Scoped Subwatershed Study, Part B: Detailed Studies and Impact Assessment (Final Report)

Settlement Area Boundary Expansion
Region of Peel
Project # 198127

Prepared for:

Region of Peel
10 Peel Centre Drive, Suite A and B, Brampton, ON L6T 4B9

1/11/2022

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1.0 Introduction

The Regional Municipality of Peel (Peel Region) has initiated an Environmental Screening and Scoped Subwatershed Study (Environmental Study) to provide water resources and natural heritage input to support a Settlement Area Boundary Expansion (SABE) Study that will determine where new settlement area growth is proposed in Peel Region. The SABE Study is being undertaken as part of the Region's Peel 2051 Regional Official Plan Review. The original branding of the Region's Official Plan Review was identified as Peel 2041 then after June 2020, with new population growth management numbers from the Province to the year 2051, it became known as the Peel 2041+ Official Plan Review. As of July 2021, the Region of Peel's Official Plan review is now referred to as the 'Peel 2051 Official Plan Review' or 'Peel 2051'.. The SABE Study will define the area of planned growth in Peel Region and the related environmental management policies, at a level sufficient to confirm the principle of development at a regional scale. The Environmental Study, which is comprised of the Phase 1: Environmental Screening (ES) Study and the Phase 2: Scoped Subwatershed Study (Scoped SWS) is one of several technical studies that are informing the SABE, the results of which will be used to identify a recommended settlement expansion area and policies to be included in the Regional Official Plan. This approach will ensure that water resources and natural heritage features and functions are protected, restored or improved, through the land development process and will set the basis for future local municipal official plan amendment(s) (LOPA), led by the Town of Caledon. The LOPA(s) are proposed to be supported by detailed subwatershed study(s) to be completed at a time appropriate to the anticipated timing of the corresponding LOPA(s).

The terminology used to define the various areas under study is important for context and clarity. The **Initial Study Area** for this study is defined as the Agricultural and Rural lands in the Town of Caledon (Caledon) excluding lands within the Greenbelt Plan Area. Within this area, a **Focus Study Area (FSA)** has been established over the course of the study, which is described as "a broad area in the southern part of Caledon that serves as the basis for the SABE technical studies", within which the Settlement Area Boundary Expansion (SABE) will be identified. The **Settlement Area Boundary Expansion Study** is the overall study being undertaken by Peel Region to identify expansions to settlement areas (defined in the Growth Plan) to accommodate population and employment growth to 2051 after accounting for intensification in the Region's built up areas. The feasibility of any proposed expansion will be determined and the most appropriate location for any proposed expansion will be identified, with reference to the results of comprehensive technical studies, including the Scoped SWS.

Settlement Areas are defined per the 2019 Growth Plan as follows:

> "Urban areas and *rural settlements* within municipalities (such as cities, towns, villages and hamlets) that are:
>
> - built up areas where development is concentrated and which have a mix of land uses; and
> - lands which have been designated in an official plan for development in accordance with the policies of this Plan.
>
> Where there are no lands that have been designated for development, the *settlement area* may be no larger than the area where development is concentrated."

Phase 1 of the Environmental Study constituted the Environmental Screening Study which was completed in mid-2020 with a report being submitted to Peel Region to provide input to defining the limits and constraints associated with the Focus Study Area (ref. Wood et. al., May 29, 2020). The analyses and guidance provided in that report focused on identifying key environmental features and constraints within the overall study area, related to the terrestrial features, aquatic features, and the hydrogeologic and surface water systems. The environmental features and systems identified through this screening exercise have been integrated with the findings from the parallel study process led by the Hemson Consulting Team working on behalf of Peel Region, involving additional technical studies including municipal servicing, transportation, agricultural, cultural heritage, and climate change etc., to identify further constraints, needs, and opportunities, to define a Focus Study Area (FSA). The Environmental Screening Study included an assessment of a sufficient extent of land to ensure the FSA identified for the SABE provides adequate area, accounting for natural heritage and water resource system requirements, to accommodate the Region's growth requirements to 2051 and thereby enable one or more settlement area expansions.

Phase 2 of the Environmental Study entails the Scoped Subwatershed Study (Scoped SWS) to define and support the selection of the SABE and establish preliminary management strategies and future study guidance. The following summarizes the primary components (parts) of the Scoped SWS:

Part A: Existing Conditions and Characterization

Part B: Detailed Studies and Impact Assessment (this report)

Part C: Implementation Plan

The Part A: Existing Conditions and Charcterization Report has been completed, reviewed, and approved by Peel Region and the Technical Advisory Committee (TAC). The Part A Report has built upon the findings from Phase 1 of the Environmental Study, and further characterizes the environmental and water resources features, areas and systems within, and bounding the FSA, identifies limitations and constraints to development potential by location within the FSA, and thereby further informs refinement of the FSA to establish the SABE.

The Part B: Detailed Studies and Impact Assessment report provides an overview of the anticipated impacts associated with future development within the FSA, and provides general guidance for management opportunities and requirements for future environmental studies to support subsequent stages of land use planning. This Part B report has initially been completed for the entirety of the FSA to further inform refining the Region's SABE. Subsequent iterations of this Part B report provided a more focused discussion and assessment of anticipated impacts associated with future development within the SABE specifically, which include further details on the various land uses and also the primary servicing infrastructure associated with roads and municipal water and wastewater. Furthermore, the report also provides detailed discussion of future study requirements expected to be conducted at the local scale specific to support Caledon's LOPA.

The Scoped Subwatershed Study is an evolving document. At their March 11, 2021 meeting, Regional Council passed several resolutions, including a resolution opposing construction of any transportation corridor traversing the Region of Peel, and specifically the currently proposed GTA West 413 Highway and Transmission Corridor. This corridor had been proposed as the northern boundary of the Focus Study Area and preliminary Settlement Area Boundary Expansion (SABE) concept in December 2020. Subsequent to that meeting, the Region Staff in consultation with the Region's planning consultant (Hemson) requested that the December 2020 SABE concept with identified employment and community areas be further analyzed as well as "testing" areas which were being considered subject to the findings of additional study. These areas were analyzed as part of an updated Part B report, which ultimately informed the delineation of a Staff Recommended SABE in November 2021.

2.0 Part B: Detailed Studies and Impact Assessment

The impact assessment has been completed across disciplines, to assess the impact of the future development within the FSA, in the absence of management and mitigation. For the purpose of this report, this assessment has been completed premised on general impacts associated with urbanization within the FSA without specific consideration to the specific form and location of development (i.e. detailed land uses; location of streets, blocks and required servicing; receiving watercourses/systems, etc.). The findings of this impact assessment represent the basis from which specific management strategies and design criteria are developed. The results of the impact assessment and associated management strategies have been refined based upon the generalized land uses and boundaries for the SABE (i.e. refined community area and employment area boundaries). The following sections summarize the key findings from the Part A Characterization, in order to provide context for the work which follows, as well as the details associated with the impact assessment for the respective study disciplines.

2.1 Summary of Characterization Outcomes

The SABE Study Team (Hemson led) has been responsible for the initial identification and selection of the Focus Study Area (FSA). As noted earlier, numerous technical disciplines are engaged through Hemson on behalf of Peel Region to provide input to the project process (e.g., Agriculture, Transportation, Servicing, etc.). As a separate, but inter-related project, the Environmental Team (Wood led) has been working in parallel and close consultation to ensure that technical inputs to the FSA, and ultimately the SABE Study, are provided accordingly. The initial input to this process was outlined in the Environmental Screening report (May, 2020).

The Scoped SWS Part A: Characterization report (January 2022) provides a detailed discussion of the background information provided for use in the Scoped SWS, discipline-specific findings of the characterization, and integrated mapping of the features, areas and systems within the FSA related to the natural heritage system (NHS), and Water Resource System (WRS). The latter constitutes key hydrologic areas, and key hydrologic features, as defined by current Provincial and Regional policy, as well as initial constraint assessments of the watercourses and headwater drainage features within the FSA. The following sections provide a high-level overview of key findings from the Part A report (January 2022).

2.1.1 Surface Water Quantity and Groundwater Resources

2.1.1.1 Surface Water Characterization

Baseline Characterization

Drainage Patterns:

The FSA primarily extends across the headwaters of the Upper Etobicoke Creek Subwatershed, West Humber River Subwatershed and the Main Humber Subwatershed within TRCA jurisdiction. Toward the west, the FSA lands fall within headwater reaches of the Credit River Watershed, encompassing the upstream limits of three (3) subwatersheds, namely the Credit River (Glen Williams to Norval) Subwatershed, Huttonville Creek Subwatershed and Fletcher's Creek Subwatershed. The portions of the FSA within the Etobicoke Creek and Humber River Watersheds discharge toward well-defined riverine systems and open watercourses, which extend throughout the respective portions of the FSA within each subwatershed. The portions of the FSA within the Credit River Watershed are within the upstream and eastern limits of the respective subwatersheds and drain towards watercourse features directly outside of the FSA. Runoff from the FSA within the Upper Etobicoke Creek Subwatershed, West Humber River Subwatershed and Main Humber River Subwatershed is conveyed toward the main branches of the respective watercourses via several headwater drainage features and agricultural tile drains, and/or in the form of direct surface runoff and upper soil layer interflow. The primary watercourses through the FSA also receive and convey runoff from lands upstream and external to the FSA.

Soils:

The soils within an area directly influence the infiltration potential under pre-development and post-development land use conditions, as well as the requirements for mitigating impacts to flooding and erosion following development. Higher permeability material, such as sand and gravel, have lower pre-development runoff potential, hence are generally more sensitive to increases in impervious coverage and associated increases in storm runoff volumes and peak flow rates. As such, development areas with higher permeability soils tend to have relatively higher storage volume requirements for flood and erosion protection; where groundwater levels are deeper, these soils also afford greater opportunities for infiltrating storm runoff. By contrast, lower permeability material, such as clay, generally has a higher pre-development runoff potential, hence a relatively lower sensitivity to increases in impervious coverage and associated increases in storm runoff volumes and peak flow rates. As such, development areas with lower permeability soils tend to have relatively lower storage volume requirements for flood and erosion control compared to areas with higher permeability soils, as well as relatively lower capture volume requirements for maintaining water budget and groundwater recharge. Higher groundwater levels in areas with lower permeability soils generally present a constraint to servicing, and may require additional management requirements to mitigate groundwater interaction (i.e. use of synthetic liners, importing fill material to raise finished grade).

The surficial soils mapping for the FSA indicates that surficial soils consist primarily of Clay Loam, Sandy Loam and Clay. This blend of soils is noted to also be largely consistent with the lands external to the FSA, with some higher deposits of Loam in the northern part of the West Humber Subwatershed, and higher deposits of Clay moving downstream of the FSA in both the Etobicoke Creek and Humber River Watersheds. The surficial geology mapping for the FSA indicates that the surficial geology consists primarily of diamicton, which is a poorly sorted sediment containing a range of particle sizes. There are local occurrences of clay, silt and sand, however, the mapping suggests the FSA is predominantly diamicton. Similarly, areas to the north of the FSA consist of diamicton and local occurrences of clay, silt and sand. The areas of the Humber River Watershed located downstream of the FSA are largely clay and silt, which is similar to the findings of the surficial soil mapping. Overall, the soils within the FSA are considered to exhibit relatively low infiltration and comparatively high runoff potential. A summary of the soils by subwatershed is provided in Table 2.1.1.1.

Table 2.1.1.1. Summary of Soil Composition by Subwatershed (%)

Subwatershed	Soil Type					
	Clay Loam	Sandy Loam	Clay	Loam	Muck	Bottom Land
Main Humber	85.5	0.8	-	9.7	-	4.1
West Humber	70.1	4.1	15.3	0.2	-	10.3
Upper Etobicoke	86.3	1.2	-	-	0.2	12.3
Fletcher's	100	-	-	-	-	-
Huttonville	100	-	-	-	-	-
Main Credit	89.5	-	-	-	-	10.5
Spring Creek	100	-	-	-	-	-

Topography:

The topography of a development area influences the grading requirements for a development to implement storm infrastructure. Areas with shallow grades (i.e. 2% or less) which drain to poorly defined streams (i.e. headwater drainage features, unconfined watercourses) generally require relatively large volumes of imported fill material to achieve the grades necessary for storm drainage. By contrast, areas with steeper grades (i.e. 2% or greater) which drain toward confined watercourses tend to offer better opportunities for balancing cut and fill within the site and constructing storm infrastructure below existing grade without requiring significant volumes of imported fill.

The ground slopes at the surface within the FSA have been characterized based upon the 5 m 2012 DEM for the Etobicoke Creek provided by TRCA and the 1 m 2017 Digital Elevation Model for the Humber River provided by Peel Region for use in this study. The information in the DEM mapping indicates that the surficial slopes within the FSA are relatively moderate and are generally less than 2 % with some areas approaching slopes as high as 15 % or greater on the tableland near the open watercourses. A summary of the proportion of ground slope class by subwatershed is presented in Table 2.1.1.2, and is shown graphically on Drawing WR1 (see Appendix G).

Table 2.1.1.2. Summary of Topographic Composition by Subwatershed (%)

Subwatershed	Ground Slope		
	0% – 2%	2% – 5%	>5%
Main Humber	36	33	31
West Humber	58	30	12
Upper Etobicoke	65	21	14
Fletcher's	79	19	2
Huttonville	73	19	8
Main Credit	97	2	1
Spring Creek	47	39	12

Existing Land Use:

The existing land use conditions within the FSA are primarily agricultural, with the exception of land designated as an airport for the Brampton Flight Centre and Flying Club, two greenspace areas between Dixie Road and Airport Road in the West Humber River Subwatershed which represent Golf Courses, the Banty's Roost Golf Course and the Mayfield Golf Course, as well as local occurrences of low-density residential land uses. The lands toward the west and south of the FSA are primarily residential, with some institutional, commercial, and recreational land uses. The existing developments external to the FSA lie toward the south, within the Fletcher's Creek Subwatershed, as well as the Etobicoke Creek Watershed and the West Humber Subwatershed. The existing development within the Fletcher's Creek Subwatershed and the West Humber subwatershed also include stormwater management facilities which provide local stormwater quality and quantity control for the existing developments within the respective watersheds. The lands toward the north, which lie upstream and external to the FSA, are primarily agricultural, with some forests and natural areas, and some isolated commercial, recreational, and estate residential land uses.

Detailed Characterization and Assessment

The surface water system has been characterized for surface water quality, as well as quantity specific to hydrologic response (flows) and hydraulic performance (open watercourse systems).

Hydrology:

The previously completed hydrologic studies for the Etobicoke Creek and Humber River watersheds were both prepared on behalf of TRCA, using the modelling software Visual OTTHYMO (VO). Both studies applied the synthetic design storm methodology, and generated peak flow rates for events ranging from the 2 through to 100-year return period, as well as for the 350-year, 500-year return period and the Regional Storm event. These studies did not include a continuous simulation assessment, as the versions of VO used in those assessments were specifically intended for event-based modelling only. Neither study characterized existing conditions land use or assessed the impact of future land development on the regional-scale water balance or erosion potential of downstream receivers.

The hydrologic analyses for the Fletcher's Creek and Huttonville Creek Subwatersheds applied the Hydrologic Simulation Program-Fortran (HSP-F) hydrologic model. HSP-F is both an event based and continuous hydrologic model, although it is more commonly used for continuous modelling. In addition to the differences in model platform and methodologies, several discrepancies between the boundaries of the Credit River, Etobicoke Creek, and Humber River watersheds were noted based upon a review of the subcatchment boundary information for each hydrologic model. A number of areas were identified as either overlapping or unaccounted for as part of the separate studies.

Flood Vulnerable Areas:

As part of the current study, TRCA has provided a GIS mapping shapefile indicating the limits of existing flood vulnerable areas (FVAs), as defined through hydraulic modelling and floodline mapping. This information has indicated that four (4) FVAs are located downstream of the FSA along the Upper Etobicoke Creek in Downtown Brampton, Main Humber in Bolton and further downstream in Vaughan, as well as the confluence of the West Humber and Lower Main Humber branches in northern Etobicoke (ref. Drawing WR5, Appendix G). Supplemental assessments completed for this Scoped SWS (ref. Part A Report, Section 2.3.2.3) have indicated that flood damages at the Downtown Brampton FVA along the Etobicoke Creek would occur for events more severe than the 50 year return period, and flood damages at the FVA along the Humber River would occur for events above the 100 year return period.

Flood Hazards:

Regulatory flood hazard mapping has been established for various reaches of regulated watercourses within the FSA. In several instances, the flood hazard mapping has been "estimated" along some reaches (primarily along the unconfined watercourses), hence has not been developed based upon field verified hydraulic structures and current topographic mapping. Furthermore, flood hazard mapping has not been delineated along certain reaches which would typically attract TRCA regulation flood hazard studies and delineation under the Authority's current practice (i.e. generally watercourses with contributing drainage areas greater than 25 ha), hence the extent of floodline mapping will need to be extended along various reaches through the FSA to establish that floodline mapping, as part of future studies for all regulated watercourses within the area, and is to apply the approved hydraulic modelling for the respective watercourses. Where flood hazard mapping is currently available, the results indicate that the Regulatory flood hazard is largely contained within the well-defined riverine systems and does not extend onto the tableland adjacent to the confined systems.

Key Hydrologic Features and Key Hydrologic Areas:

Consolidated mapping of key hydrologic features and key hydrologic areas within the FSA has been prepared, based upon the background information provided for the Scoped Subwatershed Study, for the various components per Section 4.2.1 of the Growth Plan for the Greater Golden Horseshoe and Section 3.2.5 of the Greenbelt Plan. The key hydrologic features mapping depicts the permanent and intermittent streams, lakes, seepage areas and springs, and wetlands within the FSA. The key hydrologic areas mapping depicts the Ecologically Significant Groundwater Recharge Areas, areas of shallow depth to water table, and contributing drainage areas to flood vulnerable areas. The key hydrologic features and key hydrologic areas mapping are included in Appendix G. Additional mapped key groundwater areas include Significant Groundwater Recharge Areas (SGRAs) and Highly Vulnerable Aquifers (HVAs) which are presented in Appendix G.

2.1.1.2 Groundwater Characterization

The FSA is situated almost completely within the South Slope physiographic region which is characterized by till plains. The gently sloping glacial till plain of the South Slope represents the southern slope of the elevated Oak Ridges Moraine found north of the FSA and is characterized by finer grained, silty to clayey till.

Within the FSA, the ground surface generally slopes from 285 meters above sea level (masl) in the northwest to a low of 215 masl in southeast. Surface drainage networks of the Etobicoke Creek in the western portion of the FSA and the Humber River through the central and eastern portions of the FSA, originate from the west and north and drain south and east. Due to the fine-grained nature of the surficial soils, runoff is relatively high and infiltration is relatively low, however this is not considered to prohibit the application of green infrastructure and Low Impact Development Best Management Practices (LID BMPs) for stormwater management.

Paleozoic bedrock in the FSA includes the Queenston Formation shales found at the bedrock surface in the western and central parts of the FSA, and Georgian Bay Formation shales that are found beneath the Queenston Formation. Regionally, the bedrock dips to the southwest. Numerous bedrock valleys exist within and adjacent to the FSA and are infilled with thicker sequences of overburden sediments.

The surficial geology in the FSA consists primarily of fine-grained sediments characterized by the sandy silt to silty clay sediments associated with the Halton Till and Wildfield Till (ref. Drawing GW-4, Appendix G). Two small, localized surficial patches of sand and gravel deposits are found overlying these till units in the central part of the FSA, as well as small areas of fine-grained glaciolacustrine deposits found near Mayfield

Rd. in the western and eastern extents of the FSA. Surficial patches of sand and gravel deposits are also found along and north of King Street adjacent to the FSA. Modern silt, sand and gravel deposits can be found along the watercourses in the FSA.

There is an interpreted sequence of six unconsolidated Quaternary deposits overlying the bedrock within the FSA. The thickness of these overburden units combined varies across the FSA from less than 5 m along some watercourses, to 160 m thick in the northern part of the FSA where overburden sediments fill in a deep bedrock valley. North of the FSA, overburden thickens to over 200 m along parts of a bedrock valley. The thicknesses and continuity of the units varies across the FSA. The six stratigraphic units include the following:

- *Halton Till* – The Halton Till occurs at surface across the majority of the FSA as a primarily fine-grained till unit consisting of sandy silt to clayey silt. The till ranges in thickness from zero thickness where it has been eroded along to thicknesses exceeding 30 m and approaching 50 m in areas of inferred bedrock valleys.
- *Oak Ridges Moraine Deposits* –The Oak Ridges Moraine deposits are found beneath the Halton till and are predominantly comprised of fine sands and silts but coarser sands and gravels can dominant local areas. The deposits of the Oak Ridges Moraine are interpreted to be thickest (approximately 80 m thick) in the FSA along the northwest boundary of the FSA in the area of the bedrock valleys. The deposits thin downslope towards the southeast where they are inferred to become discontinuous approaching Mayfield Rd.
- *Newmarket Till* – The Newmarket Till is a dense silty sand till found below the Oak Ridges Moraine deposits and the Halton Till where the Oak Ridges Moraine is absent. This till is interpreted to be discontinuous across the FSA, with thickest accumulations, up to 30 m, occurring within bedrock valleys.
- *Thorncliffe Formation* - The Thorncliffe Formation is generally considered a relatively coarser unit comprised of glaciofluvial sands and silty sand; however, towards the south this unit is mainly comprised of glaciolacustrine silts, sands, and clay. This formation is discontinuous across the FSA and occurs primarily in the bedrock valleys.
- *Sunnybrook Drift* - The Sunnybrook Drift is interpreted to be a relatively finer grained unit comprised of silts and clays. It is interpreted to be largely absent across the FSA.
- *The Scarborough Formation* – The sediments consist of organic sands overlying silts and clays. Where present, the Scarborough Formation is interpreted as a thin layer on bedrock, except for thicker accumulations 50 m to 60 m thick in bedrock valleys.

Aquifer and aquitard units are defined on the basis of the estimated ability of the unit to yield water and correlates with hydraulic conductivity so that stratigraphic units are considered aquifers where the hydraulic conductivity is relatively high and aquitards where the hydraulic conductivity is relatively low. The main aquifer units interpreted include the Oak Ridges Moraine Deposits, Thorncliffe Formation and Scarborough Formation. Conversely, the main aquitards are conceptualized as the Halton Till, Newmarket Till, and Sunnybrook Drift. The Paleozoic bedrock units are generally interpreted to be poor aquifers except where they are sufficiently weathered or fractured.

Regionally, the groundwater table ranges from a high of approximately 430 masl in the west associated with the Niagara Escarpment, to a low of approximately 170 masl to the east along the Humber River valley. Across the FSA, shallow groundwater is interpreted to flow from northwest to southeast following ground surface (ref. Drawing GW-7, Appendix G). Shallow groundwater divides appear to exist to the west of Mississauga Road and east of Coleraine Drive. Within the FSA, the groundwater table ranges in elevation from approximately 280 to 220 masl, with some wells reporting flowing conditions indicating water levels at or above ground surface (ref. Drawing GW-7, Drawing GW-8a, Appendix G). Groundwater in deeper aquifer systems also generally flows from the Niagara Escarpment eastward and from the Oak Ridges Moraine southeastward within the FSA. The bedrock valleys may act as preferential flow pathways with groundwater moving toward and along them. It is expected that the majority of flow within the aquifer units underlying the FSA is derived from regional recharge within the Oak Ridges Moraine that is upgradient of the FSA.

Long-term trend data in groundwater levels within the aquifers directly underlying the FSA are limited but available data indicate seasonal variations of approximately 1 m with highs in the spring. The water table within the Halton Till is generally within the upper 3 m of ground surface and varies 1-2 m seasonally based on the geotechnical studies reviewed for this study as well as studies done in similar Halton Till settings (i.e., Brampton, Milton). Monitoring wells installed in the lower portions of this till complex may show lower static water levels demonstrating potentially strong downward hydraulic gradients.

The Halton Till will generally control the shallow groundwater components of horizontal and vertical flow and subsequent local recharge to the underlying aquifer units. The horizontal component of groundwater flow will be relatively weak due to the low permeability of the silt/clay sediments, but the weathered, fractured portions of the till unit are expected to transmit more significant quantities of water but on a more local scale. Groundwater flow within the discontinuous sand lenses that potentially occur within the Halton Till may also be significant on a local scale where these sand lenses intercept surface water features.

The Oak Ridges Moraine Groundwater Program (ORMGP) staff has prepared draft mapping of potential groundwater “Areas of Concern” (AOC) for the area surrounding the FSA (Drawing GW-8a, Appendix G) as part of an overall goal to identify areas where elevated groundwater levels may pose an issue for subsurface construction or maintenance beyond what would be considered typical with respect to dewatering volumes, both short term and long term, and the potential impacts related to disposal of the water or the impact on groundwater levels. A significant reduction in groundwater levels may lead to an impact on water levels in surface water features, groundwater discharge and available water in water supply wells, particularly when dewatering a confined hydrostratigraphic unit.

Within the FSA, recharge ranges between approximately 20 and 125 mm/year due to the predominance of finer-grained surficial deposits associated with the Halton and Wildfield tills. Higher recharge correlates with the more permeable deposits along King Street, north of Macville, along Bramalea Road North of Mayfield Road and at the intersection of Kennedy and Old School Road (ref. Drawings GW-4 and GW-9, Appendix G).

Significant Groundwater Recharge Areas (SGRAs), which represent areas of relatively higher groundwater recharge rates that are important for providing groundwater recharge to an aquifer and Ecologically Significant Groundwater Recharge Areas (ESGRAs) which represent areas of land where groundwater recharge occurs that may directly support groundwater-dependent features such as coldwater streams, wetlands and their ecological functions, are presented on Drawing GW-9. Within the FSA, SGRAs are interpreted in small, localized areas that coincide with small pockets of sands and gravels mapped at ground surface (ref. Drawing GW-4, Appendix G). ESGRAs were delineated across the FSA through modelling, the details of which were presented in the ‘Scoped Subwatershed Study Part A – Existing Conditions and Characterization (Final Report)’ (Wood, January 2022). The ESGRAs were predominant in the southwestern portion of the FSA and in some areas of the north part of the northeastern portion of the FSA.

Potential groundwater discharge for the FSA has been presented through two modelling methods. Seepage Areas and Springs represents a simulated output from the TRCA Expanded Groundwater Flow Model that represents where groundwater discharge equals or exceeds the median discharge. The model predicts that groundwater is likely to discharge along the majority of the higher order watercourses found in the FSA. A

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second method presents groundwater discharge areas where the interpolated water table elevation is greater than ground surface elevations. The distribution of these discharge areas is similar to that of the seepage and springs layer in that it follows many of the higher order streams in the FSA, but also includes some areas away from the streams. Results from both methods are shown on Drawing GW-10 (Appendix G). Groundwater discharge is expected to occur where stream reaches have incised through the Halton Till and into the Oak Ridges Moraine sediments, as well as where the Halton Till is thin such that the till is sufficiently fractured to be hydraulically active and connected with Oak Ridges Moraine sediments. Drawing GW-5a (ref. Appendix C) presents areas where the Halton Till is less than 3m thick. A comparison of GW-5a with the discharge areas shown on Drawing GW-10 (ref. Appendix C) shows various areas where they correlate, particularly within the stream valleys

Wetland areas that coincide with the potential groundwater discharge areas shown on Drawing GW-10 (Appendix G) may indicate a more relevant groundwater function compared with overland flow to the feature.

The baseline water balance is presented within the groundwater impact assessment (Section 2.3.1.2).

The majority of the domestic wells in the FSA are completed within the overburden as opposed to bedrock. The Thorncliffe and Scarborough Aquifers can provide large capacity wells, although these aquifers may be more limited in extent within the FSA. Wells are also found within the Halton Till complex either in the discrete sand lenses or as large diameter bored/dug wells in the less permeable clay/silt. Capacities within the major aquifer units can range from 4 gallons per minute (gpm) to 100's of gpm or 26 m^3/day to greater than 654 m^3/day. Wells within the Halton Till are generally less than 1 gpm (6.54 m^3/day).

Policies exist within Wellhead Protection Areas (WHPAs) that have been delineated around municipal wells as part of the Source Water Protection program to protect the long-term quality of the groundwater supply. There are no WHPAs within the FSA although there are WHPAs adjacent to the FSA (ref. Drawing GW-12, Appendix G)

Highly Vulnerable Aquifers (HVAs) have also been delineated as part of the Source Water Protection program. These refer to aquifers that are highly susceptible to contamination from both human and natural sources and, similar to WHPAs, certain land uses may be restricted within these areas as presented in Official Plans. The distribution of HVAs in the FSA is shown on Drawing GW-12 (Appendix G). Regionally, HVAs are predominant north of the FSA; however, some patches of HVAs are present throughout the FSA.

2.1.2 Aquatic Resources and Water Quality

Most of the watercourses in the FSA are small or intermediate warmwater streams (ref. Map F1 – Appendix G).

Within the FSA, small coldwater streams are present in the western headwaters of Etobicoke Creek, Campbells Cross Creek in the West Humber watershed, and several small watercourses in the Main Humber watershed in the north-eastern portion of the FSA (ref. Map F1 – Appendix G).

Brook Trout (*Salvelinus fontinalis*) are not present in the coldwater streams in the Etobicoke Creek watershed (TRCA, 2006) but do occur in coldwater streams in the Humber River watershed.

Redside Dace (*Clinostomus elongatus*), an endangered fish species both provincially and federally, is the only aquatic species at risk known to occur within, or in the immediate vicinity of, the FSA. Reaches of the four largest tributaries in the West Humber subwatershed are Redside Dace habitat within the FSA and Redside Dace habitat is present downstream from the FSA in the Main Humber, Huttonville Creek and Fletchers Creek subwatersheds (ref. Map F2 – Appendix G).

The surface water quality along the reaches of the Upper Etobicoke Creek, Humber River, and Huttonville Creek through, and downstream of, the FSA is generally of high quality, compared to current Provincial Water Quality Objectives (PWQO) standards and surface water chemistry reported in literature. The water quality varies amongst the sampled parameters and across the available sites, with local exceedances shown with regards to metals, nutrients, microorganisms and Total Suspended Solids (TSS). However, as noted in the Part A report, January, 2022, the available background information was limited to the broader systems, with varying periods of record, and limited details regarding the conditions at the time of sampling (i.e. wet weather or dry weather). Consequently, further sampling and analysis as part of future studies to distinguish the conditions at the time of monitoring (i.e. wet weather vs. dry weather), as well as conducting multi-year / seasonal samples and direct sampling within the FSA, would be required to more accurately characterize the surface water quality within the FSA and associated effectiveness of any planned management strategies.

2.1.3 Stream Morphology, Erosion Hazards and Assessment

The primary purpose of the fluvial geomorphology assessment is to identify surface water feature types and extents, general form and function, erosion hazards, and erosion sensitivity for features within and adjacent to the FSA that may be impacted by development. Within the scoped level of the current study, the geomorphic assessment has followed a desktop approach with limited fieldwork.

Clear definitions of surface water feature types are essential when identifying and characterizing features, as the type of analyses, impacts upon these features, and opportunities for management differ. Following comments received from TRCA, definitions established in the Phase 2 Part A Characterization report have been updated as follows:

Watercourses

Watercourses are defined by the Conservation Authorities Act as "a*n identifiable depression in the ground in which a flow of water regularly or continuously occurs*."

Typical features of watercourses include permanent or intermittent flow regimes, defined bed and banks, features that exhibit clear evidence of active channel process including planform, profile, and material sorting, with evidence of a balance between erosion and deposition throughout the reach. They are often second-order or greater, but may be first order when verified by the practitioner(s). Watercourses are regulated features by the Conservation Authority (CA), and fish are also typically found within these features.

Headwater Drainage Features (HDFs)

Non-permanently flowing drainage features that may not have defined bed or banks have been designated as HDFs. The presence of bed and bank definition within these features may be attributed to anthropogenic intervention (e.g., cutting a drainage feature into the surface), or seasonally as spring freshet concentrates flows in depressions, causing channel development into surfaces lacking vegetated cover. HDFs are first order intermittent and ephemeral channels, swales, and connected headwater wetlands, but do not include rills or furrows. Within TRCA jurisdiction, the CA regulates HDFs when, through application of the HDF Guidelines, features are determined to have "protection" or "conservation" management. HDFs may also be regulated when features are determined to have "mitigation" management. HDFs are not regulated when they have been determined to have "no management" required. Fish may or may not be found within the features.

Previous work in other jurisdictions has utilized a threshold contributing area to surface water features to help scope HDFs and Watercourses prior to detailed assessment. This was not applied under the desk study completed as part of the Phase 2 Part A, January 2022 report, and it was noted that HDFs and low-order watercourses will require field confirmation at future planning stages. As part of the current Phase 2 Part B study, minimum drainage area thresholds of 25 ha and 50 ha were used to identify additional potential HDFs using ArcHydro analysis of OMNR LiDAR topographic information. Map SM-2 of Appendix C (Phase 2 Part B) presents the updated reach mapping including the potential HDFs with a minimum 25 ha drainage area. The potential HDFs identified in the ArcHydro analysis have not been assessed and will also require field confirmation at future planning stages.

The characterization (ref. Phase 2 Part A, January, 2022) focused on available mapping, aerial imagery, and previous reporting. Through the desktop assessment for the characterization, surface water features within and downstream of the FSA were divided into segments (reaches) and identified at a preliminary level as watercourses and HDFs (ref. Appendix G, Map SM-1, Phase 2 Part A). Reach nomenclature from Mayfield West (AMEC, 2012) was maintained in the current study where there is overlap. However, the reach delineation was updated based on current observations and the scoped level of study. Limited fieldwork was completed as windshield assessments to attempt to confirm feature type and presence on the landscape from a nearby vantage (road or watercourse crossing). In total, 418 reaches were delineated for this study, of those 182 are classified as watercourse, and the remaining 236 are considered HDFs. Due to the limited fieldwork, feature type and reach breaks should finalized through future detailed geomorphic studies which will be carried out in subsequent planning studies.

It was also noted that additional headwater drainage features may be present on the landscape that could not be identified in the desktop study or were not observed during the windshield assessment. Although subsequent ArcHydro analysis completed as part of the Part B study identified additional potential HDFs, it remains true that additional HDFs may be present which were not identified through the work to date.

Based on mapping and the findings of the windshield assessment, erosion hazard limits (meander belt and stable top of slope hazards) were delineated accordingly for confined (stable top of slope) and unconfined (meander belt width) settings. The erosion hazard mapping was updated as part of the Part B study to include a 10 m erosion access allowance as per CA requirements, and to adjust erosion hazard limits for several low-order reaches (ref. Appendix C Map SM-2, Phase 2 Part B). This was completed at a high-level for the purpose of characterizing the larger study area and developing an initial characterization of area hazards. Development will need to avoid erosion hazards and incorporate applicable setbacks for watercourse reaches. These erosion hazards are subject to confirmation and/or refinement, and finalization through future planning stages.

Rapid Geomorphic Assessments were not completed under the current study as per the TOR. It is recommended that detailed reach walks and surveys be completed to guide future planning studies and watercourse management. For headwater drainage features, future studies are required to fully characterize their form and function. HDFs should be assessed as per the TRCA/Credit Valley Conservation (CVC) guidelines for the "Evaluation, Classification, and Management of Headwater Drainage Features" (TRCA and CVC 2014) to develop management recommendations.

An assessment of erosion sensitivity was completed primarily through air photo interpretation, windshield assessments and review of background data. A map was compiled of sites considered to be undergoing excessive erosion, based on the windshield assessment. Additional work was completed to analyze and map stream power within and downstream of the FSA, which can be used to characterize erosion sensitivity. The methods and results of the stream power analysis are described below under the subsection Stream Power Mapping.

An erosion threshold assessment was not completed as part of the current study as per the TOR. Rather, background studies within and adjacent to the study area were reviewed.

Erosion thresholds were determined for the Mayfield West, Phase 2 Secondary Plan Comprehensive Environmental Impact Study and Management Plan, Part A - Existing Conditions and Characterization (2014). Erosion thresholds were determined for sites MEC-R1, MEC-R2, MEC-R5, MEC-R8, MEC-R25 and MFC-R3. The results are presented in Table 2.1.3.1. The critical velocities determined for these reaches ranged from 0.41 m/s (MEC-R5) to 1.13m/s (MEC-R25). Critical discharge rates ranged from 0.06 m^3/s (MFC-R5) to 2.15 m^3/s (MEC-R1). These values were initial, conservative values and would be subject to refinement through future monitoring.

Table 2.1.3.1. Summary of Mayfield West SWS Erosion Threshold Results

Reach Name, Mayfield West SWS	Critical Discharge (m^3/s)	Critical Velocity (m/s)	Reach Name, Peel Settlement Expansion Scoped SWS
MEC-R1	2.15	0.90	MEC-R1
MEC-R2	0.68	0.72	MEC-R2
MEC-R5	0.56	0.41	MEC-R3
MEC-R8	1.16	0.63	-
MEC-R25	1.64	1.13	MEC-R4(2)
MFC-R3	0.06	0.74	MEC-R2

Erosion thresholds were also determined as part of the North West Brampton Urban Development Area Phase 1 – Subwatershed Characterization and Integration (2010) fluvial geomorphology study. Following consultation with CVC, detailed field collection sites used for the erosion threshold calculations were located downstream of the North West Brampton Study Area. These were sites EM10 and SW4, which are part of the CVC Effectiveness Monitoring and Fletchers Creek Monitoring programs respectively, both located downstream of Bovaird Drive. Table 2.1.3.2 presents the critical discharge rates and velocities that were used in the durational assessment to inform stormwater management criteria.

Table 2.1.3.2. Summary of Northwest Brampton Erosion Threshold Results

Reach Name, Mayfield West SWS	Critical Discharge (m^3/s)	Critical Velocity (m/s)
EM10	0.59	0.65
SW4 – Bed	0.91	0.54*
SW4 – Bank (6.5N/m^2)	0.39	0.55*

*Average Velocity at Critical Discharge

Additional Background Studies

Additional stream morphology background studies were received during the Part B update. These studies are summarized below, and excerpted HDF mapping is included in Appendix C2.

- TRCA. 2020. *Etobicoke Creek Watershed Plan - Technical Characterization Report (ECWP) - Water Resource System: Features and Areas.* Prepared for: Toronto and Region Conservation Authority (TRCA), Dec. 17, 2020.
    - The ECWP Technical Characterization Report for the Water Resource System (WRS) describes the characterization of regulated watercourses and HDFs within the Etobicoke Creek watershed, a portion of which overlaps with the FSA. The stream and HDF assessment included a desk study and field program. A strategic sampling of 97 HDFs were assessed in the field to inform the HDF assessment. HDFs and permanent and intermittent streams were mapped through the watershed. Stream reaches were classified as either permanent

  - or intermittent. HDF reaches were classified as permanent, intermittent, neither or unknown.

- Matrix Solutions, 2017. *Overall Benefit Strategy for Strategic Planning of Urban Development Projects Within Redside Dace-Regulated Habitat West Humber River Subwatershed, Brampton, Ontario*. Prepared For: The Corporation of The City of Brampton, November 2017.
  - This study of the West Humber River subwatershed overlaps with a portion of the FSA. The study included reach delineation and meander belt mapping for watercourse reaches, and identification and mapping of Redside Dace habitat. Watercourse reaches classified as Occupied, Recovery, Contributing and Historical habitat were identified. For all occupied and recovery reaches, a 30 m setback was applied on either side of the meander belt width to delineate the regulated Redside Dace habitat.
- Aquafor Beech, 2013. Headwater Drainage Feature Assessment in support of the Bolton Residential Expansion Study (BRES). Prepared for: Dougan and Associates, June 16, 2013.
  - This report describes the HDF assessment that was completed for the BRES lands, which are included in the FSA. The HDF assessment followed the most recent HDF protocol developed by TRCA at the time of the study (2013), and HDF management classifications were identified.

Stream Power Mapping

Stream power is a general physical property of fluvial systems that is an expression of potential sediment transport, or the long-term ability of the channel to do geomorphic work (Phillips and Desloges, 2014). As such, it is also an index of erosion potential and reach sensitivity to future hydrological conditions from land use or climate changes. The calculation and mapping of stream power for subwatershed drainage networks is also a relatively practical task given the availability of high-resolution digital elevation models (DEM), hydrological models and/or regional discharge equations, and advanced spatial analysis tools in GIS. The unit or specific stream power (ω, W/m^2) of a channel is calculated as:

$$\omega = \gamma QS/w$$

where γ is the specific weight of water (9792 kg m/m^3 s^2 at 20°C), Q is the discharge (m^3/s), S is the channel slope, and w is the channel width (m).

The stream power for the FSA study area, including reaches upstream and downstream within the subwatersheds, was calculated using channel slopes and drainage areas derived from the Ontario Digital Terrain Model 0.5 m LiDAR dataset that is publicly available. For improved accuracy of the LiDAR drainage network and flow accumulation mapping, the DEM was hydrological conditioned by cutting the stream channels through the road crossings. To provide first-order estimates of stream power, the 2-year discharge and channel width values were scaled to drainage area based on regional relationships presented in Phillips and Desloges (2014). The results of the stream power analysis are presented on Map SM-3 in Appendix C.

Based on the small drainage areas and gentle slopes of most of the low-order streams within the FSA study area—and within fine-grained soils of the Peel Plain—the dominant stream power is in the range of 10-20 W/m^2, although values of 20-50 W/m^2 are mapped more frequently on the east side of the study area within the West Humber subcatchment. Higher stream powers of 40-60 W/m^2 are seen in some reaches within or immediately downstream of the FSA (e.g., WHT4(2), SC(1) and (2)), and are likely associated with subtle changes in surface geology, inputs of coarse gravel to the channel, and/or historic channel modifications. The highest stream powers mapped in the range of 60-90 W/m^2 are downstream of the study area of the West Humber and are typically where tributaries steepen as they enter well-defined valleys of larger branches.

The stream power mapping presented in Map SM-3 (Appendix C) provides an inventory of sensitive reaches within and immediately downstream of the FSA—typically those in the 20-60 W/m^2 range—that should be prioritized and targeted for future field assessment and monitoring to evaluate the potential of erosion impacts from future developments.

2.1.4 Natural Systems

2.1.4.1 Terrestrial Features and Wildlife

Characterization findings for the FSA have been structured based on general feature/habitat types that are present based on available information provided by TRCA and CVC; site investigations for field verification have not been undertaken. General feature/habitat types have been summarized for wetlands, woodlands, and open/early successional habitat.

Wetlands

Based on the available ELC data, 335 ELC wetland polygons were identified within the FSA + 120m. Polygons were represented by eight plant community types, including:

- Meadow marsh (MAM)
- Shallow marsh (MAS)
- Shallow aquatic (SA)
- Floating-leaved shallow aquatic (SAF)
- Mixed shallow aquatic (SAM)
- Submerged shallow aquatic (SAS)
- Deciduous swamp (SWD)
- Thicket swamp (SWT)

In total, ELC wetland polygons accounted for 203.3 ha (2.5%) of the FSA and adjacent 120m area. Among the seven subwatersheds (SWS) within the FSA, the West Humber River SWS had the most wetland features and largest coverage of wetland area followed in order (based on area coverage) by Upper Etobicoke Creek, Main Humber, Fletchers Creek, and the Credit River subwatersheds; there were no wetland features identified in the Huttonville Creek or Spring Creek subwatersheds within the FSA. Table 2.1.4.1 summarizes the number of wetland and aquatic features and associated area coverage within the FSA, as well as general descriptions of where these communities tend to be located. ELC types present within the broader SWS areas, but not within the FSA included: Shrub bog (BOS), Treed bog (BOT), Open fen (FEO), Shrub fen (FES), Treed fen (FET), Marsh (MA), Coniferous swamp (SWC), and Mixed swamp (SWM).

Table 2.1.4.1. Summary of Wetland and Aquatic Features by Type Present in the FSA

Wetland Type	Number of Features in FSA	Area Coverage within FSA (ha)	Location within the FSA
Wetlands			
Shallow Marsh (MAS)	91	20	Shallow marsh features occur across the FSA landscape, often larger MAS features being associated with natural riparian corridors. Some common species in these areas include broad-leaved sedge species, Reed Canary Grass, and both Broad and Narrow-leaved Cattail. Where soil type is known, it is often mineral in nature rather than organic.

Wetland Type	Number of Features in FSA	Area Coverage within FSA (ha)	Location within the FSA
Meadow Marsh (MAM)	142	114	These features combined total 114 ha in size. Similar to shallow marsh communities, they are evenly distributed across the landscape with large features occurring along riparian corridors. A majority of these features are dominated by Reed Canary Grass or broad-leaved sedges, and can be mineral or organic in nature.
Thicket Swamp (SWT)	25	16	Although sparse, these features are distributed evenly across the FSA. Dominant species in these mineral thicket swamp communities include willow species, Red-osier Dogwood, and Silky Dogwood. These communities often occur as small pockets within agricultural fields, although some larger features do occur along riparian corridors.
Deciduous Swamp (SWD)	54	48.5	Typical dominant species in these areas include Red Elm, Willow, Green Ash, Black Ash, Paper Birch and Silver Maple. Soil type in these swamps is mineral rather than organic. Similar to other wetland types in the FSA, larger deciduous swamps occur along riparian corridors, with smaller pockets within woodlots adjacent to agricultural fields.
Aquatic			
Open Aquatic (OA)	105	23	These features are distributed fairly evenly across the FSA with the most occurring withing the West Humber Subwatershed. These communities are often associated with natural river features or SWM ponds.
Shallow Aquatic (SA)	3	0.1	These features are confined to the eastern and central sections of the FSA, and are described as small, shallow depressions adjacent to agricultural fields.
Mixed Shallow Aquatic (SAM)	4	0.4	These features are confined to small, isolated features within or adjacent to agricultural fields, and are often dominated by Bur-reed or Pondweed species.
Submerged Shallow Aquatic (SAS)	9	2	Submerged shallow aquatic communities across the FSA, with a few features in each section of the area (western, central and eastern). These areas are often dominated by Pondweed, Coon-tail, or Stonewort species, and can be found in natural areas, adjacent to agricultural field, and in in

Wetland Type	Number of Features in FSA	Area Coverage within FSA (ha)	Location within the FSA
			anthropogenic areas such as residential properties and gold courses.
Floating-leaved Shallow Aquatic (SAF)	7	0.74	Floating-leaved shallow aquatic communities occur across the FSA as small features within natural woodlots or forests. These areas are often dominated by Duckweed.

Woodlands

Based on the available ELC data, there were 362 woodland features identified within the FSA and adjacent 120m. Polygons were represented by seven ELC community series types including:

- Cultural plantation
- Cultural savannah
- Cultural woodland
- Coniferous forest
- Deciduous forest
- Mixed forest
- Deciduous swamp

In total, woodland ELC polygons accounted for 417.6 ha (5.2%) of the FSA and adjacent 120m. Among the seven subwatersheds within the FSA, the West Humber River SWS had the most woodland features and largest coverage of woodland area followed in order (based on area coverage) by Upper Etobicoke Creek, Fletchers Creek, the Credit River, and Main Humber subwatersheds; there were no woodland features identified in the Huttonville Creek or Spring Creek subwatersheds within the FSA (Table 2.1.4.2).

Table 2.1.4.2 summarizes the number of woodland features and area coverage within the FSA, as well as general descriptions of where these communities tend to be located.

Table 2.1.4.2. Summary of Woodland Features by Type Present in the FSA

Woodland Type	Number of Features in FSA	Area Coverage within FSA (ha)	Location within FSA
Cultural Woodland (CUW)	48	52	Most of these are found clustered in the central FSA, with some scattered through the western section and only occurring a few times in the eastern portion. A
Cultural Savannah (CUS)	37	45	Predominantly location in western and central portions of FSA; typically along edges of forests or agricultural fields.
Cultural Plantation (CUP)	65	51	Throughout FSA, resulting from anthropogenic-based disturbances which may or may not be maintained.
Deciduous Forest (FOD)	139	199	Throughout FSA but slightly more abundant in the western and central sections of the FSA, often associated with larger natural areas located along riparian corridors.
Mixed Forest (FOM)	18	20	These communities are mostly found in the western portion of the FSA, although they are evenly distributed within that section.

Woodland Type	Number of Features in FSA	Area Coverage within FSA (ha)	Location within FSA
Coniferous Forest (FOC)	1	0.66	Located in a block of forest in the western section of the FSA, also containing mixed and deciduous forest communities adjacent to an agricultural area.
Deciduous Swamp (SWD)	54	48.55	Throughout FSA; similar to other wetland types in the FSA, larger deciduous swamps occur along riparian corridors, with smaller pockets within woodlots adjacent to agricultural fields.

Open/Early Successional Features

Based on the available ELC data, there were 510 open/early successional features identified within the FSA and adjacent 120m. Polygons were represented by all five ELC community series types including:

- Cultural Plantation (CUP)
- Cultural Meadow (CUM)
- Cultural Thicket (CUT)
- Cultural Woodland (CUW)
- Cultural Savannah (CUS)

In total, cultural communities accounted for 729 ha of the FSA and surrounding 120m. Table 2.1.4.3 summarizes the number of cultural features and area coverage within the FSA, as well as general descriptions of where these communities tend to be located.

Table 2.1.4.3. Summary of Open/Early Successional Features by Type Present in the FSA

Cultural Community Type	Number of Features in FSA	Area Coverage within FSA (ha)	Location within FSA
Cultural Meadow (CUM)	293	511	These communities are sometimes found as old, unused farm fields, but can also be present as open areas in more natural sites along rivers. Cultural meadows are often dominated by non-native plant species, with mineral soil types that are dry to moist.
Cultural Plantation (CUP)	65	51	The species present and site conditions for these types of communities can be variable, but they are all the result of anthropogenic-based disturbances which may or may not be maintained. These communities often have parent mineral material or mineral soil.
Cultural Thicket (CUT)	67	70	They tend to be found in the central and southern half of the eastern section of the FSA, typically as denser, overgrown edges of agricultural fields. As is typical of cultural communities, dominant species tend to be non-native such as Buckthorn or other exotic mixes of species. These communities often have parent mineral material or mineral soil.
Cultural Savannah (CUS)	37	45	Cultural savannahs are mostly found in the western and central sections of the FSA, often found on the edge of natural forests or agricultural fields. Like most cultural community types, non-native species are mainly dominant, although a few features have native deciduous or hawthorn species present as well. These communities often have parent mineral material or mineral soil.
Cultural Woodland (CUW)	48	52	Most of these are found clustered in the central FSA, with some scattered through the western section and only occurring a few times in the eastern portion.

Flora

In total 125 unique plant species records occurred within the FSA based on available secondary source data; this compares to 760 unique records associated with the broader seven Subwatershed areas within the Region of Peel. Within the Subwatershed areas in the FSA, the Upper Etobicoke Creek and West Humber Subwatersheds had the highest number of records (73 and 93, respectively). The remaining four Subwatershed areas had eight or fewer records, with Spring Creek and Huttonville Creek having no available records.

In general, the number of flora records within the FSA area is low. In part, this reflects a combination of sampling of a limited number of vegetated areas within FSA, some SWS areas within the FSA being relatively small (e.g. Credit River, Fletcher's Creek, and Spring Creek, and Main Humber), and that the vegetation cover may be limited within these areas (e.g. Credit River, Spring Creek, Huttonville Creek).

The flora species records available within the FSA are reflective of the inventories being undertaken relatively in high-quality natural areas. Species occurrence data were available from and provided by TRCA and CVC watershed monitoring programs; as such it reflects a sub-set of species occurrence tied to the sites selected for and available to these monitoring activities. Therefore, the species records presented are not considered representative of the general characteristics of vegetated areas across the FSA; in particular they are not anticipated to reflect the composition of natural features that are located in areas that have received high levels of disturbances and/or are represented by cultural type features.

Fauna

Overall, records of 76 fauna species were identified through secondary sources in the FSA. This included seven amphibian species, 58 bird species, five mammal species, two invertebrate species and four reptile species.

Species occurrence with each group tended to be higher for the FSA areas within the Upper Etobicoke and West Humber Subwatershed. In part, this reflects the larger area of the FSA occupied by these subwatersheds, and potentially more site investigations that have been undertaken in these areas. Conversely, the lower number of species occurrences in the other FSA Subwatershed areas may reflect a combination of lack of site-specific sampling within the FSA, SWS areas within the FSA having limited extent (e.g. Credit River, Fletcher's Creek, and Spring Creek, and Main Humber), and that existing suitable habitat may be relatively limited within these areas (e.g. Credit River, Spring Creek).

Records within the FSA tended to be associated with existing woodland and wetland features (particularly in the west and central FSA areas), with very few records associated with agricultural lands and/or along watercourses. As with flora records, this may reflect the location of monitoring site selection and/or availability of suitable habitat.

2.1.5 Natural Heritage System and Water Resource System

2.1.5.1 Natural Heritage System

Approach

Through the Characterization Report (Part A) of the Scoped SWS, a review of existing natural systems mapping for the FSA (Part A, Section 2.4.1) was conducted. Specifically, it considered the Provincial Natural Heritage System (NHS), the Peel Greenlands System, and the Conservation Authority NHS (individually and as a consolidated CA NHS). This review compared and contrasted the methods used and overall approach to each type of system mapping.

As a Regional project, the Greenlands System Policies in the ROP provide important policy direction for establishing an NHS for the FSA. Provincial policies for the Greenbelt Plan NHS apply within those areas mapped as Greenbelt NHS which traverse the FSA. The CA NHS provides important information and perspective for areas considered important natural cover to meet the objectives set forth through those studies. In the context of the current study, the CA NHS has been used to provide guidance in establishing targets for the FSA NHS and as a vetting tool against which to compare the proposed FSA NHS.

The Core Area, Natural Areas and Corridors (NAC) and Potential Natural Areas and Corridors (PNAC) categories within the ROP provide guidance for identification of their composite features across the Region. Refinement of areas, criteria, etc. is appropriate at refined scales through appropriate planning studies (e.g., SWS, Local Area Municipality Official Plans, Natural Heritage Study, etc.) in order to reflect the specific character of the area for which land use planning is being advanced. Additionally, the structure of the Greenlands System is such that it relies on further studies to make determinations as to the significance (Provincial, Regional, Municipal) of features in order to confirm how features and areas are to be addressed at finer planning scales (i.e. to inform development)

The current Scoped Subwatershed Study provides the platform through which this refinement should occur at a regional scale. It is recognized that the current Scoped SWS is based primarily on available information and desktop analysis and that detailed SWSs will follow to confirm or refine the approach set out for the Preliminary NHS for the FSA. The Characterization Report (Part A) considered existing conditions. As such, the report focused on the identification of *existing features* that are recommended to comprise the NHS using available datasets and analyses. Through Part A, the following NHS feature classes were identified and mapped:

- **Key Features** include those features and areas that are recommended to be protected as part of a connected NHS through this scoped study. Key features are comprised of all *Core Areas* as defined in the ROP and a sub-set of *NAC* and *PNAC* features which meet specific criteria set out based on analyses conducted for the FSA. Many Key Natural Heritage Features and some Key Hydrologic Features will be captured as Key Features of the FSA NHS.
- **Supporting Features** include those features and areas that are not, based on available information identified as Key Features but meet criteria as Supporting Features. For some features in this category, further assessment is required to determine if they meet Key Feature criteria; others require further assessment to evaluate their functions, interactions and contributions to the NHS in order to determine how they are managed (e.g., protect / retain in-situ, replicate, compensate, no management required).
- **Other Features** include those features and areas that are not Key or Supporting features but meet criteria as 'Other Features'. This category may include small and/or isolated features, features or areas requiring further assessment to determine their status (e.g., if they are / include Key Features).

The following areas were also identified as required to form a robust and connected system, but were not identified through the Characterization Report:

- **Corridors / Linkages** are used to build upon NHS features to create a connected and integrated system.
- **Enhancement Areas** are used to improve the form and/or function of the NHS by infilling, extending or adding to the features and areas that comprise the NHS (i.e. Key Features, Supporting Features). Consideration will be given to a range of information to identify potential enhancement areas.

Identification of these areas is informed by the Characterization Report (Part A), including targets set out in that report, and the Impact Assessment (Part B- this report) to ensure a robust and connected system is identified and direction provided for implementation at future planning stages. Criteria for and mapping of these areas is provided in Section 2.4.2.2 of this report.

Criteria for identification of Key Features and Supporting Features were detailed in the Characterization Report, including analyses to support the proposed criteria (ref. Section 2.5.2.3).

Preliminary NHS Features

Key Features of the NHS were identified using criteria set out in the Characterization Report (ref. Section 2.5.2.3; Table 2.6.2.12) and include the following:

- Key Feature:
    - Woodlands
    - Wetlands
    - Valleylands
    - Environmentally Sensitive / Significant Areas

  - Significant Wildlife Habitat
  - Fish Habitat
  - Provincially significant Life Science and Earth Science Areas of Natural and Scientific Interest (ANSI)
  - Regionally significant Life Science ANSIs
  - Habitat for Endangered and Threatened Species confirmed in consultation with the MECP
  - Headwater drainage features identified as Protection or Conservation[1]
  - Key Natural Heritage Features as defined in the Greenbelt Plan and the Growth Plan within applicable areas of the FSA
  - Key Hydrologic Features as defined in the Greenbelt Plan and the Growth Plan within applicable areas of the FSA
  - Sand Barrens, Savannahs, and Grasslands (as defined through the Provincial Plans and per associated ELC classification)

- Supporting Features:
  - Woodlands
  - Wetlands
  - Valleylands
  - Regionally significant Earth Science ANSIs
  - Headwater drainage features identified as Mitigation[1]
  - Successional habitats
  - Open aquatic habitats

- Other Features:
  - Woodlands
  - Wetlands
  - Successional habitats
  - Open aquatic habitats

The application of the criteria, set out in Table 2.6.2.12 of the Characterization Report (Table 2.6.2.12, Appendix G) using available feature data for the FSA, is shown on Figure DA2-6 (Appendix G).

2.1.6 Geotechnical and Slope Stability

A desktop study was performed to identify areas of potential watercourse and valley slope instabilities within the 'Focused Study Area'. Slope stability is dependent on a number of factors; slope inclination, soil stratigraphy, groundwater table, slope vegetation, table land drainage features, proximity to watercourse, and previous landslide history.

Some factors can be determined and others inferred based on a desktop study alone, others require a visual inspection of the physical slope, and others a subsurface investigation. As the scope for the Scoped SWS was limited to a desktop study, these factors were either determined based on available resources or assumed, to determine the slope stability risk rating and associated level of investigation. The methodology and rating system of the "Technical Guide – River and Stream Systems: Erosion Hazard Limit", prepared by the Ontario Ministry of Natural Resources (2002) was used. This categorizes slopes as either 'low', 'slight' or 'moderate'. The level of investigation to determine the long term stable top of slope increases when the risk of instability increases, with a visual inspection required for 'low' risk, a visual inspection, subsurface investigation or conservative analysis for a 'slight' risk, and a subsurface investigation for 'moderate risk'.

[1] Pending identification or confirmation based on further assessment through future stages of study (e.g., detailed subwatershed studies, site-specific studies)

Resources used to assess the slope factors were: topographic mapping provided by Peel Region for geometry (height, inclination, and proximity to watercourse), soil data and mapping from the Ontario Geological Survey for soils, and aerial images for signs of active/historical failures and slope vegetation. Due to the resolution of images only large and unobscured failures were visible.

For planning/development purposes, the identification of the long-term stable top of slope (LTSTOS) is important, as this is the point from which no development is allowed by the applicable conservation authority between the LTSTOS and the watercourse. In addition, an emergency access allowance of 10 m (in addition to the LTSTOS, away from the watercourse) is required by the CVC and TRCA to provide a buffer for any future repairs or access to the slope.

Credit River Watershed: no permanent watercourses or accessible slopes were noted in the FSA project limits

Etobicoke Watershed: All watercourses within the Etobicoke Creek watershed were classified as low or slight instability risk. Watercourses to the west of Chinguacousy Road are likely classified as unconfined systems, with watercourses to the east of Chinguacousy Road predominantly confined systems

Humber Watershed: All watercourses within the Humber River watershed were classified as low or slight instability risk with the exception of two areas which were moderate risk;

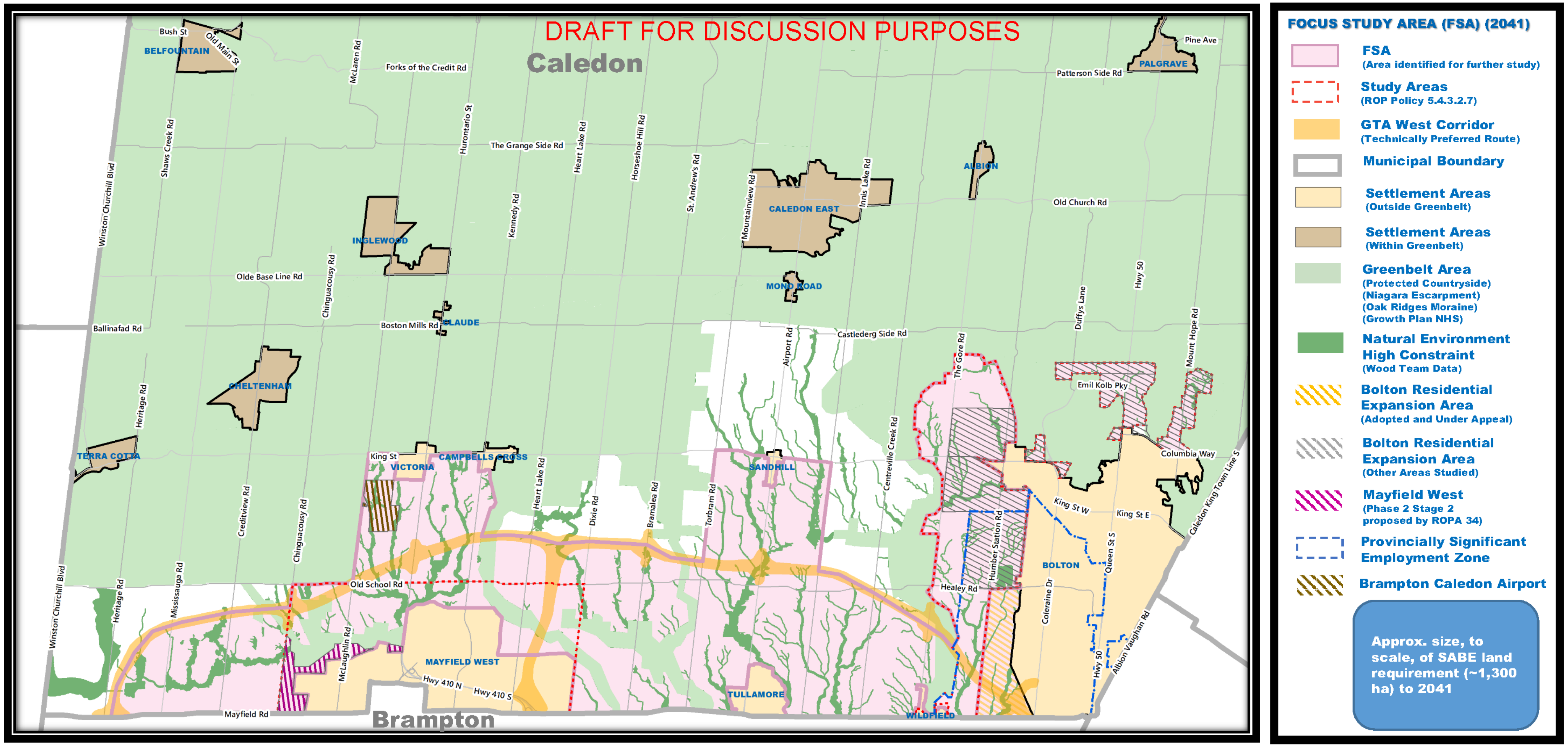
- a slope failure noted immediately east of The Gore Road ~1.1km south of King Street (West Humber subwatershed)
- an area ~700 m east of the intersection between Emil Kolb Parkway and King Street (Main Humber River subwatershed)

For confined watercourses, all areas will be required to incorporate a toe erosion allowance (where the watercourse is within 15 m of the toe of slope) along with the erosion access allowance. Large additional setbacks to obtain a stable top of slope are not anticipated with the possible exception of a few 'moderate instability risk' areas. Classification will ultimately need to be confirmed by future site inspections and some areas will require subsurface investigations and slope analyses. It is expected that some areas may have localized toe erosion and sloughing of the toe, but this does not always mean an instability of the overall slope.

Irrespective of the preliminary slope stability ratings, any proposed municipal service watercourse crossings (water, wastewater, stormwater and transportation) will have to undertake a 'moderate instability potential' level investigation consisting of site inspection, boreholes, piezometers, lab tests, surveying and report.

2.2 Land Use

Hemson, working on behalf of the Region of Peel, developed an initial FSA map, released in February 2020, based on input provided during the screening phases discussed earlier. The derivation of the FSA map has considered the high constraint features, as well as the orientation/alignment of the proposed GTA West Transportation Corridor's Preferred Route, as identified by the Ministry of Transportation, as well as the existing communities of Bolton, Mayfield, Tullamore and other smaller hamlets. The FSA limits have been intentionally established to encompass a geography beyond the specific growth needs for residential and employment lands for Peel to 2051, in order to allow for refinement and adjustments based on various constraints and opportunities related to environmental management and other technical study input. Figure 2.2.1.1 depicts the location of the FSA as initially identified in February 2020, currently without any distinction for future land use type (i.e. residential, employment, mixed), nor any specific detail on supporting infrastructure associated with new roads (arterial and collectors) or any major servicing corridors.



Disclaimer: This map has been developed for the Settlement Area Boundary Expansion (SABE) Study and represents an area to be studied for the purpose of identifying a SABE. For additional information, please refer to the *Settlement Area Boundary Expansion Study Phase A: Focus Study Area* report.

Note:

(1) There may be opportunities to expand rural settlements outside the FSA as part of the SABE Study.
(2) Other natural environmental constraints not identified on this map, including features not captured through existing mapping and potential buffers, will be identified through further analysis and may further limit development.
(3) ROP Policy 5.4.3.2.7 as it relates to the area surrounding Bolton is under appeal.
(4) The ~1,300 ha SABE is based on a draft land needs assessment which is under review.

N

1 cm = 1 km

Figure 2.2.1.1. Focus Study Area (FSA)

The land use planning to determine the limits of future development has represented an evolving process. At the time of writing, various land classifications have been identified which represent potental future development areas as part of the SABE, as well as other lands within the FSA which have been identified for future development as part of separate and parallel planning processes. These land classifications are depicted on Figure 2.2.1.2, and are described below.

The **Preliminary SABE Concept** represents those portions of the FSA which have been identified as draft conceptual locations for future community and employment development as provided to Regional Council in December 2020. The development of these areas is anticiapted to satisfactorily address the Region's planning targets, however is subject to further refinement and revision through the completion of the overall planning process including additional technial assessments to establish the recommended SABE.

The **SABE Testing Areas** represent those portions of the FSA which are undergoing further analysis by the Region as locations where further refinements to the SABE may be considered in response to direction and input received to date. The ultimate inclusion or exclusion of some or all of these areas is contingent upon the conclusions and recommendations from the overall planning process to establish the recommended SABE. Analysis of these and other areas including refinements to the SABE will also be considered further in response to Regional Council direction regarding the GTA West Transporation Corridor.

The **Bolton Residential Expansion Study (ROPA 30) and Mayfield West Phase 2 Stage 2 (ROPA 34) Lands** have been included within the Region's urban boundary and are subject to policies in the Reginal Official Plan. The detailed land use planning for these areas to establish the specific land uses is being undertaken through a separate and parallel process. These lands have MMAH (Mayfield West Phase 2) and LPAT (BRES ROPA 30) approved policy direction for growth to 2031 and may proceed in accordance with those policies and supporting studies being completed for the Town of Caledon. Although the Town of Caledon is undertaking separate and parallel studies to establish secondary plans and environmental management for these areas, the management recommendations established through the secondary planning process for the BRES and Mayfield West Phase 2 Lands should address and be consistent with the guidance provided through the Scoped Subwatershed Study being completed for the recommended SABE.

The **GTA West (August 2020 Preferred Route)** is a transportation corridor which extends through the FSA. The planning for the GTA West, including the completion of studies to assess the environmental impacts and esablish a recommended environmental and stormwater management plan, is being completed by the Province of Ontario, and which is subject to both federal and provincial EA processes. Although the planning, impact assessment and environmental management plan for the GTA West are beyond the scope of this Scoped Subwatershed Study, the alignment, extent, and potential implications of the GTA West corridor nevertheless is to be considered by the Scoped Subwatershed Study. The **FSA Take Outs** represent areas that are considered unavailable for development based on a methodology developed by the Region to identify natural heritage features and areas that are eligble to be excluded for the purpose of calculating a minimum density target for the designated greenfield area and ensuring a sufficient land area (net of environmental and non-environmenal constraints) is available to meet land needs. The FSA Take Outs shown in Figure 2.2.1.2 do not represent the conceptual Natural Heritage System (NHS) being developed through the Scoped SWS that will be refined and implemented in accordance with Regional policy direction for the SABE in the Town of Caledon Official Plan through secondary planning.

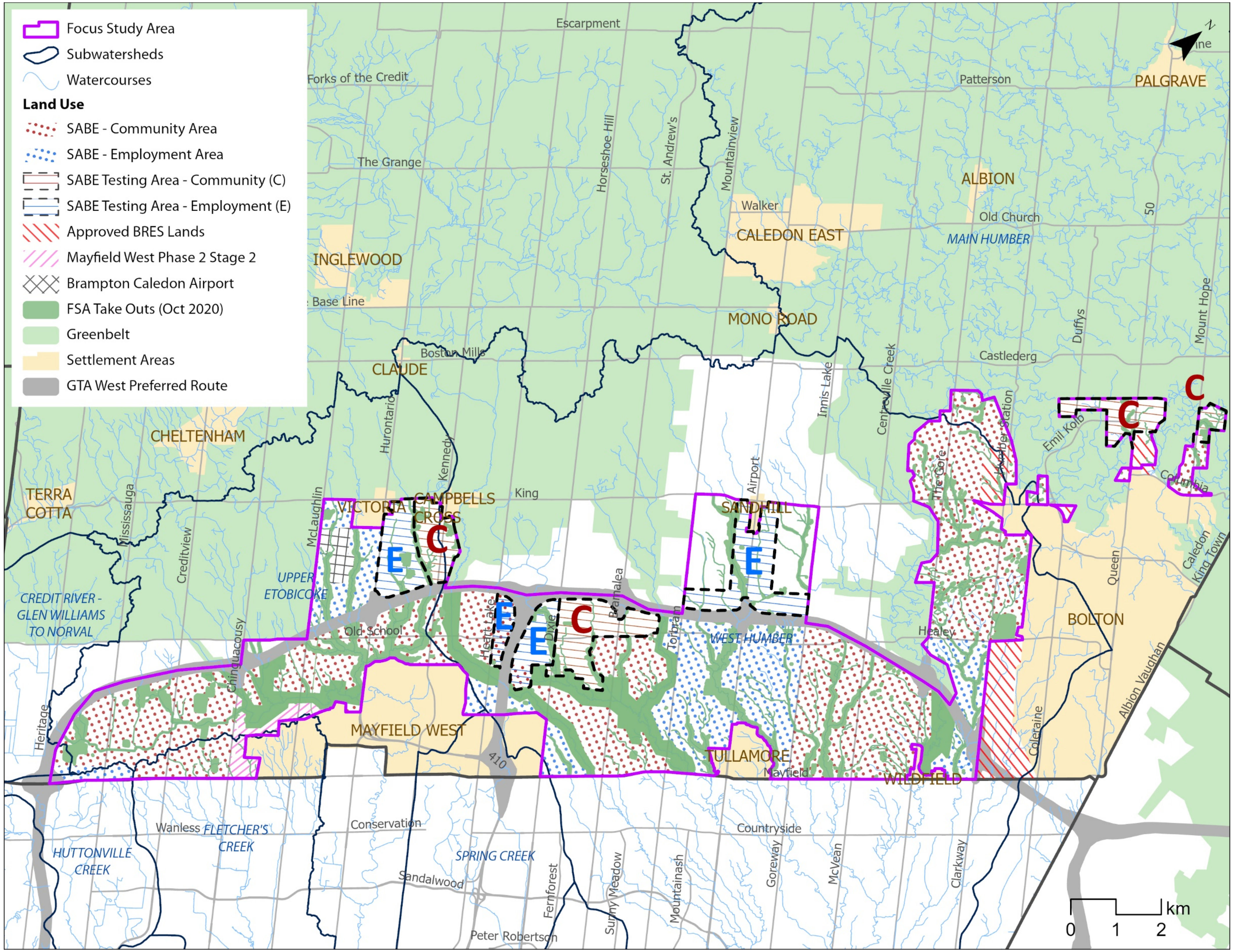


Figure 2.2.1.2. Land Classifications for the Focus Study Area (FSA)

In August 2021, an impact assessment was completed for the above land classifications and "testing areas" to determine anticipated impacts and provide guidance regarding management alternatives and preliminary criteria. The results of that impact assessment informed the development of a **Staff Recommended SABE**, which combined areas and aspects of the Preliminary SABE Concept and the SABE Testing Areas. The Staff Recommended SABE is presented in Figure 2.2.1.3.

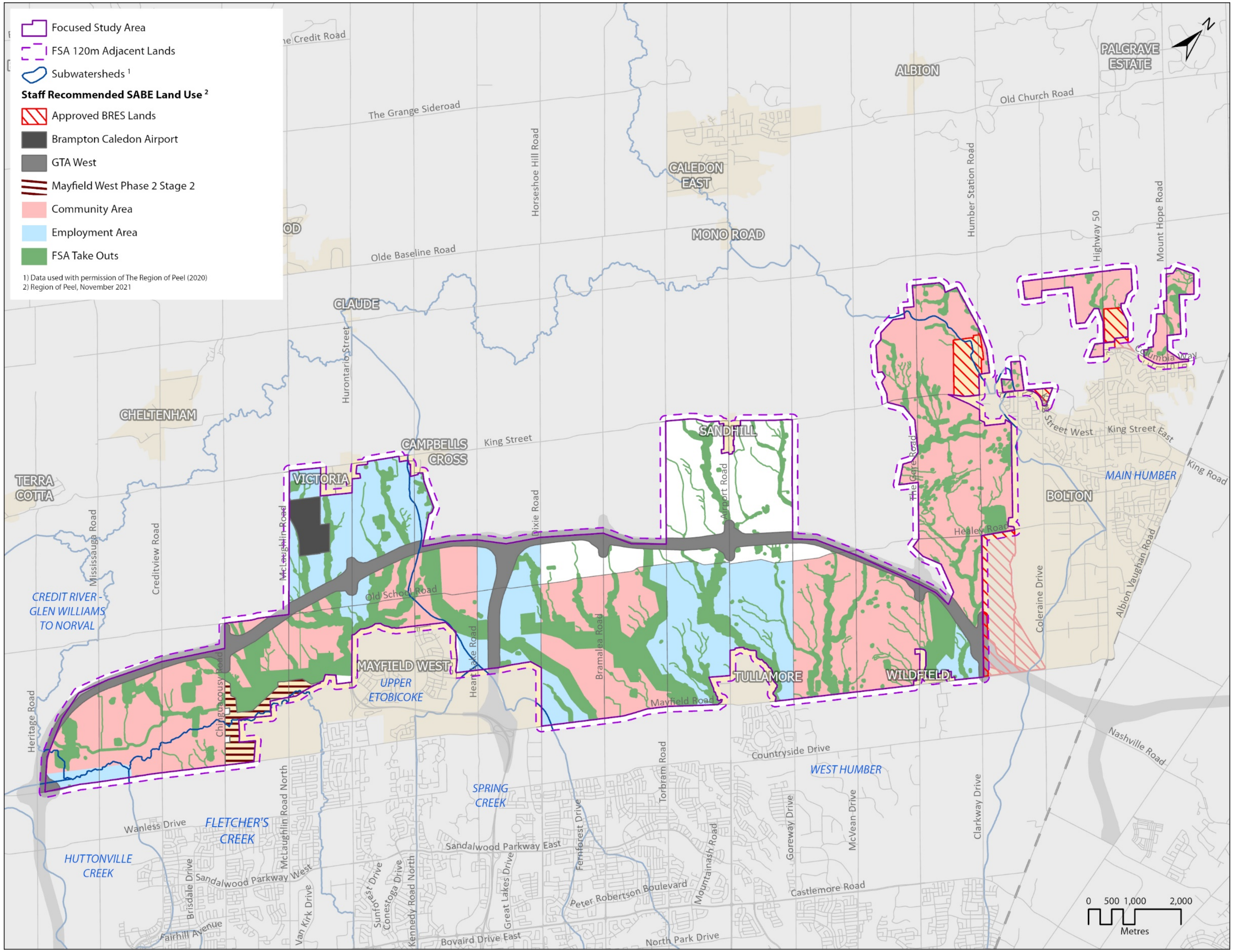


Figure 2.2.1.3. Staff Recommended SABE

In summary, For the purpose of this Part B Report, the impact assessment has beeen completed for the entire FSA, and has been premised on a uniform blend of community (i.e. residential) and employment land needs, with a representative gross impervious coverage of 51% for all candidate future development areas. The source of the coverage (imperviousness) estimate is based on work conducted by TRCA with Peel Region to assess off site flood risk. This value of imperviousness coverage is intended to represent a blend of all land uses rather than any one type explicitly for sensitivity testing purposes.

Subsequent to the completion of the impact assessment, the prelimiary SABE concept and land use mix have been identified as part of the SABE delineation by the Hemson Team. The more detailed land use information presented in the preliminary SABE concept has been used to evaluate management alternatives and establish the preliminary management plan to mitigate the anticipated impacts. This more detailed land use mix was the subject of a subsequent impact assessment for which guidance was developed regarding management alternatives and criteria. The results of this impact assessment were provided to the Region and the Hemson Team, and a Staff Recommended SABE was ultimately advanced for further evaluation, and to confirm that the development boundary of the Staff Recommended SABE was supportable and the environmental impacts mitigable and/or manageable. Therefore as noted, the findings presented herein for the Staff Recommended SABE have built upon the findings for the preliminary SABE concept and the SABE Testing Areas as retained herein and advanced in previous iterations of the assessment, and refined as appropriate based upon the changes to the development form and extent as presented in the Staff Recommended SABE.

2.3 Detailed Studies

The first stage of the impact assessments has been completed, to assess the impact of the future development within the FSA, in the absence of management and mitigation in order to understand the potential impact to natural systems and recommend appropriate management requirements. Recognizing the scale of the current land use planning for the FSA, this assessment has been completed based upon the insights gained from previous studies within the respective subwatersheds encompassing the SABE, as well as guidance from studies elsewhere within the GTA for similar physiographic and environmental conditions. This assessment has considered the anticipated impacts associated with each land classification noted above (i.e. Preliminary SABE Concept, SABE Testing Areas, Bolton Residential Expansion Study (ROPA 30) and Mayfield West Phase 2 Stage 2 (ROPA 34) Lands, and GTA West). The following sections present the findings of the impact assessment for the respective study disciplines.

2.3.1 Surface Water Quantity and Groundwater Resources

2.3.1.1 Focus Study Area

Surface Water Impact Assessment

As noted in the Part A report, the FSA primarily extends across the headwaters of the Upper Etobicoke Creek Subwatershed, West Humber River Subwatershed and the Main Humber Subwatershed within TRCA jurisdiction. On the west side, the FSA lands fall within the headwater reaches of the Credit River Watershed, encompassing the upstream limits of three (3) subwatersheds, namely the Credit River (Glen Williams to Norval) Subwatershed, Huttonville Creek Subwatershed and Fletcher's Creek Subwatershed. The subwatershed boundaries with respect to the FSA have been summarized on Drawing WR1 (ref. Appendix G). The approximate contributing drainage areas of the FSA within each subwatershed are summarized in Table 2.3.1.1.

Table 2.3.1.1. Summary of Contributing Drainage Areas by Subwatershed

Watershed	Subwatershed	Total Subwatershed Drainage Area (ha)	FSA Contributing Lands	
			Area (ha)	% of Total
Credit River	Credit River – Glen Williams to Norval	2353	23	1.0 %
	Huttonville Creek	1510	43	2.8 %
	Fletcher's Creek	4169	186	4.5 %
Etobicoke Creek	Upper Etobicoke Creek	9978	2027	20.3 %
Humber River	West Humber River	20223	5335	26.4 %
	Main Humber River	35781	438	1.2 %

In addition to the above, it is recognized that minor portions of the FSA may extend into the headwaters of the Spring Creek Subwatershed of the Etobicoke Creek Watershed, based upon a review of available mapping. The size of the areas potentially within the Spring Creek Subwatershed is quite small (i.e. <5 ha total), hence it is anticipated that any development of these areas would be graded such that stormwater management requirements for these lands would be addressed by the stormwater management plan for the balance of the development within the adjacent subwatershed (i.e. Upper Etobicoke Creek Subwatershed and West Humber River Subwatershed).

The conversion of rural lands to urban land use, without stormwater management, is recognized to reduce the amount of rainfall which infiltrates into the ground, increasing the volume of surface runoff generated from storm and snowmelt events, as well as the rate at which runoff is conveyed toward receiving systems. In addition, runoff from urban land uses is recognized to generally increase the concentration and mass loadings of heavy metals and certain phosphorus-based chemicals, as well as certain anions, particularly chlorides from road salts during winter maintenance, and increased temperature in surface runoff. These impacts, if unmitigated, are generally recognized to result in an increased risk of flooding and erosion along watercourses and drainage systems proximate to the new urban area, as well as a deterioration to the water quality and associated ecology within the receiving systems. These changes to runoff volume, rate, and water quality resulting from urban development, may likewise translate to an increased risk of flooding and erosion at a broader subwatershed or watershed scale within the receiving system, and similar deterioration to the surface water quality. The risk of flooding and erosion, as well as the impacts to surface water quality, are also recognized to depend upon the proportion and location of new development relative to the total contributing drainage area to the location of interest within the subject drainage area/subwatershed. The following section summarizes the anticipated impacts of future development within the FSA to the receiving systems within the respective subwatersheds which constitute the FSA.

Flooding: Off-Site Impact Assessment

Methodology

As part of the impact assessment for the FSA lands, an off-site hydraulic impact assessment has been completed for the Etobicoke Creek and Humber River, Flood Vulnerable Areas (FVAs) located downstream of the FSA, in order to evaluate anticipated flood risk impacts resulting from future urbanization within the designated Whitebelt (rural and agricultural) areas of the FSA within the Etobicoke Creek and Humber River Watersheds.

This has been completed using the as-approved HEC-RAS hydraulic models for both FVAs, as follows:

- Etobicoke Creek – Brampton SPA, Wood, March 2014
- Humber River – Humber in Toronto, Wood, 2017

The primary input for the off-site hydraulic assessment is based on the results of the hydrologic impact assessment completed by TRCA (ref. Hydrologic Assessment Memo, TRCA, November 2019), which identified the potential changes in peak flow rates associated with a "50% Whitebelt build-out" and "100% Whitebelt build-out" scenarios for the Humber River Watershed. The coverage assumption for the built-out areas, based on input from Peel Region, was based on an impervious level of 51% representing an average of all land uses considered for this area.; this coverage is considered sufficiently representative for the current preliminary assessment to provide an indication of potential impacts from future development at a regional planning scale. Furthermore, the hydrologic assessment completed by TRCA did not include updated modelling for the Etobicoke Creek Watershed, therefore the "Ultimate" future land use condition from the 2013 Etobicoke Creek Subwatershed Study has been utilized in the future land use hydraulic impact assessment (ref. Etobicoke Creek Hydrology Update, MMM Group, April 2013). Further details regarding the Whitebelt land use changes and impact assessment has been summarized in the subsequent section.

The change in flood risk within the FVAs has been summarized in two different ways: the first being the change in hydraulic performance related to both water surface elevation and wetted width/floodline limits, and the second being the potential increase in flood damages (costs) within the affected FVAs. The flood damage costs have been estimated using Flood Damage Curves as provided in the National Flood Damage Guidelines (ref. Canadian Guidelines and Database of Flood Vulnerability Functions, March 2017). The damage curves provided in these guidelines vary based upon the building type, structure/contents, number of stories, etc. The damage curves provide a flood damage cost per building footprint ($\$/m^2$) which can be used to estimate the associated damages with respect to a certain flood depth at the affected building.

The details regarding the flood vulnerable sites located within the affected FVAs have been sourced from a previous study completed by AMEC in 2014 on behalf of TRCA (ref. TRCA Flood Protection and Remedial Capital Works Program, AMEC, 2014). This study included the development of a Query Processing Tool (QPT) which determined the flood damage costs and associated risk to life for all FVAs within TRCA's jurisdiction. The QPT is built upon a large database including details of all flood vulnerable sites (buildings and roads), hydraulic model results, and flood damage curves. It should be noted that the flood vulnerable sites for both the Etobicoke Creek and Humber River FVAs consist of both buildings and roadways; however, flood vulnerable roads (FVRs) have not been included in the current flood damage cost estimations.

Given the scope of the current assessment, a simplified spreadsheet approach has been applied for the flood damage cost estimation, in order to utilize the most recent (2017) publication of the flood damage curves, and hydraulic modelling from both the 2014 and 2017 studies. The data related to the flood vulnerable sites have been sourced directly from the QPT databases and GIS shapefiles generated as part of the previous study on behalf of TRCA (ref. TRCA Flood Protection and Remedial Capital Works Program, AMEC, 2014).

A GIS point shapefile of the flood vulnerable buildings within the FVAs has been sourced from the 2014 AMEC study, which has been used in conjunction with the results from the as-approved HEC-RAS models for both the Etobicoke Creek and Humber River FVAs. Both models have been executed for all storm events (2- through 100-year, and Regional Storm) with the as-approved steady state flows in order to represent the baseline condition, and executed with the future Whitebelt development flows, in order to quantify potential impacts. However, only the 100-year and Regional Storm events are included in the updated mapping.

The mapping function in HEC-RAS (RAS-Mapper) has been used to generate water surface elevation (WSE) maps in a raster format using the DEM/Terrain file associated with the respective hydraulic model. It should be noted that the mapping capabilities of RAS-Mapper are limited, by which the flood extents can only be plotted to the extent of the bounding cross-sections. A detailed floodplain delineation / clean-up is out of scope to the current study (i.e. spills analysis) and has thus not been completed for this assessment, as it is assumed that the characterization of changes to flood risks can be sufficiently determined through the hydraulic results (WSE, wetted width) and the estimated extents, in order to assess the impacts associated with headwater development.

The resulting maps provide estimated flood inundation limits and have been used to extract the resulting maximum WSE surrounding the flood vulnerable buildings; given that the GIS shapefile for the building locations is a point file, the maximum WSE result has been extracted using a buffer area of 5 m surrounding the building point location.

The extracted WSE has then been used against the "lowest elevation" associated with the building, which was previously determined through the 2014 AMEC study with TRCA, in order to establish a water depth result at each affected building. This resulting water depth was then used to determine the estimated damages resulting from the floodplain inundation, based upon the associated flood damage curve and the building footprint area.

It should be noted that if a building footprint was not available in the existing databases, a placeholder area has been applied in order to utilize the flood damage curve; given the nature of the current comparative assessment, this gap filling approach will not change the outcome and/or conclusions of the baseline and future Whitebelt development conditions comparisons.

For the purpose of the current assessment, the flood damage curves have been simplified into three (3) general building types/categories listed below. The damage curves utilized in the current assessment can be found in Appendix D.

- Commercial (assuming Non-Residential Retail – Class C6, surface level damages only)
- Miscellaneous (assuming Non-Residential Institution – Class N1, surface level damages only)
- Residential (assuming Residential Class B – Single Unit Dwellings, average between single- and two-story units, allows for calculation of basement flood damages)

The distribution of flood vulnerable buildings within the downstream FVAs are summarized in Table 2.3.1.2.

Table 2.3.1.2. Number of Buildings within Flood Vulnerable Areas Downstream of FSA

Building Type	Etobicoke Creek FVA	Humber River FVA
Commercial (Retail)	110	0
Miscellaneous (Institutional)	13	3
Residential	68	63
Total	**191**	**66**

As demonstrated in Table 2.3.1.2, the Etobicoke Creek FVA is located within Downtown Brampton and has a significant number of flood vulnerable buildings, with over half being designated commercial uses. The Humber River FVA is located within a less dense urban community, with primarily residential properties located within the floodplain.

Baseline Conditions

As outlined in the methodology section, the hydraulic models for both the Etobicoke Creek and Humber River FVAs have been executed using the as-approved steady state flows to generate baseline conditions for hydraulic results, floodplain limits and associated flood damage estimates. The 100-year and Regional Storm event WSE maps and the susceptible buildings within the Etobicoke Creek and Humber River FVA systems are presented on Drawing WR10a and Drawing WR10b, respectively (ref. Appendix A).

The resulting flood damage curves for the baseline (as-approved model) conditions for each FVA has been summarized in Table 2.3.1.3.

Table 2.3.1.3. Direct Flood Damage Estimations for Downstream FVAs – Baseline Conditions

FVA	2-yr to 50-yr	100-yr	Regional	Average Annual
Etobicoke Creek	-	$ 9,044	$ 125,938,520	$ 576,481
Humber River	-	-	$ 18,359,764	$ 84,026

The resulting flood damage estimates under baseline conditions result in average annual damages of $576K and $84K for the Etobicoke Creek and Humber River FVAs, respectively. No damages are predicted to occur as a result of riverine flooding under the 2- through 50-year events, with the primary source of damages occurring under the Regional Storm for both systems. These damage estimates have been used as the baseline condition for comparison to the future Whitebelt land use conditions, in order to estimate the potential impacts and change in flood risk, as well as associated potential damages.

Future Land Use Conditions (Whitebelt)

Etobicoke Creek

As mentioned previously, the Etobicoke Creek watershed was not included in the Whitebelt Modelling scenario completed by TRCA (ref. Hydrologic Assessment Memo, TRCA, November 2019); as per TRCA's recommendation, the future development flows, including the 2- through 100-year peak flow results (with existing SWM) and the Regional Storm event (without SWM), from the Etobicoke Hydrology Study have been employed in the current assessment (ref. Etobicoke Creek Hydrology Update, MMM Group, April 2013). In addition to the hydrologic modelling and analyses undertaken by TRCA, the Downtown Brampton Flood Protection Class Environmental Assessment (AECOM, June 2020) provided a preferred alternative, which is estimated to remove 19 ha of currently flood-prone lands from the Regulatory floodplain. The recommendations advanced in the June 2020 Class EA were based upon 2D MIKE FLOOD modelling of the FVA and flow rates generated from the April 2013 Hydrology Update. The application of the 2D MIKE FLOOD modelling for the Downtown Brampton FVA is recognized to be beyond the scope of the current study, hence the findings presented herein are considered to represent a conservative estimation of the anticipated flooding impacts within the Downtown Brampton FVA.

In order to replicate the potential for development within the headwater drainage area (per the FSA), the "Ultimate" land use condition evaluated in the Etobicoke Hydrology Study has been selected as the hydrologic input for the HEC-RAS steady state flow table generation. This future land use condition is described as "areas beyond the Official Plan (OP) within the headwaters are developed, while Environmental Protection Area (EPA) and Greenbelt area remain in their existing condition." While this condition is not specific to the FSA lands alone, it is assumed to provide a sufficient representation of headwater development, in order to characterize the potential flood impacts downstream.

It should be noted that the HEC-RAS model used in this assessment has applied an energy balance approach in order to establish the equivalent flow split between the by-pass channel and the spill to the SPA/Flood Damage Centre (FDC) for the Regional Storm event; the by-pass channel has sufficient capacity for all events up to and including the 350 year (ref. Downtown Brampton Flood Protection Feasibility Study, Amec Foster Wheeler, 2016), therefore a flow split is only required for the Regional Storm event. As noted previously, the analyses presented herein have not applied the 2D MIKE FLOOD modelling developed for the recently completed Downtown Brampton Flood Protection Class Environmental Assessment. Moreover, the preferred alternative advanced in the Class Environmental Assessment consists of expanding the valley corridor within the upstream limits of the FVA, thereby removing an estimated 19 ha of currently flood prone land from the Regulatory floodplain. The preferred alternative advanced in the Class EA has not been explicitly incorporated into the impact assessment, although the influence of this recommendation has been considered in the interpretation of the results.

This energy balance has been updated for the future development flows, by which the input flows to both the by-pass channel and spill into the SPA/FDC have been determined through an iterative process to ensure the hydraulic grade lines (HGLs) for both systems are equivalent at the upstream confluence point. The baseline flow split (2014) and future flows updated flow split are summarized in Table 2.3.1.4.

Table 2.3.1.4. Flow Proportion Update for Etobicoke Creek Spill into Downtown Brampton FVA – Regional Storm

Creek System	Baseline Conditions (2014)		Future Land Use Conditions	
	Regional Flow (m^3/s)	Flow Split (%)	Regional Flow (m^3/s)	Flow Split (%)
Total	306	-	344.7	-
By-pass	143.3	46.8 %	156.5	45.4 %
SPA / FDC	162.7	53.2 %	188.2	54.6 %

As demonstrated in Table 2.3.1.4, the flow proportion between the two hydraulic systems remains generally similar to the split under baseline conditions, with both systems experiencing a higher flow, and the FDC system accommodating an additional 1.5 % (+/-) of the total flow entering the system at the confluence point.

The future conditions peak flows for the reaches within and bounding the FVA have been sourced from the "Ultimate" land use conditions hydrologic assessment as part of the Etobicoke Hydrology Study. The storm events selected for this analysis include the Regional Storm and 2- through to 100-year design storm events; it should be noted that the 350-year has not been included in the current assessment, as it is not an input for potential flood damage calculations in the QPT.

The future conditions steady flow table utilized in the hydraulic assessment and the comparison to baseline conditions flows are presented in Table 2.3.1.5 and Table 2.3.1.6.

Table 2.3.1.5. HEC-RAS Steady Flow Table – Future Land Use (Ultimate) Conditions – Etobicoke Creek

Reach	River Station	Hydrologic Flow Node	Regional	100-yr	50-yr	25-yr	10-yr	5-yr	2-yr
Sections 26to28	26.82	2.13	345.80	95.84	83.11	70.95	55.40	45.42	32.10
Sections 26to28	26.81	2.14	342.12	95.80	83.11	70.94	55.31	45.41	32.12
Sections 26to28	26.76	2.15	344.71	96.39	83.60	71.33	55.58	45.61	32.29
Sections 26to28	26.73	2.15	344.71	96.39	83.60	71.33	55.58	45.61	32.29
FDC[1]	26.57	-	188.21	0.10	0.10	0.10	0.10	0.10	0.10
Brampton bypass	26.71	-	156.50	96.39	83.60	71.33	55.58	45.61	32.29
Sections15&25&26	26.34	2.16	344.98	96.13	83.54	71.19	55.41	45.52	32.32

Note: [1] The by-pass channel has sufficient capacity for up to the 350 year event (baseline conditions = 128.9 m^3/s) – therefore a placeholder of 0.10 m^3/s was maintained in the model for all design storm events (HEC-RAS requires a flow value > 0).

Table 2.3.1.6. Peak Flow Comparisons – Future Land Use (Ultimate) – Etobicoke Creek

Reach	River Station	Hydrologic Flow Node	Regional	100-yr	50-yr	25-yr	10-yr	5-yr	2-yr
Sections 26to28	26.82	2.13	18%	27%	24%	21%	17%	17%	19%
Sections 26to28	26.81	2.14	18%	25%	23%	20%	15%	16%	18%
Sections 26to28	26.76	2.15	13%	16%	14%	11%	7%	8%	10%
Sections 26to28	26.73	2.15	13%	16%	14%	11%	7%	8%	10%
FDC	26.57	-	16%	0%	0%	0%	0%	0%	0%
Brampton bypass	26.71	-	9%	16%	14%	11%	7%	8%	10%
Sections15&25&26	26.34	2.16	15%	12%	10%	8%	3%	3%	6%

The future Whitebelt (ultimate) development land use condition is demonstrated to produce a Regional Storm peak flow of approximately 18% higher than baseline conditions; the relative increase across the design storms is shown to be higher, at a maximum increase of 27% during the 100-year within the most upstream reach (Sections 26 to 28), and less of an increase (maximum of 12%) in the reach downstream of the FVA. These flows have been incorporated into the approved HEC-RAS model (2014) and simulated for all the noted storm events.

The results of the future land use conditions hydraulic assessment have been summarized in terms of the change in water surface elevation (WSE), wetted top width (i.e. simulated floodplain width), and approximate mapping of the flood extents. The results for the simulated WSE changes and wetted width throughout the impacted reaches are summarized in Table 2.3.1.7 and Table 2.3.1.8. The future conditions flood extents for both the 100 year and Regional events are presented on Drawing WR1a and Drawing WR1b (ref. Appendix A).

Table 2.3.1.7. Summary Changes of HEC-RAS Computed WSE for Future Whitebelt Conditions – Etobicoke Creek FVA

Storm Event	HEC-RAS Reach	Average Change in Flow (%)	Average Diff in WSE (m)	Max Diff in WSE (m)	Min Diff in WSE (m)
100 YR	Sections 26to28	21%	0.20	0.45	-0.02
	FDC	0%	0.01	0.15	0
	Brampton bypass	16%	0.15	0.2	0
	Sections15&25&26	12%	0.11	0.14	0
	Total Summary	***10%***	***0.10***	***0.45***	***-0.02***
Regional	Sections 26to28	16%	0.14	0.27	0
	FDC	16%	0.17	0.26	0
	Brampton bypass	9%	0.20	0.52	0
	Sections15&25&26	15%	0.13	0.28	0
	Total Summary	***14%***	***0.16***	***0.52***	***0***

Table 2.3.1.8. Summary Changes of HEC-RAS Wetted Width for Future Whitebelt Conditions – Etobicoke Creek FVA

Storm Event	HEC-RAS River/ Reach	Average Change in Flow (%)	Average Diff in Top Width (m)	Max Diff in Top Width (m)	Min Diff in Top Width (m)
100 YR	Sections 26to28	21%	14.21	41.04	-0.32
	FDC	0%	0.41	7.93	0
	Brampton bypass	16%	0.61	0.79	0
	Sections15&25&26	12%	2.85	11.28	0
	Total Summary	***10%***	***3.70***	***41.04***	***-0.32***
Regional	Sections 26to28	16%	8.41	33.15	0
	FDC	16%	3.28	13.91	0
	Brampton bypass	9%	7.66	104.01	0
	Sections15&25&26	15%	8.61	39.08	0
	Total Summary	***14%***	***6.29***	***104.01***	***0***

The results in Table 2.3.1.7 demonstrate that under the Whitebelt land use conditions, the WSE will increase by an average of approximately 0.10 m during the 100-year, with the maximum increase shown as 0.45 m occurring within the most upstream reach. Similar trends are seen during the Regional Storm event, with an average increase of approximately 0.16 m and a maximum increase of 0.52 m occurring within the by-pass channel.

These increases in simulated WSE result in an expansion of the floodplain, demonstrated in Table 2.3.1.8 and on Drawing WR1a and Drawing WR1b (ref. Appendix A). The results indicate an average increased wetted top width of 3.7 m and 6.3 m during the 100-year and Regional Storm events, respectively. There are local occurrences of larger floodplain expansions, including maximum increases of 41 m within the upstream reach during the 100-year, and over 100 m in the by-pass channel during the Regional Storm event.

The flood damage costs associated with the future land use conditions have been estimated at each of the flood vulnerable buildings within the expanded floodplain. The results are considered to be conservative in nature, as they are based upon 1D HEC-RAS modelling rather than the 2D modelling completed for the June 2020 Class EA, and have not explicitly accounted for implementing the preferred alternative from the Class EA which would remove approximately 19 ha of currently flood prone land from the Regulatory floodplain. Nevertheless, the results of this assessment are considered sufficient to allow for a comparison to baseline conditions and characterization of the associated downstream flood risk related to uncontrolled Whitebelt development, particularly recognizing the scale of the current level of study. The results of this analysis are summarized in Table 2.3.1.9.

Table 2.3.1.9. Direct Flood Damage Estimations for Future Whitebelt Conditions – Etobicoke Creek FVA

Land Use Condition	2-yr to 25-yr	50-yr	100-yr	Regional	Average Annual
Baseline	-	-	$ 9,044	$ 125,938,520	$ 576,481
Future Whitebelt	-	$ 9,408	$ 166,583	$ 140,146,562	$ 643,524
Difference to Baseline (%)	-	- %	1742%	11%	12%

Under the future Whitebelt land use conditions, minor damages are shown to occur during the 50-year storm event which are roughly equivalent to the damage estimates of the 100-year baseline conditions. This is a significant result as it demonstrates an increased flood risk to vulnerable buildings under the higher frequency events. The damage estimates are shown to increase significantly under the 100-year event, at a magnitude of over 15 times the baseline conditions estimate.

The flood damage estimates for the Regional Storm event demonstrate a smaller magnitude of change (11%), however, a larger dollar amount of approximately $14M; this is considered to be a conservative estimate of the anticipated damages, due to the estimated frequency of the Regional Storm event (i.e. 0.4%) which has been applied in the analysis. This increase is primarily due to the increased flood depths occurring at each of the flood vulnerable buildings, as well as two (2) additional flood vulnerable buildings not previously impacted under baseline conditions, which are now estimated to incur flood damages within the expanded floodplain. The Regional Storm event remains as the primary source for average annual damages, generating an increase of approximately 12% in direct flood damages on an average annual basis. It should be noted that the absolute flood damage costs generated as part of this assessment represent simplified estimations, therefore the reported dollar amounts should be interpreted accordingly. The foregoing assessment has also not accounted for the benefits which would be associated with the implementation of the recommendations advanced in the Downtown Brampton Flood Protection Environmental Assessment (AECOM, June 2020), which is estimated to remove 19 ha of currently flood-prone lands from the Regulatory floodplain. The important finding from this assessment is the proportion of the noted changes and the resulting increases to flood risk in downstream systems as a result of the higher peak flows occurring from uncontrolled development within the headwaters. Nevertheless, it should be noted that this assessment did not account for future development within the FSA, hence future development in the FSA will be required to include measures to mitigate increased downstream flood risk

For potential Whitebelt development within the upper Etobicoke Creek Watershed, it can be seen that higher flood depths and wider flood extents are expected within the Downtown Brampton FVA, which results in significantly higher damages within the primarily urban/commercial downtown core. These damages are demonstrated to occur during the major storm events and begin to occur earlier under higher frequency events, than shown under baseline conditions (50-year and above). This demonstrates the relative sensitivity of the Etobicoke Creek system, and the downstream effects within the dense urbanized area of the Downtown Brampton SPA.

Humber River

As outlined previously, the primary input for the Humber River off-site hydraulic assessment is the results of the hydrologic impact assessment completed by TRCA (ref. Hydrologic Assessment Memo, TRCA, November 2019), which assumed a 51% impervious coverage. This assessment identified the changes in peak flow rates associated with a "50% Whitebelt build-out" and "100% Whitebelt build-out" scenarios for the Humber River Watershed. For the purpose of this assessment, only the 100% Whitebelt build-out scenario has been carried forward to characterize the potential flood risk associated with uncontrolled development in the headwaters.

This assessment was completed by TRCA using the "Future OP no SWM" Visual OTTHYMO (VO) model developed as part of the Humber River Hydrology Update as a base model; TRCA completed necessary model updates in the headwater drainage areas to represent the potential Whitebelt development and urbanized land use conditions. This was completed by adjusting a variety of subcatchment parameters and applying an assumed 51% imperviousness for future urban development; further details related to the model updates can be found in the Memo prepared by TRCA (ref. Hydrologic Assessment Memo, TRCA, November 2019).

In accordance with industry standard floodplain mapping methodologies, the 2- through 100-year design storm events are simulated using the hydrologic flow results of the existing land use conditions with SWM practices in place, and the Regional Storm event flows are sourced from the future land use conditions without SWM to provide the most conservative estimate of floodplain limits. Given that the Whitebelt hydrologic impact assessment completed by TRCA utilized a base model which did not contain SWM, further data mining has been completed in order to more accurately represent the impacts or changes to the flood risks under the design storm events (2- through 100-year), so that an appropriate comparison could be completed against the baseline conditions which would receive the benefit of peak flow control from existing SWM.

In order to develop representative flow results for the design storm events which could be incorporated into the hydraulic modelling, the peak flows from the "Future OP + 100% Whitebelt (no SWM)" have been compared against the "Future OP (no SWM)" at select nodes to determine the change (or delta) in peak flow which can be attributed to the uncontrolled Whitebelt development. This delta peak flow has then been added to the "Existing with SWM" peak flows as per baseline conditions (approved model), to demonstrate the increase in peak flow associated with the uncontrolled Whitebelt development. This approach has been applied for each of the design storms (2- through 100-year), in absence of a Whitebelt development model which contains existing SWM. The Regional Storm event peak flows have been sourced directly from the Future OP + 100% Whitebelt (no SWM) scenario, as this methodology is consistent with the baseline conditions and does not require future data processing.

An example of this peak flow approach is presented in Table 2.3.1.10 for the 100-year event at one of the flow change locations in the HEC-RAS model.

Table 2.3.1.10. Whitebelt Development Peal Flow Example – 100 year

Node ID	River (Reach)	100-year Peak Flow (m^3/s)				
		EX HEC-RAS (Existing w SWM)	Future OP (no SWM)	Future OP + 100% Whitebelt (no SWM)	Delta	Whitebelt Flow
45	West Humber Creek (Reach1)	222.03	312.40	575.43	263.02	485.05

The resulting future land use (Whitebelt) conditions peak flows for the design storms and the Regional Storm event have been applied in the Humber River HEC-RAS model (Humber in Toronto, Wood, 2017) at a total of five (5) flow change locations. These locations have been selected to focus on reaches within the FVA and select reaches downstream to ensure appropriate tailwater conditions for HEC-RAS computations.

The future conditions steady state flow table and the comparison to baseline conditions flows are presented in Table 2.3.1.11 and Table 2.3.1.12.

Table 2.3.1.11. HEC-RAS Steady Flow Table – Future Land Use (Whitebelt) Conditions – Humber River

River (Reach)	River Station	Hydrologic Flow Node	Regional	100-yr	50-yr	25-yr	10-yr	5-yr	2-yr
West Humber Crk (Reach 1)	2569.364	45	1251.96	485.05	413.51	339.45	246.24	127.65	75.69
Lower Humber (Reach 5)	3220.292	49.9	1745.41	603.89	509.85	422.09	313.64	152.59	87.37
Lower Humber (Reach 4)	5219.595	0.155	1705.31	593.80	500.18	415.96	310.83	152.92	86.33
Lower Humber (Reach 3)	3047.155	49.5	1706.59	593.80	500.18	415.96	310.83	152.92	86.36
Lower Humber (Reach 2)	2359.812	49.3	1720.16	584.02	495.42	413.29	305.54	153.99	88.55

Table 2.3.1.12. Peak Flow Comparisons – Future Land Use (Whitebelt) – Humber River

Reach	River Station	Hydrologic Flow Node	Regional	100-yr	50-yr	25-yr	10-yr	5-yr	2-yr
West Humber Crk (Reach 1)	2569.364	45	41%	118%	117%	115%	108%	119%	94%
Lower Humber (Reach 5)	3220.292	49.9	21%	64%	64%	60%	55%	62%	46%
Lower Humber (Reach 4)	5219.595	0.155	21%	62%	62%	59%	54%	62%	45%
Lower Humber (Reach 3)	3047.155	49.5	21%	62%	62%	59%	54%	62%	45%
Lower Humber (Reach 2)	2359.812	49.3	21%	60%	61%	59%	53%	60%	40%

The future Whitebelt development land use conditions result in a Regional Storm peak flow of approximately 41% higher than baseline conditions at the downstream point of the West Humber Creek, as this system contains contributions from the vast majority of the Whitebelt development lands. Downstream of the confluence point of the West Humber and Main Humber River, an approximate 21% increase in the Regional Storm peak flow is shown throughout the Lower Humber River. The relative increase across the design storms is seen to be higher, with increases ranging from 94-118% within the West Humber Creek and increases of 40-64% within the Lower Humber River. These flows have been incorporated into the approved HEC-RAS model (2017) and simulated for all the noted storm events.

The results of the future land use conditions hydraulic assessment have been summarized in terms of the change in water surface elevation (WSE), wetted top width (i.e. simulated floodplain width), and mapping of the flood extents. The results for the simulated WSE changes and wetted width throughout the impacted reaches, both within the FVA and local connecting tributaries, are summarized in Table 2.3.1.13 and Table 2.3.1.14. The future conditions flood extents for both the 100 year and Regional Storm events are presented on Drawing WR2a and Drawing WR2b (ref. Appendix A).

Table 2.3.1.13. Summary Changes of HEC-RAS Computed WSE for Future Whitebelt Conditions – Humber River FVA

Storm Event	HEC-RAS		Average Change in Flow (%)	Average Diff in WSE (m)	Max Diff in WSE (m)	Min Diff in WSE (m)
	River	Reach				
100 YR	Berry Creek	Reach 1	0%	0.92	0.95	0.88
	Lower Humber	Reach 4	62%	1.01	1.02	1.01
		Reach 5	64%	1.23	1.34	0.89
		Reach 6	0%	0.93	1.08	0.74
	West Humber Creek	Reach 1	118%	1.16	1.75	0.78
	Total Summary		***64%***	***1.10***	***1.75***	***0.74***
Regional	Berry Creek	Reach 1	0%	0.92	0.95	0.88
	Lower Humber	Reach 4	21%	0.91	0.92	0.91
		Reach 5	21%	0.42	1.23	0.31
		Reach 6	0%	0.40	0.42	0.37
	West Humber Creek	Reach 1	41%	0.56	1.36	0.41
	Total Summary		***22%***	***0.59***	***1.36***	***0.31***

Table 2.3.1.14. Summary Changes of HEC-RAS Wetted Width for Future Whitebelt Conditions – Humber River FVA

Storm Event	HEC-RAS		Average Change in Flow (%)	Average Diff in Top Width (m)	Max Diff in Top Width (m)	Min Diff in Top Width (m)
	River	Reach				
100 YR	Berry Creek	Reach 1	0%	14.58	62.13	3.04
	Lower Humber	Reach 4	62%	5.14	6.02	4.58
		Reach 5	64%	30.22	91.94	4.1
		Reach 6	0%	7.43	17.23	2.32
	West Humber Creek	Reach 1	118%	119.31	518.32	2.15
	Total Summary		***64%***	***53.35***	***518.32***	***2.15***
Regional	Berry Creek	Reach 1	0%	14.58	62.13	3.04
	Lower Humber	Reach 4	21%	39.84	74.47	8.44
		Reach 5	21%	54.01	279.38	0.43
		Reach 6	0%	9.81	26.32	0.86
	West Humber Creek	Reach 1	41%	12.56	41.23	1.51
	Total Summary		***22%***	***27.16***	***279.38***	***0.43***

The results in Table 2.3.1.13 demonstrate that under the Whitebelt land use conditions, the simulated WSE would increase by an average of approximately 1.10 m during the 100-year event, with a maximum increase of 1.75 m occurring within the West Humber Creek, and a minimum increase of 0.74 m, which demonstrates flood depth increases within all reported / connecting systems. Similar trends are seen under the Regional Storm event, with an average WSE increase of approximately 0.59 m, a maximum increase of 1.36 m occurring within the West Humber Creek and a minimum increase of 0.31 m across all reported / connecting systems.

There are two (2) connecting tributaries which do not experience changes in peak flow as a result of Whitebelt development; these include the Lower Humber Reach 6, which is located upstream of the confluence with the West Humber, and the Berry Creek tributary which contributes to the Lower Humber River directly downstream of Albion Road. Both of these systems demonstrate WSE increases under the 100-year and Regional Storm events, which can be attributed to the tailwater influences with the FVA alone, as these systems would not experience direct changes to peak flow and hydrologic relationships as a result of Whitebelt development.

These simulated increases in WSE result in an expansion of the floodplain, demonstrated in Table 2.3.1.14 and on Drawing WR2a and Drawing WR2b (ref. Appendix A). The results indicate an average increased wetted top width of 53.35 m and 27.16 m during the 100-year and Regional Storm events, respectively. There are local occurrences of larger floodplain expansions, including a maximum increase of over 500 m during the 100-year event within the West Humber Creek just upstream of the Albion Road crossing, and over 270 m in the Lower Humber River during the Regional Storm event. It should be noted that these large occurrences of top width expansion are primarily in locations where artificial levees or high points contained the flow within the main channel under baseline conditions and are now being exceeded within the floodplain.

The flood damage costs associated with the future land use conditions have been estimated at each of the flood vulnerable buildings within the expanded floodplain. This allows for a comparison to baseline conditions and characterization of the associated downstream flood risk related to uncontrolled Whitebelt development. The results of this analysis are summarized in Table 2.3.1.15.

Table 2.3.1.15. Direct Flood Damage Estimations for Future Whitebelt Conditions – Humber River FVA

Land Use Condition	2-yr to 50-yr	100-yr	Regional	Average Annual
Baseline	-	-	$ 18,359,764	$ 84,026
Future Whitebelt	-	$ 355,397	$ 32,163,356	$ 151,267
Difference to Baseline (%)	-	- %	75%	80%

Under the future Whitebelt land use conditions, minor damages are shown to occur beginning during the 100-year storm event, which under baseline conditions did not incur any damage estimates as a result of riverine flooding. This is significant as it demonstrates the flood risk increasing in frequency and is no longer only limited to the Regional Storm event.

The flood damage estimates for the Regional Storm event demonstrate a 75% increase, which equates to an estimated dollar amount of approximately $14M. This increase is primarily due to the increased flood depths occurring at each of the flood vulnerable buildings, as well as twenty-three (23) additional flood vulnerable buildings incurring flood damages as a result of the expanded floodplain. The Regional Storm event remains as the primary source for average annual damages, generating an increase of approximately 80% in direct flood damages on an average annual basis.

It should be noted that the absolute flood damage costs generated as part of this assessment represent simplified estimations, therefore the reported dollar amounts should be interpreted accordingly. The important finding from this assessment is rather the proportion of the noted changes and the resulting increases to flood risk in downstream systems as a result of the higher peak flows occurring from uncontrolled development within the headwaters.

For development within the upper Humber River Watershed, it can be seen that higher flood depths and wider flood extents are expected within the Humber River FVA, as well as within the hydraulically connected systems upstream and connecting tributaries, as a result of the tailwater influences. These hydraulic impacts result in higher damages occurring during the major storms, and flood damages beginning to occur during the more frequent storm events (no longer limited to the Regional Storm). This demonstrates the sensitivity of the Humber River system, and the effects further downstream within the watershed.

Main Humber Subwatershed

Flood Risk (on-site/off-site):

Per Table 2.3.1.1, the portion of the FSA within the Main Humber Subwatershed is relatively small in size (i.e. 438 ha), and represents a small proportion of the total subwatershed area (i.e. 1.2 %). The portions of the FSA within the subwatershed drain toward the major confined watercourses via a series of headwater drainage features, hence there is currently no formal flood hazard delineated within the designated FSA lands within the main Humber Subwatershed. Although these portions of the FSA lie upstream of designated FVAs within the Humber River Watershed, it is anticipated that development of these lands would have a negligible impact to off-site/downstream flood risk due to the small proportion of these areas relative to the total contributing drainage areas to the FVAs. Moreover, as the lands drain directly toward the well-defined and regulated watercourse systems, it is anticipated that development of these lands would not represent a local flood risk, provided that the current discharge locations are retained and utilized post-development. As such, stormwater management for quantity controls, if required for these areas, may not require over-control of peak flows for flood protection of downstream properties (i.e. post-to-pre control anticipated to be sufficient); furthermore, quantity controls for the Regional (Hurricane Hazel) Storm event may not be required for these areas. However, recent analyses completed by TRCA for the Humber River

SWM Quantity Control Criteria Updates (WSP, November 2, 2020) have concluded that over-control of peak flows for all strorm events (i.e. 2 year through 100 year return period storms as well as Regional Storm event) would be required to achieve watershed-scale flood protection, based on the application of synthetic design storms for hydrologic analysis. The requirements for stormwater management are thus to be established as part of future studies (i.e. local SWSs) and are recommeded to apply continuous simulation and account for the spatial variability in rainfall across the watershed.

Erosion Risk:

The erosion assessment completed for the Part A report indicated that no erosion sensitive sites are currently located proximate to the FSA in the Main Humber Subwatershed. While it is anticipated that development of the FSA within the Main Humber Subwatershed would increase erosion potential along the receiving watercourses, it is anticipated that any potential erosion impacts may be mitigated through conventional practices (i.e. extended-detention storage within end-of-pipe facilities with drawdown times less than 5 days, implementation of Low Impact Development (LID) infiltration-based Best Management Practices (BMPs).

Water Budget:

The key hydrologic features and key hydrologic areas within, and proximate to, the FSA within the Main Humber Subwatershed include several ecologically significant groundwater recharge areas (ESGRAs), small occurrences of wetlands and simulated seepage areas/springs and highly vulnerable aquifers (HVAs). As such, development of the FSA within the Main Humber Subwatershed, without mitigation, has the potential to reduce groundwater discharge contributions to these areas. Measures to promote groundwater recharge through the application of LID BMPs which promote infiltration and/or evapotranspiration will be required to mitigate these impacts. The implementation of these measures will require infiltration of clean runoff (i.e. rootop runoff) and pre-treatment of surface runoff from other paved surfaces (i.e. roads, parking lots, driveways) to maintain the quality of infiltrated surface runoff. This is disussed in further detail in Section 2.3.1.2.

West Humber Subwatershed

Flood Risk (on-site/off-site):

The portion of the FSA within the West Humber Subwatershed is relatively large in size (i.e. 5335 ha), and represents a sizeable proportion of the total subwatershed area (i.e. 26.4 %). The portions of the FSA within the subwatershed drain toward the major confined watercourses, as well as various unconfined watercourses, hence some of the contributing areas have a regulated flood hazard associated with the drainage features through the site, as well as through downstream properties. Moreover, as portions of the lands drain directly toward the unconfined watercourses and drainage features offsite, it is anticipated that development of these lands, in the absence of stormwater management, would increase peak flows offsite, thus presenting a local flood risk to adjacent properties. It is anticipated that stormwater management for quantity controls would be required to control post-development flows to pre-development levels for all events including the Regional Storm event, in order to mitigate both local and subwatershed-scale flood risks. As the FSA is located toward the headwaters, a uniform application of post-to-pre control or a combination of strategic post-to-pre control and undercontrol may provide adequate flood protection, and over-control of peak flows for flood protection of downstream properties would not be required due to the size of the Humber River Watershed (i.e. 903 km^2 +/-) and the associated variability in coverage of rainfall. However, recent analyses completed by TRCA for the Humber River SWM Quantity Control Criteria Updates (WSP, November 2, 2020) have concluded that over-control of peak flows for all strorm events (i.e. 2 year through 100 year return period storms as well as Regional Storm event) would be required to achieve watershed-scale flood protection, based on the application of synthetic design storms for hydrologic analysis. The requirements for stormwater management are thus to be established as part of future studies (i.e. local SWSs) and are recommeded to apply continuous simulation and account for the spatial variability in rainfall across the watershed.

Erosion:

The erosion assessment completed for the Part A report indicated that erosion sensitive sites are within and bounding the FSA in the West Humber Subwatershed. As such, it is anticipated that development of the FSA within the West Humber Subwatershed would increase erosion potential along the receiving watercourses. The erosion impacts may be mitigated through the provision of extended detention storage within end-of-pipe facilities, potentially in combination with LID BMPs which promote infiltration and/or evapotranspration to reduce the volume of surface runoff). The specific requirements for mitigating erosion impacts are to be determined as part of future studies.

Water Budget:

The key hydrologic features and key hydrologic areas within and proximate to the FSA within the West Humber Subwatershed include ecologically significant groundwater recharge areas (ESGRAs), areas with shallow depth to water table, areas of significant groundwater recharge areas (SGRAs) and highly vulnerable aquifers (HVAs). In addition, key hydrologic features in the form of simulated seepage areas/springs and wetlands are located within this portion of the FSA. As such, development of the FSA within the West Humber Subwatershed has the potential to reduce groundwater discharge contributions to these areas, potentially impacting the habitat associated with sensitive ecological features. Measures to promote groundwater recharge through the application of LID BMPs which promote infiltration and/or evapotranspiration will be required to mitigate these impacts. The implementation of these measures will require infiltration of clean runoff (i.e. rootop runoff) and pre-treatment of surface runoff from other paved surfaces (i.e. roads, parking lots, driveways) to maintain the quality of infiltrated surface runoff. This is discussed further in Section 2.3.1.2.

Upper Etobicoke Creek Subwatershed

Flood Risk (on-site/off-site):

The portion of the FSA within the Upper Etobicoke Creek Subwatershed is relatively large in size (i.e. 2027 ha), and represents a sizeable proportion of the total subwatershed area (i.e. 20.3 %). The portions of the FSA within the subwatershed drain toward the major confined watercourses and various unconfined watercourses, hence some of the contributing areas have a regulated flood hazard associated with the drainage features through the site, as well as through downstream properties. Moreover, as portions of the lands drain directly toward the unconfined watercourses and drainage features offsite, it is anticipated that development of these lands, in the absence of stormwater management, would increase peak flows offsite, thus presenting a local flood risk to adjacent properties. As such, it is anticipated that stormwater management for quantity controls would be required to control post-development flows to pre-development levels for all events including the Regional Storm event, in order to mitigate both local and subwatershed-scale flood risks. As the FSA is located toward the headwaters, a uniform application of post-to-pre control or a combination of strategic post-to-pre control and undercontrol provide adequate flood protection, and over-control of peak flows for flood protection of downstream properties would not be required. However, current stormwater management criteria for the Etobicoke Creek Watershed, as prescribed in the Etobicoke Creek Hydrology Update Draft Final Report (MMM Group Limited, April 2013) and applied by TRCA require over-control of peak flows for all strorm events (i.e. 2 year through 100 year return period storms as well as Regional Storm event) within the Upper Etobicoke Creek Subwatershed, including the limits of the preliminary SABE concept, to achieve watershed-scale flood protection, based on the application of synthetic design storms for hydrologic analysis. The requirements for stormwater management are thus to be established as part of future studies (i.e. local SWSs) and are recommeded to apply continuous simulation and account for the spatial variability in rainfall across the watershed.

Erosion:

The erosion assessment completed for the Part A report indicated that erosion sensitive sites are within and bounding the FSA in the Upper Etobicoke Creek Subwatershed. Consequently, it is anticipated that development of the FSA within the Upper Etobicoke Creek Subwatershed would increase erosion potential along the receiving watercourses. The erosion impacts may be mitigated through the provision of extended detention storage within end-of-pipe facilities, potentially in combination with LID BMPs which promote infiltration and/or evapotranspiration to reduce the volume of surface runoff).

Water Budget:

The key hydrologic features and key hydrologic areas within and proximate to the FSA within the Upper Etobicoke Creek Subwatershed include ecologically significant groundwater recharge areas (ESGRAs), areas with shallow depth to water table, areas of significant groundwater recharge areas (SGRAs) and highly vulnerable aquifers (HVAs). In addition, key hydrologic features in the form of simulated seepage areas/springs and wetlands are located within this portion of the FSA. As such, development of the FSA within the Upper Etobicoke Creek Subwatershed has the potential to reduce groundwater discharge contributions to these areas, potentially impacting aquatic habitat supporting sensitive ecological features. Measures to promote groundwater recharge through the application of LID BMPs which promote infiltration and/or evapotranspiration will be required to mitigate these impacts. The implementation of these measures will require infiltration of clean runoff (i.e. rootop runoff) and pre-treatment of surface runoff from other paved surfaces (i.e. roads, parking lots, driveways) to maintain the quality of infiltrated surface runoff. This is discussed further in Section 2.3.1.2.

Fletcher's Creek Subwatershed

Flood Risk (on-site/off-site):

The portion of the FSA within the Fletcher's Creek Subwatershed is relatively small in size (i.e. 196 ha), and represents a small portion of the total subwatershed area (i.e. 4.5 %). The portions of the FSA within the subwatershed drain toward the headwater drainage features, which are not regulated based upon flood hazard definition. This segment of the FSA drains directly toward the unconfined watercourses and drainage features offsite, hence it is anticipated that development of these lands in the absence of stormwater management would increase peak flows offsite, thus presenting a local flood risk to adjacent properties. As such, it is anticipated that stormwater management for quantity controls would be required to control post-development flows to pre-development levels for all events including the Regional Storm event, in order to mitigate both local and subwatershed-scale flood risks. As the FSA is located within the headwaters of the subwatershed, it is anticipated that a uniform application of post-to-pre control or a combination of strategic post-to-pre control and undercontrol would provide adequate flood protection, and over-control of peak flows for flood protection of downstream properties would not be required. The requirements for stormwater management are to be established as part of future studies.

Erosion:

The erosion assessment completed for the Part A report indicated that erosion sensitive sites have been identified within areas of the Fletcher's Creek Subwatershed downstream of the FSA. As such, it is anticipated that development of the FSA within the Fletcher's Creek Subwatershed would increase erosion potential along the receiving watercourses. Based upon findings from previous studies, it is anticipated that the erosion impacts may be mitigated through the provision of extended detention storage within end-of-pipe facilities, and may potentially be combined with LID BMPs which promote infiltration and/or evapotranspiration to reduce the volume of surface runoff.

Water Budget:

The key hydrologic features and key hydrologic areas within and proximate to the FSA within the Fletcher's Creek Subwatershed are limited to shallow depth to groundwater, small occurences of ecologically significant groundwater recharge areas (ESGRAs) and a wetland, and the presence of headwater drainage features. Although development of the FSA within the Fletcher's Creek Subwatershed has the potential to reduce groundwater recharge, it is not anticipated to represent a significant impact to the groundwater system, key hydrologic features or areas. Nevertheless, measures to promote groundwater recharge through the application of LID BMPs which promote infiltration and/or evapotranspiration should be implemented as part of the stormwater management plan in the area. This is discussed further in Section 2.3.1.2.

Huttonville Creek Subwatershed

Flood Risk (on-site/off-site):

The portion of the FSA within the Huttonville Creek Subwatershed is small in size (i.e. 43 ha), and represents a small portion of the total subwatershed area (i.e. 2.8 %). The portions of the FSA within the subwatershed drain toward the headwater drainage features, which are not regulated based upon flood hazard definition. This segment of the FSA drains directly toward the unconfined watercourses and drainage features offsite, hence it is anticipated that development of these lands in the absence of stormwater management would increase peak flows offsite, thus presenting a local flood risk to adjacent properties. As such, it is anticipated that stormwater management for quantity controls would be required to control post-development flows to pre-development levels for all events including the Regional Storm event, in order to mitigate both local and subwatershed-scale flood risks. As the FSA is located within the headwaters of the subwatershed, it is anticipated that a uniform application of post-to-pre control or a combination of strategic post-to-pre control and undercontrol would provide adequate flood protection, and over-control of peak flows for flood protection of downstream properties would not be required.

Erosion:

The erosion assessment completed for the Part A report indicated that erosion sensitive sites have been identified within areas of the Huttonville Creek Subwatershed downstream of the FSA. As such, it is anticipated that development of the FSA within the Huttonville Creek Subwatershed would increase erosion potential along the receiving watercourses. Based upon findings from previous studies, it is anticipated that the erosion impacts may be mitigated through the provision of extended detention storage within end-of-pipe facilities, and may potentially be combined with LID BMPs which promote infiltration and/or evapotranspiration to reduce the volume of surface runoff.

Water Budget:

No key hydrologic features and one key hydrologic areas have been identified within or proximate to the FSA within the Huttonville Creek Subwatershed including a highly vulnerable aquifer hence while development of the FSA within the Huttonville Creek Subwatershed has the potential to reduce groundwater recharge, it is not anticipated to represent a significant impact to the groundwater system, key hydrologic features or areas. Nevertheless, measures to promote groundwater recharge through the application of LID BMPs which promote infiltration and/or evapotranspiration should be implemented as part of the stormwater management plan in the area. This is discussed further in Section 2.3.1.2.

Main Credit River (Glen Williams to Norval)

Flood Risk (on-site/off-site):

The portion of the FSA discharging toward the Main Branch of the Credit River is relatively small in size (i.e. 23 ha), and represents a small proportion of the local subwatershed area (i.e. 1.0 %). The portions of the FSA within the subwatershed drain toward the major confined watercourses via a series of headwater drainage features, hence there is currently no flood hazard delineated within the designated FSA lands. As the land drain directly toward the well-defined and regulated watercourse systems, it is anticipated that development of these lands would not represent a local flood risk, provided that the current discharge locations are retained and utilized post-development. As such, it is anticipated that stormwater management for quantity controls, if required for this area, would not require over-control of peak flows for flood protection of downstream properties (i.e. post-to-pre control anticipated to be sufficient). Furthermore, quantity controls for the Regional (Hurricane Hazel) Storm event may not be required for this area, however this would be subject to confirmation as part of detailed studies.

Erosion:

The erosion assessment completed for the Part A report indicated that no erosion sensitive sites are currently located proximate to the FSA discharging toward the Credit River Main Branch. While it is anticipated that development of the FSA within this area would increase erosion potential along the receiving watercourses, it is anticipated that the erosion impacts may be mitigated through conventional practices (i.e. extended-detention storage within end-of-pipe facilities with drawdown times less than 5 days, implementation of LID BMPs which promote infiltration and/or evapotranspiration). The specific requirements for mitigating erosion impacts are to be determined as part of future studies.

Water Budget:

The key hydrologic areas within and proximate to the FSA discharging toward the Credit River include areas with shallow depth to water table, an ecologically significant groundwater recharge area (ESGRA), and a wetland, although it is recognized that additional key hydrologic areas and features may be located downstream along the Credit River Main Branch. While the size of the FSA within this area is of such small magnitude that development of this area is not anticipated to present an adverse impact to key hydrologic features or areas, measures to manage water budget through the application of LID BMPs which promote infilrration and/or evapotranspiration are nevertheless required as part of the storwmater management system. This is discussed further in Section 2.3.1.2.

Groundwater Impact Assessment

The increase in impervious surfaces reduces the natural infiltration and increases runoff when unmitigated. These changes lead to a decrease in groundwater recharge, groundwater levels and a potential decrease to groundwater discharge to wetlands and stream reaches. Reduced infiltration may also lead to a decrease in recharge to the deeper water producing (aquifers) units, particularly the upper aquifer consisting of the Oak Ridges Moraine deposits where it exists in the study area.

An existing conditions water balance was developed for each of the seven subwatersheds that occur within the FSA as part of the Existing Conditions and Characterization Part A report. The water balance parameters (i.e., evapotranspiration [ET], recharge, runoff and precipitation) were estimated from a model developed by the ORMGP and based on a 10-year climate record from 2004 to 2014, and are provided in Table 2.3.1.16 in units of mm/year and m^3/day. The existing water balance values were quite similar among the seven subwatersheds (i.e., within 25 to 40 mm of each other) as a result of the similarity of the physical conditions throughout the FSA (e.g., similar surficial geology [largely finer grained till], land use [non-urban] and ground surface topography). A positive change in storage (surplus) is presented as part of the water balance presented in Table 2.3.1.16. The majority of the apparent imbalance is most likely attributed to net groundwater outflow and potential change in storage due to a 10-year climate record. This imbalance represents less than 2% of total precipitation. Additional details about the existing conditions water balance can be found within 'Scoped Subwatershed Study Part A – Existing Conditions and Characterization (Final Report)' (Wood, January 2022).

Table 2.3.1.16. Existing Conditions Water Balance (Focus Study Area)

Authority	Watershed	Subwatershed	Total Area in FSA (m^2)	P	ET	RO	R	ΔS
				(mm/year)				
CVC	Credit River	Credit River - Glen Williams to Norval	230,000	810	545	140	120	5
		Fletcher's Creek	1,910,000	810	535	150	120	5
		Huttonville Creek	430,000	810	515	175	115	5
TRCA	Humber River	Main Humber	4,310,000	785	520	150	105	10
		West Humber	53,390,000	790	530	135	120	5
	Etobicoke Creek	Spring Creek	70,000	790	520	155	105	10
		Upper Etobicoke	20,250,000	800	520	140	135	5
				(m^3/day)				
CVC	Credit River	Credit River - Glen Williams to Norval	230,000	510	343	88	76	3
		Fletcher's Creek	1,910,000	4,239	2,800	785	628	26
		Huttonville Creek	430,000	954	607	206	135	6
TRCA	Humber River	Main Humber	4,310,000	9,269	6,140	1,771	1,240	118
		West Humber	53,390,000	115,556	77,525	19,747	17,553	731
	Etobicoke Creek	Spring Creek	70,000	152	100	30	20	2
		Upper Etobicoke	20,250,000	44,384	28,849	7,767	7,490	277

P – Precipitation; ET – Evapotranspiration; RO – Runoff; R – Recharge; ΔS – Change in Storage

Future development and transition from rural agricultural land use to urban land use without mitigation has the potential to reduce ET and recharge and increase runoff. The existing water balance informs future stormwater management plans that seek to maintain the pre-development water balance at a subcatchment to subwatershed level, based on an understanding of the operative factors (e.g., changes in hydraulic conductivity, vegetation and imperviousness) that influence the spatial and temporal variability in runoff and groundwater flow/discharge. Areas that currently have a higher recharge (e.g., areas that are sandier with higher hydraulic conductivity) may require more infiltration management/mitigation measures where these recharge areas support aquatic or terrestrial habitats compared to less permeable areas.

A future conditions water balance with no mitigation was estimated for the seven subwatersheds in the FSA for the impact assessment. The overall impact assessment for the FSA has assumed a representative impervious coverage of 51% (Section 2.2). Water budget parameters for developable lands were estimated for the FSA subwatersheds using ORMGP model output from an existing medium density residential development on the Halton Till in the Brampton area located adjacent to the FSA (ORMGP 2018). A medium density residential development was considered representative for this exercise as this land use has been associated with a similar magnitude of total imperviousness (50% including developable and NHS areas) in areas already developed in Brampton and in other municipal studies in southern Ontario (e.g. Matrix and SSP&A 2014, Matrix 2020). The Halton Till was considered appropriate as the majority of the FSA is covered at surface by the Halton Till or Wildfield Till, which are considered relatively finer grained sediments (ref. Drawing GW-4, Appendix G). ORMGP modelled average water budget parameters (i.e., ET, runoff, and recharge) were used for this representative development available from the ORMGP (2018; Table 2.3.1.17) and then scaled to the area of developable lands in each subwatershed (Table 2.3.1.18a and 2.3.1.18b). Where lands within each subwatershed were considered undevelopable (i.e., NHS lands as per the Peel Official Plan), water budget parameters were carried forward from the existing conditions assessment (Table 2.3.1.16) and then scaled to the area of undevelopable lands (Table 2.3.1.18a and 2.3.1.18b).

The change in water balance between existing conditions and estimated post development conditions, is presented as a deficit or surplus in Tables 2.3.1.18a (in units of mm/year) and 2.3.1.18b (in units of m^3/day) for each subwatershed. The deficit in recharge for a generalized medium density residential development, with average imperviousness (50%) on Halton Till has the potential to reduce recharge by 66 to 87 mm/year (13 to 10,678 m^3/day) or 76 mm/year (2,409 m^3/day) on average. This development also has the potential to increase runoff (surplus) by 319 to 354 mm/year (65 to 47,327 m^3/day) or 335 mm/year (10,238 m^3/day) on average.

Given the similarity in surficial geology throughout the FSA, the level of infiltration or runoff mitigation due to increased imperviousness and reduction in vegetation needed to maintain existing conditions will be expected to be similar in all subwatersheds. Low Impact Development Best Management Practices are recommended to mitigate recharge reductions and the increase in runoff. Areas of sand mapped at surface may offer opportunities for additional infiltration; however, these occurrences are localized, and small in extent, and infrequent in the FSA. The areas of groundwater concern mapping show that the depth to groundwater and upward gradients are present in many areas underlying FSA and may restrict centralized infiltration (e.g., subsurface infiltration tanks galleries).

Under future development ET may be reduced by 230 to 279 mm/year (49 to 34,803 m^3/day) or 253 mm/year (7,501 m^3/day) on average across the FSA from increased impervious surfaces (Table 2.3.1.18a and 2.3.1.18b). Strategies that have the potential to mitigate reduced ET include those that promote and enhance vegetation in developed areas.

Table 2.3.1.17. Representative Water Balance for a Medium Density Residential Development on Halton Till

Authority	Watershed	Subwatershed	Total Area in FSA (m^2)	P	ET	RO	R	ΔS
				(mm/year)				
CVC	Credit River	Credit River - Glen Williams to Norval	230,000	810	266	494	39	11
		Fletcher's Creek	1,910,000	810	266	494	39	11
		Huttonville Creek	430,000	810	266	494	39	11
TRCA	Humber River	Main Humber	4,310,000	785	266	494	39	(14)
		West Humber	53,390,000	790	266	494	39	(9)
	Etobicoke Creek	Spring Creek	70,000	790	266	494	39	(9)
		Upper Etobicoke	20,250,000	800	266	494	39	1
				(m^3/day)				
CVC	Credit River	Credit River - Glen Williams to Norval	230,000	510	168	311	25	7
		Fletcher's Creek	1,910,000	4,239	1,392	2,585	204	58
		Huttonville Creek	430,000	954	313	582	46	13
TRCA	Humber River	Main Humber	4,310,000	9,269	3,141	5,833	461	(165)
		West Humber	53,390,000	115,556	38,909	72,259	5,705	(1,316)
	Etobicoke Creek	Spring Creek	70,000	152	51	95	7	(2)
		Upper Etobicoke	20,250,000	44,384	14,758	27,407	2,164	55

P – Precipitation; ET – Evapotranspiration; RO – Runoff; R – Recharge; ΔS – Change in Storage

Table 2.3.1.18.a Future Conditions Water Balance for a Medium Density Residential Development on Till in the Focus Study Area (mm/year)

Authority	Watershed	Subwatershed	Total Area in FSA (m^2)	Undevelopable / Developable Area in FSA (m^2)		P	ET	RO	R	ΔS
						(mm/year)				
CVC	Credit River	Credit River - Glen Williams to Norval	230,000	Undevelopable	0	0	0	0	0	0
				Developable	230,000	810	266	494	39	11
				Deficit/Surplus vs Existing		**0**	**(279)**	**354**	**(81)**	**6**
		Fletcher's Creek	1,910,000	Undevelopable	0	0	0	0	0	0
				Developable	1,910,000	810	266	494	39	11
				Deficit/Surplus vs Existing		**0**	**(269)**	**344**	**(81)**	**6**
		Huttonville Creek	430,000	Undevelopable	0	0	0	0	0	0
				Developable	430,000	810	266	494	39	11
				Deficit/Surplus vs Existing		**0**	**(249)**	**319**	**(76)**	**6**
TRCA	Humber River	Main Humber	4,310,000	Undevelopable	0	0	0	0	0	0
				Developable	4,310,000	785	266	494	39	(14)
				Deficit/Surplus vs Existing		**0**	**(254)**	**344**	**(66)**	**(24)**
		West Humber	53,390,000	Undevelopable	5,271,577	78	52	13	12	0
				Developable	48,118,423	712	240	445	35	(8)
				Deficit/Surplus vs Existing		**0**	**(238)**	**324**	**(73)**	**(13)**
	Etobicoke Creek	Spring Creek	70,000	Undevelopable	0	0	0	0	0	0
				Developable	70,000	790	266	494	39	(9)
				Deficit/Surplus vs Existing		**0**	**(254)**	**339**	**(66)**	**(19)**
		Upper Etobicoke	20,250,000	Undevelopable	1,882,296	74	48	13	13	0
				Developable	18,367,704	726	241	448	35	1
				Deficit/Surplus vs Existing		**0**	**(230)**	**321**	**(87)**	**(4)**
Average Subwatershed Deficit/Surplus vs Existing Condition						**-**	**(253)**	**335**	**(76)**	**(6)**

P – Precipitation; ET – Evapotranspiration; RO – Runoff; R – Recharge; ΔS – Change in Storage

Table 2.3.1.19.b Future Conditions Water Balance for a Medium Density Residential Development on Till in the Focus Study Area (m^3/year)

Authority	Watershed	Subwatershed	Total Area in FSA (m^2)	Undevelopable / Developable Area in FSA (m^2)		P	ET	RO	R	ΔS
						(m^3/day)				
CVC	Credit River	Credit River - Glen Williams to Norval	230,000	Undevelopable	0	0	0	0	0	0
				Developable	230,000	510	168	311	25	6
				Deficit/Surplus vs Existing		**0**	**(176)**	**223**	**(51)**	**3**
		Fletcher's Creek	1,910,000	Undevelopable	0	0	0	0	0	0
				Developable	1,910,000	4,239	1,392	2,585	204	47
				Deficit/Surplus vs Existing		**0**	**(1,408)**	**1,800**	**(424)**	**21**
		Huttonville Creek	430,000	Undevelopable	0	0	0	0	0	0
				Developable	430,000	954	313	582	46	11
				Deficit/Surplus vs Existing		**0**	**(293)**	**376**	**(90)**	**5**
TRCA	Humber River	Main Humber	4,310,000	Undevelopable	0	0	0	0	0	0
				Developable	4,310,000	9,269	3,141	5,833	461	106
				Deficit/Surplus vs Existing		**0**	**(2,999)**	**4,062**	**(779)**	**(12)**
		West Humber	53,390,000	Undevelopable	5,271,577	11,410	7,655	1,950	1,733	72
				Developable	48,118,423	104,147	35,067	65,125	5,141	1,186
				Deficit/Surplus vs Existing		**0**	**(34,803)**	**47,327**	**(10,678)**	**527**
	Etobicoke Creek	Spring Creek	70,000	Undevelopable	0	0	0	0	0	0
				Developable	70,000	152	51	95	7	2
				Deficit/Surplus vs Existing		**0**	**(49)**	**65**	**(13)**	**(0)**
		Upper Etobicoke	20,250,000	Undevelopable	1,882,296	4,126	2,682	722	696	26
				Developable	18,367,704	40,258	13,386	24,859	1,963	453
				Deficit/Surplus vs Existing		**0**	**(12,782)**	**17,814**	**(4,831)**	**201**
Average Subwatershed Deficit/Surplus vs Existing Condition						**-**	**(7,501)**	**10,238**	**(2,409)**	**(327)**

P – Precipitation; ET – Evapotranspiration; RO – Runoff; R – Recharge; ΔS – Change in Storage

General Consideration for Groundwater Impacts

In addition to the change in the water balance described in the foregoing, other considerations for potential groundwater impacts are presented below. It is expected that these considerations will generally apply through the FSA given the relatively consistent nature of surficial geology and subsequent potential recharge across the undeveloped lands within the FSA (ref. Drawings GW-4, GW-9, Appendix G) and the current application of a general land use across the FSA. The prevalence of the fine-grained surficial till is expected to generally limit the groundwater connection to surface water features with exceptions, as discussed in detail in 'Scoped Subwatershed Study Part A – Existing Conditions and Characterization (Final Report)' (Wood, January 2022) and summarized in Section 2.1.1.2 of this report. In particular, where the till unit is thinner (Drawing GW-5a, Appendix G) and groundwater from the upper aquifer has the potential to discharge to surface, and local groundwater flow through the shallow fractured till may contribute to surface water features. It is generally expected that the overall unmitigated reduction in recharge to the underlying aquifers within the FSA may be a relatively smaller portion of regional recharge contributing to those aquifers.

As previously noted, various types of subsurface infrastructure and the related construction have the potential to impact the groundwater flow system by reducing water levels, intercepting groundwater flow and subsequently affecting groundwater discharge or groundwater recharge to deeper systems.

These impacts can occur as a result of the following:

- Short term dewatering during construction and potential longer-term dewatering where infrastructure is constructed below the water table.
- Foundations constructed below the water table which require sump pumps or Foundation Drain Collector (FDC) systems to reduce groundwater levels.
- Interception of groundwater and subsequent flow along potential permeable pathways associated with permeable backfill within servicing and utility trenches.

The extent of the infrastructure (i.e., spatial size and depth) and location within the groundwater flow system, will determine the extent of the potential impact and the extent and type of groundwater management technique. The potential groundwater impacts described above would be greater and more prevalent in soils that have a greater hydraulic conductivity. This would occur in the more permeable sand or silty sand units at surface, and within deeper discrete sand lenses and within the Oak Ridges Moraine upper aquifer or fractured bedrock, where the infrastructure goes to that depth.

The existence of a shallow groundwater table and the potential for strong upward gradients, reflected in flowing wells (Drawing GW-8a, Appendix G), if intercepted, can lead to geotechnical issues, extensive dewatering and related decrease in groundwater levels which may impact existing wells and potential groundwater discharge.

Dewatering activities may intercept the shallow groundwater flow that would normally flow into the local watercourses or wetlands. To minimize any disruption to the flow conditions or water levels within the affected surface water features, the intercepted groundwater flows should be returned to the feature. In the case of wetlands, the groundwater pumped during construction may exceed the natural groundwater discharge and care should be taken not to disrupt the temporal hydroperiod. Dewatering activities must take into account the seasonal reliance on groundwater for ecological needs. The volumes of groundwater pumped during construction, spatial area being affected (i.e., extent water level drawdown), proximity to the ecological feature and the timing should be considered within the overall construction planning.

All dewatering activities must account for the quality of water be removed, and the discharge point or receiving body as it relates to potential water quality impacts. Potential erosional issues related to discharge quantities and discharge points need to be assessed. Groundwater takings for construction dewatering are regulated by the MECP. Where construction dewatering is greater than 50,000 L/day but less than 400,000 L/day registration on the Environmental Activity and Sector Registry will be required. For dewatering greater than 400,000 L/day a Permit To Take Water (PTTW) will be required as per Ontario Regulation 387/04. Additional PTTW information can be found at https://www.ontario.ca/page/permits-take-water.

Utilizing a dedicated (third pipe) system [i.e., Foundation Drain Collector (FDC) systems] provides an option to direct higher quality water, particularly to address temperature impacts, to surface water features. The design of these systems relates to outlet location and potential volumes of water, may possibly be optimized to provide the maximum benefit to baseflow and various wetlands.

Similar to dewatering activities, the proximity of a subsurface structure adjacent to groundwater discharge areas in surface water courses or wetlands may redirect groundwater flow within the shallow system, around the actual discharge point. The ecological significance related to the specific locations for groundwater discharge can be very important when considering the redirection of groundwater flow. Infrastructure design or mitigative techniques should allow for groundwater flow to the natural area where it is functionally significant (i.e., direct fish habitat or support of localized hydroperiod).

Although the redirection of groundwater flow along the permeable backfill of utility trenches may eventually discharge to local surface water bodies, the overall impact may not be beneficial. As such, the redirection of groundwater flow may be managed with anti-seepage collars or clay plugs.

Agricultural tile drains are used to reduce high water tables. The removal of these agricultural drainage tiles is expected to increase water table levels and as such, higher water levels may have to be addressed where infrastructure is constructed below the water table or where siting stormwater management facilities.

The potential impacts to groundwater quality within the underlying aquifers are reduced as a result of the low permeable nature and thickness of the surficial till unit. Where the till is thinner, there is an increased potential for impact, but the till is greater than 3 m throughout the majority of the FSA (ref. Drawing GW5a, Appendix G). Groundwater quality protection should also be considered in relation to the location of the HVA locations (ref. Drawing GW-12, Appendix G). Existing domestic wells within the development area can provide a direct conduit from ground surface to the open portion of the well for contaminants to enter the groundwater flow system. Additionally, monitoring wells can provide the same short-circuiting pathway if they are not maintained. Water quality management for storm water is discussed in Section 2.4.2. The Region of Peel and Town of Caledon have referred to Salt Management Plans on their respective websites and these plans are expected to provide additional guidance aimed at minimizing potential loadings (NOTE: Specific plans need to be confirmed). In addition, the following should be considered to minimize potential water quality impacts:

- Hydrogeological sensitivity for locating underground storage tanks (i.e., surficial sand unit, proximity to water course or wetland). Require associated groundwater monitoring for storage tanks.
- Spills management plans.
- Minimize application of fertilizer, pesticides and herbicides.
- Maintain a contaminant threats inventory; employment lands may possess a higher potential risk to groundwater quality depending on the specific industries.
- Require contaminant management plans as a condition of development in employment areas for employment uses/types that are considered to be a high risk to groundwater contamination. .

Additional groundwater quality management recommendations are presented in the Approved Source Protection Plan: CTC Source Protection Region (CTC Source Protection Committee, March 25, 2019) and the supporting documents; Approved Updated Assessment Report: Toronto and Region Source Protection Area (CTC Source Protection Committee, July 24, 2015) and Approved Updated Assessment Report: Credit Valley Source Protection Area (CTC Source Protection Committee, December 5, 2019).

To prevent potential contaminants from entering the groundwater flow system through abandoned private domestic wells or unused monitoring wells, it will be necessary that they be properly decommissioned as per MECP Ontario Regulation 903.

Based on the discussion above, the following outlines the subwatershed specific potential for groundwater impacts within the FSA. Where the impacts relate more to a reduction in recharge the related deficit can be addressed through stormwater management and the implementation of Low Impact Development (LID) infiltration-based Best Management Practices (BMPs). BMPs are discussed in detail in Sections 2.3.1.1 and 2.4.2. In addition, the importation of lake-based water, applications and leakage of domestic water will offset in part the potential recharge reduction related to impervious surfaces.

The extent of the potential groundwater impacts to the various receptors (eg, aquifers, streams and wetlands) within the subwatersheds are based on the following:

- The permeable nature of the surfical sediments (Drawing GW-4),
- The thickness of the Halton Till (Drawing GW-5a),
- Areas of shallow ground water and areas of flowing wells (Drawing GW-8a),
- Areas of groundwater discharge and seeps and springs (Drawing GW-10),
- ESGRAs and SGRAs (Drawing GW-9) and
- HVAs (Drawing GW-12).

Main Humber Subwatershed

Thickness of surficial till of less than 3 m is more predominant adjacent to the FSA along various reaches correlating with the groundwater discharge and only one minor reach within the FSA.

There is one minor HVA and a number of ESGRAs.

West Humber Subwatershed

Thickness of surficial till is less than 3 m along various reaches correlating with the groundwater discharge mainly south of Healey Road. Groundwater discharge and seeps and springs occur along most of the higher order reaches. The sources of the discharge are more likely regional but local recharge should be considered for mitigation in the absence of more detailed studies.

A shallow water table exists within the central and north-eastern portion and flowing well conditions are predominant in these same areas north of Healey Road closer to King Street. Development in these areas may require extensive dewatering and result in impacts on the local flow system and potential groundwater discharge. These areas may also restrict the implementation of various stormwater practices.

There are two minor SGRAs related to the surficial sand and gravel. ESGRAs are more predominant in the eastern portion and HVAs in the central portion.

Upper Etobicoke Creek Subwatershed

Thickness of surficial till is less than 3 m in the southwestern portion north of Mayfield Road correlating with the groundwater discharge. Additional groundwater discharge and seeps and springs occur throughout this portion of the FSA but mainly to the west of Mclaughlin Road. Discharge and seeps and springs occur along most of the higher order reaches. The sources of the discharge are more likely regional but local recharge should be considered for mitigation in the absence of more detailed studies.

A shallow water table exists mainly within the western portion and along with instances of flowing well conditions. These areas give rise to the potential for extensive dewatering and associated impacts on the local flow system and potential groundwater discharge. These areas may also restrict the implementation of various stormwater practices.
There is a minor SGRA related to the surficial sand and gravel on the eastern boundary. ESGRAs are more common throughout and HVAs are more predominant in the western portion.

Fletcher's Creek Subwatershed

A shallow water table exists within the eastern limit of the FSA within the Fletcher's Creek Subwatershed. This area can give rise to the potential for extensive dewatering and associated impacts on the local flow system and potential groundwater discharge. These areas may also restrict the implementation of various stormwater practices.

An HVA is noted in the eastern portion of the FSA within this subwatershed.

Huttonville Creek Subwatershed, Main Credit Glen Williams to Norval Subwatershed

Thickness of surficial till is less than 3 m and a flowing well exist at the surface water divide increasing the potential for greater dewatering quantities.

2.3.1.2 Preliminary SABE Concept

Surface Water Impact Assessment

The Region's Planning Consulting Team led by Hemson has developed a preliminary SABE concept, depicting the conceptual locations and extent of future community and employment land uses within the FSA. The extent of the SABE within the respective subwatersheds is presented in Drawing WR-3. As the information in Drawing WR-3 indicates, the preliminary SABE concept extends across the headwaters of the Upper Etobicoke Creek Subwatershed, West Humber River Subwatershed and the Main Humber Subwatershed within TRCA jurisdiction. On the west side, the preliminary SABE concept falls within the headwater reaches of the Credit River Watershed, encompassing the upstream limits of three (3) subwatersheds, namely the Credit River (Glen Williams to Norval) Subwatershed, Huttonville Creek Subwatershed and Fletcher's Creek Subwatershed. The approximate contributing drainage areas of the community and employment land uses of the preliminary SABE concept, within each subwatershed, are summarized in Table 2.3.1.19 and the approximate contributing drainage areas as a percentage of the total subwatershed drainage area is summarized in Table 2.3.1.20.

Table 2.3.1.19. Summary of Contributing Drainage Areas for Preliminary SABE Concept by Subwatershed (ha)

Watershed	Subwatershed	Preliminary SABE Land Use		Total
		Community	Employment	
Credit River	Credit River – Glen Williams to Norval	9.68	6.23	15.92
	Huttonville Creek	1.90	35.75	37.65
	Fletcher's Creek	126.27	1.05	127.31
Etobicoke Creek	Upper Etobicoke Creek	731.32	146.03	877.35
Humber River	West Humber River	1824.51	878.84	2703.35
	Main Humber River	150.98	-	150.98

Table 2.3.1.20. Summary of Contributing Drainage Areas for Preliminary SABE Concept as Percentage of Total Subwatershed Area (%)

Watershed	Subwatershed	Preliminary SABE Land Use		Total
		Community	**Employment**	
Credit River	Credit River – Glen Williams to Norval	0.4	0.3	0.7
	Huttonville Creek	0.1	2.4	2.5
	Fletcher's Creek	3.0	0.0	3.1
Etobicoke Creek	Upper Etobicoke Creek	7.3	1.5	8.8
Humber River	West Humber River	9.0	4.3	13.4
	Main Humber River	0.4	-	0.4

The above results indicate that the majority of the preliminary SABE concept would be comprised of community land use, and would lie within the West Humber and Upper Etobicoke Creek Subwatersheds. The community land use is currently estimated to represent an imperviousness of 70%, and the employment land uses would represent an imperviousness of 90% under future conditions.

The conversion of rural lands to community land use conditions, without stormwater management, is recognized to reduce the amount of rainfall which infiltrates into the ground, increasing the volume of surface runoff generated from storm and snowmelt events, as well as the rate at which runoff is conveyed toward receiving systems. Runoff from community land uses is recognized to generally increase the concentration and mass loadings of heavy metals and certain phosphorus-based chemicals, as well as certain anions, particularly chlorides from road salts during winter maintenance, and increased temperature in surface runoff.

The higher impervious coverage resulting from the conversion of rural lands to employment land use conditions, in the absence of stormwater management, is generally recognized to provide a greater risk of flooding and erosion along watercourses and drainage systems proximate to the new urban area, as well as a deterioration to the water quality and associated ecology within the receiving systems. These changes to runoff volume, rate, and water quality resulting from development of employment land uses, may likewise translate to an increased risk of flooding and erosion at a broader subwatershed or watershed scale within the receiving system, and similar deterioration to the surface water quality. The following section summarizes the anticipated impacts of future development within the FSA to the receiving systems within the respective subwatersheds which constitute the FSA.

Main Humber Subwatershed

Flood Risk (on-site/off-site):

Per Tables 2.3.1.19 and 2.3.1.20, the portion of the preliminary SABE concept within the Main Humber Subwatershed is relatively small in size (i.e. 151 ha), and represents a small proportion of the total subwatershed area (i.e. 1.0 %). The preliminary SABE concept within the Main Humber Subwatershed consists entirely of community land use, with no employment land use. The portions of the preliminary SABE concept within the subwatershed drain toward the major confined watercourses via a series of headwater drainage features, hence there is currently no formal flood hazard delineated within the designated preliminary SABE concept within the main Humber Subwatershed. Although these portions of the preliminary SABE concept lie upstream of designated FVAs within the Humber River Watershed, it is anticipated that development of these lands would have a negligible impact to off-site/downstream flood risk due to the small proportion of these areas relative to the total contributing drainage areas to the FVAs. Moreover, as the lands drain directly toward the well-defined and regulated watercourse systems, it is anticipated that development of these lands would not represent a local flood risk, provided that the current discharge locations are retained and utilized post-development. As such, it is anticiapted that stormwater management for quantity controls, if required for these areas, would not require over-control of peak flows for flood protection of downstream properties (i.e. post-to-pre control anticipated to be sufficient). Furthermore, quantity controls for the Regional (Hurricane Hazel) Storm event may not be required for these areas, however this would be subject to confirmation as part of future detailed studies (local SWS) and a determination of the recommended SABE boundary.

Erosion Risk:

The erosion assessment completed for the Part A report indicated that no erosion sensitive sites are currently located proximate to the preliminary SABE concept in the Main Humber Subwatershed. While it is anticipated that development of the preliminary SABE concept within the Main Humber Subwatershed would increase erosion potential along the receiving watercourses, it is anticipated that any potential erosion impacts may be mitigated through conventional practices (i.e. extended-detention storage within end-of-pipe facilities with drawdown times less than 5 days, implementation of Low Impact Development (LID) infiltration-based Best Management Practices (BMPs).

Water Budget:

The key hydrologic features and key hydrologic areas within, and proximate to, the preliminary SABE concept within the Main Humber Subwatershed include several ecologically significant groundwater recharge areas (ESGRAs), and some areas with low depth to water table. As such, development of the preliminary SABE concept within the Main Humber Subwatershed would, without mitigation, be expected to reduce groundwater contributions to these areas. This is disussed in further detail in Section 2.3.1.2.

West Humber Subwatershed

Flood Risk (on-site/off-site):

The portion of the preliminary SABE concept within the West Humber Subwatershed is relatively large in size (i.e. 2703 ha), and represents a sizeable proportion of the total subwatershed area (i.e. 13.4 %). Approximately 2/3 of the preliminary SABE concept within the West Humber Subwatershed consists of community land use, with the remaining 1/3 designated for employment land use. The portions of the preliminary SABE concept within the subwatershed drain toward the major confined watercourses, as well as various unconfined watercourses, hence some of the contributing areas have a regulated flood hazard associated with the drainage features through the site, as well as through downstream properties. Moreover, as portions of the lands drain directly toward the unconfined watercourses and drainage features offsite, it is anticipated that development of these lands, in the absence of stormwater management, would increase peak flows offsite, thus presenting a local flood risk to adjacent properties; this is particularly anticipated to be the the case for the designated employments lands due to the higher impervious coverange associated with that development. It is anticipated that stormwater management for quantity controls would be required to control post-development flows to pre-development levels for all events including the Regional Storm event, in order to mitigate both local and subwatershed-scale flood risks. As the preliminary SABE concept is located toward the headwaters, it is anticipated that a uniform application of post-to-pre control or a combination of strategic post-to-pre control and undercontrol would provide adequate flood protection, and over-control of peak flows for flood protection of downstream properties would not be required due to the size of the Humber River Watershed (i.e. 903 km^2 +/-) and the associated variability in coverage of rainfall. However, as noted in the previous discussion regarding the FSA, recent analyses completed by TRCA for the Humber River SWM Quantity Control Criteria Updates (WSP, November 2, 2020) have concluded that over-control of peak flows would be required to achieve watershed-scale flood protection, based on the application of synthetic design storms for hydrologic analysis. The requirements for stormwater management are thus to be established as part of future studies (i.e. local SWSs) and are recommeded to apply continuous simulation and account for the spatial varibility in rainfall across the watershed.

Erosion:

It is anticipated that development of the preliminary SABE concept within the West Humber Subwatershed would increase erosion potential along the receiving watercourses. Similar to the flooding impacts discussed above, it is anticiapted that the erosion impacts resulting from the more intensive development associated with employment land use conditions would be greater than those resulting from community developmen. For either land use, however, the erosion impacts may be mitigated through the provision of extended detention storage within end-of-pipe facilities, potentially in combination with LID BMPs which promote infiltration and/or evapotranspiration to reduce the volume of surface runoff). The specific requirements for mitigating erosion impacts are to be determined as part of future studies.

Water Budget:

The key hydrologic features and key hydrologic areas within and proximate to the preliminary SABE concept within the West Humber Subwatershed include ecologically significant groundwater recharge areas (ESGRAs), areas with low depth to water table, and pockets of significant groundwater recharge areas. In addition, key hydrologic features in the form of seepage areas and wetlands are located within this portion of the preliminary SABE concept. Development of the preliminary SABE concept within the West Humber Subwatershed would be expected to reduce groundwater contributions to these areas, potentially impacting the water budget to sensitive ecological features, particularly for the employment development currently envisioned. Measures to manage water budget through the application of LID BMPs which promote groundwater recharge and/or evapotranspiration will be required to mitigate these impacts. The implementation of these measures will require infiltration of clean runoff (i.e. rootop runoff) and pre-treatment of surface runoff from other paved surfaces (i.e. roads, parking lots, driveways) to maintain the quality of infiltrated surface runoff.

Upper Etobicoke Creek Subwatershed

Flood Risk (on-site/off-site):

The portion of the preliminary SABE concept within the Upper Etobicoke Creek Subwatershed is relatively large in size (i.e. 934 ha), and represents a sizeable proportion of the total subwatershed area (i.e. 8.8 %). Approximately 4/5 of the preliminary SABE concept within the Upper Etobicoke Creek Subwatershed consists of community land use, with the remaining 1/5 designated for employment land use. The portions of the preliminary SABE concept within the subwatershed drain toward the major confined watercourses and various unconfined watercourses, hence some of the contributing areas have a regulated flood hazard associated with the drainage features through the site, as well as through downstream properties. Moreover, as portions of the lands drain directly toward the unconfined watercourses and drainage features offsite, it is anticipated that development of these lands, in the absence of stormwater management, would increase peak flows offsite, thus presenting a local flood risk to adjacent properties. As such, it is anticipated that stormwater management for quantity controls would be required to control post-development flows to pre-development levels for all events including the Regional Storm event, in order to mitigate both local and subwatershed-scale flood risks. As the preliminary SABE concept is located toward the headwaters, it is anticipated that a uniform application of post-to-pre control or a combination of strategic post-to-pre control and undercontrol would provide adequate flood protection, and over-control of peak flows for flood protection of downstream properties would not be required.

Erosion:

It is anticipated that development of the preliminary SABE concept within the Upper Etobicoke Creek Subwatershed would increase erosion potential along the receiving watercourses. Similar to the flooding impacts discussed above, it is anticiapted that the erosion impacts resulting from the more intensive development associated with employment land use conditions would be greater than those resulting from community developmen. For either land use, however, the erosion impacts may be mitigated through the provision of extended detention storage within end-of-pipe facilities, potentially in combination with LID BMPs which promote infiltration and/or evapotranspiration to reduce the volume of surface runoff).

Water Budget:

The key hydrologic features and key hydrologic areas within and proximate to the preliminary SABE concept within the Upper Etobicoke Creek Subwatershed include ecologically significant groundwater recharge areas (ESGRAs), areas with low depth to water table, and pockets of significant groundwater recharge areas. In addition, key hydrologic features in the form of seepage areas and wetlands are located within this portion of the preliminary SABE concept. Development of the preliminary SABE concept within the Upper Etobicoke Creek Subwatershed would be expected to reduce groundwater contributions to these areas, potentially impacting the water budget to sensitive ecological features, particularly for the employment development currently envisioned. As such, development of the preliminary SABE concept within the Upper Etobicoke Creek Subwatershed would reduce groundwater contributions to these areas, potentially impacting water budget to sensitive ecological features. Measures to manage water budget through the application of LID BMPs which promote groundwater recharge and/or evapotranspiration will be required to mitigate these impacts.

Fletcher's Creek Subwatershed

Flood Risk (on-site/off-site):

The portion of the preliminary SABE concept within the Fletcher's Creek Subwatershed is relatively small in size (i.e. 127 ha), and represents a minor proportion of the total subwatershed area (i.e. 3.1 %). The preliminary SABE concept within the Fletcher's Creek Subwatershed consists almost entirely of community land use, with a small portion (i.e. 1 ha) designated for employment land use. The portions of the preliminary SABE concept within the subwatershed drain toward the headwater drainage features, which are not regulated based upon flood hazard definition. This segment of the preliminary SABE concept drains directly toward the unconfined watercourses and drainage features offsite, hence it is anticipated that development of these lands in the absence of stormwater management would increase peak flows offsite, thus presenting a local flood risk to adjacent properties. As such, it is anticipated that stormwater management for quantity controls would be required to control post-development flows to pre-development levels for all events including the Regional Storm event, in order to mitigate both local and subwatershed-scale flood risks. As the preliminary SABE concept is located within the headwaters of the subwatershed, it is anticipated that a uniform application of post-to-pre control would provide adequate flood protection, and over-control of peak flows for flood protection of downstream properties would not be required. Furthermore, given the similar land use conditions within the preliminary SABE concept and the land use conditions assessed as part of previous Subwatershed Studies for the Fletcher's Creek Subwatershed, it is anticipated that the sizing criteria established as part of previous studies would provide guidance for establishing stormwater management sizing criteria for the preliminary SABE concept. The requirements for stormwater management are to be established as part of future studies.

Erosion:

It is anticipated that development of the preliminary SABE concept within the Fletcher's Creek Subwatershed would increase erosion potential along the receiving watercourses. Based upon findings from previous studies, it is anticipated that the erosion impacts may be mitigated through the provision of extended detention storage within end-of-pipe facilities, and may potentially be combined with LID BMPs which promote infiltration and/or evapotranspiration to reduce the volume of surface runoff.

Water Budget:

The key hydrologic features and key hydrologic areas within and proximate to the preliminary SABE concept within the Fletcher's Creek Subwatershed are limited to shallow depth to groundwater and the presence of headwater drainage features. Although development of the preliminary SABE concept within the Fletcher's Creek Subwatershed would be anticipated to reduce groundwater recharge, it is not anticipated to represent a significant impact to the groundwater system, key hydrologic features or areas. Nevertheless, measures to manage water budget through the application of LID BMPs which promote groundwater recharge and/or evapotranspiration will be required as part of the stormwater management plan for the area..

Huttonville Creek Subwatershed

Flood Risk (on-site/off-site):

The portion of the preliminary SABE concept within the Huttonville Creek Subwatershed is small in size (i.e. 38 ha), and represents a small portion of the total subwatershed area (i.e. 2.5 %). The preliminary SABE concept within the Huttonville Creek Subwatershed consists almost entirely of employment land use, with a small portion (i.e. 2 ha) designated for community land use. The portions of the preliminary SABE concept within the subwatershed drain toward the headwater drainage features, which are not regulated based upon flood hazard definition. This segment of the preliminary SABE concept drains directly toward the unconfined watercourses and drainage features offsite, hence it is anticipated that development of these lands in the absence of stormwater management would increase peak flows offsite, thus presenting a local flood risk to adjacent properties. Given the prominently employment land use proposed for this portion of the preliminary SABE concept, it is anticiapted that impacts to peak flows and associated flood risk in the absence of stormwater management would be greater compared to impactas associated with community land use development. Tt is anticipated that stormwater management for quantity controls would be required to control post-development flows to pre-development levels for all events including the Regional

Storm event, in order to mitigate both local and subwatershed-scale flood risks. As the preliminary SABE concept is located within the headwaters of the subwatershed, it is anticipated that a uniform application of post-to-pre control or a combination of strategic post-to-pre control and undercontrol would provide adequate flood protection, and over-control of peak flows for flood protection of downstream properties would not be required.

Erosion:

It is anticipated that development of the preliminary SABE concept within the Huttonville Creek Subwatershed would increase erosion potential along the receiving watercourses. Similar to the flooding impacts discussed above, it is anticiapted that the erosion impacts resulting from the more intensive development associated with employment land use conditions would be greater than those resulting from community development. Based upon findings from previous studies, it is anticipated that the erosion impacts may be mitigated through the provision of extended detention storage within end-of-pipe facilities, and may potentially be combined with LID BMPs which promote infiltration and/or evapotranspiration to reduce the volume of surface runoff.

Water Budget:

Very few key hydrologic features and key hydrologic areas have been identified within or proximate to the preliminary SABE concept within the Huttonville Creek Subwatershed, hence while development of the preliminary SABE concept within the Huttonville Creek Subwatershed would be anticipated to reduce groundwater recharge, it is not anticipated to represent a significant impact to the groundwater system, key hydrologic features or areas. Nevertheless, measures to manage water budget through the application of LID BMPs which promote groundwater recharge and/or evapotranspiration will be required as part of the stormwater management plan for the area..

Main Credit River (Glen Williams to Norval)

Flood Risk (on-site/off-site):

The portion of the preliminary SABE concept discharging toward the Main Branch of the Credit River is relatively small in size (i.e. 23 ha), and represents a small proportion of the local subwatershed area (i.e. 0.7 %). Approximately 3/5 of the preliminary SABE concept draining towater the Main Credit River consists of community land use, with the remaining 2/5 designated for employment land use. The portions of the preliminary SABE concept within the subwatershed drain toward the major confined watercourses via a series of headwater drainage features, hence there is currently no flood hazard delineated within the designated preliminary SABE concept. As the land drains directly toward the well-defined and regulated watercourse systems, it is anticipated that development of these lands would not represent a local flood risk, provided that the current discharge locations are retained and utilized post-development. As such, it is anticipated that stormwater management for quantity controls, if required for this area, would not require over-control of peak flows for flood protection of downstream properties (i.e. post-to-pre control anticipated to be sufficient). Furthermore, quantity controls for the Regional (Hurricane Hazel) Storm event may not be required for this area, however this would be subject to confirmation as part of detailed studies.

Erosion:

While it is anticipated that development of the preliminary SABE concept within this area would increase erosion potential along the receiving watercourses, it is anticipated that the erosion impacts may be mitigated through conventional practices (i.e. extended-detention storage within end-of-pipe facilities with drawdown times less than 5 days, implementation of LID BMPs which promote infiltration and/or evapotranspiration). The specific requirements for mitigating erosion impacts are to be determined as part of future studies.

Water Budget:

The key hydrologic areas within and proximate to the preliminary SABE concept discharging toward the Credit River include areas with low depth to water table, although it is recognized that additional key hydrologic areas and features may be located downstream along the Credit River Main Branch. While the size of the preliminary SABE concept within this area is of such small magnitude that development of this area is not anticipated to present an adverse impact to key hydrologic features or areas, measures to manage water budget through the application of LID BMPs which promote groundwater recharge and/or evapotranspiration will be required as part of the stormwater management plan for the area..

Groundwater Impact Assessment

Similar to the method described in Section 2.3.1.1 for the FSA, an existing conditions water balance was developed for each of the preliminary SABE concept community and employment areas that occur within the seven subwatersheds (ref. Drawing GW-13, Appendix B). The water balance parameters (i.e., ET, recharge, runoff and precipitation) were estimated from a model developed by the ORMGP (ORMGP 2018) and are provided in Table 2.3.1.21 in units of mm/year and m^3/day. The existing water balance values were quite similar among the seven subwatersheds (i.e., within 22 to 100 mm of each other) as a result of the similarity of the physical conditions throughout the preliminary SABE (e.g., similar surficial geology [largely finer grained till], land use [non-urban] and ground surface topography). Additional details about the physical conditions can be found within 'Scoped Subwatershed Study Part A – Existing Conditions and Characterization (Final Report)' (Wood, January 2022).

Table 2.3.1.21. Existing Conditions Water Balance for Preliminary SABE Concept Areas

Authority	Watershed	Subwatershed	Preliminary SABE Concept Area	Area (km^2)	Existing Conditions Water Balance (e.g., Agriculture)				
					P	ET	RO	R	ΔS
					(mm/year)				
CVC	Credit River	Credit River - Glen Williams to Norval	Community	0.10	809	548	133	122	6
			Employment	0.06	809	545	136	122	6
		Fletcher's Creek	Community	1.26	809	532	153	118	6
			Employment	0.01	809	492	204	107	6
		Huttonville Creek	Community	0.02	809	472	233	97	7
			Employment	0.36	809	515	174	113	7
TRCA	Humber River	Main Humber	Community	1.51	787	514	161	104	8
		West Humber	Community	18.25	790	527	137	119	7
			Employment	8.79	792	532	139	115	6
	Etobicoke Creek	Spring Creek	Employment	0.07	792	522	157	106	7
		Upper Etobicoke	Community	6.68	805	521	135	143	6
			Employment	1.95	795	525	151	112	7
					(m^3/day)				
CVC	Credit River	Credit River - Glen Williams to Norval	Community	0.10	215	145	35	32	2
			Employment	0.06	138	93	23	21	1
		Fletcher's Creek	Community	1.26	2,799	1,840	529	408	21
			Employment	0.01	23	14	6	3	0
		Huttonville Creek	Community	0.02	42	25	12	5	0
			Employment	0.36	792	504	170	111	7
TRCA		Main Humber	Community	1.51	3,255	2,126	666	430	33

Authority	Watershed	Subwatershed	Preliminary SABE Concept Area	Area (km²)	Existing Conditions Water Balance (e.g., Agriculture)				
					P	ET	RO	R	ΔS
					(mm/year)				
	Humber River	West Humber	Community	18.25	39,489	26,343	6,848	5,948	350
			Employment	8.79	19,070	12,809	3,347	2,769	144
	Etobicoke Creek	Spring Creek	Employment	0.07	150	99	30	20	1
		Upper Etobicoke	Community	6.68	14,734	9,536	2,471	2,617	110
			Employment	1.95	4,257	2,811	808	600	37

P – Precipitation; ET – Evapotranspiration; RO – Runoff; R – Recharge; ΔS – Change in Storage

A future conditions water balance with no mitigation was estimated for the preliminary SABE concept community and employment areas in each of the seven subwatersheds for the impact assessment (ref. Drawing GW-13, Appendix B). The overall impact assessment has assumed a representative impervious coverage of 70% for community areas (e.g., high rise and mid-rise land uses) and 90% for employment areas (e.g., industrial land uses). The water budget parameters for community areas were estimated using ORMGP model output from an existing high-density residential development on the Halton Till in the Brampton area located adjacent to the preliminary SABE concept areas (ORMGP 2018). Water budget parameters for employment areas were estimated using ORMGP model output (ORMGP 2018) from an existing industrial/employment development on the Halton Till in the south central Brampton area. The Halton Till was considered appropriate as the majority of the preliminary SABE concept areas are covered at surface by the Halton Till or Wildfield Till, which are considered relatively finer grained sediments (ref. Drawing GW-4, Appendix G). The future conditions water balance for these land areas (Table 2.3.1.22) includes only the developable lands (ref. Drawing GW-13, Appendix B); areas including the greenbelt, GTA West corridor, Brampton Caledon Airport and other FSA takeouts were not included in this assessment.

The change in water balance between existing conditions and estimated post development conditions is presented as a deficit or surplus in Table 2.3.1.23, for each preliminary SABE concept community and employment area in each subwatershed. The deficit in recharge for a generalized high-density residential (community) development on Halton Till has the potential to reduce recharge by 63 to 109 mm/year (3 to 4,249 m^3/day) or 83 mm/year (1,142 m^3/day) on average. This development also has the potential to increase runoff (surplus) by 298 to 398 mm/year (16 to 19,695 m^3/day) or 372 mm/year (4,984 m^3/day) on average. The assessment, assuming average imperviousness similar to industrial (employment) development on Halton Till, has the potential to reduce recharge even further (i.e., 99 to 115 mm/year and 106 mm/year on average; or 3 to 2,600 m^3/day and 551 m^3/day on average).

Under future development in community areas, ET may be reduced by 237 to 313 mm/year (12 to 14,596 m^3/day) or 284 mm/year (3,685 m^3/day) on average from increased impervious surfaces (Table 2.3.1.23). Similarly, and to a greater extent, future development in employment areas may reduce ET by 298 to 351 mm/year (9 to 8,138 m^3/day) or 328 mm/year (1,726 m^3/day) on average from greater impervious surfaces (Table 2.3.1.23). Strategies that have the potential to mitigate reduced ET include those that promote and enhance vegetation in developed areas. Similar mitigation strategies as described in Section 2.3.1.1 would be applicable for the preliminary SABE concept community and employment areas.

Table 2.3.1.22. Representative Future Conditions Water Balance for a High-Density Residential Development (Community) and Industrial Development (Employment) on Halton Till

Authority	Watershed	Subwatershed	Preliminary SABE Concept	Area (km²)	Future Conditions Water Balance				
					P	ET	RO	R	ΔS
					(mm/year)				
CVC	Credit River	Credit River - Glen Williams to Norval	Community	0.10	809	235	531	34	9
			Employment	0.06	809	194	594	7	14
		Fletcher's Creek	Community	1.26	809	235	531	34	9
			Employment	0.01	809	194	594	7	14
		Huttonville Creek	Community	0.02	809	235	531	34	9
			Employment	0.36	809	194	594	7	14
TRCA	Humber River	Main Humber	Community	1.51	787	235	531	34	(13)
		West Humber	Community	18.25	790	235	531	34	(10)
			Employment	8.79	792	194	594	7	(3)
	Etobicoke Creek	Spring Creek	Employment	0.07	792	194	594	7	(3)
		Upper Etobicoke	Community	6.68	805	235	531	34	5
			Employment	1.95	795	194	594	7	0
					(m^3/day)				
CVC	Credit River	Credit River - Glen Williams to Norval	Community	0.10	215	62	141	9	2
			Employment	0.06	138	33	101	1	2
		Fletcher's Creek	Community	1.26	2,799	813	1,837	118	31
			Employment	0.01	23	6	17	0	0
		Huttonville Creek	Community	0.02	42	12	28	2	0
			Employment	0.36	792	190	582	7	14
TRCA	Humber River	Main Humber	Community	1.51	3,255	972	2,196	141	(54)
		West Humber	Community	18.25	39,489	11,747	26,543	1,700	(500)
			Employment	8.79	19,070	4,671	14,302	169	(72)
	Etobicoke Creek	Spring Creek	Employment	0.07	150	37	113	1	(1)
		Upper Etobicoke	Community	6.68	14,734	4,301	9,719	622	92
			Employment	1.95	4,257	1,039	3,180	37	0

P – Precipitation; ET – Evapotranspiration; RO – Runoff; R – Recharge; ΔS – Change in Storage

Table 2.3.1.23 Change in Future Conditions Water Balance vs. Existing Conditions Water Balance

Authority	Watershed	Subwatershed	Preliminary SABE Concept	Area (km²)	Change in Water Balance				
					P	ET	RO	R	ΔS
					(mm/year)				
CVC	Credit River	Credit River - Glen Williams to Norval	Community	0.10	0	(313)	398	(88)	3
			Employment	0.06	0	(351)	458	(115)	8
		Fletcher's Creek	Community	1.26	0	(297)	378	(84)	3
			Employment	0.01	0	(298)	390	(100)	8
		Huttonville Creek	Community	0.02	0	(237)	298	(63)	2
			Employment	0.36	0	(321)	420	(106)	7
TRCA	Humber River	Main Humber	Community	1.51	0	(279)	370	(70)	(21)
		West Humber	Community	18.25	0	(292)	394	(85)	(17)
			Employment	8.79	0	(338)	455	(108)	(9)
	Etobicoke Creek	Spring Creek	Employment	0.07	0	(328)	437	(99)	(10)
		Upper Etobicoke	Community	6.68	0	(286)	396	(109)	(1)
			Employment	1.95	0	(331)	443	(105)	(7)
Average Deficit/Surplus vs. Existing Condition for Community Lands					**0**	**(284)**	**372**	**(83)**	**(5)**
Average Deficit/Surplus vs. Existing Condition for Employment Lands					**0**	**(328)**	**434**	**(106)**	**(1)**
					(m^3/day)				
CVC	Credit River	Credit River - Glen Williams to Norval	Community	0.10	0	(83)	106	(23)	1
			Employment	0.06	0	(60)	78	(20)	1
		Fletcher's Creek	Community	1.26	0	(1,027)	1,308	(291)	10
			Employment	0.01	0	(9)	11	(3)	0
		Huttonville Creek	Community	0.02	0	(12)	16	(3)	0
			Employment	0.36	0	(314)	411	(104)	7
TRCA	Humber River	Main Humber	Community	1.51	0	(1,154)	1,530	(290)	(87)
		West Humber	Community	18.25	0	(14,596)	19,695	(4,249)	(850)
			Employment	8.79	0	(8,138)	10,955	(2,600)	(217)
	Etobicoke Creek	Spring Creek	Employment	0.07	0	(62)	83	(19)	(2)
		Upper Etobicoke	Community	6.68	0	(5,235)	7,248	(1,995)	(18)
			Employment	1.95	0	(1,772)	2,372	(562)	(37)
Average Deficit/Surplus vs. Existing Condition for Community Lands					**0**	**(3,685)**	**4,984**	**(1,142)**	**(157)**
Average Deficit/Surplus vs. Existing Condition for Employment Lands					**0**	**(1,726)**	**2,319**	**(551)**	**(41)**

P – Precipitation; ET – Evapotranspiration; RO – Runoff; R – Recharge; ΔS – Change in Storage

In addition to the change in the water balance described in the foregoing, other considerations for potential groundwater impacts are provided in Section 2.3.1.1. It is expected that these considerations will generally apply through the SABE given the relatively consistent nature of surficial geology and subsequent potential recharge across the undeveloped lands within the SABE. The general subwatershed specific groundwater impacts presented in Section 2.3.1.1 apply to the SABE lands as well.

2.3.1.3 SABE Testing Areas

Surface Water Impact Assessment

The Region's Planning Consulting Team led by Hemson has identified additional lands within the FSA, which are not currently designated for the preliminary SABE concept, however which may ultimately be included within the final recommended SABE. These lands, referred to as the SABE testing areas, are depicted in Drawing WR-3. As the information in Drawing WR-3 indicates, the SABE testing areas are localized to TRCA jurisdiction, and lie within the Main Humber Subwatershed, the West Humber Subwatershed, and the Upper Etobicoke Creek Subwatershed. The approximate contributing drainage areas of the community and employment land uses of the SABE testing areas, within each subwatershed, are summarized in Table

2.3.1.24 and the approximate contributing drainage areas as a percentage of the total subwatershed drainage area is summarized in Table 2.3.1.25.

Table 2.3.1.24. Summary of Contributing Drainage Areas for SABE Testing Areas by Subwatershed (ha)

Watershed	Subwatershed	Preliminary SABE Land Use		Total
		Community	Employment	
Credit River	Credit River – Glen Williams to Norval	-	-	-
	Huttonville Creek	-	-	-
	Fletcher's Creek	-	-	-
Etobicoke Creek	Upper Etobicoke Creek	71.51	136.15	207.66
Humber River	West Humber River	305.03	316.96[1.]	621.99[1.]
	Main Humber River	138.34	-	138.34

NOTE: [1.] Values include 73.57 ha of employment land which are currently identified as community land use within the preliminary SABE concept.

Table 2.3.1.25. Summary of Contributing Drainage Areas for SABE Testing Areas as Percentage of Total Subwatershed Area (%)

Watershed	Subwatershed	Preliminary SABE Land Use		Total
		Community	Employment	
Credit River	Credit River – Glen Williams to Norval	-	-	-
	Huttonville Creek	-	-	-
	Fletcher's Creek	-	-	-
Etobicoke Creek	Upper Etobicoke Creek	0.7	1.4	2.1
Humber River	West Humber River	1.5	1.6	3.1
	Main Humber River	0.4	-	0.4

The above results indicate that the majority of the SABE testing area would be comprised of employment land use, and would lie within the West Humber and Upper Etobicoke Creek Subwatersheds. The following section summarizes the anticipated impacts of future development of the SABE testing areas to the receiving systems within the respective subwatersheds.

Main Humber Subwatershed

Flood Risk (on-site/off-site):

Per Tables 2.3.1.24 and 2.3.1.25, the portion of the SABE testing areas within the Main Humber Subwatershed is relatively small in size (i.e. 138 ha), and represents a small proportion of the total subwatershed area (i.e. 0.4 %). The preliminary SABE concept within the Main Humber Subwatershed consists entirely of community land use, with no employment land use. The portions of the SABE testing area within the subwatershed drain toward the major confined watercourses via a series of headwater drainage features, hence there is currently no formal flood hazard delineated within the designated SABE testing area within the main Humber Subwatershed. Although these portions of the SABE testing area lie upstream of designated FVAs within the Humber River Watershed, it is anticipated that development of these lands would have a negligible impact to off-site/downstream flood risk due to the small proportion of these areas relative to the total contributing drainage areas to the FVAs. Moreover, as the lands drain directly toward the well-defined and regulated watercourse systems, it is anticipated that development of these lands would not represent a local flood risk, provided that the current discharge locations are retained and utilized post-development. As such, it is anticiapted that stormwater management for quantity controls, if required for these areas, would not require over-control of peak flows for flood protection of downstream properties (i.e. post-to-pre control anticipated to be sufficient). Furthermore, quantity controls for the Regional (Hurricane Hazel) Storm event may not be required for these areas, however this would be subject to confirmation as part of future detailed studies (local SWS) and a determination of the recommended SABE boundary.

Erosion Risk:

While it is anticipated that development of the SABE testing areas within the Main Humber Subwatershed would increase erosion potential along the receiving watercourses, it is anticipated that any potential erosion impacts may be mitigated through conventional practices (i.e. extended-detention storage within end-of-pipe facilities with drawdown times less than 5 days, implementation of Low Impact Development (LID) infiltration-based Best Management Practices (BMPs).

Water Budget:

The key hydrologic features and key hydrologic areas within, and proximate to, the SABE testing areas within the Main Humber Subwatershed include several ecologically significant groundwater recharge areas (ESGRAs), and some areas with low depth to water table. As such, development of the SABE testing areas within the Main Humber Subwatershed would, without mitigation, be expected to reduce groundwater contributions to these areas.

West Humber Subwatershed

Flood Risk (on-site/off-site):

The portion of the SABE testing areas within the West Humber Subwatershed is relatively small in size (i.e. 621.99 ha), and represents a small proportion of the total subwatershed area (i.e. 3.1 %). Approximately 1/2 of the SABE testing areas within the West Humber Subwatershed consists of employment land use, with the remaining 1/2 designated for community land use. The portions of the SABE testing areas within the subwatershed generally drain toward confined watercourses, hence several of the contributing areas have a regulated flood hazard associated with the drainage features through the site, as well as through downstream properties. As these portions of the SABE testing areas drain toward drainage features offsite, it is anticipated that development of these lands, in combination with the preliminary SABE concept and in the absence of stormwater management, would increase peak flows offsite, thus presenting a local flood risk to adjacent properties; this is particularly anticipated to be the the case for the designated employments lands due to the higher impervious coverange associated with that development. It is anticipated that stormwater management for quantity controls would be required to control post-development flows to pre-development levels for all events including the Regional Storm event, in order to mitigate both local and subwatershed-scale flood risks. As the SABE testing areas and the preliminary SABE concept are located toward the headwaters, it is anticipated that a uniform application of post-to-pre control or a combination of strategic post-to-pre control and undercontrol would provide adequate flood protection, and over-control of peak flows for flood protection of downstream properties would not be required due to the size of the Humber River Watershed (i.e. 903 km^2 +/-) and the associated variability in coverage of rainfall. However, as noted in the previous discussion regarding the FSA, recent analyses completed by TRCA for the Humber River SWM Quantity Control Criteria Updates (WSP, November 2, 2020) have concluded that over-control of peak flows would be required to achieve watershed-scale flood protection, based on the application of synthetic design storms for hydrologic analysis. The requirements for stormwater management are thus to be established as part of future studies (i.e. local SWSs) and are recommeded to apply continuous simulation and account for the spatial varibility in rainfall across the watershed.

Erosion:

It is anticipated that development of the SABE testing areas within the West Humber Subwatershed, in combination with the preliminary SABE concept, would increase erosion potential along the receiving watercourses. Similar to the flooding impacts discussed above, it is anticiapted that the erosion impacts resulting from the more intensive development associated with employment land use conditions would be greater than those resulting from community developmen. For either land use, however, the erosion impacts may be mitigated through the provision of extended detention storage within end-of-pipe facilities, potentially in combination with LID BMPs which promote infiltration and/or evapotranspiration to reduce the volume of surface runoff). The specific requirements for mitigating erosion impacts are to be determined as part of future studies.

Water Budget:

The key hydrologic features and key hydrologic areas within and proximate to the SABE testing areas within the West Humber Subwatershed include ecologically significant groundwater recharge areas (ESGRAs), areas with low depth to water table, and pockets of significant groundwater recharge areas. In addition, key hydrologic features in the form of seepage areas and wetlands are located within this portion of the SABE testing areas. Development of the SABE testing areas within the West Humber Subwatershed, in combination with development of the preliminary SABE concept, would be expected to reduce groundwater contributions to these areas, potentially impacting the water budget to sensitive ecological features, particularly for the employment development currently envisioned. Measures to manage water budget through the application of LID BMPs which promote infiltration and/or evapotranspiration will be required to mitigate these impacts. The implementation of these measures will require infiltration of clean runoff (i.e. rootop runoff) and pre-treatment of surface runoff from other paved surfaces (i.e. roads, parking lots, driveways) to maintain the quality of infiltrated surface runoff.

Upper Etobicoke Creek Subwatershed

Flood Risk (on-site/off-site):

The portion of the SABE testing areas within the Upper Etobicoke Creek Subwatershed is relatively small in size (i.e. 207.66 ha), and represents a small proportion of the total subwatershed area (i.e. 2.1 %). Approximately 2/3 of the SABE testing area within the Upper Etobicoke Creek Subwatershed consists of employment land use, with the remaining 1/3 designated for community land use. The portions of the SABE testing area within the subwatershed drain toward the major confined watercourses and various unconfined watercourses, hence some of the contributing areas have a regulated flood hazard associated with the drainage features through the site, as well as through downstream properties. Moreover, as portions of the lands drain directly toward the unconfined watercourses and drainage features offsite, it is anticipated that development of these lands, in the absence of stormwater management, would increase peak flows offsite, thus presenting a local flood risk to adjacent properties. As such, it is anticipated that stormwater management for quantity controls would be required to control post-development flows to pre-development levels for all events including the Regional Storm event, in order to mitigate both local and subwatershed-scale flood risks. As the SABE testing area is located toward the headwaters, it is anticipated that a uniform application of post-to-pre control or a combination of strategic post-to-pre control and undercontrol would provide adequate flood protection, and over-control of peak flows for flood protection of downstream properties would not be required.

Erosion:

It is anticipated that development of the SABE testing area within the Upper Etobicoke Creek Subwatershed would increase erosion potential along the receiving watercourses. Similar to the flooding impacts discussed above, it is anticiapted that the erosion impacts resulting from the more intensive development associated with employment land use conditions would be greater than those resulting from community developmen. For either land use, however, the erosion impacts may be mitigated through the provision of extended detention storage within end-of-pipe facilities, potentially in combination with LID BMPs which promote infiltration and/or evapotranspiration to reduce the volume of surface runoff).

Water Budget:

The key hydrologic features and key hydrologic areas within and proximate to the SABE testing areas within the Upper Etobicoke Creek Subwatershed include ecologically significant groundwater recharge areas (ESGRAs), areas with low depth to water table, and pockets of significant groundwater recharge areas. In addition, key hydrologic features in the form of seepage areas and wetlands are located within this portion of the SABE testing areas. Development of the SABE testing areas within the Upper Etobicoke Creek Subwatershed would be expected to reduce groundwater contributions to these areas, potentially impacting the water budget to sensitive ecological features, particularly for the employment development currently envisioned. As such, development of the SABE testing areas within the Upper Etobicoke Creek Subwatershed would reduce groundwater contributions to these areas, potentially impacting water budget to sensitive ecological features. Measures to manage water budget through the application of LID BMPs which promote infiltration and/or evapotranspiration will be required to mitigate these impacts. The implementation of these measures will require infiltration of clean runoff (i.e. rootop runoff) and pre-treatment of surface runoff from other paved surfaces (i.e. roads, parking lots, driveways) to maintain the quality of infiltrated surface runoff.

Groundwater Impact Assessment

Similar to the method described in Section 2.3.1.1 for the FSA, an existing conditions water balance was developed for each of the community and employment SABE testing areas. For the purposes of this assessment, each community testing area (CTA) and employment testing area (ETA) was numbered from 1 to 4 based on the position of the area from west to east across the FSA (labelled CTA1/ETA1 to CTA4/ETA4 on Drawing GW-13, Appendix B). The water balance parameters (i.e., ET, recharge, runoff and precipitation) were estimated from a model developed by the ORMGP (ORMGP 2018) and are provided in Table 2.3.1.26 in units of mm/year and m^3/day. The existing water balance values were quite similar among the SABE testing areas (i.e., within 11 to 30 mm of each other) as a result of the similarity of the physical conditions across the landscape (e.g., similar surficial geology [largely finer grained till], land use [non-urban] and ground surface topography).

Table 2.3.1.26. Existing Conditions Water Balance for SABE Testing Areas

SABE Testing Area	Area (km^2)	Existing Conditions Water Balance (e.g., Agriculture)				
		P	ET	RO	R	ΔS
		(mm/year)				
CTA1	0.99	791	524	149	112	6
CTA2	2.04	792	532	123	131	6
CTA3	1.17	783	532	133	110	8
CTA4	0.21	789	540	125	116	8
ETA1	1.36	791	523	150	110	8
ETA2	0.51	791	528	147	110	6
ETA3	0.99	792	541	120	124	7
ETA4	2.40	791	538	131	116	6
		(m^3/day)				
CTA1	0.99	2,148	1,423	405	304	16
CTA2	2.04	4,423	2,971	687	732	34
CTA3	1.17	2,513	1,708	427	353	26
CTA4	0.21	458	313	73	67	5
ETA1	1.36	2,951	1,951	560	410	30
ETA2	0.51	1,115	744	207	155	8
ETA3	0.99	2,146	1,466	325	336	19
ETA4	2.40	5,205	3,540	862	763	39

CTA – Community Testing Area; ETA – Employment Testing Area
P – Precipitation; ET – Evapotranspiration; RO – Runoff; R – Recharge; ΔS – Change in Storage

A future conditions water balance with no mitigation was estimated for the community and employment SABE testing areas for the impact assessment (ref. Drawing GW-13, Appendix B). Similar to the water budget assessment of the preliminary SABE concept areas (Section 2.3.1.2), the water budget parameters for community testing areas were estimated using ORMGP model output from existing high-density residential development on the Halton Till in Brampton, while parameters for employment testing areas were estimated using ORMGP model output from existing industrial/employment development on the Halton Till in the south central Brampton area (ORMGP 2018). The Halton Till was considered appropriate as the majority of the SABE testing areas are covered at surface by the Halton Till or Wildfield Till, which are considered relatively finer grained sediments. The future conditions water balance for these land areas (Table 2.3.1.27) includes only the developable lands (ref. Drawing GW-13, Appendix B); areas including the greenbelt, GTA West corridor, Brampton Caledon Airport and other FSA takeouts were not included in this assessment.

The change in water balance between existing conditions and estimated post development conditions is presented as a deficit or surplus in Table 2.3.1.28, for each SABE testing area. The deficit in recharge for a generalized high-density residential (community) development on Halton Till has the potential to reduce recharge by 76 to 97 mm/year (48 to 542 m^3/day) or 83 mm/year (261 m^3/day) on average. This development also has the potential to increase runoff (surplus) by 382 to 408 mm/year (236 to 2,279 m^3/day) or 399 mm/year (1,207 m^3/day) on average. The assessment, assuming average imperviousness similar to industrial (employment) development on Halton Till, has the potential to reduce recharge even further (i.e., 103 to 117 mm/year and 108 mm/year on average; or 145 to 717 m^3/day and 391 m^3/day on average).

Under future development in CTAs, ET may be reduced by 289 to 305 mm/year (177 to 1,659 m^3/day) or 297 mm/year (893 m^3/day) on average from increased impervious surfaces (Table 2.3.1.28). Similarly, and to a greater extent, future development in ETAs may reduce ET by 329 to 347 mm/year (471 to 2,264 m^3/day) or 339 mm/year (1,225 m^3/day) on average from greater impervious surfaces (Table 2.3.1.28). Strategies that have the potential to mitigate reduced ET include those that promote and enhance vegetation in developed areas. Similar mitigation strategies as described in Section 2.3.1.1 would be applicable for the SABE testing areas.

Table 2.3.1.27. Representative Future Conditions Water Balance for a High-Density Residential Development (Community) and Industrial Development (Employment) on Halton Till

SABE Testing Area	Area (km^2)	Future Conditions Water Balance				
		P	ET	RO	R	ΔS
		(mm/year)				
CTA1	0.99	791	235	531	34	-9
CTA2	2.04	792	235	531	34	-8
CTA3	1.17	783	235	531	34	-17
CTA4	0.21	789	235	531	34	-11
ETA1	1.36	791	194	594	7	-4
ETA2	0.51	791	194	594	7	-4
ETA3	0.99	792	194	594	7	-3
ETA4	2.40	791	194	594	7	-4
		(m^3/day)				
CTA1	0.99	2,148	638	1,442	92	(24)
CTA2	2.04	4,423	1,312	2,966	190	(45)
CTA3	1.17	2,513	754	1,704	109	(55)
CTA4	0.21	458	136	308	20	(6)
ETA1	1.36	2,951	724	2,216	26	(15)
ETA2	0.51	1,115	273	837	10	(6)
ETA3	0.99	2,146	526	1,610	19	(8)
ETA4	2.40	5,205	1,277	3,909	46	(26)

CTA – Community Testing Area; ETA – Employment Testing Area
P – Precipitation; ET – Evapotranspiration; RO – Runoff; R – Recharge; ΔS – Change in Storage

Table 2.3.1.28. Change in Future Conditions Water Balance vs. Existing Conditions Water Balance

SABE Testing Area	Area (km^2)	Change in Water Balance				
		P	ET	RO	R	ΔS
		(mm/year)				
CTA1	0.99	0	(289)	382	(78)	(15)
CTA2	2.04	0	(297)	408	(97)	(14)
CTA3	1.17	0	(297)	398	(76)	(25)
CTA4	0.21	0	(305)	406	(82)	(19)
ETA1	1.36	0	(329)	444	(103)	(12)
ETA2	0.51	0	(334)	447	(103)	(10)
ETA3	0.99	0	(347)	474	(117)	(10)
ETA4	2.40	0	(344)	463	(109)	(10)
Average Deficit/Surplus vs. Existing Condition for Community Testing Areas		**0**	**(297)**	**399**	**(83)**	**(18)**
Average Deficit/Surplus vs. Existing Condition for Employment Testing Areas		**0**	**(339)**	**457**	**(108)**	**(11)**
		(m^3/day)				
CTA1	0.99	0	(785)	1,037	(212)	(41)
CTA2	2.04	0	(1,659)	2,279	(542)	(78)
CTA3	1.17	0	(953)	1,278	(244)	(80)
CTA4	0.21	0	(177)	236	(48)	(11)
ETA1	1.36	0	(1,227)	1,656	(384)	(45)
ETA2	0.51	0	(471)	630	(145)	(14)
ETA3	0.99	0	(940)	1,285	(317)	(27)
ETA4	2.40	0	(2,264)	3,047	(717)	(66)
Average Deficit/Surplus vs. Existing Condition for Community Testing Areas		**0**	**(893)**	**1,207**	**(261)**	**(53)**
Average Deficit/Surplus vs. Existing Condition for Employment Testing Areas		**0**	**(1,225)**	**1,654**	**(391)**	**(38)**

CTA – Community Testing Area; ETA – Employment Testing Area
P – Precipitation; ET – Evapotranspiration; RO – Runoff; R – Recharge; ΔS – Change in Storage

Separate water balances were also estimated for ETA2 and the southern part of ETA3 (ref. Drawing GW-13; Appendix B). These areas have the potential to be developed as a community area or employment area depending on whether the preliminary SABE concept or SABE testing area land classification is carried forward for these areas. Water balances for these areas were developed assuming existing, community, and employment land uses (Table 2.3.1.29 and 2.3.1.30) using the same method described previously. The incremental change in water budget parameters between existing land use and community land use, and between community land use and employment land use are summarized in Table 2.3.1.29 and 2.3.1.30 for ETA2 and the southern portion of ETA3, respectively.

For ETA2, recharge is estimated to decrease by 76 mm/year (107 m^3/day) from existing to community land use, and decrease by an additional 27 mm/year (38 m^3/day) from community to employment land use. ET is estimated to decrease by 293 mm/year (413 m^3/day) from existing to community land uses, and decrease by an additional 41 mm/year (58 m^3/day) from community to employment land use. Runoff is estimated to increase by 384 mm/year (541 m^3/day) from existing to community land use, and increase by an additional 63 mm/year (89 m^3/day) from community to employment land uses.

For the southern portion of ETA3, recharge is estimated to decrease by 116 mm/year (70 m^3/day) from existing to community land use, and decrease by an additional 27 mm/year (16 m^3/day) from community to employment land use. ET is estimated to decrease by 301 mm/year (183 m^3/day) from existing to community land uses, and decrease by an additional 41 mm/year (25 m^3/day) from community to employment land use. Runoff is estimated to increase by 432 mm/year (262 m^3/day) from existing to community land use, and increase by an additional 63 mm/year (38 m^3/day) from community to employment land uses. Similar mitigation strategies as described in Section 2.3.1.1 would be applicable for ETA2 and the southern portion of ETA3.

Table 2.3.1.29. Incremental Change in Future Conditions Water Balance vs. Existing Conditions Water Balance for Employment Testing Area 2

Testing Area / Land Use	Area (km^2)	Water Balance				
		P	ET	RO	R	ΔS
		(mm/year)				
ETA2 - Existing Land Use	0.51	791	528	147	110	6
ETA2 - Community Land Use		791	235	531	34	(9)
ETA2 - Employment Land Use		791	194	594	7	(4)
Deficit/Surplus Existing to Community		**0**	**(293)**	**384**	**(76)**	**(15)**
Deficit/Surplus Community to Employment		**0**	**(41)**	**63**	**(27)**	**5**
		(m^3/day)				
ETA2 - Existing Land Use	0.51	1,115	744	207	155	8
ETA2 - Community Land Use		1,115	331	748	48	(13)
ETA2 - Employment Land Use		1,115	273	837	10	(6)
Deficit/Surplus Existing to Community		**0**	**(413)**	**541**	**(107)**	**(21)**
Deficit/Surplus Community to Employment		**0**	**(58)**	**89**	**(38)**	**7**

ETA – Employment Testing Area
P – Precipitation; ET – Evapotranspiration; RO – Runoff; R – Recharge; ΔS – Change in Storage

Table 2.3.1.30. Incremental Change in Future Conditions Water Balance vs. Existing Conditions Water Balance for Southern Portion of Employment Testing Area 3

Testing Area / Land Use	Area (km^2)	Change in Water Balance				
		P	ET	RO	R	ΔS
		(mm/year)				
ETA3 South - Existing Land Use	0.22	792	536	99	150	7
ETA3 South - Community Land Use		792	235	531	34	(8)
ETA3 South - Employment Land Use		792	194	594	7	(3)
Deficit/Surplus Existing to Community		**0**	**(301)**	**432**	**(116)**	**(15)**
Deficit/Surplus Community to Employment		**0**	**(41)**	**63**	**(27)**	**5**
		(m^3/day)				
ETA3 South - Existing Land Use	0.22	480	325	60	91	4
ETA3 South - Community Land Use		480	143	322	21	(5)
ETA3 South - Employment Land Use		480	118	360	4	(2)
Deficit/Surplus Existing to Community		**0**	**(183)**	**262**	**(70)**	**(9)**
Deficit/Surplus Community to Employment		**0**	**(25)**	**38**	**(16)**	**3**

ETA – Employment Testing Area
P – Precipitation; ET – Evapotranspiration; RO – Runoff; R – Recharge; ΔS – Change in Storage

In addition to the change in the water balance described in the foregoing, other considerations for potential groundwater impacts are provided in Section 2.3.1.1. It is expected that these considerations will generally apply through the SABE testing areas given the relatively consistent nature of surficial geology and subsequent potential recharge across the undeveloped lands within the SABE. The general subwatershed specific groundwater impacts presented in Section 2.3.1.1 for Upper Etobicoke, the West Humber and the Main Humber apply to the SABE testing areas as well.

2.3.1.4 BRES ROPA 30 Lands and Mayfield West Phase 2 Lands

Surface Water Impact Assessment

The BRES ROPA 30 and Mayfield West Phase 2 lands within the FSA have received a level of planning approval from Peel Region. These lands have been approved to accommodate planned growth to 2031 and may proceed with local approvals in advance of the completion of Region's Peel 2051 ROP Review. Although the specific land use composition within the BRES and Mayfield West Phase 2 lands are to be determined through separate and subsequent studies for Peel Region led by the Town of Caledon, the surface water management requirements for these lands are nevertheless anticipated to correspond to those being developed for the preliminary SABE concept and the SABE testing areas. The approximate contributing drainage areas of the BRES ROPA 30and Mayfield West Phase 2 lands, within each subwatershed, are summarized in Table 2.3.1.31.

Table 2.3.1.31. Summary of Contributing Drainage Areas for BRES ROPA 30 and Mayfield West Phase 2 Lands by Subwatershed (ha)

Watershed	Subwatershed	BRES	Mayfield West Phase 2
Credit River	Credit River – Glen Williams to Norval	-	-
	Huttonville Creek	-	-
	Fletcher's Creek	-	41.49
Etobicoke Creek	Upper Etobicoke Creek	-	51.09
Humber River	West Humber River	254.55	-
	Main Humber River	64.65	-

As noted above, the BRES ROPA 30 lands lie entirely within the Main and West Humber River Subwatersheds, and the Mayfield West Phase 2 Lands lie within the Upper Etobicoke Creek and Fletcher's Creek Subwatersheds. As such, the stormwater management requirements for these development areas would be anticipated to correspond to those described previously for the FSA within the respective subwatersheds.

Groundwater Impact Assessment

A water balance was not carried out for the BRES or Mayfield West Phase 2 lands but the considerations for potential groundwater impacts presented in Section 2.3.1.1 will generally apply in these areas given the relatively consistent nature of surficial geology and subsequent potential recharge across these undeveloped lands. Both BRES ROPA 30 and Mayfield West Phase 2 lands may be more susceptible to strong upward gradients (Drawing GW-8a, Appendix G)) and associated geotechnical and dewatering issues (Section 2.3.1.1).

2.3.2 Water Quality

2.3.2.1 Focus Study Area

Urbanization of the FSA would be anticipated to impact the quality of surface water primarily through increased concentrations and mass loadings of heavy metals and certain phosphorus containing chemicals associated with urban land forms. Stormwater quality controls will therefore be required, in order to mitigate these impacts. In addition, three of the main watercourses in the West Humber Subwatershed, as well as reaches of the Fletcher's Creek Subwatershed and the Huttonville Creek Subwatershed, support Redside Dace habitat, hence stormwater management is required to address enhanced stormwater quality requirements per Ministry of Natural Resources and Forestry.

In addition, given the small size of the FSA within the Huttonville Creek Subwatershed and the portion of the FSA discharging toward the Credit River Main Branch, the development area discharging toward the stormwater management facilities may in some instances be too small to sustain wet pond/wetland end-of-pipe facilities, thus requiring source controls for stormwater quality, quantity, and erosion control.

2.3.2.2 Preliminary SABE Concept

Urbanization of the preliminary SABE concept would be anticipated to impact the quality of surface water primarily through increased concentrations and mass loadings of heavy metals and certain phosphorus containing chemicals associated with urban land forms. Stormwater quality controls will therefore be required, in order to mitigate these impacts. In addition, three of the main watercourses in the West Humber Subwatershed, as well as reaches of the Fletcher's Creek Subwatershed and the Huttonville Creek Subwatershed, support Redside Dace habitat, hence stormwater management is required to address enhanced stormwater quality requirements per Ministry of Natural Resources and Forestry.

In addition, given the small size of the FSA within the Huttonville Creek Subwatershed and the portion of the preliminary SABE concept discharging toward the Credit River Main Branch, the development area discharging toward the stormwater management facilities may in some instances be too small to sustain wet pond/wetland end-of-pipe facilities, thus requiring source controls for stormwater quality, quantity, and erosion control.

2.3.2.3 SABE Testing Areas

Urbanization of the SABE testing areas would be anticipated to impact the quality of surface water primarily through increased concentrations and mass loadings of heavy metals and certain phosphorus containing chemicals associated with urban land forms. Stormwater quality controls will therefore be required, in order to mitigate these impacts. In addition, three of the main watercourses in the West Humber Subwatershed support Redside Dace habitat, hence stormwater management is required to address enhanced stormwater quality requirements per Ministry of Natural Resources and Forestry.

2.3.2.4 BRES ROPA 30 Lands and Mayfield West Phase 2 Lands

Urbanization of the BRES ROPA 30 and Mayfield West Phase 2 lands would be anticipated to impact the quality of surface water primarily through increased concentrations and mass loadings of heavy metals and certain phosphorus containing chemicals associated with urban land forms. Stormwater quality controls will therefore be required, in order to mitigate these impacts. In addition, three of the main watercourses in the West Humber Subwatershed support Redside Dace habitat, hence stormwater management is required to address enhanced stormwater quality requirements per Ministry of Natural Resources and Forestry.

2.3.3 Geotechnical and Slope Stability

As discussed in Section 2.1.1, watercourse valley slopes within the FSA and select watercourse valley slopes which may impact lands within the FSA were assessed via desktop study for instability risk. The methodology from the "Technical Guide – River and Stream Systems: Erosion Hazard Limit", prepared by the Ontario Ministry of Natural Resources (2002) was used.

During the permitting process with the appropriate conservation authority, a number of slope setbacks are applied to determine the erosion hazard limit for slopes and in turn the limits of development. For slopes, the erosion hazard limit is comprised of:

'erosion hazard limit' = 'toe erosion allowance' + 'allowance for stable slope' + 'erosion access allowance'

<u>Toe Erosion Allowance</u>

If the watercourse is >15 m from the toe of the slope a toe erosion allowance is not required. If the watercourse is <15 m from the toe of the slope a toe erosion allowance is required. The toe erosion allowance can be estimated using the soil type, field observations, and bankfull width, or determined by a fluvial geomorphologist.

<u>Allowance for Stable Slope</u>

The allowance for stable slope is the focus of the geotechnical components and relies on using the slope geometry, soil properties, and groundwater table to determine location of the stable top of slope.

<u>Erosion Access Allowance</u>

The erosion access allowance is set by the relevant permitting authority. In the case of this FSA, both the CVC and TRCA use an erosion access allowance of 10 m. This requirement is found in the CVC Watershed Planning and Regulations Policy (2010), Section 6.2.1 (b) and TRCA Planning and Development Procedure Manual (2008), Section 2.1.2.

Where the watercourse is defined as an unconfined system, the erosion hazard limit is comprised of an allowance for a flooding hazard limit or meander belt allowance plus and erosion access allowance, however, has no slope stability component.

In the Part A Characterization, the watercourse valley slopes were defined as either 'low', 'slight', or 'moderate' in terms of risk of instability. Refer to Appendix D for a figure showing an overview of the full FSA ratings, and Appendix G for more detailed figures. All ratings were based on a desktop study only and that rating would need to be confirmed with a visual assessment during subsequent development planning approval stages. Current guidance is offered as follows:

<u>Risks for 'Low' Instability Potential Slopes</u>

It is likely the physical top of slope is the stable top of slope. No additional setback beyond the toe erosion allowance (if any) and the erosion access allowance would be required.

<u>Risks for 'Slight' Instability Potential Slopes</u>

The physical top of slope may not be the stable top of slope. Any additional surcharges or works near the crest of the slope should be assessed. For development, the stable top of slope should be within the slope height distance from the physical top of slope. Toe erosion allowance (if any) and the erosion access allowance would be in addition.

<u>Risks for 'Moderate' Instability Potential Slopes</u>

The physical top of slope is likely not the stable top of slope. Any additional surcharges or works near the crest of the slope should be assessed. For development, the stable top of slope may be more than the slope height distance from the physical top of slope. Toe erosion allowance (if any) and the erosion access allowance would be in addition to other setback allowances.

If there is insufficient space to allow for the additional setback required for a stable top of slope (such as bridge crossings or other infrastructure), there are options available to stabilize the slope such as:

- Installing retaining walls at the toe of the slope several options are available:
  - Gabion baskets
  - Armour stone
  - Concrete gravity wall
- Rebuild and reinforce the slope with geotextile and/or geogrid
- Reinforce the slope with soil anchors

2.3.3.1 Focus Study Area

Credit River Watershed

No permanent watercourses or accessible slopes were noted in the FSA. No slope stability concerns are anticipated

Etobicoke Creek Watershed

All watercourse slopes were identified as 'low' risk of instability, and therefore the physical top of slope is likely the stable top of slope with the exception of the following which were identified as 'slight' risk:

- 1500 m long section from 100 m west of McLaughlin Road to Hurontario Street, ~1700 m north of Mayfield Road
- 100 m long section location ~700 m north of Old School Road and ~700 m east of Hurontario Street.

Humber River Watershed – West Humber Subwatershed

All watercourse slopes were identified as 'low' or 'slight' risk of instability except for the following which was identified as 'moderate' risk:

1. a slope failure noted immediately east of The Gore Road ~1.1km south of King Street

For the 'low' risk areas, the physical top of slope is likely the stable top of slope. The 'slight' risk areas may require and additional setback from the physical top of slope of up to the slope height to obtain the stable top of slope. As a slope failure was visible in the moderate risk, further deterioration of the slope would be expected and the stable top of slope is likely greater than the slope height in distance from the physical top of slope.

Humber River Watershed – Main Humber Subwatershed

All watercourse slopes were identified as 'low' or 'slight' risk of instability except for the following which was identified as 'moderate' risk:

2. an area ~700 m east of the intersection between Emil Kolb Parkway and King Street (Main Humber River subwatershed)

For the 'low' risk areas, the physical top of slope is likely the stable top of slope. The 'slight' risk areas may require and additional setback from the physical top of slope of up to the slope height to obtain the stable top of slope. As a slope failure was visible in the moderate risk, further deterioration of the slope would be expected and the stable top of slope is likely greater than the slope height in distance from the physical top of slope.

2.3.3.2 Preliminary SABE Concept

The preliminary SABE concept extends through the Main Humber Subwatershed, the West Humber Subwatershed, the Etobicoke Creek Subwatershed and the Credit River Watershed (ref. Drawing D-2). As noted in the previous discussion regarding the FSA, no slope stability concerns are anticipated for the slopes within the Credit River Watershed.

Etobicoke Creek Subwatershed

All watercourse slopes adjacent to the preliminary SABE concept within the Etobicoke Creek Subwatershed were identified as 'low' risk of instability, and therefore the physical top of slope is likely the stable top of slope. The preliminary SABE concept within the Etobicoke Creek Subwatershed also includes the following two locations for 'slight' risk:

- 1500 m long section from 100 m west of McLaughlin Road to Hurontario Street, ~1700 m north of Mayfield Road
- 100 m long section location ~700 m north of Old School Road and ~700 m east of Hurontario Street.

Humber River Watershed – West Humber Subwatershed

All watercourse slopes adjacent to the preliminary SABE concept within the West Humber River Subwatershed were identified as 'low' or 'slight' risk of instability. For the 'low' risk areas, the physical top of slope is likely the stable top of slope. The 'slight' risk areas may require an additional setback from the physical top of slope of up to the slope height to obtain the stable top of slope. The preliminary SABE concept within the West Humber River Subwatershed also includes the following location for 'moderate' risk:

- a slope failure noted immediately east of The Gore Road ~1.1km south of King Street

As a slope failure was visible in the moderate risk, further deterioration of the slope would be expected and the stable top of slope is likely greater than the slope height in distance from the physical top of slope.

Humber River Watershed – Main Humber Subwatershed

All watercourse slopes adjacent to the preliminary SABE concept within the Main Humber Subwatershed were identified as 'low' or 'slight' risk of instability. For the 'low' risk areas, the physical top of slope is likely the stable top of slope. The 'slight' risk areas may require and additional setback from the physical top of slope of up to the slope height to obtain the stable top of slope.

2.3.3.3 SABE Testing Areas

Etobicoke Creek Subwatershed

The watercourse slope adjacent to the SABE testing area within the Etobicoke Creek Subwatershed has been identified identified as 'low' risk of instability, and therefore the physical top of slope is likely the stable top of slope.

Humber River Watershed – West Humber Subwatershed

The watercourse slopes adjacent to the SABE testing area within the West Humber River Subwatershed were identified as 'low' or 'slight' risk of instability. For the 'low' risk areas, the physical top of slope is likely the stable top of slope. The 'slight' risk areas may require an additional setback from the physical top of slope of up to the slope height to obtain the stable top of slope.

Humber River Watershed – Main Humber Subwatershed

All watercourse slopes adjacent to the SABE testing area within the Main Humber Subwatershed were identified as 'low' or 'slight' risk of instability. For the 'low' risk areas, the physical top of slope is likely the stable top of slope. The 'slight' risk areas may require and additional setback from the physical top of slope of up to the slope height to obtain the stable top of slope.

2.3.3.4 BRES ROPA 30 Lands and Mayfield West Phase 2 Lands

The majority of the watercourse slopes adjacent to the BRES ROPA 30 and Mayfield West Phase 2 Lands were identified as 'low' or 'slight' risk of instability. For the 'low' risk areas, the physical top of slope is likely the stable top of slope. The 'slight' risk areas may require an additional setback from the physical top of slope of up to the slope height to obtain the stable top of slope. The BRES ROPA 30 lands within the Main Humber Subwatershed also include area adjacent to the 'moderate' risk area identified ~700 m east of the intersection between Emil Kolb Parkway and King Street (Main Humber River subwatershed). As a slope failure was visible in the moderate risk, further deterioration of the slope would be expected and the stable top of slope is likely greater than the slope height in distance from the physical top of slope.

2.3.4 Stream Morphology, Erosion Hazards and Assessment

2.3.4.1 Focus Study Area

Stream Morphology Impact Assessment

The Stream Morphology Impact Assessment focuses on the potential impacts to form and process of watercourses and HDFs based on the proposed changes to impervious cover. The impact assessment for watercourses was completed based on the understanding that the FSA will have a future average impervious area of 51%.

The following discussion and subsequent sub-sections covering erosion hazard corridors, stream length and realignment, headwater drainage features, road crossings, stormwater management and erosion are applicable to the FSA and to the land use classifications identified within the FSA, which include the preliminary SABE concept, the SABE testing areas, the BRES ROPA 30 lands and the Mayfield West Phase 2 lands.

The primary impacts to watercourses from urbanization are changes to the hydrologic regime, as a result of increased impervious cover. Increased surface runoff is typically mitigated through integrated stormwater management. Other impacts include changes to the sediment regime (decreased input) with increased impervious cover, and feature realignment, relocation, or removal (watercourses and HDFs). The following summarizes impacts to geomorphic character and function, and mitigation to maintain or enhance the functions that should be considered in the impact assessment:

i. Channel erosion is a necessary natural process; however anthropogenic pressures, such as uncontrolled stormwater runoff, may accelerate and exacerbate natural erosional processes, resulting in loss of property, threats to infrastructure and environmental degradation [e.g. smothering of fish nests (redds) through excessive deposition].

Erosion thresholds can be applied to provide insight regarding the capacity of each watercourse system to accommodate an altered land use or flow regime. Application of appropriate thresholds as stormwater best management practice targets should limit rates of erosion to pre-development conditions. This extends to areas downstream of the Focused Study Area (FSA). To be completed in future studies. Within the current study, better understanding towards areas more sensitive to erosion may be determined upon refinements to the landuse plan and delineation of the SABE. At present, the number of erosion sites, where observed in each subwatershed, may increase in number without SWM.

ii. Land use changes such as the removal of headwater drainage features or vegetation and increases in imperviousness, will increase flow discharges and diminish the development of resisting forces.

Maintaining appropriate hydrologic and sediment regimes will be necessary to preserve the function of the headwater channels and their role in maintaining stream health in downstream areas. The main branches of watercourses within the study area are largely protected by the Preliminary NHS, Provincial NHS, Conservation Authority NHS (natural features only) and the Peel Greenland's System Core; it will be necessary to ensure that tributaries and headwater drainage features are appropriately managed to maintain or enhance the natural functions within the overall system. At present, HDFs have only been identified at a high-level and field confirmation is required through the application of the TRCA/CVC (2014) guidelines for evaluating headwater features in future studies.

iii. Maintenance of existing riparian vegetation within the stream corridor acts to stabilize the banks, reduce flow velocities and also provides inputs of organic material and debris to streams which aid in creating a diverse morphology and habitat.

Riparian corridor protection/enhancement through the development of the Natural Heritage System along streams is a key element of a management strategy to manage and provide enhancement of form and function within a subwatershed. The main branches of watercourses within the study area are largely protected by the Preliminary NHS, Provincial NHS, Conservation Authority NHS (natural features only) and the Peel Greenland's System Core.

iv. The delineation of natural hazard limits associated with river and valley systems allows for the lateral and downstream migration of unconfined features though the floodplain, and the estimated stable top of slope for confined valleys. Planning around such hazards allows for natural stream form and function to continue, while avoiding risk to property or infrastructure.

The meander belt width and stable top of slope, plus associated setbacks represent a constraint to development and land use planning. Incorporation of these corridors and setbacks into the NHS will ensure that channels may continue to provide habitat function, linkages, and floodplain storage. Several reaches within each subwatershed have portions of the erosion hazard corridor not currently enveloped by the NHS.

Erosion Hazard Corridors

The method for delineating hazard corridors within the study area differed between confined and unconfined reaches. A stable top of slope setback was defined for confined reaches whereby the valley toe was estimated from site topography, and a stable 3:1 slope setback was determined based on the average elevation difference from the floodplain to the table land. The PPS requires that a toe erosion setback be applied where a watercourse is within 15m of the valley toe (MNR, 2002) in addition to the stable slope allowance. To be conservative, this study utilized values for "sands and silt" from the PPS whereby a toe erosion setback of 2m is required where there is no evidence of active erosion, and a setback of 8m where there is evidence of active erosion. This was informed by previous work completed as part of the geotechnical assessment for Mayfield West (AMEC, 2014). For unconfined reaches, meander belts were defined based on the central tendency of the channel planform, an additional 20% was applied to the total meander belt width as a factor of safety in-lieu of determining the 100-year erosion rate. An additional erosion access allowance of 10m per side has also been applied to the erosion hazard delineation as per setback requirements of the Conservation Authorities (and meeting the PPS requirement of 6m) for both confined and unconfined reaches.

These erosion hazard corridors are intended to contain all of the natural meander and migration tendencies, and slope stability of a channel/valley based on historic alignment and potential future alignment. This permits geomorphic adjustment to occur without risking damage to surrounding infrastructure and property. Implementation and respect for the hazard corridor can reduce and control negative impacts to watercourse systems which may occur as a result of urbanization. A secondary benefit of the hazard corridor width is to protect surrounding riparian vegetation and other ecological habitats and functions. Development within a hazard corridor is strictly limited to specific low impact and localized uses, such as trail or road crossings, and therefore disturbance to the riparian habitat is minimized. Maintaining riparian vegetation ensures resiliency of the fluvial system as proper vegetative support reduces bank erosion and widening. Updated hazard mapping is provided Map SM-2 in Appendix C. Refinements to erosion hazard mapping are expected as more detailed fieldwork may be completed through future studies.

An additional consideration is the Redside Dace (RSD) habitat classification of reaches within the study area. Under Ontario Regulation 242/08 of the Endangered Species Act (2007), for Redside Dace occupied reaches, Redside Dace habitat includes the stream, its meander belt, and a 30 m wide riparian zone on each side of the meander belt. The updated erosion hazard mapping presented in Appendix C represents erosion hazard setbacks. The Redside Dace 30 m setback has been applied to the preliminary meander belt limits and incorporated into the NHS for Redside Dace occupied reaches in Section 2.3.5 – Natural Heritage System and Water Resource System.

Table 2.3.4.1 lists the reaches in each subwatershed with erosion hazard corridors that lie partially or entirely outside of all NHS limits, including the Preliminary NHS, Provincial NHS, Conservation Authority NHS (Natural areas) or Peel's Core Greenlands. Table 2.3.4.2 presents the area of erosion hazard corridors within and outside of NHS limits for each subwatershed. While erosion hazard lands that lie wholly or partially within the NHS may be automatically protected from development by the policies protecting the NHS, erosion hazard lands have policy requirements for avoiding development regardless of whether or not they are part of an NHS. The discussion of erosion hazard areas within and outside NHS limits is provided, however, because it can be useful from a land use perspective to understand where erosion hazard limits contribute to the undevelopable land within a given area, and where they are contained within other undevelopable features.

The Fletcher's Creek Subwatershed has the highest proportion of erosion hazard area outside of any NHS limits. This is largely since the FSA encompasses only a small number of watercourse reaches, and these are unconfined headwater tributaries that are located in an agricultural setting with limited riparian cover. Similarly, many reaches of the Main Humber subwatershed within the FSA are HDFs or headwater tributaries and a moderate proportion of their erosion hazards are not encompassed by the NHS. Within the Etobicoke Creek and West Humber Subwatersheds, reaches that are entirely or partially outside of the NHS are generally tributaries rather than main stem reaches. On main stem reaches, typically only small portions of the erosion hazard limit lie outside of the NHS. One exception to this trend is the western branch of Etobicoke Creek, which has hazard lands that lie mainly outside of the NHS.

Table 2.3.4.1. Hazard Corridors and/or Regulatory Limits not Enveloped by NHS Features (Preliminary NHS, Provincial NHS, Conservation Authority NHS or Peel Greenland/s System Core)

Subwatershed	Reach ID
Etobicoke Creek	MEC-R7*, MEC-R7(1)*, MEC-R7(2)*, MEC-R6, MEC-R6(1), MEC-R6(2), MEC-R5*, MEC-R5(2)*, MEC-R4(7)*, MEC-R4(8a)*, MEC-R4(3)*, MEC-R3(1)*, **MEC-R2(2)*, MEC-R2(3)*, MEC-R2(4-3)*, MEC-R2(4-4)*, MEC-R2(4-4a)*,** MEC-R2(4-4b)*, **MEC-R2(3-1)*,** MEC-R2(3-2)1b*, MEC-R2(3-2)1a*, MEC-R2(3-2)3, MEC-R2(3-5)*, MEC-R2(3-6)*, MEC-R2(3-6a)*
Fletcher's Creek	FC(4)*, FC(3), FC(1)
Main Humber River	HRT(2)2-1, TCC(1)*, TCC(2), TCC(11)*, TCC(13)
West Humber River	**CCC(3)*, CCC(5)*, CCC(6)*, SC(2)*,** SC(2)1-1*, **SC(3)*,** SC(3)2-1*, SC(3)2-2, **SC(4)*,** SC(4)1-1, SC(4)2-1, SC(4)2-2, SC(5)*, SC(5)1-1*, WHT1(3)*, WHT1(4)*, WHT1(5)*, WHT1(6)*, WHT1(6)1-1*, WHT1(6)3-1, WHT1(6)4-1, WHT2(1)2-1, WHT2(1)1-1*, WHT2(2)1-1a*, WHT2(5)7-1*, **WHT2(6)*,** WHT2(7)1-1c*, WHT2(1)1-1*, WHT2(7)*, WHT3(2)*, WHT3(3), WHT3(3)2-1, WHT3(3)3-1, WHT3(4), WHT3(5)2-1a, **WHT3(8)*,** WHT3(7)*, WHT3(7)1-1*, WHT(A)*, WHT4(1)2-1*, WHT4(1)3-1*, WHT4(1)6-1*, WHT4(2-1)*, WHT4(3)3-1a*, WHT4(3)6-1*, WHT4(3)7-1*, WHT4(3)8-1*

*Partially enveloped
Bold: Only the 10m erosion allowance is outside the NHS

Table 2.3.4.2. Erosion Hazard Area (ha) Outside and Inside of NHS Features (Preliminary NHS, Provincial NHS, Conservation Authority NHS or Peel Greenland's System Core)

Subwatershed	Erosion Hazard Area Outside NHS (all) (ha)	Erosion Hazard Area Inside NHS (all) (ha)	% Erosion Hazard Area Outside of NHS (all)
Etobicoke Creek	77.50	201.82	28%
Fletcher's Creek	5.37	1.78	75%
Main Humber River	3.62	5.21	41%
West Humber River	185.56	541.53	26%
TOTAL	**272.06**	**750.34**	**27%**

Stream Length and Realignment

As the hazard corridor assessment indicates, many area watercourses which flow through these corridors are partially or wholly protected by the current NHS plan. Changes in land use may result in the need for realignments or relocation of existing watercourses and conservation HDFs, and/or the removal of limited function headwater drainage features (HDFs) to increase/optimize the developable area. This is particularly common in areas with several low-order streams which could be combined to reduce fragmentation of the land parcels, and which may enhance the existing natural heritage system. These types of changes are more common in areas which are already partially or fully developed, and land use changes are less significant. Realignment of watercourses in most cases is not supported, but it may be acceptable, subject to the approval of appropriate authorities, if the existing channel is degraded or has already been heavily modified as part of the existing land use, or if it can be demonstrated to enhance the NHS, (refer to Section 2.5.2 for a discussion on surface water feature constraints and management). In cases of degradation or channelization, the channel presents a restoration opportunity and realignment would be supported, subject to additional study. Should realignments be proposed, stream lengths should be maintained, if not enhanced; however, slight reductions in sinuosity may be permitted, provided there is sufficient rationale for doing so, based on an overall net gain. Any realignment is subject to local constraints and additional elements proposed during the detailed design phase. Significant loss of stream length reduces aquatic habitat and reduces the fluvial system's ability to effectively convey water and sediment that maintains a state of quasi-equilibrium. Depending on the conditions, loss of stream length may increase channel slope increasing available potential energy which could lead to increased adverse erosion.

The existing dominant land uses in the FSA are agricultural, recreational (e.g., golf course), suburban areas, valleylands and transportation (e.g., Regional Roads). These land use types, with the exception of suburban areas, are relatively low impact compared to an urbanized landscape. Further field assessment would be required to determine on site if any watercourses within the study area are severely degraded. However, the Phase 2 Part A assessment did find that many watercourse reaches had been modified (often straightened) and some have poor riparian corridors (ref Part A, Appendix E, Table 1). As the land use plan has not yet been developed, no watercourse removals or realignments have been proposed. However, there are several opportunities for rehabilitation to enhance/restore banks or short segments within protected stream reaches (refer to Section 2.5.2 for a discussion on surface water feature constraints and management). High-constraint watercourses and their corridors are to be protected in current form and location, with appropriate regulatory setbacks and ecological buffers. Realignments of high constraint watercourses are not acceptable, but minor modification through rehabilitation/enhancement may be acceptable at select locations to facilitate critical infrastructure development, or to mitigate an immediate risk. Medium constraint streams may possibly be realigned where there has been previous disturbance through anthropogenic activity, there is sufficient rationale for doing so, and provided there is a net ecological gain and subject to the approval of appropriate authorities. NHS development may identify potential zones for relocation that reduce fragmentation of the NHS. High-constraint streams (refer to Section 2.5.2) within well-defined, confined and semi-confined settings should be protected as they currently exist to ensure natural function is maintained. General riparian enhancements, farm crossing removals (fords and culverts), and in-channel habitat features (e.g., wood debris) are encouraged and would enhance the form and function of area streams, and those receiving reaches downstream.

Headwater Drainage Features

HDFs have been identified through desktop assessment, a windshield assessment and ArcHydro analysis. In future studies, HDFs should be evaluated following the TRCA / CVC (2014) protocol through which they may be assigned management recommendations. As per the TRCA / CVC (2014) protocol, management recommendations for HDFs range from 'no management' to 'protection'. Section 2.5.2 discusses each type of management recommendation. In future studies when the HDF assessments are completed, it is recommended that the initial management recommendations as per the TRCA/CVC protocols be reviewed in consultation with Technical Advisory Committee (of the respective study) to develop a consensus regarding how to determine if the HDF management recommendations are appropriate, or if there are site-specific modifiers that should alter the management recommendation from that of the TRCA/CVC guidelines (final management recommendation). The HDF protocol and final consensus on the management recommendation determines the strategy and opportunities for each feature and is important in terms of potential influence on complementary land uses.

Road Crossings and Alignments

Road crossings are an integral part of urbanization and an important consideration in terms of impacts to watercourses. Crossing locations associated with the FSA and SABE are not yet known, and therefore impacts cannot be assessed at this time. However, the following discussion presents considerations when siting and sizing crossings and road alignments.

Road crossings within TRCA's and CVC's jurisdictions should follow guidance provided in TRCA's Crossings Guideline for Valley and Stream Corridors (2015) and CVC's Technical Guidelines for Watercourse Crossings (2019), respectively.

A poorly sited road crossing can result in negative impacts to the channel and higher risk to the structure itself. There are a number of factors which should be considered when identifying the most appropriate location for a road crossing. For a large development area, it is important to minimize the number of times the proposed road network crosses the watercourse valley. This will reduce impacts to the watercourse as well as the surrounding natural heritage features. Road crossings should not be located within close succession to each other. Providing an adequate distance between crossings allows for an area of potential adjustment if there are negative impacts to the watercourse as a result of the subject crossing structure. This minimizes the risk of compromising any additional structures located downstream. Analysis of the configuration of proposed watercourse crossings should be completed when a Land Use Plan has been developed.

On a local, site-specific scale there are several risk factors which need to be considered for the individual crossings with respect to geomorphic function. These risk factors would be used to assess both crossing locations and determine appropriate structure spans and alignment; these may be considered recommendations and Section 2.5.2 may refer to them:

- **Channel Size**: The potential for lateral channel movement and erosion tends to increase with stream size. HDFs tend to exhibit low rates of lateral migration due to the stabilizing influence of vegetation on the channel bed and banks. Erosive forces in active watercourses tend to exceed the stabilizing properties of vegetation and result in higher migration rates.
- **Valley Setting**: Watercourses with wide, flat floodplains and low valley and channel slopes tend to migrate laterally across the floodplain over time. Watercourses that are confined in narrow, well drained valleys are less likely to erode laterally but are more susceptible to down-cutting and channel widening, particularly where there are changes in upstream land use. Typically, the classification of the valley will fall into one of three categories: confined, partially confined, and unconfined.
- **Meander Belt Width**: The meander belt width represents the maximum expression of the meander pattern within a channel reach. Therefore, this width/corridor covers the lateral area that the channel could potentially occupy over time. This value has been used by regulatory agencies for corridor delineation associated with natural hazards and the meander belt width is typically of a similar dimension to the Regulatory floodplain. The use of the meander belt width of structure sizing has been established as a criterion by some regulatory agencies and represents a very conservative approach.
- **Meander Amplitude**: The meander amplitude and wavelength are important parameters to ensure that channel processes and functions can be maintained within the crossing. For the purposes of this protocol, the meander amplitude of the watercourse would be measured in the vicinity of the crossing and used as a guide to determine the relative risk to the structure. The number of meander wavelengths to be considered is both dependent on the scale of the watercourse and the degree of valley confinement.

- **Rapid Geomorphic Assessment (RGA) Score:** An RGA score is essentially a measure of the stability of the channel. Channels that are unstable tend to be actively adjusting and thus are sensitive to the possible effects of the proposed crossing. Accordingly, there is more risk associated with unstable channels. The RGA score reveals three levels of stability: 0-0.20 is stable; 0.21-0.40 is moderately stable; >0.40 is unstable. This parameter may be incorporated into the assessment of road crossings when RGAs have been completed in future studies.
- **100-year Migration Rates:** Using historical aerial photographs, migration rates may be quantified (where possible) for each crossing location. A higher migration rate indicates a more unstable system and higher geomorphic risk. Ideally, watercourse crossing structures should be aligned perpendicular to and centered on a straight section of channel, or at an appropriate skew that would not affect channel processes. In terms of sizing, the structure would ideally span the meander belt width in order to accommodate the downstream migration of meander features. In many cases, however, the costs prohibit such structure sizes. From a geomorphic perspective, larger structures are favored to minimize the long-term risk and maintenance associated with natural channel adjustment.

Stormwater Management and Erosion

Channel erosion is a necessary natural process; however, anthropogenic pressures, such as uncontrolled stormwater runoff, may accelerate and exacerbate natural erosional processes, resulting in loss of property, threats to infrastructure and environmental degradation (e.g., smothering of fish nests (redds) through excessive deposition).

Erosion thresholds can be applied to provide insight regarding the capacity of each watercourse system to accommodate an altered land use or flow regime. Application of appropriate thresholds as stormwater best management practice targets should limit rates of erosion to pre-development conditions. This extends to areas downstream of the FSA. Erosion exceedance analysis is not within the current scope, but a high-level understanding of the impacts of impervious areas and unmanaged runoff on the receiving natural systems within and downstream of the FSA, has been completed.

Discussion of previously completed erosion thresholds assessments that was completed for the North West Brampton Urban Development Area Phase 1 – Subwatershed Characterization and Integration (2010) and the Mayfield West, Phase 2 Secondary Plan Comprehensive Environmental Impact Study and Management Plan (2014) is provided in Section 2.1.3. The following describes the outcome of these analyses:

Mayfield West:

- Critical discharge rates were determined at six sites (Refer to Figure 2.3.4.1.1). Five of these sites correspond to reaches within the current FSA (Refer to Table 2.1.3.1); these include MEC-R1, MEC-R2, MEC-R3, MEC-R4(2) and MEC-R2.
- Critical discharge rates ranged from 0.06 m^3/s (MEC-R2) to 2.15 m^3/s (MEC-R1). Critical velocities ranged from 0.41 m/s (MEC-R3) to 1.13m/s (MEC-R4(2)). Note reach names listed here are FSA reach names. Refer to Table 2.1.3.1 for corresponding Mayfield West study reach names.
- These critical discharge rates and velocities may be used as a general reference point to inform the future determination of SWM targets for development areas within the Upper Etobicoke Creek subwatershed in future studies. Additionally, detailed geomorphological studies should be completed to determine critical thresholds on sensitive and/or representative watercourses within and downstream of the FSA. Selection of appropriate sites for this work should be completed in consultation with the appropriate conservation authority.

North West Brampton:

- Critical discharge rates were determined at two sites located downstream of the current FSA (Refer to Figure 2.3.4.1.2).
- Site SW4 was located on Fletcher's Creek west of McLaughlin Road at Regional Road 10. At this site, critical discharge rates of 0.39 m^3/s and 0.91 m^3/s were determined for the channel banks and bed, respectively. The critical discharge rates corresponded to critical velocities of 0.55 m/s on the channel banks and 0.54 m/s on the bed. Site SW4 is downstream of the Fletcher's Creek reaches within the FSA.
- Site EM10 was located on Huttonville Creek east of Mississauga Road and south of Highway 7. The critical discharge rate and velocities at this site were 0.59 m^3/s and 0.65 m/s, respectively. Site EM10 is downstream of the FSA lands within the Huttonville Creek subwatershed.
- These critical discharge rates and velocities may be used as a general reference point to inform the future determination of SWM targets for development areas within the Fletcher's Creek and Huttonville Creek subwatersheds in future studies. Additionally, detailed geomorphological studies should be completed to determine critical thresholds on sensitive and/or representative watercourses within and downstream of the FSA. Selection of appropriate sites for this work should be completed in consultation with the appropriate conservation authority.

A stream power analysis was completed on the West Humber River and Etobicoke Creek subwatersheds, which is presented in Section 2.1.3. The results of the stream power analysis may be used in future studies to inform the identification of erosion-sensitive reaches for erosion threshold analysis.

Town Caledon
Mayfield West, Phase 2 Secondary Plan
Comprehensive Environmental Impact Study & Management Plan
Part A: Existing Conditions and Characterization
Final Report
December 2014

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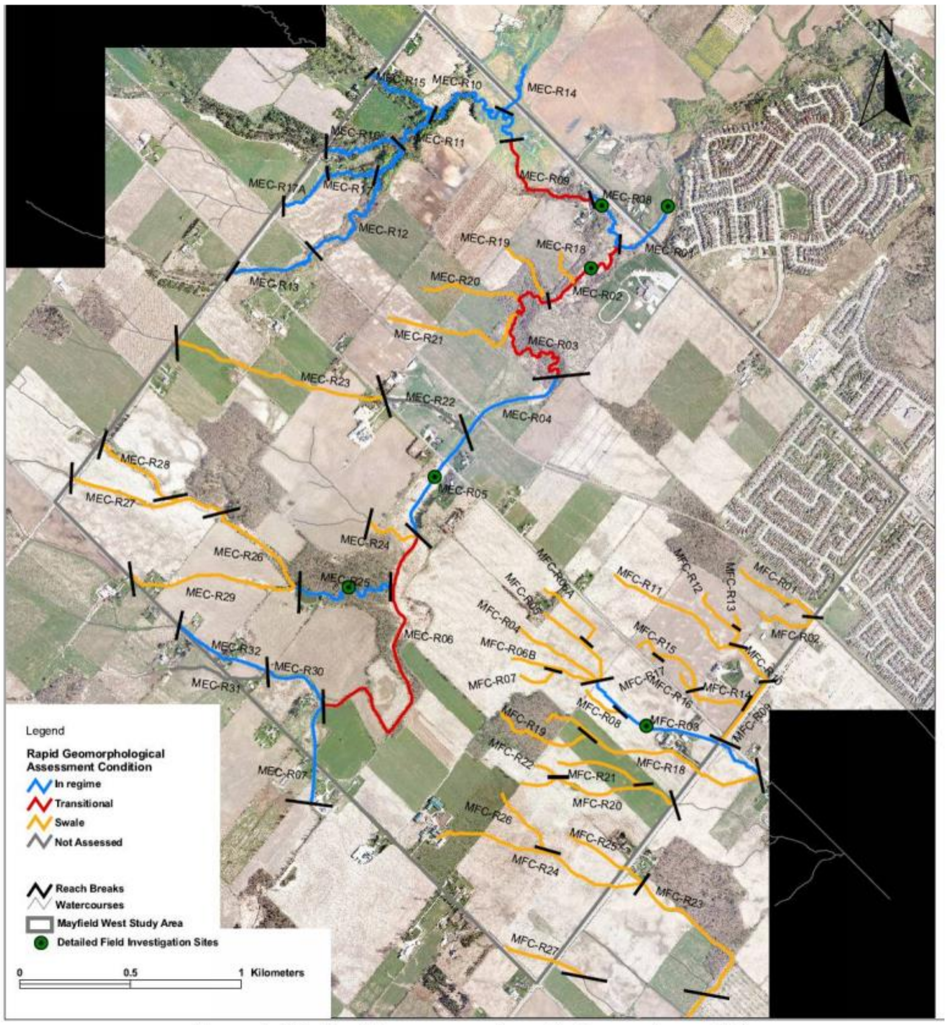

Figure 4.4.2: Rapid assessment results for reaches within the Mayfield West Study Area

Detailed Field Investigation

The results of the field assessment indicate that the landscape of the Mayfield West Phase 2 Study Area is dominated by two distinct geomorphic zones: the Etobicoke Creek valley lands and the headwaters of Etobicoke Creek and Fletchers Creek. The main branches of Etobicoke

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Figure 2.3.4.1.1. Erosion Threshold Site Locations, Mayfield West Secondary Plan, 2014.

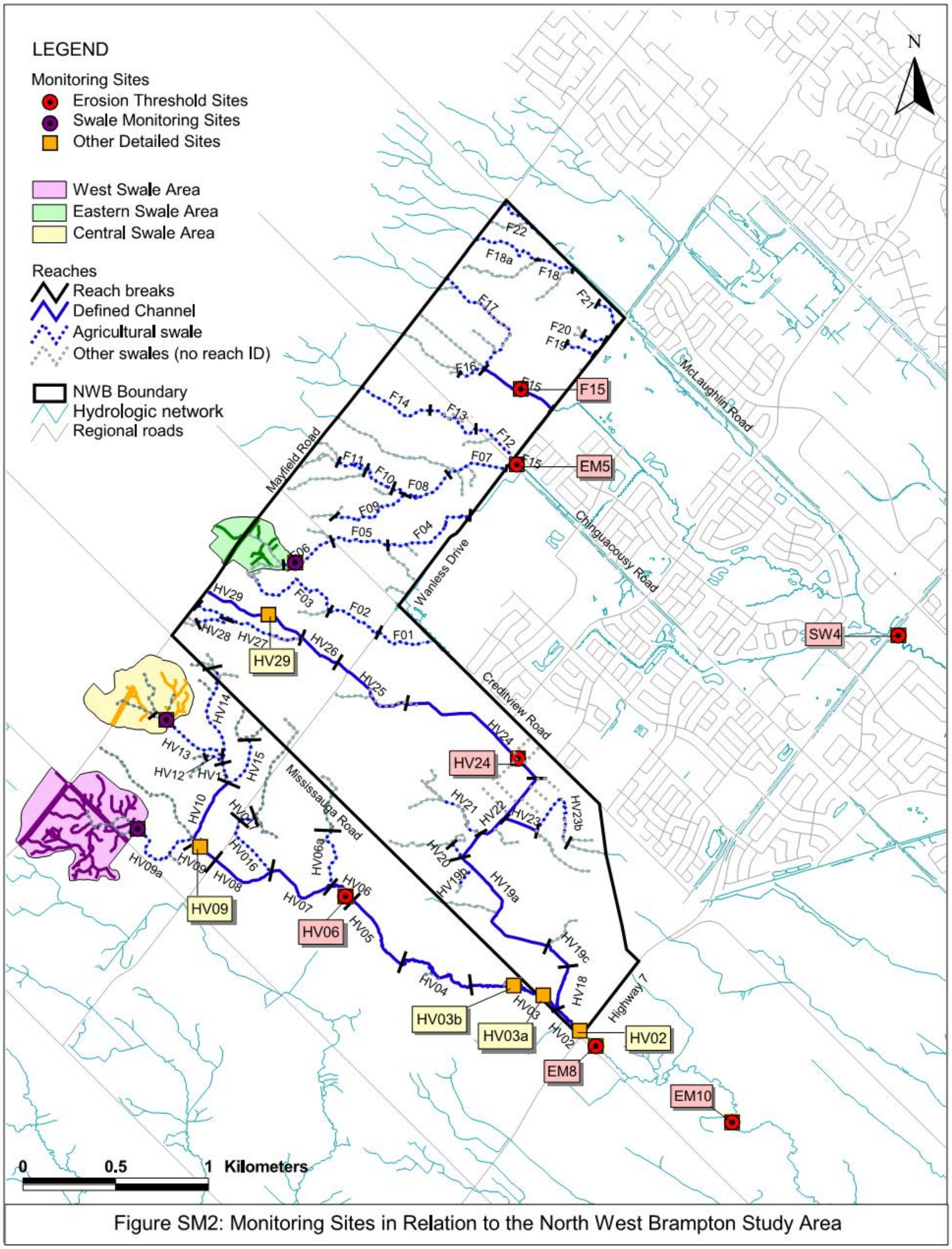


Figure 2.3.4.1.2. Erosion Threshold Site Locations, North West Brampton Urban Development Area, 2010.

Analysis by Subwatershed

A summary of the erosion hazard area, watercourse and HDF lengths and watercourse drainage density within each subwatershed of the FSA is provided in Table 2.3.4.3. Values provided exclude watercourse and HDF features within the Greenbelt and the FSA Takeout areas.

Table 2.3.4.3. Summary of Watercourses and HDFs within the FSA

Subwatershed	Erosion Hazard Area		Watercourse Length	Watercourse Drainage Density	HDF Length[1]	Potential HDF Length[2]	HDF Drainage Density[3]
	(ha)	% FSA Area	(km)	(km/km²)	(km)	(km)	
Features outside of FSA Take-Out Areas							
Main Humber	0.3	<0.01	0.0	N/A	1.1	0.0	N/A
West Humber	58.6	0.73	0.8	N/A	9.5	6.5	N/A
Etobicoke Creek	9.9	0.12	0.2	N/A	0.0	1.2	N/A
Fletcher's Creek	3.3	0.04	0.0	N/A	0.0	0.0	N/A
Features including FSA Take-Out Areas							
Main Humber	8.8	0.11	1.7	0.38	8.4	0.0	0.0000
West Humber	728.3	9.09	81.0	1.51	70.6	13.4	0.0003
Etobicoke Creek	280.1	3.50	44.8	2.20	12.8	2.7	0.0001
Fletcher's Creek	7.2	0.09	1.1	0.60	2.6	0.0	0.0000

[1]HDFs identified during desk study
[2]Potential HDFs modeled in ArcHydro based on a minimum 25 ha drainage area. Modeled for West Humber and Etobicoke Creek subwatersheds only.
[3]HDFs identified during desk study and Potential HDFs

Etobicoke Creek Subwatershed

Figures 2.3.4.2.1 and 2.3.4.2.2 present the watercourse and HDF mapping and erosion hazard corridors outside of the NHS limits for the Etobicoke Creek subwatershed, respectively. HDF and management recommendations for the subwatershed will need to be determined in future studies. Additional field assessments will need to be completed in future studies to evaluate potential impacts at the reach scale.

wood.

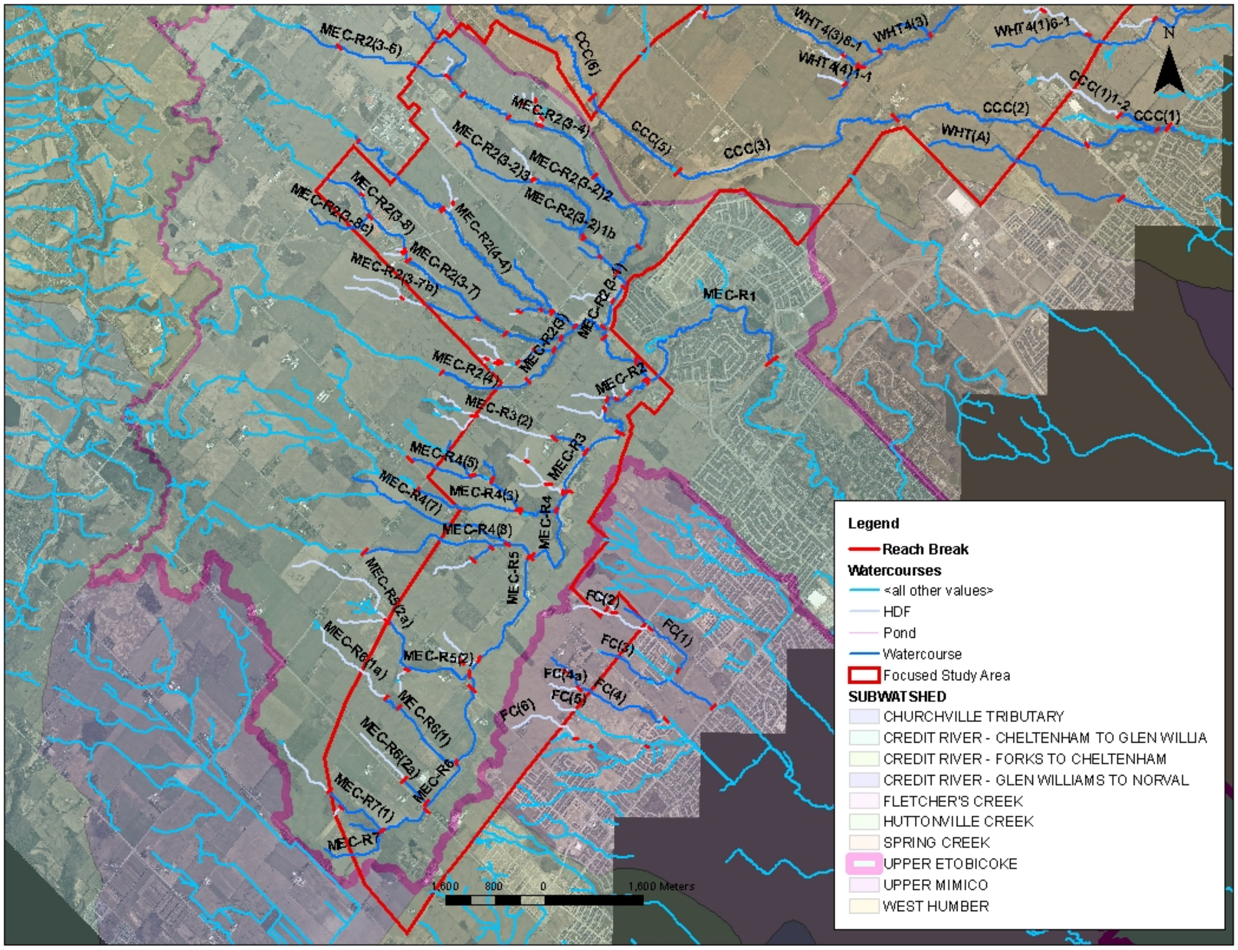


Figure 2.3.4.2.1. Watercourse and HDF Reaches, Etobicoke Creek Subwatershed

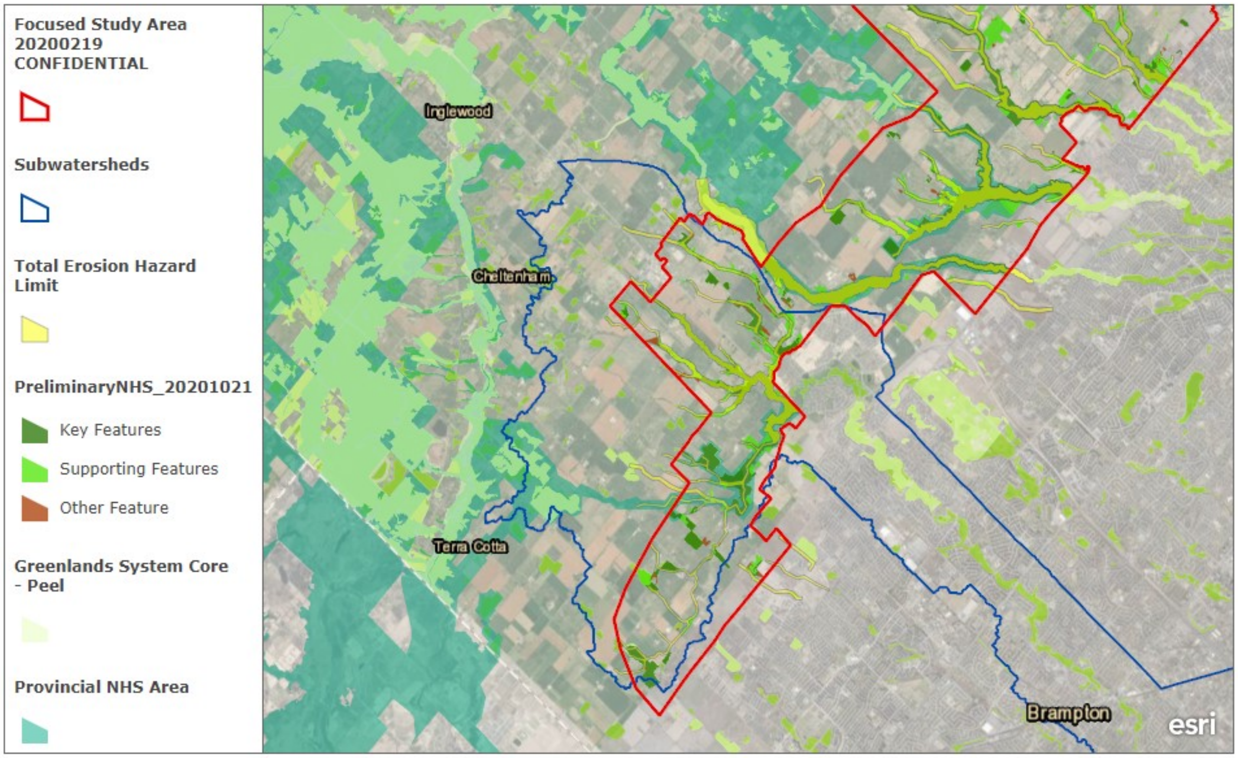


Figure 2.3.4.2.2. Erosion Hazard Limits Outside of NHS, Etobicoke Creek Subwatershed

Erosion Assessment

Map SM3 in Appendix G presents mapping of sites undergoing what is considered excessive erosion, based on observations made during the windshield assessments. Windshield assessments were completed at every road crossing within the study area except where roads were closed due to construction. Thus, SM3 depicts the subset of watercourse crossings where excessive erosion was observed and does not capture areas that could not be observed from the roadways. Field walks would need to be completed in future studies to confirm reach-scale erosion processes in areas away from road crossings.

Four erosion sites were mapped within the portion of the Etobicoke Creek Subwatershed within the FSA. Field observations included bank erosion at a culvert, incision downstream of a culvert, bank erosion on one bank within a straightened reach, and severe erosion upstream of a bridge (Reach MEC-R3). The four erosion sites were dispersed across the western portion of the subwatershed.

Under the proposed scenario (51% average impervious land use), the number of erosion sites is likely to increase without management of stormwater runoff. SWM is required to prevent channel response to urbanization, which can include continued or increased rates of bank erosion, channel degradation, channel enlargement, and degraded water quality and stream habitat. Unmanaged erosion issues at culverts in particular can lead to the development of fish barriers in cases of channel incision.

Erosion Thresholds and SWM

Utilize previously determined erosion thresholds determined as part of the Mayfield West Secondary Plan (2014) to inform initial SWM planning at a general level. As plans develop, and SWM locations are proposed, erosion thresholds should be determined for sensitive and/or representative areas downstream of potential outfalls. These values should be compared to existing thresholds and those for sensitive locations to determine the most representative. Erosion threshold evaluation for SWM is to be evaluated through future studies.

Watercourse/HDF Management

The great majority of the Etobicoke Creek watercourses and HDFs within the FSA are encompassed by the FSA Take-out. Only 0.2 km of watercourse and 1.1 km of Potential HDF length is found in the FSA excluding the FSA Take-out. The total length of mapped watercourses, HDFs and Potential HDFs including the FSA Take-out are 44.8 km, 12.8 km and 2.7 km, respectively. Refer to Table 2.3.4.3.

Feature constraints and management recommendations may be advanced through the integration of study disciplines in future studies. At that stage, further characterization and impact assessment can be made based on terrestrial or aquatic input for specific features (e.g., ponds, ELC mapping), and will be completed as land use plans are developed for the SABE. Field work to confirm/update watercourse and HDF mapping, and to complete the HDF assessment following TRCA/CVC (2014) guidelines are required through future studies to refine and finalize reach-specific constraints and management recommendations.

Erosion Hazard Delineation

Approximately 77.5 ha of erosion hazard corridors and associated setbacks are not enveloped by the Preliminary NHS, particularly along upper tributary reaches and along the western branch of Etobicoke Creek within the FSA and should be incorporated into the system. For watercourses with rehabilitation or realignment opportunities, NHS development can potentially locate preferred zones for realignment that benefit the NHS and potential land use change. Management options contained within the Classification and Management Table (Table 2.3.4.6) should be applied. In future studies when the TRCA/CVC (2014) HDF guidelines are applied, attempts should be made to include protection and conservation HDF features within the NHS, as these features provide temporary habitat, sediment and flow contributions, and ecological linkage.

Mapping provided herein has only applied this setback to the erosion limit (i.e., meander belt or stable top of slope) and 10m erosion access allowance as per setback requirements of the Conservation Authorities. Other setbacks per the respective conservation authority need to be applied to finalize the hazard delineation and refinement of the NHS.

Fletcher's Creek Subwatershed

Figures 2.3.4.2.3 and 2.3.4.2.4 present the watercourse and HDF mapping and erosion hazard corridors outside of the NHS limits for the Fletcher's Creek subwatershed, respectively. HDF and management recommendations for the subwatershed will be determined in future studies. Additional field assessments will need to be completed in future studies to evaluate potential impacts at the reach scale.

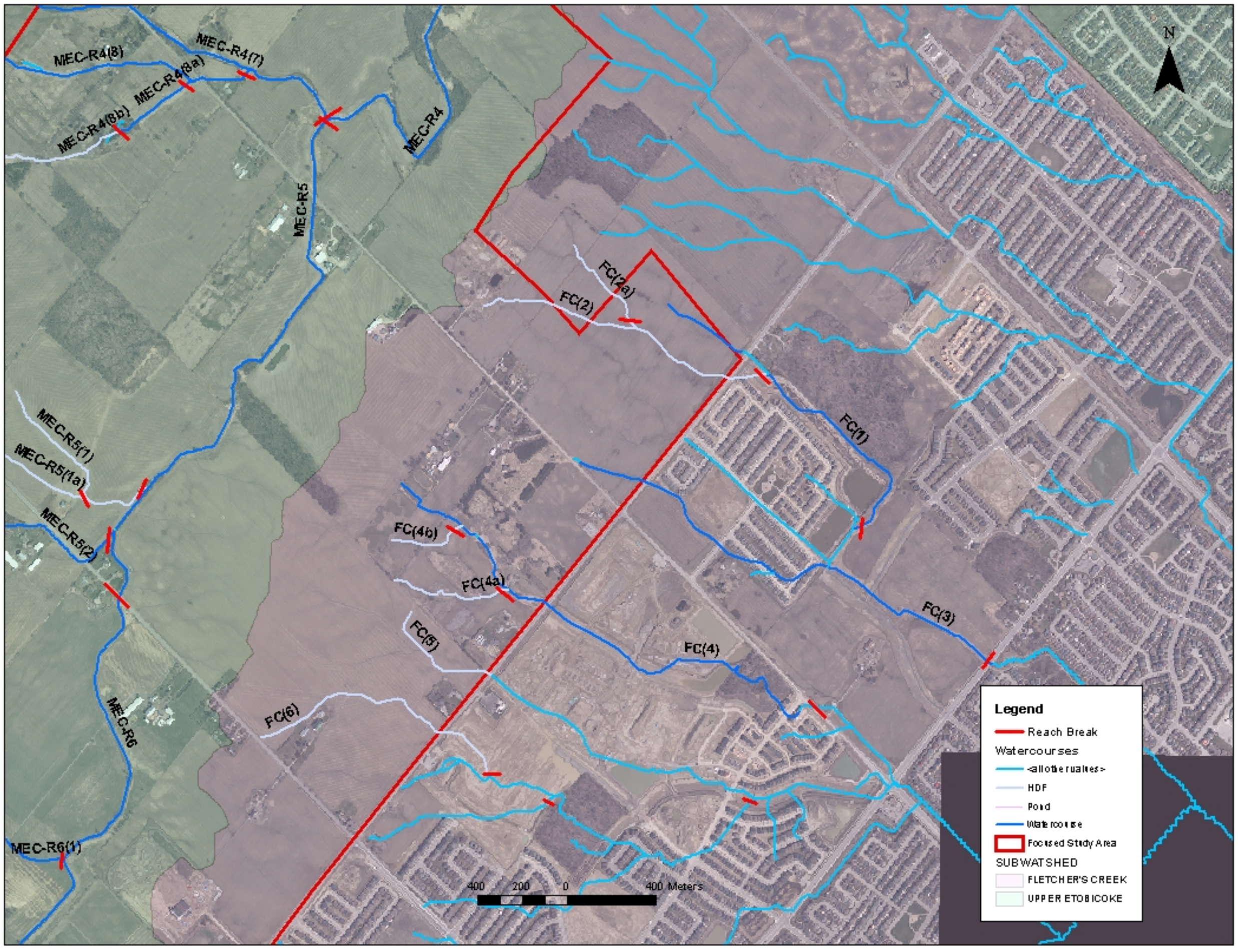
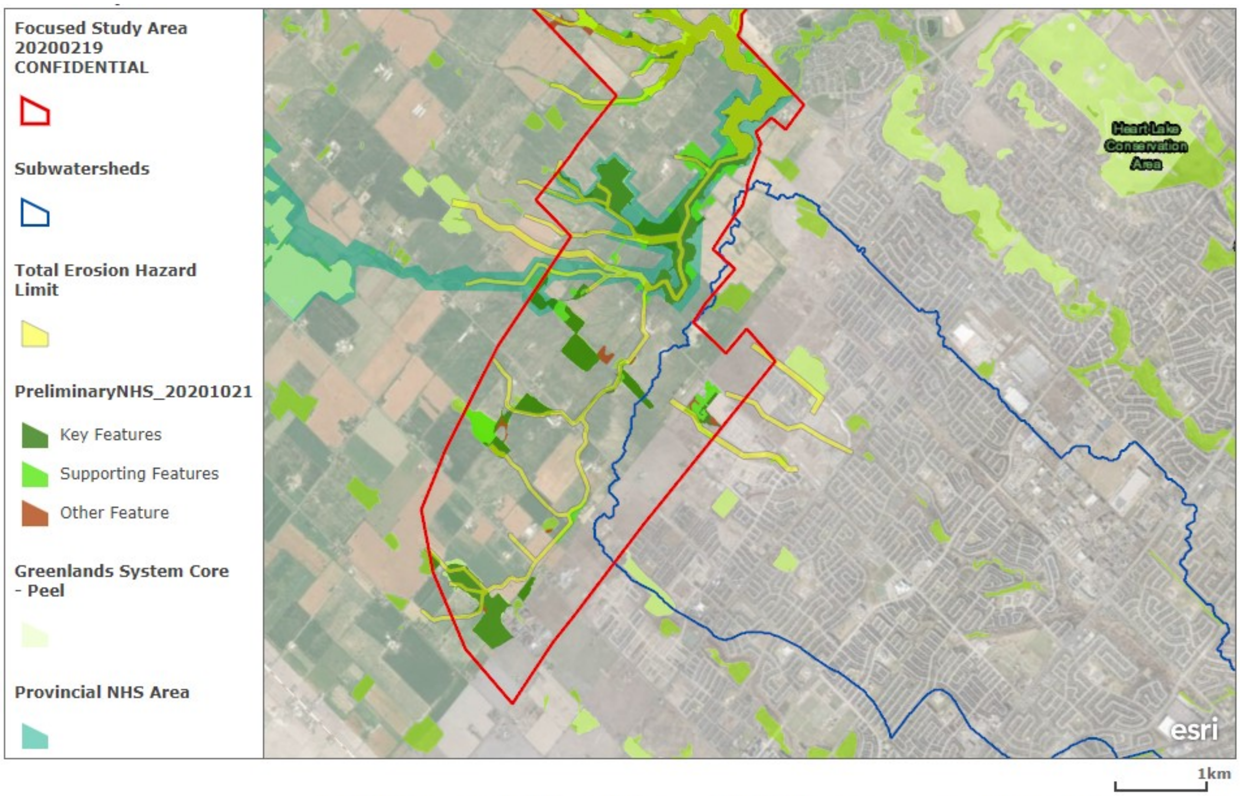


Figure 2.3.4.2.3. Watercourse and HDF Reaches, Fletcher's Creek Subwatershed



Credit Valley Conservation | City of Brampton, Town of Oakville, Earthstar Geographics | Esri, HERE, Garmin, NRCan

Figure 2.3.4.2.4. Erosion Hazard Limits Outside of NHS, Fletcher's Creek Subwatershed

Erosion Assessment

Map SM3 in Appendix G presents mapping of sites undergoing what is considered excessive erosion, based on observations made during the windshield assessments. Windshield assessments were completed at every road crossing within the study area except where roads were closed due to construction. Thus, SM3 depicts the subset of watercourse crossings where excessive erosion was observed and does not capture areas that could not be observed from the roadways. Field walks would need to be completed in future studies to confirm reach-scale erosion processes in areas away from road crossings.

No erosion sites were mapped within the portion of the Fletcher's Creek subwatershed within the FSA. Nevertheless, under the proposed scenario (51% average impervious land use), erosion sites could increase without management of stormwater runoff. SWM is required to prevent channel response to urbanization, which can include continued or increased rates of bank erosion, channel degradation, channel enlargement, and degraded water quality and stream habitat. Unmanaged erosion issues at culverts in particular can lead to the development of fish barriers in cases of channel incision.

Erosion Thresholds and SWM

Utilize previously determined erosion thresholds for Site SW4 – Fletchers Creek (Northwest Brampton SWS, 2010) to inform initial SWM planning at a general level. As plans develop, and SWM locations are proposed, erosion thresholds should be determined for sensitive and/or representative areas downstream of potential outfalls. These values should be compared to existing thresholds and those for sensitive locations to determine the most representative. Erosion threshold evaluation for SWM is to be evaluated through future studies.

Watercourse/HDF Management

All Fletcher's Creek watercourses and HDFs within the FSA are encompassed by the FSA Take-out. The total length of mapped watercourses and HDFs including the FSA Take-out are 1.1 km and 2.6 km, respectively. Refer to Table 2.3.4.3.

Feature constraints and management recommendations may be advanced through the integration of study disciplines in future studies. At that stage, further characterization and impact assessment can be made based on terrestrial or aquatic input for specific features (e.g., ponds, ELC mapping), and will be completed as land use plans are developed for the SABE. Field work to confirm/update watercourse and HDF mapping, and to complete the HDF assessment following TRCA/CVC (2014) guidelines are required through future studies to refine and finalize reach-specific constraints and management recommendations.

Erosion Hazard Delineation

Approximately 5.4 ha of erosion hazard corridors and associated setbacks are not enveloped by the Preliminary NHS and should be incorporated into the system. For watercourses with rehabilitation or realignment opportunities, NHS development can potentially locate preferred zones for realignment that benefit the NHS and potential land use change. Management options contained within the Classification and Management Table (Table 2.3.4.6) should be applied. In future studies when the TRCA/CVC (2014) HDF guidelines are applied, attempts should be made to include protection and conservation HDF features within the NHS, as these features provide temporary habitat, sediment and flow contributions, and ecological linkage.

Mapping provided here has only applied this setback to the erosion limit (i.e., meander belt or stable top of slope) and 10m erosion access allowance as per setback requirements of the Conservation Authorities. Other setbacks per the respective conservation authority need to be applied to finalize the hazard delineation and refinement of the NHS.

Main Humber River Subwatershed

Figures 2.3.4.2.5 and 2.3.4.2.6 present the watercourse and HDF mapping and erosion hazard corridors outside of the NHS limits for the Main Humber River subwatershed, respectively. HDF and management recommendations for the subwatershed will be determined in future studies. Additional field assessments will need to be completed in future studies to evaluate potential impacts at the reach scale.

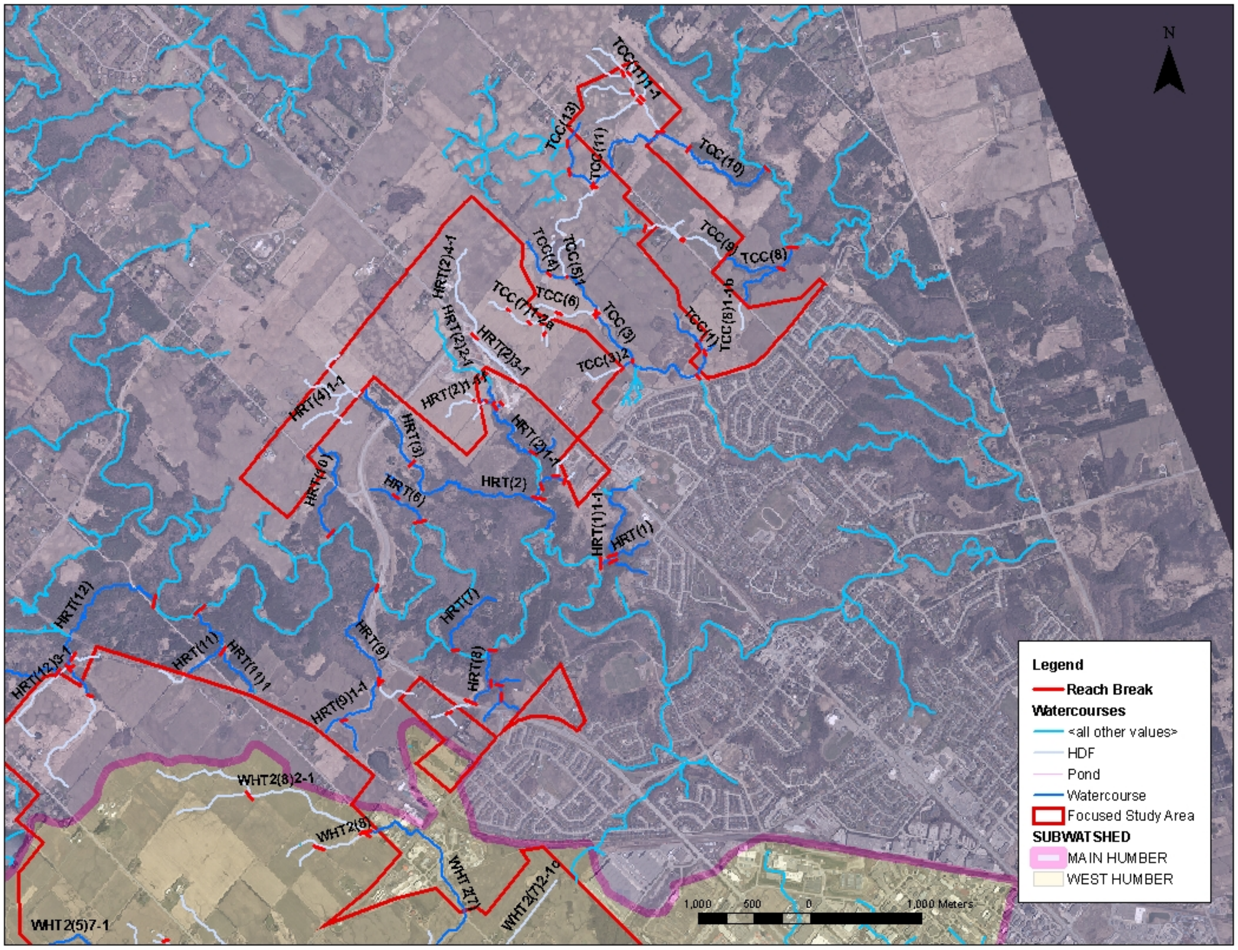


Figure 2.3.4.2.5. Watercourse and HDF Reaches, Main Humber Subwatershed

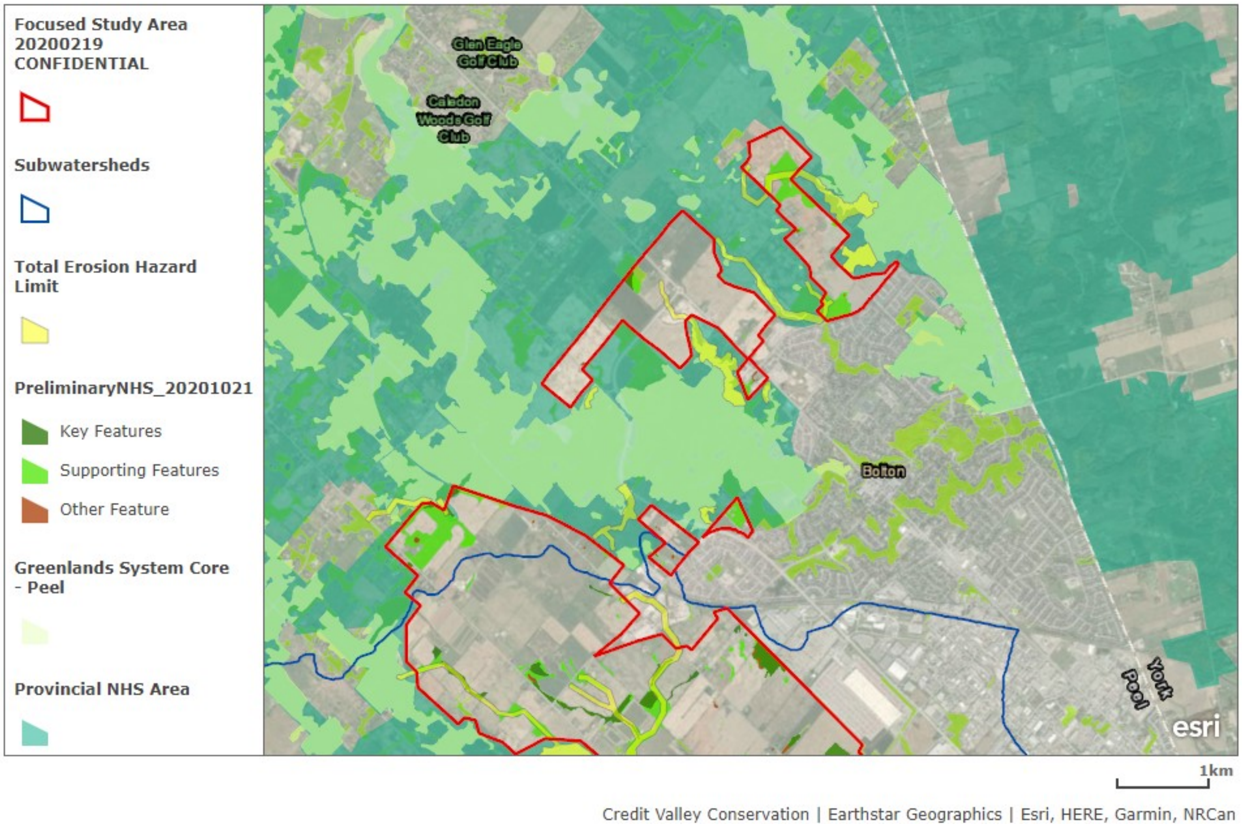


Figure 2.3.4.2.6. Erosion Hazard Limits and Preliminary NHS, Main Humber River Subwatershed

Erosion Assessment

Map SM3 in Appendix G presents mapping of sites undergoing what is considered excessive erosion, based on observations made during the windshield assessments. Windshield assessments were completed at every road crossing within the study area except where roads were closed due to construction. Thus, SM3 depicts the subset of watercourse crossings where excessive erosion was observed and does not capture areas that could not be observed from the roadways. Field walks would need to be completed in future studies to confirm reach-scale erosion processes in areas away from road crossings.

Two erosion sites were mapped within the Main Humber Subwatershed. These sites were located at the inlet and outlet of the same culvert crossing of a headwater tributary. Field observations included erosion and incision near the culvert. The culvert marks the transition of the tributary from an HDF to a watercourse.

Under the proposed scenario (51% average impervious land use), the number of erosion sites is likely to increase without management of stormwater runoff. SWM is required to prevent channel response to urbanization, which can include continued or increased rates of bank erosion, channel degradation, channel enlargement, and degraded water quality and stream habitat. Unmanaged erosion issues at culverts in particular can lead to the development of fish barriers in cases of channel incision.

Erosion Thresholds and SWM

Erosion thresholds should be determined for receiving watercourses in future studies to inform initial SWM planning. As plans develop, and SWM locations are proposed, erosion thresholds should be assessed for sensitive and/or representative areas downstream of potential outfalls. These values should be compared to existing thresholds and those for sensitive locations to determine the most representative. Erosion threshold evaluation for SWM is to be evaluated through future studies.

Watercourse/HDF Management

All Main Humber River watercourses and HDFs within the FSA are encompassed by the FSA Take-out. The total length of mapped watercourses and HDFs including the FSA Take-out are 1.7 km and 8.4 km, respectively. Refer to Table 2.3.4.3.

Feature constraints and management recommendations for watercourses and HDFs may be advanced through the integration of study disciplines in future studies. At that stage, further characterization and impact assessment can be made based on terrestrial or aquatic input for specific features (e.g., ponds, ELC mapping), and will be completed as land use plans are developed for the SABE. Field work to confirm/update watercourse and HDF mapping, and to complete the HDF assessment following TRCA/CVC (2014) guidelines are required through future studies to refine and finalize reach-specific constraints and management recommendations.

Erosion Hazard Delineation

Approximately 3.6 ha of erosion hazard corridors and associated setbacks are not enveloped by the Preliminary NHS and should be incorporated into the system. For watercourses with rehabilitation or realignment opportunities, NHS development can potentially locate preferred zones for realignment that benefit the NHS and potential land use change. Management options contained within the Classification and Management Table (Table 2.3.4.6) should be applied. In future studies when the TRCA/CVC (2014) HDF guidelines are applied, attempts should be made to include protection and conservation HDF features within the NHS, as these features provide temporary habitat, sediment and flow contributions, and ecological linkage.

Mapping provided here has only applied this setback to the erosion limit (i.e., meander belt or stable top of slope) and 10m erosion access allowance as per setback requirements of the Conservation Authorities. Other setbacks per the respective conservation authority need to be applied to finalize the hazard delineation and refinement of the NHS.

West Humber River Subwatershed

Figures 2.3.4.2.7 and 2.3.4.2.8 present the watercourse and HDF mapping and erosion hazard corridors outside of the NHS limits for the West Humber subwatershed, respectively. HDF and management recommendations for the subwatershed will be determined in future studies. Additional field assessments will need to be completed in future studies to evaluate potential impacts at the reach scale.

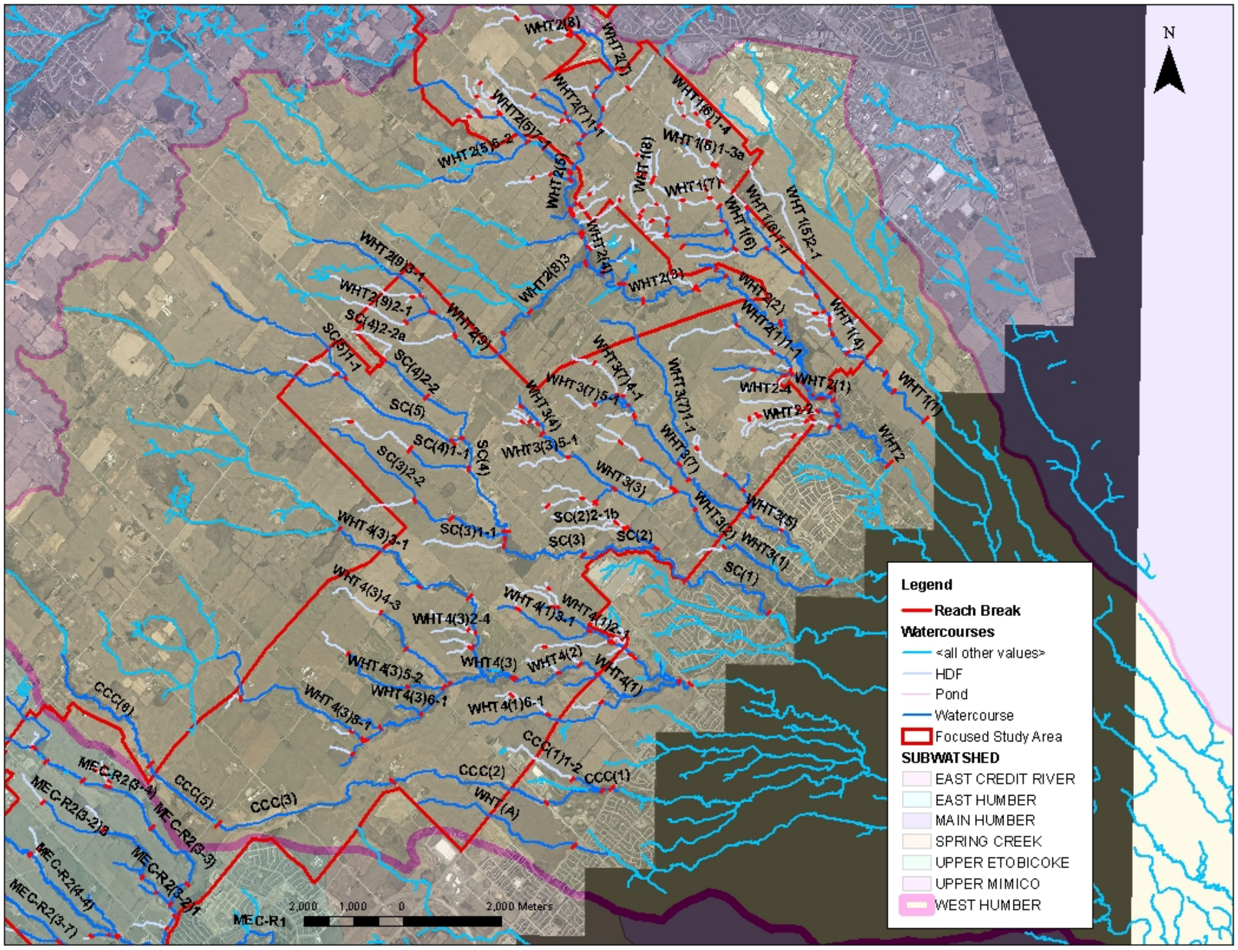


Figure 2.3.4.2.7. Watercourse and HDF Reaches, West Humber Subwatershed

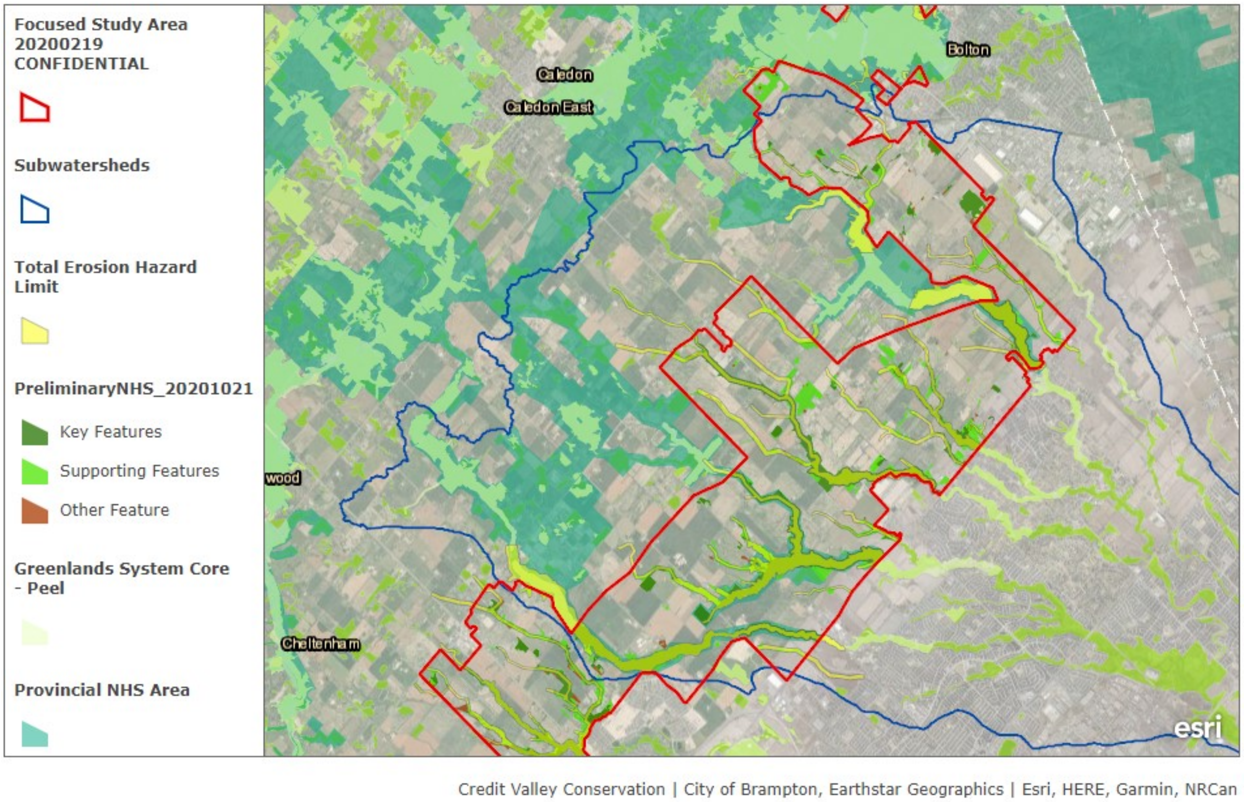


Figure 2.3.4.2.8. Erosion Hazard Limits and Preliminary NHS, West Humber River Subwatershed

Erosion Assessment

Map SM3 in Appendix G presents mapping of sites undergoing what is considered excessive erosion, based on observations made during the windshield assessments. Windshield assessments were completed at every road crossing within the study area except where roads were closed due to construction. Thus, SM3 depicts the subset of watercourse crossings where excessive erosion was observed and does not capture areas that could not be observed from the roadways. Field walks would need to be completed in future studies to confirm reach-scale erosion processes in areas away from road crossings.

Eighteen erosion sites were mapped within the West Humber Subwatershed. These sites were located both on main stem reaches and headwater tributary reaches. Many of the erosion sites were noted at existing road crossings in the form of local channel widening, bank erosion near the culvert, bed incision, culvert damage and an exposed CSP bottom. At other sites, field observations included steep banks, ditch incision and bank undercutting.

Under the proposed scenario (51% average impervious land use), the number of erosion sites is likely to increase without management of stormwater runoff. SWM is required to prevent channel response to urbanization, which can include continued or increased rates of bank erosion, channel degradation, channel enlargement, and degraded water quality and stream habitat. Unmanaged erosion issues at culverts in particular can lead to the development of fish barriers in cases of channel incision.

Erosion Thresholds and SWM

Erosion thresholds should be determined for receiving watercourses in future studies to inform initial SWM planning. As plans develop, and SWM locations are proposed, erosion thresholds should be assessed for sensitive and/or representative areas downstream of potential outfalls. These values should be compared to existing thresholds and those for sensitive locations to determine the most representative. Erosion threshold evaluation for SWM is to be evaluated through future studies.

Watercourse/HDF Management

The great majority of West Humber River watercourses and HDFs within the FSA are encompassed by the FSA Take-out. The total length of mapped watercourses, HDFs and Potential HDFs excluding the FSA Take-out are 0.8 km, 9.5 km, and 6.2 km, respectively. The total length of mapped watercourses, HDFs and Potential HDFs including the FSA Take-out are 81.0 km, 70.6 km, and 13.4 km respectively. Refer to Table 2.3.4.3.

Management recommendations for watercourses and HDFs may be advanced through the integration of study disciplines in future studies. At that stage, further characterization and impact assessment can be made based on terrestrial or aquatic input for specific features (e.g., ponds, ELC mapping), and will be completed as land use plans are developed for the SABE. Field work to confirm/update watercourse and HDF mapping, and to complete the HDF assessment following TRCA/CVC (2014) guidelines are required through future studies to refine and finalize reach-specific constraints and management recommendations.

Erosion Hazard Delineation

Approximately 185.6 ha of erosion hazard corridors and associated setbacks are not enveloped by the Preliminary NHS, particularly within upper tributary reaches with disturbed riparian corridors, and should be incorporated into the system. For watercourses with rehabilitation or realignment opportunities, NHS development can potentially locate preferred zones for realignment that benefit the NHS and potential land use change. Management options contained within the Classification and Management Table (Table 2.3.4.6) should be applied. In future studies when the TRCA/CVC (2014) HDF guidelines are applied, attempts should be made to include protection and conservation HDF features within the NHS, as these features provide temporary habitat, sediment and flow contributions, and ecological linkage.

Mapping provided here has only applied this setback to the erosion limit (i.e., meander belt or stable top of slope) and 10m erosion access allowance as per setback requirements of the Conservation Authorities. Other setbacks per the respective conservation authority need to be applied to finalize the hazard delineation and refinement of the NHS.

2.3.4.2 Preliminary SABE Concept

A summary of the potential impacts of development to geomorphic character and function, and types of mitigation, is provided in Section 2.3.4.1. This includes discussion of erosion hazard corridors, stream length and realignment, headwater drainage features, road crossings, stormwater management and erosion. These potential impacts and mitigation strategies are applicable to each of the land use classifications identified within the FSA, including the preliminary SABE concept.

A summary of the erosion hazard area and watercourse and HDF lengths within each subwatershed of the preliminary SABE concept area is provided in Table 2.3.4.4. Features within the Brampton Caledon Airport footprint were included under the FSA Take-out, as this land use is not anticipated to change. It is noted that no watercourse or HDF reaches are found in the portions of the Huttonville Creek and Credit River (Glen Williams to Norval) subwatersheds that intersect the preliminary SABE concept.

Table 2.3.4.4. Summary of Watercourses and HDFs within the Preliminary SABE Concept

Subwatershed	Erosion Hazard Area		Watercourse Length	HDF Length[1]	Potential HDF Length[2]
	(ha)	% SABE Area	(km)	(km)	(km)
Features outside of FSA Take-Out Areas					
Main Humber	0.1	<0.00	0.0	0.0	-
West Humber	30.0	0.59	0.1	9.4	3.2
Etobicoke Creek	4.6	0.09	0.0	0.0	1.0
Fletcher's Creek	1.8	0.04	0.0	0.0	-
Features including FSA Take-Out Areas					
Main Humber	2.0	0.04	0.4	3.2	-
West Humber	288.8	5.70	41.5	55.9	5.6
Etobicoke Creek	155.8	3.07	25.4	7.1	2.1
Fletcher's Creek	4.2	0.08	0.7	1.8	-

[1]HDFs identified during desk study
[2]Potential HDFs modeled in ArcHydro based on a minimum 25 ha drainage area. Modeled for West Humber and Etobicoke Creek subwatersheds only.

Etobicoke Creek Subwatershed

Figures 2.3.4.3.1 and 2.3.4.3.2 present the watercourse and HDF mapping and erosion hazard corridors for the Etobicoke Creek subwatershed within the preliminary SABE concept. HDF and management recommendations for the subwatershed will be determined in future studies. Additional field assessments will need to be completed in future studies to evaluate potential impacts at the reach scale.

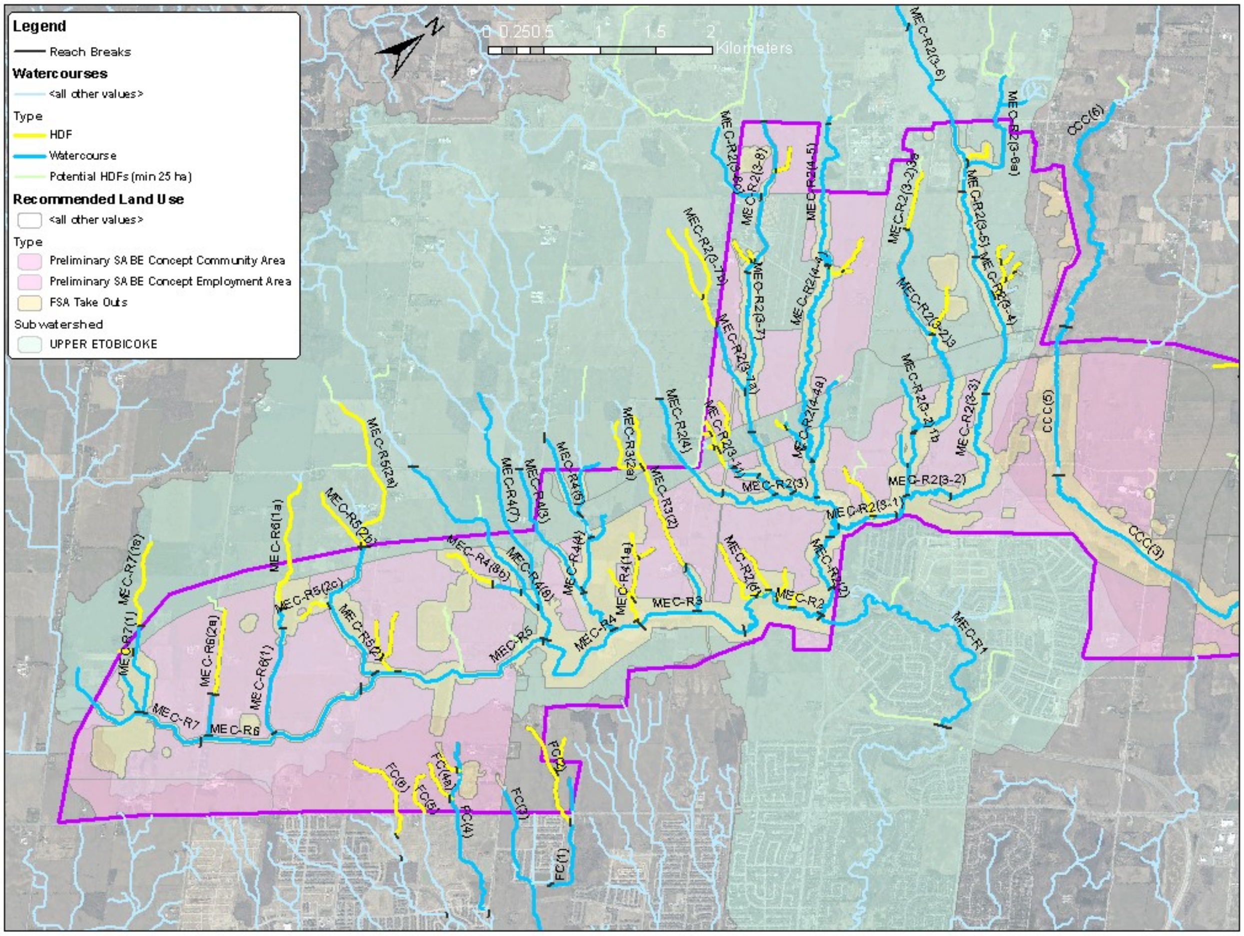


Figure 2.3.4.3.1. Watercourse and HDF reaches within preliminary SABE concept, Etobicoke Creek.

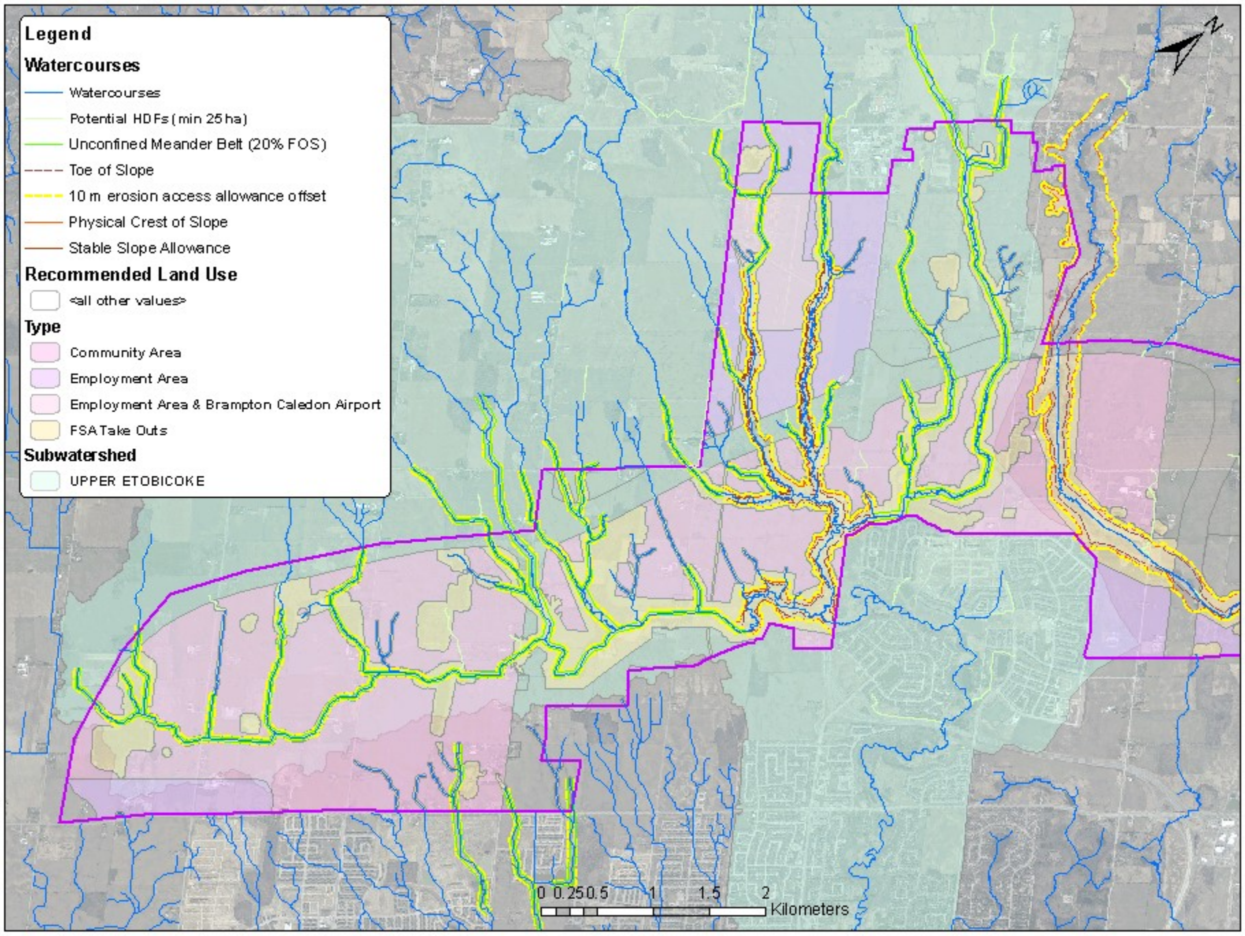


Figure 2.3.4.3.2. Erosion hazard limits within preliminary SABE concept, Etobicoke Creek.

Erosion Assessment

Map SM3 in Appendix G presents mapping of sites undergoing what is considered excessive erosion, based on observations made during the windshield assessments. Windshield assessments were completed at every road crossing within the study area except where roads were closed due to construction. Thus, SM3 depicts the subset of watercourse crossings where excessive erosion was observed and does not capture areas that could not be observed from the roadways. Field walks would need to be completed in future studies to confirm reach-scale erosion processes in areas away from road crossings.

Four erosion sites were mapped in the Etobicoke Creek Subwatershed within or downstream of the preliminary SABE concept area. One of the sites is located on a main branch of Etobicoke Creek (Reach MEC-R3), which is located within the Greenbelt. The three other sites are located within the FSA Takeout area on tributary reaches. Field observations included bank erosion at a culvert, incision downstream of a culvert, bank erosion on one bank within a straightened reach, and severe erosion upstream of a bridge (Reach MEC-R3). The four erosion sites were dispersed across the western portion of the preliminary SABE concept.

Under the proposed scenario (70% and 90% impervious land use for Community and Employment areas, respectively), the number of erosion sites is likely to increase without management of stormwater runoff. SWM is required to prevent channel response to urbanization, which can include continued or increased rates of bank erosion, channel degradation, channel enlargement, and degraded water quality and stream habitat. Unmanaged erosion issues at culverts in particular can lead to the development of fish barriers in cases of channel incision.

Erosion Thresholds and SWM

Erosion thresholds should be determined for receiving watercourses in future studies to inform initial SWM planning. As plans develop, and SWM locations are proposed, erosion thresholds should be assessed for sensitive and/or representative areas downstream of potential outfalls. These values should be compared to existing thresholds and those for sensitive locations to determine the most representative. Erosion threshold evaluation for SWM is to be evaluated through future studies.

Watercourse/HDF Management

The preliminary SABE concept is traversed by main branches of Etobicoke Creek and many tributary and HDF reaches. The westerly branch (reaches MEC-R2 to MEC-R7) flows from west to east through the western portion of the preliminary SABE, through a portion of the Mayfield West Phase 2 lands and into the Greenbelt to the east. The northerly branches of Etobicoke Creek flow south through the preliminary SABE toward the Greenbelt. Two of the northerly branches extend north of the preferred GTA West route to the north part of the preliminary SABE, where they traverse the Brampton Airport lands. Watercourses traversing the preliminary SABE vary from unconfined meandering or straightened reaches to confined meandering reaches. Preliminary geomorphic constraint rankings are provided for each reach in Table 1, Appendix G.

All watercourses are encompassed by the FSA Take-out. Only 1.0 km of Potential HDF length is found outside of the FSA Take-out. The total length of mapped watercourses, HDFs and Potential HDFs including the FSA Take-out are 25.4 km, 7.1 km and 2.1 km, respectively. Features within the Brampton Caledon Airport footprint were included under the FSA Take-out, as this land use is not anticipated to change. Refer to Table 2.3.4.5.

Management recommendations for watercourses and HDFs may be advanced through the integration of study disciplines in future studies. At that stage, further characterization and impact assessment can be made based on terrestrial or aquatic input for specific features (e.g., ponds, ELC mapping), and will be completed as land use plans are developed for the SABE. Field work to confirm/update watercourse and HDF mapping, and to complete the HDF assessment following TRCA/CVC (2014) guidelines are required through future studies to refine and finalize reach-specific constraints and management recommendations.

Note that additional HDFs were identified as part of the Etobicoke Creek Watershed Plan (ECWP) prepared for TRCA in 2020. Appendix C2 presents the HDFs mapped within the ECWP.

Erosion Hazard Delineation

Mapping provided in Figure 2.3.4.2.2 presents the erosion limit (i.e., meander belt or stable top of slope) and 10m erosion access allowance as per setback requirements of the Conservation Authorities. Other setbacks per the respective conservation authority need to be applied to finalize the hazard delineation and refinement of the NHS.

The area occupied by erosion hazard lands is 4.6 ha excluding the FSA Take-out and 155.8 ha including the FSA Take-out, which corresponds to 0.04% and 0.08% of the preliminary SABE concept area, respectively. Refer to Table 2.3.4.4.

Fletcher's Creek Subwatershed

Figures 2.3.4.3.3 and 2.3.4.3.4 present the watercourse and HDF mapping and erosion hazard corridors for the Fletcher's Creek subwatershed within the preliminary SABE concept. HDF and management recommendations for the subwatershed will be determined in future studies. Additional field assessments will need to be completed in future studies to evaluate potential impacts at the reach scale.

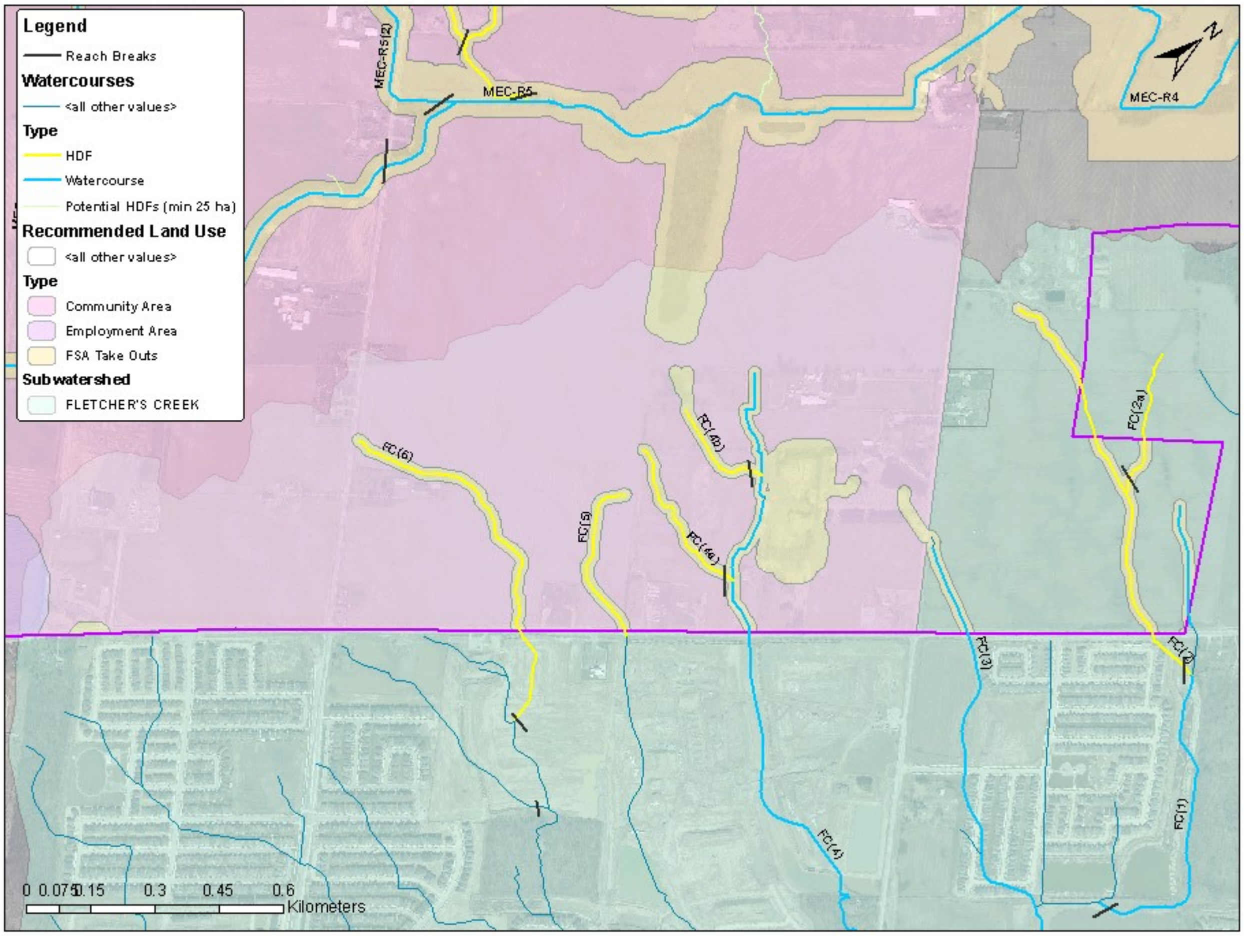


Figure 2.3.4.3.3. Watercourse and HDF reaches within preliminary SABE concept, Fletcher's Creek

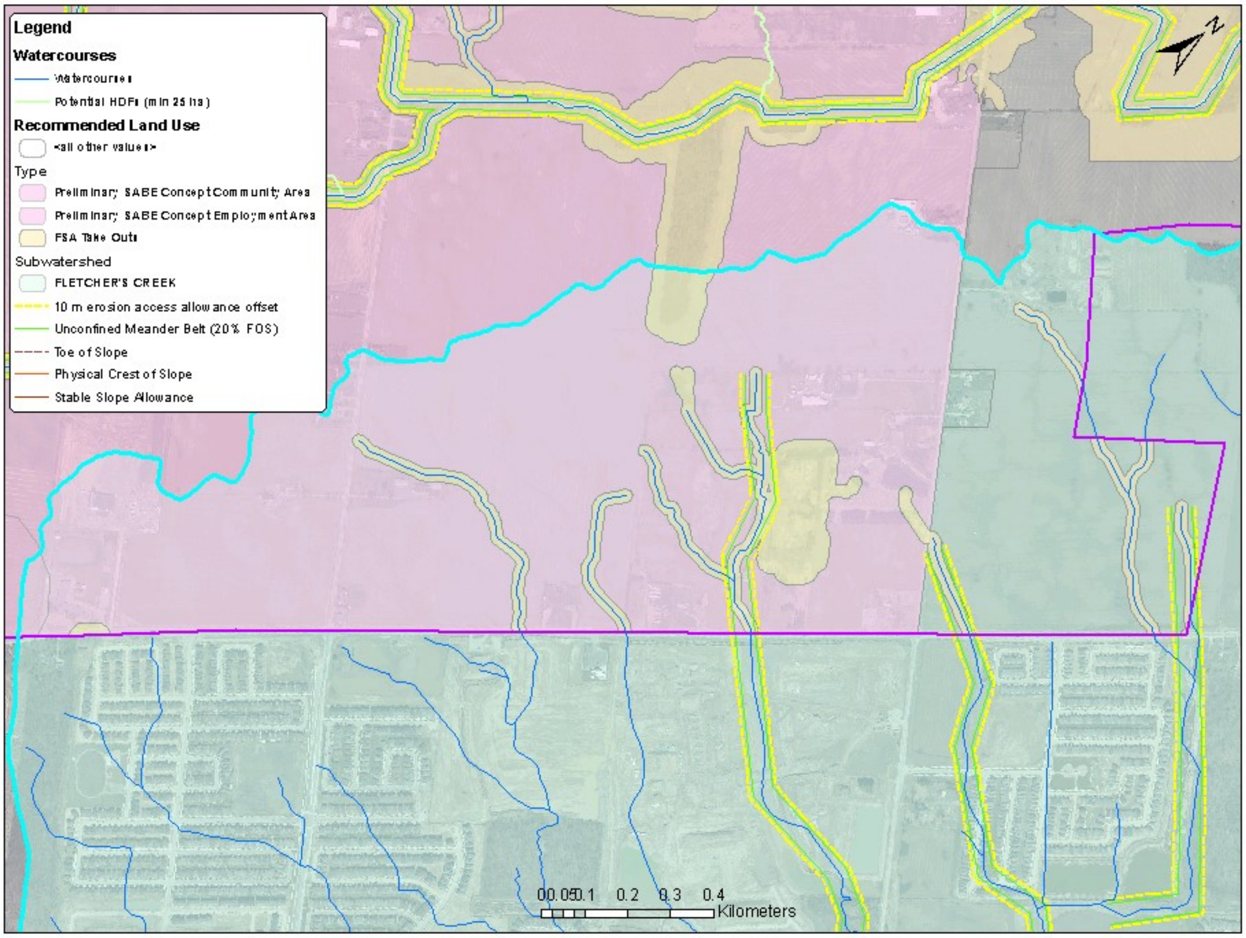


Figure 2.3.4.3.4. Erosion hazard limits within preliminary SABE concept, Fletcher's Creek

Erosion Assessment

Map SM3 in Appendix G presents mapping of sites undergoing what is considered excessive erosion, based on observations made during the windshield assessments. Windshield assessments were completed at every road crossing within the study area except where roads were closed due to construction. Thus, SM3 depicts the subset of watercourse crossings where excessive erosion was observed and does not capture areas that could not be observed from the roadways. Field walks would need to be completed in future studies to confirm reach-scale erosion processes in areas away from road crossings.

No erosion sites were mapped within the portion of the Fletcher's Creek subwatershed within the preliminary SABE concept. Nevertheless, under the proposed scenario (70% and 90% impervious land use for Community and Employment areas, respectively), erosion sites could increase without management of stormwater runoff. SWM is required to prevent channel response to urbanization, which can include continued or increased rates of bank erosion, channel degradation, channel enlargement, and degraded water quality and stream habitat. Unmanaged erosion issues at culverts in particular can lead to the development of fish barriers in cases of channel incision.

Erosion Thresholds and SWM

Utilize previously determined erosion thresholds for Site SW4 – Fletchers Creek (Northwest Brampton SWS, 2010) to inform initial SWM planning at a general level. As plans develop, and SWM locations are proposed, erosion thresholds should be determined for sensitive and/or representative areas downstream of potential outfalls. These values should be compared to existing thresholds and those for sensitive locations to determine the most representative. Erosion threshold evaluation for SWM is to be evaluated through future studies.

Watercourse/HDF Management

A small portion of the Fletcher's Creek subwatershed intersects with the preliminary SABE concept. Only six reaches are found in this subwatershed within the preliminary SABE concept, including reaches located within the FSA Take-Out areas. Four of these reaches are HDFs, while two are watercourses. Of the watercourse reaches, one (FC(4)) was assigned a Medium have preliminary geomorphic constraint ranking while the other (FC(3)) was Low constraint. Preliminary geomorphic constraint rankings are provided for each reach in **Table 1, Appendix G.**

All watercourses and HDFs are encompassed by the FSA Take-out. The total length of mapped watercourses and HDFs including the FSA-Takeout are 0.7 km and 1.8 km, respectively. Refer to Table 2.3.4.5.

Management recommendations for watercourses and HDFs may be advanced through the integration of study disciplines in future studies. At that stage, further characterization and impact assessment can be made based on terrestrial or aquatic input for specific features (e.g., ponds, ELC mapping), and will be completed as land use plans are developed for the SABE. Field work to confirm/update watercourse and HDF mapping, and to complete the HDF assessment following TRCA/CVC (2014) guidelines are required through future studies to refine and finalize reach-specific constraints and management recommendations.

Erosion Hazard Delineation

Mapping provided in Figure 2.3.4.2.4 presents the erosion limit (i.e., meander belt or stable top of slope) and 10m erosion access allowance as per setback requirements of the Conservation Authorities. Other setbacks per the respective conservation authority need to be applied to finalize the hazard delineation and refinement of the NHS.

The area occupied by erosion hazard lands is 1.8 ha excluding the FSA Take-out and 4.2 ha including the FSA Take-out, which corresponds to <0.01% and 0.04% of the preliminary SABE concept, respectively. Refer to Table 2.3.4.4.

Main Humber River Subwatershed

Figures 2.3.4.3.5 and 2.3.4.3.6 present the watercourse and HDF mapping and erosion hazard corridors for the Main Humber River subwatershed within the preliminary SABE concept. HDF and management recommendations for the subwatershed will be determined in future studies. Additional field assessments will need to be completed in future studies to evaluate potential impacts at the reach scale.

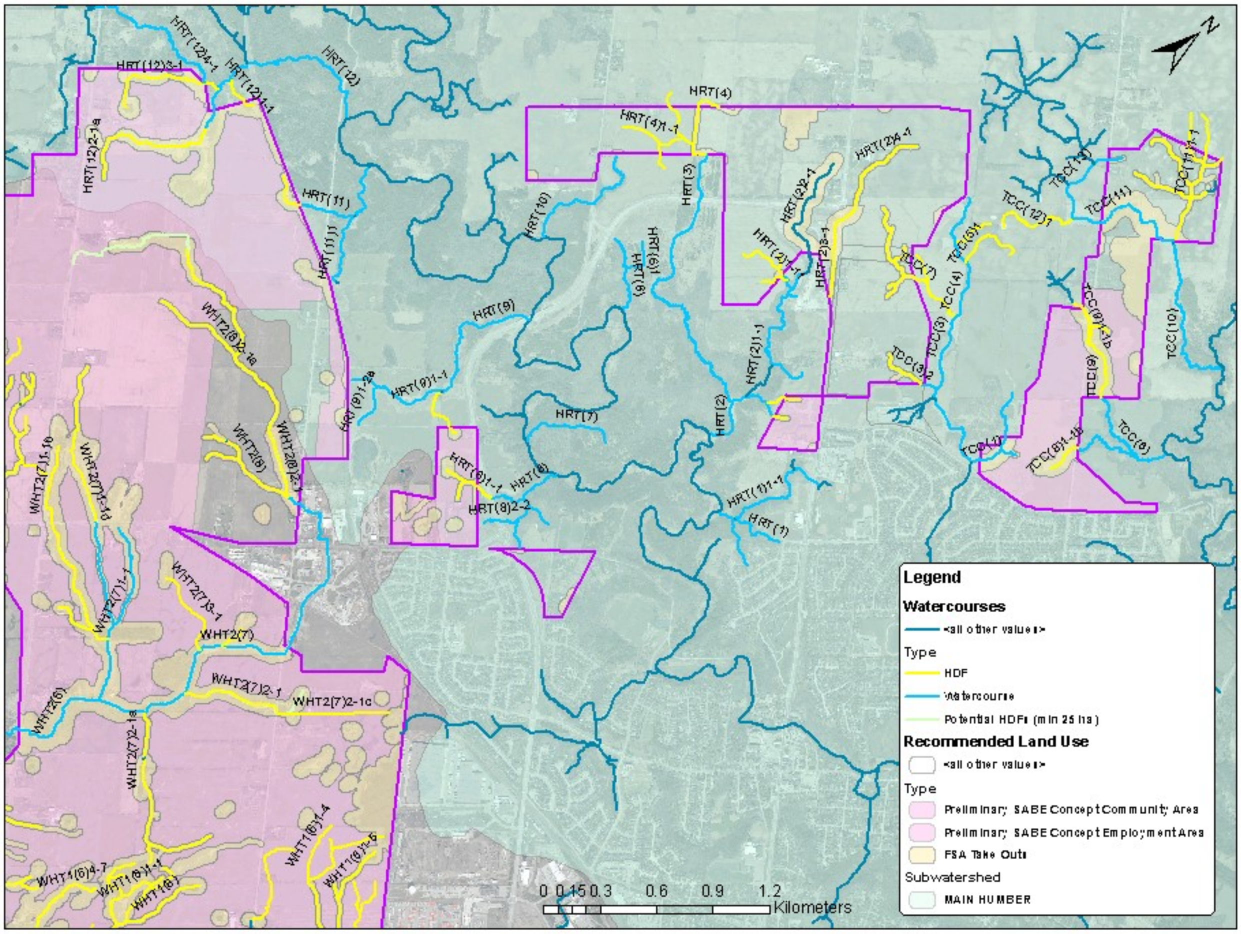


Figure 2.3.4.3.5. Watercourse and HDF reaches within preliminary SABE concept, Main Humber River

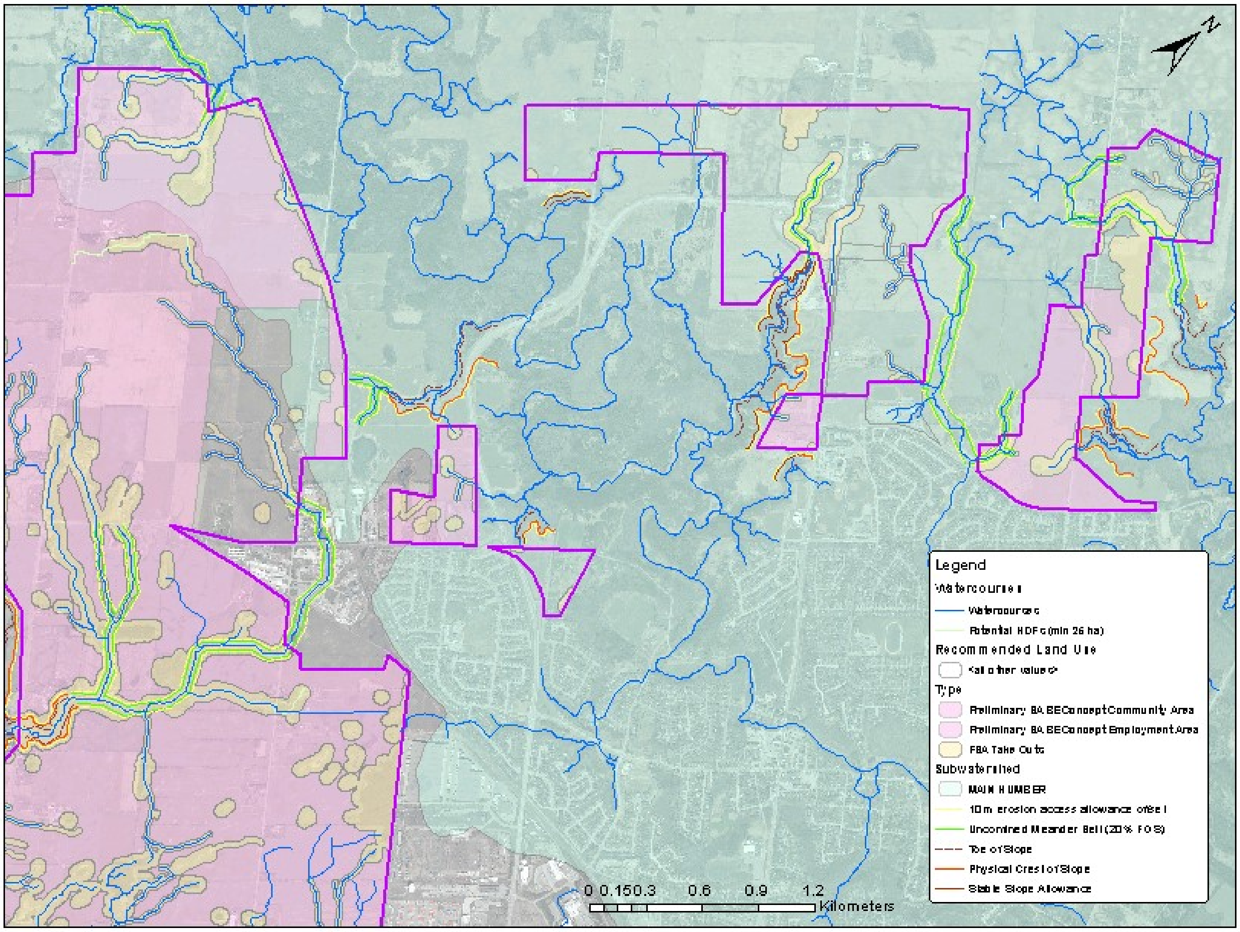


Figure 2.3.4.3.6. Erosion hazard limits within preliminary SABE concept, Main Humber River

Erosion Assessment

Map SM3 in Appendix G presents mapping of sites undergoing what is considered excessive erosion, based on observations made during the windshield assessments. Windshield assessments were completed at every road crossing within the study area except where roads were closed due to construction. Thus, SM3 depicts the subset of watercourse crossings where excessive erosion was observed and does not capture areas that could not be observed from the roadways. Field walks would need to be completed in future studies to confirm reach-scale erosion processes in areas away from road crossings.

Two erosion sites were mapped in the Main Humber River Subwatershed within the FSA Take-Out located in the easternmost portion of the preliminary SABE concept. Field observations included incision and erosion at a crossing, and erosion at a plastic culvert. The two sites are located on either side of the same crossing, on reaches TCC(8)1-1a and TCC(8)1-1b, which are part of a first order tributary.

Under the proposed scenario (70% and 90% impervious land use for Community and Employment areas, respectively), the number of erosion sites is likely to increase without management of stormwater runoff. SWM is required to prevent channel response to urbanization, which can include continued or increased rates of bank erosion, channel degradation, channel enlargement, and degraded water quality and stream habitat. Unmanaged erosion issues at culverts in particular can lead to the development of fish barriers in cases of channel incision.

Erosion Thresholds and SWM

Erosion thresholds should be determined for receiving watercourses in future studies to inform initial SWM planning. As plans develop, and SWM locations are proposed, erosion thresholds should be assessed for sensitive and/or representative areas downstream of potential outfalls. These values should be compared to existing thresholds and those for sensitive locations to determine the most representative. Erosion threshold evaluation for SWM is to be evaluated through future studies.

Watercourse/HDF Management

Four small sections of the preliminary SABE concept are located within the Main Humber River subwatershed. These areas contain HDFs and low-order watercourse reaches with Low or Medium preliminary geomorphic constraint rankings. Preliminary geomorphic constraint rankings are provided for each reach in Table 1, Appendix G.

All watercourses and HDFs are encompassed by the FSA Take-out. The total length of mapped watercourses and HDFs including the FSA-Takeout are 0.4 km and 3.2 km, respectively. Refer to Table 2.3.4.5.

Management recommendations for watercourses and HDFs may be advanced through the integration of study disciplines in future studies. At that stage, further characterization and impact assessment can be made based on terrestrial or aquatic input for specific features (e.g., ponds, ELC mapping), and will be completed as land use plans are developed for the SABE. Field work to confirm/update watercourse and HDF mapping, and to complete the HDF assessment following TRCA/CVC (2014) guidelines are required through future studies to refine and finalize reach-specific constraints and management recommendations.

Erosion Hazard Delineation

Mapping provided in Figure 2.3.4.2.6 presents the erosion limit (i.e., meander belt or stable top of slope) and 10m erosion access allowance as per setback requirements of the Conservation Authorities. Other setbacks per the respective conservation authority need to be applied to finalize the hazard delineation and refinement of the NHS.

The area occupied by erosion hazard lands is 1.0 ha excluding the FSA Take-out and 2.0 ha including the FSA Take-out, which correspond to <0.01% and 0.04% of the preliminary SABE concept, respectively. Refer to Table 2.3.4.4. Several erosion hazard limits for confined reaches outside of the preliminary SABE are found in proximity to the preliminary SABE boundaries, but do not intersect the preliminary SABE.

West Humber River Subwatershed

Figures 2.3.4.3.7 and 2.3.4.3.8 present the watercourse and HDF mapping and erosion hazard corridors for the West Humber subwatershed within the preliminary SABE concept. HDF and management recommendations for the subwatershed will be determined in future studies. Additional field assessments will need to be completed in future studies to evaluate potential impacts at the reach scale.

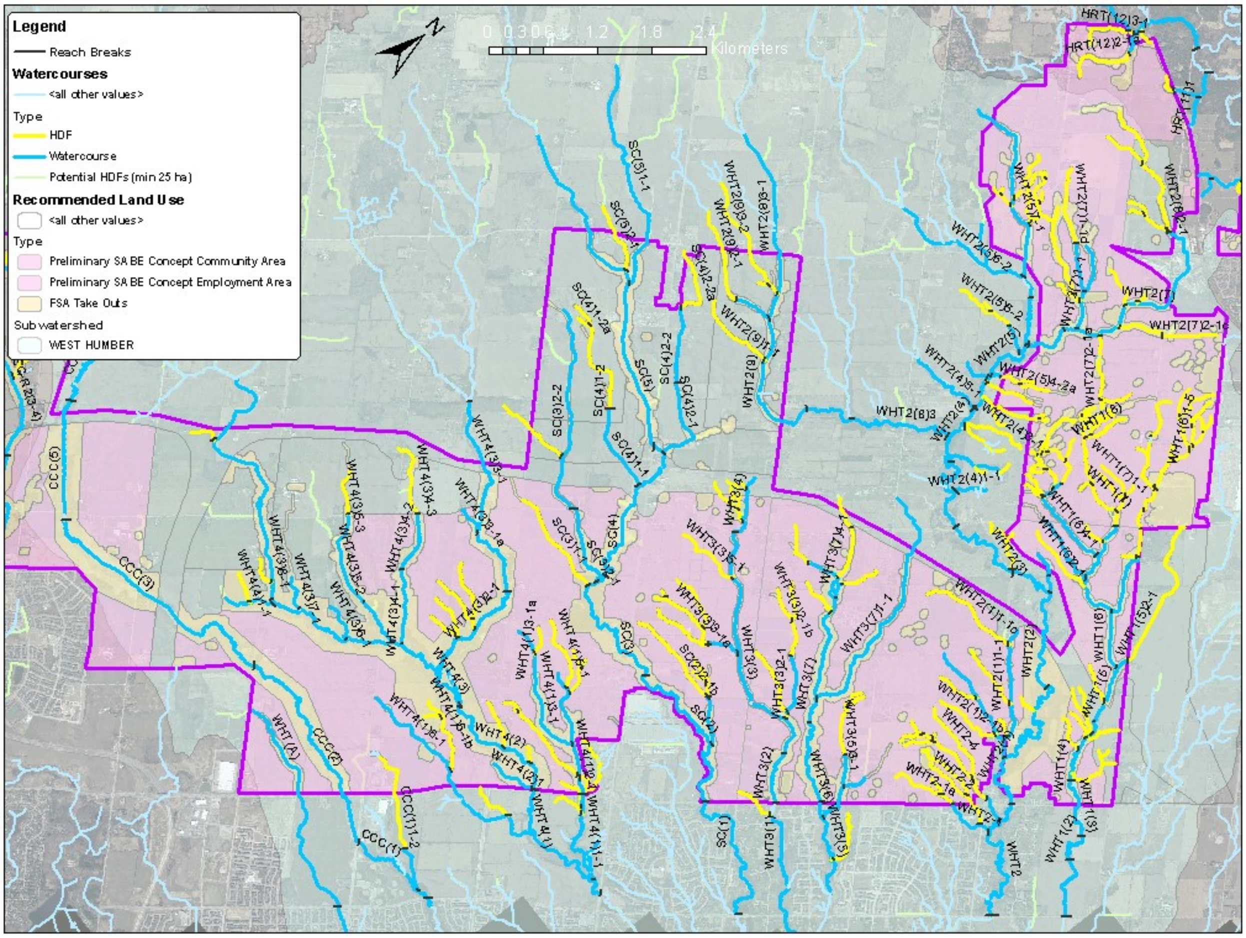


Figure 2.3.4.3.7. Watercourse and HDF reaches within preliminary SABE concept, West Humber River

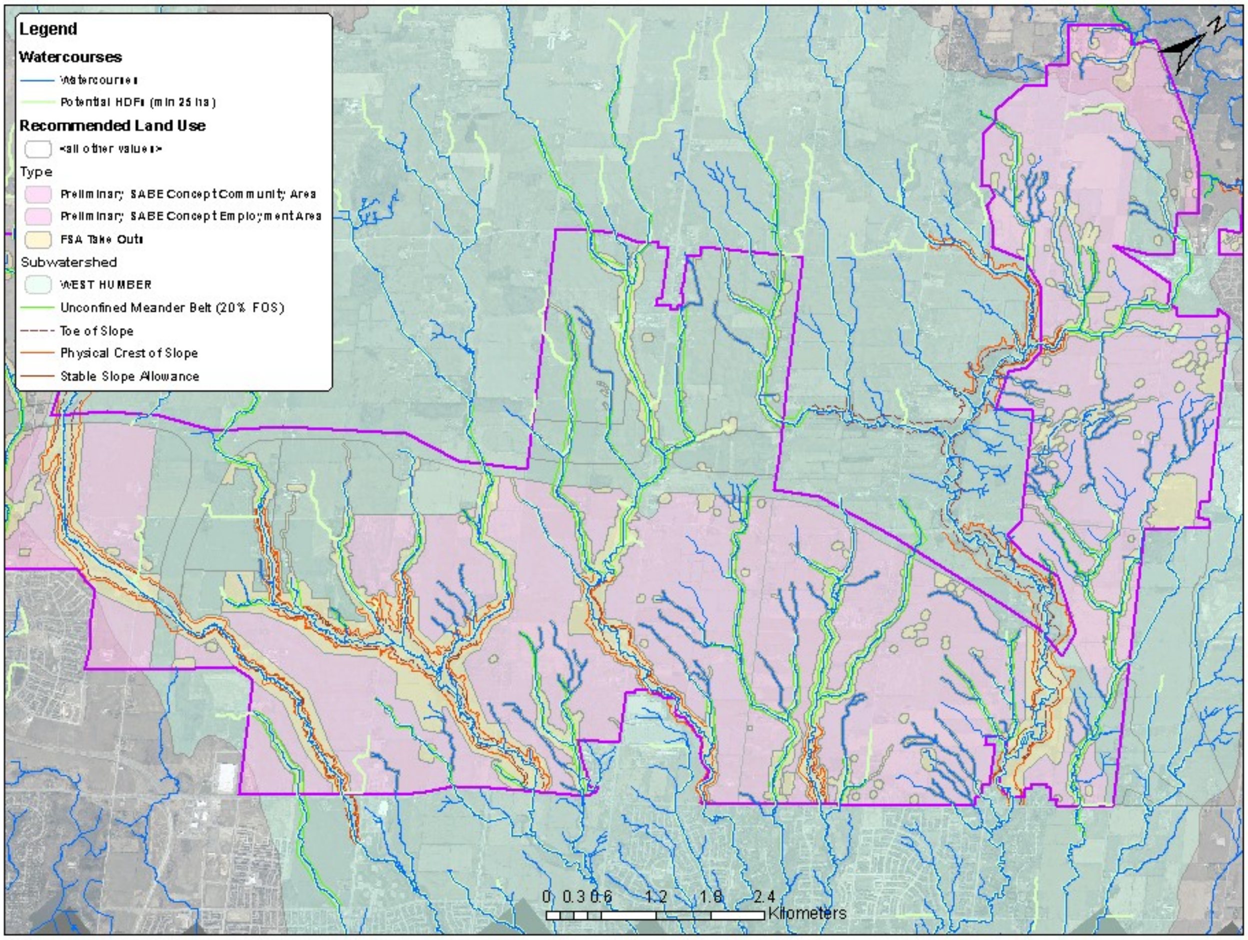


Figure 2.3.4.3.8. Erosion hazard limits within preliminary SABE concept, West Humber River

Erosion Assessment

Map SM3 in Appendix G presents mapping of sites undergoing what is considered excessive erosion, based on observations made during the windshield assessments. Windshield assessments were completed at every road crossing within the study area except where roads were closed due to construction. Thus, SM3 depicts the subset of watercourse crossings where excessive erosion was observed and does not capture areas that could not be observed from the roadways. Field walks would need to be completed in future studies to confirm reach-scale erosion processes in areas away from road crossings.

Seventeen erosion sites were mapped in the West Humber Subwatershed in receiving watercourses or HDFs immediately downstream of the preliminary SABE concept. Of these, three were located within the Greenbelt (on reaches CCC(5), WHT4(2) and WHT2) and fourteen were located within the FSA Take-Out area (on reaches WHT4(3)5-2, SC(1), SC(2), SC(3)2-1, SC(3)2-2, SC4, WHT3(2), WHT3(4), WHT3(6), WHT3(5)2-1a, WHT1(6), WHT1(6)3-1, WHT1(6)1-2, WHT1(6)1-3a). Note the erosion site on reach WHT4(3)5-2 lies on the boundary with a SABE Testing Area and was counted in both areas. Many of the erosion sites were noted at existing road crossings in the form of local channel widening, bank erosion near the culvert, bed incision, culvert damage and an exposed CSP bottom. At other sites, field observations included steep banks, ditch incision and bank undercutting.

Under the proposed scenario (70% and 90% impervious land use for Community and Employment areas, respectively), the number of erosion sites is likely to increase without management of stormwater runoff. SWM is required to prevent channel response to urbanization, which can include continued or increased rates of bank erosion, channel degradation, channel enlargement, and degraded water quality and stream habitat. Unmanaged erosion issues at culverts in particular can lead to the development of fish barriers in cases of channel incision.

Erosion Thresholds and SWM

Erosion thresholds should be determined for receiving watercourses in future studies to inform initial SWM planning. As plans develop, and SWM locations are proposed, erosion thresholds should be assessed for sensitive and/or representative areas downstream of potential outfalls. These values should be compared to existing thresholds and those for sensitive locations to determine the most representative. Erosion threshold evaluation for SWM is to be evaluated through future studies.

Watercourse/HDF Management

The preliminary SABE concept is traversed by the main branches and significant tributaries of the West Humber River as well as many lesser tributary and HDF reaches. Campbell's Cross Creek and two mainstem branches to the West Humber are protected by the Greenbelt. Salt Creek and most nearly all other watercourse reaches within the area are included in the FSA Take-Out. Watercourses traversing the preliminary SABE vary from unconfined meandering or straightened reaches to confined meandering reaches. Preliminary geomorphic constraint rankings are provided for each reach in Table 1, Appendix G.

Most watercourses and HDFs are encompassed by the FSA Take-out. The total length of mapped watercourses, HDFs and Potential HDFs excluding the FSA-Takeout are 0.1 km and 9.4 km and 3.2 km, respectively. The total length of mapped watercourses, HDFs and Potential HDFs including the FSA-Takeout are 41.4 km, 55.9 km, and 5.6 km, respectively. Refer to Table 2.3.4.5.

Management recommendations for watercourses and HDFs may be advanced through the integration of study disciplines in future studies. At that stage, further characterization and impact assessment can be made based on terrestrial or aquatic input for specific features (e.g., ponds, ELC mapping), and will be completed as land use plans are developed for the SABE. Field work to confirm/update watercourse and HDF mapping, and to complete the HDF assessment following TRCA/CVC (2014) guidelines are required through future studies to refine and finalize reach-specific constraints and management recommendations.

Erosion Hazard Delineation

Mapping provided in Figure 2.3.4.2.8 presents the erosion limit (i.e., meander belt or stable top of slope) and 10m erosion access allowance as per setback requirements of the Conservation Authorities. Other setbacks per the respective conservation authority need to be applied to finalize the hazard delineation and refinement of the NHS.

The area occupied by erosion hazard lands is 30.0 ha excluding the FSA Take-out and 288.8 ha including the FSA Take-out, which correspond to 0.59% and 5.70% of the preliminary SABE concept, respectively. Refer to Table 2.3.4.4.

2.3.4.3 SABE Testing Areas

A summary of the potential impacts of development to geomorphic character and function, and types of mitigation, is provided in Section 2.3.4.1. This includes discussion of erosion hazard corridors, stream length and realignment, headwater drainage features, road crossings, stormwater management and erosion. These potential impacts and mitigation strategies are applicable to each of the land use classifications identified within the FSA, including the SABE Testing Areas.

A summary of the erosion hazard area and watercourse and HDF lengths within each subwatershed of the SABE Testing Areas is provided in Table 2.3.4.5.

Table 2.3.4.5: Summary of Watercourses and HDFs within the SABE Testing Areas

Subwatershed	Watercourse Length		HDF Length[1]	Potential HDF Length[2]	
	ha	% Testing Areas	(km)	(km)	(km)
	Features outside of FSA Take-Out Areas				
Main Humber	0.2	0.02	0.0	1.1	-
West Humber	13.8	1.17	0.0	0.0	2.3
Etobicoke Creek	3.5	0.30	0.0	0.0	0.2
Fletcher's Creek	0.0	0.00	0.0	0.0	-
	Features including FSA Take-Out Areas				
Main Humber	6.8	0.58	1.2	4.4	-
West Humber	64.7	5.50	7.2	2.9	4.0
Etobicoke Creek	25.6	2.18	4.4	2.3	0.4
Fletcher's Creek	0.0	0.00	0.0	0.0	-

[1]HDFs identified during desk study
[2]Potential HDFs modeled in ArcHydro based on a minimum 25 ha drainage area. Modeled for West Humber and Etobicoke Creek subwatersheds only.

Etobicoke Creek Subwatershed

Figures 2.3.4.4.1 and 2.3.4.4.2 present the watercourse and HDF mapping and erosion hazard corridors for the SABE Testing Area located in the Etobicoke Creek subwatershed. HDF and management recommendations for the subwatershed will be determined in future studies. Additional field assessments will need to be completed in future studies to evaluate potential impacts at the reach scale.

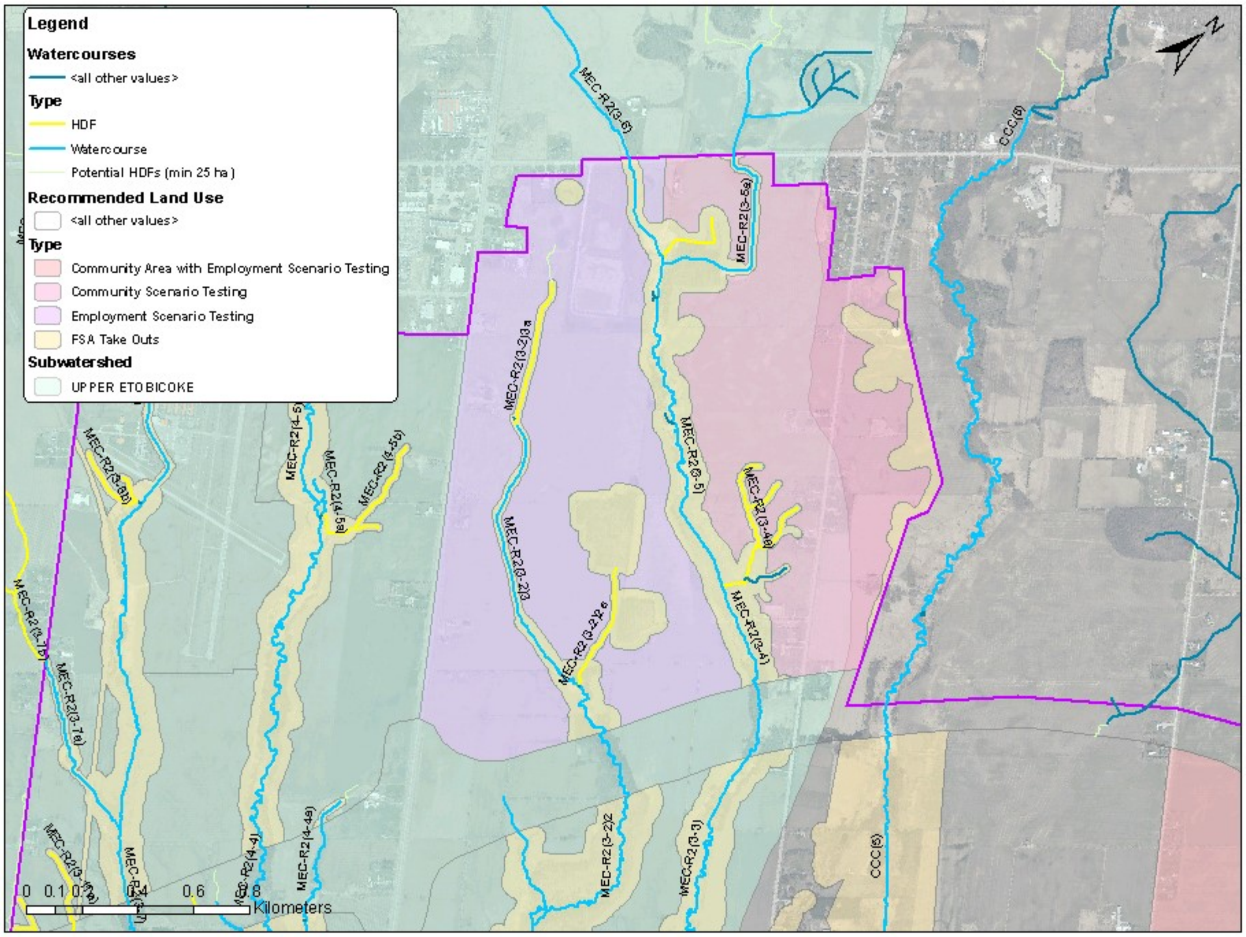


Figure 2.3.4.4.1. Watercourse and HDF reaches within SABE Testing Areas, Etobicoke Creek

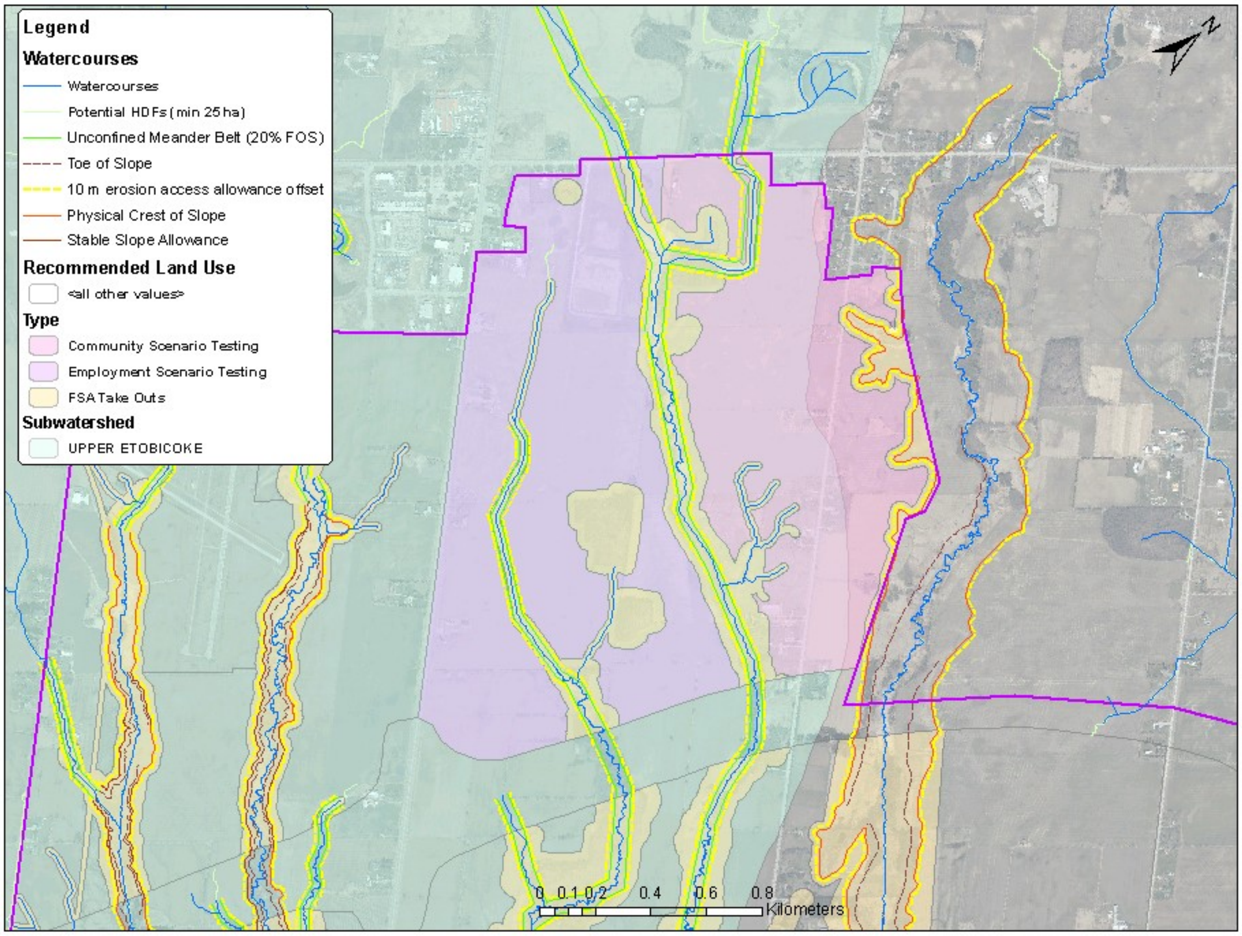


Figure 2.3.4.4.2. Erosion hazard limits within SABE Testing Areas, Etobicoke Creek

Erosion Assessment

Map SM3 in Appendix G presents mapping of sites undergoing what is considered excessive erosion, based on observations made during the windshield assessments. Windshield assessments were completed at every road crossing within the study area except where roads were closed due to construction. Thus, SM3 depicts the subset of watercourse crossings where excessive erosion was observed and does not capture areas that could not be observed from the roadways. Field walks would need to be completed in future studies to confirm reach-scale erosion processes in areas away from road crossings.

No erosion sites were mapped in the Etobicoke Creek Subwatershed within the SABE Testing Area. Nevertheless, under the proposed scenario (70% and 90% impervious land use for Community and Employment areas, respectively), the number of erosion sites is likely to increase without management of stormwater runoff. SWM is required to prevent channel response to urbanization, which can include continued or increased rates of bank erosion, channel degradation, channel enlargement, and degraded water quality and stream habitat. Unmanaged erosion issues at culverts in particular can lead to the development of fish barriers in cases of channel incision.

Erosion Thresholds and SWM

Erosion thresholds should be determined for receiving watercourses in future studies to inform initial SWM planning. As plans develop, and SWM locations are proposed, erosion thresholds should be assessed for sensitive and/or representative areas downstream of potential outfalls. These values should be compared to existing thresholds and those for sensitive locations to determine the most representative. Erosion threshold evaluation for SWM is to be evaluated through future studies.

Watercourse/HDF Management

Testing Areas E and C, located east of Hurontario Street to east of Kennedy Road, encompass the headwaters of a tributary to Etobicoke Creek (MEC-R2(3-2)1) and mainstem reaches of a second tributary (MEC-R2(3-2)). The headwaters of MEC-R2(3-2)1originate within this Testing area and flow south across the proposed GTA West footprint. Tributary MEC-R2(3-2) originates north of the testing area (south of Boston Mills Road) and runs south along the boundary of Testing Areas E and C before crossing the GTA West footprint. The testing areas encompass or intersect 6 watercourse reaches, 1 HDF reach and several potential HDFs. Preliminary geomorphic constraint rankings of the watercourses included two High Constraint reaches, three Medium Constraint reaches and one unclassified reach. Preliminary geomorphic constraint rankings are provided for each reach in Table 1, Appendix G. Note that additional HDFs were identified as part of the Etobicoke Creek Watershed Plan (ECWP) prepared for TRCA in 2020. Appendix C2 presents the HDFs mapped within the ECWP.

All watercourses and mapped HDFs are encompassed by the FSA Take-out. Only 0.2 km of Potential HDF length is found outside of the FSA Take-out. The total length of mapped watercourses, HDFs and Potential HDFs in the Etobicoke Creek subwatershed within the SABE Testing areas are 4.4 km, 2.3 km and 0.4 km, respectively. Refer to Table 2.3.4.5.

Management recommendations for watercourses and HDFs may be advanced through the integration of study disciplines in future studies. At that stage, further characterization and impact assessment can be made based on terrestrial or aquatic input for specific features (e.g., ponds, ELC mapping), and will be completed as land use plans are developed for the SABE. Field work to confirm/update watercourse and HDF mapping, and to complete the HDF assessment following TRCA/CVC (2014) guidelines are required through future studies to refine and finalize reach-specific constraints and management recommendations.

Note that additional HDFs were identified as part of the Etobicoke Creek Watershed Plan (ECWP) prepared for TRCA in 2020. Appendix C2 presents the HDFs mapped within the ECWP.

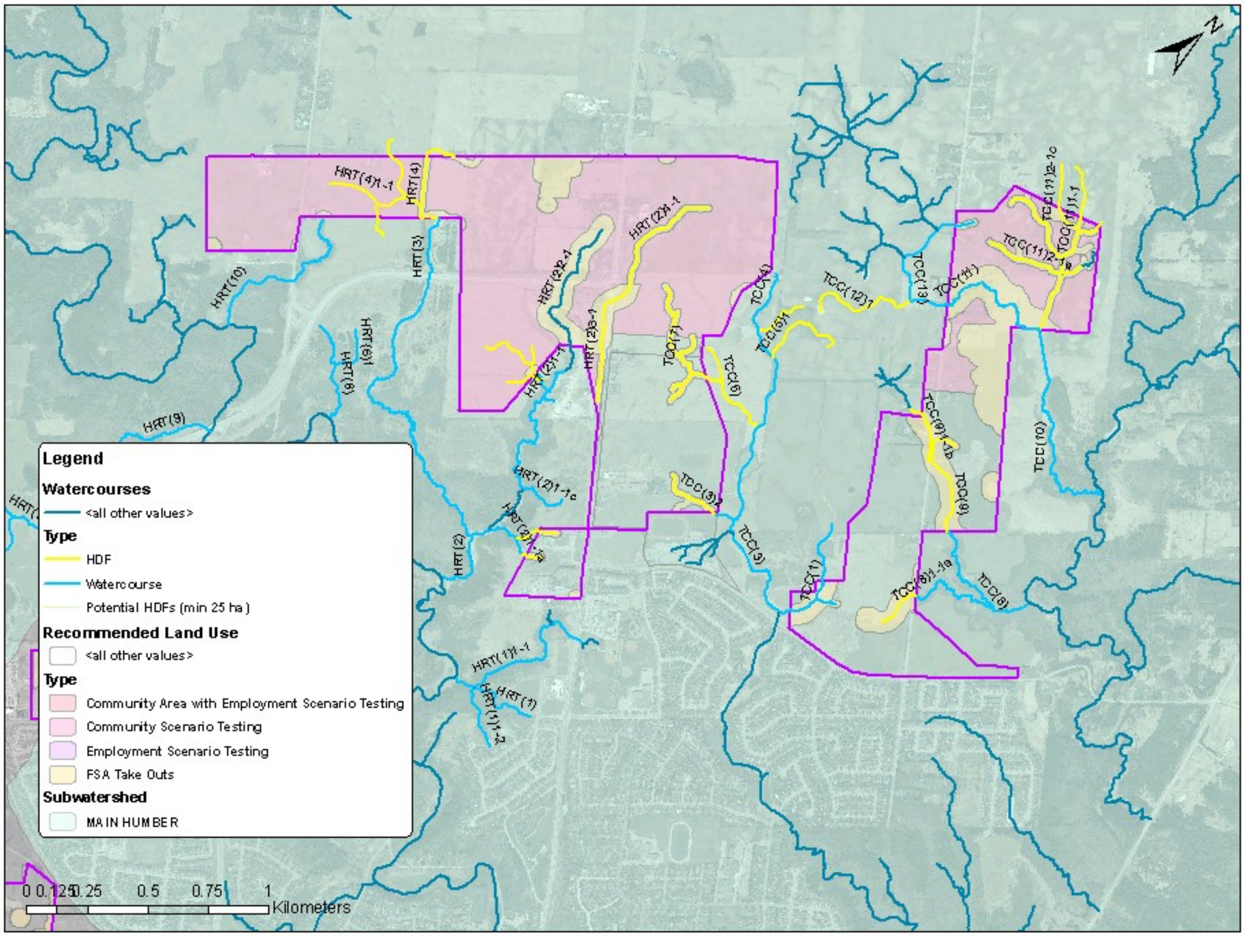
Erosion Hazard Delineation

Mapping provided in Figure 2.3.4.3.2 presents the erosion limit (i.e., meander belt or stable top of slope) and 10m erosion access allowance as per setback requirements of the Conservation Authorities. Other setbacks per the respective conservation authority need to be applied to finalize the hazard delineation and refinement of the NHS.

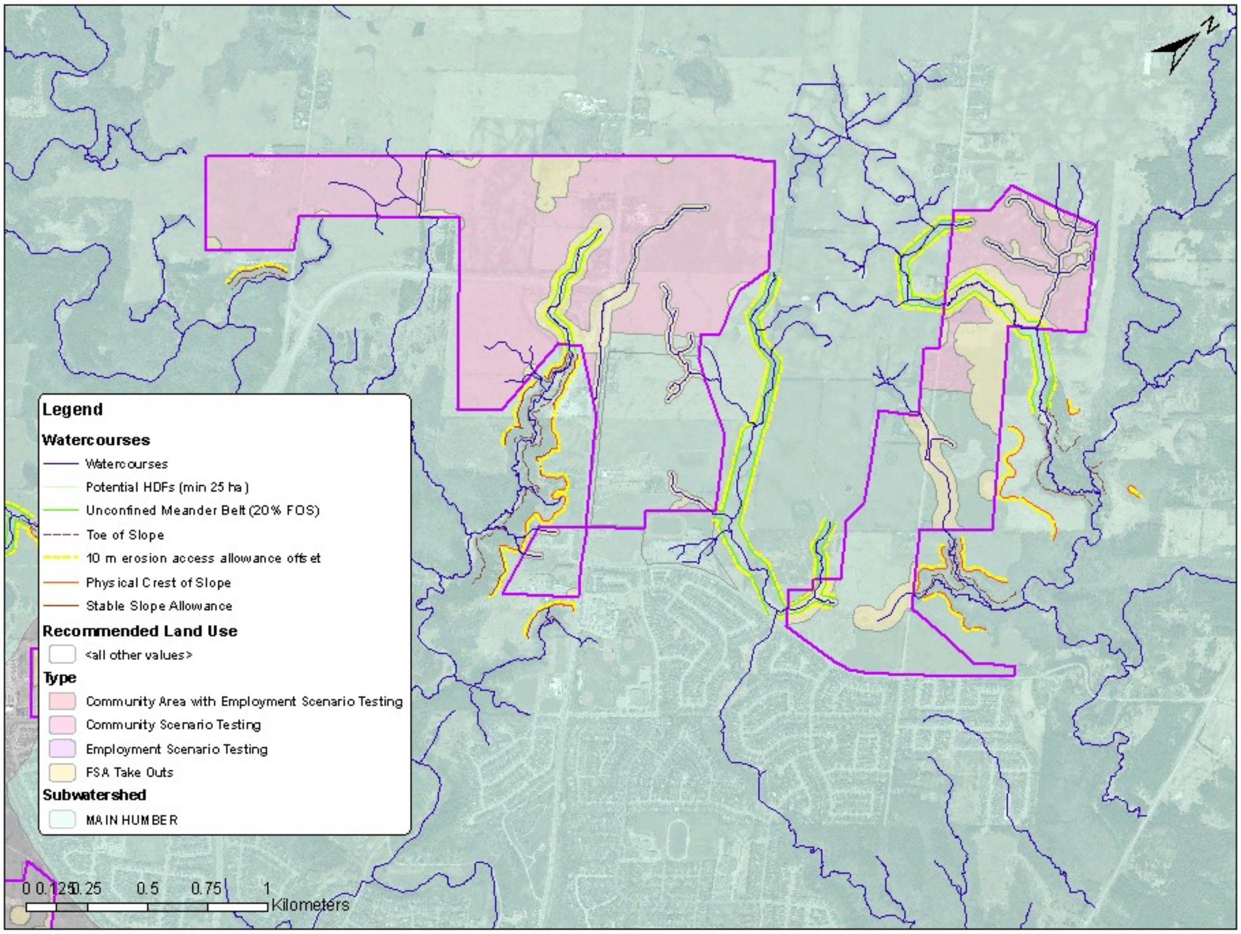
The area occupied by erosion hazard lands is 3.5 ha excluding the FSA Take-out and 25.6 ha including the FSA Take-out, which corresponds to 0.30% and 2.18% of the SABE Testing areas, respectively. Refer to Table 2.3.4.5.

Main Humber River Subwatershed

Figures 2.3.4.4.3 and 2.3.4.4.4 present the watercourse and HDF mapping and erosion hazard corridors for the Main Humber River subwatershed within the SABE Testing Areas. HDF and management recommendations for the subwatershed will be determined in future studies. Additional field assessments will need to be completed in future studies to evaluate potential impacts at the reach scale.



Figures 2.3.4.4.3. Watercourse and HDF reaches within SABE Testing Areas, Main Humber River



Figures 2.3.4.4.4. Erosion hazard limits within SABE Testing Areas, Main Humber River

Erosion Assessment

Map SM3 in Appendix G presents mapping of sites undergoing what is considered excessive erosion, based on observations made during the windshield assessments. Windshield assessments were completed at every road crossing within the study area except where roads were closed due to construction. Thus, SM3 depicts the subset of watercourse crossings where excessive erosion was observed and does not capture areas that could not be observed from the roadways. Field walks would need to be completed in future studies to confirm reach-scale erosion processes in areas away from road crossings.

No erosion sites were mapped in the Main Humber River Subwatershed within the SABE Testing Areas. Nevertheless, under the proposed scenario (70% and 90% impervious land use for Community and Employment areas, respectively), the number of erosion sites is likely to increase without management of stormwater runoff. SWM is required to prevent channel response to urbanization, which can include continued or increased rates of bank erosion, channel degradation, channel enlargement, and degraded water quality and stream habitat. Unmanaged erosion issues at culverts in particular can lead to the development of fish barriers in cases of channel incision.

Erosion Thresholds and SWM

Erosion thresholds should be determined for receiving watercourses in future studies to inform initial SWM planning. As plans develop, and SWM locations are proposed, erosion thresholds should be assessed for sensitive and/or representative areas downstream of potential outfalls. These values should be compared to existing thresholds and those for sensitive locations to determine the most representative. Erosion threshold evaluation for SWM is to be evaluated through future studies.

Watercourse/HDF Management

Two SABE Testing Areas are located within the Main Humber River subwatershed. The western area falls on either side of Queen Street north of Bolton and is adjacent to a BRES ROPA 30 area to the south. This Testing Area includes one watercourse reach (HRT(2)2-1) and 10 HDF reaches, many of which are encompassed by FSA Take-Out areas. Reach HRT(2)2-1 is a first order reach with a Low preliminary geomorphic constraint ranking. Preliminary geomorphic constraint rankings are provided for each reach in Table 1, Appendix G.

The eastern SABE Testing Area is located near Mount Hope Road north of Bolton and is adjacent to the easternmost Preliminary SABE Concept Area to the south. This Testing Area includes portions of two watercourse reaches (TCC(11) and TCC(13)) and five HDF reaches, many of which are encompassed by FSA Take-Out areas.. The watercourses are low-order reaches with Medium and Low preliminary geomorphic constraint rankings.

All watercourses are encompassed by the FSA Take-out. Only 1.1 km of HDF length is found outside of the FSA Take-out. The total length of mapped watercourses and HDFs in the Main Humber subwatershed within the SABE Testing areas including the FSA-Takeout are 1.2 km and 4.4 km, respectively. Refer to Table 2.3.4.5.

Management recommendations for watercourses and HDFs may be advanced through the integration of study disciplines in future studies. At that stage, further characterization and impact assessment can be made based on terrestrial or aquatic input for specific features (e.g., ponds, ELC mapping), and will be completed as land use plans are developed for the SABE. Field work to confirm/update watercourse and HDF mapping, and to complete the HDF assessment following TRCA/CVC (2014) guidelines are required through future studies to refine and finalize reach-specific constraints and management recommendations.

Erosion Hazard Delineation

Mapping provided in Figure 2.3.4.3.4 presents the erosion limit (i.e., meander belt or stable top of slope) and 10m erosion access allowance as per setback requirements of the Conservation Authorities. Other setbacks per the respective conservation authority need to be applied to finalize the hazard delineation and refinement of the NHS.

The area occupied by erosion hazard lands is 0.2 ha excluding the FSA Take-out and 6.8 ha including the FSA Take-out, which corresponds to 0.02% and 0.58% of the SABE Testing areas, respectively. Refer to Table 2.3.4.5. Several erosion hazard limits for confined reaches are found in proximity to the Testing Area boundaries, but do not intersect the Testing Areas.

West Humber River Subwatershed

Figures 2.3.4.4.5 and 2.3.4.4.6 present the watercourse and HDF mapping and erosion hazard corridors for the West Humber subwatershed within the SABE Testing Areas. HDF and management recommendations for the subwatershed will be determined in future studies. Additional field assessments will need to be completed in future studies to evaluate potential impacts at the reach scale.

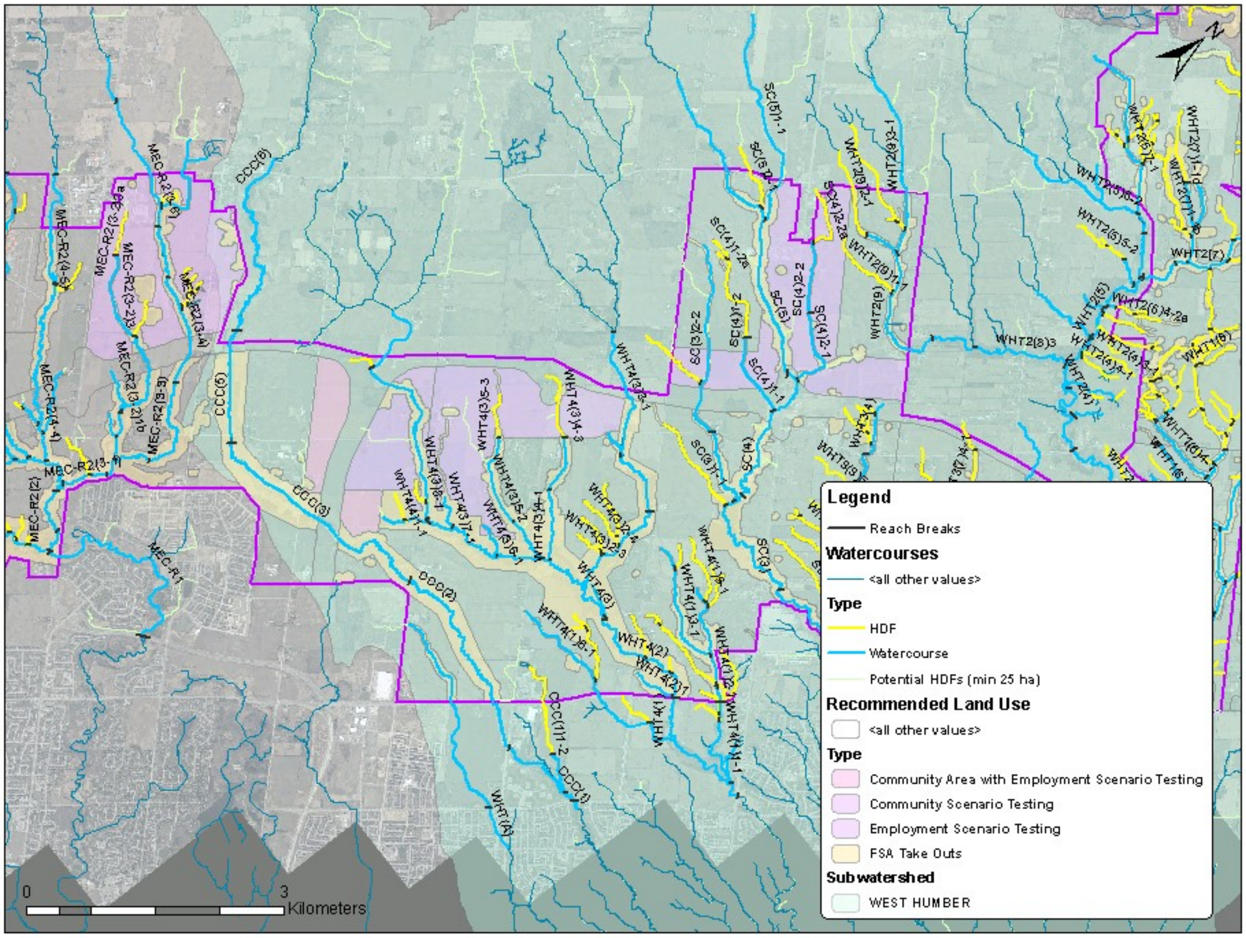


Figure 2.3.4.4.5. Watercourse and HDF reaches within SABE Testing Areas, West Humber River

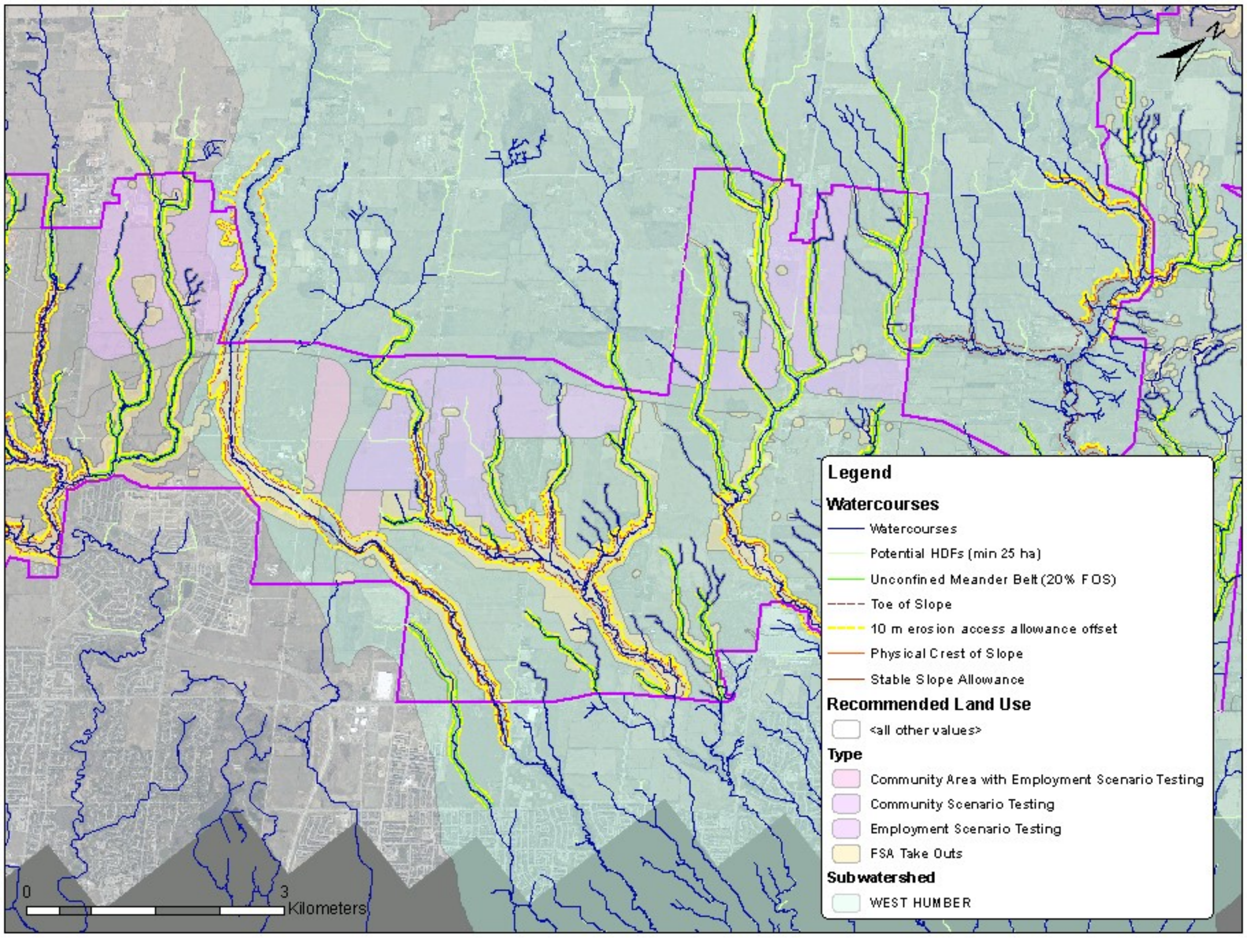


Figure 2.3.4.4.6. Erosion hazard limits within SABE Testing Areas, West Humber River

Erosion Assessment

Map SM3 in Appendix G presents mapping of sites undergoing what is considered excessive erosion, based on observations made during the windshield assessments. Windshield assessments were completed at every road crossing within the study area except where roads were closed due to construction. Thus, SM3 depicts the subset of watercourse crossings where excessive erosion was observed and does not capture areas that could not be observed from the roadways. Field walks would need to be completed in future studies to confirm reach-scale erosion processes in areas away from road crossings.

One erosion site was mapped in the West Humber Subwatershed near the southern boundary of a Testing Area in reach WHT4(3)5-2. Right bank erosion was noted near the outlet of the crossing at Old School Road.

Under the proposed scenario (70% and 90% impervious land use for Community and Employment areas, respectively), the number of erosion sites is likely to increase without management of stormwater runoff. SWM is required to prevent channel response to urbanization, which can include continued or increased rates of bank erosion, channel degradation, channel enlargement, and degraded water quality and stream habitat. Unmanaged erosion issues at culverts in particular can lead to the development of fish barriers in cases of channel incision.

Erosion Thresholds and SWM

Erosion thresholds should be determined for receiving watercourses in future studies to inform initial SWM planning. As plans develop, and SWM locations are proposed, erosion thresholds should be assessed for sensitive and/or representative areas downstream of potential outfalls. These values should be compared to existing thresholds and those for sensitive locations to determine the most representative. Erosion threshold evaluation for SWM is to be evaluated through future studies.

Watercourse/HDF Management

Five SABE Testing Areas are located within or partially within the West Humber River Subwatershed. These are located, from west to east: 1) at Kennedy Road, 2) east of Heart Lake Road, 3) west of Dixie Road, 4) from Dixie Road to east of Bramalea, and 5) from Torbram Road to Innis Lake Road. Testing Areas 2, 3 and 4 are south of the GTA West preferred footprint, while Testing Areas 1 and 5 are north of the GTA West footprint and is located in the community of Sandhill.

A small portion of Testing Area 1 extends into the West Humber River subwatershed and contains a portion of the erosion hazard lands associated with Campbell's Cross Creek.

Testing Area 2 does not contain any identified watercourse or HDF features. A potential HDF is found just west of this testing area. Its presence and proximity to the Testing Area should be confirm in future studies.

Testing Area 3 contains a portion of one tributary to the West Humber River, WHT4(3)8-1 originates north of the GTA west corridor and becomes confined partway through the Testing Area and enters the Greenbelt to the south. The Testing Area also includes one HDF reach and several potential HDFs. The reach has a Medium geomorphic constraint ranking.

Testing Area 4 contains portions of WHT4(3)8-1 as well as three first-order tributaries to the West Humber River, all of which are first-order reaches that originate within the Testing Area and flow south to join a defined valley system within the Greenbelt. WHT4(3)5-2 flows south along the border with the Preliminary SABE Concept area to the southeast. All reaches have a Medium preliminary geomorphic constraint ranking. The Testing Area also includes two HDF reaches and several potential HDFs.

Testing Area 5 contains portions of Salt Creek and three of its tributaries. Watercourses in the area flow south to cross the preferred GTA West corridor. All reaches within the study area are unconfined. Preliminary geomorphic constraints are medium on mainstem reaches and low on first-order tributaries. One HDF reach and several potential HDFs are also found in the Testing Area.

Preliminary geomorphic constraint rankings are provided for each reach in Table 1, Appendix G.

All watercourses are encompassed by the FSA Take-out. Only 2.3 km of Potential HDF length is found outside of the FSA Take-out. The total length of mapped watercourses, HDFs and Potential HDFs in the West Humber subwatershed within the SABE Testing areas including the FSA-Takeout are 7.2 km, 2.9 km and 4.0 km, respectively. Refer to Table 2.3.4.5.

Management recommendations for watercourses and HDFs will be completed through the integration of study disciplines in future studies. At that stage, further characterization and impact assessment can be made based on terrestrial or aquatic input for specific features (e.g., ponds, ELC mapping), and will be completed as land use plans are developed for the SABE. Field work to confirm/update watercourse and HDF mapping, and to complete the HDF assessment following TRCA/CVC (2014) guidelines are required through future studies to refine and finalize reach-specific constraints and management recommendations.

Erosion Hazard Delineation

Mapping provided in Figure 2.3.4.3.6 presents the erosion limit (i.e., meander belt or stable top of slope) and 10m erosion access allowance as per setback requirements of the Conservation Authorities. Other setbacks per the respective conservation authority need to be applied to finalize the hazard delineation and refinement of the NHS.

The area occupied by erosion hazard lands is 13.8 ha excluding the FSA Take-out and 64.7 ha including the FSA Take-out, which corresponds to 1.17% and 5.5% of the SABE Testing areas, respectively. Refer to Table 2.3.4.5.

2.3.4.4 BRES ROPA 30 Lands and Mayfield West Phase 2 Lands

A summary of the potential impacts of development to geomorphic character and function, and types of mitigation, is provided in Section 2.3.4.1. This includes discussion of erosion hazard corridors, stream length and realignment, headwater drainage features, road crossings, stormwater management and erosion. These potential impacts and mitigation strategies are applicable to each of the land use classifications identified within the FSA, including the BRES ROPA 30 Lands and Mayfield West Phase 2 Lands.

A summary of the erosion hazard area and watercourse and HDF lengths within each subwatershed of the BRES ROPA 30 Lands and Mayfield West Phase 2 Lands is provided in Table 2.3.4.6.

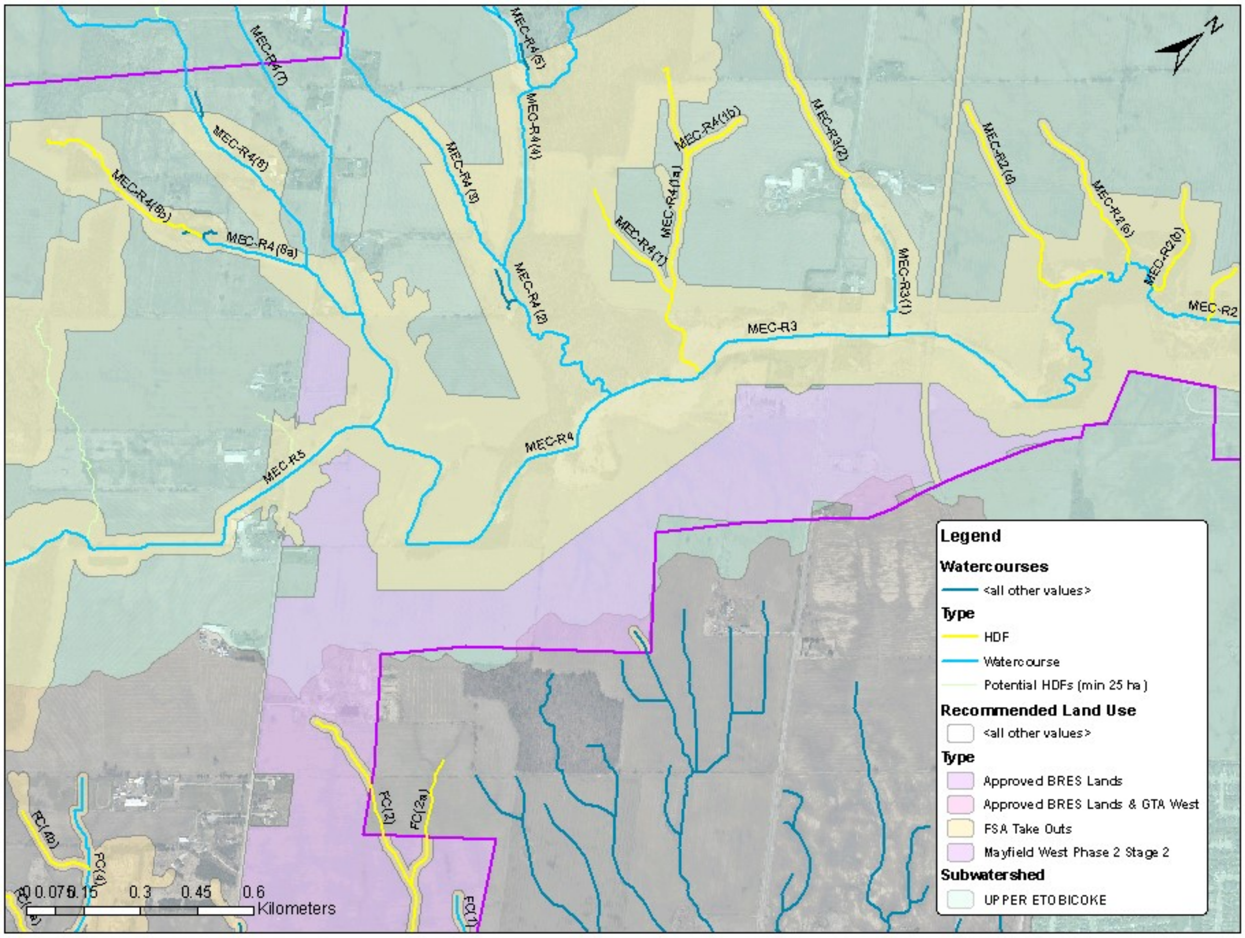
Table 2.3.4.6: Summary of Watercourses and HDFs within the BRES ROPA 30 Lands and Mayfield West Phase 2 Lands

Subwatershed	Erosion Hazard Area		Watercourse Length	HDF Length[1]	Potential HDF Length[2]
	ha	% BRES ROPA 30 & Mayfield Area	(km)	(km)	(km)
	Features outside of FSA Take-Out Areas				
Main Humber	<0.1	<0.01	0.0	0.0	-
West Humber	<0.1	<0.01	0.0	0.0	0.0
Etobicoke Creek	<0.1	<0.01	0.0	0.0	0.0
Fletcher's Creek	1.5	0.02	0.0	0.0	-
	Features including FSA Take-Out Areas				
Main Humber	<0.1	<0.01	0.0	0.6	-
West Humber	0.4	<0.01	0.1	2.1	0.0
Etobicoke Creek	0.9	0.01	0.2	0.0	0.1
Fletcher's Creek	2.9	0.03	0.5	0.9	-

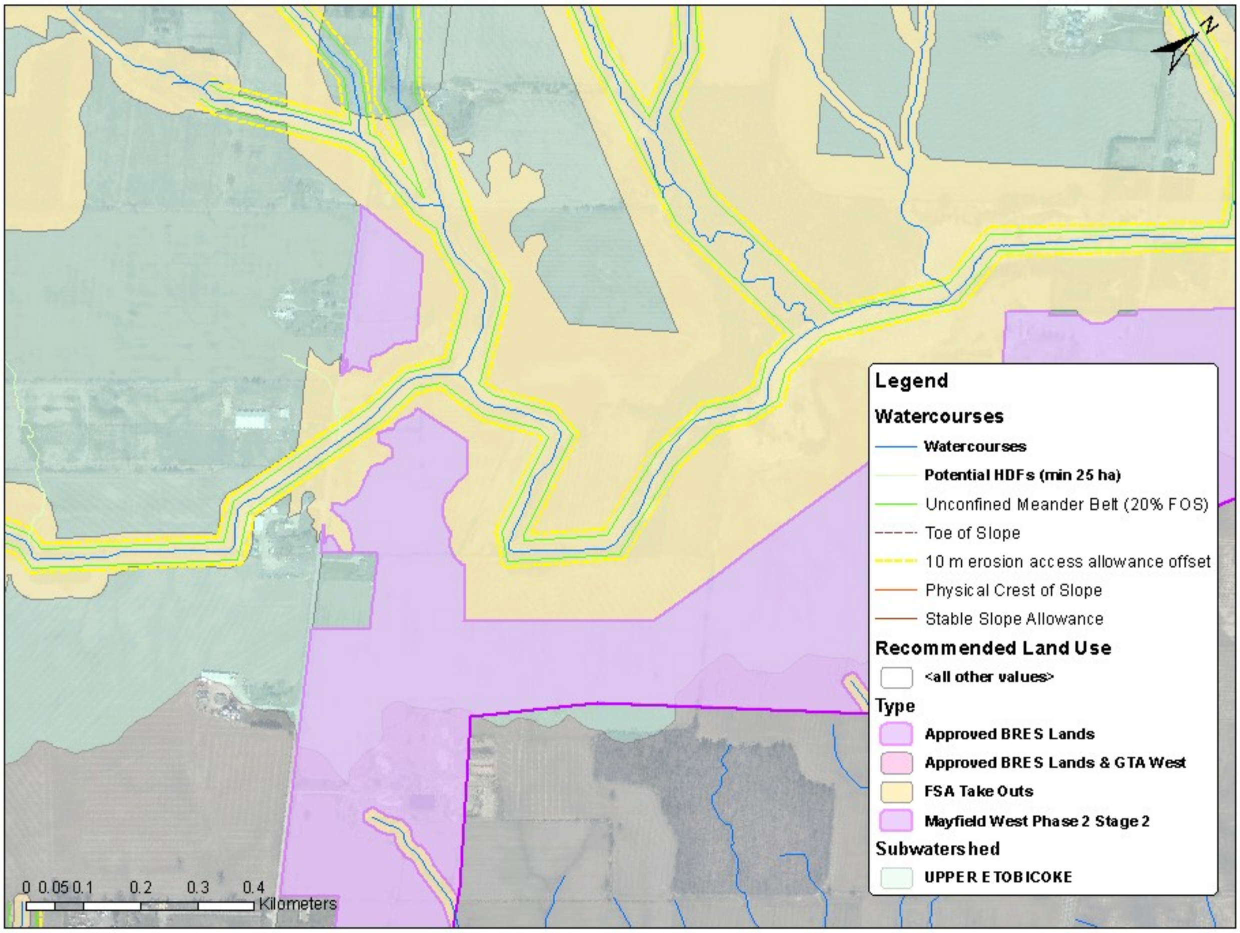
[1]HDFs identified during desk study
[2]Potential HDFs modeled in ArcHydro based on a minimum 25 ha drainage area. Modeled for West Humber and Etobicoke Creek subwatersheds only.

Etobicoke Creek Subwatershed

Figures 2.3.4.5.1 and 2.3.4.5.2 present the watercourse and HDF mapping and erosion hazard corridors for the Etobicoke Creek subwatershed within the Mayfield West Phase 2 Lands. HDF and management recommendations for the subwatershed will be determined in future studies. Additional field assessments will need to be completed in future studies to evaluate potential impacts at the reach scale.



Figures 2.3.4.5.1. Watercourse and HDF reaches within Mayfield West Phase 2 Lands, Etobicoke Creek



Figures 2.3.4.5.2. Erosion hazard limits within Mayfield West Phase 2 Lands, Etobicoke Creek

Erosion Assessment

Map SM3 in Appendix G presents mapping of sites undergoing what is considered excessive erosion, based on observations made during the windshield assessments. Windshield assessments were completed at every road crossing within the study area except where roads were closed due to construction. Thus, SM3 depicts the subset of watercourse crossings where excessive erosion was observed and does not capture areas that could not be observed from the roadways. Field walks would need to be completed in future studies to confirm reach-scale erosion processes in areas away from road crossings.

No erosion sites were mapped within the portion of the Etobicoke Creek subwatershed within the Mayfield West Phase 2 Lands. Nevertheless, under the proposed scenario (increased impervious land use), erosion in receiving watercourses could increase without management of stormwater runoff. SWM is required to prevent channel response to urbanization, which can include continued or increased rates of bank erosion, channel degradation, channel enlargement, and degraded water quality and stream habitat. Unmanaged erosion issues at culverts in particular can lead to the development of fish barriers in cases of channel incision.

Erosion Thresholds and SWM

Erosion thresholds should be determined for receiving watercourses in future studies to inform initial SWM planning. As plans develop, and SWM locations are proposed, erosion thresholds should be assessed for sensitive and/or representative areas downstream of potential outfalls. These values should be compared to existing thresholds and those for sensitive locations to determine the most representative. Erosion threshold evaluation for SWM is to be evaluated through future studies.

Watercourse/HDF Management

One tributary to Etobicoke Creek traverses the Mayfield West Phase 2 Lands (reach MEC-R5). Reach MEC-R5 has a Medium preliminary geomorphic constraint ranking, which is part of the FSA Take-out. Preliminary geomorphic constraint rankings are provided for each reach in Table 1, Appendix G. A potential HDF was also identified in the Mayfield West Phase 2 lands FSA Take-out. The area is located south of the Greenbelt which contains a main branch of Etobicoke Creek. Note that additional HDFs were identified as part of the Etobicoke Creek Watershed Plan (ECWP) prepared for TRCA in 2020. Appendix C2 presents the HDFs mapped within the ECWP.

All watercourses and HDFs were encompassed by the FSA Take-out. The total length of mapped watercourses, HDFs and Potential HDFs in the Etobicoke Creek subwatershed within the Mayfield West Phase 2 Lands including the FSA-Take-out are 0.2 km, 0.0 km and 0.1 km, respectively. Refer to Table 2.3.4.6.

Management recommendations for watercourses and HDFs may be advanced through the integration of study disciplines in future studies. At that stage, further characterization and impact assessment can be made based on terrestrial or aquatic input for specific features (e.g., ponds, ELC mapping), and will be completed as land use plans are developed. Field work to confirm/update watercourse and HDF mapping, and to complete the HDF assessment following TRCA/CVC (2014) guidelines are required through future studies to refine and finalize reach-specific constraints and management recommendations.

Note that additional HDFs were identified as part of the Etobicoke Creek Watershed Plan (ECWP) prepared for TRCA in 2020. Appendix C2 presents the HDFs mapped within the ECWP.

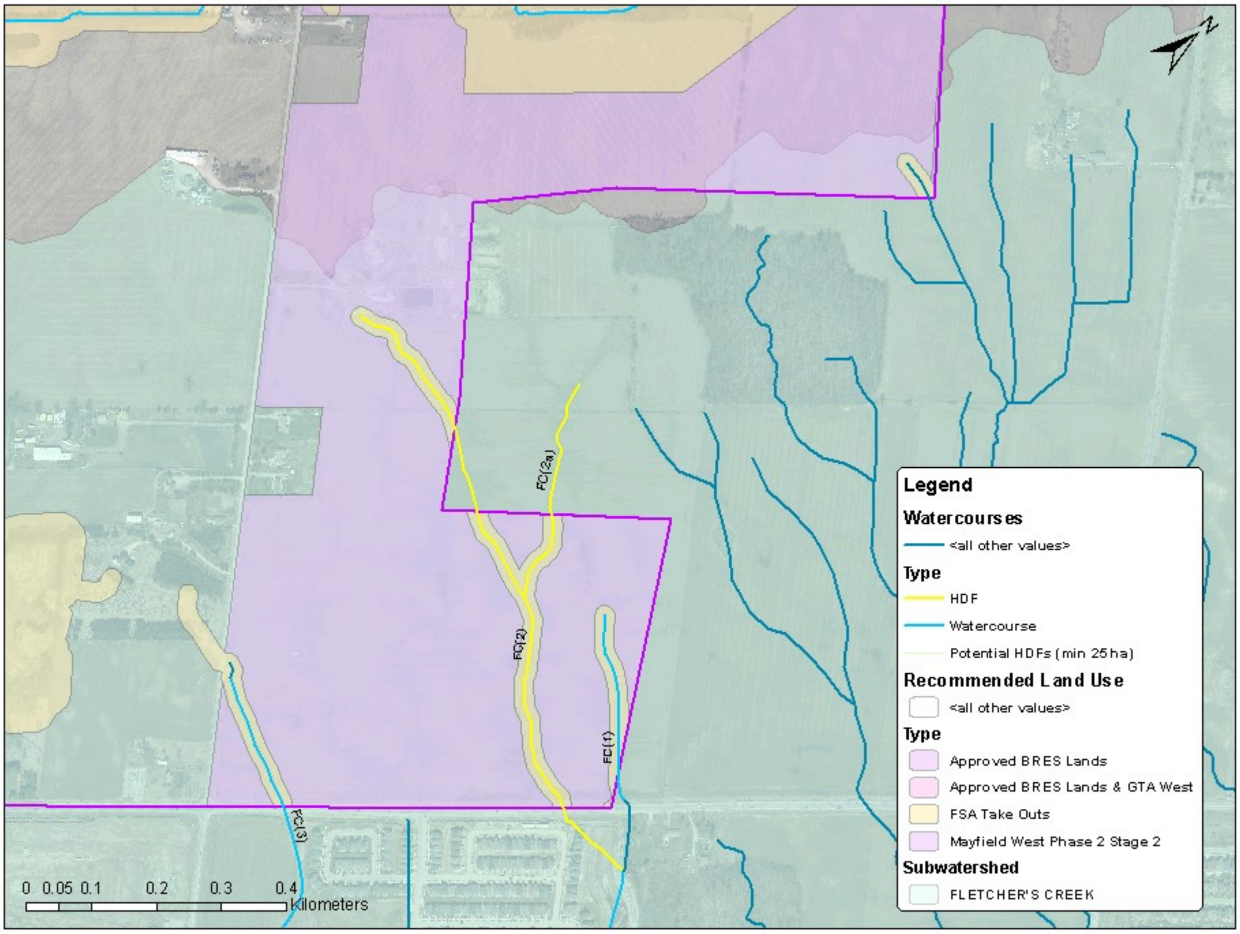
Erosion Hazard Delineation

Mapping provided in Figure 2.3.4.4.2 presents the erosion limit (i.e., meander belt or stable top of slope) and 10 m erosion access allowance as per setback requirements of the Conservation Authorities. Other setbacks per the respective conservation authority need to be applied to finalize the hazard delineation and refinement of the NHS.

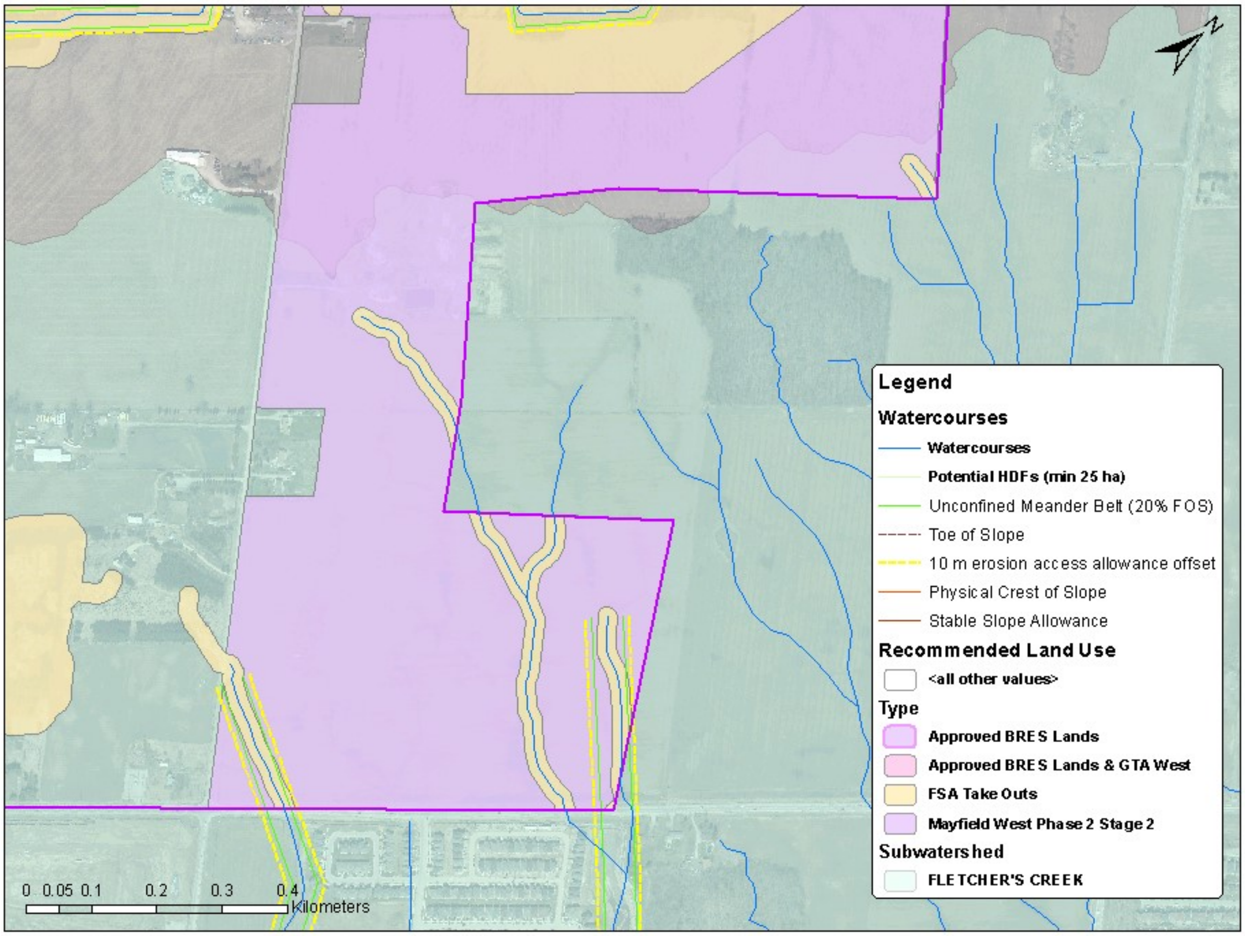
The area occupied by erosion hazard lands is 0.9 ha, which is 0.01% of the BRES ROPA 30 and Mayfield West Phase 2 Lands. The erosion hazard area is entirely within the FSA Take-out area. Refer to Table 2.3.4.6.

Fletcher's Creek Subwatershed

Figures 2.3.4.5.3 and 2.3.4.5.4 present the watercourse and HDF mapping and erosion hazard corridors for the Fletcher's Creek subwatershed within the Mayfield West Phase 2 Lands. HDF and management recommendations for the subwatershed will be determined in future studies. Additional field assessments will need to be completed in future studies to evaluate potential impacts at the reach scale.



Figures 2.3.4.5.3. Watercourse and HDF reaches within Mayfield West Phase 2 Lands, Fletcher's Creek



Figures 2.3.4.5.4. Erosion hazard limits within Mayfield West Phase 2 Lands, Fletcher's Creek

Erosion Assessment

Map SM3 in Appendix G presents mapping of sites undergoing what is considered excessive erosion, based on observations made during the windshield assessments. Windshield assessments were completed at every road crossing within the study area except where roads were closed due to construction. Thus, SM3 depicts the subset of watercourse crossings where excessive erosion was observed and does not capture areas that could not be observed from the roadways. Field walks would need to be completed in future studies to confirm reach-scale erosion processes in areas away from road crossings.

No erosion sites were mapped within the portion of the Fletcher's Creek subwatershed within the Mayfield West Phase 2 Lands. Nevertheless, under the proposed scenario (increased impervious land use), erosion sites could increase without management of stormwater runoff. SWM is required to prevent channel response to urbanization, which can include continued or increased rates of bank erosion, channel degradation, channel enlargement, and degraded water quality and stream habitat. Unmanaged erosion issues at culverts in particular can lead to the development of fish barriers in cases of channel incision.

Erosion Thresholds and SWM

Utilize previously determined erosion thresholds for Site SW4 – Fletchers Creek (Northwest Brampton SWS, 2010) to inform initial SWM planning at a general level. As plans develop, and SWM locations are proposed, erosion thresholds should be determined for sensitive and/or representative areas downstream of potential outfalls. These values should be compared to existing thresholds and those for sensitive locations to determine the most representative. Erosion threshold evaluation for SWM is to be evaluated through future studies.

Watercourse/HDF Management

Two first-order tributaries to Fletcher's Creek are found within the Mayfield West Phase 2 Lands. These reaches are FC(3) and FC(1). Both originate within the Mayfield West Phase 2 Lands and have Low preliminary geomorphic constraint rankings. Preliminary geomorphic constraint rankings are provided for each reach in Table 1, Appendix G. Portions of two HDF reaches have also been identified in the Mayfield West Phase 2 lands.

All watercourses and HDFs were encompassed by the FSA Take-out. The total length of mapped watercourses and HDFs in the Fletcher's Creek subwatershed within the Mayfield West Phase 2 Lands including the FSA-Take-out are 0.5 km and 0.9 km, respectively. Refer to Table 2.3.4.6.

Management recommendations for watercourses and HDFs may be advanced through the integration of study disciplines in future studies. At that stage, further characterization and impact assessment can be made based on terrestrial or aquatic input for specific features (e.g., ponds, ELC mapping), and will be completed as land use plans are developed. Field work to confirm/update watercourse and HDF mapping, and to complete the HDF assessment following TRCA/CVC (2014) guidelines are required through future studies to refine and finalize reach-specific constraints and management recommendations.

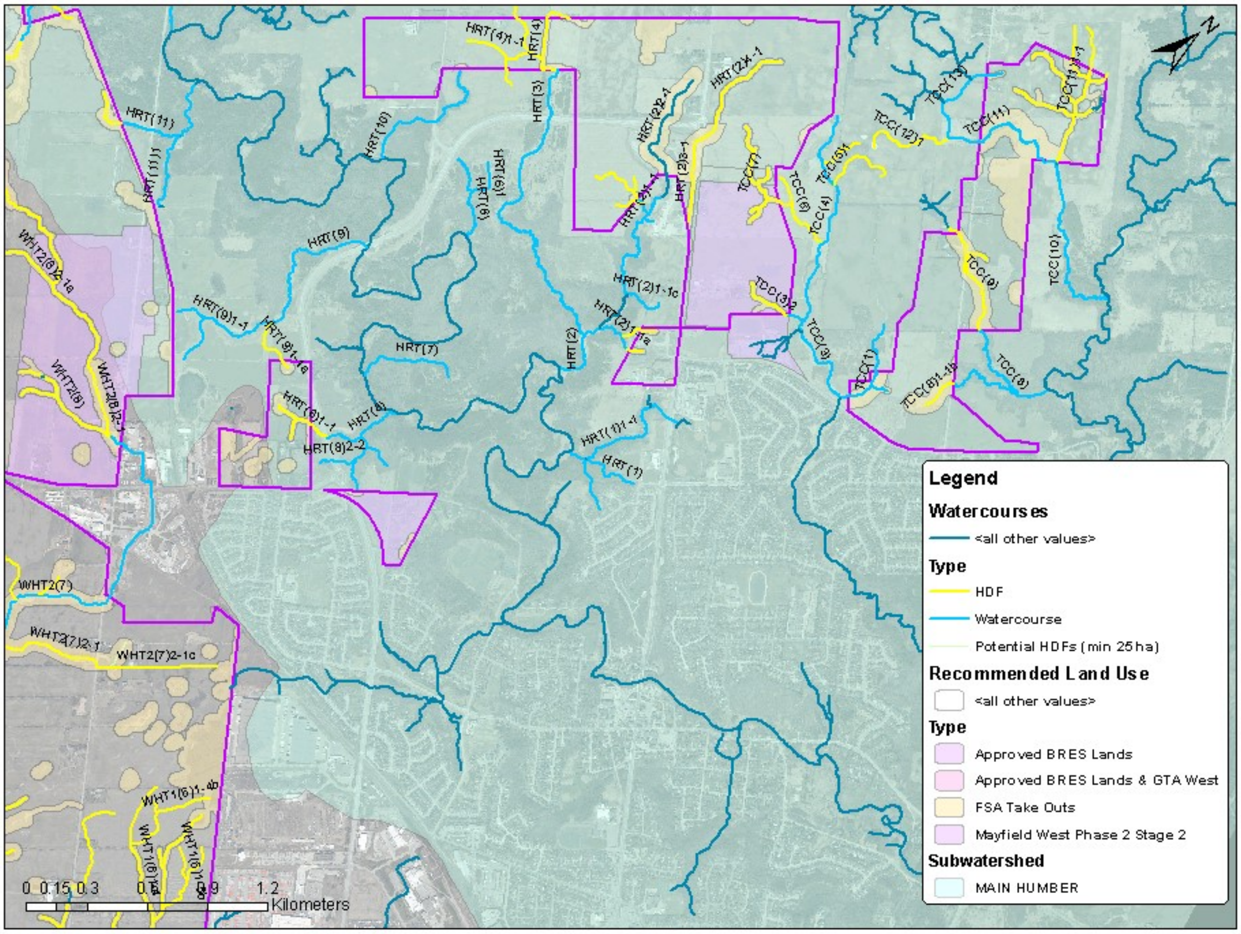
Erosion Hazard Delineation

Mapping provided in Figure 2.3.4.4.4 presents the erosion limit (i.e., meander belt or stable top of slope) and 10m erosion access allowance as per setback requirements of the Conservation Authorities. Other setbacks per the respective conservation authority need to be applied to finalize the hazard delineation and refinement of the NHS.

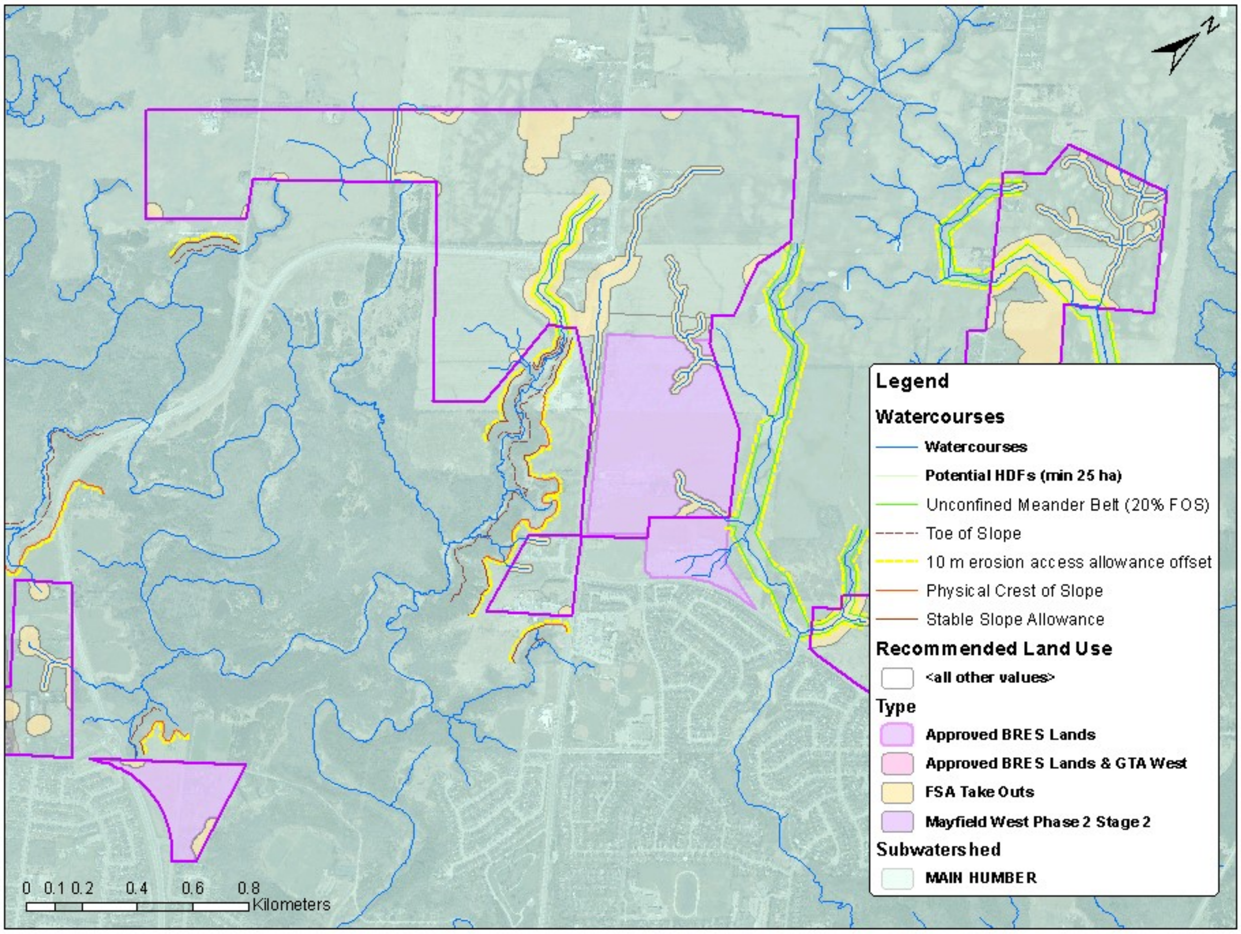
The area occupied by erosion hazard lands is 1.5 ha excluding the FSA Take-out and 2.9 ha including the FSA Take-out which correspond to 0.02% and 0.03% of the BRES ROPA 30 and Mayfield West Phase 2 Lands, respectively. Refer to Table 2.3.4.6.

Main Humber River Subwatershed

Figures 2.3.4.5.5 and 2.3.4.5.6 present the watercourse and HDF mapping and erosion hazard corridors for the Main Humber River subwatershed within the BRES ROPA 30 Lands. HDF and management recommendations for the subwatershed will be determined in future studies. Additional field assessments will need to be completed in future studies to evaluate potential impacts at the reach scale.



Figures 2.3.4.5.5. Watercourse and HDF reaches within BRES ROPA 30 Lands, Main Humber River



Figures 2.3.4.5.6. Erosion hazard limits within BRES ROPA 30 Lands, Main Humber River

Erosion Assessment

Map SM3 in Appendix G presents mapping of sites undergoing what is considered excessive erosion, based on observations made during the windshield assessments. Windshield assessments were completed at every road crossing within the study area except where roads were closed due to construction. Thus, SM3 depicts the subset of watercourse crossings where excessive erosion was observed and does not capture areas that could not be observed from the roadways. Field walks would need to be completed in future studies to confirm reach-scale erosion processes in areas away from road crossings.

No erosion sites were mapped in the Main Humber River Subwatershed within the BRES ROPA 30 Lands. Nevertheless, under the proposed scenario (increased impervious land use), the number of erosion sites in receiving watercourses or HDFs is likely to increase without management of stormwater runoff. SWM is required to prevent channel response to urbanization, which can include continued or increased rates of bank erosion, channel degradation, channel enlargement, and degraded water quality and stream habitat. Unmanaged erosion issues at culverts in particular can lead to the development of fish barriers in cases of channel incision.

Erosion Thresholds and SWM

Erosion thresholds should be determined for receiving watercourses in future studies to inform initial SWM planning. As plans develop, and SWM locations are proposed, erosion thresholds should be assessed for sensitive and/or representative areas downstream of potential outfalls. These values should be compared to existing thresholds and those for sensitive locations to determine the most representative. Erosion threshold evaluation for SWM is to be evaluated through future studies.

Watercourse/HDF Management

The BRES ROPA 30 Lands areas are located within the Main Humber River subwatershed. The easternmost BRES ROPA 30 Lands, located near Queen Street in Bolton, are adjacent to a SABE Testing Area to the north while the southeast corner of the BRES ROPA 30 Lands extend outside of the FSA. This area contains portions of four HDF reaches, and no watercourse reaches. HDFs in this area drain east to a tributary to the Humber River. HDF TCC(3)2 passes through the portion of the area that extends outside of the FSA.

The second BRES ROPA 30 Lands area, located near Coleraine Drive, contains no identified HDF or watercourse reaches. However, lands may drain from this area to an HDF north of Glasgow Road.

All HDFs were encompassed by the FSA Take-out. The total length of mapped watercourses and HDFs in the Main Humber River subwatershed within the BRES ROPA 30 Lands including the FSA-Take-out are 0.0 km and 0.6 km, respectively. Refer to Table 2.3.4.6.

An HDF assessment was completed for the BRES ROPA 30 Lands by Aquafor Beech in 2013. This study included field verification and classification of HDFs based on the 2013 TRCA protocol and identified more HDFs than the current study due to the higher level of detail. The BRES ROPA 30 Lands near Queen Street in Bolton correspond to the "Option 1 Lands" in the Aquafor report. Appendix C2 presents the management options developed for the evaluated BRES ROPA 30 Lands areas.

Management recommendations for watercourses and HDFs may be advanced through the integration of study disciplines in future studies. At that stage, further characterization and impact assessment can be made based on terrestrial or aquatic input for specific features (e.g., ponds, ELC mapping), and will be completed as land use plans are developed. Field work to confirm/update watercourse and HDF mapping, and to complete the HDF assessment following TRCA/CVC (2014) guidelines are required through future studies to refine and finalize reach-specific constraints and management recommendations.

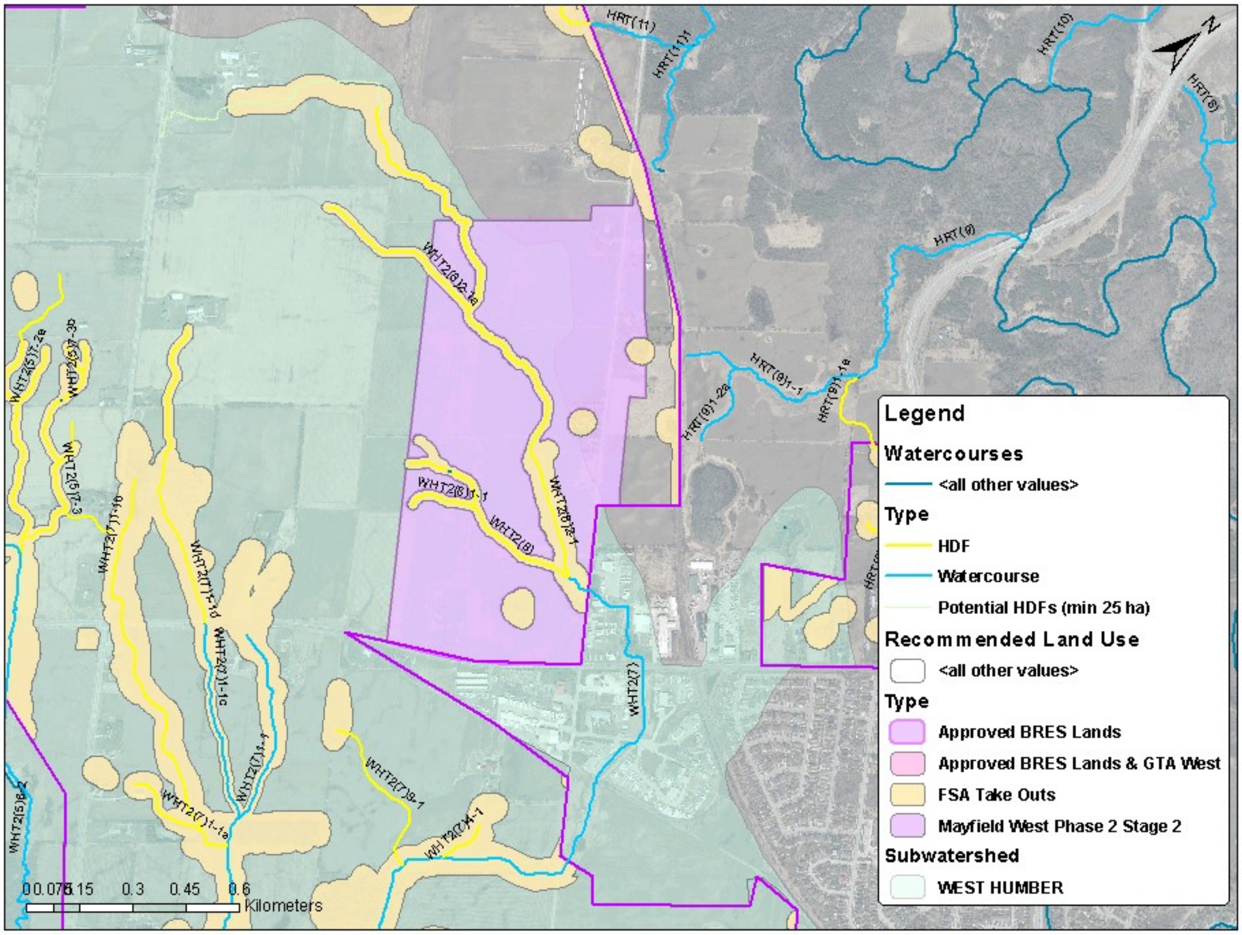
Erosion Hazard Delineation

Mapping provided in Figure 2.3.4.4.6 presents the erosion limit (i.e., meander belt or stable top of slope) and 10m erosion access allowance as per setback requirements of the Conservation Authorities. Other setbacks per the respective conservation authority need to be applied to finalize the hazard delineation and refinement of the NHS.

The area occupied by erosion hazard lands is <0.1 ha (17.6 m^2) excluding the FSA Take-out and <0.01 ha (38.4 m^2) including the FSA Take-out, which corresponds to <0.01% of the BRES ROPA 30 and Mayfield West Phase 2 Lands. Refer to Table 2.3.4.6.

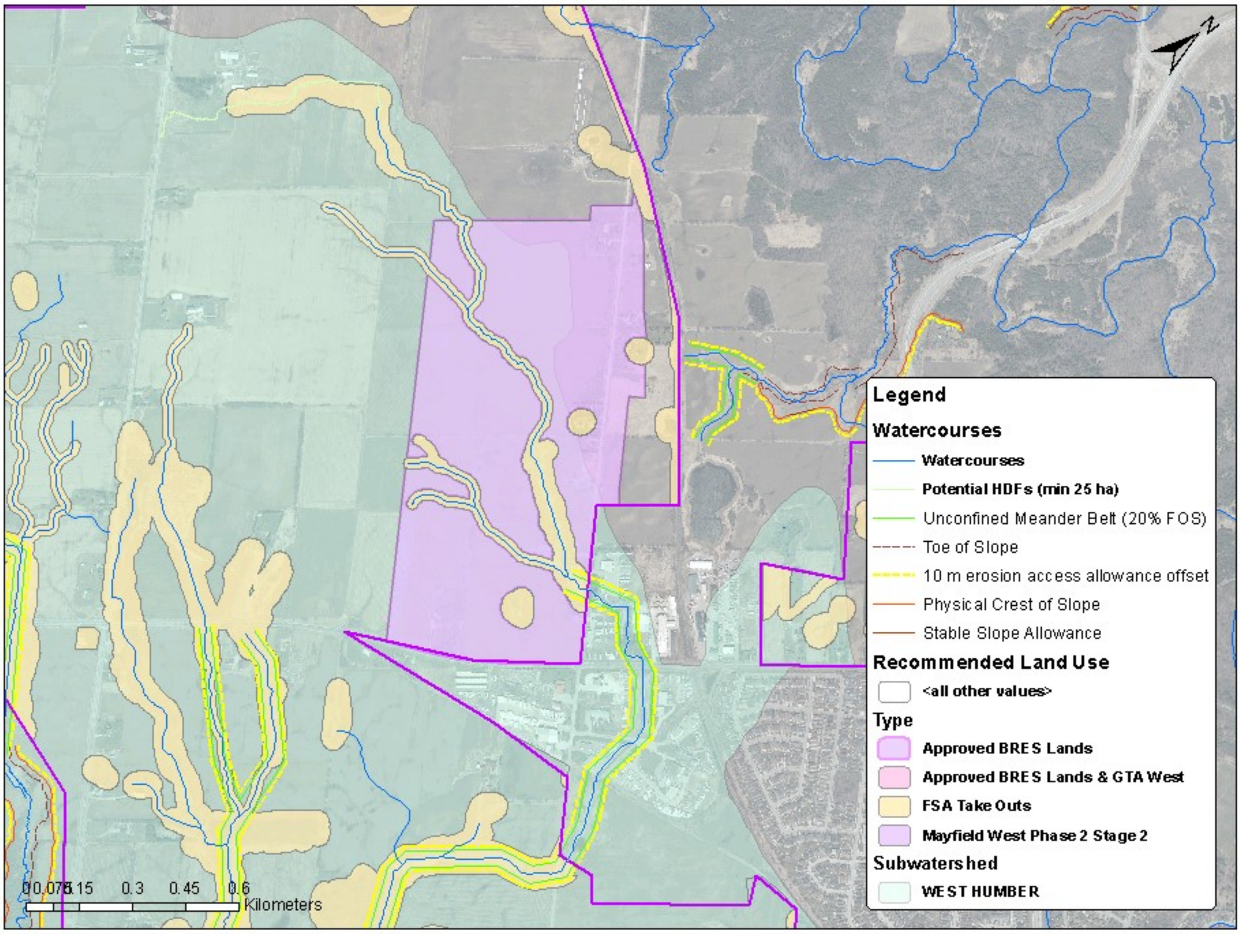
West Humber River Subwatershed

Figures 2.3.4.5.7 and 2.3.4.5.8 present the watercourse and HDF mapping and erosion hazard corridors for the West Humber subwatershed within the BRES ROPA 30 Lands. HDF and management recommendations for the subwatershed will be determined in future studies. Additional field assessments will need to be completed in future studies to evaluate potential impacts at the reach scale.



Figures 2.3.4.5.7. Watercourse and HDF reaches within BRES ROPA 30 Lands inside the FSA, Main Humber River

wood.



Figures 2.3.4.5.8. Erosion hazard limits within BRES ROPA 30 Lands, Main Humber River

Erosion Assessment

Map SM3 in Appendix G presents mapping of sites undergoing what is considered excessive erosion, based on observations made during the windshield assessments. Windshield assessments were completed at every road crossing within the study area except where roads were closed due to construction. Thus, SM3 depicts the subset of watercourse crossings where excessive erosion was observed and does not capture areas that could not be observed from the roadways. Field walks would need to be completed in future studies to confirm reach-scale erosion processes in areas away from road crossings.

No erosion sites were mapped in the West Humber Subwatershed BRES ROPA 30 Lands. Nevertheless, under the proposed scenario (increased impervious land use), the number of erosion sites is likely to increase without management of stormwater runoff. SWM is required to prevent channel response to urbanization, which can include continued or increased rates of bank erosion, channel degradation, channel enlargement, and degraded water quality and stream habitat. Unmanaged erosion issues at culverts in particular can lead to the development of fish barriers in cases of channel incision.

Erosion Thresholds and SWM

Erosion thresholds should be determined for receiving watercourses in future studies to inform initial SWM planning. As plans develop, and SWM locations are proposed, erosion thresholds should be assessed for sensitive and/or representative areas downstream of potential outfalls. These values should be compared to existing thresholds and those for sensitive locations to determine the most representative. Erosion threshold evaluation for SWM is to be evaluated through future studies.

Watercourse/HDF Management

One BRES ROPA 30 area is located within the FSA and the West Humber River subwatershed, located north of King Street and west of Humber Station Road. The area includes a portion of one watercourse reach (WHT2(7)), which is an unconfined feature with a Medium preliminary geomorphic constraint ranking. Preliminary geomorphic constraint rankings are provided for each reach in Table 1, Appendix G. The area also includes four HDF reaches (as identified in the current study) and several potential HDFs.

An HDF assessment was completed for the BRES ROPA 30 Lands by Aquafor Beech in 2013. This study included field verification and classification of HDFs based on the 2013 TRCA protocol and identified more HDFs than the current study due to the higher level of detail. The corresponding BRES ROPA 30 Lands are the "Option 3 Lands" in the Aquafor report. Appendix C2 presents the results of the 2013 HDF assessment for the evaluated BRES ROPA 30 Lands.

Additional BRES ROPA 30 Lands are located outside of the FSA between Mayfield Road and Old School Road, east of Humber Station Road. These lands appear to contain several tributaries to the West Humber River, as well as several potential HDFs. Features within these lands have not been evaluated as part of the current study.

All HDFs were encompassed by the FSA Take-out. The total length of mapped watercourses and HDFs including the FSA-Take-out are 0.1 km and 2.1 km, respectively. Refer to Table 2.3.4.6.

Management recommendations for watercourses and HDFs may be advanced through the integration of study disciplines in future studies. At that stage, further characterization and impact assessment can be made based on terrestrial or aquatic input for specific features (e.g., ponds, ELC mapping), and will be completed as land use plans are developed. Field work to confirm/update watercourse and HDF mapping, and to complete the HDF assessment following TRCA/CVC (2014) guidelines are required through future studies to refine and finalize reach-specific constraints and management recommendations.

Erosion Hazard Delineation

Mapping provided in Figure 2.3.4.4.8 presents the erosion limit (i.e., meander belt or stable top of slope) and 10m erosion access allowance as per setback requirements of the Conservation Authorities. Other setbacks per the respective conservation authority need to be applied to finalize the hazard delineation and refinement of the NHS.

The area occupied by erosion hazard lands is <0.01 ha (1.1 m^2) excluding the FSA Take-out and 0.4 ha including the FSA Take-out, which corresponds to <0.01% of the BRES ROPA 30 and Mayfield West Phase 2 Lands. Refer to Table 2.3.4.6.

2.3.5 Natural Heritage System and Water Resource System

2.3.5.1 Focus Study Area

Water Resource System

The impacts of future development on the water resource system can occur locally within the study area and downstream within the receiving system. Unmitigated, the future development of the FSA would reduce groundwater recharge, potentially affecting local seeps and springs within the area and baseflow within receiving aquatic systems. Based upon the soils within the study area, it is anticipated that the key hydrologic features within the study area (particularly wetlands) would be largely dependent upon surface water; as such, depending upon the specific type of vegetation within the receiving feature, the impacts of the land use change to the hydroperiod may result in an overabundance of runoff during critical seasons and periods for the vegetation, thereby adversely affecting the receiving feature.

In addition, portions of the FSA are recognized to lie upstream of designated flood vulnerable areas (FVAs) within the Etobicoke Creek Watershed and the Humber River Watershed. These areas are currently at risk of flooding during formative storm events, and analyses completed for this study have indicated that more frequent flooding of these areas may be anticipated following development within the SABE. Locally, portions of the FSA within the headwaters of receiving drainage systems would be anticipated to increase the rate of runoff, resulting in increased flood risk locally within the FSA and within receiving downstream systems proximate to the FSA.

The key hydrologic features and key hydrologic areas mapping, developed as part of the Part A Characterization Report have been reviewed in conjunction with the findings of the impact assessment to determine the potential impacts (without mitigation) to each of the key hydrologic features and areas identified within the respective subwatersheds encompassing the FSA. The results of this assessment are summarized in Table 2.3.5.1.

Table 2.3.5.1: Summary of anticipated impacts to key hydrologic features and key hydrologic areas by subwatershed.

Subwatershed	Key Hydrologic Feature/Key Hydrologic Area	Anticipated Impact
Main Humber Subwatershed	Watercourses and HDFs	Increased erosion potential and consequential degradation to riparian and aquatic habitat Reduced water quality
	Seepage Areas and Springs	Reduced groundwater recharge locally Potential reduction to groundwater discharge within receiving watercourses
	Wetlands	Reduced water quality to wetlands Alteration to hydroperiod, potentially affecting wetland vegetation
	Waterbodies	N/A

Subwatershed	Key Hydrologic Feature/Key Hydrologic Area	Anticipated Impact
	Significant Groundwater Recharge Areas	N/A
	Ecologically Significant Groundwater Recharge Areas	Reduced quantity of groundwater recharged within these areas Potential reduction in groundwater discharge to associated wetlands or stream reaches
	Downstream Flood Vulnerable Areas	No significant impacts anticipated
	Shallow Depth to Groundwater	N/A
	Highly Vulnerable Aquifer	Reduced quantity of groundwater recharged within these areas
West Humber Subwatershed	Watercourses and HDFs	Increased erosion potential and consequential degradation to riparian and aquatic habitat Reduced water quality Reduced water quality to Redside Dace habitat Increased flooding potentially locally and offsite
	Seepage Areas and Springs	Reduced groundwater recharge locally Potential reduction to groundwater discharge within receiving watercourses Potential reduction to baseflow within Redside Dace habitat
	Wetlands	Reduced water quality to wetlands Alteration to hydroperiod, potentially affecting wetland vegetation
	Waterbodies	Increased runoff exceeding capacity of waterbody
	Significant Groundwater Recharge Areas	Reduced groundwater recharge to two minor sand and gravel deposits.

Subwatershed	Key Hydrologic Feature/Key Hydrologic Area	Anticipated Impact
		Potential reduction to groundwater discharge to local watercourse or wetland
	Ecologically Significant Groundwater Recharge Areas	Reduced quantity of groundwater recharged within these areas Potential reduction in groundwater discharge to associated wetlands or stream reaches
	Downstream Flood Vulnerable Areas (FVA)	Increased flood risk and damages within FVA at confluence of West Humber and Main Humber Rivers.
	Shallow Depth to Groundwater	Potential for dewatering and subsequent potential reduction to groundwater discharge to local water courses or wetlands
	Highly Vulnerable Aquifer	Reduced quantity of groundwater recharged within these areas
Upper Etobicoke Creek Subwatershed	Watercourses and HDFs	Increased erosion potential and consequential degradation to riparian and aquatic habitat Reduced water quality Reduced water quality to downstream Redside Dace habitat Increased flooding potentially locally and offsite
	Seepage Areas and Springs	Reduced groundwater recharge locally Potential reduction to groundwater discharge within receiving watercourses Potential reduction to baseflow within downstream Redside Dace habitat
	Wetlands	Reduced water quality to wetlands Alteration to hydroperiod, potentially affecting wetland vegetation

Subwatershed	Key Hydrologic Feature/Key Hydrologic Area	Anticipated Impact
	Waterbodies	Increased runoff exceeding capacity of waterbody
	Significant Groundwater Recharge Areas	Reduced groundwater recharge to a minor sand and gravel deposit Potential reduction to groundwater discharge to local watercourse or wetland
	Ecologically Significant Groundwater Recharge Areas	Reduced quantity of groundwater recharged within these areas Potential reduction in groundwater discharge to associated wetlands or stream reaches
	Downstream Flood Vulnerable Areas (FVA)	Increased flood risk and damages within Downtown Brampton FVA
	Shallow Depth to Groundwater	Potential for dewatering and subsequent potential reduction to groundwater discharge to local water courses or wetlands
	Highly Vulnerable Aquifer	Reduced quantity of groundwater recharged within these areas
Fletcher's Creek Subwatershed	Watercourses and HDFs	Increased erosion potential Reduced water quality locally Nominally reduced water quality to downstream Redside Dace habitat Increased flood potentially locally and offsite
	Seepage Areas and Springs	Potential nominal reduction to baseflow within downstream Redside Dace habitat
	Wetlands	N/A
	Waterbodies	N/A
	Significant Groundwater Recharge Areas	N/A
	Ecologically Significant Groundwater Recharge Areas	N/A
	Downstream Flood Vulnerable Areas (FVA)	N/A
	Shallow Depth to Groundwater	N/A

Subwatershed	Key Hydrologic Feature/Key Hydrologic Area	Anticipated Impact
	Highly Vulnerable Aquifer	Reduced quantity of groundwater recharged within these areas
Huttonville Creek Subwatershed	Watercourses and HDFs	Increased erosion potential Reduced water quality locally Nominally reduced water quality to downstream Redside Dace habitat Increased flood potentially locally and offsite
	Seepage Areas and Springs	Nominal reduction to baseflow within downstream Redside Dace habitat
	Wetlands	N/A
	Waterbodies	N/A
	Significant Groundwater Recharge Areas	N/A
	Ecologically Significant Groundwater Recharge Areas	N/A
	Downstream Flood Vulnerable Areas (FVA)	N/A
	Shallow Depth to Groundwater	N/A
	Highly Vulnerable Aquifer	Reduced quantity of groundwater recharged within these areas
Main Credit River	Watercourses and HDFs	Increased erosion potential and consequential degradation to riparian and aquatic habitat Reduced water quality Increased flood potentially locally and offsite
	Seepage Areas and Springs	N/A
	Wetlands	Reduced water quality to wetlands Alteration to hydroperiod, potentially affecting wetland vegetation
	Waterbodies	Increased runoff exceeding capacity of waterbody
	Significant Groundwater Recharge Areas	N/A
	Ecologically Significant Groundwater Recharge Areas	Reduced quantity of groundwater recharged within these areas

Subwatershed	Key Hydrologic Feature/Key Hydrologic Area	Anticipated Impact
		Potential reduction in groundwater discharge to associated wetlands or stream reaches
	Downstream Flood Vulnerable Areas (FVA)	N/A
	Shallow Depth to Groundwater	Potential for dewatering and subsequent potential reduction to groundwater discharge to local water courses or wetlands
	Highly Vulnerable Aquifer	Reduced quantity of groundwater recharged within these areas

Natural Heritage System

Aquatic System and Fisheries

The impacts of land use and land use change on aquatic communities usually occur due to effects on habitat rather than direct impacts on the biotic communities. Direct alteration of aquatic habitats, for example stream channelization, clearly has the potential to negatively affect aquatic habitat but changes at the landscape scale, particularly those that affect how water moves through the system, are equally important. Changes to hydrogeology and hydrology can bring about changes in flow, channel form and stability, and water quality and temperature. Stormwater directed to watercourses can affect water quality and water temperature. Changes to riparian vegetation can affect bank stability, water temperature and food supply.

The planning focus is on predicting the effects of land use change on aquatic habitats and then managing the change in order to prevent harmful effects. The overall intent is to ensure that, following development, aquatic habitats continue to support healthy aquatic communities of native species that are appropriate to the habitats' natural potential. In southern Ontario, where Redside Dace habitat is present, it is typically the focus of aquatic habitat protection and management due to the species' endangered status. It is often assumed that the protection of Redside Dace habitat will inherently address, or take precedence over, the requirements of the other aquatic species that are present. A notable exception to this is coldwater streams which support species such as Brook Trout that require colder summer water temperatures than Redside Dace.

The lack of understanding of the specific habitat requirements and mechanistic linkages between habitat requirements and Redside Dace survival or abundance, limits the ability to predict the impacts of habitat changes on Redside Dace. Where Redside Dace habitat exists, the management approach is usually to assume that a best case scenario involves maintaining the existing conditions for key attributes where the impacts of change have unpredictable (and therefore potentially undesirable) consequences (e.g. a change in groundwater discharge), and moving in a positive direction for attributes where no negative and potential positive consequences are predicted (e.g. conversion of riparian buffers from row crop agriculture to natural cover). In practical terms, this management approach is equally valid, regardless of the aquatic habitat and species under considerations.

Groundwater discharge is an important factor influencing aquatic habitats in southern Ontario. Not only does it provide flow, but the cooling effects of groundwater on summer stream temperature are considered essential for maintaining the thermal conditions suitable for Redside Dace and other coolwater fish species, and for coldwater species such as Brook Trout and Mottled Sculpin. As is the case with flow, the influence of groundwater on water temperature extends downstream from the point of discharge. Therefore, groundwater discharge is not necessarily occurring within reaches occupied by coolwater species; it may be occurring upstream. Local groundwater discharge is necessary to maintain a thermal regime suitable for coldwater species, such as Brook Trout and Mottled Sculpin. Furthermore, Brook Trout spawn exclusively in locations where groundwater is percolating through the substrate, so specific discharge locations can be critically important in stream reaches where they occur.

Table 2.3.5.2 summarizes the occurrence of coldwater streams and Brook Trout within and Redside Dace within and proximate to the FSA. Each of these is considered sensitive to habitat changes that can occur as a result of urban development and specific mitigation measures are, as a result of policy in the case of Redside Dace, or may be required in order to mitigate the impacts of development, depending on the susceptibility of the specific watercourses.

Table 2.3.5.2: Occurrence of coldwater streams and fish species that are sensitive to habitat change by subwatershed.

Watershed	Sub-watershed	Coldwater streams present in FSA	Brook trout present in FSA	Redside Dace present in FSA	Redside Dace present downstream in proximity to FSA
Credit River	Credit River - Glen Williams to Norval	No	No	No	No
	Fletcher's Creek	No	No	No	Yes
	Huttonville Creek	No	No	No	Yes
Humber River	Main Humber	Yes	Yes	No	No
	West Humber	No	No	Yes	Yes
Etobicoke Creek	Upper Etobicoke Creek	Yes	No	No	No
	Spring Creek	No	No	No	No

Terrestrial Features

To evaluate potential impacts on terrestrial resources, it was assumed that Whitebelt areas within the FSA would be transitioned from a predominantly agricultural matrix, to an urban matrix, with an average impervious cover of 51%. Areas assumed to be excluded from development included lands within the Greenbelt and areas identified as Natural Environment High Constraint in the FSA land-use plan (Figure 2.2.1.1). The assessment provides the baseline for identifying additional considerations for protection, impact mitigation, and ecological connectivity as part of a conceptual NHS; these recommendations are provided in Section 2.5.2.1.

<u>Natural Cover</u>

Total natural cover within the FSA that is composed of either wetland, woodland, and/or early successional meadow or shrub-dominated features includes approximately 1157 ha of the land base (~14.4 %) (Table 2.3.5.3). Based on the proposed FSA land-use plan (Figure 2.2.1.1), approximately 817.0 ha of natural cover would be maintained, and 340.0 ha would be removed.

The majority of the natural cover that would be removed is represented by Open/Early Successional vegetation types (~ 246.3 ha); removal of wetland features represents 24.4 ha, and woodland areas 69.3 ha.

Table 2.3.5.3: Terrestrial natural features and area coverage (ha) within the FSA

Feature Type	Maintained (ha)	Removed (ha)	Current FSA Total
Open/Early Successional	384.4	246.3	630.7
Wetland	178.3	24.4	202.7
Woodland	254.3	69.3	323.5
Natural Cover Total	817.0	340.0	1157.0

Natural system quality and function based on surrounding land-use matrix

To evaluate the potential for impacts to habitat patches[2] within the FSA, methodologies to identify patches that are likely to be most affected by a transition from agriculturally dominated to urban dominated was undertaken. Characteristics such as patch size, patch shape, and matrix influence[3] were used to calculate the anticipated patch sensitivity resulting in potential impacts. Patches were scored using the TRCA's landscape analysis method, resulting in patch L-scores that are a proxy for patch quality (L1 Excellent to L5 Very Poor). The series of figures presented in DA2-2 a-g (Appendix E) show the resulting patch L-scores for wetland, woodland, and meadow habitat types with the FSA.

In general, a transition from a predominantly agricultural matrix to urban matrix is expected to have a minimal effect on the patch quality scores for woodlands and wetlands, as these features are maintained within high-constraint areas and/or the Greenbelt lands within the FSA, thus the size and shape parameter of calculated patch score will not be affected. The score for matrix influence however will increase for most of the wetland and woodland patches (i.e. the amount of urbanization within 2 km will increase). The largest change in this component of patch score would be for wetland and woodland patches that are currently greater than 2 km from existing urban areas in Brampton and Bolton, as patches that are currently close to these urban lands will have already factored in adjacent urban areas into their matrix influence scores.

Impacts to meadow patches is expected as there is an anticipated 25% reduction in ELC communities identified as Open/Early Successional habitat (Table 2.3.5.4). Where these patches are maintained, similar to woodland and wetland patches, impacts to overall patch quality would be largely influenced by changes to matrix influence.

[2] A habitat patch is any discrete area with a definite shape and habitat configuration used by a species for breeding or obtaining other resources. They may be comprised of a single or multiple habitat types (e.g., woodland, wetland, open habitats).
[3] Matrix influence refers to the effect of adjacent and intervening landscape between features or patches has on a given habitat patch or feature. This may include factors such as adjacent habitat quality, opportunities for wildlife movement (landscape permeability) and habitat type.

Table 2.3.5.4: Terrestrial patch conditions for features within the FSA

Patch Condition	Woodlands		Wetlands		Meadows		Beaches and Bluffs	
	Number	Area (ha)	Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
L3 - Fair	16	433.5	18	84.0	6.0	68.3		
L4 - Poor	117	827.1	253	206.9	165.0	834.4	4	1.1
L5 - Very Poor	6	19.1	20	12.4	15.0	59.0		

Impacts associates with the proposed land-use transition based on selection of the final SABE boundary and proposed land-uses will evaluate the change in patch scores based on existing conditions presented in Table 2.3.5.4.

Habitat Connectivity / Linkage Assessment

Habitat connectivity across the landscape was evaluated using Circuitscape (McRae et al. 2008; McRae and Shah, 2009); based on existing conditions, the results of the Circuitscape analysis is shown in Figure DA2-3. The method borrows algorithms from electronic circuit theory to predict connectivity in heterogeneous landscapes. It provides a simplified model of potential ways to connect features on the landscape, based on the degree to which land cover is ecologically permeability (i.e. how well animals can move across the landscape) as assigned by the user in the model; this is modeled using a parameter called resistance. As a simplified proxy for wildlife movement, it can be used as one of several tools or considerations to evaluate the potential importance of corridors to support ecological linkage. Circuitscape has been used to model habitat connectivity of many natural systems, including the Great Lakes Basin in Ontario (Bowman and Cordes, 2015), the CVC watershed, and as part of the Peel Climate Change Vulnerability study. Model parameters to weight the resistance of landscape features and areas in the FSA. The same model parameters used in these Circuitscape models was applied to weight the resistance of landscape features and areas in the FSA. This included weighting areas where the landscape is unnatural and assumed to be impermeable to movement as high resistance (e.g. roads and urbanized areas as resistance weight 1000); areas where landscape is unnatural but permeable to movement as medium resistance (e.g. agricultural areas as resistance weight 100); and area with natural cover were assumed to provide unimpeded movement (e.g. areas with vegetation cover as resistance weight 10).

Under current conditions, connectivity of the landscape is highest where wetland, woodland, open/early successional habitats are present and predominantly occurring along watercourses and within existing valleylands (Figure DA2-3). The predominantly agricultural matrix results in connectivity being relatively diffuse as the landscape matrix is generally permeable, with areas of high concentration being present in only a few locations across the FSA. With the FSA landscape matrix transitioning from predominately agricultural to urban over time, the relative importance of existing features along watercourses and within existing valleylands, and those that connect tableland features, will increase in importance. Although assumptions regarding land-use change have not been incorporated for the FSA in the existing conditions analysis, examples of the increase in relative connectivity importance of these areas can been seen in areas south of the FSA where the land-use matrix is largely urban (Figure DA2-3).

Native terrestrial community types and species

Impacts to particular vegetation community types within the FSA includes open/early successional, wetland, and woodland vegetation types (Table 2.3.5.5).

Woodland vegetation features that would end up being removed based on the current FSA land-use plan included Cultural Plantation, Cultural Woodland, Coniferous Forest, Deciduous Forest, and Mixed Forest. The location of woodland features that were not captured within the Greenbelt and high constraint environmental areas are shown on Figures DA2-2a to DA2-2c (Appendix E).

Wetland vegetation features that would end up being removed based on the current FSA land-use plan included Meadow Marsh, Shallow Marsh, Shallow Aquatic, Submerged Shallow Aquatic, Mixed Shallow Aquatic, Floating-leaved Shallow Aquatic, Deciduous Swamp, and Thicket Swamp. The location of wetland features that were not captured within the Greenbelt and high constraint environmental areas are shown on Figure DA2-2d to DA2-2f (Appendix E).

Open/Early Successional vegetation features that would end up being removed based on the current FSA land-use plan included Cultural Meadow, Cultural Savanah, Cultural Thicket, and hedgerows. The location of the meadow features that represent open/early successional features that were not captured within the Greenbelt and high constraint environmental areas are shown on Figure DA2-2g.

As a number of these features represent important ecological areas both functionally (composition, habitat, and connectivity), their removal would have a detrimental impact on the broader natural system. Therefore, where these features provide important habitat values, potential for connectivity, and/or opportunities for enhancement, they may be included within the Region's Natural Heritage System.

As part of the SABE impact assessment, a similar impact assessment is undertaken to ensure features that are significant are identified for protection, and identify opportunities for protection and/or enhancement where features provide important supporting habitat and/or functions.

Table 2.3.5.5: Vegetation communities (ELC community series) maintained and removed based on the conceptual FSA land-use plan

Vegetation Type Group	ELC Community Series	Maintained (ha)	Removed (ha)	Current FSA Total (ha)
Open/Early Successional	BLO	<0.1		<0.4
	BLS	<0.1		<0.1
	CBO	0.1		0.1
	CUM	295.4	215.6	511.0
	CUS	34.7	10.8	45.5
	CUT	53.5	16.8	70.3
	HR	0.6	3.1	3.7
Wetland	MAM	103.4	10.0	113.4
	MAS	15.5	5.1	20.6
	SA	0.0	0.1	0.1
	SAF	0.6	0.1	0.7

Vegetation Type Group	ELC Community Series	Maintained (ha)	Removed (ha)	Current FSA Total (ha)
	SAM	0.1	0.3	0.4
	SAS	1.2	1.1	2.3
	SWD	42.4	6.2	48.6
	SWT	15.0	1.7	16.6
Woodland	CUP	38.1	13.5	51.6
	CUW	45.7	6.3	52.0
	FOC	0.2	0.4	0.7
	FOD	159.9	39.1	199.0
	FOM	10.4	10.0	20.3

The TRCA's approach to identifying vegetation communities that include characteristics and functions that are the most sensitive to the transition from an agricultural matrix to an urban matrix are shown in Figure 2-4. The majority of vegetation communities do not have L-Rankings at this time (i.e. approximately 774.7 ha are not currently ranked, representing 65.6% of all vegetated areas within the FSA). These areas are primarily represented by open/early succession habitat types.

Vegetation communities that are anticipated to the most sensitive to land-use change in the FSA are those that are ranked as L1 to L3 communities and represent only a small portion of vegetation communities (2.1 % of all vegetated areas; 6.1% of vegetated areas with known ranking). Using existing information regarding vegetation-type sensitivity, 45 vegetation communities covering approximately 24.8 ha are identified as being particularly sensitive to the proposed land-use change (red areas on Figure DA2-4; Appendix E). The majority of vegetation communities present within the FSA are those that are likely resilient to an urban matrix and are ranked as L4, L5, or L+ (32.3% of vegetated areas; 93.8% of vegetated areas with known rankings).

Vegetation communities that are most sensitive to an urban matrix (i.e. having TRCA L-Ranks of L1 to L3) occur within the Greenbelt and/or high constraint areas within the FSA (Figure DA2-4). Some that are outside of these areas include wetland and woodland features in the west sections of the Etobicoke Creek Subwatershed, and isolated features in the main Humber River Subwatershed (Figure DA2-4).

Vegetation communities that are expected to be less sensitive to a future urban matrix are also predominantly within the Greenbelt and/or high constraint areas within the FSA (Figure DA2-4). Larger features in this category tend to be associated with the Etobicoke Creek subwatershed and the West Humber River Subwatershed. Smaller and/or more isolated features tend to be associated with the Main Humber Creek watershed in the east areas of the FSA.

Table 2.3.5.6: Sensitivity ranking summary for vegetation communities present within the FSA

Vegetation Community L-Rank	Number of Features	Area of Features (ha)
L2	4	2.0
L3	41	22.8
L4	146	98.7
L5	180	167.4
L+	140	115.1
No Rank - Further Study Required	614	774.7

Flora and Fauna Species Sensitive to Urban Environments

The transition from an agricultural to urban matrix can result in changes to the diversity of flora and fauna that are present in natural features. Generally, species that are less tolerant of urbanized areas will either decrease in abundance and/or become locally extirpated, whereas species that are tolerant/resilient, will tend to be maintained and/or increase in abundance. The majority of species occurrences for flora and fauna that are sensitive to urbanization, occur within the Greenbelt and/or high constraint environmental areas (Figures DA2-5a and DA2-5b; Appendix E). Some records however, occur in features that are not currently identified as high constraint and therefore would be directly impacted.

Flora species that are documented in the FSA that may be the most sensitive to the transition to an urban (based on TRCA L-ranks 1 to 3) are presented in Table 2.3.5.7. Locations of flora based on species L-rank are shown in Figure DA2-5b (Appendix E).

Table 2.3.5.7: Flora present in the FSA that are expected to be the most sensitive to urbanization

Sensitivity to Urbanization (TRCA L-Rank)	Scientific name	Common name	Number of records within the FSA
L1	*Pinus resinosa*	red pine	6
L2	*Carex viridula ssp. viridula*	greenish sedge	1
	Carex lasiocarpa	slender woolly sedge	1
L3	*Carex utriculata*	beaked sedge	2
	Salix nigra	black willow	2
	Iris versicolor	blue flag	11
	Claytonia caroliniana	broad-leaved spring beauty	21
	Najas flexilis	bushy naiad	1
	Prunus nigra	Canada plum	4
	Viola canadensis	Canada violet	6
	Taxus canadensis	Canada yew	6
	Dryopteris clintoniana	Clinton's wood fern	2
	Cardamine concatenata	cut-leaved toothwort	18
	Dicentra cucullaria	Dutchman's breeches	7
	Carex leptonervia	few-nerved wood sedge	1
	Potamogeton zosteriformis	flat-stemmed pondweed	1

Sensitivity to Urbanization (TRCA L-Rank)	Scientific name	Common name	Number of records within the FSA
	Potamogeton natans	floating pondweed	7
	Carex alopecoidea	foxtail wood sedge	6
	Carex crinita	fringed sedge	21
	Carex grayi	Gray's sedge	2
	Sparganium eurycarpum	great bur-reed	10
	Sparganium emersum	green-fruited bur-reed	1
	Luzula acuminata	hairy wood rush	1
	Uvularia grandiflora	large-flowered bellwort	9
	Viola rostrata	long-spurred violet	1
	Cystopteris tenuis	Mackay's fragile fern	6
	Claytonia virginica	narrow-leaved spring beauty	8
	Epilobium leptophyllum	narrow-leaved willow-herb	1
	Glyceria borealis	northern manna grass	2
	Gymnocarpium dryopteris	oak fern	1
	Carex pallescens	pale sedge	1
	Mitchella repens	partridgeberry	2
	Hypopitys monotropa	pinesap	8
	Antennaria parlinii ssp. fallax	plantain-leaved pussytoes	1
	Crataegus coccinea var. pringlei	Pringle's hawthorn	3
	Cardamine douglassii	purple cress	3
	Carex woodii	purple-tinged sedge	2
	Streptopus lanceolatus var. lanceolatus	rose twisted-stalk	5
	Euonymus obovatus	running strawberry-bush	49
	Carya ovata	shagbark hickory	20
	Hepatica acutiloba	sharp-lobed hepatica	14
	Salix lucida	shining willow	1
	Alnus incana ssp. rugosa	speckled alder	1
	Carex laxiculmis var. laxiculmis	spreading wood sedge	2
	Dicentra canadensis	squirrel-corn	17
	Lemna trisulca	star duckweed	2
	Larix laricina	tamarack	2
	Vallisneria americana	tape-grass	1
	Carex molesta	troublesome sedge	1
	Nymphaea odorata ssp. tuberosa	tuberous water-lily	1
	Carex tuckermanii	Tuckerman's sedge	14
	Chelone glabra	turtlehead	5
	Equisetum fluviatile	water horsetail	2
	Ludwigia palustris	water purslane	3
	Picea glauca	white spruce	26

Sensitivity to Urbanization (TRCA L-Rank)	Scientific name	Common name	Number of records within the FSA
	Phlox divaricata	wild blue phlox	1
	Ilex verticillata	winterberry	5
	Anemone quinquefolia var. quinquefolia	wood-anemone	8
	Equisetum sylvaticum	woodland horsetail	4

Fauna species that are documented in the FSA that may be the most sensitive to the transition to an urban (based on TRCA L-ranks 1 to 3) are presented in Table 2.3.5.8. Location of wildlife species based on L-rank are shown on Figure DA2-5b (Appendix E).

Table 2.3.5.8: Fauna present in the FSA that are expected to be the most sensitive to urbanization

Sensitivity to Urbanization (TRCA L-Rank)	Species Group	Scientific Name	Common Name	Number of records within the FSA
L2	AMPHIBIANS	*Hyla versicolor*	Gray Treefrog	2
		Lithobates catesbeianus	American Bullfrog	1
		Lithobates sylvaticus	Wood Frog	15
		Pseudacris crucifer	Spring Peeper	8
	BIRDS	*Ammodramus savannarum*	Grasshopper Sparrow	2
		Circus hudsonius	Northern Harrier	3
		Mniotilta varia	Black-and-white Warbler	1
		Seiurus aurocapilla	Ovenbird	4
	CRUSTACEANS	*Fallicambarus fodiens*	Chimney Crayfish/ Digger Crayfish	20
L3	AMPHIBIANS	*Lithobates pipiens*	Northern Leopard Frog	5
	BIRDS	*Accipiter striatus*	Sharp-shinned Hawk	2
		Chordeiles minor	Common Nighthawk	1
		Cistothorus platensis	Sedge Wren	2
		Coccyzus americanus	Yellow-billed Cuckoo	1
		Coccyzus erythropthalmus	Black-billed Cuckoo	5

Sensitivity to Urbanization (TRCA L-Rank)	Species Group	Scientific Name	Common Name	Number of records within the FSA
		Dolichonyx oryzivorus	Bobolink	1
		Empidonax alnorum	Alder Flycatcher	1
		Eremophila alpestris	Horned Lark	14
		Geothlypis philadelphia	Mourning Warbler	15
		Hylocichla mustelina	Wood Thrush	34
		Meleagris gallopavo	Wild Turkey	1
		Pipilo erythrophthalmus	Eastern Towhee	1
		Piranga olivacea	Scarlet Tanager	3
		Pooecetes gramineus	Vesper Sparrow	17
		Porzana carolina	Sora	1
		Scolopax minor	American Woodcock	10
		Setophaga virens	Black-throated Green Warbler	1
		Sphyrapicus varius	Yellow-bellied Sapsucker	1
		Toxostoma rufum	Brown Thrasher	19
	MAMMALS	*Zapus hudsonius*	Meadow Jumping Mouse	1
	REPTILES	*Chrysemys picta marginata*	Midland Painted Turtle	1
		Storeria o. occipitomaculata	Northern Red-bellied Snake	2

Species and Habitats with Policy Implications

Species with policy implications that may be impacted in areas if suitable habitat is not protected, are shown in Table 2.3.5.9. The list only includes wildlife species, as documented in the Part A Characterization report, only one species of flora conservation concern was documented within the FSA (Honey Locust, *Gleditsia triacanthos*). Species that are either Endangered or Threatened Federally and/or Provincially (locations shown in Figure DA2-5c), species that are of Specific Concern Provincially, species that are rare in Ontario (S-rank is S1, S2, or S3), and/or species that are indicators of Significant Wildlife Habitat in Ecoregion 6E are identified (locations shown on Figure DA2-5d).

Additionally, areas that have potential to support Significant Wildlife Habitat (SWH) are largely captured within the Greenbelt and high environmental constraint areas (Figure DA2-5e). Areas where SWH is located outside of these areas will require additional consideration through the SABE impact assessment. It is anticipated that where SWH is associated with key features and other areas that are protected, impacts can be avoided. Where they are not associated with key features and other areas that are protected, consideration may be given to determine if they habitat types and functions can be incorporated into ecological enhancements areas (for example, where features are represented by early successional habitat types).

In addition to the species records available for the FSA impact analysis, other species (e.g. Species at Risk) that may be present on the landscape should be considered. For example, the Natural Heritage Information Centre records for this area include the species listed in Table 2.3.5.10. Some of these species, for example Bobolink and Redside Dace, are included as records in the existing fauna data; those that are not (and other species that are present on the landscape) should be documented during future studies.

Table 2.3.5.9. Fauna Present in the FSA that have One or More Policy Implications

Species Group	Species Name	Common Name	SARA	ESA	Provincial Special Concern	Provincially Rare	SWH Indicator
AMPHIBIANS	*Lithobates catesbeianus*	American Bullfrog					1
	Anaxyrus americanus	American Toad					1
	Hyla versicolor	Gray Treefrog					1
	Lithobates clamitans	Green Frog					1
	Lithobates pipiens	Northern Leopard Frog					1
	Pseudacris crucifer	Spring Peeper					1
	Lithobates sylvaticus	Wood Frog					1
BIRDS	*Empidonax alnorum*	Alder Flycatcher					1
	Setophaga ruticilla	American Redstart					1
	Mniotilta varia	Black-and-white Warbler					1
	Coccyzus erythropthalmus	Black-billed Cuckoo					1
	Setophaga virens	Black-throated Green Warbler					1
	Polioptila caerulea	Blue-gray Gnatcatcher					1
	Dolichonyx oryzivorus	Bobolink	1	1			1
	Toxostoma rufum	Brown Thrasher					1
	Petrochelidon pyrrhonota	Cliff Swallow					1
	Chordeiles minor	Common Nighthawk	1		1		1
	Geothlypis trichas	Common Yellowthroat					1
	Tyrannus tyrannus	Eastern Kingbird					1
	Sayornis phoebe	Eastern Phoebe					1

Species Group	Species Name	Common Name	SARA	ESA	Provincial Special Concern	Provincially Rare	SWH Indicator
	Pipilo erythrophthalmus	Eastern Towhee					1
	Contopus virens	Eastern Wood-Pewee			1		
	Spizella pusilla	Field Sparrow					1
	Ammodramus savannarum	Grasshopper Sparrow			1		1
	Dumetella carolinensis	Gray Catbird					1
	Myiarchus crinitus	Great Crested Flycatcher					1
	Butorides virescens	Green Heron					1
	Picoides villosus	Hairy Woodpecker					1
	Eremophila alpestris	Horned Lark					1
	Passerina cyanea	Indigo Bunting					1
	Empidonax minimus	Least Flycatcher					1
	Geothlypis philadelphia	Mourning Warbler					1
	Colaptes auratus	Northern Flicker					1
	Circus hudsonius	Northern Harrier					1
	Stelgidopteryx serripennis	Northern Rough-winged Swallow					1
	Icterus spurius	Orchard Oriole					1
	Seiurus aurocapilla	Ovenbird					1
	Melanerpes carolinus	Red-bellied Woodpecker					1
	Sitta canadensis	Red-breasted Nuthatch					1
	Vireo olivaceus	Red-eyed Vireo					1
	Agelaius phoeniceus	Red-winged Blackbird					1
	Pheucticus ludovicianus	Rose-breasted Grosbeak					1
	Archilochus colubris	Ruby-throated Hummingbird					1
	Passerculus sandwichensis	Savannah Sparrow					1
	Piranga olivacea	Scarlet Tanager					1
	Accipiter striatus	Sharp-shinned Hawk					1
	Melospiza melodia	Song Sparrow					1
	Porzana carolina	Sora					1
	Melospiza georgiana	Swamp Sparrow					1
	Pooecetes gramineus	Vesper Sparrow					1
	Meleagris gallopavo	Wild Turkey					1
	Empidonax traillii	Willow Flycatcher					1

Species Group	Species Name	Common Name	SARA	ESA	Provincial Special Concern	Provincially Rare	SWH Indicator
	Aix sponsa	Wood Duck					1
	Hylocichla mustelina	Wood Thrush	1		1		
	Sphyrapicus varius	Yellow-bellied Sapsucker					1
	Coccyzus americanus	Yellow-billed Cuckoo					1
CRUSTACEANS	*Fallicambarus fodiens*	Chimney Crayfish/ Digger Crayfish					1
MAMMALS	*Odocoileus virginianus*	White-tailed Deer					1
REPTILES	*Storeria dekayi*	DeKay's Brownsnake					1
	Thamnophis sirtalis sirtalis	Eastern Gartersnake					1
	Chrysemys picta marginata	Midland Painted Turtle					1
	Storeria o. occipitomaculata	Northern Red-bellied Snake					1

Table 2.3.5.10. SAR NHIC Records

Species Type	Common Name	Scientific Name	SRank	SARO Status	COSEWIC Status
Bird	Bank Swallow	*Riparia riparia*	S4B	THR	THR
Bird	Barn Swallow	*Hirundo rustica*	S4B	THR	THR
Bird	Bobolink	*Dolichonyx oryzivorus*	S4B	THR	THR
Bird	Eastern Meadowlark	*Sturnella magna*	S4B	THR	THR
Bird	Eastern Wood-pewee	*Contopus virens*	S4B	SC	SC
Bird	Wood Thrush	*Hylocichla mustelina*	S4B	SC	THR
Plant	Butternut	*Juglans cinerea*	S2?	END	END
Fish	Redside Dace	*Clinostomus elongatus*	S2	END	END
Reptile	Snapping Turtle	*Chelydra serpentina*	S3	SC	SC

Climate Vulnerability

In recent years, many southern Ontario urban centres have been impacted by extreme storm events (north Toronto 2005, Hamilton 2009, West Toronto 2013, Burlington 2014, and many more), leading to considerable flood and erosion damage. These events have been speculated by many to be a result of climate change, and have prompted Federal and Provincial Ministries, Regional and Municipal governments to enact policies and programs in response to this crisis.

In 2017, Peel Region Council unanimously endorsed a Climate Change Statement of Commitment, which directed the Region of Peel to develop a climate change master plan. The climate change master plan (ref. The Climate Change Master Plan, Region of Peel, 2019), provides a framework for reducing greenhouse gas emissions and building resiliency throughout Peel Region. As part of these efforts, stormwater management infrastructure has been recommended to incorporate elements of green infrastructure and low impact development best management practices, as well as the need for planning and design of stormwater quantity controls for formative storm events above the 100 year return period.

Consideration of areas vulnerable to climate change, the TRCA's climate change vulnerability mapping has been overlain with the FSA boundary (figure DA2-6, Appendix E). Qualitatively, Most of the FSA includes low to moderate climate vulnerable areas. High vulnerability areas are also present, and located primarily along the south FSA boundary and east boundary near Bolton.

2.3.5.2 Preliminary SABE Concept

Water Resource System

As noted previously, the preliminary SABE concept encompasses most, if not all, of the FSA within the respective subwatersheds. The key hydrologic features and key hydrologic areas mapping has been reviewed in conjunction with the preliminary SABE concept to determine the size (i.e. area) of the preliminary SABE concept in each subwatershed which would impact key hydrologic features and areas. This assessment has focused primarily on the areas of the preliminary SABE concept which would impact the more discrete and local key hydrologic features and areas which are considered ecologically supportive and would require more detailed and specific management recommendations as part of future studies (i.e. significant groundwater recharge areas, ecologically sensitive groundwater recharge areas, seepage areas, springs, and wetlands), recognizing that all of the preliminary SABE concept lies upstream of regulated watercourses and/or FVAs, and large portions lie in areas with low depth to water table. The locations of key hydrologic features and key hydrologic areas relative to the preliminary SABE concept are depicted on Drawings WR-4 and WR-5 respectively. The size of the preliminary SABE concept which would impact these specific key hydrologic features and areas is presented in Table 2.3.5.11, and the proportion (i.e. percentage) of the preliminary SABE concept which would impact these features is summarized in Table 2.3.5.12.

Table 2.3.5.11. Drainage Areas of the Preliminary SABE Concept Impacting Local Ecologically Supportive Key Hydrologic Features and Areas by Subwatershed (ha)

Watershed	Subwatershed	Preliminary SABE Land Use		Total
		Community	Employment	
Credit River	Credit River – Glen Williams to Norval	9.68	5.50	15.18
	Huttonville Creek	0.17	0.69	0.86
	Fletcher's Creek	80.07	0.87	80.94
Etobicoke Creek	Upper Etobicoke Creek	730.48	139.06	813.21
Humber River	West Humber River	1809.13	872.52	2681.65
	Main Humber River	150.39	-	150.39

Table 2.3.5.12. Proportion (Percentage) of the Preliminary SABE Concept Impacting Local Ecologically Supportive Key Hydrologic Features and Areas by Subwatershed (%)

Watershed	Subwatershed	Preliminary SABE Land Use		Total
		Community	Employment	
Credit River	Credit River – Glen Williams to Norval	100	88.3	95.4
	Huttonville Creek	8.9	1.9	2.3
	Fletcher's Creek	63.4	83.1	63.6
Etobicoke Creek	Upper Etobicoke Creek	99.9	68.7	92.7
Humber River	West Humber River	99.2	99.3	99.2
	Main Humber River	99.6	-	99.6

The information in Tables 2.3.5.11 and 2.3.5.12 indicate that the vast majority of the portions of the preliminary SABE concept which lie within the Main Humber Subwatershed, West Humber Subwatershed, Upper Etobicoke Creek Subwatershed, and the Main Branch of the Credit River would affect local and ecologically supportive key hydrologic features. The information in Tables 2.3.5.11 and 2.3.5.12 indicate that the majority of the preliminary SABE concept within the Fletcher's Creek Subwatershed would affect local and ecologically supportive key hydrologic features. The portion of the preliminary SABE concept within the Huttonville Creek Subwatershed would have limited impact to ecologically supportive key hydrologic features and areas, due to the relative scarcity of those features within the portion of the preliminary SABE concept within the Huttonville Creek Subwatershed. As noted previously, the impacts of the employment land use, if unmitigated, are anticipated to have greater impact compared to community land use conditions (i.e. greater reduction in groundwater recharge, higher rates of runoff, higher rates of erosion and flood potential) due to the higher levels of impervious coverage associated with that land use.

In addition, as noted previously, the preliminary SABE concept is recognized to lie upstream of regulated watercourses and/or FVAs, and several segments of the preliminary SABE concept are recognized to lie within areas of low depth to groundwater. The impacts of the development of the preliminary SABE concept to the above key hydrologic features and key hydrologic areas are to be assessed further as part of future studies.

Natural Heritage System

Natural Cover Impacts

The overlay of SABE land-uses and natural cover is shown on figure DA2-1 (Appendix E). The conceptual land-use classifications represent those described in Section 2.2 and shown on Figure 2.2.1.2. As such, the impact assessment focuses on identifying vegetation communities, habitats, and species that are located within areas of proposed change that are outside of the 'FSA Take Outs' (ref. Figure 2.2.1.2). The assessment provides the baseline for identifying additional considerations for protection, impact mitigation, and ecological connectivity as part of a conceptual NHS; these recommendations are provided in Section 2.5.2.1.

The Preliminary SABE Concept Community land-use and Employment land-use impacts to overall natural cover are summarized in Table 2.3.5.13. Collectively, the two land-use types would result in the removal of 137.2 ha of natural cover and open aquatic features (Table 2.3.5.13).

Community land-use would result in a total of reduction of 96.1 ha of natural land cover across the Fletcher's Creek, Main Humber, Upper Etobicoke, and West Humber subwatersheds. Land cover types affected include aquatic areas, open/early successional cover, wetland, woodland, and wetland/woodland cover. Open/Early Successional land cover types would experience the largest impact with 79.7 ha being removed. This would be followed in deceasing order of impact to woodlands, wetlands, aquatic areas, and wetland/woodland cover. Impacts to open/early succession, wetland, and woodland cover would take place across all four subwatersheds. Impacts to aquatic areas would be restricted to Upper Etobicoke and West Humber subwatersheds. Impacts to wetland/wetland cover would be restricted to the West Humber watershed.

Impacts to ELC community series types associated with the land cover types impacted by Community land-use is summarized in Table 2.3.5.14. Aquatic areas impacted are restricted to open aquatic habitats occurring in the Upper Etobicoke and West Humber Watersheds. Open/Early Successional ELC community series impacts occur primarily to Cultural Meadow habitat (73.0 ha); other ELC community series/land cover impacted include Cultural Thicket and hedgerows. Impacts occur in the Fletcher's Creek, Main Humber, Upper Etobicoke, and West Humber subwatersheds. Wetland ELC types impacted include Meadow Marsh, Shallow Marsh, and Thicket Swamp. Meadow Marsh impacts occur in the Fletcher's Creek Subwatershed, Upper Etobicoke, and West Humber subwatersheds. Impacts to Shallow Marsh and Thicket Swamp occur only in the West Humber Subwatershed. Wetland/Woodland ELC types impacted included Deciduous Swamp and was restricted to the West Humber Subwatershed. Woodland ELC types impacted included Cultural Savanah, Cultural Woodland, Deciduous Forest, and Plantations. Cultural Savannah impacts occur in the Main Humber, Upper Etobicoke Creek, and West Humber subwatersheds. Cultural Woodland impacts occur in the Fletcher's Creek, Main Humber, Upper Etobicoke, and West Humber subwatersheds. Deciduous forest impacts occur in the Upper Etobicoke, and West Humber subwatersheds. Plantation impacts occur in the Fletcher's Creek, Main Humber, and West Humber subwatersheds.

Employment land-use would result in a total reduction of 41.1 ha of natural land cover across the Upper Etobicoke and West Humber subwatersheds. Land cover types affected include aquatic areas, open/early successional cover, wetlands, and woodlands. Open/early successional land cover would experience the largest impact with 37.5 ha being removed. This would be followed by small areas of wetland, woodland and aquatic areas being impacted (all with < 2 ha of removed area).

Employment land-use impacts to ELC community series type is summarized in Table 2.3.5.14. Aquatic areas impacted included open aquatic habitat in both subwatersheds. Open/Early Successional ELC types impacted include Cultural Meadow, Cultural Thicket, and Hedgerows. The removal of 35.6 ha of Cultural Meadow, primarily in the West Humber watershed, would represent the largest impact; impacts to Cultural Thicket would be much lower (1.2 ha) and only occur in the West Humber Subwatershed. Small areas of hedgerow impact (0.6 ha) would occur across both subwatersheds. Wetland ELC types impacted include Meadow Marsh and Shallow Marsh. Meadow Marsh removal would occur in both subwatersheds, but primarily in the West Humber (0.8 ha). Shallow Marsh removal would occur in only the West Humber (0.8 ha). Woodland ELC types impacted include Cultural Savannah, Deciduous Forest, and Plantation. Cultural Savana removal is relatively small (<0.1 ha) and would occur only in the West Humber Subwatershed. Deciduous Forest removal is relatively small (0.1 ha), with the majority of removal occurring in the West Humber Subwatershed. Plantation removal would occur only in the West Humber Subwatershed.

Table 2.3.5.13. Preliminary SABE Concept Impacts to Natural Cover Types by Subwatershed

Land Use and Land Cover	Fletcher's Creek	Main Humber	Upper Etobicoke	West Humber	Grand Total
Community Area					
Aquatic			1.1	0.2	1.3
Open/Early Successional	5.0	17.2	9.9	47.6	79.7
Wetland	<0.1	0.1	<0.1	3.4	3.4
Wetland/Woodland				0.1	0.1
Woodland	1.6	0.6	2.8	6.6	11.7
Sub-Total	**6.6**	**17.8**	**13.9**	**57.8**	**96.1**
Employment Area					
Aquatic			<0.1	0.4	0.5
Open/Early Successional			3.7	33.7	37.5
Wetland			<0.1	1.6	1.7
Woodland			<0.1	1.4	1.4
Sub-total			**3.8**	**37.2**	**41.1**

Table 2.3.5.14. Preliminary SABE Concept Community Land-Use Impacts to ELC Community Series and Other Vegetated Areas

Natural Cover and ELC Community Series	Fletcher's Creek	Main Humber	Upper Etobicoke	West Humber	Grand Total
Aquatic					
Open Aquatic			1.1	0.2	1.3
Open/Early Successional					
Cultural Meadow	5.0	16.6	9.5	42.0	73.0
Cultural Thicket		0.5	0.1	3.7	4.3
Hedgerow		<0.1	0.4	2.0	2.4
Wetland					
Meadow Marsh	<0.1		<0.1	1.4	1.4
Shallow Marsh				1.2	1.2
Thicket Swamp				0.8	0.8
Wetland/Woodland					
Deciduous Swamp				0.1	0.1
Woodland					
Cultural Savannah		0.2	1.2	4.1	5.4
Cultural Woodland	0.2	0.3	0.1	1.0	1.6
Deciduous Forest			1.6	<0.1	1.6
Plantation	1.4	0.2		1.5	3.1
Total	**6.6**	**17.7**	**13.9**	**57.8**	**96.0**

Table 2.3.5.15. Preliminary SABE Concept Employment Land-Use Impacts to ELC community Series and Other Vegetated Areas

Natural Cover and ELC Community Series	Upper Etobicoke	West Humber	Grand Total
Aquatic	<0.1	0.4	0.5
Open Aquatic	<0.1	0.4	0.5
Open/Early Successional	3.7	33.7	37.5
Cultural Meadow	3.7	32.0	35.6
Cultural Thicket		1.2	1.2
Hedgerow	0.1	0.5	0.6
Wetland	<0.1	1.6	1.7
Meadow Marsh	<0.1	0.8	0.8
Shallow Marsh		0.8	0.8
Woodland	<0.1	1.4	1.4
Cultural Savannah		<0.1	<0.1
Deciduous Forest	<0.1	0.1	0.1
Plantation		1.3	1.3
Total	**3.8**	**37.2**	**41.1**

Natural System Quality and Function Impacts

The overlay of SABE land-use areas and natural system patches (wetlands, woodlands, and meadows) is shown on figures in DA2-2a-i (Appendix E); as well, the land-use overlay on ELC features based on their conservation rank is shown on figure DA2-4 (Appendix E).

Impacts to ELC community series based on conservation concern ranking are presented in Table 2.3.5.16. Impacts to wetland, woodland, and meadow patches of different patch quality is summarized for Community Land-use in Table 2.3.5.17 and for Employment Land-use in Table 2.3.5.18.

Impacts to ELC community series that are of regional conservation concern (L1 to L3) occur in the West Humber subwatershed (Table 2.3.5.16).

Impacts to wetland patches identified as L3-Fair summed to 0.1, and only occurred in the Main Humber Subwatershed. Wetlands patches identified as L4 – Poor summed to 3.3 ha, occurring primarily in the West Humber Subwatershed, with smaller patch areas affected in Fletcher's Creek and Upper Etobicoke Creek subwatersheds. Wetlands patches identified as L5 – Very Poor summed to 0.1 ha and only occurred in the West Humber Subwatershed.

Impacts to woodland patches identified as L3-Fair summed to 0.3 ha, and occur in the Main Humber, Upper Etobicoke, and West Humber subwatersheds. Woodland patches identified as L4-Poor sum to 8.7 ha and occur in the Fletcher's Creek, Main Humber, Upper Etobicoke, and West Humber subwatersheds. Woodland patchers identified as L5-Very Poor sum to 11.8 ha and occur in the Fletcher's Creek and West Humber subwatersheds.

Impacts to meadow patchers identified as L3-Fair sum to 11.7 ha, and occur in the Main Humber and West Humber subwatersheds. Meadow patchers identified as L4-Poor sum to 58.2 ha and occur in the Fletcher's Creek, Main Humber, Upper Etobicoke, and West Humber subwatersheds. Meadow patches identified as L5 – Very Poor summed to 3.6 ha and occur in the Fletcher's Creek, Upper Etobicoke, and West Humber subwatersheds.

Table 2.3.5.16. Preliminary SABE Concept Land Use Impacts to ELC Community Series Conservation Concern Ranking

Type	LRank	Main Humber	Upper Etobicoke	West Humber	Grand Total
Community Area	L+	3	2	17	22
	L3			2	2
	L4		1	7	8
	L5	6	6	27	39
Employment Area	L+		3	10	13
	L4			1	1
	L5		3	3	6
		9	**15**	**67**	**91**

Table 2.3.5.17. Preliminary SABE Concept Community Land-Use Impacts to Vegetation Patches

Patch Type and TRCA L-Rank	Fletcher's Creek	Main Humber	Upper Etobicoke	West Humber	Grand Total
Wetlands					
L3 - Fair		0.1			0.1
L4 - Poor	<0.1		<0.1	3.3	3.3
L5 - Very Poor				0.1	0.1
Sub-Total	**<0.1**	**0.1**	**<0.1**	**3.4**	**3.5**
Woodlands					
L3 - Fair		<0.1	<0.1	0.2	0.3
L4 - Poor	0.8	0.6	2.8	4.5	8.7
L5 - Very Poor	0.9			2.0	2.8
Sub-Total	**1.6**	**0.6**	**2.8**	**6.7**	**11.8**
Meadows					
L3 - Fair		8.6		2.7	11.3
L4 - Poor	3.0	8.0	9.3	37.8	58.2
L5 - Very Poor	2.0		0.2	1.4	3.6
Sub-Total	**5.0**	**16.6**	**9.5**	**42.0**	**73.1**

Employment land-use impacts wetland, woodland, and meadow patches identified as L4-Poor and L5-Very Poor, and occur in the Upper Etobicoke and West Humber subwatersheds. The largest impact is to meadow patches identified as L4-Poor, predominantly in the West Humber Subwatershed. Impacts to wetland patches identified as L4-Poor summed to 1.7 ha and occur in both subwatersheds. Impacts to woodland patches identified as L4-Poor summed to 1.4 ha and occur in both sub watersheds. Impacts to meadow patches identifies as L4 sum to 35.6 ha and occur in both subwatersheds. Meadow patches identified as L5 – Very Poor summed to 0.1 ha and occur only in the West Humber Subwatershed.

Table 2.3.5.18. Preliminary SABE Concept Employment Land-Use Impacts to Vegetation Patches

Patch Type and TRCA L-Rank	Upper Etobicoke	West Humber	Sub-total
Wetlands			
L4 - Poor	<0.1	1.6	1.7
Sub-total	**<0.1**	**1.6**	**1.7**
Woodlands			
L4 - Poor	<0.1	1.4	1.4
Sub-total	**<0.1**	**1.4**	**1.4**
Meadows			
L4 - Poor	3.7	31.9	35.6
L5 - Very Poor		0.1	0.1
Sub-total	**3.7**	**32.0**	**35.6**

Habitat Connectivity / Linkage Assessment

As outlined in the FSA impact assessment, habitat connectivity across the landscape was assessed using Circuitscape (McRae et al. 2008; McRae and Shah, 2009). Using a qualitative assessment of the analysis output, the Preliminary SABE Concept land-uses are located on agricultural table land areas and outside of the main valley systems (Map DA2-3, Appendix E). As the land-use areas are located in areas that currently have relatively low ecological permeability, potential impacts to landscape connectivity would be minimized.

Species Impacts

The overlay of the SABE land-use areas on flora and fauna species occurrences are shown on figures DA2-5a-d (Appendix E). Figures DA2-5a and DA2-5b show flora and fauna records based on TRCA L-Rank. Figure DA2-5d shows records of species at risk. Figure DA2-5d shows records for provincially rare species and species of special concern.

The number of plant and wildlife species records associated with features that would be impacted by Community and Employment land-uses is relatively low as the assessment is restricted to areas were field investigations have been undertaken during previous studies.

Based on the data available, removal of vegetated cover for Community land-use overlapped with records of nine plant species (Table 2.3.5.19) located in the Upper Etobicoke and West Humber subwatersheds. Of the nine species affected, seven have records that are within identified FSA Take-Outs. The remaining two that were not represented in the FSA Take-Out areas included Tape-grass (*Vallisneria americana*) and Emerson's Hawthorn (*Crataegus submollis*).

Based on the data available, removal of vegetated cover for Community land-use overlapped with eight wildlife species located in the Fletcher's Creek, Upper Etobicoke, and West Humber subwatersheds (Table 2.3.5.20). Of the eight species affected, seven have records that are within the identified FSA Take-Outs. The remaining species that was not represented in the FSA Take-Out areas included Bobolink (*Dolichonyx oryzivorus*).

Based on the data available, removal of vegetated cover for Community land-use overlapped with records for one species of plant, Wooly Bullrush (*Scirpus cyperinus)* located within the West Humber Subwatershed. The species has records that also occur in in the FSA Take-Out areas.

Based on the data available, removal of vegetated cover for Employment land-use overlapped with four wildlife species, located in the Upper Etobicoke and West Humber subwatersheds (Table 2.3.5.22). All species that would be impacted also have records located in the FSA Take-Out areas.

Table 2.3.5.19. Preliminary SABE Concept Community Land-Use Impacts to Plant Species (based on available records)

TRCA L Rank	Common Name	Scientific Name	Upper Etobicoke	West Humber	Total	FSA Take out
L1	**Red pine**	*Pinus resinosa*		1	1	Y
L3	**Canada plum**	*Prunus nigra*		2	2	Y
	Fringed sedge	*Carex crinita*		1	1	Y
	Tape-grass	*Vallisneria americana*		1	1	N
	Tuckerman's sedge	*Carex tuckermanii*		4	4	Y
	White spruce	*Picea glauca*		1	1	Y
L4	**Blue-eyed grass**	*Sisyrinchium montanum*		2	2	Y
	Emerson's hawthorn	*Crataegus submollis*	1		1	N
	Slender willow	*Salix petiolaris*		2	2	Y
			1	**14**	**15**	

Table 2.3.5.20. Preliminary SABE Concept Community Land-Use Impacts to Wildlife Species (based on available records)

TRCA L Rank	Common Name	Scientific Name	Fletchers Creek	Upper Etobicoke	West Humber	Total	FSA Take-out
L2	**Chimney Crayfish/ Digger Crayfish**	*Fallicambarus fodiens*		1	4	5	Y
	Wood Frog	*Lithobates sylvaticus*			3	3	Y
L3	**American Woodcock**	*Scolopax minor*		1	1	2	Y
	Bobolink	*Dolichonyx oryzivorus*	1			1	N
	Brown Thrasher	*Toxostoma rufum*			1	1	Y
	Horned Lark	*Eremophila alpestris*		1	5	6	Y
	Vesper Sparrow	*Pooecetes gramineus*		5	1	6	Y
	Northern Leopard Frog	*Lithobates pipiens*			1	1	Y
			1	**8**	**16**	**25**	

Table 2.3.5.21. Preliminary SABE Concept Employment Land-Use Impacts to Plant Species (based on available records)

TRCA L Rank	Common Name	Scientific Name	West Humber	Total	FSA Take Out
L4	**Woolly bulrush**	*Scirpus cyperinus*	1	1	Y
			1	**1**	

Table 2.3.5.22. Preliminary SABE Concept Employment Land-Use Impacts to Wildlife species (based on available records)

TRCA L-Rank	Common Name	Scientific Name	Upper Etobicoke	West Humber	Total	FSA Take out
L2	**Chimney Crayfish/ Digger Crayfish**	*Fallicambarus fodiens*		1	1	Y
	Northern Harrier	*Circus hudsonius*		2	2	Y
L3	**Horned Lark**	*Eremophila alpestris*		3	3	Y
	Vesper Sparrow	*Pooecetes gramineus*	1		1	Y
			1	**6**	**7**	

Significant Wildlife Habitat

The overlay of the SABE land-use areas on the sum of candidate SWH types within 250m x 250m grids is shown on figure DA2-5e (Appendix E); occurrences of specific SWH types can be reviewed in the Part A Characterization figures DA1-5b(1-18).

Potential impact of the SABE recommended land-uses to Significant Wildlife Habitat types are summarized for Seasonal Concentration Areas (Table 2.3.5.23), Rare Vegetation Communities and Specialized Habitat for Wildlife (Table 2.3.5.24), and Habitat for Species of Conservation Concern and Movement Corridors (Table 2.3.5.25).

Community and Employment land-uses within all subwatersheds have the potential to impact various SWH types. Among the Seasonal Concentration Area types, Turtle Wintering Areas, Shorebird Migratory Stopover Areas, and Bat Maternity Colonies are the most affected within the West Humber, Upper Etobicoke, and Main Humber subwatersheds (Table 2.3.5.23). Among the Rare Vegetation Communities and Specialized Habitat for Wildlife types, Amphibian Breeding Habitat and Waterfowl Nesting Areas are generally the most affected within the West Humber, Upper Etobicoke, and Main Humber subwatersheds (Table 2.3.5.24). Among the Habitat for Species of Conservation Concern and Movement Corridors, Amphibian Movement Corridors, Terrestrial Crayfish habitat, and Marsh Breeding Bird habitat are the most affected, primarily within the West Humber, Upper Etobicoke, and Main Humber subwatersheds (Table 2.3.5.25).

Additionally, other SWH types that were not mapped for this analysis but may have the potential to be impacted by the Preliminary SABE Concept land-uses include Waterfowl Stopover and Staging Areas (Terrestrial), Reptile Hibernaculum, Old Growth Forests, and habitat for species of Special Concern and Rare

Wildlife Species. Habitat for Species of Special Concern and Rare Wildlife Species that may be present based on available data are summarized in the FSA impacts section (Table 2.3.5.9).

Table 2.3.5.23. Preliminary SABE Concept impacts to Seasonal Concentration Areas. Values presented are the number of grids of 250 m x 250 m with potential SWH present that overlap with the respective land-use type

Subwatershed	Land-use Type	Waterfowl Stopover and Staging Areas (Aquatic)	Shorebird Migratory Stopover Area	Bat Maternity Colonies	Turtle Wintering Areas	Colonially - Nesting Bird Breeding Habitat (Tree/Shrubs)	Total grids with SWH	Total SWH Types
Credit River - Glen Williams To Norval	Community Area	2	1	3	2	2	10	5
	Employment Area	1		1	1	1	4	4
Fletcher's Creek	Community Area		2	4	4	1	11	4
	Employment Area			1	1	1	3	3
Huttonville Creek	Community Area						0	0
	Employment Area			2	1	1	4	3
Main Humber	Community Area	11	16	24	36	1	88	5
Spring Creek	Employment Area						0	0
Upper Etobicoke	Community Area	24	50	93	81	37	285	5
	Employment Area	9	17	22	34	10	92	5
West Humber	Community Area	54	102	64	174	21	415	5
	Employment Area	14	74	44	102	6	240	5

Table 2.3.5.24. Preliminary SABE Concept impacts to Rare Vegetation Communities and Specialized Habitat for Wildlife. Values presented are the number of grids of 250 m x 250 m with potential SWH present that overlap with the respective land-use type

Subwatershed	Land-use Type	Savannah	Other Rare Vegetation Communities	Waterfowl Nesting Area	Bald Eagle and Osprey Nesting, Foraging, and Perching Habitat	Turtle Nesting Areas	Seeps and Springs	Amphibian Breeding Habitat (Woodland)	Amphibian Breeding Habitat (Wetlands)	Total SWH Grids	Total SWH Types
Credit River - Glen Williams To Norval	Community Area		2	3	3			3	2	13	5
	Employment Area			1	1			1	1	4	4
Fletcher's Creek	Community Area		1	6	3		1	3	4	18	6
	Employment Area		1	1			1	1	1	5	5
Huttonville Creek	Community Area									0	0
	Employment Area		1	2			1	2	1	7	5
Main Humber	Community Area	6	2	28	22	17	21	20	34	150	8
Spring Creek	Employment Area									0	0
Upper Etobicoke	Community Area	5	29	91	83	19	62	77	82	448	8
	Employment Area			10	21	21	17	20	36	125	6
West Humber	Community Area	12	23	81	45	69	36	54	182	502	8
	Employment Area	4	8	42	28	24	27	38	110	281	8

Table 2.3.5.25. Preliminary SABE Concept impacts to Habitat for Species of Conservation Concern and Movement Corridors. Values presented are the number of grids of 250 m x 250 m with potential SWH present that overlap with the respective land-use type

Subwatershed	Land-use Type	Marsh Breeding Bird Habitat	Open Country Bird Breeding Habitat	Shrub/Early Successional Bird Breeding Habitat	Terrestrial Crayfish	Amphibian Movement Corridors	Total SWH Grids	Total SWH Types
Credit River - Glen Williams To Norval	Community Area	1			2	2	5	3
	Employment Area				1	1	2	2
Fletcher's Creek	Community Area	2			3	4	9	3
	Employment Area				1	1	2	2
Huttonville Creek	Community Area						0	0
	Employment Area				1	1	2	2
Main Humber	Community Area	20	4	4	27	33	88	5
Spring Creek	Employment Area						0	0
Upper Etobicoke	Community Area	51			80	81	212	3
	Employment Area	18			34	34	86	3
West Humber	Community Area	111		18	147	188	464	4
	Employment Area	79	5	4	85	111	284	5

Climate Vulnerable Areas

Climate vulnerable areas present within the Preliminary SABE Concept land-use areas are presented in Table 2.3.5.26 and shown on figure DA2-6 (Appendix E). Of the three vulnerability areas identified (low, medium, and high), removal of high vulnerability areas is assumed to have the potential for exacerbating environmental impacts of land-use change based on future climate change scenarios. Based on this assumption, the Preliminary SABE Concept land-uses have the largest potential impact in the Fletcher's Creek and West Humber subwatersheds based on the extent of high vulnerability areas affected.

Table 2.3.5.26. TRCA Climate vulnerable areas present within the Recommend SABE land-use areas

Subwatershed and Land-use Area	Low Vulnerability Area (ha)	Moderate Vulnerability Area (ha)	High Vulnerability Area (ha)	Total
CREDIT RIVER - GLEN WILLIAMS TO NORVAL				
Community Area		9.2	0.5	9.7
Employment Area		0.7	5.6	6.2
FLETCHER'S CREEK				
Community Area	2.3	18.3	105.7	126.3
Employment Area			1.0	1.0
HUTTONVILLE CREEK				
Community Area		0.0	1.9	1.9
Employment Area		0.9	34.9	35.8
MAIN HUMBER				
Community Area	68.0	80.8	2.2	151.0
SPRING CREEK				
Employment Area	1.5	0.3	5.1	6.9
UPPER ETOBICOKE				
Community Area	115.7	540.9	11.5	668.1
Employment Area	18.8	168.0	8.6	195.4
WEST HUMBER				
Community Area	428.1	1169.0	153.9	1750.9
Employment Area	135.0	640.2	103.7	878.8
Grand Total	**769.4**	**2628.2**	**434.5**	**3832.1**

2.3.5.3 SABE Testing Areas

Water Resource System

As noted previously, the SABE testing areas occupy smaller portions of the FSA within the respective subwatersheds. The key hydrologic features and key hydrologic areas mapping has been reviewed in conjunction with the SABE testing areas to determine the size (i.e. area) of the SABE testing areas in each subwatershed which would impact key hydrologic features and areas. This assessment has focused primarily on the areas of the SABE testing areas which would impact the more discrete and local key hydrologic features and areas which are considered ecologically supportive and would require more detailed and specific management recommendations as part of future studies (i.e. significant groundwater recharge areas, ecologically sensitive groundwater recharge areas, seepage areas, springs, and wetlands), recognizing that all of the SABE testing areas lie upstream of regulated watercourses and/or FVAs, and large portions lie in areas with low depth to water table. The locations of key hydrologic features and key hydrologic areas relative to the SABE testing areas are depicted on Drawings WR-4 and WR-5 respectively. The size of the SABE testing areas which would impact these specific key hydrologic features and areas is presented in Table 2.3.5.27, and the proportion (i.e. percentage) of the SABE testing area which would impact these features is summarized in Table 2.3.5.28.

Table 2.3.5.27. Drainage Areas of the SABE Testing Areas Impacting Local Ecologically Supportive Key Hydrologic Features and Areas by Subwatershed (ha)

Watershed	Subwatershed	Preliminary SABE Land Use		Total
		Community	Employment	
Credit River	Credit River – Glen Williams to Norval	-	-	-
	Huttonville Creek	-	-	-
	Fletcher's Creek	-	-	-
Etobicoke Creek	Upper Etobicoke Creek	48.58	136.15	184.74
Humber River	West Humber River	298.52	315.40	613.92
	Main Humber River	138.05	-	138.05

Table 2.3.5.28. Proportion (Percentage) of the SABE Testing Areas Impacting Local Ecologically Supportive Key Hydrologic Features and Areas by Subwatershed (%)

Watershed	Subwatershed	Preliminary SABE Land Use		Total
		Community	Employment	
Credit River	Credit River – Glen Williams to Norval	-	-	-
	Huttonville Creek	-	-	-
	Fletcher's Creek	-	-	-
Etobicoke Creek	Upper Etobicoke Creek	67.9	100	89.0
Humber River	West Humber River	97.9	99.5	98.7
	Main Humber River	99.8	-	99.8

The information in Tables 2.3.5.27 and 2.3.5.28 indicate that the vast majority of the portions of the SABE testing area would affect local and ecologically supportive key hydrologic features. As noted previously, the impacts of the employment land use, if unmitigated, are anticipated to have greater impact compared to community land use conditions (i.e. greater reduction in groundwater recharge, higher rates of runoff, higher rates of erosion and flood potential) due to the higher levels of impervious coverage associated with that land use.

In addition, as noted previously, the SABE testing areas are recognized to lie upstream of regulated watercourses and/or FVAs, and portions of the SABE testing areas are recognized to lie within areas of low depth to groundwater. The impacts of the development of the SABE testing areas to the above key hydrologic features and key hydrologic areas are to be assessed further as part of future studies.

Natural Heritage System

Natural Cover Impacts

The overlay of SABE land-uses and natural cover is shown on figure DA2-1 (Appendix E). The conceptual land-use classifications represent those described in Section 2.2 and shown on Figure 2.2.1.2. As such, the impact assessment focuses on identifying vegetation communities, habitats, and species that are located within areas of proposed change that are outside of the 'FSA Take Outs' (ref. Figure 2.2.1.2). The assessment provides the baseline for identifying additional considerations for protection, impact mitigation, and ecological connectivity as part of a conceptual NHS; these recommendations are provided in Section 2.5.2.1.

SABE Testing Areas would collectively impact 16.5 ha of natural cover in the Main Humber, Upper Etobicoke, and West Humber subwatersheds.

The Community testing scenario contributes to the removal of 6.8 ha of natural cover. Removal of Open/Early Successional cover would be 6.1 ha across all three subwatersheds. Removal of Wetland cover would be 0.4 ha across all three subwatersheds. Removal of Woodland cover would be 0.3 ha in the Main Humber and West Humber subwatersheds.

ELC community series types affected by the Community testing scenario are summarized in Table 2.3.5.30. Open/Early Succession ELC community series types removed include Cultural Meadows (6.1 ha) and Cultural Thicket (<0.1 ha). Cultural Meadow features would be affected across all three subwatersheds, whereas Cultural Thicket would only be affected in the Main Humber subwatershed. Wetland ELC community series removed would include Meadow Marsh (0.4 ha) and Shallow Marsh (<0.1 ha). Meadow March features would be affected across all three subwatersheds, whereas Shallow Marsh would only be affected in the Main Humber subwatershed. Woodland ELC community series removed would include Cultural Woodland (<0.1 ha) and Plantation (0.3 ha). Cultural woodland removal would only occur in the Main Humber subwatershed, and the Plantation removal would only occur in the West Humber subwatershed.

The Employment testing scenario contributes to the removal of 9.0 ha of natural cover. Removal of Aquatic areas would be 0.2 ha in the Upper Etobicoke Subwatershed. Removal of Open/Early Succession would be 7.5 ha, primarily within the West Humber Subwatershed and a smaller area in the Upper Etobicoke Subwatershed. Removal of wetland cover would be relatively low (<0.1 ha), and only occurs in the Upper Etobicoke Subwatershed. Removal of woodland cover would be 1.3 ha, and occur in the Upper Etobicoke and West Humber subwatersheds.

ELC community series types affected by the Employment testing scenario are summarized in Table 2.3.5.31. Aquatic areas include removal of open aquatic features in the Upper Etobicoke subwatershed. Open/Early Successional ELC community series types include Cultural Meadow (7.4 ha) and Cultural Thicket (<0.1 ha). Removal of Cultural Meadow occurs across both subwatersheds, whereas removal of Cultural Thicket would only occur in the Upper Etobicoke subwatershed. Wetland ELC community series type includes Meadow Marsh (<0.1 ha) in the Upper Etobicoke subwatershed. Woodland ELC community series types include Deciduous Forest (0.2 ha), Mixed Forest (0.6 ha), and Plantation (0.5 ha). Removal of Deciduous Forest would only occur in the Upper Etobicoke subwatershed. Removal of Mixed Forest would only occur in the West Humber subwatershed. Removal of plantation would occur in both subwatersheds.

The Community Area with Employment Scenario testing contributes to the removal of 0.6 ha, and would only affect Open/Early Successional cover in the West Humber subwatershed. ELC community series types affected by the Community Area with Employment Scenario Testing includes Cultural Meadow (0.5 ha) and Cultural Thicket (0.1 ha) (Table 2.3.5.32).

Table 2.3.5.29. SABE Testing Area Scenario Impacts to Natural Cover

SABE Testing Area Scenario and Natural Cover Type	Main Humber	Upper Etobicoke	West Humber	Total
Community Scenario Testing				
Open/Early Successional	3.1	0.4	2.7	6.1
Wetland	0.1	0.1	0.3	0.4
Woodland	<0.1		0.3	0.3
Subtotal	**3.2**	**0.4**	**3.2**	**6.8**
Employment Scenario Testing				
Aquatic		0.2		0.2
Open/Early Successional		0.5	6.9	7.5
Wetland		<0.1		<0.1
Woodland		0.4	0.9	1.3
Subtotal		**1.2**	**7.9**	**9.0**
Community Area with Employment Scenario Testing				
Open/Early Successional			0.6	0.6
Subtotal			**0.6**	**0.6**
Total	**3.2**	**1.6**	**11.7**	**16.5**

Table 2.3.5.30. SABE Testing Scenario Community Land-Use Impact ELC Community Series

Natural Cover and ELC Community Series	Main Humber	Upper Etobicoke	West Humber	Total
Open/Early Successional				
Cultural Meadow	3.0	0.4	2.7	6.1
Cultural Thicket	<0.1			<0.1
Wetland				
Meadow Marsh	<0.1	0.1	0.3	0.4
Shallow Marsh	<0.1			<0.1
Woodland				
Cultural Woodland	<0.1			<0.1
Plantation			0.3	0.3
Total	**3.2**	**0.4**	**3.2**	**6.8**

Table 2.3.5.31. SABE Testing Scenario Employment Land-Use Impact to ELC Community Series

Natural Cover And ELC Community Series	UPPER ETOBICOKE	WEST HUMBER	Total
Aquatic			
Open Aquatic	0.2		0.2
Open/Early Successional			
Cultural Meadow	0.5	6.9	7.4
Cultural Thicket	<0.1		<0.1
Wetland			
Meadow Marsh	<0.1		<0.1
Woodland			
Deciduous Forest	0.2		0.2
Mixed Forest		0.6	0.6
Plantation	0.2	0.3	0.5
Total	**1.2**	**7.9**	**9.0**

Table 2.3.5.32. SABE Testing Scenario Community Area with Employment Scenario Land-Use Impact to ELC Community Series

Natural Cover and ELC Community Series	West Humber	Total
Open/Early Successional	0.6	0.6
Cultural Meadow	0.5	0.5
Cultural Thicket	0.1	0.1
Total	**0.6**	**0.6**

Natural System Quality and Function Impacts

The overlay of SABE land-use areas and natural system patches (wetlands, woodlands, and meadows) is shown on figures in DA2-2a-i (Appendix E); as well, the land-use overlay on ELC features based on their conservation rank is shown on figure DA2-4 (Appendix E).

SABE Testing scenario land-use impacts to ELC community series based on conservation ranking are presented in Table 2.3.5.33. None of the ELC community that are impacted by the SABE Testing scenario land-uses are identified as regional conservation concern.

Impacts to wetland, woodland, and meadow patches of different patch quality are summarized for the Community scenario testing in Table 2.3.5.34. Wetland patches impacted are identified as L4-Poor and occur within the Main Humber, Upper Etobicoke, and West Humber subwatersheds. Woodland patches impacted are identified as L3-Fair occurring in the Main Humber subwatershed, and L4-Poor in the West Humber subwatershed. Meadow patches impacted are identified as L4-Poor within all three subwatersheds, and L5-Poor in the Upper Etobicoke subwatershed.

Impacts to wetland, woodland, and meadow patches of different patch quality located within the Upper Etobicoke and West Humber subwatersheds are summarized for the Employment scenario testing in Table 2.3.5.35. Wetland patches impacted are L5-Poor and located in the Upper Etobicoke subwatershed. Woodland patches impacted are L4-Poor and located in both subwatersheds, Meadow patches impacted are identified as L4-Poor in both subwatersheds, and L5-Very Poor in the Upper Etobicoke subwatershed.

Impacts to meadow patches for the Community Area with Employment scenario testing are summarized in Table 2.3.5.36. Meadow patches impacted are identified as L4-Poor and occurring in the West Humber subwatershed.

Table 2.3.5.33. SABE Scenario Testing Land-Use Impacts to ELC community Series Conservation Concern Ranking

Type	LRank	Main Humber	Upper Etobicoke	Grand Total
Community Scenario Testing	L+	2	1	3
Employment Scenario Testing	L+		2	2
	L5		3	3
Total		**2**	**6**	**8**

Table 2.3.5.34: SABE Testing Scenario Community Land-Use Impacts to Vegetation Patches

Patch Type and TRCA L-Rank	Main Humber	Upper Etobicoke	West Humber	Total
Wetland Patches				
L4 - Poor	0.1	0.1	0.3	0.4
Sub-total	**0.1**	**0.1**	**0.3**	**0.4**
Woodland Patches				
L3 - Fair	<0.1			<0.1
L4 - Poor			0.3	0.3
Sub-total	**<0.1**		**0.3**	**0.3**
Meadow Patches				
L4 - Poor	3.0	0.1	2.7	5.8
L5 - Very Poor		0.2		0.2
Sub-total	**3.0**	**0.4**	**2.7**	**6.1**

Table 2.3.5.35. SABE Testing Scenario Employment Land-Use Impacts to Vegetation Patches

Patch Type and TRCA L-Rank	Upper Etobicoke	West Humber	Total
Wetland Patches			
L5 - Very Poor	<0.1		<0.1
Sub-total	**<0.1**		**<0.1**
Woodland Patches			
L4 - Poor	0.4	0.9	1.3
Sub-total	**0.4**	**0.9**	**1.3**
Meadow Patches			
L4 - Poor	0.5	6.9	7.4

Patch Type and TRCA L-Rank	Upper Etobicoke	West Humber	Total
L5 - Very Poor	<0.1		<0.1
Sub-total	**0.5**	**6.9**	**7.4**

Table 2.3.5.36. SABE Testing Scenario Community Area with Employment Scenario Land-Use Impacts to Vegetation Patches

Patch type and TRCA L-Rank	West Humber	Total
Meadow Patches		
L4 - Poor	0.5	0.5
Total	**0.5**	**0.5**

Habitat Connectivity / Linkage Assessment

As outlined in the FSA impact assessment, habitat connectivity across the landscape was assessed using Circuitscape (McRae et al. 2008; McRae and Shah, 2009). Using a qualitative assessment of the analysis output, the SABE Scenario testing land-uses are located predominantly on agricultural table land areas and outside of the main valley systems (Map DA2-3, Appendix E). As the land-use areas are located in areas that currently have relatively low ecological permeability, potential impacts to landscape connectivity would be minimized.

Species Impacts

The overlay of the SABE land-use areas on flora and fauna species occurrences are shown on figures DA2-5a-d (Appendix E). Figures DA2-5a and DA2-5b show flora and fauna records based on TRCA L-Rank. Figure DA2-5d shows records of species at risk. Figure DA2-5d shows records for provincially rare species and species of special concern.

The number of plant and wildlife species records associated with features that would be impacted by the SABE testing scenario areas for Community and Employment land-uses is relatively low. There are no flora records for the features that are within the areas identified for these land-uses. Fauna records included only five species (Table 2.3.5.37). Four species would be impacted by Community scenario testing areas within the Main Humber, Upper Etobicoke, and West Humber subwatersheds.

Consideration should be given to other species of conservation concern that may be present on the landscape but not documented as part of the data set used for the current impact assessment. For example, NHIC records include species at risk that may be impacted by the proposed land-uses, but have not been field confirmed at this stage (see Table 2.3.5.9 for species records).

Table 2.3.5.37. SABE Testing Area Scenario Impacts to Wildlife Species

SABE Testing Scenario	TRCA L-Rank	Common Name	Scientific Name	Main Humber	Upper Etobicoke	West Humber	Total
Community Scenario Testing	L2	Wood Frog	*Lithobates sylvaticus*		1		1
	L3	American Woodcock	*Scolopax minor*	1			1
		Brown Thrasher	*Toxostoma rufum*	1			1
		Horned Lark	*Eremophila alpestris*			2	2
Employment Scenario Testing	L3	Horned Lark	*Eremophila alpestris*			1	1
		Vesper Sparrow	*Pooecetes gramineus*		1		1
				2	2	3	7

Significant Wildlife Habitat

The overlay of the SABE land-use areas on the sum of candidate SWH types within 250m x 250m grids is shown on figure DA2-5e (Appendix E); occurrences of specific SWH types can be reviewed in the Part A Characterization figures DA1-5b(1-18).

Potential impact of the SABE Scenario Testing land-uses to Significant Wildlife Habitat types are summarized for Seasonal Concentration Areas (Table 2.3.5.38), Rare Vegetation Communities and Specialized Habitat for Wildlife (Table 2.3.5.39), and Habitat for Species of Conservation Concern and Movement Corridors (Table 2.3.5.40).

Community and Employment Scenario testing land-uses have the potential to affect a variety of SWH types in the Upper Etobicoke, Main Humber, and West Humber subwatersheds. Among the Seasonal Concentration Area types, Turtle Wintering Areas, Shorebird Migratory Stopover Areas, and Bat Maternity Colonies are the most affected within the three subwatersheds (Table 2.3.5.38). Among the Rare Vegetation Communities and Specialized Habitat for Wildlife types, Amphibian Breeding Habitat and Waterfowl Nesting Areas are generally the most affected within the three subwatersheds (Table 2.3.5.39). Among the Habitat for Species of Conservation Concern and Movement Corridors, Amphibian Movement Corridors, Terrestrial Crayfish habitat, and Marsh Breeding Bird habitat are the most affected, primarily within the three subwatersheds (Table 2.3.5.40).

Additionally, other SWH types that were not mapped for this analysis but may have the potential to be impacted by the SABE scenario testing land-uses include Waterfowl Stopover and Staging Areas (Terrestrial), Reptile Hibernaculum, Old Growth Forests, and habitat for species of Special Concern and Rare Wildlife Species. Habitat for Species of Special Concern and Rare Wildlife Species that may be present based on available data are summarized in the FSA impacts section (Table 2.3.5.9).

Table 2.3.5.38. SABE Scenario Testing impacts to Seasonal Concentration Areas. Values presented are the number of grids of 250 m x 250 m with potential SWH present that overlap with the respective land-use type

Subwatershed	Land-use Type	Waterfowl Stopover and Staging Areas (Aquatic)	Shorebird Migratory Stopover Area	Bat Maternity Colonies	Turtle Wintering Areas	Colonially - Nesting Bird Breeding Habitat (Tree/Shrubs)	Total SWH Grids	Total SWH Types
Main Humber	Community Scenario Testing	3	11	16	25	2	57	5
Upper Etobicoke	Community Scenario Testing	1	11	5	14	1	32	5
	Employment Scenario Testing	2	9	12	14	5	42	5
West Humber	Community Area with Employment Scenario Testing	4	3	3	4	1	15	5
	Community Scenario Testing	1	9	11	17	6	44	5
	Employment Scenario Testing	1	4	12	16	2	35	5

Table 2.3.5.39. SABE Scenario Testing impacts to Rare Vegetation Communities and Specialized Habitat for Wildlife. Values presented are the number of grids of 250 m x 250 m with potential SWH present that overlap with the respective land-use type

Subwatershed	Land-use Type	Savannah	Other Rare Vegetation Communities	Waterfowl Nesting Area	Bald Eagle and Osprey Nesting, Foraging, and Perching Habitat	Turtle Nesting Areas	Seeps and Springs	Amphibian Breeding Habitat (Woodland)	Amphibian Breeding Habitat (Wetlands)	Total SWH Grids	Total SWH Types
Main Humber	Community Scenario Testing		2	22	11	13	10	14	24	96	7
Upper Etobicoke	Community Scenario Testing			5	4	5	4	5	15	38	6
	Employment Scenario Testing		1	3	6	5	6	9	19	49	7
West Humber	Community Area with Employment Scenario Testing			3	3	3	3	3	5	20	6
	Community Scenario Testing	2	3	13	7		9	11	23	68	7
	Employment Scenario Testing	6	2	6	5	3	5	8	15	50	8

Table 2.3.5.40: SABE Scenario Testing impacts to Habitat for Species of Conservation Concern and Movement Corridors. Values presented are the number of grids of 250 m x 250 m with potential SWH present that overlap with the respective land-use type

Subwatershed	Land-use Type	Marsh Breeding Bird Habitat	Open Country Bird Breeding Habitat	Shrub/Early Successional Bird Breeding Habitat	Terrestrial Crayfish	Amphibian Movement Corridors	Total SWH Grids	Total SWH Types
Main Humber	Community Scenario Testing	14	9	4	22	22	71	5
Upper Etobicoke	Community Scenario Testing	11			14	15	40	3
	Employment Scenario Testing	9			14	18	41	3
West Humber	Community Area with Employment Scenario Testing	3			5	5	13	3
	Community Scenario Testing	9			15	22	46	3
	Employment Scenario Testing	4	11		6	14	35	4

Climate Vulnerable Areas

Climate vulnerable areas present within the SABE Scenario testing land-use areas are presented in Table 2.3.5.41 and shown on figure DA2-6 (Appendix E). Of the three vulnerability areas identified (low, medium, and high), removal of high vulnerability areas is assumed to have the potential for exacerbating environmental impacts of future land-use change based on future climate change scenarios. There were no high vulnerability areas associated with the SABE Scenario testing land-use area.

Table 2.3.5.41: TRCA Climate vulnerable areas present within the SABE Scenario Testing land-use areas.

Subwatershed and Land-use area	Low Vulnerability Area (ha)	Moderate Vulnerability Area (ha)	High Vulnerability Area (ha)	Total
Main Humber				
Community Scenario Testing	48.3	90.1	0	138.3
Upper Etobicoke				
Community Scenario Testing		71.5	0	71.5
Employment Scenario Testing		136.2	0	136.2
West Humber				
Community Area with Employment Scenario Testing	27.0	46.6	0	73.6
Community Scenario Testing	192.1	39.3	0	231.5
Employment Scenario Testing	80.0	236.9	0	317.0
Total	**347.4**	**620.6**		**968.0**

2.3.5.4 BRES ROPA 30 Lands and Mayfield West Phase 2 Lands

Water Resource System

The key hydrologic features and key hydrologic areas mapping has been reviewed in conjunction with the BRES ROPA 30 and Mayfield West Phase 2 Lands to determine the size (i.e. area) of the development areas in each subwatershed which would impact key hydrologic features and areas. This assessment has focused primarily on the areas of the BRES ROPA 30 and Mayfield West Phase 2 Development Areas which would impact the more discrete and local key hydrologic features and areas which are considered ecologically supportive and would require more detailed and specific management recommendations as part of future studies (i.e. significant groundwater recharge areas, ecologically sensitive groundwater recharge areas, seepage areas, springs, and wetlands). The locations of key hydrologic features and key hydrologic areas relative to the BRES ROPA 30 and Mayfield West Phase 2 Lands are depicted on Drawings WR-4 and WR-5 respectively. The size of the BRES ROPA 30 and Mayfield West Phase 2 Areas which would impact these specific key hydrologic features and areas is presented in Table 2.3.5.42, and the proportion (i.e. percentage) of the BRES ROPA 30 and Mayfield West Phase 2 Areas which would impact these features is summarized in Table 2.3.5.43.

Table 2.3.5.42. Drainage Areas of the BRES ROPA 30 and Mayfield West Phase 2 Areas Impacting Local Ecologically Supportive Key Hydrologic Features and Areas by Subwatershed (ha)

Watershed	Subwatershed	BRES ROPA 30	Mayfield West Phase 2
Credit River	Credit River – Glen Williams to Norval	-	-
	Huttonville Creek	-	-
	Fletcher's Creek	-	1.59
Etobicoke Creek	Upper Etobicoke Creek	-	50.94
Humber River	West Humber River	200.16	-
	Main Humber River	61.03	-

Table 2.3.5.43. Proportion (Percentage) of the BRES ROPA 30 and Mayfield West Phase 2 Areas Impacting Local Ecologically Supportive Key Hydrologic Features And Areas by Subwatershed (%)

Watershed	Subwatershed	BRES ROPA 30	Mayfield West Phase 2
Credit River	Credit River – Glen Williams to Norval	-	-
	Huttonville Creek	-	-
	Fletcher's Creek	-	3.8
Etobicoke Creek	Upper Etobicoke Creek	-	99.7
Humber River	West Humber River	81.3	-
	Main Humber River	94.4	-

The information in Tables 2.3.5.42 and 2.3.5.43 indicate that the vast majority of the portions of the BRES ROPA 30 lands, as well as the majority of the portions of the Mayfield West Phase 2 Lands within the Upper Etobicoke Creek Subwatershed, would affect local and ecologically supportive key hydrologic features. The results further indicate that the very little of the Mayfield West Phase 2 lands within the Fletcher's Creek Subwatershed would affect local and ecologically supportive key hydrologic features and areas. As noted previously, the planning for the BRES ROPA 30 and Mayfield West Phase 2 Lands is being completed through a separate and parallel process to the current study to establish the preferred SABE concept, hence the detailed impact assessment and management requirements are to be completed and established through that separate parallel process.

Natural Heritage System

Natural Cover

The overlay of SABE land-uses and natural cover is shown on figure DA2-1 (Appendix E). The conceptual land-use classifications represent those described in Section 2.2 and shown on Figure 2.2.1.2. As such, the impact assessment focuses on identifying vegetation communities, habitats, and species that are located within areas of proposed change that are outside of the 'FSA Take Outs' (ref. Figure 2.2.1.2). The assessment provides the baseline for identifying additional considerations for protection, impact mitigation, and ecological connectivity as part of a conceptual NHS; these recommendations are provided in Section 2.5.2.1.

The Land-uses identified as the BRES ROPA 30 Lands, Mayfield West Phase 2 Lands, and the Brampton Airport (identified as Employment land-use) represent areas that are under-going separate planning processes (BRES ROPA 30 lands and Mayfield West Phase 2) and/or not likely to have their zoning revised through this process (i.e., the Brampton Airport lands). Collectively these areas include 10.6 ha of natural cover (Table 2.3.5.44).

Natural cover affected by the approved BRES ROPA 30 lands are situated in the Main Humber subwatershed and would include removal of 4.6 ha of Open/Early Successional cover, and 0.1 ha of wetland cover. ELC community series types affected include Cultural Meadow and Shallow Marsh, respectively (Table 2.3.5.45).

Natural cover affected by the Mayfield West Phase 2 Stage 2 lands are situated within the Upper Etobicoke subwatershed and would include removal of 1.9 ha of Open/Early Successional Cover, and 0.1 ha of wetland cover. ELC community series types affected include Cultural Meadow and Meadow Marsh, respectively (Table 2.3.5.46).

Natural cover present on the Brampton Airport lands that would be affected by land-use change, should it be proposed, are present in the Upper Etobicoke subwatershed and would include removal of 3.9 ha of Open/Early Successional cover, and <0.1 ha of both wetland and woodland cover. Open/Early Successional ELC community series types affected include Cultural Meadow and areas identified as hedgerow (Table D31). Wetland ELC community series types affected include Meadow Marsh (Table 2.3.5.47). Woodland ELC community series types affected include plantation (Table 2.3.5.47).

Table 2.3.5.44. BRES ROPA 30 Lands, Mayfield West Phase 2 Stage 2, and Brampton Airport Impacts to Natural Cover

Land-use Planning Area and Natural Cover Type	Main Humber	Upper Etobicoke	Total
Approved BRES ROPA 30 Lands			
Open/Early Successional	4.6		4.6
Wetland	0.1		0.1
Sub-total	**4.7**		**4.7**
Mayfield West Phase 2 Stage 2			
Open/Early Successional		1.9	1.9
Wetland		0.1	0.1
Sub-total		**2.0**	**2.0**
Employment Area & Brampton Caledon Airport			
Open/Early Successional		3.9	3.9
Wetland		<0.1	<0.1
Woodland		<0.1	<0.1
Sub-total		**3.9**	**3.9**
Total	**4.7**	**5.9**	**10.6**

Table 2.3.5.45. Approved BRES ROPA 30 Lands potential impacts to ELC community Series

Natural Cover type and ELC Community Series	Main Humber	Total
Open/Early Successional	4.6	4.6
Cultural Meadow	4.6	4.6
Wetland	0.1	0.1
Shallow Marsh	0.1	0.1
Total	**4.7**	**4.7**

Table 2.3.5.46. Mayfield West Phase 2 Stage 2 Potential Impacts to ELC community Series

Natural Cover type and ELC Community Series	Upper Etobicoke	Total
Open/Early Successional		
Cultural Meadow	1.9	1.9
Wetland		
Meadow Marsh	0.1	0.1
Total	**2.0**	**2.0**

Table 2.3.5.47. Brampton Airport Lands Potential Impacts to ELC community Series

Natural Cover type and ELC Community Series	Upper Etobicoke	Total
Open/Early Successional		
Cultural Meadow	3.9	3.9
Hedgerow	<0.1	<0.1
Wetland		
Meadow Marsh	<0.1	<0.1
Woodland		
Plantation	<0.1	<0.1
Total	**3.9**	**3.9**

Natural System Quality and Function Impacts

The overlay of SABE land-use areas and natural system patches (wetlands, woodlands, and meadows) is shown on figures in DA2-2a-i (Appendix E); as well, the land-use overlay on ELC features based on their conservation rank is shown on figure DA2-4 (Appendix E).

BRES ROPA 30 Lands, Mayfield West Phase 2 lands, and Brampton Airport lands potential impacts to ELC community series based on conservation ranking are presented in Table 2.3.5.48. None of the ELC community that are impacted by the SABE Testing scenario land-uses are identified as regional conservation concern.

Impacts to wetland, woodland, and meadow patches of different patch quality is summarized for the BRES ROPA 30 lands in Table 2.3.5.48, Mayfield West Phase 2 lands in Table 2.3.5.50, and the Brampton Airport lands in Table 2.3.5.51.

Impacts to natural cover patches in the BRES ROPA 30 lands are restricted to the Main Humber subwatershed. Wetland patches affected are identified as L4-Poor and sum to 0.1 ha. Meadow patches affected are identified as L4-Poor and sum to 4.6 ha.

Impacts to natural cover patches in the Mayfield West Phase 2 lands are restricted to the Upper Etobicoke subwatershed. Wetlands patches affected are identified as L3-Fair and sum to 0.1 ha. Meadow patches affected are identified as L4-Poor and sum to 1.9 ha.

Impacts to natural cover patchers on the Brampton Airport lands, should they be developed, are restricted to the Upper Etobicoke subwatershed (Table 2.3.5.51). Wetlands patches affected are identified as L4-Poor and are less than 0.1 ha. Woodland patches affected are identified as L4-Poor and are less than 0.1 ha. Meadow patches affected are identified as L4-Poor and sum to 3.9 ha.

Table 2.3.5.48. BRES ROPA 30 Lands and Brampton Airport lands potential impacts to ELC community series conservation concern ranking.

Type	LRank	Main Humber	Upper Etobicoke	Grand Total
Approved BRES ROPA 30 Lands	L+	1		1
	L5	1		1
Employment Area & Brampton Caledon Airport	L+		1	1
	L5		3	3
Total		**2**	**4**	**6**

Table 2.3.5.49. BRES ROPA 30 Lands Impact to Vegetation Patches

Patch Type and L-Rank	Main Humber	Total
Wetland Patches		
L4 - Poor	0.1	0.1
Sub-total	0.1	0.1
Meadow Patches		
L4 - Poor	4.6	4.6
Sub-total	4.6	4.6

Table 2.3.5.50. Mayfield West Phase 2 Stage 2 Impacts to Vegetation Patches

Patch Type and L-Rank	Upper Etobicoke Creek	Total
Wetland Patches		
L3 - Fair	0.1	0.1
Sub-total	0.1	0.1
Meadow Patches		
L4 - Poor	1.9	1.9
Sub-total	1.9	1.9

Table 2.3.5.51. Brampton Airport Impacts to Vegetation Patches

Patch Type and L-Rank	Upper Etobicoke Creek	Total
Wetland Patches		
L4 - Poor	<0.1	<0.1
Sub-total	<0.1	<0.1
Woodland Patches		
L4 - Poor	<0.1	<0.1
Sub-total	<0.1	<0.1

Patch Type and L-Rank	Upper Etobicoke Creek	Total
Meadow Patches		
L4 - Poor	3.9	3.9
Sub-total	3.9	3.9

Habitat Connectivity / Linkage Assessment

As outlined in the FSA impact assessment, habitat connectivity across the landscape was assessed using Circuitscape (McRae et al. 2008; McRae and Shah, 2009). Using a qualitative assessment of the analysis output, the BRES ROPA 30 lands, Mayfield West Phase 2, and Brampton Airport lands are located predominantly on agricultural table land areas and outside of the main valley systems (Map DA2-3, Appendix E). As the land-use areas are located in areas that currently have relatively low ecological permeability, potential impacts to landscape connectivity would be minimized.

Species Impacts

The overlay of the SABE land-use areas on flora and fauna species occurrences are shown on figures DA2-5a-d (Appendix E). Figures DA2-5a and DA2-5b show flora and fauna records based on TRCA L-Rank. Figure DA2-5d shows records of species at risk. Figure DA2-5d shows records for provincially rare species and species of special concern.

The number of plant and wildlife species records associated with features that would be impacted by BRES ROPA 30 Lands, Mayfield West Phase 2 lands, and the Brampton Airport lands is very low. There are no flora or fauna records for the BRES ROPA 30 lands, or the Brampton Airport lands. The only plant record for natural areas affected in the Mayfield West Phase 2 lands is Honey Locust (*Gleditsia triacanthos*), which is ranked as a likely horticultural variety (Table 2.3.5.52). The only wildlife record for the Mayfield West Phase 2 lands is Horned Lark, which also has records from within the high constraint natural area take-outs (Table 2.3.5.53). Consideration should be given to other species of conservation concern that may be present on the landscape but not documented as part of the data set used for the current impact assessment. For example, NHIC records include species at risk that may be impacted by the proposed land-uses, but have not been field confirmed at this stage (see Table 2.3.5.9 for species records).

Table 2.3.5.52. Mayfield West Phase 2 Stage 2 Impact to Plant Species (based on available records)

TRCA L-Rank	Common Name	Scientific Name	Fletchers Creek	Total	Within FSA Take out
L+	Honey-locust	*Gleditsia triacanthos*	1	1	N
Total			1	1	

Table 2.3.5.53: Mayfield West Phase 2 Stage 2 Impact to Wildlife Species (based on available records)

TRCA L Rank	Common Name	Scientific Name	Fletchers Creek	Total	Within FSA Take out
L3	Horned Lark	*Eremophila alpestris*	1	1	Y
Total			1	1	

Significant Wildlife Habitat

The overlay of the SABE land-use areas on the sum of candidate SWH types within 250m x 250m grids is shown on figure DA2-5e (Appendix E); occurrences of specific SWH types can be reviewed in the Part A Characterization figures DA1-5b(1-18).

Potential impact of the BRES ROPA 30 Lands, Mayfield West Phase 2 lands, and the Brampton Airport lands to Significant Wildlife Habitat types are summarized for Seasonal Concentration Areas (Table 2.3.5.54), Rare Vegetation Communities and Specialized Habitat for Wildlife (Table 2.3.5.55), and Habitat for Species of Conservation Concern and Movement Corridors (Table 2.3.5.56).

The various land-use areas have the potential to affect a variety of SWH types in the Fletcher's Creek, Main Humber, Upper Etobicoke, and West Humber subwatersheds. Among the Seasonal Concentration Area types, Turtle Wintering Areas and Bat Maternity Colonies are the most affected. Potential impacts to Turtle Wintering Areas mainly occur within the Main Humber, Upper Etobicoke, and West Humber subwatersheds associated with all three land-use areas (Table 2.3.5.54). Potential impacts to Bat Maternity Colonies mainly occur in the Upper Etobicoke subwatershed related to Brampton Airport lands and Mayfield West Phase 2 lands. Among the Rare Vegetation Communities and Specialized Habitat for Wildlife types, Amphibian Breeding Habitat, Waterfowl Nesting Areas, and Seeps and Springs are generally the most affected within the Main Humber, Upper Etobicoke, and West Humber subwatersheds associated with all three land-use areas (Table 2.3.5.55). Among the Habitat for Species of Conservation Concern and Movement Corridors, Amphibian Movement Corridors and Terrestrial Crayfish habitat are the most affected, primarily within the Main Humber, Upper Etobicoke, and West Humber subwatersheds (Table 2.3.5.56).

Additionally, other SWH types that were not be mapped for this analysis may have the potential to be impacted by the BRES ROPA 30 lands, Mayfield West Phase 2 lands, and the Brampton Airport lands include Waterfowl Stopover and Staging Areas (Terrestrial), Reptile Hibernaculum, Old Growth Forests, and habitat for species of Special Concern and Rare Wildlife Species. Habitat for Species of Special Concern and Rare Wildlife Species that may be present based on available data are summarized in the FSA impacts section (Table 2.3.5.9).

Table 2.3.5.54. BRES ROPA 30 Lands, Mayfield West and Brampton Airport Potential Impacts to Seasonal Concentration Areas

Subwatershed	Land-use Type	Waterfowl Stopover and Staging Areas (Aquatic)	Shorebird Migratory Stopover Area	Bat Maternity Colonies	Turtle Wintering Areas	Colonially - Nesting Bird Breeding Habitat (Tree/Shrubs)	Total SWH Grids	Total SWH Types
Fletcher's Creek	Mayfield West Phase 2 Stage 2			5	5	3	13	3
Main Humber	Approved BRES ROPA 30 Lands	6	6	4	12		28	4
Upper Etobicoke	Employment Area & Brampton Caledon Airport	1	3	9	12	5	30	5
	Mayfield West Phase 2 Stage 2	3	7	10	11	5	36	5
West Humber	Approved BRES ROPA 30 Lands	1	6		9		16	3

Table 2.3.5.55. BRES ROPA 30 Lands, Mayfield West, and Brampton Airport potential impacts to Rare Vegetation Communities and Specialized Habitat for Wildlife

Subwatershed	Land-use Type	Savannah	Other Rare Vegetation Communities	Waterfowl Nesting Area	Bald Eagle and Osprey Nesting, Foraging, and Perching Habitat	Turtle Nesting Areas	Seeps and Springs	Amphibian Breeding Habitat (Woodland)	Amphibian Breeding Habitat (Wetlands)	Total SWH Grids	Total SWH Types
Fletcher's Creek	Mayfield West Phase 2 Stage 2			6	5		5	5	5	26	5
Main Humber	Approved BRES ROPA 30 Lands			5	4	8	4	3	11	35	6
Upper Etobicoke	Employment Area & Brampton Caledon Airport				9	5	8	9	12	43	5
	Mayfield West Phase 2 Stage 2			11	9	1	9	9	11	50	6
West Humber	Approved BRES ROPA 30 Lands								8	8	1

Table 2.3.5.56. BRES ROPA 30 Lands, Mayfield West and Brampton Airport potential impacts to Habitat for Species of Conservation Concern and Movement Corridors

Subwatershed	Land-use Type	Marsh Breeding Bird Habitat	Terrestrial Crayfish	Amphibian Movement Corridors	Total SWH Grids	Total SWH Types
Fletcher's Creek	Mayfield West Phase 2 Stage 2	1	3	3	7	3
Main Humber	Approved BRES ROPA 30 Lands	7	11	12	30	3
Upper Etobicoke	Employment Area & Brampton Caledon Airport	3	12	12	27	3
	Mayfield West Phase 2 Stage 2	7	11	11	29	3
West Humber	Approved BRES ROPA 30 Lands	7	7	9	23	3

Climate Vulnerable Areas

Climate vulnerable areas present within the BRES ROPA 30 Lands, Mayfield West Phase 2, and Brampton Airport lands are presented in Table 2.3.5.57 and shown on figure DA2-6 (Appendix E). Of the three vulnerability areas identified (low, medium, and high), removal of high vulnerability areas is assumed to have the potential for exacerbating environmental impacts of future land-use change based on future climate change scenarios. Based on this assumption, the land-uses have potential to impact environmental areas in the Fletcher's Creek, Main Humber, Upper Etobicoke, and West Humber subwatersheds based on the extent of high vulnerability areas affected.

Table 2.3.5.57. TRCA Climate vulnerable areas present within the BRES ROPA 30 Lands, Mayfield West Phase 2, and Brampton Airport lands.

Subwatershed and Land-use area	High Vulnerability area (ha)	Low Vulnerability area (ha)	Moderate Vulnerability area (ha)	Total Area (ha)
FLETCHER'S CREEK				
Mayfield West Phase 2 Stage 2	33.9		7.6	41.5
MAIN HUMBER				
Approved BRES ROPA 30 Lands	4.8	5.5	43.4	53.7
UPPER ETOBICOKE				
Employment Area & Brampton Caledon Airport			63.3	63.3
Mayfield West Phase 2 Stage 2	8.5	0.9	41.7	51.1
WEST HUMBER				
Approved BRES ROPA 30 Lands		0.2	47.4	47.6
Total	**47.3**	**6.6**	**203.3**	**257.2**

2.4 GTA West Impact Assessment

2.4.1 Surface Water Quantity and Groundwater Resources

The GTA West corridor currently is understood to extend along the north limit of the preliminary SABE concept, and extend through the centre of the area. The GTA West lies within the West Humber Subwatershed, the Upper Etobicoke Creek Subwatershed, the Huttonville Creek Subwatershed, and the areas draining directly to the Credit River Main Branch.

Development of the GTA West is anticipated to primarily impact the local hydrology, with relatively limited impacts further downstream along the receiving system. Of particular significance, hydraulic structures (i.e. bridges and culverts) would be required along the GTA West to span regulated watercourses, which would need to be appropriately sized to mitigate hydraulic impacts to upstream properties (i.e. increased water surface elevations). Furthermore, stormwater management will need to be provided for the GTA west, in order to mitigate impacts to flooding and erosion downstream, as well as to address impacts to water budget resulting from the future roadway. Given the shallow water table and potential for upward hydraulic gradients in some areas construction of subsurface infrastructure associated with the GTA West may lead to the interception of shallow groundwater flow and dewatering activities affecting flow to local reaches or wetlands. Groundwater management practices will have to be put in place to address potential ecological impacts related to reductions in functional groundwater discharge. It is understood that the planning for the GTA West corridor is being completed by the Province through a separate, although parallel, process to the Region's planning process to establish the recommended SABE, and that the stormwater and environmental management for the GTA West would be separate from that required for the SABE and other development areas within the FSA.

2.4.2 Aquatic Resources and Water Quality

The development of the GTA West is anticipated to increase contaminant loadings to receiving watercourses, particularly heavy metals, oil and grease. In addition, portions of the GTA West within the West Humber Subwatershed are recognized to lie upstream of Redside Dace habitat, which would affect TSS loading and result in thermal enrichment to the receiving systems.

As previously noted, the planning for the GTA West corridor is being completed by the Province through a separate, although parallel, process to the Region's planning process of to establish the recommended SABE, and that the stormwater and environmental management for the GTA West would be separate from that required for the SABE and other development areas within the FSA.

2.4.3 Stream Morphology, Erosion Hazards and Assessment

A summary of the erosion hazard area and watercourse and HDF lengths within each subwatershed of the GTA West Preferred Route is provided in **Table 2.4.3.1. Table 2.4.3.2** presents a list of watercourses that cross the GTA West footprint from the FSA within each subwatershed and reach descriptions are provided in the text below. Watercourse reaches that intersect but do no cross the GTA West footprint are also presented in **Table 2.4.3.2,** along with the number of intersecting HDFs. It is noted that while the GTA West footprint crosses a portion of the Credit River (Glen Williams To Norval) subwatershed, no HDFs or watercourses intersect the GTA West footprint within the FSA.

It is understood that the characterization and impact assessment of features within the GTA West lands are being evaluated by others through a separate process. Crossing locations associated with the GTA West are not yet known, and therefore impacts to the preliminary SABE concept, SABE Testing Areas and BRES ROPA 30 and Mayfield lands cannot be assessed at this time. However, it is anticipated that, at a minimum, existing channel locations will be maintained at major watercourse crossings. Road crossings within TRCA's and CVC's jurisdictions should follow guidance provided in TRCA's Crossings Guideline for Valley and Stream Corridors (2015) and CVC's Technical Guidelines for Watercourse Crossings (2019), respectively.

Table 2.4.3.1. Summary of Watercourses and HDFs within the GTA West Preferred Route

Subwatershed	Erosion Hazard Area		Watercourse Length	HDF Length[1]	Potential HDF Length[2]
	ha	% Area	(km)	(km)	(km)
West Humber	38.8	7.08	3.8	3.1	0.7
Etobicoke Creek	25.2	4.60	4.3	1.3	0.2

[1]HDFs identified during desk study
[2]Potential HDFs modeled in ArcHydro based on a minimum 25 ha drainage area.

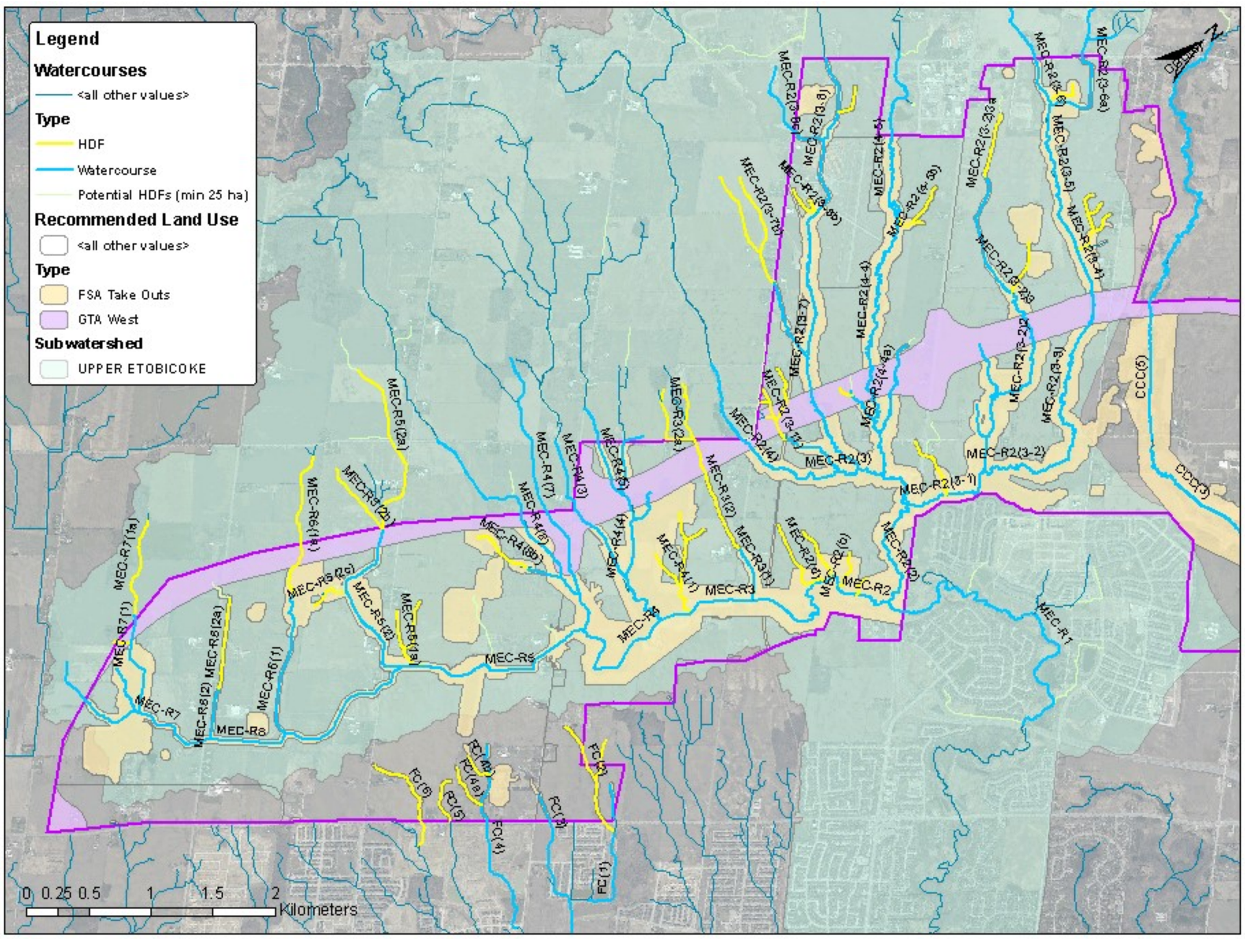
Table 2.4.3.2. Summary of Watercourses Crossings within the GTA West Preferred Route

Subwatershed	No. Watercourse Crossings	Intersecting Watercourses	No. Intersecting HDFs[1]
West Humber	9	WHT1(5)1-1 SC(4)1-1	14
Etobicoke Creek	12	MEC-R2(3-2)1b MEC-R2(4-4b) MEC-R4(6)	10

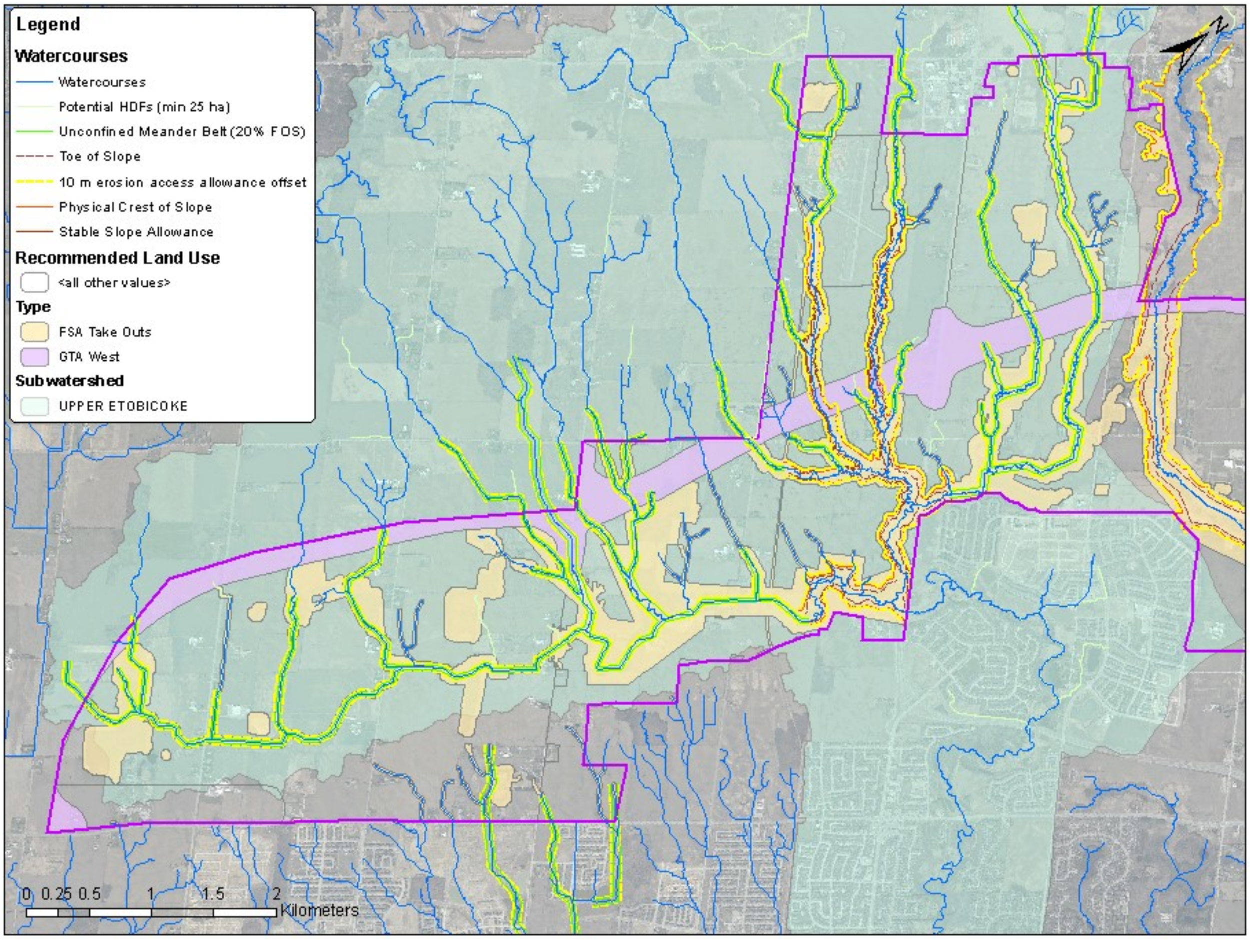
[1]HDFs identified during desktop study. Excludes Potential HDFs identified by ArcHydro.

Etobicoke Creek Subwatershed

Figures 2.4.3.1 and 2.4.3.2 present the reach mapping and erosion hazard limits within the portions of the GTA West Preferred Route in the FSA that are found in the Etobicoke Creek subwatershed.



Figures 2.4.3.1. Watercourse and HDF reaches within the GTA West Preferred Route inside the FSA, Etobicoke Creek



Figures 2.4.3.2. Erosion hazard limits within the GTA West Preferred Route inside the FSA, Etobicoke Creek

An erosion site is located immediately downstream of the preferred GTA West footprint on reach MEC-R2(4) (refer to Map SM3, Appendix G). Erosion sites are also located downstream of the preferred GTA West footprint on tributary MEC-R5(2) within the subwatershed. It is understood that the future works along the GTA West roadway will manage potential risk of erosion to downstream features.

The total length of mapped watercourses, HDFs and Potential HDFs in the Etobicoke Creek subwatershed within the preferred GTA West footprint are 4.3 km, 1.3 km and 0.2 km, respectively. The area occupied by erosion hazard lands is 25.2 ha which correspond to 4.60% of the preferred GTA West footprint. Refer to Table 2.4.3.1. Note that additional HDFs were identified as part of the Etobicoke Creek Watershed Plan (ECWP) prepared for TRCA in 2020. Appendix C2 presents the HDFs mapped within the ECWP.

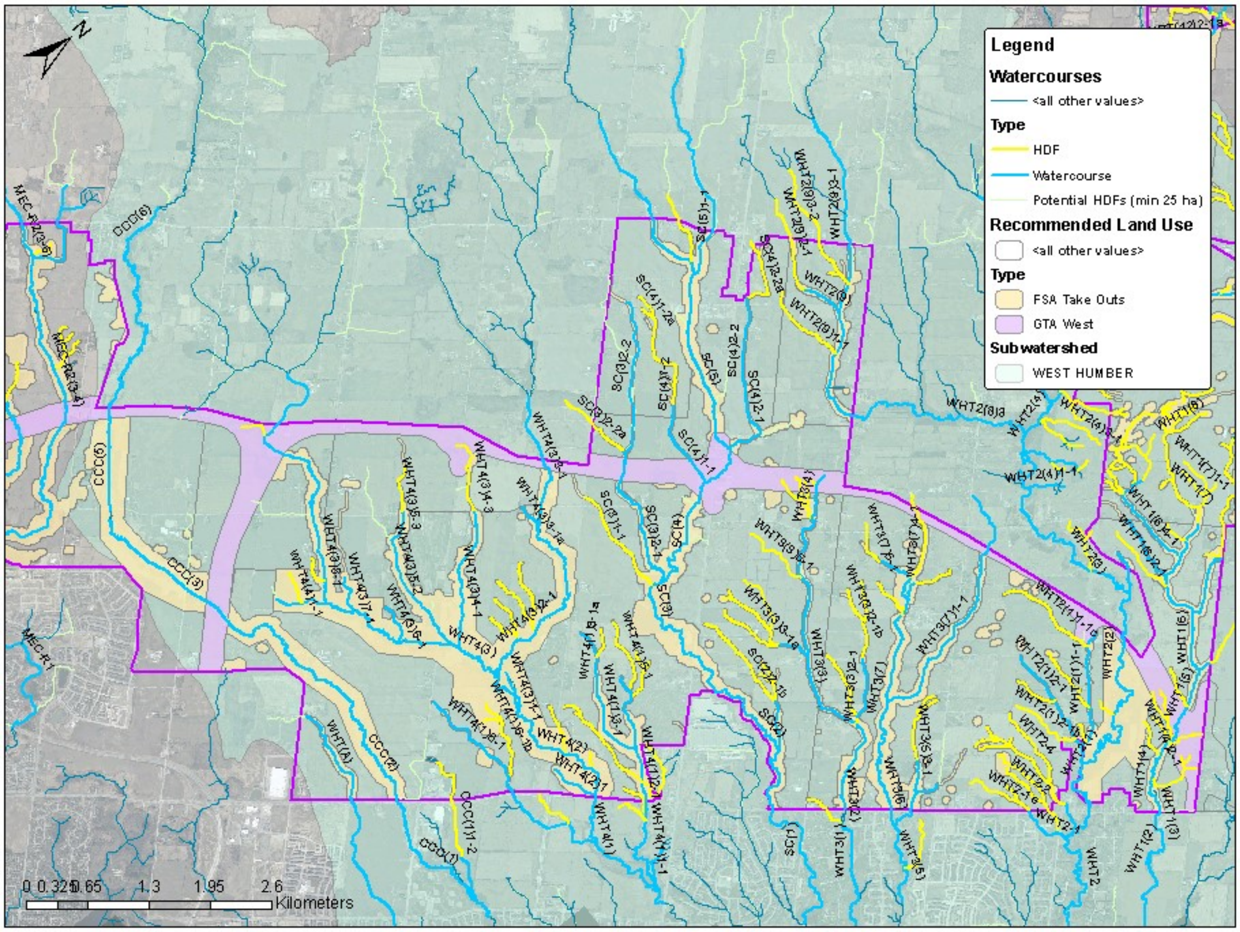
Reaches crossings the GTA West preferred route footprint (East to West):

- MEC-R2(3-4). Geomorphic constraint: Medium. Notes: channel more straightened and not actively meandering, some confinement.
- MEC-R2(3-2)2. Geomorphic constraint: High. Notes: Very sinuous, in forested area, confined.
- MEC-R2(4-4a). Geomorphic constraint: Medium. Notes: moderate sinuosity, not confined, originates in farm field.
- MEC-R2(4-4). Geomorphic constraint: High. Notes: Sinuous channel within forest and valley.

- MEC-R2(3-7). Geomorphic constraint: High. Notes: within confined system, reach has been straightened.
- MEC-R2(4). Geomorphic constraint: Medium. Notes: Downstream incising at culvert, minor sinuosity, bordered by trees.
- MEC-R4(5). Geomorphic constraint: Low. Notes: road cracking over culvert, abundant instream vegetation, standing water, downstream culvert entrance blocked by vegetation.
    - Additional notes: Reach MEC-R4(6) branches off Reach MEC-R4(5) below GTA West footprint. Geomorphic constraint: Low. Notes: road cracking over culvert, instream vegetation us and ds, difficult to see channel definition.
- MEC-R4(3). Geomorphic constraint: Medium. Notes: road closed, could not access.
- MEC-R4(7). Geomorphic constraint: Low. Notes: in farm field, defined, road closed could not access.
- MEC-R5(2). Geomorphic constraint: Medium. Note: straightened along road, erosion on right bank, some rounded stone placed on bank, debris jam downstream of skewed CSP.
    - Additional notes: Classified as HDF in upstream half of GTA West footprint. Additional HDF joins reach below GTA West footprint.
- MEC-R7(1). Geomorphic constraint: Low. Notes: appears straightened.
    - Additional notes: Classified as HDF in upstream half of GTA West footprint. Additional HDF joins reach below GTA West footprint.
- MEC-R7. Geomorphic constraint: Medium. Notes: erosion left bank at culvert, no armouring, standing water with algae, bank height vertical 1 m.

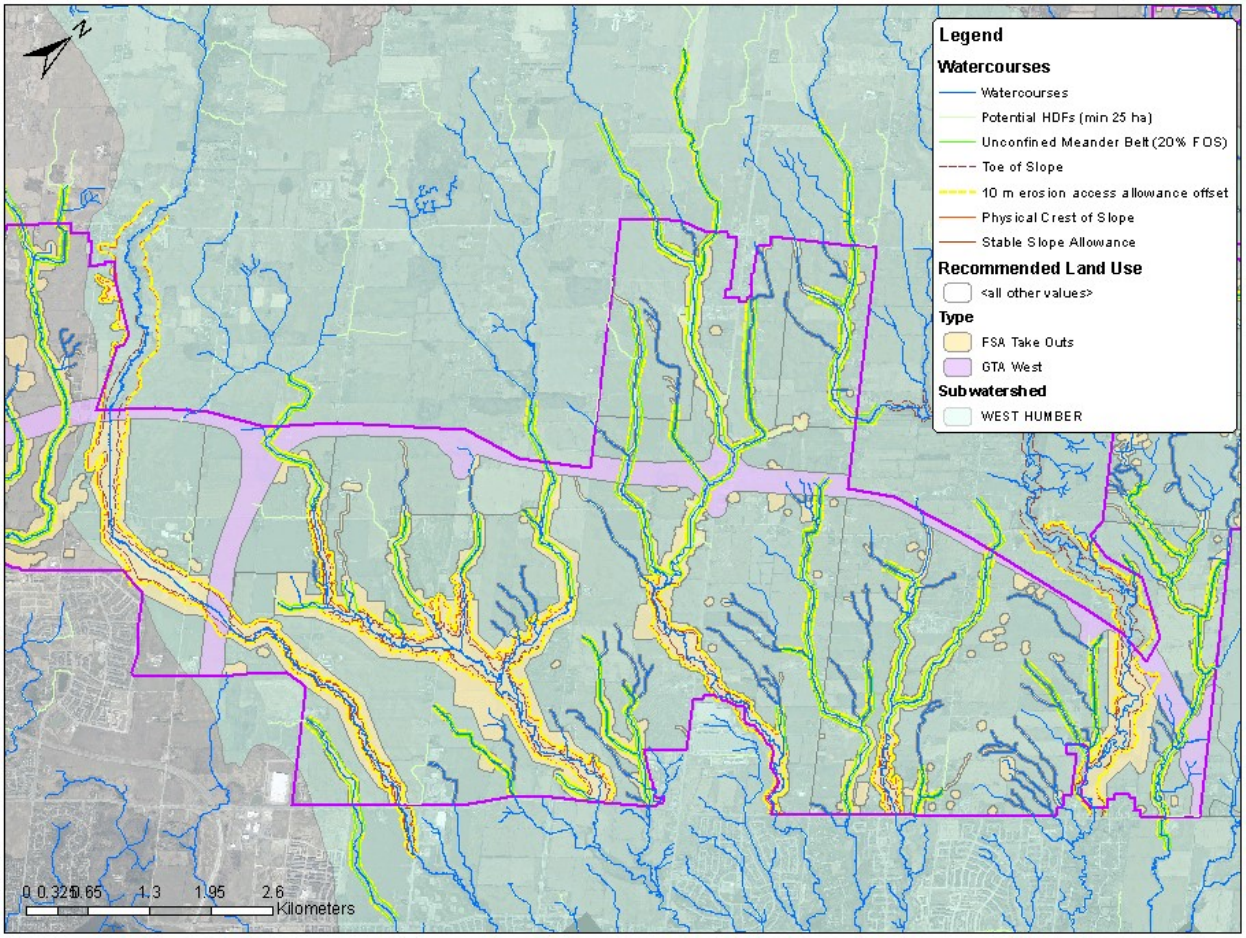
West Humber River Subwatershed

Figures 2.4.3.2 and 2.4.3.3 present the reach mapping and erosion hazard limits within the portions of the GTA West Preferred Route in the FSA that are found in the West Humber River subwatershed.



Figures 2.4.3.3. Watercourse and HDF reaches within the GTA West Preferred Route inside the FSA, West Humber River

wood.



Figures 2.4.3.4. Erosion hazard limits within the GTA West Preferred Route inside the FSA, West Humber River

Two erosion sites are located within the GTA West footprint on reach WHT2(2) (refer to Map SM3, Appendix G). Erosion sites are also located downstream of the GTA West footprint on four other tributaries within the subwatershed (WHT3(4), SC(3)2-1, SC(4), and CCC(5)). It is understood that future works along the GTA West roadway will manage potential risk of erosion to downstream features.

The total length of mapped watercourses, HDFs and Potential HDFs in the Etobicoke Creek subwatershed within the preferred GTA West footprint are 3.8 km, 3.1 km and 0.7 km, respectively. The area occupied by erosion hazard lands is 38.8 ha which correspond to 7.08% of the preferred GTA West footprint. Refer to Table 2.4.3.1.

Reaches crossings the GTA West preferred route footprint (East to West):

- WHT1(5) & WHT1(4). Geomorphic constraint: Medium. Notes: cattails, dry, channel poorly defined
- WHT2(2): Geomorphic constraint High. Notes: within valley, widening at crossing, banks well vegetated.
- WHT3(7)1-1. Geomorphic constraint: Low. Notes: north side poorly defined grass lined channel; south side ditch along road, fence crosses watercourse and flows around a fill pile.
- WHT3(4). Geomorphic constraint: Medium. Notes: Ditch incising along road, standing water, abundant in channel vegetation
- SC(3)2-2. Geomorphic constraint: Medium. Notes: erosion occurring near driveway, frogs present.

- WHT4(3)8-1. Geomorphic constraint: Medium. Notes: Dixie Rd crossing concrete box culvert, frogs present, left bank has armourstone, coarse platy bed, algae in standing water; downstream less defined, more vegetation in channel, soft substrate; Old School Rd Crossing upstream large boulders place on prop.
- SC(4) & SC(5). Geomorphic constraint High. Notes: erosion at Old School Rd crossing at culvert, culvert cracking, frogs present, abundant grass in channel; Airport Rd crossing, new gabions next to culvert, channel choked with vegetation, banks vertical, soft substrate.
    - Additional Notes; SC(4)1-1 branches off of SC(4) under GTA West footprint. SC(4)1-1 geomorphic constraint: Low. Notes: Not visible from road, channel appears straightened.
- WHT4(3)3-1. Geomorphic constraint: Medium. Notes: upstream fish present, concrete box culvert, banks vertical but well vegetated; downstream culvert cracking, banks well vegetated.
- CCC(5). Geomorphic constraint High. Notes: upstream minimal flow, channel 2 to 3 m, concrete box culvert, some erosion at sides of culvert, cattails further upstream; downstream channel wider 4 to 5 m, banks well vegetated, standing water.

2.4.4 Natural Heritage System

Natural Cover Impacts

The overlay of the GTA West alignment and natural cover is shown on figure DA2-1 (Appendix E). The conceptual land-use classifications represent those described in Section 2.2 and shown on Figure 2.2.1.2. As such, the impact assessment focuses on identifying vegetation communities, habitats, and species that are located within areas of proposed change that are outside of the 'FSA Take Outs' (ref. Figure 2.2.1.2). The assessment provides the baseline for identifying additional considerations for protection, impact mitigation, and ecological connectivity as part of a conceptual NHS; these recommendations are provided in Section 2.5.2.1.

The GTA West Corridor would result in a total of reduction of 75.5 ha of natural cover within the general SABE area (i.e., the FSA) within the Upper Etobicoke (26.6 ha) and West Humber (48.9 ha) subwatersheds (Table 2.4.4.1). Natural cover types affected including aquatic, open/early successional, wetland, wetland/woodland, and woodland features. Open/Early Successional land cover types would experience the largest impact with 38.6 ha being removed, followed by Woodland (23.1 ha), Wetland (7.7 ha), Wetland/Woodland (5.6 ha), and Aquatic (0.5 ha).

Table 2.4.4.1. Natural Cover Impacts associated with the draft GTA West Corridor Alignment

Row Labels	Upper Etobicoke	West Humber	Total
Aquatic	0.3	0.2	0.5
Open/Early Successional	7.2	31.5	38.6
Wetland	2.9	4.7	7.7
Wetland/Woodland	1.4	4.2	5.6
Woodland	14.8	8.2	23.1
Total	26.6	48.9	75.5

Impacts to ELC community series types associated with the land cover types impacted by Community land-use is summarized in Table 2.4.4.2. Aquatic areas impacted are restricted to small Open Aquatic features located in both subwatersheds. Open/Early Successional ELC community series types impacted include Cultural Meadows and Cultural Thickets. Of the 34.5 ha of Cultural Meadows impacted, 28.3 ha occur in the

West Humber subwatershed, and the remaining 6.2 ha in the Upper Etobicoke subwatershed. Most of the impact to cultural thickets occur within the West Humber subwatershed (3.2 ha) compared to the Etobicoke Creek subwatershed (0.9 ha). Wetland ELC community series types impacted include Meadow Marsh (6.1 ha), Shallow Marsh (1.0), and Thicket Swamp (0.6 ha). Meadow Marsh impacts were relatively the same across subwatersheds, Shallow Marsh impacts occur primarily in the West Humber subwatershed (1.0 ha), and Thicket Swamp impacts occurred only in the West Humber subwatershed. Wetland/Woodland ELC community series type impacted included Deciduous Swamp. Impacts are higher in the West Humber subwatershed (4.2 ha) compared to the Upper Etobicoke subwatershed (1.4 ha). Woodland ELC community series types impacted included Cultural Savannah, Cultural Woodland, Deciduous Forest, Mixed Forest, and Plantation. Deciduous forests features are the most impacted (16.5 ha), with most occurring in the Upper Etobicoke subwatershed (9.8 ha) and the remaining in the West Humber subwatershed (6.7 ha). Cultural Woodland removal would be 2.1 ha in the Etobicoke Creek subwatershed and 1.1 ha in the West Humber subwatershed. Plantation removal would be 1.7 ha in the Upper Etobicoke subwatershed and 0.1 ha in the West Humber subwatershed. Cultural Savannah removal would be 0.8 ha in the Upper Etobicoke subwatershed and 0.3 ha in the West Humber Subwatershed. Mixed forest removal would only occur in the Upper Etobicoke subwatershed (0.5 ha).

Table 2.4.4.2. Ecological Land Classification Community Series types and land cover impacted by the GTA West Corridor

Row Labels	Upper Etobicoke	West Humber	Total
Aquatic			
Open Aquatic	0.3	0.2	0.5
Open/Early Successional			
Cultural Meadow	6.2	28.3	34.5
Cultural Thicket	0.9	3.2	4.1
Wetland			
Meadow Marsh	2.9	3.2	6.1
Shallow Marsh	<0.1	1.0	1.0
Thicket Swamp		0.6	0.6
Wetland/Woodland			
Deciduous Swamp	1.4	4.2	5.6
Woodland			
Cultural Savannah	0.8	0.3	1.1
Cultural Woodland	2.1	1.1	3.1
Deciduous Forest	9.8	6.7	16.5
Mixed Forest	0.5		0.5
Plantation	1.7	0.1	1.9
Total	26.6	48.9	75.5

Natural System Quality and Function Impacts

The overlay of GTA West corridor and natural system patches (wetlands, woodlands, and meadows) is shown on figures in DA2-2a-i (Appendix E); as well, the land-use overlay on ELC features based on their conservation rank is shown on figure DA2-4 (Appendix E).

The GTA West potential impacts to ELC community series based on conservation ranking are presented in Table 2.4.4.3. The alignment would potentially impact six ELC features that are of reginal conservation concern (L1-L3) and 19 ELC features that are of conservation concern in urban areas (L4). Impacts would be realized in the Upper Etobicoke and West Humber subwatersheds.

Impacts to wetland, woodland, and meadow patches of different patch quality are summarized for the GTA West Corridor in Table 2.4.4.4.

Impacts to wetland patches identified as L4-Poor summed to 13.3 ha, with most affected patch areas in the West Humber subwatershed (9.0 ha), and remaining areas in the Upper Etobicoke subwatershed (4.3 ha).

Impacts to woodland patches identified as L3-Fair summed to 12.6 ha and for L4-Poor summed to 16.1 ha. Impact to both woodland patch groups was slightly higher in the Upper Etobicoke subwatershed, compared to the West Humber subwatershed.

Impacts to Meadow patches identified as L4-Poor summed to 33.8 ha, with the majority of removal occurring in the West Humber subwatershed (28.3 ha). Impacts to Meadow patches identified as L5-Very Poor summed to 0.6 ha and only occurred in the Upper Etobicoke subwatershed.

Table 2.4.4.3. GTA West potential impacts to ELC community series conservation concern ranking

Type	LRank	Upper Etobicoke	West Humber	Grand Total
GTA West	L+	9	4	13
	L2	1		1
	L3	2	3	5
	L4	13	6	19
	L5	15	3	18
Total		**40**	**16**	**56**

Table 2.4.4.4. Natural System Quality and Function of Wetland, Woodland and Meadow Patches associated with the GTA West Corridor Lands

Row Labels	Upper Etobicoke	West Humber	Total
Wetland Patches			
L4 - Poor	4.3	9.0	13.3
Sub-total	4.3	9.0	13.3
Woodland Patches			
L3 - Fair	6.9	5.7	12.6
L4 - Poor	9.3	6.8	16.1
Sub-total	16.2	12.5	28.7
Meadow Patches			
L4 - Poor	5.5	28.3	33.8
L5 - Very Poor	0.7		0.7
Sub-total	6.2	28.3	34.5

Habitat Connectivity / Linkage Assessment

As outlined in the FSA impact assessment, habitat connectivity across the landscape was assessed using Circuitscape (McRae et al. 2008; McRae and Shah, 2009). Using a qualitative assessment of the analysis output, the GTA West alignment would have a significant impact on the ecological connectivity of the landscape. The proposed alignment cross a minimum of 13 locations that have moderate to high ecological permeability (Map DA2-3).

Species Impacts

The overlay of the GTA West corridor on flora and fauna species occurrences are shown on figures DA2-5a-d (Appendix E). Figures DA2-5a and DA2-5b show flora and fauna records based on TRCA L-Rank. Figure DA2-5d shows records of species at risk. Figure DA2-5d shows records for provincially rare species and species of special concern.

The number of plant and wildlife species records associated with features that would be impacted by the GTA West corridor is relatively low as the assessment is restricted to areas where data was available for the scoped SWS based on field investigations undertaken during previous studies.

Based on the data available, removal of vegetation cover for the GTA West corridor overlapped with records for 24 plant species (Table 2.4.4.5). This included 13 species in the Upper Etobicoke subwatershed and 19 species in the West Humber subwatershed. Generally, the species identified represent those of high quality deciduous forest habitats; fifteen of the species are identified as L1 or L3 using TRCA sensitivity ranking, indicating they are typically found in higher quality patches with low disturbance.

Based on available date, removal of vegetation cover for the GTA West corridor overlapped with records for nine wildlife species (Table 2.4.4.6). This included six species in the Upper Etobicoke subwatershed and three species in the West Humber subwatershed. Of the nine species, six are bird species, two are amphibian species, and one is reptile. All were identified as TRCA sensitivity ranks of L2 or L3 which indicates that all species are typically found in high functioning ecological habitats that are sensitive to urbanization. Species represented included those that are a mixed of high quality deciduous forest (e.g., Ovenbird and Wood Thrush), vernal pools (e.g. Spring Peeper and Wood Frog) and successional habitat (e.g. Brown Thrasher and Vesper Sparrow).

Consideration should be given to other species of conservation concern that may be present on the landscape but not documented as part of the data set used for the current impact assessment. For example, NHIC records include species at risk that may be impacted by the proposed land-uses, but have not been field confirmed at this stage (see Table 2.3.5.9 for species records).

Table 2.4.4.5. Plant Species Records associated with the GTA West Corridor

TRCA L Rank	Common_Nam	Scientific	Upper Etobicoke	West Humber	Total
L1	Red pine	*Pinus resinosa*	1		1
L3	Broad-leaved spring beauty	*Claytonia caroliniana*	1	3	4
	Canada yew	*Taxus canadensis*	1	1	2
	Cut-leaved toothwort	*Cardamine concatenata*	1	1	2
	Dutchman's breeches	*Dicentra cucullaria*		1	1
	Foxtail wood sedge	*Carex alopecoidea*	1	1	2

TRCA L Rank	Common_Nam	Scientific	Upper Etobicoke	West Humber	Total
	Gray's sedge	*Carex grayi*	1		1
	Large-flowered bellwort	*Uvularia grandiflora*		3	3
	Narrow-leaved spring beauty	*Claytonia virginica*		1	1
	Purple-tinged sedge	*Carex woodii*		2	2
	Running strawberry-bush	*Euonymus obovatus*	2	4	6
	Shagbark hickory	*Carya ovata*	2	2	4
	Sharp-lobed hepatica	*Hepatica acutiloba*		4	4
	Spreading wood sedge	*Carex laxiculmis var. laxiculmis*	1		1
	Wood-anemone	*Anemone quinquefolia var. quinquefolia*		4	4
L4	Barren strawberry	*Geum fragarioides*		1	1
	Crested wood fern	*Dryopteris cristata*		1	1
	Downy Solomon's seal	*Polygonatum pubescens*		1	1
	Le Conte's violet	*Viola affinis*		1	1
	Michigan lily	*Lilium michiganense*	2	2	4
	Red trillium	*Trillium erectum*	2	1	3
	White trillium	*Trillium grandiflorum*	3		3
	Wild leek	*Allium tricoccum*	4		4
	Woolly bulrush	*Scirpus cyperinus*		1	1
			22	35	57

Table 2.4.4.6. Wildlife Species Records associated with the GTA West Corridor

TRCA L Rank	CommonName	ScientificName	Upper Etobicoke	West Humber	Total
L2	Ovenbird	*Seiurus aurocapilla*	1		1
	Spring Peeper	*Pseudacris crucifer*		1	1
	Wood Frog	*Lithobates sylvaticus*		1	1
L3	Black-billed Cuckoo	*Coccyzus erythropthalmus*	1		1
	Brown Thrasher	*Toxostoma rufum*		1	1
	Mourning Warbler	*Geothlypis philadelphia*	2		2
	Vesper Sparrow	*Pooecetes gramineus*	1		1
	Wood Thrush	*Hylocichla mustelina*	1		1
	Northern Red-bellied Snake	*Storeria o. occipitomaculata*	1		1
			7	3	10

Significant Wildlife Habitat Impacts

The overlay of the GTA West Corridor on the sum of candidate SWH types within 250m x 250m grids is shown on figure DA2-5e (Appendix E); occurrences of specific SWH types can be reviewed in the Part A Characterization figures DA1-5b(1-18).

Potential impact of the GTA West Corridor to Significant Wildlife Habitat types are summarized for Seasonal Concentration Areas (Table 2.4.4.7), Rare Vegetation Communities and Specialized Habitat for Wildlife (Table 2.4.4.8), and Habitat for Species of Conservation Concern and Movement Corridors (Table 2.4.4.9).

The GTA West corridor is proposed within the Credit River – Glen Williams to Norval, Huttonville Creek, Upper Etobicoke, and West Humber subwatersheds and has the potential to impact various SWH types. Among the Seasonal Concentration Area types, Turtle Wintering Areas, Shorebird Migratory Stopover Areas, and Bat Maternity Colonies are the most affected within the West Humber and Upper Etobicoke subwatersheds (Table 2.4.4.7). Among the Rare Vegetation Communities and Specialized Habitat for Wildlife types, Amphibian Breeding Habitats, Seeps and Springs, Bald Eagle and Osprey habitat, and Waterfowl Nesting Areas are generally the most affected, occurring predominantly within the West Humber and Upper Etobicoke subwatersheds (Table 2.4.4.2). Among the Habitat for Species of Conservation Concern and Movement Corridors, Amphibian Movement Corridors, Terrestrial Crayfish habitat, and Marsh Breeding Bird habitat are the most affected, and occur within the West Humber and Upper Etobicoke subwatersheds (Table 2.3.5.25).

Additionally, other SWH types that were not mapped for this analysis but may have the potential to be impacted by the GTA West corridor include Waterfowl Stopover and Staging Areas (Terrestrial), Reptile Hibernaculum, Old Growth Forests, and habitat for species of Special Concern and Rare Wildlife Species. Habitat for Species of Special Concern and Rare Wildlife Species that may be present based on available data are summarized in the FSA impacts section (Table 2.3.5.9).

Table 2.4.4.7: Seasonal Concentration Areas impacted by the proposed GTA West alignment. Values presented are the number of grids of 250 m x 250 m with potential SWH present that overlap with the respective land-use type

Subwatershed	Waterfowl Stopover and Staging Areas (Aquatic)	Shorebird Migratory Stopover Area	Bat Maternity Colonies	Turtle Wintering Areas	Colonially - Nesting Bird Breeding Habitat (Tree/Shrubs)	Total SWH Grids	Total SWH Types
Credit River - Glen Williams To Norval			**1**			1	1
Huttonville Creek						0	0
Upper Etobicoke	**5**	**20**	**30**	**35**	**13**	103	5
West Humber	**13**	**24**	**24**	**48**	**12**	121	5

Table 2.4.4.8. Rare Vegetation Communities and Specialized Habitat for Wildlife impacted by the proposed GTA West alignment. Values presented are the number of grids of 250 m x 250 m with potential SWH present that overlap with the respective land-use type.

Subwatershed	Savannah	Other Rare Vegetation Communities	Waterfowl Nesting Area	Bald Eagle and Osprey Nesting, Foraging, and Perching Habitat	Turtle Nesting Areas	Seeps and Springs	Amphibian Breeding Habitat (Woodland)	Amphibian Breeding Habitat (Wetlands)	Total SWH Grids	Total SWH Types
Credit River - Glen Williams To Norval		**1**	**1**	**1**			**1**		4	4
Huttonville Creek									0	0
Upper Etobicoke		**7**	**26**	**30**	**10**	**24**	**24**	**36**	157	7
West Humber	**4**	**4**	**26**	**4**	**13**	**8**	**17**	**47**	123	8

Table 2.4.4.9 Habitat for Species of Conservation Concern and Movement Corridors impacted by the proposed GTA West alignment. Values presented are the number of grids of 250 m x 250 m with potential SWH present that overlap with the respective land-use type.

Subwatershed	Marsh Breeding Bird Habitat	Open Country Bird Breeding Habitat	Shrub/Early Successional Bird Breeding Habitat	Terrestrial Crayfish	Amphibian Movement Corridors	Total SWH Grids	Total SWH Types
Credit River - Glen Williams To Norval						0	0
Huttonville Creek						0	0
Upper Etobicoke	**22**			**32**	**32**	86	3
West Humber	**24**	**12**	**2**	**40**	**48**	126	5
Grand Total	**46**	**12**	**2**	**72**	**80**	212	5

2.4.5 Geotechnical and Slope Stability

All watercourse slopes adjacent to the GTA west corridor were identified as 'low' or 'slight' risk of instability. For the 'low' risk areas, the physical top of slope is likely the stable top of slope. The 'slight' risk areas may require an additional setback from the physical top of slope of up to the slope height to obtain the stable top of slope. These findings are to be confirmed by other studies completed in support of the GTA west corridor.

2.5 Staff Recommended SABE

2.5.1 Summary of Land Use Refinements

As noted in Section 2.2, the boundary and land use composition of the SABE has been established through an iterative and collaborative process. The Staff Recommended SABE, which represents the latest version of the land use plan for the boundary expansion, has built upon the findings from the previous preliminary concepts and options advanced through the planning process.

The limits and land use conposition for the Staff Recommended SABE has been comapred against the limits of the Preliminary SABE Concept and SABE Testing Areas previously evaluated, to identify the locations where development had been added/removed, and where the form of development (i.e. community/employment) had been revised. The locations with differences in development are presented in Figure 2.5.1.1, and details regarding the differences are summarized in Table 2.5.1.1.

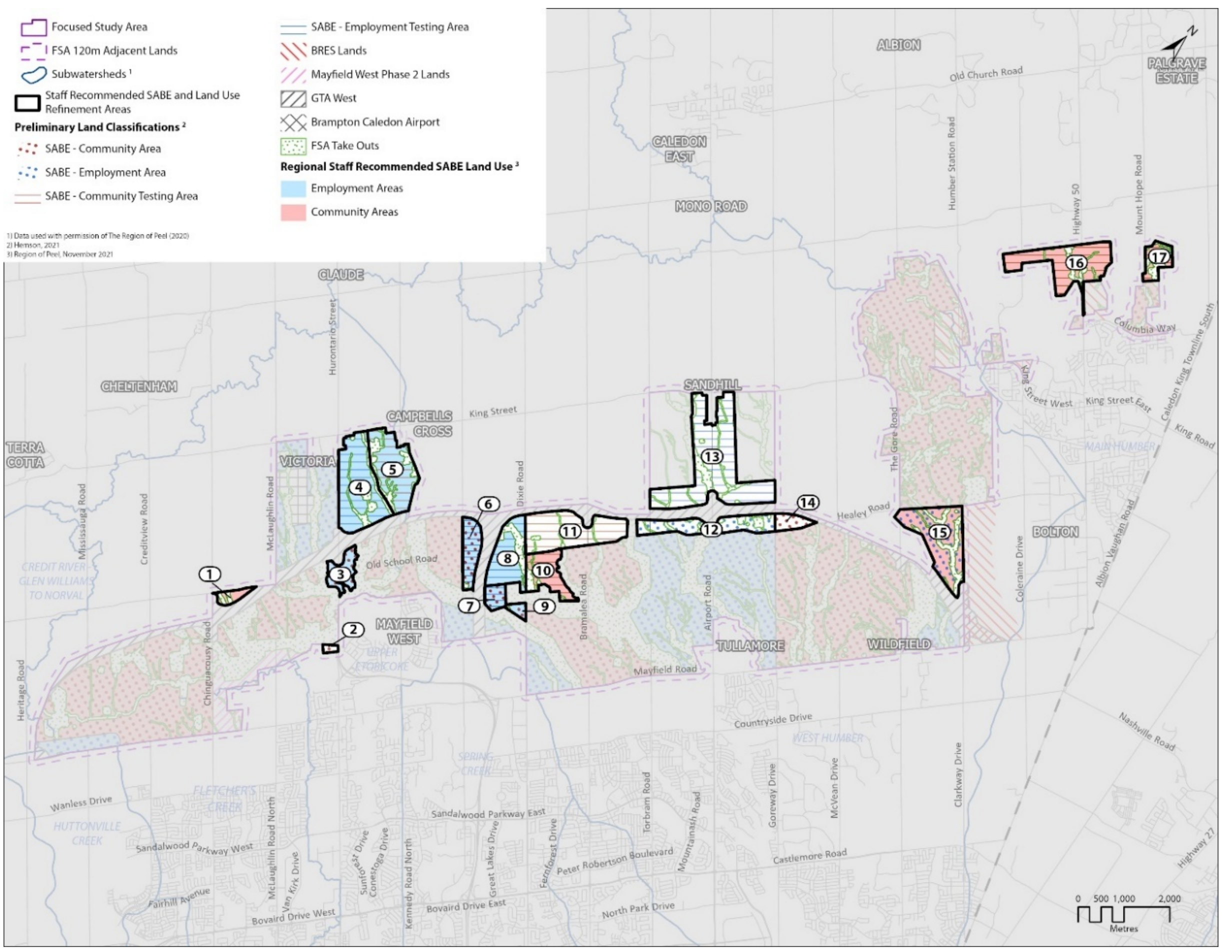


Figure 2.5.1.1. Regional Staff Recommended SABE and Land Use Refinement Areas

Table 2.5.1.1. Details Regarding Land Use Refinement Areas for Staff Recommended SABE

Refinement Area ID	Original SABE Classification	Staff Recommended SABE Classification	Area Changed (ha)*
1	Outside of SABE	Community Area	11.70
2	Community Area	Outside of SABE	5.40
3	Community Area	Employment Area	39.85
4	Employment Scenario Testing	Employment Area	135.86
5	Community Scenario Testing	Employment Area	98.56
6	Community Area and Employment Scenario Testing	Employment Area	50.95
7	Community Area and Employment Scenario Testing	Employment Area	22.27
8	Employment Scenario Testing	Employment Area	78.82
9	Community Area	Employment Area	9.82
10	Community Scenario Testing	Community Area	58.35
11	Community Scenario Testing	Outside of SABE	143.01
12	Employment Area	Outside of SABE	70.95
13	Employment Scenario Testing	Outside of SABE	240.18
14	Community Area	Outside of SABE	23.42
15	Employment Area	Community Area	110.87
16	Community Scenario Testing	Community Area	121.38
17	Community Scenario Testing	Community Area	21.08

*This is specifically the area of land use that has changed within the polygon (does not include the FSA take outs area as they remain the same)

The information in Table 2.5.1.1 indicates that the boundary of the Staff Recommended SABE has included a 11.7 ha parcel (ref. Refinement Area 1) which was not previously included in either the Preliminary SABE Concept or the SABE Testing Areas. Nevertheless, it is noted that this area was included within the limits of the FSA, hence has been considered in the impact assessment presented above.

The information in Table 2.5.1.1 further notes that five (5) areas which were previously included in either the Preliminary SABE Concept and/or the SABE Testing Areas (ref. Refinement Areas 2, 11, 12, 13, and 14) have been removed from the boundary of the Staff Recommended SABE. The removal of these areas represents a 482.96 ha reduction to the total area of the SABE compared to that presented in the previous impact assessments.

The above information indicates that the Staff Recommended SABE has retained 514.05 ha of the SABE Testing Areas into the boundary expansion area (ref. Refinement Areas 4, 5, 8, 10, 16 and 17), and has modified the land use for 233.76 ha (ref. Refinement Areas 3, 6, 7, 9 and 15) compared to that previously presented in the Preliminary SABE Concept.

Lastly, it is noteworthy that all differences between the Staff Recommended SABE and the preliminary SABE concept lie within the Humber River Watershed and the Etobicoke Creek Subwatershed. As such, the impacts previously presented for the portions of the preliminary SABE concept within CVC jurisdiction (i.e. the Fletcher's Creek Subwatershed, the Huttonville Creek Subwatershed, and the Main Credit River Glen Williams to Norval) apply to the Staff Recommended SABE.

The following sections provide an overview of the impacts associated with the above refinements to the Staff Recommended SABE.

2.5.2 Surface Water Quantity and Groundwater Resources

As indicated in the preceding section, the Region's Planning Consulting Team led by Hemson has developed a Staff Recommended SABE, building upon the preliminary SABE concept and SABE testing areas, and the associated impact assessment completed. The extent of the Staff Reccommended SABE lies within the limits of the preliminary SABE concept and the SABE testing areas. Consequently, the Staff Recommended SABE extends across the headwaters of the Upper Etobicoke Creek Subwatershed, West Humber River Subwatershed and the Main Humber Subwatershed within TRCA jurisdiction. On the west side, the preliminary SABE concept falls within the headwater reaches of the Credit River Watershed, encompassing the upstream limits of three (3) subwatersheds, namely the Credit River (Glen Williams to Norval) Subwatershed, Huttonville Creek Subwatershed and Fletcher's Creek Subwatershed. The proportion of employment and community land uses within the Staff Recommended SABE are likewise comparable to the proportions presented for the preliminary SABE concept, whereby the majority of the Staff Recommended SABE would be comprised of community land use, and would lie within the West Humber and Upper Etobicoke Creek Subwatersheds. Consistent with the previous impact assessments completed for the preliminary SABE concept and the SABE testing areas, the community land use for the Staff Recommended SABE is currently estimated to represent an imperviousness of 70%, and the employment land uses would represent an imperviousness of 90% under future conditions.

As noted previously, the conversion of rural lands to community land use conditions, without stormwater management, is recognized to reduce the amount of rainfall which infiltrates into the ground, increasing the volume of surface runoff generated from storm and snowmelt events, as well as the rate at which runoff is conveyed toward receiving systems. Runoff from community land uses is recognized to generally increase the concentration and mass loadings of heavy metals and certain phosphorus-based chemicals, as well as certain anions, particularly chlorides from road salts during winter maintenance, and increased temperature in surface runoff. The higher impervious coverage resulting from the conversion of rural lands to employment land use conditions, in the absence of stormwater management, is generally recognized to provide a greater risk of flooding and erosion along watercourses and drainage systems proximate to the new urban area, as well as a deterioration to the water quality and associated ecology within the receiving systems. These changes to runoff volume, rate, and water quality resulting from development of employment land uses, may likewise translate to an increased risk of flooding and erosion at a broader subwatershed or watershed scale within the receiving system, and similar deterioration to the surface water quality.

Main Humber Subwatershed

Flood Risk (on-site/off-site):

Similar to the findings for the preliminary SABE concept, the portion of the Staff Recommended SABE within the Main Humber Subwatershed is relatively small in size, and likewise represents a small proportion of the total subwatershed area (i.e. 1.0 %). The Staff Recommended SABE within the Main Humber Subwatershed consists entirely of community land use, with no employment land use. The portions of the Staff Recommended SABE within the subwatershed drain toward the major confined watercourses via a series of headwater drainage features, hence there is currently no formal flood hazard delineated within the designated Staff Recommended SABE within the main Humber Subwatershed. Although these portions of the Staff Recommended SABE lie upstream of designated FVAs within the Humber River Watershed, it is anticipated that development of these lands would have a negligible impact to off-site/downstream flood risk due to the small proportion of these areas relative to the total contributing drainage areas to the FVAs. Moreover, as the lands drain directly toward the well-defined and regulated watercourse systems, it is anticipated that development of these lands would not represent a local flood risk, provided that the current discharge locations are retained and utilized post-development. As such, it is anticiapted that stormwater management for quantity controls, if required for these areas, would not require over-control of peak flows for flood protection of downstream properties (i.e. post-to-pre control anticipated to be sufficient). Furthermore, quantity controls for the Regional (Hurricane Hazel) Storm event may not be required for these areas, however this would be subject to inputs from relevant agencies and confirmation as part of future detailed studies (local SWS).

Erosion Risk:

The erosion assessment completed for the Part A report indicated that no erosion sensitive sites are currently located proximate to the Staff Recommended SABE in the Main Humber Subwatershed. While it is anticipated that development of the Staff Recommended SABE within the Main Humber Subwatershed would increase erosion potential along the receiving watercourses, it is anticipated that any potential erosion impacts may be mitigated through conventional practices (i.e. extended-detention storage within end-of-pipe facilities with drawdown times less than 5 days, implementation of Low Impact Development (LID) infiltration-based Best Management Practices (BMPs).

Water Budget:

The key hydrologic features and key hydrologic areas within, and proximate to, the Staff Recommended SABE within the Main Humber Subwatershed include several ecologically significant groundwater recharge areas (ESGRAs), and some areas with low depth to water table. As such, development of the Staff Recommended SABE within the Main Humber Subwatershed would, without mitigation, be expected to reduce groundwater contributions to these areas.

West Humber Subwatershed

Flood Risk (on-site/off-site):

The portion of the Staff Recommended SAB within the West Humber Subwatershed is relatively large in size, and represents a sizeable proportion of the total subwatershed area (i.e. 13 % +/-). The majority of the Staff Recommended SABE within the West Humber Watershed comprises community land use, with the remainder consisting of employment land use. The portions of the Staff Recommended SABE within the subwatershed drain toward the major confined watercourses, as well as various unconfined watercourses, hence some of the contributing areas have a regulated flood hazard associated with the drainage features through the site, as well as through downstream properties. Moreover, as portions of the lands drain directly toward the unconfined watercourses and drainage features offsite, it is anticipated that development of these lands, in the absence of stormwater management, would increase peak flows offsite, thus presenting a local flood risk to adjacent properties; this is particularly anticipated to be the the case for the designated employments lands due to the higher impervious coverange associated with that development. It is anticipated that stormwater management for quantity controls would be required to control post-development flows to pre-development levels for all events including the Regional Storm event, in order to mitigate both local and subwatershed-scale flood risks. As the Staff Recommended SABE is located toward the headwaters, it is anticipated that a uniform application of post-to-pre control or a combination of strategic post-to-pre control and undercontrol would provide adequate flood protection, and over-control of peak flows for flood protection of downstream properties would not be required due to the size of the Humber River Watershed (i.e. 903 km^2 +/-) and the associated variability in coverage of rainfall. However, as noted in the previous discussion regarding the FSA and the preliminary SABE concept, recent analyses completed by TRCA for the Humber River SWM Quantity Control Criteria Updates (WSP, November 2, 2020) have concluded that over-control of peak flows would be required to achieve watershed-scale flood protection, based on the application of synthetic design storms for hydrologic analysis. The requirements for stormwater management are thus to be established as part of future studies (i.e. local SWSs) and are recommeded to apply continuous simulation and account for the spatial varibility in rainfall across the watershed.

Erosion:

It is anticipated that development of the Staff Recommended SABE within the West Humber Subwatershed would increase erosion potential along the receiving watercourses. Similar to the flooding impacts discussed above, it is anticiapted that the erosion impacts resulting from the more intensive development associated with employment land use conditions would be greater than those resulting from community developmen. For either land use, however, the erosion impacts may be mitigated through the provision of extended detention storage within end-of-pipe facilities, potentially in combination with LID BMPs which promote infiltration and/or evapotranspiration to reduce the volume of surface runoff). The specific requirements for mitigating erosion impacts are to be determined as part of future studies.

Water Budget:

The key hydrologic features and key hydrologic areas within and proximate to the Staff Recommended SABE within the West Humber Subwatershed include ecologically significant groundwater recharge areas (ESGRAs), areas with low depth to water table, and pockets of significant groundwater recharge areas. In addition, key hydrologic features in the form of seepage areas and wetlands are located within this portion of the Staff Recommended SABE. Development of the Staff Recommended SABE within the West Humber Subwatershed would be expected to reduce groundwater contributions to these areas, potentially impacting the water budget to sensitive ecological features, particularly for the employment development currently envisioned. Measures to manage water budget through the application of LID BMPs which promote groundwater recharge and/or evapotranspiration will be required to mitigate these impacts. The implementation of these measures will require infiltration of clean runoff (i.e. rootop runoff) and pre-treatment of surface runoff from other paved surfaces (i.e. roads, parking lots, driveways) to maintain the quality of infiltrated surface runoff.

Upper Etobicoke Creek Subwatershed

Flood Risk (on-site/off-site):

The portion of the Staff Recommended SABE within the Upper Etobicoke Creek Subwatershed is relatively large in size, and represents a sizeable proportion of the total subwatershed area (i.e. 8 % +/-). Approximately 4/5 of the Staff Recommended SABE within the Upper Etobicoke Creek Subwatershed consists of community land use, with the remainder designated for employment land use. The portions of the Staff Recommended SABE within the subwatershed drain toward the major confined watercourses and various unconfined watercourses, hence some of the contributing areas have a regulated flood hazard associated with the drainage features through the site, as well as through downstream properties. Moreover, as portions of the lands drain directly toward the unconfined watercourses and drainage features offsite, it is anticipated that development of these lands, in the absence of stormwater management, would increase peak flows offsite, thus presenting a local flood risk to adjacent properties. As such, it is anticipated that stormwater management for quantity controls would be required to control post-development flows to pre-development levels for all events including the Regional Storm event, in order to mitigate both local and subwatershed-scale flood risks. As the Staff Recommended SABE is located toward the headwaters, it is anticipated that a uniform application of post-to-pre control or a combination of strategic post-to-pre control and undercontrol would provide adequate flood protection, and over-control of peak flows for flood protection of downstream properties would not be required.

Erosion:

It is anticipated that development of the Staff Recommended SABE within the Upper Etobicoke Creek Subwatershed would increase erosion potential along the receiving watercourses. Similar to the flooding impacts discussed above, it is anticiapted that the erosion impacts resulting from the more intensive development associated with employment land use conditions would be greater than those resulting from community developmen. For either land use, however, the erosion impacts may be mitigated through the provision of extended detention storage within end-of-pipe facilities, potentially in combination with LID BMPs which promote infiltration and/or evapotranspiration to reduce the volume of surface runoff).

Water Budget:

The key hydrologic features and key hydrologic areas within and proximate to the Staff Recommended SABE within the Upper Etobicoke Creek Subwatershed include ecologically significant groundwater recharge areas (ESGRAs), areas with low depth to water table, and pockets of significant groundwater recharge areas. In addition, key hydrologic features in the form of seepage areas and wetlands are located within this portion of the preliminary SABE concept. Development of the Staff Recommended SABE within the Upper Etobicoke Creek Subwatershed would be expected to reduce groundwater contributions to these areas, potentially impacting the water budget to sensitive ecological features, particularly for the employment development currently envisioned. As such, development of the Staff Recommended SABE within the Upper Etobicoke Creek Subwatershed would reduce groundwater contributions to these areas, potentially impacting water budget to sensitive ecological features. Measures to manage water budget through the application of LID BMPs which promote groundwater recharge and/or evapotranspiration will be required to mitigate these impacts.

Groundwater Impact Assessment

The staff recommended SABE includes areas which have either been added or removed from the preliminary SABE concept or have made changes to the land classification. These modifications will change the water balance for both the existing and future land use conditions as presented in Sections 2.3.1.2 and 2.3.1.3. Where the classification changes from community area to employment area a greater potential for reductions in recharge can occur and will be reflected in the future land use water balance calculations. These reductions in recharge, where unmitigated, could lead to a lowering of the water table and local reductions in groundwater discharge. Measures to promote groundwater recharge through the application of LID infitration BMPs will be required to mitigate these impacts. The implementation of these measures will require infiltration of clean runoff (i.e. rootop runoff) and pre-treatment of surface runoff from other paved surfaces (i.e. roads, parking lots, driveways) to maintain the quality of infiltrated surface runoff. Potential impacts related to the key hydrologic features and key hydrologic areas are presented within the subwatershed specific water budget discussions above.

In addition to the change in the water balance described above, other considerations for potential groundwater impacts are generally related to various types of subsurface infrastructure and the related construction have the potential to impact the groundwater flow system by reducing water levels, intercepting groundwater flow and subsequently affecting groundwater discharge or groundwater recharge to deeper systems. The existence of a shallow groundwater table and the potential for strong upward gradients, if intercepted, can lead to geotechnical issues, extensive dewatering and related decrease in groundwater levels which may impact existing wells and potential groundwater discharge to water courses or wetlands. Additional discussion related to these potential impacts are provided in Section 2.3.1.1 and is applicable to the staff recommended SABE given the consistent nature of the surficial geology and similar locations of current development areas excepting the inclusion of Refinement Area 1 (Figure 2.5.1.1) which does not present any potential groundwater impacts that haven't already been noted.

2.5.3 Aquatic Resources and Water Quality

Urbanization of the Staff Recommended SABE would be anticipated to impact the quality of surface water primarily through increased concentrations and mass loadings of heavy metals and certain phosphorus containing chemicals associated with urban land forms. Stormwater quality controls will therefore be required, in order to mitigate these impacts. In addition, three of the main watercourses in the West Humber Subwatershed support Redside Dace habitat, as well as reaches of the Fletcher's Creek Subwatershed and the Huttonville Creek Subwatershed, hence stormwater management is required to address enhanced stormwater quality requirements per Ministry of Natural Resources and Forestry.

In addition, given the small size of the Staff Recommended SABE within the Huttonville Creek Subwatershed and the portion of the Staff Recommended SABE discharging toward the Credit River Main Branch, the development area discharging toward the stormwater management facilities may in some instances be too small to sustain wet pond/wetland end-of-pipe facilities, thus requiring source controls for stormwater quality, quantity, and erosion control.

2.5.4 Stream Morphology, Erosion Hazards and Assessment

The potential impacts to stream morphology and erosion hazards are generally the same as those described in the detailed impact studies above (Section 2.3.4). Urbanization of the Staff Recommended SABE would increase the proportion of impervious land use and consequently is anticipated to increase the number of erosion sites without management of stormwater runoff. Stormwater management (SWM) is required to prevent channel response to urbanization, which can include continued or increased rates of bank erosion, channel degradation, channel enlargement, and degraded water quality and stream habitat. Unmanaged erosion issues at culverts, can lead to the development of fish barriers in cases of channel incision. Erosion thresholds should be determined for receiving watercourses in future studies to inform initial SWM planning.

In general, watercourses, mapped HDFs, and erosion hazard areas within the Staff Recommended SABE are largely but not entirely encompassed by the FSA Take-out and Natural Heritage System (NHS). Any features or erosion hazard areas that are currently excluded should be incorporated into the FSA Take-out and NHS in future planning stages.

Management recommendations for watercourses and HDFs may be advanced through the integration of study disciplines in future studies. At that stage, further characterization and impact assessment can be made based on terrestrial or aquatic input for specific features (e.g., ponds, ELC mapping), and will be completed as land use plans are developed for the SABE. Field work to confirm/update watercourse and HDF mapping, and to complete the HDF assessment following TRCA/CVC (2014) guidelines are required through future studies to refine and finalize reach-specific constraints and management recommendations.

Differences in land use types between the Preliminary SABE Concept to the Staff Recommended SABE will result in differences in the percent imperviousness of some areas, which affects the degree of anticipated impacts to watercourses, HDFs, and erosion hazards. Notable differences in potential impacts are discussed below, and refer to land use refinement areas (Section 2.5.1).

- **Reduced Impact: Refinement Areas 2 and 11-14** are not included in the Staff Recommended SABE. These areas include a portion of an HDF reach in Upper Etobicoke Creek (Are 2) and several HDFs and tributaries to the West Humber River (Areas 11-14). The exclusion of these areas from potential development will eliminate potential impacts to stream morphology and erosion hazards. All sites are located near the upstream (northern) portion of the Staff Recommended SABE and as such will not experience downstream impacts related to development of the Staff Recommended SABE.

wood.

- **Moderately Reduced Impact: Refinement Area 15** has been updated from an Employment Area to a Community Area. This will presumably reduce the proposed imperviousness of this area, and as a result a slight decrease in potential impacts to stream morphology and erosion hazards may be anticipated in this area. Refinement Area 15 includes HDFs and tributaries to the West Humber River.
- **No Change: Refinement Areas 4, 8, 10, 16 and 17** have been updated from Employment Scenario Testing to Employment Area, or from Community Scenario Testing to Community Area. The impacts to stream morphology and erosion hazards will remain the same within these areas.
- **Moderately Increased Impact: Refinement Areas 3, 5, 6, 7, and 9** have been updated from either Community Areas, Community Scenario Testing Areas or Community Area and Employment Scenario Testing Areas to Employment Areas. As such the imperviousness will generally increase within these areas from 70% to 90%, resulting in increased potential impacts to stream morphology and erosion hazards. These areas include HDFs and tributaries to Etobicoke Creek, erosion hazard lands associated with Campbell's Cross Creek in the West Humber River subwatershed, and lands without surface water features which drain to Campbell's Cross Creek.
- **Increased Impact: Refinement Area 1** is included in the Staff Recommended SABE and was not included in the Preliminary SABE Concept. As such this area will be subject to significantly increased imperviousness compared to a no-development scenario and increased potential impacts to stream morphology and erosion hazards. This area includes portions of two tributaries to Etobicoke Creek.

2.5.5 Natural Heritage System

Overall, changes in the proposed land-use area associated with the Region's Staff Recommended SABE do not affect the overall results of the impact assessment presented for the terrestrial features outlined in Section 2.3.5. All but one land-use change area (refinement area 1, Figure 2.5.1.1) was included as part of the impacts assessment associated with the Preliminary SABE Concepts for Community and Employment lands and the SABE Testing Areas.

Of the seventeen refinement areas, five are proposed to be outside of the SABE (refinement areas 2, 11, 12, 13, and 14; Figure 2.5.1.1). Collectively, removing these areas from the SABE will primarily help to reduce cumulative impacts within the West Humber River subwatershed with approximately 478 ha of land being proposed outside of the recommended SABE; approximately five hectares is proposed in the Etobicoke River Subwatershed. As such, impacts anticipated for the features in areas that were previously identified as Community/Community Testing (2, 11, 14) or Employment/Employment Testing (12, 13) land-uses within these areas will now be largely avoided.

Areas that have been recommended as Community land-use were previously assessed as Community Scenario Testing areas (refinement areas 10, 16, 17), Employment Area (refinement area 15), and previously outside of the prior SABE impact testing areas (refinement area 1). General characteristics of natural features and species that may be impacted within these areas include:

- Refinement area 10: Located in the westerly section of the West Humber subwatershed. Primarily lower function meadow patches that provides low ecological connectivity; notwithstanding, the associated natural cover may support a variety of SWH types.
- Refinement area 15: Located in the easterly section of the West Humber subwatershed. Includes a mix of lower function meadow and wetland patches that provide low to high ecological connectivity potential and may support a variety of SWH types.
- Refinement areas 16 and 17: Located in the northerly areas of the Main Humber subwatershed. Includes a mix of low to fair woodland, wetland, and meadow patches that provide low to moderate

connectivity potential and may support a variety of locally important flora and fauna, and a variety of SWH types.

- Refinement area 1: Located in the west central area of the Upper Etobicoke Creek subwatershed. As noted previously, this area was not assessed as part of the previous impact assessment. The area is relatively small (11. 7 ha) and includes two drainage features. Natural features include wetland patches with moderate connectivity potential, and a variety of SWH types.

Areas that have been recommended as Employment land-use were previously assessed as Community Areas (3, 9), Mixed Community/Employment areas (6, 7), Community Testing areas (5), and Employment Testing areas (4, 8). General characteristics of natural features and species that may be impacted within these areas include:

- Refinement area 3: Located in the central area of Upper Etobicoke Creek subwatershed. Includes a lower function woodland patch that provides moderate connectivity potential is currently mapped outside of high constraint areas. The feature may support a variety of SWH types.
- Refinement areas 4 and 5: Located in the upper area of the Upper Etobicoke Creek subwatershed, and area 5 partially within the West Humber subwatershed. These two areas support a diverse mix of low to fair functioning wetland, woodland, and meadow features that support moderate landscape connectivity potential. The features present are known to include those that are sensitive to urbanization and/or support a variety of species that are sensitive to urbanization, and a variety of SWH types.
- Refinement areas 6, 7, 8, and 9: Concentrated in the west section of the West Humber Creek subwatershed. Natural areas include a mix of low to fair functioning wetland and woodland patches identified as high constraint, and meadow patches not identified as high constraint. Natural features occur predominantly within refinement area 8. Where present, features provide low to moderate landscape connectivity potential. Features located in area 8 provide habitat for species that are known to be sensitive to urbanization. As well, where features are present, they have potential to support a variety of SWH types.

Where natural features do occur within the Community and Employment refinement areas, most occur within high constraint areas and are therefore recommended to be included in the Region's Natural Heritage System. Where features occur outside of identified high-constraint areas, they may be incorporated into the Scope SWS NHS recommendations for protection and/or to provide functional enhancements to improve existing conditions and/or provide improved connectivity. Given the focus on landscape scale characterization using existing data at this stage, and not field verification, validation and analysis will be required in the future, for example as part of updating during detailed subwatershed studies.

2.5.6 Geotechnical and Slope Stability

The Staff Recommended SABE extends through the Main Humber Subwatershed, the West Humber Subwatershed, the Etobicoke Creek Subwatershed and the Credit River Watershed. As noted in the previous discussion regarding the FSA and the preliminary SABE concept, no slope stability concerns are anticipated for the slopes within the Credit River Watershed.

Etobicoke Creek Subwatershed

All watercourse slopes adjacent to the Staff Recommended SABE within the Etobicoke Creek Subwatershed were identified as 'low' risk of instability, and therefore the physical top of slope is likely the stable top of slope. The Staff Recommended SABE within the Etobicoke Creek Subwatershed also includes the following two locations for 'slight' risk:

- 1500 m long section from 100 m west of McLaughlin Road to Hurontario Street, ~1700 m north of Mayfield Road
- 100 m long section location ~700 m north of Old School Road and ~700 m east of Hurontario Street.

Humber River Watershed – West Humber Subwatershed

All watercourse slopes adjacent to the Staff Recommended SABE within the West Humber River Subwatershed were identified as 'low' or 'slight' risk of instability. For the 'low' risk areas, the physical top of slope is likely the stable top of slope. The 'slight' risk areas may require an additional setback from the physical top of slope of up to the slope height to obtain the stable top of slope. The Staff Recommended SABE within the West Humber River Subwatershed also includes the following location for 'moderate' risk:

- a slope failure noted immediately east of The Gore Road ~1.1km south of King Street

As a slope failure was visible in the moderate risk, further deterioration of the slope would be expected and the stable top of slope is likely greater than the slope height in distance from the physical top of slope.

Humber River Watershed – Main Humber Subwatershed

All watercourse slopes adjacent to the Staff Recommended SABE within the Main Humber Subwatershed were identified as 'low' or 'slight' risk of instability. For the 'low' risk areas, the physical top of slope is likely the stable top of slope. The 'slight' risk areas may require and additional setback from the physical top of slope of up to the slope height to obtain the stable top of slope.

2.6 Land Use Evaluation and Impact Assessment/Management

2.6.1 Integrated Impact Assessment

The foregoing investigations and discussions of the existing natural systems have proceeded on a discipline-specific basis, working toward an integrated characterization and assessment of the features, functions and form related to the existing systems. This integration has allowed for a fuller understanding of the fundamental environmental components and systems within the study area. An integrated characterization and assessment of each study discipline generally occurs on two levels, namely: i) integrated characterization to validate or confirm the findings of respective disciplines, and ii) an integrated characterization of key environmental features and systems to define the functions, attributes, and interdependencies, and to thereby provide guidance for establishing management opportunities and requirements based on future land uses.

Primary environmental elements stemming from the discipline-specific characterization work described in the previous report sections included:

- Natural Heritage (including valley and stream corridors, wetlands, woodlands and significant wildlife habitat)
- Surface water features (watercourses and HDFs)
- Recharge and Discharge Areas

Each of these elements to varying degrees has required an integrated assessment in order to establish the significance and associated sensitivity of the features, particularly in the context of the proposed urbanizing setting; the following provides some associated guidance in this regard:

i. Natural Heritage Units
    - diversity and significance of species (flora and fauna)
    - potential for corridor linkage and benefits to key biota

- presence/absence of fluvial unit
- local catchment area (size and land use)
- groundwater influence to sustainability of habitats and functions
- feature size, plant community diversity, and proximity to other features

ii. Watercourses and Headwater Drainage Features
- presence/absence of form/stability
- baseflow /intermittent/permanent
- groundwater discharge (reach specific)
- presence/absence of riparian corridor vegetation
- bankfull/riparian/flood flows
- floodplain
- erosion sensitivity
- fish habitat (direct/indirect)
- benthic invertebrates
- temperature/water quality

iii. Recharge and Discharge Areas
- rate of infiltration/recharge
- location of functional recharge areas
- functional relationship to watercourses, wetlands or terrestrial features
- quantity of groundwater flux

The foregoing factors/considerations (and others) have been summarized as they relate to the respective environmental units, features and systems. The following sections provide insight regarding these units, features and systems, which have been used in subsequent study stages to inform the preliminary and future land use planning process.

2.6.2 Climate Change

Urban flooding associated with impervious surfaces, inadequate drainage infrastructure, and short-duration, high-intensity rainfall events is one of the most significant drivers of disaster loss in Canada and is expected to become more common in a changing climate (ref. Warren and Lulham, June 2021). The projected changes in climate will increase risk for Canada's ageing infrastructure, causing structural damage, compromising system reliability and threatening health and safety. These risks may be minimized by integrating Climate Change information into the design, operation and management of infrastructure projects. In this respect, integrating Climate Change adaptation into the design and maintenance of infrastructure is essential to ensuring reliable operation of and resiliency of infrastructure.

Nature-based solutions such as forests and wetlands, working landscapes, and other open spaces that conserves or enhances ecosystem values and functions are recognized to mitigate water-related impacts of Climate Change. In addition, green infrastructure and nature-based adaptation methods such as green roofs, bioswales (sloped, vegetated surfaces), bioretention ponds, rain gardens, urban trees and vegetative swales are recognized to reduce the risks from storm water runoff, and have been successfully implemented in various municipalities across Canada. These methods, combined with more traditional structural measures (i.e. end-of-pipe stormwater management facilities for flood control, two-stage channels for high and low flows, relief channels for high flows, adding in-stream structures) would reduce the risks from riverine flooding.

Green infrastructure, such as parks, wetlands and green roofs, in Canada's cities and towns increase the quality of life for residents and improve climate resilience. Recognizing the value of the benefits associated with green infrastructure and nature-based adaptation solutions will be useful in advancing their use to reduce impacts from climate change and other stressors.

2.6.3 Preliminary Management Strategy

The results of the foregoing impact assessment have been used to establish a preliminary management strategy for the NHS, watercourses, and water resources systems for the FSA. Where available, recommendations from previous studies have been used to determine specific metrics, and are referenced as appropriate in the following sections.

2.6.3.1 Natural Heritage System

Goals for the NHS and preliminary targets were set out in Part A: Characterization. Through this section, we explore how these goals will be supported through system management and provide direction for implementation through future studies (e.g., detailed subwatershed studies, secondary plans, etc.).

Goals for the NHS

Goals for the NHS provide high-level guidance for the identification of the NHS for the FSA and should guide future studies and land use planning for its management. Goals for the FSA build upon those identified in systems applicable to the area and specifically draw from and align closely with the goals and principles identified in the Conservation Authority natural heritage systems within Peel (CA NHS) as presented in the Conservation Authority Natural Heritage System for the Region of Peel (CVC 2019). Goals include:

- Develop a system (NHS) that balances policy direction, emerging science and natural heritage planning best practices.
- Establish a robust, connected and ecologically resilient system (NHS) for the long-term benefit of environmental and public health, well-being and safety.
- Provide opportunities and direction for the enhancement of the NHS to establish a sustainable system in a changing landscape matrix and that supports climate change resilience.

An additional goal of the CA NHS, while not specifically addressed through this study, is relevant to long-term management of the NHS by local area municipalities and opportunities to align land use planning (e.g., open space, parks, trails) with system-level planning:

- To provide outdoor appreciation and recreational opportunities and to promote healthy communities (CA NHS).

While primarily outside the scope of the current study, it is important that all levels of land use planning process consider the interface between the built and natural environments and recognize the intrinsic benefits provided through access to nature for the mental and physical well-being of future residents. It is important that consideration be given to this so that the system and future land use planning is structured in a way that can support this goal while also continuing to support resilient ecological functions. Where appropriate, discussion and guidance provided here highlights some potential opportunities in this area.

The scoped nature of the current subwatershed study must be taken into consideration and it be recognized that system refinements will occur through future stages of work (e.g., detailed subwatershed studies and other future studies identified in the scoped SWS Part C Implementation Report) to confirm and refine direction provided here. To this end, the following guiding principles have been set and are specific to the current stage of work:

- Develop clear and well-documented guidance for the identification and confirmation of the system to ensure consistency through future stages of study.
- Identify a broad range of enhancement opportunities to provide flexibility for system refinement through future studies while still ensuring that system target(s) can be met.
- Provide direction for implementation that will support future stages of land use planning and decision-making in achieving net benefit outcomes for the NHS.

Targets for the NHS

General targets were set for the FSA NHS to provide guidance for the identification of features which comprise the NHS from a policy basis and inform approaches to management. Set out in Part A, they have been copied here to support preparation and review of preliminary management strategies presented in this section.

Table 2.6.3.1. Targets for the NHS

Feature Type	Target for the FSA NHS
Natural Cover*	• No net loss of natural cover.
Woodland	• No net loss of existing woodland cover. • Increase total woodland cover through NHS enhancement with a focus on creation of table land features.
Wetland	• No net loss of wetland cover. • Increase total wetland cover through NHS enhancements.
Valley and Stream Corridors	• No net loss of ecological and hydrologic functions provided by valleylands. • Increase natural cover within valley and stream corridors through NHS enhancement.
Successional / Open Habitats	• Maintain important existing successional / open habitats contiguous to other features and areas of the NHS. • Increase representation and quality of open country habitats across the landscape through NHS enhancement opportunities; strive to create at least one habitat area with a minimum size threshold of 5ha.
Aquatic	• Achieve 75% naturally vegetated watercourse length through protection of existing, enhancement or restoration[4].
Sand Barrens, Savannahs, Grasslands	• Protection of all Sand Barrens, Savannahs and Grasslands where they occur.
NHS Enhancement	• Identify distributed enhancement opportunities across the NHS to support the development of a robust and sustainable system. • Increase natural cover* by 30%

* For purposes of this target, 'natural cover' is defined as all existing natural cover within the FSA using mapped vegetation communities (e.g., Cultural Meadow, Forest, Wetland, etc.) in datasets used for the purposes of this study..

[4] 75% naturalized stream length is to be based on the total stream length of protected watercourses and HDFs (Protection, Conservation) as determined through a detailed subwatershed study.

Existing natural cover within the FSA is low. To preserve existing functions and support a net improvement in the long-term, an overarching goal of 'no net loss' of natural cover has been established. Implementation of this target will be guided by the direction provided in this report (Part B) and Part C (Implementation).

Feature or NHS element specific targets have been created to guide identification of the NHS and to support implementation of the NHS through future studies and land use planning processes.

The Net Gain Mitigation Hierarchy: A Framework for System Management

In support of the goals for the NHS, management of the Natural Heritage System will be guided by a net benefit mitigation hierarchy. The mitigation hierarchy is a sequential approach to planning and decision-making. Emphasis is placed on avoidance, followed by minimization and mitigation to achieving no negative impact before considering other options. The net benefit mitigation hierarchy requires that the final outcome exceeds no negative impact and achieves a net positive outcome. In the context of this Scoped SWS, this is measured as a net benefit to the NHS. The net gain will be guided by the system targets and will be achieved through enhancement (primary method), restoration, regenerative opportunities, etc. The net gain mitigation hierarchy is generally described as follows:

1. Avoid Creating the Impact – this can be achieved through a range of actions including protecting features and functions, siting, management techniques and design.
2. Minimize and Mitigate the Impact(s) – where impacts cannot be avoided, effort should be placed on opportunities to minimize impacts to the extent possible and mitigate remaining impacts.
3. Restore the system –Restoration includes opportunities to address existing issues or impacts to improve the form or function of the system in-situ.
4. Enhance the System – enhancements in the system context generally include additions to natural cover, increasing habitat diversity to enhance functions, etc. These can be used to support retaining a feature in-situ to avoid impact(s) and support achieving a net benefit outcome.
5. Replication / Compensation – replication and/or compensation may be considered *in limited circumstances*. Replication and/or compensation are to be considered only after consideration is given to preceding steps in the hierarchy.

Informed by the Mitigation Hierarchy, management of the NHS is guided by the following objectives:

- Avoid (as a priority) and minimize impacts to the NHS through siting and design.
- Implement mitigation measures to address anticipated impacts that cannot be avoided (e.g., buffers) and after opportunities to minimize have been integrated.
- Connect the system through linkages at multiple scales to ensure the continued flow and movement of species and materials across the landscape.
- Enhance the NHS to achieve a net benefit through habitat creation, restoration and, *where appropriate* through integrated planning of green infrastructure, parks, open space and the NHS.
- *Where appropriate*, consider replication of existing features in a location that better supports its form and function in the context of the NHS as a whole.
- *Where appropriate* consider compensation as a mechanism to maintain natural cover on the local landscape and/or achieve a net benefit to the system.

These management objectives support the protection and long-term sustainability of the NHS and consider its connectivity and value to areas beyond its limits (i.e., external connections and interactions). Guidance for the management of the NHS is applicable to any planning area used for future studies or plans (e.g., subwatershed, SABE, SABE testing areas, secondary plans etc.).

Detailed guidance on system management to facilitate implementation is addressed in Part C: Implementation.

System Components

The Natural Heritage System is comprised of the following components:

- **Key Features** include those features and areas that are recommended to be protected as part of a connected NHS through this scoped study. Key features are comprised of all *Core Areas* as defined in the ROP and a sub-set of *NAC* and *PNAC* features which meet specific criteria set out based on analyses conducted for the FSA. Many Key Natural Heritage Features and some Key Hydrologic Features will be captured as Key Features of the FSA NHS.
- **Supporting Features** include those features and areas that are not, based on available information identified as Key Features but meet criteria as Supporting Features. For some features in this category, further assessment is required to determine if they meet Key Feature criteria; others require further assessment to evaluate their functions, interactions and contributions to the NHS in order to determine how they are managed (e.g., protect / retain in-situ, replicate, compensate, no management required).
- **Other Features** include those features and areas that are not Key or Supporting features but meet criteria as 'Other Features'. This category may include small and/or isolated features, features or areas requiring further assessment to determine their status (e.g., if they are / include Key Features).
- **Linkages** provide connectivity within and across the system and to features and areas external to the FSA to support a connected and resilient system structure.
- **Enhancements** are opportunities to strengthen the system in supporting the goal of establishing a robust and resilient NHS and support net benefit targets.

It is important to note that this scoped Subwatershed Study sets out a detailed framework for the NHS and completes preliminary feature component mapping, identifies linkages conceptually on the landscape and identifies opportunities for enhancement. Due to the scoped nature of this study, it is expected that refinements to the system will occur through subsequent stages of study.

While refinements are expected, all future work is to be consistent with the goals, targets, approaches, structure and basic composition of the NHS. Guidance is provided through subsequent sections.

Features

The Characterization Report (Part A) establishes preliminary NHS criteria in consideration of an analysis of existing conditions (scoped to available information), applicable policies (e.g., PPS, Greenbelt Plan, Growth Plan, ROP) and an assessment of cover representation within the system. Delineation was completed using available datasets (e.g., valleyland mapping, ELC); it is expected that there will be discrepancies with 'on-the-ground' feature limits in some cases and when compared across datasets. This level of refinement is to be addressed through future detailed studies (e.g., detailed subwatershed study) in which field-studies are completed.

Application of the criteria developed through the Characterization Report generated a map showing the preliminary features of the FSA NHS (Figure DA8a-g – Categorization by Feature Type, Figure DA9a-c – Preliminary NHS, Appendix E). Table 2.6.3.2 provides a summary of the features of the FSA NHS identified as Key Features, Supporting Features and Other Features.

Table 2.6.3.2. Composition of Preliminary FSA NHS Features

Feature Type[a]	Key Feature			Supporting Feature			Other Features		
	ha	% of NHS	% of FSA	ha	% of NHS	% of FSA	ha	% of NHS	% of FSA
Wetland	182.4	13%	2%	21.6	2%	<1%	n/a	n/a	n/a
Woodland	388	28%	5%	25.7	2%	<1%	4.7	<1%	<1%
Valleyland	479.3	35%	6%	2214.5	16%	3%	n/a	n/a	n/a
Savannah, Sand Barren	18.1	1%	<1%	n/a	n/a	n/a	n/a	n/a	n/a
Early Successional Habitats	n/a	n/a	n/a	509.9	37%	6%	30.5	2%	<1%
Waterbodies	n/a	n/a	n/a	11.5	1%	<1%	9.0	1%	<1%
SAR Habitat[b]	289.6	21%	4%	n/a	n/a	n/a	n/a	n/a	n/a
Totals[c]	**883.8**	**64%**	**11%**	**467.6**	**34%**	**6%**	**26.82**	**2%**	**<1%**

[a] No ESAs, Provincially or Regionally Significant ANSIs occur within the FSA.
[b] Regulated Redside Dace Habitat mapped in accordance with the species habitat regulation (O. Reg 242/08)
[c] Feature types overlap within the NHS. As such, totals and a sum of individual feature types do not align. Totals account for overlap and represent the total land area occupied.

Combined, Key Features and Supporting Features represent 17% of the FSA; of this 11% of the FSA (~884ha) is Key Features and 6% (~468ha) is Supporting Features. Under existing conditions, approximately 15% of the FSA is comprised of natural cover (i.e., vegetation communities). This discrepancy in natural cover (15%) vs. NHS cover (17%) is owing to the limit(s) of the NHS being defined by valleylands, which do not, in some areas, currently have natural cover (e.g., portions are active agriculture).

As noted, natural features and areas across the FSA are largely linear and focused along existing watercourses and valley systems. This distribution is reflected in the composition of the NHS with Valleylands comprising 35% of the Key Features and 16% of the Supporting Features identified. Early successional habitats are the dominant Supporting Feature (37%) of the FSA. Features of the Preliminary NHS will be assessed through detailed field investigations through future studies (e.g., detailed subwatershed study) to assess form and function of features to determine how they are to be managed and to confirm or refine feature boundaries (e.g., valleylands).

When comparing the preliminary FSA NHS to other systems identified within the FSA, the FSA NHS includes:

- 92% of the CA NHS (excluding enhancement areas)
    - The CA NHS includes all natural cover. The FSA NHS applies a set of criteria for identifying features which comprise the NHS from available natural cover. This is the primary driver for rate of capture.

  - Subsequent stages of work (i.e., detailed subwatershed studies) will assess features to confirm how they are to be managed. Through this process, the total capture rate may change. This may be particularly associated with early successional habitats and open aquatic communities captured in the FSA NHS as they are assessed through field investigation to confirm status, function, and management.
  - Retention of natural cover not identified as a feature of the FSA NHS is encouraged where it occurs within a linkage or enhancement area.

- 99% of the Greenlands Core Areas
  - Policies of the ROP were a major policy driver for identification of Key Features for the FSA NHS. As such, alignment between the mapped Greenlands Core Areas and the FSA NHS were expected.
  - Per Table 2.6.3.2, Valleylands represent the predominant feature type of the NHS. Mapping for this feature class is a mapped component of the Greenland Core Areas and was used to inform and delineate the Preliminary FSA NHS.
  - Although all Greenlands Core Areas should be captured as key features, minor discrepancies exist where Core Areas have either been developed, converted to agricultural lands, or classified as a different feature type based on current data (e.g. historically identified as a woodland or wetland and identified as a lower constraint feature type based on ELC data).

- 65% of the Province's NHS
  - The Province's NHS was developed at a very coarse scale. The boundary of the Province's NHS includes features, linkages and adjacent landscape areas which may be suitable for enhancement. As such, comparison of capture does not accurately reflect representation of features of the Province's NHS within the FSA NHS.
  - The limits of the Province's NHS have been used to inform enhancement opportunities (See Enhancement Opportunities section below).

Feature Management

Management of features of the NHS will be informed by additional, detailed studies. Through these studies, features (e.g., woodlands, wetlands, successional habitats, etc.) will be assessed to:

- Evaluate form and function of the feature (Intrinsic function) (species, vegetation communities, etc.) and the features function in the context of the system (providing important supportive or contributory functions (e.g., upland or foraging habitat for breeding amphibians), relative representation on the landscape, etc.).
- Identify sensitivity to change and to potential impacts associated with development.
- Confirm / Refine Feature Limits.
- Confirm or update feature category (Key, Supporting, Other) in accordance with system criteria (Part A) and considerations above to recommend / determine the management outcome. For example, Supporting or Other Features may be determined to be Key Features (e.g., Significant Wildlife Habitat) through detailed assessment.
- Informed by the above, recommend a feature management outcome (Protect In-Situ, Replicate, Compensate, No Management).

- Identify mitigation measures (including buffers) in accordance with the feature management outcome and as informed by feature form and function, and anticipated impacts associated with the adjacent land use(s).

Guidance for the selection / application of management outcomes and mitigation measures are discussed in Part C: Implementation. Management outcomes are briefly summarized below.

Protect In-Situ

Protection in-situ is to be the primary management mechanism for features of the NHS. Retaining features in-situ aligns with the primary objective of the mitigation hierarchy of avoiding impacts a. It is also preferrable to alternatives (e.g., replication, compensation) as it avoids disruption, loss of habitat complexity (soil structure, hydrology), lag time in habitat function, etc.

Key Features are to be protected in-situ with very few exceptions (see below). Protection In-Situ for Supporting or Other Features will be informed by site-specific assessment of the role of the feature within the NHS, including location in context of the Provincial NHS, Linkage, or Enhancement Area; all or a portion of a Supporting Feature or Other Feature may be protected in-situ based on the outcome of an assessment process.

Replicate

Replication is a 'like-for-like' re-creation of a habitat type on the local landscape and with a net gain to the system achieved through the replication process. In planning for replication, a replacement ratio will be determined through detailed study to support a net gain outcome. Replication is based on re-locating the same function in close proximity so that there is little or no change to the system overall and, through its relocation on the landscape, better supports the form and function(s) of the feature and the NHS. For example, a tableland wetland must be replicated as a tableland wetland. Selection of location, identification of a compensation ratio and design shall be completed in consultation with appropriate agencies and in consideration of targets presented for the system.

Timing and phasing of compensation activities relative to the proposed impact should be considered. To the extent possible, compensation areas should be established early to reduce effects of lag between implementation and reaching full function.

For **Key Features**, replication should only be considered where retaining a feature in-situ in an urbanizing landscape matrix will result in an impact to its form or function that cannot be reasonably mitigated. In these instances, consideration may be given to replication of the feature in a location that is in close proximity to its original location that will ensure its form and function are sustained for the long term within the system. All reasonable alternatives (i.e., avoid, minimize, mitigate) options must be considered in advance of proposing replication. This is to include option(s) for retaining in situ with linkage(s), enhancements, buffers, etc. Interactions between the feature and other elements of the NHS and WRS must be taken into consideration in determining whether replication is appropriate.

Replication and compensation of features is not recommended for Core Areas of the Greenlands System (a subset of Key Features of the Preliminary NHS), which are to be protected to a no development and site alteration protection standard except as may be permitted in accordance with the Regional Official Plan and provincial policy requirements.

Consideration may be given to replication of **Supporting or Other Features** where re-location on the landscape will maintain or improve their function within the system while permitting some flexibility to land use planning. Interactions between the feature and other elements of the NHS and WRS must be taken into consideration in determining whether replication is appropriate. All management recommendations are to be informed by detailed assessment as described in the Protect In-Situ section above. Protection in-situ is preferred wherever possible.

Compensate

Compensation is a means of addressing impacts through the creation of new natural features or functions on the landscape.

For **Key Features**, and consistent with replication, compensation should only be considered where retaining a feature in-situ in an urbanizing landscape matrix will result in an impact to its form or function that cannot be reasonably mitigated. In these instances, consideration may be given to compensation. All reasonable alternatives (avoid, minimize, retain with mitigation measures in place, replication, etc.) must be considered in advance of proposing compensation. Interactions between the feature and other elements of the NHS and WRS must be taken into consideration in determining whether replication is appropriate.

Consideration may be given to compensation of **Supporting or Other Features** where it presents an improved condition for the system (i.e., net gain). Interactions between the feature and other elements of the NHS and WRS in addition to feature type, lag time to reaching full function, etc. must be taken into consideration in determining whether replication is appropriate. All management recommendations are to be informed by detailed assessment as described in the Protect In-Situ section above. Protection in-situ is preferred wherever possible.

Where compensation is determined to be the preferred management outcome, it will be planned to achieve a net gain for the system. In planning for compensation, a compensation ratio will be determined through detailed study to support a net gain outcome. This can include:

- **Like-for-Like Compensation** (e.g., meadow for meadow). This is used where an assessment determines that creation of the same habitat type provides the best available system opportunity.
- **Alternative Habitat Compensation** (e.g., wetland for meadow). This is used where an assessment determines that creation of an alternative habitat type provides the best available system opportunity.

Determination regarding the type of compensation and potential location for compensation will be informed by site-specific conditions. To the extent practicable, preference is given to compensation activities being located in places on the landscape which provide the greatest benefit to the system. This may favor on-site compensation, or a location where long-term benefits will be best achieved. Selection of location, type of compensation, identification of a compensation ratio and design shall be completed in consultation with appropriate agencies and in consideration of targets presented for the system.

No Management Required

Based on detailed, site-specific assessment, the management outcome for some features may be 'no management required'. This management outcome will apply to features where they do not provide a notable supportive role or benefit to the system (e.g., small, monocultural, highly disturbed, highly invasive dominant, highly isolated with little system interaction, etc.).

Where this recommendation is made, consideration should be given to creation of similar habitat cover types within enhancement areas (i.e., as part of, not in addition to). This approach will support system targets (e.g., no net loss of cover), and provide additional direction for enhancement opportunities (i.e., habitat type and composition) in some areas.

Mitigation

Implementation of a mitigation strategy applies to all components of the NHS, including features protected in-situ, replicated, or habitats created through compensation. A mitigation strategy may include a range of measures. Discussion of mitigation measures for potential development impacts is provided in Part C.

Ecological buffers (buffers) are an important component of a mitigation strategy where development is proposed adjacent to sensitive or significant feature(s) of the NHS. At the system-scale, buffers represent a primary mitigation tool, however in planning and implementing mitigation, they are to be considered as one part of a mitigation strategy. The best approach is to apply multiple layers of mitigation to reduce reliance on buffers to address all potential impacts and focus on weaving mitigation, net benefit and regenerative opportunities throughout the land planning and design process where possible.

Buffers can support multiple parts of the mitigation hierarchy:

- **Avoid** – through proper design, buffers may effectively avoid some types of potential impacts (e.g., sedimentation)
- **Minimize** – buffers can minimize potential impacts (e.g., edge effects, hydrologic, noise, light).
- **Restore and Enhance** – where existing edges of habitats may have experienced degradation (e.g., dumping, invasive species), implementation of buffers can provide an opportunity to address these impacts. Similarly, while not considered as 'enhancement areas' (due to their primary function being to mitigate impacts), buffers established as self-sustaining natural vegetation will add natural cover to the landscape and the NHS, providing some associated benefits and supports to the system. Additionally, inclusion of habitat enhancements (e.g., nesting structures, hibernacula, etc.) can be used to support the NHS.
- **Mitigate** – as the primary function of buffers, their role in mitigating impacts is well established. Mitigation can address a range of potential impacts (hydrology, sedimentation, edge effects, etc.).

Buffers are to be informed by both existing conditions and sensitivities, and the anticipated impacts that a buffer is being used to mitigate. Where possible, opportunities to address impacts (avoid, minimize) 'at-source' through siting and design for land uses should be considered as part of a layered approach to mitigation. This approach will reduce the overall impact of developments, encourage sustainable design and support development of resilient system(s) and communities.

Guidance for the planning and design of buffers at future planning stages is provided in Part C: Implementation.

Upon implementation, buffers are considered a Supporting Feature in the NHS.

Linkages

Under existing conditions, the landscape of the FSA is relatively permeable to wildlife as illustrated in the 'existing conditions' connectivity assessment (Section 2.3.5; Figure DA10). Wildlife movement is presumed strongest through areas of natural cover, however agricultural and rural cover maintains a moderate degree of permeability without significant barriers to general dispersion. Barriers do exist across the existing landscape such as roads, rural development, etc. to varying degrees and influenced by factors such as vegetation through rural development (e.g., cover opportunities) and the size, width and volume of traffic on roads, etc. The 'existing conditions' linkage assessment provides supportive information for the identification of system linkages by highlighting areas of potential or anticipated areas for concentrated movement or opportunities to strengthen movement pathways.

As the landscape matrix urbanizes, landscape permeability will decline, and fragmentation of the system and isolation of its component features can occur. Identification and implementation of linkages forms a critical component of the NHS to maintain connectivity within, avoid or minimize fragmentation of the system and connect the NHS to areas outside of the FSA. The following objectives have guided the approach and development of criteria for linkages for the FSA NHS:

- Ensure a connected NHS that can support existing functions under a developed land use scenario.
- Maintain and where possible enhance movement and connectivity to features and areas within and external to the FSA.
- Explore opportunities for softened interfaces between the natural and built environment that support the functions of the NHS and WRS.

To achieve these objectives the following general approach has been used:

- Use available literature, NHS features and supplementary analyses (e.g., habitat connectivity) to inform identification of landscape linkage locations and establish recommended linkage parameters (widths, design, etc.)
- Identify and enhance connections along existing pathways / corridors where possible and across the landscape where necessary.
- Identify linkages of sufficient size and to replace landscape permeability that will be lost through land development north-south and east-west, as appropriate and reflective of existing condition.
- Use linkages at multiple landscape scales to meet connectivity objectives.
- Create local-scale connections to maintain feature interactions, including connecting isolated Key Features wherever possible.

Type and Composition

In consideration of the above objectives and the general approach advocated for FSA NHS linkages, three linkage categories have been identified:

- **Major Landscape Linkage** | These are large, landscape connections which connect major corridors / areas south of the FSA to those north of the FSA. They are generally aligned with and/or are in the same areas as the province's NHS where linkages are interpreted as a key function. Major Landscape Linkages are comprised of a Minimum Vegetated Width and a Permeable Landscape Zone.
- **Local Landscape Linkage** | These are smaller scale (width) linkages which provide landscape-level connectivity within or to areas external to the FSA. They often provide important redundancy in landscape connectivity, link and connect blocks of features. Local Landscape Linkages are comprised of a Minimum Vegetated Width and a Permeable Landscape Zone.
- **Feature (or Site)-Scale Linkage** | These represent small, localized linkages intended to connect over short distances. Feature-Scale Linkages are comprised of a Minimum Vegetated Width.

Opportunities to integrate connections along active transportation corridors, trails, etc., connecting to and through natural areas, parks and other open space land uses should be explored through more detailed stages of land use planning in addition to the formal linkages described above. These informal connections may have a less natural aspect / design but can provide additional connectivity for urban adapted species and plants. Integrating native species into landscape design is encouraged; invasive species and other species that pose a risk of establishing in natural areas connected by these informal connections should not be used.

Table 2.6.3.3 provides a summary of Minimum Vegetation Width and Permeable Landscape Zone for each linkage type identified for the FSA.

Table 2.6.3.3. FSA Linkage Types

Linkage Type	Minimum Vegetated Width	Permeable Landscape Zone (total width)	Total
Major Landscape Linkage	100+ m	60+ m	160+ m
Local Landscape Linkage	60+ m	30+ m	90+ m
Feature (or Site) Scale	30+ m	n/a	30+ m

The values presented in Table 2.6.3.3 represent minimum widths recommended to support connectivity and habitat of the FSA NHS. Implemented widths may be greater than those in the table based on feature limits, distance between features, etc. Major Landscape and Local Landscape Linkages have been mapped through this scoped Subwatershed Study; feature (or Site)-Scale Linkages have not been mapped (see sections below).

The **Minimum Vegetated Width** (MVW) of a corridor represents the minimum recommended width of natural, self-sustaining vegetation to be established within the linkage. MVWs have been developed based on:

- Literature with respect to species requirements
- Existing NHS Key Feature widths and, where applicable, floodplain widths through the proposed linkages

Within any given corridor, no areas should have less than the minimum width of natural self-sustaining vegetation identified for the linkage (i.e., the MVW). All existing natural features and areas within the MVW are to be retained and/or enhanced (Key Features, Supporting Features, Other Features, and/or other natural vegetation communities). Areas not currently supporting natural self-sustaining vegetation are to be established as such; these areas are further discussed in the enhancement section below. Vegetated width(s) may be greater than the MVW based on the limits of Key Features, enhancement opportunities and retention of Supporting Features or other natural features identified as providing important functions within the NHS. In no way is the MVW intended to indicate or support the removal of features beyond its limit; features are to be considered in the context of the NHS (i.e., as Key Features, Supporting Features, etc.), have applicable protections and policies afforded them, and be addressed accordingly. Where buffers are required, they shall apply to features occurring within the MVW; the greater extent of the buffer or the MVW shall apply.

The **Permeable Landscape Zone** (PLZ) is a blended transition between natural and built form, allowing for some permeable land uses with supportive or complementary functions to occur within this designated portion of a comprehensive linkage (i.e., MVW+PLZ). This zone may be comprised of a combination of land uses / covers as outlined in Table 2.6.3.4.

Table 2.6.3.4. Land Use / Cover Composition - PLZ

Land Use / Cover	PLZ Composition Guidance
Natural heritage features and areas	Per existing conditions and as informed by detailed study and direction provided in this Scoped SWS.
Buffers to features of the NHS	As determined through detailed study and in accordance with direction provided in this Scoped SWS.
Enhancement Areas	A minimum of 30% of lands outside of existing natural cover captured as part of the NHS **and** excluding required buffers to features of the NHS.
General development and infrastructure*	Up to 30% of 'developable lands' in the PLZ (i.e., those portions not constrained by NHS features, buffers).
Linkage compatible uses	Balance of developable lands within the PLZ.

*Defined here as development and infrastructure permitted in accordance with applicable policies and plans (e.g., zoning).

Linkage-compatible uses refers to 'non-natural' land uses (i.e., not natural vegetation communities) which support or preserve the function of the linkage. Specifically, linkage-compatible uses may include the following:

- Naturalized gardens or landscaping which utilize native species appropriate to the site.
- Natural-design stormwater facilities (e.g., naturalized ponds or swales).
- Open space or parks.
- Amenity spaces for facilities or institutions such as long-term care, hospitals, schools, etc.
- Small-scale food production (e.g., urban regenerative agriculture, community vegetable gardens).
- Trail(s).

Confirmation of compatibility will be determined through detailed study (e.g., Environmental Impact Study or equivalent). Compatibility will be based on demonstration that the landscape remains permeable to movement and that function of the linkage is improved (preferred), supported or maintained.

Linkages of the NHS

Landscape-Scale Linkages (i.e., Major and Local Landscape Linkages) have been mapped for the Scoped SWS and are shown on the Figure DA2-10 (Appendix E). Feature (or Site)-Scale Linkages have not been mapped; site-scale linkages are to be assessed through more detailed levels of study with the objective of maintaining habitat connectivity to support species, and to maintain a connected and resilient NHS. Some linkages have been identified conceptually through this scoped NHS (Figure DA2-10) to reflect uncertainty in terms of location or alignment, and/or type of linkage that should be implemented. Linkages identified for the FSA NHS are discussed in the sections below.

Landscape-Scale Linkages

A total of four Major Landscape Linkages were identified within the FSA. These generally correspond with where the Greenbelt NHS traverses the FSA. They represent major linkages that connect to systems external to the FSA. They provide major movement corridors and are to be of sufficient width to permit large animal movement, provide habitat to support residency and movement of slow animals. The Major Landscape Linkages were mapped using an approximated corridor centerline along Key Features (predominantly watercourses). Linkage widths were based on minimum widths targets and an approximated average width of the NHS Key Features through the corridor where minimum widths were exceeded.

Six Local Landscape Linkages were identified and mapped within the FSA. The Local Landscape Linkages connect the Major Landscape Linkages and provide north-south, east-west movement opportunities. As with the Major Landscape Linkages, these linkages were mapped using an approximated corridor centerline.

Composition of the mapped linkages (Major and Local Landscape Linkages) is provided in Table 2.6.3.5. Wherever possible, linkages followed existing feature pathways; where not available, effort was made to identify minimum distance opportunities for connecting. Landscape Linkage alignments will be confirmed and/or refined through subsequent study (i.e., detailed subwatershed studies).

Table 2.6.3.5. FSA Linkage Land Cover Summary presented as area (ha) and the proportion of the linkage occupied by each category (%).

	Key Features	Supporting Features	Other Features	Outside of NHS Features	Total Area
Major Landscape linkage					976.2 ha
Minimum Vegetation Width	257.2 ha (75%)	14.4 ha (4%)	0.0 ha (0%)	73.0 ha (21%)	344.6 ha
Permeable Landscape Zone	62.6 ha (25%)	17.4 ha (7%)	0.1 ha (<1%)	166.7 ha (67%)	246.8 ha
Local Landscape Linkage					
Minimum Vegetation Width	130.0 ha (50%)	34.1 ha (13%)	0.8 ha (<1%)	95.1 ha (37%)	260.0 ha
Permeable Landscape Zone	43.3 ha (35%)	11.5 ha (9%)	0.2 ha (<1%)	69.8 ha (56%)	124.8 ha

Feature (or Site)-Scale Linkages

Feature (or Site)-Scale Linkages have not been mapped. Locations of, and widths for feature scale linkages are to be determined through detailed study and will be informed by (at a minimum) field surveys to assess feature form, function and interactions, and linkage modeling provided in this scoped Subwatershed Study or as completed through a future study. Guidance for identifying locations for linkages and establishing appropriate widths and design is provided below in Part C: Implementation.

Conceptual Linkages

Conceptual linkages have been identified to address two specific conditions:

- To recognize connections to existing or planned Peel Greenlands Network corridors outside of the FSA for which further assessment is required to determine the appropriate linkage type (e.g., as a Local Landscape Linkage or Site-Scale Linkage) and final alignment.
- Linkages that should be recognized through the current study, but whose location, alignment and type will be informed by detailed study. For example, a connection to a linkage of the Greenlands System south of the FSA, or where information on features (e.g., a Headwater Drainage Feature) is required to inform alignment.

These conceptual linkages have been mapped to ensure continuity from the current scoped Subwatershed Study and future land use planning and studies. Rationale for identification of and guidance on each Conceptual Linkage is provided in Table 2.6.3.6 below.

Table 2.6.3.6. FSA Linkage Land Cover Summary

Conceptual Linkage	Recommendation & Rationale	Next Steps
L01	**Linkage Required** Secondary Planning for Heritage Heights in nearing completion. The NHS for that land area includes an extension to Mayfield Road. L01 has been identified to extend and connect the system in HH with the NHS in the FSA / SABE.	**Refinement** Refinements to this conceptual linkage will include final alignment to connect to Heritage Heights Secondary Plan Area NHS and final alignment within the FSA based on site-specific conditions; final linkage type recommended (e.g., Local Landscape Scale or Site-Scale) and from this process final linkage width, target species, etc.
L02	**Linkage Required** Connect to existing drain and Greenlands System south of Mayfield Road and extend system connectivity. L02 has been identified to extend and connect the System with the NHS in the FSA / SABE.	**Refinement** Refinements to this conceptual linkage will include final alignment within the FSA based on site-specific conditions, but is to connect to the existing Greenlands Network; final linkage type recommended (e.g., Local Landscape Scale or Site-Scale) and from this process final linkage width, target species, etc.
L03	**Linkage Required** Connect habitat complex within the NHS to central linkage. L03 has been conceptually mapped based on shortest connection distance and along existing mapped features. It has been mapped due to potential as a Local Landscape Linkage.	**Refinement** Refinements to this conceptual linkage will include final alignment within the FSA based on site-specific conditions; final linkage type recommended (e.g., Local Landscape Scale or Site-Scale) and from this process final linkage width, target species, etc.
L04	**Linkage Recommended** Provide system connectivity for habitat complex within the NHS. Adding redundancy reduces travel distances and decreases road crossings for wildlife. L04 identified as a potential Local Landscape Linkage.	**Confirmation and Refinement** Detailed studies (e.g., a detailed subwatershed study) will confirm the recommendation for a linkage and inform the type of linkage to be implemented. Refinement of the linkage will include location (informed by site-specific study), linkage type, width, target species, etc.
L05	**Linkage Highly Recommended** East-west connectivity is very poor in the eastern half of the FSA. Establishing / enhancing this movement will support a robust, connected and more resilient system.	**Confirmation and Refinement** Confirmation and refinement of features of the NHS and their functions is required through detailed study (e.g., a detailed subwatershed study) to inform linkage type and alignment. Consideration is to be given to the implementation of this east-west linkage.

Conceptual Linkage	Recommendation & Rationale	Next Steps
		Other refinements may include final alignment / placement on the landscape, linkage type (e.g., Local Landscape Linkage, Site-Scale Linkage), final linkage width, etc.
L06	**Linkage Strongly Recommended** East-west connectivity is very poor in the eastern half of the FSA. Establishing / enhancing this movement will support a robust, connected and more resilient system. The conceptual location follows mapped supporting features and minimizes length to connect the Local Landscape Linkage along Salt Creek with the Greenbelt Plan NHS (east, outside of FSA). Site-specific assessment is required to inform features on the landscape and may result in an amended alignment to achieve this east-west connectivity objective.	**Confirmation and Refinement** Due to low presence of existing features on the landscape and that the current study is a Scoped SWS (existing information, no field surveys); further detail is needed to confirm a) features present on the landscape that can be utilized to support a linkage, b) how system connectivity can be best achieved to support ecological form and function, c) what type of linkage would be appropriate (e.g., Major or Local Landscape Scale), d) feasibility with regards to broad land use planning and long-term function of the system. Refinements to the conceptual linkage may include location(s) and alignment (e.g., one, as shown, or several locations to connect east-west), final width, etc.
L07	**Linkage Recommended** This linkage is flagged as a potential Local Landscape Scale Linkage. Based on preliminary information available in the Scoped Subwatershed Study, this corridor provides an opportunity to connect to the West Humber Valley and into the Greenbelt Plan NHS north of the FSA (outside of study area). Additional site-scale information should be used to inform the existing features and conditions. Identified as a potential opportunity to create landscape scale linkage redundancy in the NHS. Redundancy supports system function and will support system resilience where increased pressures occur (e.g., through Climate Change).	**Refinement** Further information on the features and functions present in this valleyland / watercourse corridor is required to inform the type of linkage that should be established.
L08	**Linkage Recommended** Supports redundancy in system connectivity east-west connectivity. Conceptual alignment follows an existing	**Confirmation and Refinement** Further information on the features and functions present in this valleyland / watercourse corridor is required to inform

Conceptual Linkage	Recommendation & Rationale	Next Steps
	watercourse / valley and links to the major West Humber using a terrestrial link.	the type of linkage that should be established.
L09	**Linkage Strongly Recommended** This conceptual linkage primarily follows an existing watercourse / valleyland. This northerly east-west link is an important connection for features and areas to the north into adjacent areas and ultimately connecting to the Main Humber valley through external connections.	**Confirmation and Refinement** Due the scoped nature of the current study (existing information, no field surveys), further detail is needed to confirm a) features present on the landscape that can be utilized to support a linkage, b) how system connectivity can be best achieved to support ecological form and function, c) what type of linkage would be appropriate (e.g., Major or Local Landscape Scale), d) feasibility with regards to broad land use planning and long-term function of the system. Refinements to the conceptual linkage may include location(s) and alignment (e.g., one, as shown, or several locations to connect east-west), final width, etc.

Enhancement Areas

The PPS provides direction for land use planning to protect and, where possible, improve ecological function and biodiversity of natural heritage systems. Identification of Enhancement Areas through this scoped Subwatershed study supports this direction and the identified system goals of establishing a robust and connected system. An enhancement target to increase natural cover by 30% (based on natural cover captured in the NHS) through enhancements to the NHS was set. This target was informed by the CA NHS enhancement targets for Peel and Caledon and specifically, the relative composition of enhancements within the CA NHS. Enhancement areas for the NHS are shown on Figure DA11a-c (Appendix E).

Two broad types of enhancements have been identified through the scoped SWS:

- **Defined Enhancements** are discrete areas which meet specific criteria and/or objectives to support the system. The entirety of the defined area is considered the enhancement opportunity (i.e., 100% restoration / enhancement within its boundary). These areas have discrete limits based on available mapping and criteria used to identify them. The type of enhancement (e.g., type of natural cover, design) and final limits of the enhancement area(s) are to be informed by field work and confirmed or refined through detailed subwatershed study.
- **Un-Defined Enhancements** include mapped areas of which a portion is considered the enhancement opportunity (as a % of total land area), and a subwatershed-specific target for as yet unmapped enhancements to support achieving the enhancement target. Refinement of this enhancement group (i.e., mapping of a discrete enhancement area) is to be completed through a detailed subwatershed study (or comparable study).

Within these, several enhancement types were identified representing common groups or opportunities that could be identified through this scoped subwatershed study. Each enhancement type was identified independent of the others to create a layered set of enhancements. This approach was taken as it:

- Permits the clear identification and documentation of method and rationale for identifying enhancement opportunities;
- It assists in illustrating where enhancements can support multiple benefits / opportunities;
- Recognizes the scoped nature of the current study and that enhancements will be refined through a detailed subwatershed study and informed by detailed field study and analyses; and
- Provides a comprehensive set of enhancement opportunities which meet the enhancement target.

This approach results in overlapping enhancement areas (i.e., the same geographic area may be captured within multiple enhancement types). Summaries for each enhancement type do not remove these overlaps as it serves to illustrate the total potential area associated with each enhancement type. Similarly, the values presented in this section does not exclude buffers as may be applied to features of the NHS; buffers are not considered as contributing to achieving the enhancement target and are to be removed from final enhancement area calculations.

Enhancement types are summarized in Table 2.6.3.6 and briefly described below. Enhancement areas identified under each type are also summarized in the sections below.

The enhancement areas identified may be refined or revised through subsequent detailed studies. Through detailed work, it may be determined that some areas are unsuitable for enhancement and identify alternative locations which are more suitable and provide better opportunities for the system.

Table 2.6.3.6. Enhancement Types and Criteria

Enhancement Type	Feature Types Applicable To	Criteria
Defined Enhancement Areas		
Improved shape, size, contiguity[1] *Site-level infill efforts. This is comprised of 'In-System' and 'Out of System' enhancements.*	Terrestrial Key and Supporting Features of the NHS	• In-System Enhancements: o Areas within valleylands of the NHS not currently under natural cover. • Out of System Enhancements: o Fill gaps, 'holes' or inlets <120 wide within, along the perimeter of, or between Key Features o Fill bays and inlets <1ha within existing Key Feature blocks o Identify larger infills which provide strategic opportunities to improve the system. o Connect Key Features to a significant valleyland where they occur within 60m.
Floodplain[2] *Opportunities for enhancements presented within floodplains where development is generally restricted.*	Floodplain	• All floodplain areas (as mapped) not currently under natural cover.

Enhancement Type	Feature Types Applicable To	Criteria
Linkage – Minimum Vegetated Width *Enhancements associated with the establishment of natural, self-sustaining vegetation to facilitate habitat connectivity for the FSA NHS linkages.*	Minimum Vegetated Width(s) – Major and Local Landscape Linkages, Feature (or Site) Scale Linkages	• Portions of the Minimum Vegetated Widths not currently under natural cover and not currently occupied by an incompatible land use to enhancement (e.g., a roadway).
Un-Defined Enhancement Areas		
Linkage – Permeable Landscape Zones *Enhancements associated with the establishment of natural, self-sustaining vegetation to facilitate habitat connectivity for the FSA NHS linkages.*	Land within the Permeable Landscape Zone(s) – Major and Local Landscape Linkages and not in natural cover	• A minimum of 30% of the PLZ outside of natural cover and buffers comprising the NHS is to be established as natural, self-sustaining vegetation.
Provincial NHS *Enhancements within the Greenbelt Plan and Growth Plan NHS as directed by the plan*	Land within the Greenbelt Plan and Growth Plan NHS and outside of NHS features.	• In accordance with policies of the plans. • Policy 3.2.2.3(e) (Greenbelt Plan) and 4.2.2.3(a)(vi) (Growth Plan) require that 30% of the total developable area will remain or be returned to natural self-sustaining vegetation.
Un-mapped Enhancements *Opportunities identified through future, detailed studies that support one or more of the following: habitat diversity (heterogeneity), feature size, shape, species-specific habitat objectives (e.g., Species at Risk).*	All Terrestrial and / or Aquatic Features of the NHS	• Site selection, opportunities and design will be made through future studies. o Direction provided on a subwatershed basis informed by enhancements identified through preceding types, relative natural cover, and guidance set out in this study.

[1] Additional refinement of areas identified through this scoped subwatershed study may also occur as detailed information becomes available. This may include elimination of some enhancement areas and/or the identification of others not identified here.
[2] It is anticipated that floodplain mapping will be refined through future planning stages. As such areas available for enhancement within floodplains will be refined through future planning stages.

Defined Enhancements

Improved Shape, Size and/or Contiguity

Discrete enhancement areas have been identified to support improvements to the shape, size or contiguity of the system. Through these enhancements, there are opportunities to improve edge to interior ratios, support or create interior habitat, increase habitat size or diversity, widen narrow connections, maintain existing permeability across the system, etc. Enhancements of this nature are grouped as In-System Enhancements and Out-of-System Enhancements. In many areas, these occur contiguously (e.g., a 'bay' within the NHS may be currently agricultural with a portion occurring within a Significant Valley and the balance occurring outside the mapped NHS); to reflect that these polygons are part of the same enhancement opportunity, Improved Shape, Size and/or Contiguity Enhancements have been identified as 'patches' comprised of contiguous In-System and Out-of-System polygons.

A total of 266.29 ha was identified for this enhancement type. Of these 188.69ha (~71%) are In-System Enhancements and 77.59ha (29%) are Out-of-System Enhancements. A detailed table with these enhancement patches is provided in Appendix E and shown on Figure DA12a-c. The detailed table includes a summary of where enhancements overlap with areas supporting or may inform opportunities presented by these enhancements (e.g., climate vulnerability, TRCA enhancement opportunities, ESGRA, SGRA, etc.).

In-System Enhancements

The limit(s) of portions of the NHS (Key Feature and Supporting Feature) are defined by valleys in accordance with the Greenland policies for Peel (refer to the Part A: Characterization Report for criteria used to identify the features of the NHS). As a landform feature, delineation of these areas was based on available mapping of physical characteristics (e.g., stable top of slope) and as such can and do include areas of land currently not under natural cover. Where this occurs, the areas not currently in natural cover have been identified as in-system enhancement opportunities. Although within the NHS, they are considered system enhancement opportunities as they can add to natural cover, improve habitat diversity, etc.

Out-of-System Enhancements

Criteria were used to identify enhancement opportunities focused on improvements to the system for shape, size and/or contiguity:

- Fill gaps, 'holes' or inlets <120 wide within, along the perimeter of, or between Key Features
- Fill bays and inlets <1ha within existing Key Feature blocks
- Connect Key Features to a significant valleyland where they occur within 60m.
- Identify larger infills which provide strategic opportunities to improve the system.

Using these criteria, enhancement areas were identified across the system consisting of predominantly small polygons/patches.

Floodplain Enhancement

Lands within the mapped floodplain and not currently under natural cover are identified as enhancement opportunities. Lands within the floodplain are regulated and development is constrained within them. Establishing natural vegetation within floodplains has the potential to support the water resource system and natural heritage system through habitat creation and enhancement, creating or supporting connections within the system, hydrologic support for terrestrial and aquatic features, providing infiltration opportunities to support groundwater systems, attenuating flooding, etc.

A total of 255.54ha were identified as Floodplain Enhancement opportunities. Of these, 49.25ha (19%) occur 'in-system' and 206.30ha (81%) occur 'out-of-system'.

Linkage Minimum Vegetated Width (MVW) Enhancements

The Minimum Vegetated Width (MVW) of linkages are to be maintained as, or established as, natural self-sustaining vegetation. Areas not currently under natural cover are identified as enhancement areas. Mapped enhancements through this scoped subwatershed study are based on the preliminary alignments of the Major Landscape Linkages and Local Landscape Linkages. In addition to lands within these two landscape linkage types, Feature (or Site) Scale Linkages are comprised of a MVW and will represent additional enhancements to be identified and mapped through future stages of study (e.g., a detailed subwatershed study).

A total of 228.69ha for enhancement within the MVW of Large Landscape and Local Landscape Linkages was identified.

Table 2.6.3.7. Summary of Enhancement Opportunities

Enhancement Type	Total Area (Ha)
Improve shape, size, contiguity Enhancements	245.37
In-System Enhancements (Key Features)	*139.27*
In-System Enhancements (Supporting Feature)	*49.42*
Out-of-System Enhancement	*77.59*
Floodplain Enhancements	255.54
Linkage – Minimum Vegetation Width Enhancements	228.69
Linkage – Permeable Landscape Zone Enhancements	72.22
Provincial NHS Enhancements	91.54
Other Enhancements (not mapped)	13.55
Total Enhancement Opportunity Area[2]	**661.54**

[1] All enhancement areas listed are 'as mapped'. Enhancement types were delineated independently and such overlap across the FSA (e.g., a linkage enhancement area may overlap with floodplain or shape, size, contiguity enhancements, occur within the Greenbelt Plan NHS outside of features).
[2] The total listed removes all 'overlap' so that enhancement areas are not double counted in the total. It does not exclude preliminary buffers on Key Features.
[3] Areas listed for Un-Defined Enhancement Areas represent an assumption that 30% of the mapped enhancement area is 'enhanced' (e.g., 10ha total mapped area = 3ha of assumed enhancement area).

Un-Defined Enhancements

Linkage - Permeable Landscape Zone
The Major and Local Landscape Linkages include a Permeable Landscape Zone (PLZ) intended to create a softer transition between natural and built areas through establishment of land uses that support or are compatible with linkage functions (e.g., parks, natural-design stormwater facilities). A minimum of 30% of the PLZ outside of natural features comprising the NHS is to be maintained or established as self-sustaining vegetation. Decisions regarding the final enhancement area (i.e., proportion of the PLZ enhanced) is to be informed by the form and function of adjacent habitats, and opportunities presented by the area being assessed (refer to 'Stacking Enhancement Benefits' section below). Enhancements within the PLZ may contribute to overall size of the NHS, strengthen linkage function(s), add to habitat diversity in the local landscape and increase overall natural cover.

Potential enhancements range from 72.22ha at 30% enhancement of the total area identified.

Provincial NHS

The Greenbelt NHS defines the great majority of the Province's NHS within the FSA. Policies for the Greenbelt Plan NHS apply to lands occurring within the Greenbelt Plan NHS.

Three small areas of the Province's NHS are defined by the Growth Plan NHS within the FSA. NHS policies of the Growth Plan apply to lands occurring within the Growth Plan until such time as they are included within a Settlement Area; upon integrations into a Settlement Area, features and Natural Heritage System(s) are to be identified and protected in accordance with the PPS. The PPS directs municipalities to identify and protect an NHS. The PPS provides the minimum standards; however, municipalities may do more. It is recommended that the boundary of the Growth Plan NHS be maintained for identifying system enhancement opportunities in a manner consistent with the Greenbelt Plan NHS. The small portions defined by the Growth Plan NHS are contiguous with areas of the Greenbelt Plan NHS and as such create logical extensions from these areas to lands and portions of the NHS occurring outside of the FSA.

In accordance with the above, lands within the Province's NHS and outside of identified features of the FSA NHS are identified as potential enhancement areas. A minimum of 30% of the *developable area* (i.e. lands not occurring within a feature to be retained as part of the FSA NHS or within a linkage of the FSA NHS) are to be maintained or established as self-sustaining natural vegetation.

Decisions regarding the final enhancement area (i.e., proportion to be enhanced) is to be informed by the form and function of adjacent habitats, and opportunities presented by the area being assessed (refer to 'Stacking Enhancement Benefits' section below). Enhancements within the Province's NHS may contribute to overall size of the NHS, strengthen linkage function(s), add to habitat diversity in the local landscape and increase overall natural cover.

Potential enhancements range from 91.54ha at 30% enhancement of the total area identified.

Other Enhancements

Through this scoped subwatershed study, enhancement opportunities have been identified based on best available information and system-scale opportunities. In part, with the objective of estimating how much land within the SABE will be required to address the NHS goals and targets, and also to identify opportunities on the landscape for further consideration, and identify where additional lands are required to be identified through future study. It is recognized that detailed study will identify additional opportunities to enhance and support a robust system that cannot be readily identified at the scale of the current Scoped SWS.

The following provides guidance for the identification of 'other enhancements' through future studies:

- Site selection, opportunities and design will be made through future studies.
- 'Other enhancements' are to be identified as defined enhancement areas or as un-defined enhancements with specific direction re: the amount of restoration area (e.g., 30% of lands within a delineated area).
- 'Other enhancements' are to increase natural cover of the NHS. The type of design shall be informed by the system targets set out in this Scoped SWS.
- Quantitative direction is provided by Subwatershed to meet the overall system enhancement target in a distributed manner across the FSA. This quantitative direction has been informed by:
    - Existing natural cover occurring within the preliminary NHS
    - Mapped enhancements identified through this Scoped SWS
- Through future studies, these enhancement opportunities are to be informed by a range of factors including:
    - Feature proximity (groupings), shape and position on the landscape
    - Habitat diversity or assemblage (i.e., opportunities to improve or enhance)
    - TRCA climate vulnerability modeling

- TRCA landscape connectivity areas
- TRCA modelled enhancement opportunities (CA NHS)
- Existing natural cover and opportunities (or lack of) on the local landscape
- Opportunities to support a robust system at the site or subwatershed scale
- Potential interactions and opportunities with the WRS and NHS functions (e.g., ESGRA, SGRA)
- Potential opportunities to support Species at Risk

Several general areas have been identified across the FSA for consideration in the identification of other discrete enhancement opportunities through future, detailed studies (Figure DA2-13). These areas have been identified based on numerous factors:

- **Relative position on the landscape and the preliminary NHS**. Opportunities to expand natural cover and habitat at key junctures (e.g., confluence of two major valleys, or at intersection of several linkages) can improve the overall form and function of the NHS.
- **Potential ecological and hydrologic complexity**. Areas where, based on information used in the Scoped SWS, there is some indication of potential interactions on the landscape that could create complex ecological conditions (e.g., high habitat diversity, microtopography) and/or indicate hydrologic connection and interactions between groups of small features (e.g., wetlands).
- **Supporting or Contributing to Species at Risk**. Redside Dace are known to occur in the FSA and areas downstream of the FSA. Opportunities to enhance areas associated with occupied or contributing habitat has the potential to further support protection and recovery of the species.
- **Intersections and interactions between the NHS and the WRS.** Restore and enhance areas that will benefit the Natural Heritage and Water Resource Systems across multiple factors and specifically in areas which directly support important surface and groundwater contributory functions or in areas of downstream vulnerability (e.g., downstream flood risk).
- **Climate change resilience**. Identify opportunities on the landscape where enhancement of the NHS can support resilience to climate change. Select areas identified as being at increased vulnerability to climate change to support a resilient system that supports biodiversity, ecological and water quality and quantity in the long-term.

These areas do not represent mapped enhancement opportunities and as such are not included in enhancement area calculations. They are intended to provide some direction for further assessment and consideration through more detailed studies in the development of final enhancement areas.

A total of 8 broad areas have been identified. Information on these areas is provided in Table 2.6.3.8.

Table 2.6.3.8. Areas for Enhancement Consideration through Detailed Studies

Area	Potential System-Benefit Opportunities	Preliminary Restoration Opportunities
F1	This is an area of several headwaters for Fletcher's Creek and mapped as candidate contributing habitat for the Redside Dace (*Clinostomus elongatus*), an endangered freshwater fish species. This area of Fletchers Creek is identified as High climate vulnerability area (TRCA Climate Vulnerability)	• Restoration and/or enhancement of lands in this headwater area to support downstream habitat for Redside Dace (e.g., baseflow, water quality, allochthonous inputs). • Supportive or compatible land uses to support hydrologic conditions supporting the headwater features. • Opportunity to support climate change resilience.
UE1 and UE2	UE1 and UE2 are considered together as they represent similar opportunities. Confluence of two significant valleylands, major bend in the valley and connections to areas north and south of the FSA within the Upper Etobicoke Creek Subwatershed. This presents potential opportunities to strengthen this NHS confluence, increasing habitat diversity, size of habitat complex(es) and support movement. UE1 is in ‘moderate’ climate vulnerable area. UE2 is in a ‘low’ climate vulnerable area. (TRCA Climate Vulnerability) Both areas overlap with TRCA ‘Local Connectivity’ areas (Forest to Forest).	• Range of potential habitat opportunities (e.g., wetland, woodland, meadow). To be informed by detailed, site-specific information to identify opportunities which support local conditions (e.g., support features or functions, increase diversity, etc.) • Increase size and shape of the NHS. • Opportunities for integration of parks and other open spaces adjacent to the NHS to provide access to nature (community health), recreation, etc.
UE3 and UE4	Opportunities to connect Key Features, integrate other areas of existing natural cover and improve system shape and size within the Upper Etobicoke Creek Subwatershed. Support linkage functions and system contiguity. Both areas occur within a ‘moderate’ climate vulnerable area (TRCA Climate Vulnerability).	• Restoration of existing and enhancement to create new natural cover. Habitat opportunities could include meadow, thicket, forest or wetland and should be informed by site-specific study.

Area	Potential System-Benefit Opportunities	Preliminary Restoration Opportunities
	UE4 is strongly aligned with a TRCA 'Local Connectivity area (Forest to Forest),	• Proximity to an existing development may support inclusion of linkage supportive or compatible uses to also support community health (access to nature, physical and mental wellbeing).
WH1, WH2 and WH3	Although located in different areas, these conceptual enhancements have been identified on a similar basis. These areas within the West Humber Creek Subwatershed have clusters of small depressional wetlands and mottled soils (aerial imagery). This may indicate hydrologic interactions and interdependencies in these areas to support these features. Similarly, they may support more complex local or micro-topography or complex habtiats. Opportunities restore and enhance these areas present opportunities for diverse habitat complexes which could support both ecological and hydrologic functions. Detailed assessment is required to determine existing conditions and assess hydrologic interactions and functions. Per TRCA Climate Vulnerability modeling: WH1 is in an area of 'low' climate vulnerability, WH2 is in a 'moderate' climate vulnerability area, and WH3 is in an area of 'high' climate vulnerability.	• Connect small features to key features and other components of the NHS to support a robust and connected NHS, reduce feature isolation. • WH1 – located at a headwater for catchment area. Support headwater and hydrologic function, create habitat patch. • WH2 – connect Key Features and supporting features into a habitat patch. Predominantly in a headwater area, support function. • WH3 – create habitat node, connected to a Local Landscape Linkage in an area with limited areas of substantial natural cover within the subwatershed.

Assessing the Enhancement Target

Focus through this scoped subwatershed study has been to identify a broad range of enhancement area(s) to support the achievement of the 30% natural cover increase[5] target through implementation of the NHS. This has included identification of a range of enhancement opportunities across the FSA in the form of mapped defined and undefined enhancements and consideration for currently un-mapped enhancement opportunities and guidance for their identification through site-specific study (e.g., a detailed subwatershed study).

[5] 30% increase based on existing natural cover within the FSA based on available ecological land classification mapping.

To assess whether the scoped subwatershed study has effectively supported the enhancement target, an analysis of enhancement opportunities with all overlaps between enhancement opportunities removed was completed. For this analysis: Defined enhancements were calculated at 100% enhancement and un-defined enhancement area was calculated at 30% enhancement (ha). Where defined enhancement areas overlap with un-defined enhancement areas, the defined enhancement took precedence for area calculations.

Buffers are not considered system enhancements; their primary function is to mitigate anticipated impacts associated with adjacent development. In order to reflect the influence of buffers on enhancement opportunities (ha), preliminary buffers – 30m applied to Key Features of the NHS – were applied their area removed from the enhancement opportunities to obtain a more accurate estimate of land available to support the enhancement target. This approach was used to approximate their influence only; buffers will be confirmed through future studies. While buffers are not counted as 'enhancements', they are to be established as self-sustaining vegetation and as such contribute to overall natural cover, providing an additive function. Buffers are further discussed in the System Management Strategy section below.

Based on the above, enhancement areas can be summarized as follows:

- Approximately 60% of all mapped enhancements (by area) occur within the FSA NHS (within and outside of the Greenbelt Plan NHS):
    - 33% occur within unvegetated portions of Key and Supporting Feature Valleylands
    - 27% occur within mapped MLL and LLL linkages
- Of the 40% that occur outside of the FSA NHS:
    - ~17% are within the Greenbelt Plan NHS (non-vegeated areas)
    - ~16% are associated with floodplains
    - ~6% occur on apparently unconstrained lands (outside the Greenbelt Plan NHS, FSA NHS, or floodplain).

This summary illustrates that the majority of mapped enhancements occur within the FSA NHS (60%) and of the 40% that occur outside of the FSA NHS, only 6% occur on apparently unconstrained lands. These lands are considered 'apparently unconstrained' as detailed study is required to confirm natural heritage and other constraints that influence land use opportunities.

Based on existing natural cover (1333.6 ha), a total of 400ha of land must be enhanced achieve the 30% natural cover increase target. At the FSA scale, mapped enhancements represent a potential 29% increase in natural cover (389.54 ha). While this represents a small target shortfall of 1% (10.46ha), this outcome illustrates that the target can be achieved. Moreover, the framework for enhancements presented in this scoped subwatershed study provides flexibility through implementation to refine enhancement opportunities. Of particular note are opportunities in the Areas for Enhancement Consideration (Table 2.6.3.8), opportunities informed by site-specific study (e.g., species-specific enhancements, etc.), emerging studies (e.g., climate vulnerability), etc. which can be used to build upon the work completed. The enhancements identified through this scoped subwatershed study support the system goal of establishing a robust, connected and resilient system.

To support a distributed approach to system enhancement, reflect existing conditions, and support future studies (e.g., detailed subwatershed studies), it is recommended that the enhancement target be refined and implemented at the subwatershed scale. Table 2.6.3.9 provides a breakdown of existing natural cover, target area, and potential increase in natural cover by achieving the enhancement target for each subwatershed of the FSA. Table 2.6.3.10 summarizes the subwatershed-level enhancement target (ha) and mapped enhancements within each subwatershed (ha). As noted above, the final selection of enhancement areas, including identification of additional or alternative enhancements to meet the enhancement target is to occur through subsequent study to reflect site-specfic condition, emerging information, etc.

Translated into a change in total land cover across the FSA, implementation of the enhancement target represents a ~5% potential increase in total natural cover from ~17% (existing natural cover within the FSA) to ~22% (existing natural cover + enhancement target [400ha]). Relative potential increases to natural cover varies by subwatershed (Table 2.6.3.9).

Based on the information presented here, a target to increase natural cover by 30% through enhancement areas is achievable and appropriate to be implemented within the FSA. The majority of enhancements identified occur within the system (features, linkages) or within lands partially or wholly constrained (e.g., Provincial NHS, floodplains). Due to the low existing natural cover within the FSA, achieving the enhancement target will still place the local landscape below recommendations for landscape-scale cover targets (e.g. How Much Habitat is Enough) but provides opportunity for a significant move to protect existing functions (e.g., biodiversity) and build resilience (e.g., climate change).

Table 2.6.3.9. Summary of Enhancement Requirements to Achieve 30% Natural Cover Increase Target

Subwatershed	Land Area within the FSA (ha)	Mapped Natural Cover (ha)	Existing Natural Cover (% of land area within the FSA)	Enhancement Required to Achieve 30% Natural Cover Increase Target (ha)	Potential Natural Cover* (% of land area within the FSA)
Credit River – Glen Williams to Norval	23.39	4.07	18%	1.22	23%
Fletcher's Creek	190.72	13.89	7%	4.17	9%
Huttonville Creek	43.00	1.89	4%	0.57	6%
Main Humber	430.79	58.41	14%	17.52	19%
Spring Creek	6.93	0.00	0%	0.00	0%
Upper Etobicoke	2025.48	379.03	19%	113.71	30%
West Humber	5338.96	876.27	16%	262.89	26%
Summary	**8059.28**	**1333.56**	**17%**	**400.01**	**22%**

*Based on achieving the 30% natural cover enhancement target.

Table 2.6.3.10. Summary of Enhancements Target Area (ha) and Mapped Enhancements (ha) by Subwatershed

Subwatershed	Enhancement Required to Achieve 30% Natural Cover Increase Target (ha)	Mapped Enhancement Opportunities[6] (Scoped SWS) (ha)
Credit River – Glen Williams to Norval	**1.22**	0.00
Fletcher's Creek	**4.17**	0.00
Huttonville Creek	**0.57**	0.00
Main Humber	**17.52**	5.21
Spring Creek	**0.00**	0.00
Upper Etobicoke	**113.71**	119.97
West Humber	**262.89**	264.36
Summary	**400.01**	**389.54**

[6] Areas presented here: (1) removes overlap between enhancement types (discrete enhancements take precedence for area calculations); (2) applies a 30% restoration factor to un-defined enhancement areas, and (3) excludes preliminary buffers (30m applied to Key Features).

Recognizing Additional Opportunities

The Region of Peel Climate Change Master Plan recognizes the increased impacts to natural systems associated with climate change (p. 7). Chapter 4 of the Plan provides direction on preparing for climate change through transforming Peel into a well-prepared and resilient community. This includes addressing the anticipated stressors placed on natural systems through climate change (climatic variability and extremes) paired with existing pressures (e.g., development and growth, increased use and pressure on existing natural areas). Action 14 of the Plan is to "Protect and Increase Green Infrastructure Throughout Peel" and explores the role of green infrastructure in building a resilient community.

As defined in the Plan, Green Infrastructure *"can be natural or human-made, can include parks, trees, shrubs, urban forests, green roofs and walls, gardens, bioswales, natural channels and watercourses, and constructed wetlands. Green infrastructure reduces the risk of heat stress and flooding primarily by increasing infiltration and reducing runoff, increasing evaporative cooling, and providing shading and areas for reprieve. Reducing heat and flood risk through the expansion of green infrastructure can benefit a range of services."*

The NHS is a major element of Green Infrastructure within the Region. Opportunities to integrate and consider co-benefits of planning parks and open space in ways that support green infrastructure functions between natural and non-natural opportunities should be explored.

It is recognized that through refinements to the NHS, detailed field assessment, floodplain mapping, etc. that refinements will occur. Refinements to enhancement areas through subsequent stages of work (e.g., detailed subwatershed study) is to be informed by:

- Detailed field-assessment and analyses to identify interactions, interdependencies, sensitivities, etc.
- Form, function and composition of existing habitats adjacent to / in local landscape and opportunities to expand, support existing function(s), or fill 'gaps' in habitat representation;
- Overlapping benefit opportunities, including:
  - Ecologically Significant Groundwater Recharge Area
  - Significant Groundwater Recharge Area
  - Contiguous to Redside Dace Habitat (Occupied)
  - TRCA Climate Change Vulnerability
  - TRCA Linkage Connectivity
- Indigenous Traditional Knowledge[7]
- Opportunities for co-benefit or integrated planning for green infrastructure.
- The recommended system enhancement target and direction provided herein.

System Summaries by Subwatershed

Preceding sections identify the preliminary NHS for the FSA and provide direction for the refinement of the NHS through detailed studies to follow (e.g., detailed subwatershed studies). It is anticipated that detailed studies will occur at refined scales (e.g., by subwatershed or similar). To ensure consistency with the intent of the NHS presented herein, and to facilitate implementation through future detailed studies, summaries of the system are provided for each subwatershed of the FSA (relevant to portions of the subwatershed occurring within the FSA).

[7] Indigenous people have lived on and with the land for countless generations. Traditional knowledge and ways of knowing should be included as a means through which enhancement opportunities are identified and informed. Consultation through comprehensive subwatershed studies is strongly recommended.

The FSA captures portions of seven (7) subwatersheds. Table 2.6.3.11 summarizes the watershed areas and their representation within the FSA.

Table 2.6.3.11. Subwatersheds of the FSA

Area	Subwatershed (ha)	Area within FSA (ha (% of watershed within FSA)	As a Function of FSA Land Area
Credit River – Glen Williams to Norval	1,119.37	23.40 (2%)	<1%
Fletcher's Creek	4,166.64	190.71 (5)	2%
Huttonville Creek	1,509.10	43.00 (3%)	<1%
Main Humber	20,706.00	441.86 (2%)	5%
Spring Creek	4,887.75	6.93 (<1%)	<1%
Upper Etobicoke	9,972.30	2,025.52 (21%)	25%
West Humber	18,198.30	5,574.32 (31%)	66%

Features or other components of the NHS occur within each subwatershed. These are summarized in Table 2.6.3.12 and discussed by subwatershed below. Area (ha) is provided in each column with the percent of the subwatershed land area captured by the NHS component shown in brackets. To facilitate comparison across the subwatersheds, the table also presents the proportion of the system (i.e., Feature, Linkage, Enhancement) represented within each subwatershed as a percent. There is overlap between component of the NHS (Features, Linkages and Enhancements); areas presented or these components cannot be added to create a cumulative area of the NHS. A high-level summary of total Preliminary NHS area, comprised of Features, Linkages and Enhancements is provided in Table 2.6.3.13.

Table 2.6.3.12. NHS Component Summary by Subwatershed presented as hectares with % of land area for the subwatershed provided in brackets.

	Features by Subwatershed				
	Credit River – Glen Williams to Norval	Fletcher's Creek	Main Humber	Upper Etobicoke	West Humber
NHS Features					
Key Features	4.07 (17%)	3.63 (2%)	3.51 (1%)	275.75 (14%)	596.82 (11%)
Supporting Features	0.00 (0%)	5.93 (3%)	47.96 (11%)	108.70 (5%)	305.07 (5%)
Other Features	0.00 (0%)	0.90 (<1%)	1.08 (<1%)	13.92 (1%)	10.93 (<1%)
Total	**4.07 (17%)**	**10.46 (6%)**	**52.55 (12%)**	**398.36 (20%)**	**912.81 (16%)**
Linkages					
Linkages[1]	0.00 (0%)	0.00 (0%)	7.06 (2%)	260.02 (13%)	709.18 (13%)
Enhancements[2]					
Defined Enhancements					
In-System Enhancements	0.00 (0%)	0.00 (0%)	3.52 (1%)	27.39 (1%)	133.79 (2%)
Out-of-System Enhancements	0.00 (0%)	0.00 (0%)	0.01 (<1%)	42.52 (2%)	38.15 (1%)
Floodplain Enhancements	0.00 (0%)	0.00 (0%)	2.12 (<1%)	125.68 (6%)	127.74 (2%)
Linkage - MVW	0.00 (0%)	0.00 (0%)	1.26 (<1%)	68.63 (3%)	158.8 (2%)
Un-Defined Enhancements					
Linkage - PLZ	0.00 (0%)	0.00 (0%)	0.39 (<1%)	19.94 (1%)	51.89 (1%)
Provincial NHS Enhancements	0.00 (0%)	0.00 (0%)	0.25 (<1%)	26.02 (1%)	65.26 (1%)
Other Enhancements	1.22 (5%)	3.13 (2%)	9.19 (2%)	0 (0%)	0 (0%)

[1]Linkages overlap with features of the NHS and Enhancements of the NHS. Summary values between categories (i.e., features, linkages, enhancements) cannot be combined linearly.
[2]Enhancement areas (ha) shown represent the actual area recommended for enhancement. For Defined enhancements, this is 100% of the mapped area; for un-defined enhancements this represents 30% of the mapped area.
[3]Mapped enhancements overlap to illustrate type of enhancement opportunity present and inform future refinements. Enhancement area total removes these overlaps to represent a composite area.

Distribution of the NHS across the subwatersheds is presented in Table 2.6.3.13. While the majority of the NHS occurs in two subwatersheds – the Upper Etobicoke and West Humber – the distribution of the NHS is relatively consistent with the proportion of lands within the FSA within each subwatershed (Table 2.6.3.11). Similarly, the distribution of linkages and enhancements is generally reflective of this overall distribution as well.

Table 2.6.3.13. Proportion of NHS Components by Subwatershed

NHS Component	Credit River – Glen Williams to Norval	Fletcher's Creek	Main Humber	Upper Etobicoke	West Humber
NHS Features	<1%	1%	4%	29%	66%
Linkages*	0%	0%	<1%	27%	73%
Enhancements	<1%	<1%	2%	34%	53%

*Includes mapped Major and Local Landscape Linkages. Does not include conceptual linkages.

The NHS has been built out from existing natural cover through the categorization as features as part of (i.e., Key, Supporting and Other features) or outside the system, identifying linkages to connect features and areas of the system across the landscape and enhancements within, along and extending from these areas to achieve a net gain and meet enhancement targets for the system. This is reflected in the total land area of the NHS within each subwatershed, as shown in Table 2.6.3.12 and as can be seen on Figure series DA2-9, DA2-10 and DA2-11. Of the 2074.46ha of the FSA NHS, 718.50 ha (~35%) is within the Greenbelt Plan NHS. A simplified depiction of the NHS, including features, linkages and enhancements is provided on Figure DA2-14.

Table 2.6.3.12. Total Area of NHS by Subwatershed

Subwatershed	Consolidated Preliminary NHS[1] (ha)	Preliminary NHS as a % of total Subwatershed Land Area in FSA
Credit River – Glen Williams to Norval	5.29	23%
Fletcher's Creek	13.58	7%
Huttonville Creek	0.00	0%
Main Humber	66.58	15%
Spring Creek	0.00	0%
Upper Etobicoke	661.79	33%
West Humber	1340.76	25%
Total within the FSA	**2074.46**	**26%**

[1] This includes all Key, Support and Other Features, Linkage Areas and Enhancements (Defined and Un-defined) and exludes preliminary buffers (30m on Key Features of the FSA NHS).

Credit River – Glen Williams to Norval

Located at the westerly edge of the FSA, only a very small portion (2%) of the subwatershed occurs within the FSA. Correspondingly the proportion of the NHS represented in the subwatershed is also small (0.3%). The portion of the NHS within the subwatershed is comprised of a portion of one Key Feature (forest) representing 17% (4.07 ha) of the total land area of the subwatershed within the FSA. No Supporting or Other Features were identified in this subwatershed.

No landscape linkages or enhancements have been mapped within the subwatershed in the preliminary NHS. To meet the enhancement target 1.22ha of 'other enhancement' area is to be identified through future study.

Fletcher's Creek

Located at the southwestern portion of the FSA, only a small portion (5%) of the subwatershed occurs within the FSA. Similarly, the proportion of the NHS represented in the subwatershed is also small (0.8%). The portion of the NHS within the subwatershed is comprised of a portion of one Key Feature (woodland), as well as a feature complex comprised of Key Features (plantation), Supporting Features (meadow), and Other features (meadow, plantation). Collectively, the Key Features, Supporting Features, and Other Features represents 2% (3.63 ha), 3% (5.39 ha), and <1% (0.9 ha) of the total land area of the subwatershed within the FSA, respectively.

No landscape linkages or enhancements have been mapped within the subwatershed in the preliminary NHS. To meet the enhancement target 3.13ha of 'other enhancement' area is to be identified through future study.

Main Humber

Located at the northern edge of the FSA, a very small section (2%) of the subwatershed occurs within the FSA. The proportion of the NHS represented in the subwatershed is similarly small (4%). The portion of the NHS within the subwatershed is comprised of several small dispersed Key Features (woodland, forest) representing 1% (3.51 ha), several large Supporting Features (meadow, wetland) representing 11% (47.96 ha), and several small Other Features (aquatic, meadow) representing <1% (1.08 ha) of the total land area of the subwatershed within the FSA.

The proportion of the Linkages represented in the subwatershed accounts for <1% of the total linkages identified. One Local Landscape Linkage (LLL) runs east to west to improve connectivity of the Cold Creek and a large contiguous forest, to a meadow patch. Feature (or site) scale linkages have not been mapped at this time; these will be assessed and identified in future studies (e.g., detailed subwatershed study).

Shape, Size & Contiguity Enhancement, Linkage, Floodplain and Provincial NHS Enhancements have been identified representing with 2% (7.07 ha) of the total land area of the subwatershed within the FSA. To meet the enhancement target 9.19ha of 'other enhancement' area is to be identified through future study.

Upper Etobicoke

Located at the southern section of the FSA, a significant portion (21%) of the subwatershed occurs within the FSA. An equally significant proportion of the NHS, second largest, is represented in the subwatershed (29%). The portion of the NHS within the subwatershed is comprised of Key Features (forest, wetland) representing 14% (275.75 ha), Supporting Features (Meadow, Thicket) representing 5% (108.70 ha), and Other Features (meadow, hedgerows) representing 0.7% (13.92 ha) of the total land area of the subwatershed within the FSA.

The proportion of the Linkages represented in the subwatershed accounts for 27% of the total linkages identified for the NHS. A group of linkages with one Local Landscape Linkage (LLL) running north-south, spans from the West Humber subwatershed to the Upper Etobicoke subwatershed. This LLL connects to a Major Landscape Linkage (D) that runs both north-south and east-west before connecting to a second LLL, that runs north-south. This grouping of linkages connects several Key Features (forest, wetland) on the landscape, and represents 13% (260.02 ha) of the total land area of the subwatershed within the FSA. Feature (or site) scale linkages have not been mapped at this time; these will be assessed and identified in future studies (e.g., detailed subwatershed study).

Shape, Size & Contiguity, Linkage, Floodplain and Provincial NHS Enhancements and Conceptual Enhancement(s) have been identified representing a total of 11% (224.23 ha) of the total land area of the subwatershed within the FSA. The proportion of the Enhancements represented in the subwatershed accounts for 35% of the total enhancements identified.

West Humber

Located at the northeastern portion of the FSA, a significant portion (31%) of the subwatershed occurs within the FSA. The largest proportion of the NHS is represented in the subwatershed (66%). The portion of the NHS within the subwatershed is comprised of Key Features (thickets, meadows) representing 11% (596.82 ha), Other Features (plantation, aquatic) representing 5% (305.07 ha) and Supporting Features (meadow, aquatic) representing 0.2% (10.93 ha of the total land area of the subwatershed within the FSA.

The proportion of the Linkages represented in the subwatershed accounts for 73% of the total linkages identified. The West Humber Subwatershed includes two groupings of linkages, the first of which is comprised of two north-south linkages with a short east-west linkage to connect features with a Major Landscape Linkage, which encompasses a section of the West Humber River adding connectivity for several Key Features. This linkage improves connectivity between a wetland, forest, and meadow habitat. The second grouping of linkages which connects several Key Features includes two Major Landscape Linkages, one that runs north-south and the other east-south, connected by Local Landscape Linkage. The third linkage in the West Humber Watershed is a Local Landscape Linkage that runs north-south along the Salt Creek. Feature (or site) scale linkages have not been mapped at this time; these will be assessed and identified in future studies (e.g., detailed subwatershed study).

Size, Shape & Contiguity, Linkage, Floodplain, Provincial NHS have been identified representing a total of 8% (416.70 ha) of the total land area of the subwatershed within the FSA. The proportion of the Enhancements represented in the subwatershed accounts for 53% of the total enhancement areas identified.

Achieving Targets for the NHS

The preliminary management strategy set out through the preceding sections provides initial direction and guidance for management of the NHS. While written to the FSA in its entirety, the direction provided is applicable to any area occurring within the FSA (e.g., the SABE, SABE Testing, etc.).

Through the identification of the Features, Linkages (Major Landscape, Local Landscape and Feature (or Site) Scale) and Enhancement Areas, the NHS for the FSA is a robust system which captures a significant portion of existing features on the landscape and has regard for the anticipated change in land use within the ultimate SABE lands to ensure a sustainable and resilient system.

Targets for the NHS supporting no net loss (e.g., woodlands, wetlands) are supported through management outcomes which include protection in-situ wherever possible, but also provide guidance for replication and compensation to address features which may be impacted by development where policy requirements permits replication and compensation of the features.

Successional / Open habitats have been captured within the preliminary NHS as Supporting and Other Habitats where they are contiguous to Key Features of the NHS. This approach recognizes the potential interactions and supportive functions between these and other features of the NHS and flags then for detailed assessment through future study.

Fish habitat is protected as part of the NHS. Watercourses (permanent, intermittent) and Headwater Drainage Features (HDF) identified as Protection or Conservation (per Section 2.3.4) will be protected as part of the NHS and managed in accordance with direction provided here, Part C: Implementation and applicable regulations and legislation. Buffers applicable to aquatic habitat are to be restored to natural, self-sustaining vegetation and will support achieving the aquatic habitat target.

Very few "sand barrens, savannahs, grasslands" occur within the FSA. All are captured within the NHS as Key Features.

All features of the NHS will be managed in accordance with direction provided here and in Part C: Implementation, applicable policies, regulation and legislation.

Taking guidance from the CA NHS, a target was set to increase natural cover by 30% through enhancement areas. This target is to be carried forward to future studies, policy, and levels of planning and achieved in the implementation of the planning for the SABE. This enhancement target has been achieved through this scoped subwatershed study through mapped enhancements and direction for identification of enhancements through future, detailed studies. The enhancement target is achievable with the majority of the enhancement opportunities identified within the NHS (e.g, within valleylands, linkages), hazard lands and the province's NHS.

Reflection on Goals for the NHS - Summary

Goals for the NHS provided high-level guidance for the identification of the NHS for the FSA. Presented at the beginning of Section 2.5.2.1, this section provides a brief summary of the preliminary NHS in reflection of the goals.

- Develop a system (NHS) that balances policy direction, emerging science and natural heritage planning best practices.
    - Policy direction was used to build initial criteria for features of the NHS and to inform the direction to create linkages and enhancements.
    - Best practices and good science were used to refine feature criteria and inclusion, inform linkage locations and widths, plan for and identify locations for enhancement.
- Establish a robust, connected and ecologically resilient system (NHS) for the long-term benefit of environmental and public health, well-being and safety.
    - Through the preliminary NHS presented in the scoped subwatershed study, a robust system has been identified with some flexibility retained for good land use planning.
    - Planning for and consideration of biodiversity impacts, climate change and land use changes have been used to inform system planning and management.
- Provide opportunities and direction for the enhancement of the NHS to establish a sustainable system in a changing landscape matrix and that supports climate change resilience.
    - A range of enhancement opportunities have been identified with a recommended target to ensure system planning requirements provide intended outcomes.
    - Informed by good practice, climate vulnerability information and multi-disciplinary considerations, they represent opportunity to create a resilient system for the long-term.

While not a specific goal for the NHS, consideration was also given to the following goal from the CA NHS:

- To provide outdoor appreciation and recreational opportunities and to promote healthy communities (CA NHS).
    - Through the approaches taken (e.g., the Permeable Landscape Zone for Landscape Linkages, Enhancement Areas – in particular the Conceptual Enhancements) consideration has been given to opportunities to create an interactive and accessible interface with the natural environment.
    - Access to nature, and in particular 'large park' spaces is important for growing populations so that residents can achieve the physical and mental benefits of access to nature. Creating a robust system, such as through the Conceptual Enhancements, will assist in supporting this.

2.6.3.2 Preliminary SABE Concept

Water System (Surface and Ground)

The results of the impact assessment have demonstrated that, in the absence of stormwater management, future development of the preliminary SABE concept within the FSA would be anticipated to increase the risk of flooding and erosion along receiving drainage features within the FSA and downstream, as well as degrading the quality of surface runoff to aquatic habitat and terrestrial features and the supply of surface water and potentially groundwater to sensitive features. Previous studies within the respective subwatersheds encompassing the preliminary SABE concept include recommendations for stormwater management, which serve as an indication of the stormwater management requirements for the preliminary SABE concept, subject to further assessment as part of subsequent studies. The following provides an overview of stormwater management criteria for flood control, erosion control, water quality control, and water budget management for similar developments within the subwatersheds and in other municipalities through the GTA.

Flood Control:

The end-of-pipe storage volume requirements for flood control, above extended detention storage volume requirements, vary according to soil type, surface slopes, and land use conditions. No stormwater management facility sizing criteria has been provided for development within the Main Humber River or West Humber River Subwatershed; in the absence of this information, a literature review has been completed for subwatershed studies in various municipalities across the GTA (i.e. Mississauga, Brampton, Markham, and Milton) to determine the potential range of unitary storage volume required for quantity control for the 100 year and Regional Storm events. The range of incremental detention storage volumes within end-of-pipe facilities for 100 year and Reigional Storm control based upon a literature review of subwatershed study recommendations through the GTA, is summarized in Table 2.6.3.10. The specific requirements for mitigating flooding impacts will need to be determined as part of future studies. It is also important as part of future studies to not only assess the impacts locally but also on a subwatershed basis to ensure that hydrograph timing effects are considered when establishing the levels of control warranted by the proposed development. Furthermore, as noted previously, the sizing of flood control facilities should consider the influence of climate change, and should therefore assess stormwater management facility performance for climate adjusted storm events.

Table 2.6.3.10. Range of Detention Storage Requirements for 100 Year and Regional Storm Event Flood Controls Across GTA (m^3/impervious hectare)

Operating Condition	Unitary Storage Volume[1, 2]
100 Year	400 - 1250
Regional Storm Event	0 - 1200

NOTES: 1. Unitary 100 year storage volumes are exclusive of extended detention storage requirements for erosion and/or stormwater quality control.
2. Unitary Regional Storm event storage volumes are in addition to 100 year storage volumes and extended detention storage volume requirements.

Erosion Control:

Similar to flood control volume requirements within end-of-pipe facilities, the extended detention storage volume requirements for erosion control vary according to soil type, surface slopes, and land use conditions. In addition, analyses completed for the Fletcher's Creek and Huttonville Creek Subwatershed Study (Amec et. al., June 2011) indicate that extended detention storage requirements may be reduced through the implementation of LID BMPs which promote infiltration and/or evapotranspiration as part of the formal stormwater management plan for the development area. No stormwater management facility sizing criteria has been provided for development within the Main Humber River or West Humber River Subwatershed; in the absence of this information, a literature review has been completed for subwatershed studies in various municipalities across the GTA (i.e. Mississauga, Brampton, Markham, and Milton) to determine the potential range of unitary extended detention storage volume required for erosion control. The range of incremental extended detention storage volumes within end-of-pipe facilities for erosion control based upon a literature review of subwatershed study recommendations through the GTA, is summarized in Table 2.6.3.11. The specific requirements for mitigating erosion impacts will need to be determined as part of future studies

Table 2.6.3.11. Range of Extended Detention Storage Requirements for Erosion Control Across GTA (m^3/impervious hectare)

Operating Condition	Unitary Storage Volume
Extended Detention/Erosion	150 - 500

Water Budget:

For water budget, measures to promote groundwater recharge through the application of LID infitration BMPs will be required to mitigate these impacts. The implementation of these measures will require infiltration of clean runoff (i.e. rootop runoff) and pre-treatment of surface runoff from other paved surfaces (i.e. roads, parking lots, driveways) to maintain the quality of infiltrated surface runoff. Studies completed for other municipalities within the GTA have demonstrated that a relatively modest capture rate (i.e. 1 mm/impervious ha – 6 mm/impervious ha) would be sufficient in low permeability environments to maintain groundwater recharge for relatively impermeable soils, whereas larger capture volumes (i.e. 10 mm/impervious ha – 15 mm/impervious ha or more) may be required for more permeable soils. The sizing of LID infiltration BMPs should also consider requirements to sustain or augment baseflow within receiving watercourses, hence should include a holistic assessment of the existing groundwater and aquatic systems, potentially requiring a spatially varied sizing criteria for LID infiltration BMPs. In this respect, green infrastructure and natural infrastructure represent critical components to the stormwater management strategy.

Water Quality

For stormwater quality control and thermal mitigation, the stormwater quality controls should provide stormwater quality control to anEnhanced standard of treatment per current Provincial guidelines (ref. MOE, 2003), and should also incorporate measures to mitigate thermal enrichment of runoff to receiving systems. In addition to satisfying requirements to provide stormwater quality treatment to an Enhanced Standard, as per current MECP criteria, stormwater quality management for three of the main watercourses in the West Humber Subwatershed as well as the Fletcher's Creek and Huttonville Creek are Redside Dace habitat, hence stormwater management is required to address the requirements outlined in the Guidance for Development Activities in Redside Dace Protected Habitat Version 1.2 (Ministry of Natural Resources and Forestry, March 2016), specifically providing discharge temperatures below 24°C for stormwater Whitebelt management facilities connected to Redside Dace streams and have dissolved oxygen concentrations of at least seven milligrams per litre, and TSS levels less than 25 mg/L above background conditions.

***Regulatory Controls**:*

The results of the offsite impact assessment for the West Humber River have demonstrated that future development within the, Whitebelt upstream of the designated flood vulnerable area (FVA) would increase the risk and frequency of flooding within the FVA compared to existing conditions. Consequently, future development of the preliminary SABE concept within the West Humber Subwatershed would be required to incorporate measures to mitigate the increased risk of flooding through the FVA for all events, including the Regional Storm event. A review of the hydraulic structures through and downstream of the FSA and preliminary SABE concept, as documented in the Part A report indicates that the hydraulic structures consist of single or multi-span bridges, hence hydraulic structure upgrades are anticipated to be less feasible as the size of opening has, in most instances, been optimized for hydraulic conveyance. As such, it is anticipated that Regional Stom controls for the preliminary SABE concept, to mitigate increased flood risk to the downstream known FVAs, would be required. Where feasible this could consist of additional detention storage within end-of-pipe facilities. Where detention storage within end-of-pipe facilities is infeasible or less practical, alternative measures (i.e. strategic online storage, use of NHS buffers, distributed system storage etc. per the Guidance in TRCA, 2016) may be investigated, however would be required to consider environmental conditions and constraints in establishing these alternatives.

***Green Infrastructure and Natural Infrastructure**:*

As noted previously, green infrastructure and natural infrastructure aim to return the hydrology of a site as closely as possible to its predevelopment conditions, and increases resiliency and sustainability of infrastructure. In addition, these assets can reduce impacts of Climate Change associated with extreme heat, drought, flooding and sea-level rise, while delivering multiple co-benefits. As such, the integration of integrating green infrastructure into the stormwater management system represents a critical component of working toward mitigating the impacts of direct and indirect impacts of urbanization on flooding, erosion, and Climate Change.

Upper Etobicoke Creek:

Flooding:

The end-of-pipe storage volume requirements for flood control for the Upper Etobicoke Creek Subwatershed have been previously provided within the Mayfield West Phase 2 Comprehensive Environmental Impact Study and Management Plan (Amec et. al., December 2014). The volume requirements are presented in Table 2.6.3.12, per the recommendations of that study.

Table 2.6.3.12. Detention Storage Requirements for 100 Year and Regional Storm Event Quantity Control for Upper Etobicoke Creek per Amec et. al., December 2014 (m^3/impervious hectare)

Operating Condition	Unitary Storage Volume[1, 2]
100 Year	575
Regional Storm	0

NOTES: 1. Unitary 100 year storage volumes are exclusive of extended detention storage requirements for erosion and/or stormwater quality control.
2. Unitary Regional Storm event storage volumes are in addition to 100 year storage volumes and extended detention storage volume requirements.

As noted previously, stormwater management sizing criteria for quantity control are dependent upon the type and extent of development within a given study area, hence it is anticipated that the stormwater management requirements for the preliminary SABE concept within the Upper Etobicoke Creek Subwatershed would differ from those determined for the Mayfield West Phase 2 Comprehensive Environmental Impact Study and Management Plan. In that regard, it is anticipated that the storage volumes required for 100 year and Regional Storm control would be comparable to the range provided in Table 2.6.3.10, rather than the values outlined in Table 2.6.3.12. Nevertheless the storage volume requirements are to be determined as part of future studies. In addition, as discussed earlier, off-site impact management needs to be assessed both locally and regionally at a subwatershed scale, to ensure that hydrograph timing effects will be considered. Furthermore, as noted previously, the sizing of flood control facilities should consider the influence of climate change, and should therefore assess stormwater management facility performance for climate adjusted storm events. This will be particularly important for the Etobicoke Creek through Downtown Brampton where works are planned as part of the Riverwalk project to protect the City's downtown core from major flooding., as advanced in the Downtown Brampton Flood Protection Environmental Assessment (AECOM, June 2020).

Erosion:

The end-of-pipe extended detention storage volume requirements for erosion control for development within the Upper Etobicoke Creek Subwatershed have been previously provided within the Mayfield West Phase 2 Comprehensive Environmental Impact Study and Management Plan (Amec et. al., December 2014). The volume requirements are presented in Table 2.6.3.13, per the recommendations of that study.

Table 2.6.3.13. Extended Detention Storage Requirements for Erosion Control for Upper Etobicoke Creek per Amec et. al., December 2014 (m^3/impervious hectare)

Operating Condition	Unitary Storage Volume
Extended Detention/Erosion	325

As noted previously, stormwater management sizing criteria for erosion control are dependent upon the type and extent of development within a given study area. As such, it is anticipated that the stormwater management requirements for the preliminary SABE concept within the Upper Etobicoke Creek Subwatershed would differ from those determined for the Mayfield West Phase 2 Comprehensive Environmental Impact Study and Management Plan. and are to be determined as part of future studies.

Green Infrastructure and Natural Infrastructure:

As noted previously, green infrastructure and natural infrastructure aim to return the hydrology of a site as closely as possible to its predevelopment conditions, and increases resiliency and sustainability of infrastructure. In addition, these assets can reduce impacts of Climate Change associated with extreme heat, drought, and flooding, while delivering multiple co-benefits. As such, the integration of integrating green infrastructure into the stormwater management system represents a critical component of working toward mitigating the impacts of direct and indirect impacts of urbanization on flooding, erosion, and Climate Change.

Fletcher's Creek:

Flooding:

The end-of-pipe storage volume requirements for flood control within the Fletcher's Creek Subwatershed have been previously provided within the Mayfield West Phase 2 Comprehensive Environmental Impact Study and Management Plan (Amec et. al., December 2014), as well as the Fletcher's Creek and Huttonville Creek Subwatershed Study for Northwest Brampton (Amec et. al., June 2011). The range of volume requirements are presented in Table 2.6.3.14, per the recommendations of those studies.

Table 2.6.3.14. Detention Storage Requirements for 100 Year and Regional Storm Event Quantity Control for Fletcher's Creek per Amec et. al., December 2014 and Amec et. al., June 2011 (m^3/impervious hectare)

Operating Condition	Unitary Storage Volume[1, 2]
100 Year	600 - 1250
Regional Storm	0 - 1225

NOTES: 1. Unitary 100 year storage volumes are exclusive of extended detention storage requirements for erosion and/or stormwater quality control.
2. Unitary Regional Storm event storage volumes are in addition to 100 year storage volumes and extended detention storage volume requirements.

The information in Table 2.6.3.14 indicates that the detention storage volume requirements for the Fletcher's Creek Subwatershed, as determined by previous Subwatershed Studies, varies by location. Nevertheless, given that the portion of the preliminary SABE concept within the Fletcher's Creek Subwatershed is proximate to the locations and extent of development assessed as part of previous studies, it is anticipated that the detention storage volume requirements for quantity control would be in the range established as part of the previous studies. The specific storage volume requirements will be determined as part of future studies. In addition, as discussed earlier, off-site impact management needs to be assessed both locally and regionally at a subwatershed scale, to ensure that hydrograph timing effects will be considered. Furthermore, as noted previously, the sizing of flood control facilities should consider the influence of climate change, and should therefore assess stormwater management facility performance for climate adjusted storm.

Erosion:

The end-of-pipe extended detention storage volume requirements for erosion control within the Fletcher's Creek Subwatershed have been previously provided within the Mayfield West Phase 2 Comprehensive Environmental Impact Study and Management Plan (Amec et. al., December 2014) as well as the Fletcher's Creek and Huttonville Creek Subwatershed Study for Northwest Brampton (Amec et. al., June 2011). The volume requirements are presented in Table 2.6.3.15, per the recommendations of those studies.

Table 2.6.3.15. Extended Detention Storage Requirements for Erosion Control per Amec et. al., December 2014 and Amec et. al., June 2011 (m^3/impervious hectare)

Operating Condition	Unitary Storage Volume
Extended Detention/Erosion	250

As noted previously, stormwater management sizing criteria for erosion control are dependent upon the type and extent of development within a given study area. While the stormwater management sizing criteria for the preliminary SABE concept to provide erosion control within the Fletcher's Creek Subwatershed may differ from those determined for the December 2014 and June 2011 Subwatershed Studies, it is anticipated that the unitary sizing criteria would be comparable to those determined from the previous studies for similar land use conditions (i.e. residential). Furthermore, the results of the June 2011 Subwatershed Study indicate that extended detention storage requirements may be reduced through the implementation of LID BMPs which promote infiltration and/or evapotranspiration, as part of the formal stormwater management plan for the development area. End-of-pipe extended detention storage requirements for erosion control will be determined as part of future studies.

Green Infrastructure and Natural Infrastructure:

As noted previously, green infrastructure and natural infrastructure aim to return the hydrology of a site as closely as possible to its predevelopment conditions, and increases resiliency and sustainability of infrastructure. In addition, these assets can reduce impacts of Climate Change associated with extreme heat, drought, and flooding, while delivering multiple co-benefits. As such, the integration of integrating green infrastructure into the stormwater management system represents a critical component of working toward mitigating the impacts of direct and indirect impacts of urbanization on flooding, erosion, and Climate Change.

Huttonville Creek:

Flooding:

The end-of-pipe storage volume requirements for flood control, above extended detention storage volume requirements, have been previously provided for development within the Huttonville Creek Subwatershed within the Fletcher's Creek and Huttonville Creek Subwatershed Study for Northwest Brampton (Amec et. al., June 2011). The range of volume requirements are presented in Table 2.6.3.16, per the recommendations of those studies.

Table 2.6.3.16. Detention Storage Requirements for 100 Year and Regional Storm Event Quantity Control for Huttonville Creek per Amec et. al., June 2011 (m^3/impervious hectare)

Operating Condition	Unitary Storage Volume[1, 2]
100 Year	550 - 1150
Regional Storm	975 - 1200

NOTES: 1. Unitary 100 year storage volumes are exclusive of extended detention storage requirements for erosion and/or stormwater quality control.
2. Unitary Regional Storm event storage volumes are in addition to 100 year storage volumes and extended detention storage volume requirements.

The information in Table 2.6.3.16 indicates that the detention storage volume requirements for the Huttonvilile Creek Subwatershed, as determined by previous Subwatershed Studies, varies by location. Nevertheless, given that the portion of the preliminary SABE concept within the Huttonville Creek Subwatershed is proximate to the locations and extent of development assessed as part of previous studies, it is anticipated that the detention storage volume requirements for quantity control would be in the range established as part of the previous studies. The specific storage volume requirements will be determined as part of future studies. In addition, as discussed earlier, off-site impact management needs to be assessed both locally and regionally at a subwatershed scale, to ensure that hydrograph timing effects will be considered. Furthermore, as noted previously, the sizing of flood control facilities should consider the influence of climate change, and should therefore assess stormwater management facility performance for climate adjusted storm events.

Erosion:

The end-of-pipe extended detention storage volume requirements for erosion control within the Huttonville Creek Subwatershed have been previously provided within the Fletcher's Creek and Huttonville Creek Subwatershed Study for Northwest Brampton (Amec et. al., June 2011). The range of volume requirements are presented in Table 2.6.3.17, per the recommendations of those studies.

Table 2.6.3.17. Extended Detention Storage Requirements for Erosion Control per Amec et. al., June 2011 (m^3/impervious hectare)

Operating Condition	Unitary Storage Volume
Extended Detention/Erosion	200 - 325

As noted previously, stormwater management sizing criteria for erosion control are dependent upon the type and extent of development within a given study area. While the stormwater management sizing criteria for the preliminary SABE concept to provide erosion control within the Huttonville Creek Subwatershed may differ from those determined for June 2011 Subwatershed Study, it is anticipated that the unitary sizing criteria would be comparable to those determined from the previous study for similar land use conditions (i.e. residential). Furthermore, the results of the June 2011 Subwatershed Study indicate that extended detention storage requirements may be reduced through the implementation of LID BMPs which promote infiltration and/or evapotranspiration as part of the formal stormwater management plan for the development area. End-of-pipe extended detention storage requirements for erosion control will be determined as part of future studies.

Green Infrastructure and Natural Infrastructure:

As noted previously, green infrastructure and natural infrastructure aim to return the hydrology of a site as closely as possible to its predevelopment conditions, and increases resiliency and sustainability of infrastructure. In addition, these assets can reduce impacts of Climate Change associated with extreme heat, drought, and flooding, while delivering multiple co-benefits. As such, the integration of integrating green infrastructure into the stormwater management system represents a critical component of working toward mitigating the impacts of direct and indirect impacts of urbanization on flooding, erosion, and Climate Change.

General SWM Practices:

Recognizing the above requirements, the following technologies and practices are available to address the anticipated stormwater management criteria for flood and erosion control, stormwater quality and thermal contol, and maintaining water budget:

Stormwater quantity controls for flooding and/or erosion:

- End-of-pipe facilities (i.e. wetlands, wet ponds, hybrid facilities, dry ponds).
- Source controls (i.e. underground tanks, pipe storage, surface storage in parking lots, rooftop detention storage).
- Perforated pipes.
- LID BMPs which promote infiltration and/or evapotranspiration.

Water Budget/Infiltration/Evapotranspiration

- Green roofs
- White roofs
- Habitat creation (i.e. vernal pools)
- Tree trench boxes
- Bioswales/biofilters.

- Infiltration trenches.
- Rain gardens.
- Bioretention bumpouts.
- Rain barrels.
- Increased topsoil thickness.
- Perforated pipes/exfiltration systems.
- Exfiltration tanks.

TSS removal as per current (2003) MOE criteria:

- Wet end-of-pipe facilities (i.e. wetlands, wet ponds, hybrid facilities).
- Vegetated technologies (i.e. grassed swales, buffer strips, etc.).
- Oil/grit separators.
- Bioswales/biofilters.
- Infiltration trenches.

Thermal control:

- LID BMPs which promote infiltration and/or evapotranspiration
- Urban terrestrial canopy (also NHS)
- Facility shading (includes orientation and length/width ratio)
- Facility cooling trenches
- Facility bottom draws
- Stormwater management facility orientation
- Concrete Sewer System
- Underground Storage Facilities
- Green & White roofs
- Floating Islands
- Other measures

The specific measures applied will need to be established as part of future detailed studies (local SWS), based upon the land use condition of the contributing drainage area, and subject to approval by the respective municipality and Conservation Authority, and Provincial ministries including MECP. In addition, given the small size of the preliminary SABE concept discharging toward the Credit River Main Branch and the Huttonville Creek Subwatershed, the development area discharging toward those stormwater management facilities may be too small to sustain wet pond/wetland end-of-pipe facilities, thus requiring source controls for stormwater quality, quantity, and erosion control.

As indicated in the foregoing, it is anticipated that LID BMPs and green infrastructure will form an essential component of the stormwater management plan specifically to maintain groundwater recharge and manage water budget, augment erosion protection for the receiving watercourses, and improve resiliency of infrastructure. This may also include source controls to provide stormwater quantity control for development areas which are too small to support wet end-of-pipe facilities. Several technologies and techniques are available for incorporating into the stormwater management plan for future development areas, however it is recognized that each LID BMP provides different functional benefits. A summary of the function for common LID BMPs and source controls is provided in Table 2.6.3.18. The selection of LID BMP for implementation should consider the specific hydrologic function required for the respective components of the water resource system.

Table 2.6.3.18. Stormwater Management Function Provided by Selected LID Stormwater BMP's and Stormwater Source Control Practices

Practice	Flood Control	Erosion Control	Quality Control	Water Balance	Evapotranspiration	Groundwater Recharge
Rooftop Detention Storage	X					
Parking Lot Storage	X					
Amended Topsoil		X	X	X	X	X
Green Roofs		X	X	X	X	
White Roofs				X	X	
Tree Trench Boxes		X	X	X	X	X
Habitat Creation (i.e. vernal pools)		X	X	X	X	X
Oil/Grit Separators			X			
Rainwater Harvesting		X		X		
Pervious Pipes		X	X	X		X
Oversized Pipes	X					
Permeable Pavement		X	X	X		X
Soakaway Pits		X	X	X		X
Infiltration Trenches		X	X	X		X
Bioretention Bumpouts		X	X	X	X	X
Grassed Swales			X			
Biofilters/Bioswales		X	X	X	X	X

In addition to the foregoing practices, the stormwater management system should be established with consideration for the influence of climate change. In this regard, the stormwater management facility performance should be assessed for climate adjusted storm events. The planning of quantity controls for these events should account for the influence of any proposed Regional Storm control facilities on mitigating flood risk under climate change adjusted storm events, applying an appropriate methodology .

Preliminary Stormwater Management Facility Siting:

Preliminary siting of stormwater management facilities has been completed for the preliminary SABE concept and the SABE testing areas. Stormwater management facilities locations have been delineated using the subcatchment boundary plans for the current hydrologic modelling of the respective subwatersheds, and further discretized to identify prelimianry contributing draiange areas based on land use boundaries, transportation corridors, and regulated watercourses, and generally respecting maximum contributing drainage areas of 60 ha. The preliminary stormwater management facility locations are presented in Drawing WR-6.

The preliminary stormwater management facility locations are recognized to be subject to revision and refinement as part of subsequent studies and stages of planning and design. Furthermore, it is recognized that for certain land uses (i.e. employment), opportunities may exist to implement source controls rather than end-of-pipe facilities due to the size of contribuitng drainage area, and subject to municipal and Conservation Authority approval.

Site Grading Considerations:

The portion of the preliminary SABE concept within the Main Humber Subwatershed, as well as portions within the West Humber Subwatershed and Upper Etobicoke Creek Subwatershed are located adjacent to confined and well defined watercourse features. The overburden thickness mapping in these areas suggests deeper groundwater levels within the tableland in these locations, hence it is anticipated that requirements for imported fill in these locations would be limited, and cut and fill may be balanced at the site to achieve the grades required for storm servicing.

Other portions of the preliminary SABE concept within the West Humber Subwatershed and the Upper Etobicoke Creek Subwatershed discharge toward unconfined but regulated watercourses. In these areas it is anticipated that imported fill may be required to achieve the grades required for storm servicing, although the quantity of imported fill would be anticipated to be relatively minor.

For the balance of the preliminary SABE concept which extends through the headwaters of Fletcher's and Huttonville Subwatersheds, as well as within the subwatershed discharging to the Main Credit River and within the headwaters of the West Humber and Upper Etobicoke Creek Subwatershed, the areas are drained by and toward headwater drainage features and watercourses with limited definition. In these areas, it is anticipated that imported fill would be required in order to achieve the grades required for storm servicing. The volume required may be offset by grading portions of these sites to drain toward deeper valley systems within the Upper Etobicoke Creek Subwatershed and the Humber Watershed, however this would be subject to further assessment as part of future studies and approval by the municipality and the Conservation Authority.

All site grading will be required to comply with Town of Caledon development design standards, and should include evaluations of major and minor system conveyance capacity. Evaluating major system conveyance capacity for events greater than the 100 year return period should be considered, to account for the potential influence of climate change in the design of the municipal pluvial system.

Drainage Features – Watercourses and HDFs

Feature Classification and Management Strategies

Watercourses and HDFs form an intricate surface water network that primarily conveys water and sediment, but also provides functional processes which drive the ecological health of riparian and aquatic systems including direct and indirect habitat, linkages, thermal regime and water quality. Management of these drainage features requires integration between each discipline to determine current function, and future requirements for protection, mitigation, and/or enhancement at the reach and site-specific scales.

Stream management is to be approached on a reach or feature basis as these units display relative homogeneity with respect to form, function, and habitat. Key management practices, in terms of stream morphology, are recommended according to the geomorphic constraint rating, or HDF management recommendation. Management strategies may include several options, or specific guidance. Note that HDF assessments are required through future study, and only then may management recommendations be determined.

Watercourse features are protected and regulated by the Conservation Authority. HDFs are regulated by the Conservation Authority when, through application of the HDF Guidelines, features are determined to have "protection" or "conservation" management and, in some cases, "mitigation" management, but not "no management." Both Watercourses and HDFs may provide some important functions that should be considered when evaluating impacts from development and identifying management opportunities. Regulation of watercourses does not preclude them from modification through development, but substantial rationale would be required to justify channel design works and realignments, to the satisfaction of applicable review agencies. Therefore, it is prudent to determine appropriate management opportunities and constraints for area drainage features that seek to maintain, mitigate, or enhance the form and function required for each feature. The management constraints/recommendations will also impact the delineation of the NHS as some features may require protection which are not regulated (i.e., HDFs), or other regulated or non-regulated features may have realignment opportunities.

An integration of key characteristics and functions for each discipline can be applied through the development of a watercourse constraint ranking, and through the application of a Headwater Drainage Feature Assessment (e.g., CVC/TRCA, 2014). Geomorphic constraints for watercourses have been identified, while the integrated watercourse constraints recommendations may be advanced as part of future studies following further development of the land use plan. In the current scoped study, this can only be completed based on existing data with some minor field confirmation, and recommendations for further analysis. As a result, constraint rankings determined in this study may be considered preliminary, as field observations are required to characterize surface water feature function. HDF assessments cannot be completed in any capacity under the current desktop scope of work, as they require seasonally-based field investigations to evaluate form and function on a feature-by-feature basis.

Watercourse Feature Constraints – Classification & Management

An integration of key characteristics and functions, for each discipline will be applied in the development of a constraint ranking for watercourses within the SABE. Each watercourse will be assessed a ranking of high, medium, or low, on a reach-by-reach basis, based upon various environmental factors and considerations, with individual rankings per discipline. A constraint ranking will then be established, conservatively, by utilizing the most limiting constraint observed for the feature, which may be suggested by all, few, or even one discipline. The findings of the assessment will ultimately provide guidance regarding the management opportunities and requirements for each watercourse feature within the study area. This process may be advanced for the SABE in future studies to determine management recommendations for each feature.

At this stage of the study, only preliminary geomorphic constraint rankings have been evaluated for watercourse reaches. The data sources used to determine the preliminary geomorphic constraints include:

- 2015 orthoimagery provided by Region of Peel (to assess the presence of a defined channel, floodplain or valley)
- 1m contour mapping provided by Region of Peel and TRCA (to assess the presence of a defined floodplain or valley)
- Watercourse mapping provided by the Region of Peel and TRCA (to determine the location and planform of watercourses)
- Crest of slope mapping provided by TRCA (to inform erosion hazard assessment)
- ArcHydro analysis completed by Matrix (2021) (to confirm watercourse mapping and determine drainage areas)
- Windshield assessment at existing watercourse crossings (to confirm presence of a defined channel, floodplain and valley; to confirm degree of morphological development (i.e., presence of riffle-pools), and observe evidence of instability and past modifications).

The following sections summarize, in general, the definitions and criteria to be applied by discipline, in developing the individual constraint rankings for the area watercourses at a scoped, desktop level of study.

High Constraint Watercourses (mapped as solid red lines; ref. Maps SM4-1 to SM 4-24, Appendix C3)

High constraint watercourses are features that have attributes (e.g. floodplains, unstable banks) that attract Conservation Authority regulations, and have usually been deemed high-quality systems that should not be re-located and replicated in a post-development scenario. They must remain open and protected in their present condition and locations, with the exception of select localized sites where rehabilitation may be of benefit to the system.

Surface Water (Hydrology)
These corridors contain a well-defined channel within a well-defined and established valley system, with large contributing drainage areas (i.e. generally 200 ha or more).

Geomorphology
These corridors contain a defined active channel with well-developed channel morphology (i.e., riffle-pool), material sorting, floodplain development, and/or a well-defined valley. These watercourses have an associated erosion hazard (meander belt or stable top of slope). .

Aquatic (Fisheries)
Permanently wetted (flowing or standing water over most of watercourse length) that is generally associated with continuous or seasonal groundwater discharge, or with wetland storage and/or pond flows. Fish community (or the potential for) is present and natural habitat is usually fully developed. Either habitat and/or flow source characteristics may be difficult to replicate or maintain.

-and/or-

Habitat occupied by species at risk.

Hydrogeology (Groundwater)
High constraint rankings based upon groundwater inputs are assigned based upon the presence of baseflow, and the manner in which groundwater contributions support local or downstream aquatic habitat. In subwatersheds managed by TRCA, this classification shall be informed by the TRCA Expanded

Groundwater model and TRCA's Seepage Areas and Springs mapping which presents where potential groundwater discharge may occur.

Terrestrial/Riparian
The watercourse segments that are within terrestrial features that are of high ecological quality; are determined to be provincially, regionally, and/or locally significant; and/or are determined to provide critical habitat functions for wildlife (e.g. consistent with criteria for Significant Wildlife Habitat). These include significant woodlands, significant life-science ANSIs, ESAs, the Provincial NHS, PSWs, and other valleylands that may provide a linkage function across the landscape.

High-constraint watercourses and their corridors are to be protected in current form and location, with appropriate regulatory setbacks and ecological buffers. Realignments of high constraint watercourses are not acceptable. Minor modification through rehabilitation/enhancement may be acceptable at select locations where it provides an enhancement to the system, given sufficient rationale.

Medium Constraint Watercourses (mapped as solid blue lines; ref. Maps SM4-1 to SM 4-24, Appendix C3)

Medium constraint watercourses have attributes (e.g., floodplains, unstable banks) that attract Conservation Authority regulation, but are typically highly impacted. These watercourses may possibly be realigned where there has been previous disturbance through anthropogenic activity, there is sufficient rationale for doing so, and provided there is a net ecological gain and subject to the approval of appropriate authorities. Any realignment designs should use natural channel design and other principles of environmental design.

Surface Water (Hydrology)
These reaches have relatively smaller contributing drainage areas (i.e. generally between 25 ha and 200 ha), and typically are not located within defined valley corridors.

Geomorphology
These reaches may have well-defined morphology (defined bed and banks, evidence of erosion/sedimentation, and sorted substrate). These reaches maintain geomorphic function and have potential for rehabilitation. In many cases, these reaches are presently exhibiting evidence of geomorphic instability or environmental degradation due to historic modifications and land use practices.

Aquatic (Fisheries)
Seasonally wetted (flowing or standing water) that is generally associated with seasonally high groundwater discharge or seasonally extended contributions from wetlands/ponds (no perennial flow). May provide an extended seasonal migration route for fish. Fish community (or the potential for) is present for an extended seasonal period. Potential permanent refuge fish habitat may be provided by naturally occurring storage features such as channel pools, wetlands, and other water bodies.

Hydrogeology (Groundwater)
Medium constraint rankings are established in conjunction with the aquatic constraint ranking, and as having potential groundwater discharge based on the TRCA Expanded Groundwater model and TRCA's Seepage Areas and Springs mapping.

Terrestrial/Riparian
Watercourse segment that is within terrestrial features that are determined to be of low or moderate ecological quality; are determined to be not provincially, regionally, and/or locally significant; and/or are determined to not provide critical habitat functions for wildlife (e.g. consistent with criteria for Significant Wildlife Habitat). These include unevaluated wetlands,

Medium Constraint watercourses are to remain open and protected with applicable hazard corridors, regulatory setbacks, and ecological buffers. Channel/corridor realignment (horizontal and vertical) may possibly occur where there has been previous disturbance through anthropogenic activity, there is sufficient rationale for doing so, and provided there is a net ecological gain and subject to the approval of appropriate authorities. Restoration and enhancement must be included in design options.

Low Constraint Watercourses (ref. Maps SM4-1 to SM 4-24, Appendix C3)

These features are ephemeral in nature and are typically poorly defined, lacking function or quality as defined by each discipline for High and Medium constraint features when completing a desktop assessment. If constraint analysis does not designate a watercourse as having high or medium constraint, it will be classified as a low constraint. For the purpose of mapping at the Scoped Subwatershed Study scale, these features have been maintained as watercourse reaches, but may be redesignated as headwater drainage features following field confirmation in future studies. As their feature type and presence cannot be confirmed at the desktop scale, future studies, further analysis, and field confirmation is required to confirm feature presence and type, and then undertake the appropriate assessments to determine the feature constraint and management opportunities.

Headwater Drainage Features

Headwater Drainage Features are not being mapped or evaluated in detail in the current study, and future work through subsequent planning stages is required to confirm these features and evaluate them following the CVC/TRCA (2014) guidelines (Table 2.6.3.19) will allow for management recommendations to be mapped similarly to the constraint rankings presented here for watercourses. In the current study, at the scoped level, headwater drainage features are ***only*** being identified as HDFs, and are not subject to detailed site investigations or study integration, however, if there are critical issues around HDFs (e.g. terrestrial features and/or corridors) that may be identified, constraints and management will be addressed through the lens of the appropriate policy framework. Integration with other study components will capture such "red-flags" for each feature, where possible through the scoped level of study. This integration and identification of constraints around HDFs at a desktop level may be advanced for features within the SABE in future studies.

Table 2.6.3.19. Recommended HDF Management Classifications (TRCA/CVC 2014)

HDF Classification	Description/Management
Protection	Important Functions: e.g. swamps with amphibian breeding habitat; perennial headwater drainage features; seeps and springs; SAR habitat; permanent fish habitat with woody riparian cover • Protect and/or enhance the existing feature and its riparian zone corridor, and groundwater discharge or wetland in-situ; • Maintain hydroperiod; • Incorporate shallow groundwater and base flow protection techniques such as infiltration treatment; • Use natural channel design techniques or wetland design to restore and enhance existing habitat features, if necessary; realignment not generally permitted; • Design and locate the stormwater management system (e.g. extended detention outfalls) are to be designed and located to avoid impacts (i.e. sediment, temperature) to the feature.

HDF Classification	Description/Management
Conservation	Valued Functions: e.g. seasonal fish habitat with woody riparian cover; marshes with amphibian breeding habitat; or general amphibian habitat with woody riparian cover. • Maintain, relocate, and/or enhance drainage feature and its riparian zone corridor; • If catchment drainage has been previously removed or will be removed due to diversion of stormwater flows, restore lost functions through enhanced lot level controls (i.e. restore original catchment using clean roof drainage), as feasible; • Maintain or replace on-site flows using mitigation measures and/or wetland creation, if necessary; • Maintain or replace external flows, • Use natural channel design techniques to maintain or enhance overall productivity of the reach; • Drainage feature must connect to downstream.
Mitigation	Contributing Functions: e.g. contributing fish habitat with meadow vegetation or limited cover • Replicate or enhance functions through enhanced lot level conveyance measures, such as well-vegetated swales (herbaceous, shrub and tree material) to mimic online wet vegetation pockets, or replicate through constructed wetland features connected to downstream; • Replicate on-site flow and outlet flows at the top end of system to maintain feature functions with vegetated swales, bioswales, etc. If catchment drainage has been previously removed due to diversion of stormwater flows, restore lost functions through enhanced lot level controls (i.e. restore original catchment using clean roof drainage); • Replicate functions by lot level conveyance measures (e.g. vegetated swales) connected to the natural heritage system, as feasible and/or Low Impact Development (LID) stormwater practices (refer to Conservation Authority Water Management Guidelines for details);
Recharge Protection (the current study recommends that recharge protection is incorporated into the 'mitigation' classification)	Recharge Functions: e.g. features with no flow with sandy or gravelly soils • Maintain overall water balance by providing mitigation measures to infiltrate clean stormwater, unless the area qualifies as an Area of High Aquifer Vulnerability under the Oak Ridges Moraine Conservation Plan (ORMCP) or Significant Recharge Areas under the Source Water Protection Act. These areas will be subject to specific policies under their respective legislation. • Terrestrial features may need to be assessed separately through an Environmental Impact Study to determine whether there are other terrestrial functions associated with them.
Maintain or Replicate Terrestrial Linkage (the current study recommends that terrestrial linkages are incorporated into the 'Conservation' classification)	Terrestrial Functions: e.g. features with no flow with woody riparian vegetation and connects two other natural features identified for protection • Maintain the corridor between the other features through in-situ protection or if the other features require protection, replicate and enhance the corridor elsewhere • If the feature is wider than 20 m, it may need to be assessed separately through an Environmental Impact Study to determine whether there are other terrestrial functions associated with it.

HDF Classification	Description/Management
No Management Required	Limited Functions: e.g. features with no or minimal flow; cropped land or no riparian vegetation; no fish or fish habitat; and no amphibian habitat. • The feature that was identified during desktop pre-screening has been field verified to confirm that no feature and/or functions associated with headwater drainage features are present on the ground and/or there is no connection downstream. These features are generally characterized by lack of flow, evidence of cultivation, furrowing, presence of a seasonal crop, and lack of natural vegetation. No management recommendations required.

Erosion Hazard Corridors

Watercourse features and associated hazard limits (i.e., meander belts for unconfined systems, and stable top of slopes for confined systems) should be incorporated into the development of the NHS in order to protect the feature and habitat, as well as to mitigate risks associated with the hazard. Following designation of geomorphic constraint rankings to each watercourse reach, should a medium constraint watercourse be realigned or relocated, a design meander belt and appropriate setbacks should be developed and then incorporated into the NHS. Realignment recommendations and opportunities (locations) are not explicitly identified in a subwatershed study, however, Table 1 of Phase 2 Part A – Appendix E provides field observations which may indicate restoration opportunities at a provisional level where the channel has been straightened or degraded. It is noted that these observations were made where windshield assessments were completed and is not a comprehensive inventory of potential restoration opportunities. Realignments of high constraint watercourses are not acceptable, but where necessary and sufficiently justified to the satisfaction of applicable review agencies, minor modification through rehabilitation/enhancement of high-constraint (red) watercourses may be considered at select locations where it provides an enhancement to the system or to address an immediate issue or permit the construction of essential infrastructure.

Corridor Enhancements and Rehabilitation

Enhancements of watercourse corridors should include the removal of barriers to the movement of water and sediment in the downstream direction, and fish in the upstream direction (e.g., severe debris jams/dams, weirs), provided they do not serve a necessary function (e.g., grade control). In the case of grade control weirs, opportunities to replace the structure with natural channel design features (e.g., a series of riffles) should be explored.

Rehabilitation options to improve the geomorphic function of watercourses, primarily those of medium constraint classification that been previously channelized or modified by agricultural practices may include:

- Re-establish a functioning floodplain: Creating a bankfull channel with better connectivity to a wider floodplain, or terrace, allows flows and fine sediment to overtop the banks during periods of high water levels. This excess water would then travel across the floodplain, dissipating energy across a much larger surface area. Vegetation would also decrease velocity, thus reducing erosion issues downstream
- Provide a low-flow channel: Creating a low-flow channel will provide storage and refugia for aquatic organisms during drought conditions as well as reducing the potential for sedimentation within the channel.
- Re-establish a 'natural' meander planform: Using reference reaches as an indication of channel planform prior to agricultural influences; it is obvious that historical ditching and straightening has removed the natural meander planform of many reaches within the study area. This channelization effectively increases stream gradient and, consequently, the stream energy available to erode bed

and banks. The restoration of a more 'natural' meandering planform can help to re-establish more natural geomorphological processes and increase geomorphological diversity.

- Re-establish riparian vegetation: Re-establishing a healthy riparian vegetation community can help increase bank stability in addition to creating shading and improving fish and wildlife habitat. The provision of bank vegetation also provides a source of woody debris and organic matter for the stream, as well as providing a natural buffer to reduce fine sediment input from tilled agricultural fields.

Maintenance of Channel Length and Sediment Supply

Stream length and sinuosity should be maintained at a minimum unless rationale is provided where a balance cannot be maintained between pre- and post- construction. Drainage density targets have historically been applied to maintain stream length and function but have not been specifically evaluated in the Phase 2 impact assessment. Previous work applied the more historical SWS practice of developing drainage density targets. The Huttonville Creek, Springbrook Creek and Churchville Tributary SWS (2004) identified drainage densities of 4.17 km/km^2 and 4.23 km/km^2 for Huttonville Creek and Springbrook Creek respectively and provided drainage density targets ranging from 1.21 – 4.21 km/km^2. These densities are targets are presented for reference purposes only, to provide context about historical approaches that have been used in the study area.

Although there have been drainage density targets developed for existing areas within and downstream of the FSA, the trend towards a feature-by-feature evaluation of headwaters through the application of TRCA/CVC (2014) guidelines provides a more comprehensive and detailed approach to managing drainage features than a drainage density target has historically. It is recommended to apply the constraint ranking methodology for watercourses and HDF evaluations to determine appropriate strategies to manage surface water features that maintains or enhances the function of each feature.

The HDF management recommendations that will be determined for each feature will essentially act to maintain the functional role of each feature to supply water and sediment in the downstream direction. It is also noted that sediment supply / transport under existing conditions is influenced by human activities, including agricultural land management and potential inputs from road surface drainage, and therefore does not represent "natural" conditions. Conservation and Mitigation management recommendations maintain connectivity, and the supply role of each feature. Some features may be replicated with LID BMPs or swales to maintain the primary function(s).

Channel design and subsequent channel management practices will be required to encourage the delivery of natural sediment supply. Streams in corridors should be designed such that natural erosion may occur in keeping with the nature of the channel, thereby replicating the natural potential to generate sediment for transport downstream. Naturalization of swales in urban areas should be encouraged where possible to facilitate natural sediment generation.

It is however noted that it is not necessarily desirable to replicate current sediment supply conditions in the headwaters since these are heavily impacted by agricultural practices, resulting in potential higher volumes of fine sediment conveyance of poor quality than would occur under more "natural" conditions.

Road Crossings

Road crossings should be oriented and sized appropriately using geomorphic risk factors (e.g. bankfull width, channel stability, erosion rates, meander amplitude), ref. "Road Crossings and Alignments " in Section 2.3.4.1. Road crossings within TRCA's and CVC's jurisdictions should follow guidance provided in TRCA's Crossings Guideline for Valley and Stream Corridors (2015) and CVC's Technical Guidelines for Watercourse Crossings (2019), respectively.

To help guide consideration of potential valley crossings, the presences of high constraint features such as wetland and woodland key features, Redside Dace occupied reaches, and erosion hazard lands were considered. A simple count of the presence of these constraints was applied to 50m x 50m grid cells that overlap with valleyland areas. The resulting constraint scores are shown on map DA2-7 (Appendix E). Sensitivity scores range from 0 (low sensitivity) to 5 (high sensitivity).

Erosion Thresholds and SWM

Critical discharges should be applied as SWM targets to mitigate adverse erosion downstream following development and major alteration to site hydrology. Future studies should identify potential SWM discharge locations and erosion thresholds should be determined for receiving watercourses, and then compared to values adjacent and downstream for representativeness and sensitivity.

2.6.3.3 SABE Testing Areas

As noted in Section 2.3.1.3, the SABE testing areas are located within the Main Humber Subwatershed, the West Humber Subwatershed, and the Upper Etobicoke Creek Subwatershed. Consequently, the stormwater management requirements for the SABE testing areas are anticipated to correspond to the requirements and criteria established for the preliminary SABE concept, and as discussed in the preceding section.

Similarly, the watercourse and HDF management requirements for the SABE testing areas are anticipated to correspond to the requirements established for the preliminary SABE concept, and as discussed in the preceding section.

Natural Heritage System

The SABE Testing Areas are scattered across the central and east portions of the FSA and occur within the Upper Etobicoke subwatershed, Main Humber subwatershed, and the West Humber subwatershed. The largest proportion of SABE Testing Areas is located within the West Humber subwatershed. The majority of SABE Testing Areas are located north of the Preliminary SABE lands. Through the land planning process, FSA Take-Out Areas captured the majority of the preliminary NHS included in the FSA, these area totals have been excluded from the data tables presented in this section and only the remaining areas are discussed.

Key Features identified in the Community Scenario Testing Areas (0.11 ha) and the Employment Scenario Testing Areas (0.33 ha) include small patches of forest, plantation, and wetland habitat contiguous to FSA Take-Out Areas. Supporting Features identified in the Community Scenario Testing Areas (3.42 ha) and the Employment Scenario Testing Areas (7.13 ha) include small patches of meadow, wetland, and woodland habitat. Other Features identified in the Community Scenario Testing Areas (1.27 ha) and the Employment Scenario Testing Areas (0.15 ha) include small patches of meadow, plantation, and habitat (Table 2.6.3.22).

NHS Linkages connect the system across the FSA. Within the SABE Testing land use areas, 6.43 ha of Major Landscape Linkage (0.74 ha MVW and 5.70 ha PLZ) and 2.78 ha of Local Landscape Linkage (1.39 ha MVW and 1.40 ha PLZ) occur in the Community Scenario Testing. In the Employment Scenario Testing land use areas a very small (<0.001 ha) area of Major Landscape Linkage (MVW and PLZ combined) and 5.54 ha of Local Landscape Linkage (1.27 ha MVW and 4.27 ha PLZ).

NHS Enhancement Areas have been identified in the Main Humber subwatershed, West Humber subwatershed, and the Upper Etobicoke subwatershed, with a total of 16.36 ha for Community Scenario Testing and 12.08 ha for Employment Scenario Testing. As a function of land area, these represent 3% and 3% of these land use areas for Community Scenario Testing and Employment Scenario Testing, respectively. These areas have been identified to serve a variety of enhancements including improving features (Key, Floodplain, Linkage), and improving the shape, size, and/or contiguity of a feature, opportunities to create substantive system benefits for long-term system resilience. All Enhancement Areas are less than 5 ha in area. See Table 2.6.3.23 for all identified enhancement opportunities including Conceptual Enhancement Areas.

Management of the NHS (features, linkages, enhancements) is to be conducted in accordance with guidance provided in Section 2.5.2.1 and Part C: Implementation. Detailed assessment and analyses through detailed subwatershed studies is to be used to inform final management direction for the system, guided and informed by direction provided herein.

Table 2.6.3.22. NHS Features – SABE Testing Areas

	Key Features	Supporting Features	Other Features	Linkages	Enhancement Areas
Community Scenario Testing	0.11 (0.02%)	3.42 (0.7%)	1.27 (0.2%)	9.21 (2%)	12.35 (3%)
Employment Scenario Testing	0.33 (0.07%)	7.13 (2%)	0.15 (0.03%)	5.54 (1%)	16.07 (3%)

[1]Enhancement Areas value presented is a composite total which removes overlap between enhancement types. It does not account for % enhancement targets (i.e., includes the total area for enhancements 'as mapped').

2.6.3.4 BRES ROPA 30 and Mayfield West Phase 2 Lands

As noted in Section 2.3.1.4, the BRES ROPA 30 and Mayfield West Phase 2 Lands are located within the Main Humber Subwatershed, the West Humber Subwatershed, the Upper Etobicoke Creek Subwatershed, and Fletcher's Creek Subwatershed. Consequently, the stormwater management requirements for the BRES ROPA 30 and Mayfield West Phase 2 Lands are anticipated to correspond to the requirements and criteria established for the preliminary SABE concept, and as discussed in the preceding sections. Further, as noted previously, the stormwater management criteria for these lands are to be established as part of a separate study process to the development of the preliminary SABE concept.

Similarly, the watercourse and HDF management requirements for the BRES ROPA 30 and Mayfield West Phase 2 Lands are anticipated to correspond to the requirements established for the preliminary SABE concept, and as discussed in Section 2.5.2.1.

Natural Heritage System

The BRES ROPA 30 and Mayfield West Phase 2 land occupies a relatively small portion of the FSA compared to other land use types. The BRES ROPA 30 Land encompass land within the West Humber and Main Humber subwatersheds and the Mayfield Land encompass land within the Upper Etobicoke and Fletcher's Creek subwatersheds. Through the land planning process, FSA Take-Out Areas captured the majority of the preliminary NHS included in the FSA, these area totals have been excluded from the data tables presented in this section and only the remaining areas are discussed.

The BRES ROPA 30 Lands do not contain Key Features, Other Features, or Linkages. Supporting Features are identified by two patches (3.27 ha) consisting of meadow and wetland habitat. NHS Enhancement Areas are located in the West Humber subwatershed with a total of 4.13 ha. As a function of land area, this represents 1% of this land use area for the BRES ROPA 30 Lands. These areas have been identified to enhance floodplain areas (Table 2.6.3.24).

The Mayfield West Phase 2 Stage 2 Land Key Feature is one small (0.09 ha) patch of wetland habitat. The Supporting Features consists of four small (1.92 ha total) patches of meadow habitat. The Mayfield West Lands do not contain Other Features. Large portions of the mapped landscape linkages (Major and Local Landscape Linkages) overlap with / occur within the FSA Take-Out Areas, however 10.71 ha of Major

Landscape Linkages (MLL) and 0.47 ha of Local Landscape Linkage (LLL) occur in the Mayfield West Lands not accounted for in the FSA Take-Out Areas.

NHS Linkages connect the system across the FSA. Within the Mayfield West land use areas, there is 10.71 ha of Major Landscape Linkage (2.67 ha MVW and 8.04 ha PLZ) and 0.48 ha of Local Landscape Linkage (0.18 ha MVW and 0.29 ha PLZ). No Major Landscape Linkage areas or Local Landscape Linkage areas occur within the BRES ROPA 30 Lands.

NHS Enhancement Areas within the Mayfield West Lands have been identified in the Upper Etobicoke subwatershed with a total of 16.27 ha. As a function of land area, this represents 18% of this land use area for the Mayfield West Land. These areas have been identified to serve a variety of enhancements including improving features (Key, Supporting, Linkage), and improving the shape, size, and/or contiguity of a feature, opportunities to create substantive system benefits for long-term system resilience. All Enhancement Areas are less than 5 ha in area. See Table 2.6.3.25 for all identified enhancement opportunities including Conceptual Enhancement Areas.

Management of the NHS (features, linkages, enhancements) is to be conducted in accordance with guidance provided in Section 2.5.2.1. Detailed assessment and analyses through detailed subwatershed studies is to be used to inform final management direction for the system, guided and informed by direction provided herein.

Table 2.6.3.24. NHS Features – BRES ROPA 30 and Mayfield West Phase 2 Lands

	Key Features	Supporting Features	Other Features	Linkages	Enhancement Areas [1]
Approved BRES ROPA 30 Lands	0.00 (0%)	3.27 (1%)	0.00 (0%)	0.00 (0%)	4.13 (1%)
Mayfield West Phase 2 Stage 2	0.09 (0.1%)	1.92 (2%)	0.00 (0%)	11.18 (12%)	8.29 (9%)

[1]Enhancement Areas value presented is a composite total which removes overlap between enhancement types. It does not account for % enhancement targets (i.e., includes the total area for enhancements 'as mapped').

2.6.3.5 Staff Recommended SABE

The watercourse and HDF management requirements for the SABE testing areas are anticipated to correspond to the requirements established for the preliminary SABE concept. Refer to Section 2.6.3.2 – Drainage Features for guidance on watercourse and HDF classification and management, erosion hazard corridor management, corridor enhancements and rehabilitation, maintenance of channel length and sediment supply, road crossings, and erosion thresholds.

Natural Heritage System

The Natural Heritage System, as presented in Section 2.6.3.1, has been identified for the FSA to ensure that a comprehensive, landscape-level system could be implemented for the SABE without concern that small adjustments in boundaries would alter the overall guidance or direction for the system. Following from this, direction established through both the Characterization Report (Part A) and the current Impact Assessment Report (Part B) are applicable across any SABE delineated within the FSA. Minor refinements to boundaries of the SABE, such as from the Preliminary SABE Concept to the Staff Recommended SABE, or refinement(s) to development type (community of employment) do not alter the guidance presented. Specifically, the following continue to apply in the form they are presented in Section 2.6.3.1:

- Goals and Guiding Principles for the NHS
- Targets for the NHS
- The Net Gain Mitigation Hierarchy: A Framework for System Management
- System Components
    - Feature Types (Key, Supporting, Other)
    - Linkages (Types, Widths, Locations on the Landscape etc.)
    - Enhancement Areas (Types, locations)
- Approach to overall system and feature management

Revisions to the SABE boundary between the Preliminary SABE Concept and the Staff Recommended SABE will result in some changes to the composition of features and areas of the NHS. Consideration has been given to the potential influence of these changes on the natural cover, sensitive features, and areas in **Section 2.5.5**. While these compositional changes will influence site-specific management in future land use planning stages (e.g., detailed subwatershed studies), the overall recommendations, guidance and direction for the NHS set out through this report remain appropriate and valid. It is recognized that numeric directions with respect to Enhancement Areas to support the achievement of system targets will need to be updated upon the confirmation of a final SABE boundary. However, as the targets are relative (e.g., no net loss, percent increase, etc.), they can be applied to the final SABE and achieved through implementation within that finalized boundary.

It is recommended that numeric summaries and guidance that uses numeric values (i.e., Enhancement Area requirements) be updated to reflect the Final SABE to ensure clear and consistent guidance is available to inform detailed subwatershed studies and land use planning processes. This should occur at the time of the selection and confirmation of a final SABE.

2.7 Detailed Scope for Local Subwatershed Study(s)

The general management recommendations outlined in this Scoped Subwatershed Study are to be assessed in detail and refined as part of future Local Subwatershed Studies. The Local Subwatershed Studies are to be completed in support of subsequent Secondary Plans, and prior to consideration of Draft Plan Approvals. The local Subwatershed Studies should include multi-year field work supporting detailed technical analyses including hydrology, hydraulics, hydrogeology, geotechnical investigations, and fluvial geomorphology, as well as an integrated evaluation of aquatic habitat, terrestrial features, watercourse systems, key hydrologic areas and key hydrologic features.

Of particular importance, the Local Subwatershed Studies are required to establish targets for developing the environmental and stormwater management strategy for the respective Secondary Plan Area. In this respect, monitoring programs are to be implemented as part of Local Subwatershed Studies, to provide a more detailed characterization and assessment of the natural heritage and water resources systems and the interdependent linkages within these systems, to develop a refined constraint assessment of the natural features and systems within the respective Secondary Plan Area, and calibrate/validate the numerical models used for the hydrologic and hydraulic analyses and groundwater assessment. Consultation with agencies and other important groups will provide opportunities to obtain and be informed by updated studies, data and information that can inform refinements and further the land use planning process. General Terms of Reference building from this Scoped SWS for Local Subwatershed Studies are included in Appendix F.

Appendix A

Surface Water

Appendix B

Groundwater

Appendix C

Stream Systems

Appendix D

Geotechnical

Appendix E

Natural Heritage Systems

Appendix F

Detailed Subwatershed Study Terms of Reference

Appendix G

Excerpts From Part A Characterization Report