmental agency collaboration             <ul style="list-style-type: none"> <li>increase collaboration with CA's on localized problems- CA's currently involved, however objective to improve natural environment through collaborative partnership</li> <li>Longer list of identified problems will lead to longer list of projects – preferred to have CA's involved earlier at the identification stages of the process.</li> </ul> </li> <li>AM of Watercourses – considerable data available (photos, assessments, descriptions) related to condition assessments:             <ul style="list-style-type: none"> <li>Inventory of all the assets is difficult to compile – work in progress.</li> <li>Lack of georeferenced assets – room for improvement for GIS based inventory.</li> <li>Good database of watercourse drawings</li> </ul> </li> </ul>



## D.4 Asset Management: Pipes – Existing Action

Action D.4	Asset Management: Pipes
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
<b>Description</b>	<ul style="list-style-type: none"> <li>• Inspections and conditions assessment:             <ul style="list-style-type: none"> <li>○ CCTV completed for storm sewer system via contracted service                 <ul style="list-style-type: none"> <li>▪ Focus/priority of systems at highest risk – such as, oldest and/or trunk sewers</li> <li>▪ Preliminary inspection trends for minor/major systems are determined with consideration to existing resources, current state of infrastructure, inspection costs, etc. – the approximate trends for each risk level include the following:                     <ul style="list-style-type: none"> <li>• Lower Risk Level – goal of every 10-12 years</li> <li>• Medium Risk Level – goal of every 5-10 years</li> <li>• Highest Risk Level – goal of every 3 years</li> </ul> </li> <li>▪ Inspection schedule is typically determined based upon age of infrastructure (life cycle) and available budgets/resources to conduct the work.</li> </ul> </li> <li>○ WOM division leads the management of CCTV storm sewer inspection contracts. Work advances in collaboration with Stormwater Assets &amp; Programming staff who establish the inspection priorities.</li> <li>○ Prioritization for inspections and repairs/capital forecasts completed by City staff based upon results of inspection.</li> </ul> </li> <li>• Cleaning of CBs and Flushing of Sewer System (based upon blockages found during inspections):             <ul style="list-style-type: none"> <li>○ CBs are cleaned on a 3-year cycle – 51,420 CBs total, target of approx. 17,000 per year. Amount per year not formally tracked.</li> <li>○ Flushing completed on an as-needed basis through identification of issue areas to compete the CCTV survey/investigation.</li> </ul> </li> <li>• Capital project prioritizing/budgeting             <ul style="list-style-type: none"> <li>○ Initial scoping of the project – data gathering, scope definition, coordination with Capital Works department.</li> </ul> </li> <li>• Continue improving the asset summaries through GIS data             <ul style="list-style-type: none"> <li>○ First cut of asset register through AM plan</li> </ul> </li> <li>• Create/implement and maintain the current programs:             <ul style="list-style-type: none"> <li>○ Protocols and actions (open ended, establishing the guidelines for taking action – new contracts, new staff)</li> <li>○ Establishing the issues and how to resolve, examples include utility cross bores, cross-connections, telecommunications – how do we address these issues, corrective actions through City programs.</li> </ul> </li> <li>• Emergency/failure response:             <ul style="list-style-type: none"> <li>○ Includes utility intrusion, collapse/failure, external taps into system.</li> <li>○ Currently struggling with how to respond to these situations:                 <ul style="list-style-type: none"> <li>▪ 1. Resources and 2. Establishing a shared understanding throughout all staff levels that if these failures/near-failures are not addressed efficiently, the long-term, compounding effect will be detrimental to the service delivery, project</li> </ul> </li> </ul> </li> </ul>

Action D.4	Asset Management: Pipes
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<p>delivery and therefore the City's ability to maintain a state of good repair throughout the storm sewer system.</p> <ul style="list-style-type: none"> <li>• Project review and coordination with other departments (overlap of projects) <ul style="list-style-type: none"> <li>◦ Currently established for review and coordination of multiple disciplines and city infrastructure.</li> </ul> </li> <li>• City-owned Assets: <ul style="list-style-type: none"> <li>◦ CBs = 51,420 approx.</li> <li>◦ Point assets = 31,830 (includes MHs, Headwalls, Outfalls, etc. – majority are MHs)</li> <li>◦ Linear assets = 81,500 pipe segments (29,150 mains/trunks, 1,345 FDC and 51,420 CB leads) <ul style="list-style-type: none"> <li>▪ 1.9 million meters (1,906 km) of pipe (primary linear infrastructure)</li> <li>▪ 1,813.8 km of pipe included in network of 'mains' and 'trunks'</li> <li>▪ 92.9 km of pipe included in FDC system</li> </ul> </li> <li>◦ Remaining pipes are CB leads and service laterals</li> </ul> </li> </ul>
<b>Rationale</b>	The stormwater drainage system is one of the largest assets owned and operated by the City; the storm sewer system represents majority of this value, and as such requires regular inspection and investigation in order to identify and prioritize needs for maintenance, restoration and/or replacement to maintain its function and performance across the City.
<b>Department/Division/Section</b>	T&W/IPES/ES
<b>Partnerships</b>	<ul style="list-style-type: none"> <li>• WOM – completes additional inspections of storm sewer infrastructure.</li> <li>• ROP – interconnected (dual tiered municipality) with management of linear infrastructure.</li> <li>• Stakeholders who improve the infrastructure (roads projects), often leads to upgrades in storm sewers simultaneously. <ul style="list-style-type: none"> <li>◦ Transportation Asset Management</li> <li>◦ Transit (Transitway, proposed LRT/BRTs).</li> </ul> </li> <li>• Ministry of Transportation – often involved in roads projects.</li> </ul>
<b>FTEs</b>	<ul style="list-style-type: none"> <li>• 2 FTEs - primarily working on inspection program (GIS support and documentation)</li> <li>• Majority of time spent for AM or subset of AM works.</li> </ul>
<b>Equipment</b>	<ul style="list-style-type: none"> <li>• CCTV Equipment (Contractor)</li> <li>• CB Cleaning Equipment (Contractor)</li> <li>• Roadway Sweeping Equipment (City and Contractor)</li> <li>• GIS Database (City)</li> </ul>
<b>Annual Budget (Capital budget, O&amp;M, Year)</b>	<p>Capital: \$8.7 million/year (2019-2028 average)</p> <p>O&amp;M: \$5.6 million/year</p> <p>Values from 'Lifecycle Management' chapter of 2021 Stormwater AMP</p>

Action D.4	Asset Management: Pipes
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
Relevant Legislative/Policy /Emerging Practices	Wood – will be an output from the Legislative Checklist (TBC) SW Asset Management Plan to be completed in 2021 and inform the Stormwater Program.
Industry Best Practices	<p>Inspections &amp; Condition Assessments:</p> <ul style="list-style-type: none"> <li>There is currently no Regulatory minimum LOS, however the industry standard suggests up to a 25 year cycle on pipes that have a projected 100 year lifespan. <ul style="list-style-type: none"> <li>This demonstrates the baseline conditions assessment, which will then be re-inspected over a 25-year cycle (or 4% of the system per year) as a minimum requirement.</li> </ul> </li> <li>If the inspections are not completed, and problems go undetected, they could result in potential increased flooding and possible need for costly emergency pipe repairs and replacement to protect public health and safety at 30-40% increased cost.</li> </ul> <p>CB Cleaning &amp; Flushing:</p> <ul style="list-style-type: none"> <li>City of Toronto (ref. 2017 WWFMP Implementation Update): <ul style="list-style-type: none"> <li>Catch basins on arterial roads are cleaned on an annual basis.</li> <li>Catch basins on local roads are cleaned every two years.</li> <li>Toronto Water initiated a pilot project including digital data collection to quantify the materials removed to inform a review of service standards, modify cleaning frequency and delineate priority zones across the city.</li> <li>Transportation Services is in the process (as of 2017) to map low lying areas and implement a proactive pre- and post-extreme rain event inspection and cleaning program around catch basins in low-lying areas.</li> </ul> </li> </ul> <p>Street Sweeping:</p> <ul style="list-style-type: none"> <li>City of Toronto (ref. 2017 WWFMP Implementation Update): <ul style="list-style-type: none"> <li>Transportation Services sweep arterial roads twice per month, collector roads once per month, and local roads once to three times a year.</li> </ul> </li> </ul> <p>Emergency/Failure Response:</p> <ul style="list-style-type: none"> <li>City of Seattle Public Utilities (SPU) – Flooding Response: <ul style="list-style-type: none"> <li>If residents observe flooding or ponding, drainage or sewer backups, sewer overflows or blocked culverts or creek, they are encouraged to call the SPU's Operations Response Center who will then prioritize and resolve the issues.</li> <li>The City will activate the Emergency Operation Center during severe storm events to help coordinate response efforts; alerts are sent out across the City via radio, TV, social media, etc.</li> </ul> </li> </ul> <p><b>Other Best Practices to Consider (under development):</b></p> <ul style="list-style-type: none"> <li>City of Brampton – Stormwater Financing Study, Wood, 2020</li> </ul>

Action D.4	Asset Management: Pipes
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
<b>Recommendations</b>	
<b>a. People</b>	<ul style="list-style-type: none"> <li>Confirm the need for additional staff with the City – Potential to add staff to aid in emergency response for storm sewer issues, and potential to combine with Emergency spills (24/7 position mentioned).</li> </ul>
<b>b. Equipment</b>	<ul style="list-style-type: none"> <li>Continue to expand and refine GIS data – first cut of digital database and organization being completed as part of ongoing SW AM plan.</li> </ul>
<b>c. Policy</b>	N/A
<b>d. Program</b>	<ul style="list-style-type: none"> <li>Establish an Emergency Response Program to improve the City's ability to react quickly to issues.               <ul style="list-style-type: none"> <li>Through additional staff resources, develop an on-call / rotational position which supports emergency spills (quality) and flooding issues (quantity) to organize City staff / crew response to issues.</li> </ul> </li> </ul>
<b>e. Methodology</b>	<ul style="list-style-type: none"> <li>Conduct preventative City storm sewer modelling / projections to establish areas at-risk to urban flooding during extreme events.</li> <li>Mapping of low-lying areas / large drainage area to inlet ratio which can be indicative of infrastructure prone to debris/blockages.</li> <li>Evaluating risk of infrastructure failure to include environmental and cost implications.</li> <li>Hoping for ways to improve the categorization and risk of failure, want to grow the use of GIS as the primary mapping database to integrate with other AM departments.</li> <li>Through initiatives such as the integrated rainfall monitoring program (Action C7), a municipal warning system could be developed and/or allow for the City to evaluate the storm sewer network under extreme storm events to establish at-risk areas – compare this modeling with resident calls / complaints, prioritize issues.</li> <li>Training for City staff members regarding infrastructure emergency response.</li> </ul>
<b>f. Other</b>	
<b>City Commentary</b>	<ul style="list-style-type: none"> <li>Expand and refine GIS data – considerable data currently available, however, needs to be combined and/or synthesized in more detailed ranking and breakdown of the infrastructure conditions.               <ul style="list-style-type: none"> <li>Evaluating risk (environmental/cost not currently included but are important factors)</li> <li>Hoping for ways to improve the categorization and risk of failure, want to grow the use of GIS as the primary mapping database to integrate with other AM departments.</li> </ul> </li> <li>Emergency response – want to improve the City's ability to react quickly to issues such as responding to infrastructure that is at or near failure.               <ul style="list-style-type: none"> <li>Issues related to staff resources, as well as internal conflicts regarding priority of issues.</li> </ul> </li> </ul>

Action D.4	Asset Management: Pipes
Service Delivery	Plan/ <b>Program</b> /Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>Capital budget structure is currently separated by: Watercourses, SWMFs, Other STM/SWM Studies/Works.</li> <li>Current budgets/expenditures for the three asset classes are not proportional to their % of the overall stormwater asset value. In the future, as more storm sewer assets reach the end of their first lifecycle, this trend will have to change.</li> <li>Supporting Documents: <ul style="list-style-type: none"> <li>AM Framework – Municipal Finance Office of Ontario</li> <li>ISO 55001 AM Management System</li> <li>Risk Management in Piping System NASSCO</li> </ul> </li> </ul>

## D.5 Asset Management: SWMF's – Existing Action

Action D.5	Asset Management: Stormwater Management Facilities
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
<b>Description</b>	<ul style="list-style-type: none"> <li>• Annual Conditions Assessment completed for City-owned/maintained SWMFs every summer. These inspections result in the following:               <ul style="list-style-type: none"> <li>○ Maintenance reports/orders when deficiencies found.</li> <li>○ WOM will complete minor works i.e. debris clean-up.</li> <li>○ WOM will establish the maintenance contract services, which may require contracting the work externally.</li> </ul> </li> <li>• Wet ponds – Annual Conditions Assessment (ECA Compliance)               <ul style="list-style-type: none"> <li>○ Survey of sedimentation completed currently on an as-needed basis based on sediment volume forecasting.</li> </ul> </li> <li>• OGS units – currently only 2 under Environmental Services authority (in treatment train with SWMFs), contract inspections externally for clean out for the time being.</li> <li>• Microsoft Access database for all assets – summary of all findings through inspections.               <ul style="list-style-type: none"> <li>○ Additional internal documents (excel sheets)</li> <li>○ Ultimate goal for asset management of SWMFs to be incorporated into ESRI (GIS) to create a centralized system for AM planning.</li> </ul> </li> <li>• Monitoring at SWMFs               <ul style="list-style-type: none"> <li>○ Water Quality testing (auto samplers) – contracted externally.</li> <li>○ Completed in compliance with ECA requirements.</li> <li>○ Only been completed at 1 facility: Lake Saigon likely next. Plan to monitor all wet facilities on a rolling basis.</li> </ul> </li> <li>• Discussions regarding flood control/quantity monitoring works (flood control) – plans to initiate additional quantity monitoring in 2021 (i.e. Lake Saigon).</li> <li>• LID for Roads Program – coupled with road resurfacing projects, LID BMPs included as part of contract to increase the number of LID BMPs within the City.               <ul style="list-style-type: none"> <li>○ Allows for two years of lead time for design and planning of LID BMPs across the City.</li> </ul> </li> <li>• Assets = 80 SWMFs:               <ul style="list-style-type: none"> <li>○ 40 wet ponds</li> <li>○ 8 dry ponds</li> <li>○ 16 overland flow parks</li> <li>○ 14 LID BMPs</li> <li>○ 1 underground storage system</li> <li>○ 1 pumping station</li> </ul> </li> </ul>
<b>Rationale</b>	<p>SWMFs offer a variety of hydrologic benefits including water quality, erosion control and flood control benefits, as well as socio-economic value within the watershed; these facilities represent a significant component of the storm drainage system value owned and operated by the City. Completing annual condition assessments of SWMFs assist in prioritizing</p>

Action D.5	Asset Management: Stormwater Management Facilities
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	maintenance activities and capital projects as well as long-term planning of the City resources.
Department/Division/Section	T&W/IPES/ES
Partnerships	<ul style="list-style-type: none"> <li>Internal partners at the City: <ul style="list-style-type: none"> <li>Forestry group (LID BMP design) – maintenance of plantings (input for types of plantings/trees), conducting LID BMP research project (tree health of plantings in LIDs) <ul style="list-style-type: none"> <li>SWM pond – help with the trees/plantings for maintenance &amp; involved in planting plans for restoration works.</li> </ul> </li> <li>Transportation &amp; Works department –Integrated Roads programs (various city departments); <ul style="list-style-type: none"> <li>Started this year (integrated).</li> <li>LIDs integrated into road projects.</li> </ul> </li> <li>Capital Works department – involved with road resurfacing, pond dredging, etc.</li> <li>WOM – conducts minor maintenance done in house through works yards (non-contracted), and through coordinators.</li> <li>Transitway – Involved in support of SWMF's through internal Service Level Agreement</li> <li>Community Services through Parks Development section as it relates to potential for future internal Service Level Agreements</li> </ul> </li> <li>Conservation Authorities – CVC/TRCA <ul style="list-style-type: none"> <li>CA's will request input from the City when they are completing their own studies and propose SWM.</li> <li>LID BMP Monitoring program – water quality/quantity <ul style="list-style-type: none"> <li>CVC conducting monitoring for select projects.</li> </ul> </li> </ul> </li> <li>MECP – ECA compliance monitoring</li> </ul>
FTEs	1 FTE, 1 Co-op student (summer only, primarily completing inspection work and maintenance reports)
Equipment	<ul style="list-style-type: none"> <li>Microsoft Access database for all assets</li> <li>Survey Equipment</li> <li>Auto-samplers (contracted)</li> <li>Grab Samples</li> <li>Camera &amp; Cell Phone</li> </ul>
Annual Budget (Capital budget, O&M, Year)	<ul style="list-style-type: none"> <li>O&amp;M – cost centers = \$50,000/year, bulk accounts = approx. \$380,000/year for SWMFs <ul style="list-style-type: none"> <li>Approx. \$430,000 per year – includes minor maintenance</li> <li>From SW AMP – 2019 SWMF Operating Budget was \$2.8M (+/-) per year – operating budgets are split into various cost centers.</li> <li>Majority of assets are relatively new ponds, as they continue to age they will need higher budget to keep up with maintenance requirements. <ul style="list-style-type: none"> <li>Cost center allocation is new as of this year.</li> </ul> </li> </ul> </li> </ul>

Action D.5	Asset Management: Stormwater Management Facilities
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>○ Minor maintenance (works yards) – no consulting – debris, cleaning inlet/outlets, etc.</li> <li>• Capital budgets – dredging/clean-out separate from O&amp;M               <ul style="list-style-type: none"> <li>○ 10-year capital budget (2019-2028 SWMF Capital Program) – \$159M (+/-) (funds set aside for new facilities) or approx. \$16M per year (from SW AMP)                   <ul style="list-style-type: none"> <li>▪ 2 pond retrofits, 5 new wet ponds, 7 underground storage facilities                       <ul style="list-style-type: none"> <li>• Current Budget focus on Cooksville Creek Watershed</li> </ul> </li> <li>▪ Includes land acquisition, construction, etc.</li> </ul> </li> <li>○ Monitoring/minor modification to facilities – \$80,000 per year</li> <li>○ Bathymetric survey for all facilities – \$250,000 every 5 years, goal for completing half of facilities in one year (i.e. every 2.5 years).</li> <li>○ Dredging projects – receives input from forestry department for planting plans.</li> </ul> </li> </ul>
<b>Relevant Legislative/Policy /Emerging Practices</b>	<p>Emerging Changes:</p> <ul style="list-style-type: none"> <li>• ECA consolidation – MECP to develop a city-wide ECA for all city-owned facilities (as opposed to all facilities having separate ECAs)               <ul style="list-style-type: none"> <li>○ Monitoring requirement is currently unknown for city-wide process – each facility has had different monitoring / frequency requirements under separate ECAs.</li> </ul> </li> </ul> <p>Supporting Documentation:</p> <ul style="list-style-type: none"> <li>• 2003 Design Manual for SWMFs – used to determine cleanout frequency of wet ponds.</li> <li>• TRCA guidelines – LID BMP maintenance guidelines, SWMF maintenance guidelines (BP around dredging) – pond dredging standard work completed by the City.</li> </ul>
<b>Industry Best Practices</b>	<p><b>MECP SWM Planning &amp; Design Manual – Operation, Maintenance and Monitoring (June 2019)</b></p> <ul style="list-style-type: none"> <li>• Provincial guidance is well established with regards to the planning, design and implementation of SWM practices. The MECP SWM Planning &amp; Design Manual includes a chapter focusing on Operation, Maintenance and Monitoring of SWM practices; the chapter (chapter 6), includes discussion of the following topics:               <ul style="list-style-type: none"> <li>○ <i>Inspections, grass cutting, weed control, plantings, sediment removal and disposal, winter operations, maintenance enhancements.</i></li> </ul> </li> <li>• For the following SWM practices:               <ul style="list-style-type: none"> <li>○ <i>Wet ponds/wetlands, dry ponds, infiltration basins, infiltration trenches, filter strips, buffer strips, filters, oil/grit separators (OGS), roof leader discharge to soakaway pits, perforated pipe systems, grassed swales.</i></li> </ul> </li> </ul>



Action D.5	Asset Management: Stormwater Management Facilities
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>This guide represents a comprehensive overview of the maintenance requirements for various types of SWM facilities and/or practices that may have been designed and constructed on a site.</li> <li>With respect to SWM facility monitoring, it's understood that monitoring for water quality and/or quantity is often not feasible for each individual facility (costs/resources). <ul style="list-style-type: none"> <li>The general approach applied across the province is for the proponent to complete physical operation monitoring to verify the facility is operating as designed.</li> </ul> </li> </ul> <p><b>Town of Oakville – SWMF monitoring program:</b></p> <ul style="list-style-type: none"> <li>City assumed SWMFs through the development process undergo routine maintenance including: <ul style="list-style-type: none"> <li><i>Removal of debris in and around the pond;</i></li> <li><i>Removal of invasive vegetation;</i></li> <li><i>Maintenance of structures (i.e. gates, locks, valves, etc.);</i></li> <li><i>Maintenance of surrounding vegetation and plants.</i></li> </ul> </li> <li>Non-routine maintenance includes bank stabilization, structure repairs and removal of excess sediment.</li> <li>Clean-outs of SWMFs are required approx. once every 5-10 years to remove accumulated sediment and ensure function / performance; this includes soil sampling / testing to ensure proper material management and disposal.</li> </ul> <p><b>TRCA – Practical Guidance on Inspecting and Maintaining Low Impact Development Stormwater Infrastructure, TRIECA 2014 Conference</b>  <b>TRCA – Low Impact Development Stormwater Management Practice Inspection and Maintenance Guide, 2016</b></p> <ul style="list-style-type: none"> <li>The TRCA LID Inspection and Maintenance (I&amp;M) Guide was developed to assist municipalities and property managers with integrating LID BMPs into their SWM asset management programs and is largely split into two (2) parts; Part 1 provides guidance and steps to developing an LID BMP I&amp;M program (detailed below) and Part 2 provides standard protocols for inspection, testing and maintenance of various structural LID BMPs, including: <ul style="list-style-type: none"> <li>Bioretention and dry swales, enhanced swales, vegetated filter strips and soil amended areas, permeable pavements, underground infiltration systems, green roofs and rainfall cisterns.</li> </ul> </li> <li>As outlined in Part 1, the following steps are recommended when developing an LID BMP I&amp;M Program: <ul style="list-style-type: none"> <li><i>Step 1: Develop BMP inventory.</i> <ul style="list-style-type: none"> <li>Includes compiling info related to physical (i.e. location, type, design, condition, etc.) and regulatory (i.e. public vs private, ROW, access, easements, etc.) conditions.</li> </ul> </li> <li><i>Step 2: Develop policies and documents.</i></li> </ul> </li> </ul>

Action D.5	Asset Management: Stormwater Management Facilities
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>▪ Establishing legal and administrative framework (i.e. official plan policy, stormwater utility by-law, easement conditions, maintenance agreements, I&amp;M plan templates for each BMP, etc.)</li> <li>○ <i>Step 3: Implement policies through plan review.</i> <ul style="list-style-type: none"> <li>▪ Develop and enforce maintenance agreements, inspection and maintenance plans, maintenance easements through agreements between the municipality and property owner.</li> </ul> </li> <li>○ <i>Step 4: Establish inspection schedule and responsibilities.</i> <ul style="list-style-type: none"> <li>▪ Construction Inspections → Project Acceptance Inspections → Routine Operation Inspections → Compliance and Performance Verification Inspections.</li> </ul> </li> <li>○ <i>Step 5: Develop training and outreach materials.</i> <ul style="list-style-type: none"> <li>▪ Inspector training (i.e. BMP details, how it works, what should be inspected, issues with construction, inspection/testing procedures, etc.)</li> <li>▪ Outreach Education to property owners/managers after project acceptance – i.e., list of local contractors with LID BMP I&amp;M or repair experience, estimated budgets for I&amp;M, reporting procedures, etc.</li> </ul> </li> <li>○ <i>Step 6: Develop tracking system.</i> <ul style="list-style-type: none"> <li>▪ Links to GIS and GPS field data for database systems, automated notification systems related to overdue reports or maintenance activities, tracking changes in property ownership, etc.</li> </ul> </li> <li>○ <i>Step 7: Perform and document inspection and maintenance.</i> <ul style="list-style-type: none"> <li>▪ Require as-built drawings post project acceptance, use standard forms for in-field documentation, take photos and incorporate into I&amp;M tracking database.</li> </ul> </li> <li>○ <i>Step 8: Administer compliance and enforcement procedures.</i> <ul style="list-style-type: none"> <li>▪ ECA or maintenance agreement, property standards by-law, notice of violation, stormwater utility fee credit revocation, civil penalty.</li> </ul> </li> </ul> <p><b>MNRF (Aurora District) – SWM Pond Clean Out BMPs Guidance (2016)</b></p> <ul style="list-style-type: none"> <li>• <b>Authorizations for Stormwater Management Pond Clean-Outs:</b> <ul style="list-style-type: none"> <li>○ Stormwater management (SWM) ponds are considered as “Sewage Works” under the Ontario Water Resources Act. However, they are often connected to natural watercourses through an inflow and/or an outflow, or are located within the designated floodplains. As a result, SWM ponds are considered to be “Ontario” waters.</li> <li>○ As a result of these connections to the natural environment, SWM ponds may become inhabited by aquatic wildlife such as fish, turtles and frogs, although they are often not designed/intended</li> </ul> </li> </ul>

Action D.5	Asset Management: Stormwater Management Facilities
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<p>for aquatic habitat. When clean-out activities are being carried out, it is best to anticipate the presence of these species, which may require a license or authorization under the <i>Fish and Wildlife Conservation Act</i>, 1997.</p> <ul style="list-style-type: none"> <li>▪ <i>Fish Capture Authorization – Where stormwater management ponds are considered “Ontario” waters as described above, a Licence to Collect Fish for Scientific Purposes under O. Reg. 664/98 of the FWCA will be required to capture and remove fish from the stormwater management pond prior to clean-out operations.</i></li> <li>▪ <i>Wildlife Capture Authorizations, Animal Care - A Wildlife Scientific Collector’s Authorization (WSCA) under the FWCA may be required for stormwater management pond clean-outs where there will be intentional or anticipated incidental capture, handling and/or relocation of herpetofauna (e.g. frogs, turtles).</i></li> </ul> <ul style="list-style-type: none"> <li>• <b>Application Requirements / Details:</b> <ul style="list-style-type: none"> <li>○ <i>Clean-Out Methods: stormwater management ponds can be cleaned using a variety of methods including dewatering and dredging, hydraulic dredging, vacuum truck and others. Where possible, it is best to employ techniques that do not require the removal of fish and/or wildlife.</i></li> <li>○ <i>Clean-Out Timing: Due to the invasive nature of stormwater management pond cleanouts, they are generally only permitted to occur between April 15 and September 30 of any year in order to protect hibernating herpetofauna. However, this timing can be flexible based on site characteristics and weather conditions.</i></li> <li>○ <i>Other Relevant Details – any other details which can assist MNRF staff in undertaking their review (i.e. fish/wildlife surveys, unique site characteristics relating to the pond, pond location with respect to natural environment (flowing waters, floodplain, etc.).</i></li> </ul> </li> <li>• <b>Species at Risk and Sensitive Species:</b> <ul style="list-style-type: none"> <li>○ <i>If aquatic or terrestrial Species at Risk (SAR) are known to occur in the area of the stormwater management pond or if surveys within and around the pond have confirmed the presence of SAR, additional information and/or an authorization may be required under the Endangered Species Act, 2007 (ESA).</i></li> <li>○ Specific guidance is provided regarding facility clean-outs in or adjacent to regulated Redside Dace habitat (ref. Best Management Practices for Minimizing Impacts to Redside Dace during Stormwater Management Pond Clean-Outs, 2016). <ul style="list-style-type: none"> <li>▪ These BMPs include construction timing, erosion and sediment controls, removal/disposal of harmful substances, monitoring of dewatering discharge, etc.</li> </ul> </li> </ul> </li> </ul>
<b>Recommendations</b>	

Action D.5	Asset Management: Stormwater Management Facilities
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
<b>a. People</b>	<ul style="list-style-type: none"> <li>Provide training to City staff regarding LID BMP inspection and maintenance protocols for existing and future LID BMP facilities.</li> </ul>
<b>b. Equipment</b>	<ul style="list-style-type: none"> <li>Continue to refine centralized digital database (ESRI system) – georeferenced photographs / notes to continuously update database with inspections and logs connected to AM system.</li> </ul>
<b>c. Policy</b>	<ul style="list-style-type: none"> <li>LID BMP maintenance guidelines/documents currently ongoing – goal to finalize and implement in 2021.</li> </ul>
<b>d. Program</b>	<ul style="list-style-type: none"> <li>Wet Pond Facilities:               <ul style="list-style-type: none"> <li>Goal is to increase the frequency of wet pond survey on a 5-year cycle.</li> <li>Develop SWM pond monitoring requirements (quality and quantity) for existing facilities.                   <ul style="list-style-type: none"> <li>Ensure consistency with ECA LI submission requirements – developing storm sewer and SWM inventory with SWM goals.</li> </ul> </li> </ul> </li> <li>Establish LID BMP maintenance program based upon guidelines currently in development – LID BMPs require unique maintenance practices, guidelines and formalized program would be efficient</li> <li>Pursue collaboration opportunities inter-departmental Service Level Agreements (SLAs) to support stormwater assets managed by other internal stakeholders (e.g. Parks). SLAs would facilitate internal cost transfer to provide technical expertise to other groups as the Stormwater Asset Management Program is focused on Transportation &amp; Works owned/managed assets</li> </ul>
<b>e. Methodology</b>	<ul style="list-style-type: none"> <li>Utilizing the guidance provided by the TRCA LID BMP I&amp;M Guideline, develop inventory of LID BMPs and standard protocols / inspection check-lists for LID BMP monitoring.</li> </ul>
<b>f. Other</b>	
<b>City Commentary</b>	<p>Desired Program Changes/Considerations:</p> <ul style="list-style-type: none"> <li>Goal is to increase the frequency of wet pond survey to a 5-year cycle.</li> <li>Integrating SWMFs into the asset management program (centralized database) – ESRI system to be assessed/consolidated with all other SW assets.</li> <li>Do not currently have a formal LID BMP maintenance program – LID BMPs require unique maintenance practices, guidelines and formalized program would be efficient.               <ul style="list-style-type: none"> <li>Current maintenance focused more so on debris / general clean up.</li> <li>LID BMP maintenance guidelines/documents – goal to finalize and implement in 2021.</li> </ul> </li> <li>Pond monitoring program – need to formalize the amount and type of monitoring at each facility.               <ul style="list-style-type: none"> <li>Quality &amp; Quantity – need to get a target of facilities monitored/year.</li> <li>Plan to advance quality/quantity monitoring at 1 facility (Lake Saigon) in 2021.</li> </ul> </li> </ul>

Action D.5	Asset Management: Stormwater Management Facilities
Service Delivery	Plan/ <b>Program</b> /Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>• OGS units – Take over inspection and maintenance duties for Transitway OGS units;               <ul style="list-style-type: none"> <li>○ OGS monitoring program – only currently 2 OGS units as part of ES group monitoring (in treatment train with ponds).                   <ul style="list-style-type: none"> <li>▪ More will be coming (approx. 8-10 additional Transitway units) – implementation of monitoring more regularly is needed, as warranties coming to an end.</li> </ul> </li> </ul> </li> </ul>

## D.6 Culvert/Bridge Assessments – Future Action

Action D.6	Culvert/Bridge Assessments
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
<b>Description</b>	<ul style="list-style-type: none"> <li>• Make use of the most recent Conservation Authority NDMP floodplain mapping updates and associated hydrologic/hydraulic models to complete capacity analyses on bridge/culvert structures throughout the City. Size/limit of structures needs to be established but generally those along regulated water features</li> <li>• Focus on identifying hydraulic “bottlenecks” caused by undersized structures on “regulated” watercourses (generally &gt; 50ha DA), particularly those that are also associated with flood-vulnerable buildings.</li> <li>• The planning and implementation of capital improvement works for culverts/bridges to be issued through a City-wide prioritization program, based on risk factors.</li> <li>• Proposed project / program will involve a City-wide evaluation of culvert/bridge capacity (i.e. including required/recommended capacity) that can be combined with structural and maintenance assessments (completed by the Roads group) to identify low, medium and high priority structures for replacement/upgrades and capital planning</li> </ul>
<b>Rationale</b>	<ul style="list-style-type: none"> <li>• Culverts/Bridges on City road crossings of regulated watercourses have a direct impact on upstream flood plains and at-risk areas.; by better understanding those that constitute the greatest “bottleneck” to capacity the City can coordinate and optimize its efforts to reduce flood risks and build in resiliency to future changes due to Climate Change and land use change.</li> </ul>
<b>a. Best Practices</b>	<p><b>Town of Whitby – Bridges and Culverts Master Plan, 2020.</b></p> <ul style="list-style-type: none"> <li>• The Town of Whitby has completed a Bridges and Culverts Hydraulic Capacity Assessment Master Plan to identify high risk bridges and culverts based on insufficient hydraulic capacity and flood vulnerable municipal roadways – this assessment included more than 150 structures owned by the Town.</li> <li>• The overall goals of the study included:             <ul style="list-style-type: none"> <li>○ <i>Identify high risk locations where culvert capacity is insufficient by current municipal engineering standards;</i></li> <li>○ <i>Identify required hydraulic capacity improvements necessary to meet municipal engineering standard;</i></li> <li>○ <i>Inform future mitigation planning to ensure municipal roadways will not be at risk to washout during severe weather events;</i></li> <li>○ <i>Establish a quantitative understanding of riverine flood conveyance capacity at municipal watercourse crossings;</i></li> <li>○ <i>Identify/confirm existing flood vulnerable municipal roadways;</i></li> <li>○ <i>Better understand resiliency toward flooding risks and future climate change considerations;</i></li> </ul> </li> </ul>

Action D.6	Culvert/Bridge Assessments
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
	<ul style="list-style-type: none"> <li>○ and Assist with planning for future mitigation projects to reduce flood risk to residents.</li> <li>• To achieve these goals and identify the prioritization of structure upgrades over the next 10 to 20 years, the following tasks were completed: <ul style="list-style-type: none"> <li>○ Survey all town owned crossings (bridges and culverts) to confirm size and hydraulic parameters;</li> <li>○ Complete hydrology and hydraulic modelling at all town owned crossings;</li> <li>○ Compare hydraulic modelling results to bridge and culvert design criteria;</li> <li>○ Undertake a risk assessment to determine the crossings that pose the highest risk to the public from failure due to undersized hydraulic capacity;</li> <li>○ Develop design alternatives for the highest risk crossings that meet the design criteria and reduce the risk of failure;</li> <li>○ Determine the preferred alternative at each of the highest risk crossings by evaluating the relative impacts of each alternative;</li> <li>○ Identify mitigation measures and permitting requirements for the preferred alternatives that will be implemented during detailed design; and</li> <li>○ Prioritize replacement works for the highest risk crossings to inform future Town capital budgets.</li> </ul> </li> <li>• This project ensured that preferred alternatives were selected including the following considerations: <ul style="list-style-type: none"> <li>○ Future land use changes, consistent with the Town's Official Plan, and future growth and development;</li> <li>○ Climate change projections and related impacts on future rainfall events; and</li> <li>○ Integrated risk assessment which considers flooding in conjunction with impact and vulnerability factors.</li> </ul> </li> </ul> <p><b>Other Best Practices to Consider (under development):</b></p> <ul style="list-style-type: none"> <li>• City of Hamilton – City-Wide Bridge Upgrade Assessment, Amec Foster Wheeler, 2019</li> </ul>
<b>b. Relevant Legislative/Policy /Emerging Practices</b>	Wood – will be an output from the Legislative Checklist (TBC)
<b>Suggested Department and Partnerships</b>	<ul style="list-style-type: none"> <li>• Internal City Departments (Roads &amp; Parks)</li> <li>• Relevant CA's (modelling/floodplain mapping)</li> <li>• ROP (regional roadways)</li> <li>• Railway groups (i.e. CNR and CP) for railway crossings</li> </ul>
<b>Resource Needs</b>	Wood & City input

Action D.6	Culvert/Bridge Assessments
Service Delivery	Plan/Program/Policy/Partnership/Procedure/Project
<b>Estimated Costs</b>	<ul style="list-style-type: none"> <li>Bridge/Culvert Assessment (initial project) initiative has an estimated budget of \$100,000.</li> </ul>
<b>City Commentary</b>	<ul style="list-style-type: none"> <li>Discussion regarding the opportunity for risk-based flooding analysis, which would include items such as the class of the road, emergency access routes (hospital, fire, etc.), local land use (density), threat to life, etc. – would be important for prioritization of replacement, as well as potentially informing which structures to be included in the analysis.</li> </ul>



## D.7 Integrated Rainfall Monitoring Program (with CA's) – Existing Action

Action D.7	Integrated Rainfall Monitoring Program
Service Delivery	Plan/ Program/Policy/Partnership/Procedure
Description	
Rationale	
a. Best Practices	
b. Legislation/Policy Existing	
c. Legislation/Policy Emergency	
Suggested Department and Partnerships	
Resource Needs	
Estimated Costs	

*D.8 Shoreline Management – Future Action (New to Fill Gap from Checklist)*

Action D.8	Shoreline Management
Service Delivery	Plan/Program/Policy/Partnership/Procedure
Description	
Rationale	
d. Best Practices	
e. Legislation/Policy Existing	
f. Legislation/Policy Emergency	
Suggested Department and Partnerships	
Resource Needs	
Estimated Costs	

D.9 City-Wide Water Quality Retrofit Program – Existing Action

Action D.9	Water Quality Retrofit Program (City-wide)
Service Delivery	Plan/ <b>Program</b> /Policy/Partnership/Procedure
<b>Description</b>	<p>The City's first over-arching review of stormwater quality retrofit opportunities was completed in 1995. For many years, the principles within that document guided the retrofit program noting that the suspected upper limit for water quality control would be approximately 25% on an area-basis. The subsequent update of Mississauga's Stormwater Quality Control Strategy (Nov.2017) provided additional recommendations for opportunities to increasingly explore low impact development. (Reference Actions B.2-LID Roads Program &amp; B.3-Flood Control Retrofit Project)</p> <p>Although options may be limited, the City continues to have a duty to explore and carry out water quality improvements. Efforts to go beyond the 25% upper limit would be augmented by exploring incentivization on private lands (Reference Action C.3-Incentivization).</p>
<b>Rationale</b>	
<b>a. Best Practices</b>	
<b>b. Legislation/Policy Existing</b>	
<b>c. Legislation/Policy Emergency</b>	
<b>Suggested Department and Partnerships</b>	
<b>Resource Needs</b>	
<b>Estimated Costs</b>	

## Glossary:

AM: Asset Management

BP: Best Practice

CA: Conservation Authority

CB: Catch Basin

CCTV: Closed-circuit Television

CH: Conservation Halton

CVC: Credit Valley Conservation

DFO: Department of Fisheries

ECA: Environmental Compliance Approval

ES: Environmental Services

FDC: Foundation Drain Collector

FTE: Full Time Equivalent

GARR: Gauge Adjusted Radar Rainfall

GIS: Geographic Information System

IPES: Infrastructure, Planning and Engineering Services

ISO: International Organization for Standardization

LI: Linear Infrastructure

LID BMP: Low Impact Development Best Management Practice

LOS: Level of Service

MBOT: Mississauga Board of Trade

MECP: Ministry of Environment, Conservation and Parks

MNRF: Ministry of Natural Resources and Forestry

MOU: Memorandum of Understanding

O&M: Operations and Maintenance

O. Reg: Ontario Regulation

OGS: Oil Grit Separator

P2: Pollution Prevention

PGMN: Provincial Groundwater Monitoring Network

QA/QC: Quality Assurance and Quality Control

ROIT: Return on Investment Tool

ROP: Region of Peel

ROW: Right of Way

STM: Storm

SW: Stormwater

SWM: Stormwater Management

SWMF: Stormwater Management Facility

T&W: Transportation and Works

TOR: Transfer of Review

TRCA: Toronto Region Conservation Authority

W/C: Watercourse

WISKI: Water Information Systems by KISTERS

WOM: Works, Operations and Maintenance