Carruthers Creek Watershed Plan
Stormwater Management

Prepared for the Region of Durham

May, 2019

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Foreword

The Region of Durham recognizes watershed plans as an effective tool to inform the management of Durham's water resources, natural heritage, and natural hazards, such as flooding. In 2015, the Region retained the Toronto and Region Conservation Authority (TRCA) to update the watershed plan for Carruthers Creek.

This four-year study will build upon the goals, objectives, and management recommendations established in the 2003 *Watershed Plan for Duffins Creek and Carruthers Creek*.

The following report is one of a series of scenario analysis technical reports that follow the watershed characterization studies (completed in 2017). Information contained in these technical reports will examine potential impacts of future growth and land use changes in combination with other influences such as climate change. Additionally, these technical reports provide the knowledge base necessary to develop the plan's management recommendations. Any recommendations contained in the scenario analysis technical reports are consolidated in the Carruthers Creek Watershed Plan's management framework. The Watershed Plan is the final source for goals, objectives, indicators and management recommendations related to Carruthers Creek. Readers are encouraged to refer to the technical reports for more detailed implementation suggestions.

1 Introduction

Precipitation or snow melt can be distributed in several different ways (TRCA, 2012). Some of this water soaks into the ground (infiltration and interflow) and can replenish aquifers (recharge), some of it will evaporate or be absorbed or released to the atmosphere by vegetation (evapotranspiration), and the remainder will run off surfaces and flow directly into creeks, rivers and storm sewers (runoff). The culmination of a system's infiltration, evapotranspiration, and runoff is commonly described as the water balance. In natural settings, the presence of vegetation and permeable surfaces, such as soils, mean that only a relatively small proportion of the rainfall will produce runoff. During the process of urbanization, the most significant change to the natural environment is the conversion of pervious surfaces (e.g. forests, meadows, agricultural fields) to impervious surfaces (e.g. roads, parking lots, rooftops), which reduces infiltration and evapotranspiration. As a result, significantly more runoff is typically generated in urbanized areas when compared to natural or rural areas (TRCA, 2012).

During storm events, the increase in surface runoff associated with development (commonly referred to as stormwater) can result in riverine flooding and stream erosion. Additionally, stormwater can significantly alter water quality within a watershed because it can pick up pollutants from human activity and transport these pollutants directly to creeks, rivers and water bodies. Examples of stormwater pollutants frequently encountered in urban areas are chlorides from de-icing operations, fuel and oil from roads, litter, fertilizers, and sediment transported from construction sites. In addition to downstream flooding and erosion, the sheer force and volume of polluted stormwater can cause aquatic habitat destruction, altered stream flow regimes that become "flashier", combined sewer overflows, damage to infrastructure, contaminated water, and hydrological changes to ecosystems such as wetlands and woodlands.

Stormwater management is a term that describes the practices used to minimize the impact of polluted and flashier runoff flowing into lakes and streams while reducing the strain that stormwater places on municipal infrastructure (TRCA, 2002). Prior to the 1980s, stormwater management focused solely on flood control (stormwater quantity). Through the constant evolution of best management practices (BMPs), stormwater management now provides a higher level of protection for the environment, property, and residents by incorporating mitigation provisions for water quality, aquatic and terrestrial ecosystem habitat, groundwater recharge, and erosion control in addition to water quantity control (TRCA, 2012). To achieve this higher level of protection, a variety of stormwater BMPs, green infrastructure (GI), and Low Impact Development (LID) measures can be used including lot-level controls, conveyance controls, and end-of-pipe stormwater facilities. This approach of using multiple stormwater management treatment methods to reduce the impacts of stormwater runoff is known as the "treatment train". The aim of this sustainable treatment train approach is to treat stormwater as close to the source as possible, either by delaying/reducing the stormwater runoff or by removing pollutants before conveying it downstream. In effect, it attempts to mimic the natural, pre-development water balance.

2 Stormwater Management in the Carruthers Creek Watershed

Existing development within the Carruthers Creek watershed is concentrated within the Town of Ajax, south of Taunton Road while the portions of City of Pickering within the watershed remain almost entirely rural (Figure 1). This is reflected in the amount of impervious surface cover in the municipalities within the watershed. In 2015, the percent impervious cover of the overall watershed was 24.1% (TRCA, 2019). The *Aquatic Impact Assessment* (TRCA, 2019) for the Carruthers Creek Watershed Plan provides a detailed breakdown of percent impervious cover by catchment and by each land use scenario proposed as part of the watershed plan. Impervious surfaces associated with urban development can drastically increase stormwater runoff and should be managed with stormwater controls that meet current design criteria. Based on the *Watershed Plan for Duffins Creek and Carruthers Creek* (TRCA, 2003), approximately 64% of the urban/developed areas of the watershed have stormwater controls in place that meet current TRCA criteria. Of the remaining 36%, 29% have no stormwater management controls and 7% have water quantity control only. These differences in the level of control are indicative of the age of development within the watershed and the corresponding stormwater management practices at the time of development. A detailed inventory of the level of stormwater controls in place in the developed areas of the watershed should be completed to measure improvements in the watershed since the publication of the previous watershed plan. As of 2019, The Town of Ajax has a total of 62 publicly- and privately-owned stormwater management ponds across the municipality, of which 38 are located within the Carruthers Creek watershed. The City of Pickering has one privately-owned stormwater management pond within the Carruthers Creek watershed.

The following sections will highlight the stormwater management approach within the Carruthers Creek watershed by focusing on:

- **protecting** the watershed through future planning processes;
- **restoring** existing stormwater management facilities to original performance; and
- **enhancing** the watershed by focusing on identified stormwater management in high priority areas.

2.1 Protect

As stormwater management continues to evolve, so to do the unique challenges facing municipalities in terms of dealing with stormwater runoff. Municipalities will have to address the impacts of increased runoff as greenfield development occurs to accommodate population growth and climate change brings altered precipitation patterns and more frequent extreme weather events (Environmental Commissioner of Ontario, 2016). The Town of Ajax, City of Pickering, and the Regional Municipality of Durham have all expressed the importance of stormwater management moving forward. For example, stormwater management and LID are included in the Town of Ajax and City of Pickering Officials Plans, including guidelines for supporting approaches that minimize impermeable surfaces. In fact, the Town of Ajax made it a priority to "implement innovative approaches to stormwater runoff" as part of their *Community Action Plan (CAP) 2015-2018* (Town of Ajax, 2017). The CAP is undergoing an update to inform the 2018-2022 council which is set to be released in 2019. The MECP *Made-in-Ontario Environment Plan* (MECP, 2019) directly specifies the importance of improving municipal wastewater and stormwater management. Additionally, *Durham Region's Towards Resilience: Durham Community Climate Adaptation Plan* (The Regional Municipality of Durham, 2016) emphasizes stormwater management to achieve the objectives of reducing the severity and frequency of urban flooding, the risk of flood damages, and the impacts of flooding. The Town of Ajax also published

their *Ajax Climate Risk and Resiliency Plan* (Town of Ajax, 2019), which focuses heavily on identifying vulnerable areas prone to stormwater and overland flooding.

As part of stormwater management BMPs, environmental design criteria guide the planning and design requirements of stormwater management infrastructure for developers, consultants, municipalities, and landowners. These criteria are designed to:

- Prevent any increase in flood risk potential;
- Maintain runoff volume, frequency, and duration from frequent storm events;
- Protect water quality;
- Preserve groundwater recharge and baseflow characteristics;
- Prevent undesirable geomorphic changes in watercourses; and,
- Maintain hydrologic functions of ecosystems and the diversity of terrestrial and aquatic life.

There are several design criteria documents for stormwater management that are utilized within the Carruthers Creek watershed including: the TRCA*'s Stormwater Management Criteria* (2012), which consolidates and builds upon current design guidelines and requirements relating to stormwater management and provides additional and specific detail for areas within TRCA's jurisdiction; the Province of Ontario's *Stormwater Management Planning and Design Manual* (2003); the Town of Ajax's *Design Criteria for Stormwater Management and Storm Drainage* (2016); City of Pickering's *Stormwater Management Design Guidelines* (2012); and the Region of Durham's *Design and Construction Specifications for Regional Services* (2013). The design criteria include parameters for flood protection, water quality, erosion control, and water balance, and are developed considering the interactions and cumulative effect of numerous single developments and address a set of stormwater management facilities and practices to control the stormwater related impacts of development and redevelopment within the watershed (TRCA, 2012).

It is recommended that any future development adheres to the requirements of the most relevant, up-to-date, and stringent design criteria available. This will include the MECP's upcoming *LID Stormwater Management Guidance Manual* (2017) once it is released, which is to be used in conjunction with the Province's *Stormwater Management and Design Manual* (2003).

2.2 Restore

Operations and maintenance responsibilities are an important component of effective stormwater management and fall on the owners of these facilities to implement (MOE, 2003). Stormwater management for water quality control requires routine operations and maintenance to preserve the water quality improvement functions of ponds and LID features. For example, since many pollutants (e.g. metals, nutrients) bind to sediment, sediment removal is required as part of ongoing maintenance. There are many factors that can influence sedimentation rates and maintenance requirements including type of stormwater management facility, upstream land use, wildlife, and human activity. The lack of maintenance is one of the main factors that contribute to the failure and poor performance of stormwater management facilities (MOE, 2003).

The first step to improved operations and maintenance of both stormwater management facilities and LID projects is sufficient monitoring and inspection protocols. Assessments like those completed by the Town of Ajax (2017-2018) on 12 of their stormwater management wet ponds helps to prioritize maintenance items, sediment disposal options, and funding requests for each facility. Additionally, the Town of Ajax completed the *Lake Driveway Rain Garden Performance Monitoring Report* (2017) to evaluate the shoreline rain garden LID pilot project and verify the level of

water quality protection provided following construction. The City of Pickering's *Frenchman's Bay Stormwater Management Plan* (2009) recommends implementing an ongoing stormwater management monitoring program that allows for adaptive management, which could be utilized outside of the plan's study area throughout the Carruthers Creek watershed.

In addition to the routine clean out and removal of sediments, other regular maintenance activities and programs can have a positive effect on stormwater management operations. The City of Pickering's *Frenchman's Bay Stormwater Management Plan* (2009) identified a group of projects, programs, and policies designed to address issues related to flooding, erosion, and poor water quality in Frenchman's Bay and its tributary watersheds. Although this study focused outside of the Carruthers Creek watershed, some of the operations and program recommendations could also be suitable for priority areas identified within the Carruthers Creek watershed such as:

- Increased frequency of catchbasin cleaning;
- Increased frequency of road sweeping;
- Improved road salt management and use;
- Increased enforcement of sediment controls associated with construction and development; and,
- Improved community engagement and education.

It is vital to the sustainable performance of stormwater management that maintenance activities are considered early on during the design and construction phases of stormwater management facilities, LID projects, and retrofits, such as Oil and Grit Separator Units.

2.3 Enhance

The Carruthers Creek watershed is almost fully developed south of Taunton Road, therefore, opportunities to implement large-scale stormwater management and LID projects in new developments are limited. However, small-scale opportunities do exist especially at sites of redevelopment and at the residential lot-level, including LID projects on homeowners' properties, such as rain barrels, rain gardens and permeable paving. As LID is part of a broader movement of smart city design and sustainable urban development, LID techniques are constantly being refined and identified to be incorporated more completely into urban design. LID approaches can work with the public's desire for vibrant cities, healthy lifestyles, clean water, walkable cities and reduced heat island effects in urban centres. Furthermore, LID will become increasingly more important as an effective approach of climate change adaptation.

The *Low Impact Development Treatment Train Tool* (LID TTT) has been developed by Lake Simcoe Region Conservation Authority (LSRCA), Credit Valley Conservation (CVC) and Toronto and Region Conservation Authority (TRCA) as a tool to help developers, consultants, municipalities and landowners understand and implement more sustainable stormwater management planning and design practices in their watersheds. The purpose of the tool is to analyze annual and event-based runoff volumes and pollutant load removal by the use of BMPs and LID techniques. The LID TTT provides preliminary water budget analysis (i.e. surface evapotranspiration, surface runoff, infiltration to soil) and pollutant load removal estimates for pre- and post-development scenarios. The tool is built upon the open source EPA SWMM5 model providing a user-friendly interface for novice modellers and cross-compatibility with SWMM5 for further model development.

The LID TTT should be applied to all priority areas identified within the Carruthers Creek watershed to optimize GI to achieve the level of benefit required as part of redevelopment. The following priority areas have been identified within the Carruthers Creek watershed:

2.3.1 South Ajax

The *Watershed Plan for Duffins and Carruthers Creek* (2003) recommended that southern Ajax (Highway 401 to the north, Carruthers Creek to the east, Lake Ontario to the south, and East Duffins Creek to the west) be a priority area for exploring stormwater management retrofit opportunities and for the potential of implementing new management practices to improve water quality in Lake Ontario. Lower Carruthers (located in South Ajax) lacks stormwater controls and has also been identified as a Flood Vulnerable Area by TRCA (See Figure 2). Based on this recommendation from the 2003 Watershed Plan, The *Ajax Stormwater Management Retrofit Master Plan Class EA* (2011) was initiated. The Master Plan found that 90% of the pollutant loading was traceable to six (6) of the 14 sewersheds investigated in the South Ajax study area and recommended end-of-pipe alternatives for the six (6) identified sewersheds. Four (4) out of the six (6) identified sewersheds are located within Carruthers Creek watershed including sewersheds 11, 12, 17, and 18.

2.3.2 Downtown Ajax

Downtown Ajax is located within southern Ajax and entirely within the Carruthers Creek watershed (Station Street to the north, Harwood Avenue to the east, Hunt Street to the south, and Commercial Avenue to the west) and currently has no stormwater management measures as it was built in the 1950's prior to stormwater control practices. The *Town of Ajax Downtown Class EA Study* (2017) was initiated to review and recommend road network improvements as part of the Downtown Ajax redevelopment and intensification plans. The EA found that the Commercial Avenue storm sewer network floods during the 25 mm storm events, the Harwood Avenue storm sewer network and all the manholes from Station Street to Hunt Street exhibit flooding conditions during the existing 2-year storm condition. Specific recommendations for stormwater management including improvements to storm sewer networks and implementation of LID in specific priority areas can be found in Section 7.4.1 of the EA.

2.3.3 Transportation Infrastructure Pinch-points

The *Ajax Climate Vulnerability Assessment of Stormwater and Overland Flooding* was completed as part of the *Ajax Climate Risk and Resiliency Plan* (2019) and identified threats and risks to storm sewer systems and riverine flooding because of changing climate trends across the Town of Ajax. As part of the study, a Flood Vulnerability Map was produced which shows that the majority of lands subject to creek and river flooding in the event of both the 1:100-year storm and Regional storm were natural areas, such as woodlands. However, a few properties are noted to be within the flooding extents of the three creeks (Duffins, Carruthers, and Lynde) in the Town of Ajax. Most flood vulnerable areas identified within Carruthers Creek watershed occur upstream of major transportation creek crossings including the CP Railway, Kingston Road, Highway 401, and Bayly Street. Using parameters of channel velocity and sheer stress, the study identified areas of high stream bank erosion potential at the Rossland Road East and Kerrison Drive East crossings on Carruthers Creek. These priority areas located at transportation infrastructure crossings are due to undersized or damaged culverts.

3 Funding Stormwater Management

Proper funding is needed to address gaps and priority areas in stormwater management through the design and construction of new stormwater management facilities and/or retrofits. Competing priorities within City of Pickering and Town of Ajax make it more difficult to dedicate stormwater funds specifically to Carruthers Creek watershed. For example, the City of Pickering has identified their priority of addressing the long-standing concerns regarding the ongoing decline in the quality of the Frenchman's Bay ecosystem by seeking means to control the quantity and quality of stormwater entering the local creeks and Frenchman's Bay. As such, the *Frenchman's Bay Stormwater Management Plan* (2009) identified priority projects that will utilize the majority of stormwater funding in the City of Pickering's 2019 Capital Budget and Five Year Capital Plan. Additionally, the Town of Ajax has competing priorities in stormwater management as areas within the Duffins Creek (specifically the Pickering Village Flood Vulnerable Area identified by TRCA) and Lynde Creek watersheds are also prone to flooding and lack enhanced stormwater controls.

Inadequate funding has created a $6.8 billion stormwater infrastructure deficit in Ontario (ECO, 2016). Aging infrastructure, paired with the increased frequency and severity of weather events, will challenge the municipalities within Durham Region to manage stormwater effectively. Because of this, *Towards Resilience: Durham Community Climate Adaptation Plan* (2016) recommended the investigation, development, and implementation of a region-wide stormwater fee and credit program. Currently, the municipalities within the Carruthers Creek watershed fund stormwater management through property tax funding, development charges, and intergovernmental transfers/grants (Baetz *et al.*, 2018). Currently, property taxes do not provide dedicated funding for stormwater management, rather, the money collected goes towards a range of municipal projects and services. Development charges can only be applied to new development projects and cannot be used to recover costs of stormwater management retrofits or operations and maintenance. Intergovernmental transfer/grants are usually limited to what projects they will fund and what timeline the project must be completed within.

The *Storm Water Management Fee and Credit Program: Research and Recommendations* report (Baetz *et al.*, 2018) proposed that a hybrid stormwater fee program be implemented in Durham Region, accompanied by a recognition program that educates and engages property owners. The hybrid stormwater fee program would charge a flat rate to property owners unconnected to municipal water and waste water services and charge a tiered rate for property owners connected to water and wastewater services based on the amount of impervious surface on the property. All money raised through this fee would fund stormwater management capital projects, operations, and maintenance across Durham Region. Similar stormwater management fee programs have been implemented in municipalities across Ontario including in Mississauga, Kitchener, Richmond Hill, and Vaughan.

4 Recommendations

1. Adhere to the most up- to-date stormwater management design criteria, stormwater management best management practices, and promote innovative approaches to stormwater management for any new developments.

2. Stormwater management retrofits in existing developed areas may not allow for the up-to-date stormwater management design criteria to be met. Therefore, focus should be placed on meeting design criteria as much as possible given site characteristics.

3. All stormwater management facilities are monitored and maintained regularly through a region wide monitoring program

4. Utilize the most current technologies, including the Low Impact Development Treatment Train Tool (LID TTT), to inform stormwater management design and implementation.

5. A detailed inventory of the level of stormwater controls currently in place in the developed areas of the watershed should be completed to measure improvements since the publication of the previous watershed plan and to set a baseline to measure performance of future work.

6. A holistic stormwater management plan should be developed for the entire Region of Durham to coordinate efforts within local municipalities in establishing targets such as flood reduction, water quality improvements, and erosion control regarding stormwater management.

7. Additional funding must be dedicated to stormwater management throughout the watershed on an annual basis. Implementation of the hybrid stormwater fee and recognition program is highly recommended.

5 Conclusion

Effective stormwater management criteria are one of the important management initiatives currently being practiced in the Carruthers Creek watershed. The science of stormwater management continues to evolve and it is critical that watershed managers and stakeholders continue to demand the highest level of available technology and encourage the use of innovative design techniques. Additionally, it is crucial that sustainable, dedicated funding is allocated towards stormwater management to improve operations and maintenance standards as well as to address local enhancement priorities within the watershed.

6 References

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Figure 1: Carruthers Creek Watershed

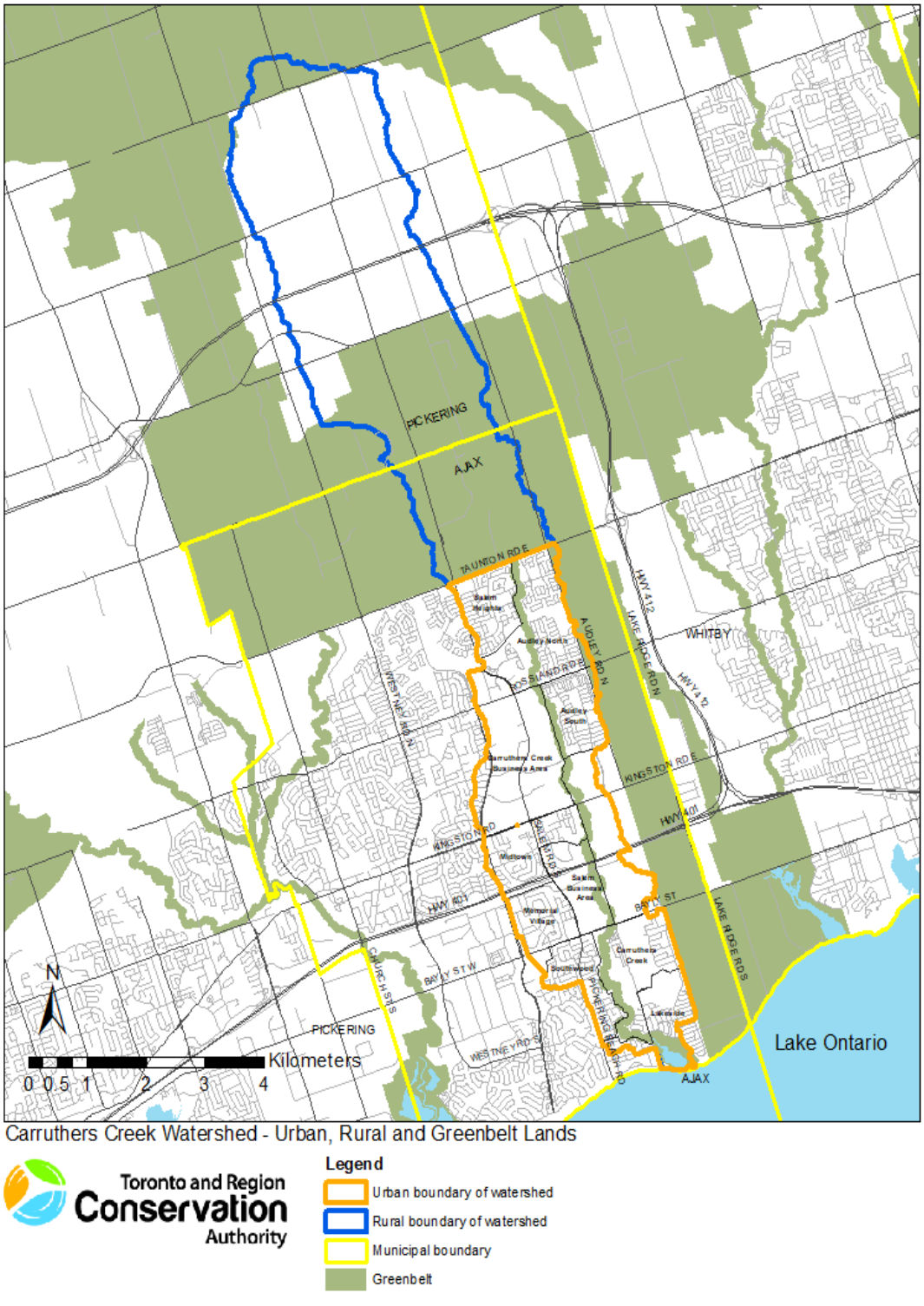


Figure 1. Urban, rural, and Greenbelt boundaries within the Carruthers Creek Watershed.

Figure 2: Lower Carruthers Flood Vulnerable Area

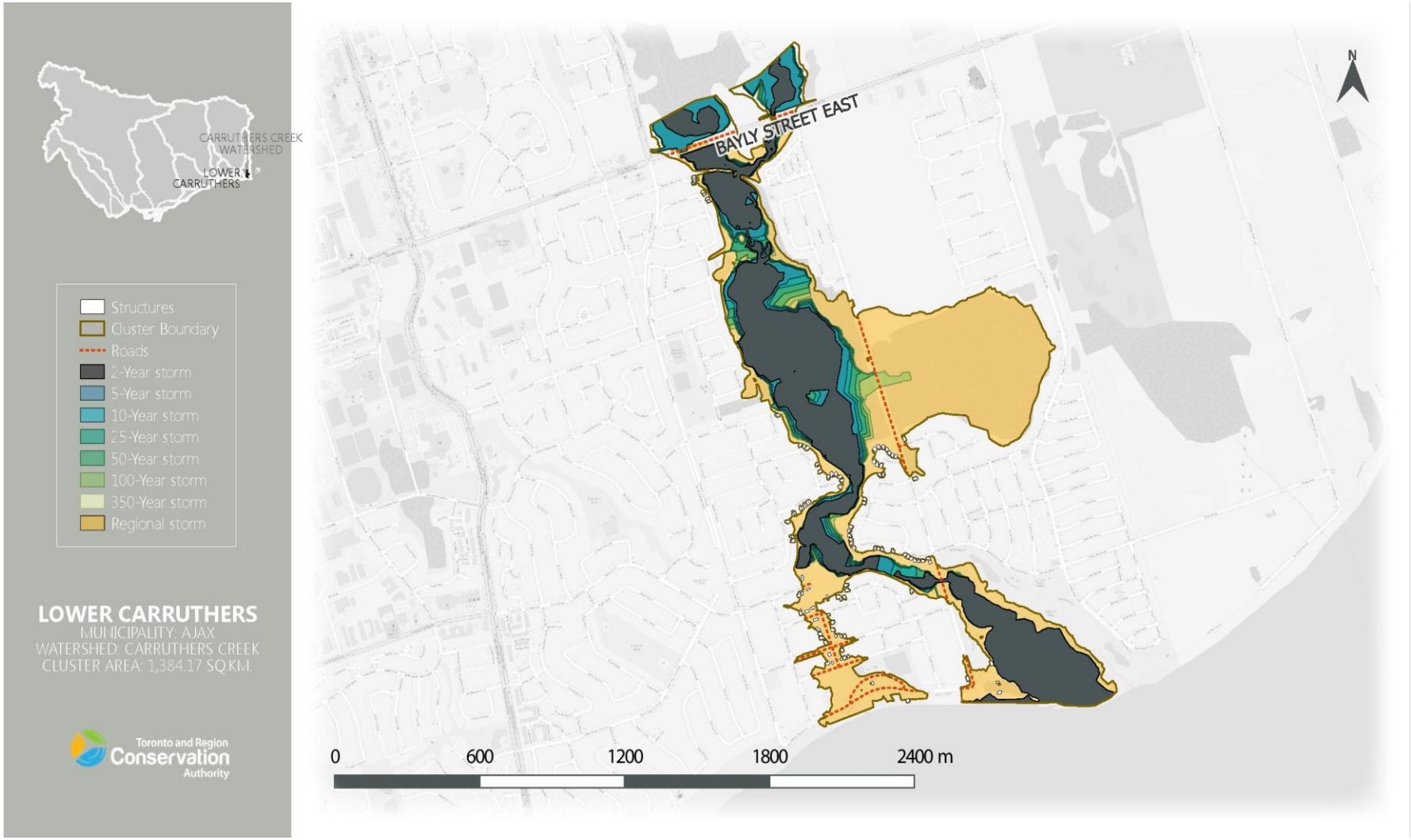
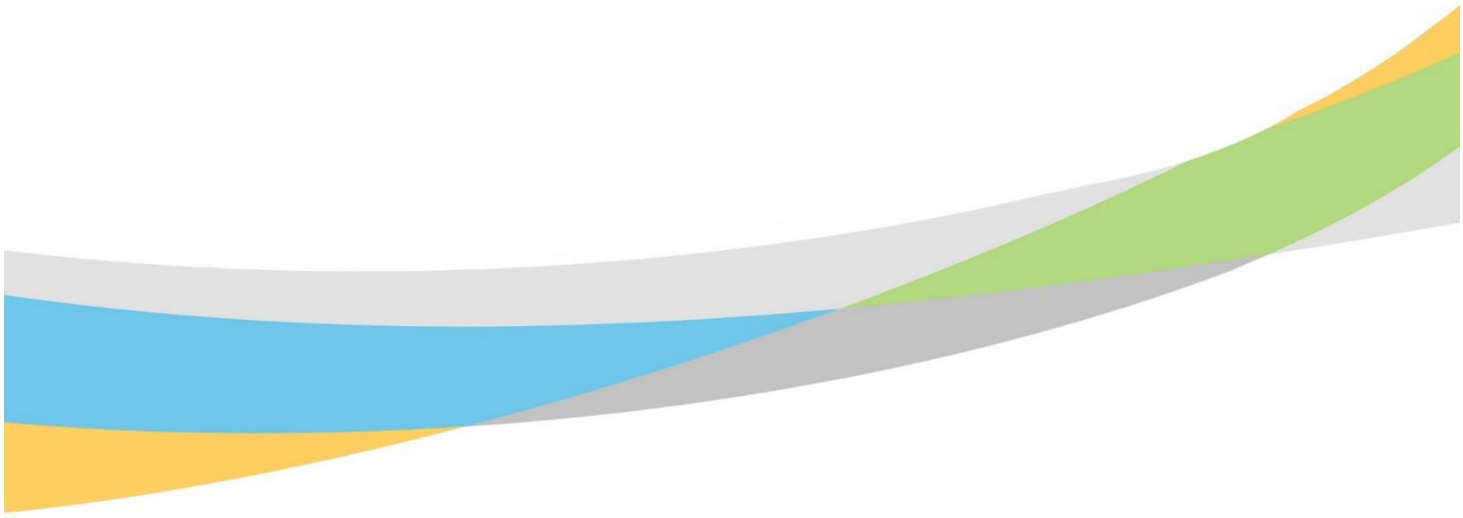


Figure 1. The Lower Carruthers Flood Vulnerable Area (FVA) was identified by TRCA's Flood Risk Assessment Project by combining current riverine flood hazard information and flood exposure information to calculate flood vulnerability and quantify flood risk. FVAs across TRCA's jurisdiction were ranked based on risk with the Lower Carruthers FVA ranking 32 out of 41 total FVAs.



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