Carruthers Creek Watershed Plan

Phase 1 Technical Report Summaries

1) Aquatic Crossing and Barrier Assessment Report

This report identifies the location, type, and physical characteristics of the existing aquatic crossings in Carruthers Creek watershed. Aquatic barriers are natural and artificial structures that may restrict the movement and passage of fish species during certain flow conditions, or permanently depending on the type and size of the structure. Barriers may also alter the hydrology of a stream and, in turn, influence sedimentation, increase erosion, and affect water quality. In 2016, TRCA analysed data collected through an extensive field inventory to determine the extent that these crossings and barriers impede fish passage in Carruthers Creek. The majority were natural barriers such as debris jams or beaver dams, which is encouraging since these are typically “temporary” and may be removed naturally through spring flows or storm flows, or under certain circumstances may not be barriers to small fish species at all. Although a large number of crossings associated with roads and trails were identified, only a few (7) were identified as barriers. The information collected will help inform management decisions regarding the modification or removal of barriers to maintain or restore fish communities and habitat, and help to regulate flows and sediment transport.

2) Aquatic Habitat and Community Characterization Report

This report identifies the existing aquatic communities along with the physical habitat conditions found in Carruthers Creek watershed. Fish and benthic macroinvertebrates (BMI) were chosen as indicator organisms, and instream habitat including temperature, sediments, structure, cover, and vegetation were also examined, as these variables influence the ecology of the BMI and fish communities. Characterization of the current aquatic habitats and communities in Carruthers Creek was achieved through the review of historical datasets and reports, the compilation and analysis of data from recent monitoring projects, and additional monitoring specifically conducted to support this study.
Aquatic communities and their associated habitats vary within the headwaters, mid-reaches and lower portions of the watershed and are influenced by biophysical characteristics and by the varied land use practices from the headwaters to the river mouth. The headwater reaches exhibit cooler and more stable water temperatures and habitat, while sites closer to the mouth and downstream of developed areas are warmer and less stable. Fish biodiversity has fluctuated over the years but was found to have returned to the point where species richness in recent samples (2015 and 2016) was as high as the peak richness observed in the last three decades. Although the results of the aquatic habitat and community characterization are encouraging, they do reflect the effects of urbanisation and changing land use in portions of the watershed and suggest that there is still much room for improvement. Aquatic ecosystems that support a diverse biological community are considered to be healthier and more resilient to both natural and human-induced stressors such as chemical spills, floods, invasive

species and climate change. Measuring and reporting on the state of aquatic habitats and the communities they support in our rivers and streams is an important step towards effective decision making and planning for these essential resources.

3) Fluvial Geomorphology Assessment

This report characterizes the rate and locations of the movement of stream channels, or channel morphology, in Carruthers Creek watershed since the 2003 watershed plan was completed. Characterizing the channel morphology of a watershed is important because the physical form and function of a watercourse are key elements of aquatic habitat (PARISH, 2004). Further, establishing a baseline condition enables watershed managers to assess potential impacts from changes to the watershed.

Following completion of the 2003 watershed plan for Carruthers Creek, TRCA established the Regional Watershed Monitoring Program (RWMP). Under this program, Matrix Solutions Inc. (formerly PARISH Geomorphic Ltd.) established ten monitoring stations along Carruthers Creek in 2003 which were updated every three years through 2012. For the current assessment, Matrix Solutions Inc. completed an updated desktop assessment using recent aerial imagery and data collected following the RWMP protocol during detailed site visits in 2016 at each of the ten monitoring stations. This report contains an analysis of the full monitoring dataset which includes years 2003, 2006, 2009, 2012, and 2016.
The assessment indicates that the watercourse is an active channel, whether the cross-section is enlarging, aggrading, or continually adjusting while maintaining a similar size. Sites on the smaller tributaries of the creek suggest that channel dimensions are increasing. Comparatively, while the main branch sites exhibited active channel processes, overall change was relatively minimal, which indicates the larger channel's resilience to changes in the surrounding area. The information collected as part of this study will be used in Phase 2 of the watershed plan to make recommendations for management of the natural heritage system and watercourses.

4) Headwater Drainage Features Report

This report characterizes the headwater drainage features (HDF) in the watershed. HDF are small intermittent and ephemeral (short-lived) streams, swales, and headwater wetlands. They have many hydrological and ecological functions which help to maintain watershed health, however, these features and their functions can be altered by urban and agricultural land uses. HDF help to slow down and improve the quality of stormwater runoff; provide habitat for fish, insects, and amphibians; regulate sediment transport; and transport organic material to feed downstream fish communities. In 2015, TRCA staff analysed data collected through a series of three field visits to better understand the hydrological and ecological functions of HDF in the watershed. TRCA found that the majority of the headwater drainage features have been altered in some way by human activities, with varied levels of impact on natural headwater functions. The information collected as part of this study will be used in later phases of the watershed plan development to recommend management measures for headwater drainage features to ensure that their watershed functions are protected, enhanced, and restored.

5) Hydrogeology Report

This report documents the groundwater conditions in Carruthers Creek watershed utilising high quality data that exist within adjacent watersheds, augmented with relatively lower quality data (*e.g.,* MOECC water well records), and streamflow gauging records (since 2007) that exist within the watershed. The information used is available from the Oak Ridges Moraine Groundwater Program's information system. Groundwater in Carruthers Creek watershed is utilised for a rural water supply from private wells and also provides groundwater discharge to streams that maintain annual flow.

Three aquifer systems are present in the watershed: one shallow (Oak Ridges Moraine/ Mackinaw Interstadial aquifer complex) and two deep (Thorncliffe aquifer complex and the Scarborough aquifer complex). The shallow aquifer is not present south of the Lake Iroquois shoreline. The deep Thorncliffe and Scarborough aquifer complexes are mapped throughout the watershed and occur at shallower depth south of the Lake Iroquois shoreline (Whitevale Road) as the ground surface elevation is lower due to erosion of overlying deposits by Glacial Lake Iroquois. Groundwater recharge estimates for the headwaters and lower portions of the watershed are similar 30 to 90 mm/year, with the highest values in the watershed (180mm/year) occurring on the Glacial Lake Iroquois shoreline in the Greenbelt. Some data gaps exist relative to hydrogeology in the watershed, which include:

- No Carruthers watershed based monitoring of groundwater levels and quality; and
- No Carruthers watershed focused analysis of possible impacts from various potential land use scenarios (groundwater flow modelling).

These data gaps are anticipated to be addressed during Phase 2. The installation of a groundwater monitoring nest of wells in Pickering will allow for measurement of groundwater level changes and groundwater quality. Also, various possible land use scenarios will be analysed from a water budget perspective utilising an existing numerical groundwater flow model that will be refined based on the updated information in this Phase 1 report.

6) Surface Water Quality Characterization

This report characterizes the surface water quality in Carruthers Creek watershed for which there are provincial or federal water quality objectives. Concerns such as eutrophication, toxicity to aquatic life, water clarity, and aesthetics, are influenced by surface water quality. Surface water quality in Carruthers Creek is variable and reflects the local sources, contributions, and land use in the watershed. In 2015 and 2016, TRCA staff collected water samples during low flow and runoff events at three locations in Carruthers Creek watershed for water quality analysis. Construction and agricultural influences in the headwaters contributed nutrients, bacteria (*E.coli)*, metals, and suspended solids to the creek. Higher concentrations of chloride were observed in areas with urban development, as were concentrations of *E.coli*, metals, nitrogen and phosphorus. Concentrations of many water quality variables were elevated during runoff flow from wet weather. Exceedances of the water quality objectives were often highest in the rural headwaters, lowest above the urban sampling location, and second highest below the urban area. Understanding watershed delivery of nutrients, pollutants, and materials that affect water quality is fundamental to inform management of the watersheds and Lake Ontario, which Carruthers Creek drains into.

7) Terrestrial Natural Heritage

This report characterizes the vegetation and wildlife found in Carruthers Creek watershed in the context of the quantity and quality of the available habitat patches (the size, shape, and surrounding land use). The amount of natural cover, along with the quality and distribution throughout the watershed, is not only important habitat for wildlife, but it also performs many ecosystem services for people. Natural cover improves air quality, reduces the risk of flooding and provides opportunities for pollination of food crops. Standardized protocols were used for the field data collection including the Ecological Land Classification for Southern Ontario and the Breeding Bird Atlas. North of Taunton Road, a higher number of species of conservation concern was detected compared to the south because of their sensitivity to various disturbances related to land use development. However, to the south, the marsh at the mouth of Carruthers Creek is highly productive with an active heronry and flora species that have not been observed in the TRCA jurisdiction for decades. The data collected will be used in later phases of the watershed plan development to determine recommendations for management and protection of terrestrial wildlife.