Appendix A

Roadmap for Town-wide Rainwater Management Strategy

Summary of Rainwater Related Studies and Reports:

1. **Stormwater Master Plan (SWMP) – 2019 – Reported to Council October 2019**
   - **Purpose:** study of the potential for urban flooding based on the capacity of the Town's minor system (i.e. storm sewers) and major overland flow routes (i.e. roadways), to understand the extent of this vulnerability and develop an action plan to help minimize impacts. The study focused on areas of the community that were developed pre 1980 as design standards have evolved since that time.
   - **Comments:** The work program for the study was broken down into three phases:
     - **Phase 1** of the SWMP was completed in 2015 and included a review of the structural condition of the existing underground storm sewer pipe infrastructure within the focus area. Results indicate that the underground pipe network is generally in a good state of repair.
     - **Phase 2** focused on assessing the functional performance and capacity of the storm water system (within the focus area) including underground storm sewer pipes, roadside ditches and major overland flow corridors (road right-of-way). This assessment provided insight into how these systems perform during a range of runoff/rainfall events, including the impacts of climate and land use changes. Results from this analysis has been used to develop a series of recommendations /projects to address vulnerabilities and minimize risk exposure.
     - **Phase 3** will focus on the development and assessment of financial strategies necessary to deliver the recommendations/projects defined in Phase 2. Phase three will now be rolled into the Town-wide Rainwater Management Strategy.
   - **Recommendations & Results:**
     - **Phase 1** identified some storm sewer pipes that were in poor condition and recommended that CCTV inspection be performed to assess actual repair and renewal needs.
     - CCTV inspection of storm pipe infrastructure identified in poor condition has been completed.
     - Total of $7.5 million for the lining and/or replacements was included into the 2022-2031 capital forecast.
     - **Phase 2** identified relatively low cost minor works that are deemed beneficial to advance in select areas of the community to improve drainage function and reduce flood risk exposure.
     - $1.6 million added in the 2019 capital forecast for three different types low cost minor works to install inlet control devices (ICDs) in street storm catch basins, 21 locations identified to increase the inflow capacity to the storm sewer system to mitigate localize ponding and 8 locations to install improved inlet grates to reduce the potential for debris blockages. This work is expected to be tendered in 2022
     - **Phase 2** also identified some longer term capital upgrades and improvements to the storm sewer network at approximate cost of $230 million. These capital upgrades and improvements are to be evaluated and prioritized within the RWM Strategy

2. **Town Wide Flood Study – 2008 – Reported to Council 2008**
   - **Purpose:** This study used existing information at the Town and at Conservation Halton to determine where riverine flood vulnerabilities existed. The intent of this study was to identify the areas of concern at a high level so that more detailed and site specific studies could be undertaken in the future.

- **Comments:** The study identified the riverine systems where more detailed and site specific study was required. The areas that were identified for further review were grouped into reaches or creek systems, recognizing that there could be similarities between those sites and allowing for more holistic solutions to be developed. The detailed studies (see below) were planned to recommend flood prevention solutions, with consideration for the characteristics of the sites, land ownership, and opportunities for creek enhancements.
- **Recommendations & Results:** the study identified the need to review six (6) of the Town's river/creek systems in more detail Fourteen Mile, McCraney, Lower Wedgewood, Lower Morrison, Joshuas and Sheldon Creeks, and was expanded to include a seventh area (Munn's Creek) as more information became available.
  Studies on all seven (7) river/creek systems have been completed or are nearing completion as identified in section 3 below.

3. Detailed Riverine Flood Improvement Studies – 2019 and ongoing

- **Purpose:** Various detailed riverine studies as per the recommendations of the Town-wide Flood Study report completed in 2008**.** Each individual river/creek study looked at the specific flood plain area and surrounding community to identify potential improvements that could be incorporated to help mitigate flood damage.
- **Recommendations & Results:** The recommendations from the studies completed to date range in application from emergency preparedness; to minor improvements; to significant infrastructure upgrades. A summary of the status of each study and various recommendations is provided below:

Study	Status of Study	Recommendations
Munn's Creek	Completed and Reported to Council Sept, 2019	McCraney Street and Miller Road Crossing Replacements, Onslow – Oakdale Pedestrian Bridge Crossing Replacement – **Estimated total $3.3 Million**
Sheldon Creek	Completed and Reported to Council Nov, 2021	Emergency preparedness Rebecca St. spill, emergency preparedness/flood proofing by landowners downstream of Lakeshore Great Lakes Blvd and Wilmot Crescent Berm Construction **Estimated total $300,000**
Lower Wedgewood/ Lower Morrison Creek	Study Target completion Q2/Q3 2022	Offline flood storage Cornwall Road Park Underground Storage Tank, various culvert upgrades, four localized flood protection berms. **Estimated total $12.8 million**
Joshua Creek	Study Target completion Q2/Q3 2022	Short-term – emergency preparedness Long-term –review opportunities to construct the rail bridge to pass the Regional Storm without overtopping when the bridge is scheduled for replacement.
Fourteen Mile & McCraney Creek	Study Target completion Q3/Q4 2022	To be confirmed through the Class EA.

The short-term improvements and emergency preparedness measures will be reviewed and implemented in 2022 and future years. The identified infrastructure upgrades and improvements are to be evaluated and prioritized within the overall RWM Strategy.

4. Coronation Park Area Drainage Improvements – 2017 - Reported to Council June 2017

- **Purpose:** Municipal Class Environmental Assessment (EA) study to investigate whether drainage improvements within and around Coronation Park would help to improve neighbourhood drainage and reduce flooding in Coronation Park.
- **Comments:** The study and addendums to the study identified and confirmed drainage issues (i.e. standing water within ditches, deteriorating driveway culverts, minor ditch erosion and inadequate flow capacity) and developed preferred solutions to address these issues (such as storm sewer capital projects) within the Coronation Park area
- **Recommendations & Results:** High priority drainage improvements identified in the report been summarized below:

Recommended Improvements	Status
Channel improvements within Coronation Park to receive flows from proposed storm sewers - **$1.1 million**	Main channel reconstructed completed in 2019
New storm sewers and ditch improvements on Westminster Drive and outlet improvements - **$4.9 Million**	Works to be tendered in 2022 with construction to begin in 2022
New storm sewers and ditch improvements on Woodhaven Park Drive and outlet improvements - **$10.6 Million**	Design work to be completed in 2022 with construction to begin in 2023
New trunk storm sewer along Lakeshore Road West from Third Line to Coronation Park $1.0 Million not including design or other factors	Future project to be part of Lakeshore Road West reconstruction

5. Coronation Waterfront Park Shoreline Assessment Study – 2022

- **Purpose:** an assessment of the Coronation Park shoreline and review of alternatives to help reduce the potential for flooding. This study was a result of the Flood Damage, Shoreline Restoration and Remediation report to Council in April 2020 in which staff were directed to undertake an assessment of vulnerable flood prone waterfront parks and harbours.
- **Comments:** Coronation Park experienced flooding as a result of the high lake levels in 2017 and 2019 which caused areas of the park to be closed or partially closed for public safety throughout the spring and summer months. This lead to the cancellation of town events, closure of park amenities and damage to shoreline protection, footbridges and trail infrastructure. Trees within the parks may have also suffered damage due to sustained low oxygen levels in soil caused by standing floodwaters. The assessment reviewed three causes of flooding due to standing water from high lake levels and associated groundwater, channel outlet blockages and lake based storm surge and wave overtopping.
- **Recommendations & Results:** Recommended work includes offshore breakwaters and groynes that may be used to reduce channel blockages. In addition, a phased landscaping design approach is recommended to reduce standing water and flooded lands. There are numerous Town trees within the areas that would benefit from landscaping/filling – however landscaping/filling would be detrimental to tree health. One possible strategy is to landscape/fill lands over time as trees move through their lifecycle. The report

recommended five options ranging in "Minor Maintenance" at $190,000 to "Protect Parkland to 100 yr and 25 yr Flood Level for certain assets" at $4.5 million. Staff will now co-ordinate with other key players including emergency services and Conservation Halton to determine the best overall plan which will be evaluated and prioritized as part of the overall RWM Strategy.

6. Harbours Risk and Flood Assessment Study – 2021

- **Purpose:** a flood impact study and assessment of the infrastructure in Oakville Harbour and Bronte Inner Harbour to identify improvements to help reduce the potential for flooding. This study was a result of the Flood Damage, Shoreline Restoration and Remediation report to Council in April 2020 in which staff were directed to undertake an assessment of vulnerable flood prone waterfront parks and harbours.
- **Comments:** The study was completed in April 2021 by Shoreplan Engineering Limited which included an assessment of the coastal site conditions, design water levels, and design wave heights in the harbours considering the recent extreme water level conditions on Lake Ontario. An inventory and condition assessment of the Town's harbour structures identifying key features of the structures, areas without protection and provided flood proofing or control recommendations including time lines, upgrades or repairs, and construction cost estimates.
- **Recommendations & Results:** Priorities for improving the shoreline protection were established by the condition of the existing shore protection and potential impacts due to flooding at an estimated total of $18.9 million. A summary of the various improvements is provided in the table below, it should be noted that $3.7 million was included in the 2022 capital budget for Seawall Rehab at Shipyard Park in Oakville Harbour and Berta Point in Bronte Harbour due to priority needs. The remaining identified capital upgrades and improvements are to be evaluated and prioritized within the overall RWM Strategy.

Priority	Oakville Harbour	Bronte Inner Harbour
High	Hillmer Park reach O1 TOWARF reach O 14 – 18 South shore of Oakville Yacht Squadron reach O25 Shipyard Park reach O27 **Total estimate for all -$3.1 million**	Bronte Yacht Club reach B18-19 North shore of Bronte Creek reach B2-4 **Total estimate for all -$5.1 million**
Medium	Busby Park reach O8 Oyster Bay reach O22-23 **Total estimate for all $4.6 million**	South shore of Bronte Creek reaches B18-19 Berta Point reach B20 **Total estimate for all $5.3 million**
Low	Erchless Estate reach O11-13 Lakeshore Road Bridge reach O29 **Total estimate for both $0.8 million**	
Maintenance	Maintenance on east pier - **$40,000**	

7. Municipal Natural Asset Initiative Pilot Study - 2018

- **Purpose:** the main objectives of the pilot was to establish a financial value for stormwater (SW)services provided by natural assets, based on what it would cost to replace the water quality and quantity control provided by natural assets with engineered stormwater. For the purposes of the pilot the site chosen was the Maplehurst Avenue area with the key municipal natural assets (MNA) of interest being: remnant channels, ditches/swales and

watercourses that traverse alongside roads, within parks, natural areas, urban forests and open spaces.

- **Comments:** Based on the study, the value of the municipal stormwater service provided by the 240+ meter remnant channel in this area was estimated at $1.24M (existing) to $1.44M (stressed) conditions. It was noted that the stormwater system relies on MNA for overland conveyance and storage of SW along with other benefits including infiltration that reduce flows. A natural system such as a remnant channel or ditch provides a service that goes beyond simply flow conveyance. Therefore, replacing natural systems with engineered or gray systems that fail to provide equivalent service, can introduce unnecessary risk and negative environmental impacts. Evaluating the options of a MNA system and/or gray infrastructure remain an important element in determining the appropriate actions.
- **Recommendations & Results: I**n order to continue moving forward on this initiative, it was recommended that the results of this pilot be incorporated into a number of cross departmental next steps. Some specific items include:
    - The SWMP will integrate pilot findings when considering, for example, the value of maintaining or improving the function of a rural road cross section with ditches/swales versus an urban cross section with buried pipes. The full MNAI Technical report will be included as an appendix to the SWMP.
    - Pilot outcomes will be leveraged to develop stormwater management policy including a planning context to reflect stormwater management needs, the value of MNA in providing SW service with additional benefits to deal with the impacts of intensification, and climate variability.
    - The pilot findings will also be integrated into Asset Management practices to account for the value of service provided by MNA and also to better reflect the replacement, operation and maintenance aspects of MNA.