Scoped Subwatershed Study, Part C: Implementation Plan (Final Draft)

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

8/19/2021

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1.0 Introduction

The Regional Municipality of Peel (Peel Region) has initiated an Environmental Screening and Scoped Subwatershed Study (SWS) ("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 Screening and Scoped Subwatershed Study (Scoped SWS) are 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.

The Environmental Screening and Scoped SWS has been undertaken to ensure that watershed planning information has been considered as a fundamental component of the SABE Study to inform where new settlement areas in Peel should be located and how they should be managed. The purpose of the Study is to identify management recommendations at a regional level to ensure that natural systems are protected, restored and improved; that Water Resource System Management requirements, including ground and surface water quantity and quality are addressed; that natural heritage and water resource system planning requirements are met; and that natural system resilience and the impacts of a changing climate are fully considered in management recommendations.

The Scoped SWS addresses Provincial and Regional policy requirements that the feasibility and location of the settlement expansion has considered: 1) the potential impacts to watershed conditions; 2) the planning for new community and employment areas has been informed by the appropriate watershed planning information; and 3) management recommendations demonstrate that impacts will be avoided, or if avoidance is not possible, are minimized and mitigated. Key deliverables of the study include:

- integrated natural heritage and Water Resource System Management guidance demonstrating that the settlement expansion will be planned to avoid, minimize and mitigate potential negative impacts to the environment taking into account climate change considerations
- identification of a preliminary stormwater management strategy to avoid and manage impacts on watershed conditions, including water quantity and quality
- identification of a conceptual water resource system
- identification of a conceptual natural heritage system
- monitoring
- guidelines for local level environmental studies (refer to Scoped SWS June 17 PGMC Staff Report

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 LOPAs are proposed to be supported by detailed subwatershed study(s) to be completed at a time appropriate to the anticipated timing of the LOPA.

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 Caledon excluding lands within the Greenbelt. 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 component which was completed in mid-2020 with a draft 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 Team working on behalf of Peel Region, involving additional technical studies including municipal servicing, transportation, agricultural, cultural heritage, and climate change, 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 expansion areas to be delineated.

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, requirements 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

Part C: Implementation Plan (this report)

The Part A: Existing Conditions and Charcterization Report (Draft) has been completed and submitted to Peel Region and the Technical Advisory Committee (TAC) in September 2020. The Draft 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 (Draft) provides an overview of the anticipated impacts associated with future development within the FSA. The Part B report identified three (3) land classifications, representing future development within the FSA corresponding to different levels of planning study and approval. The three land classifications are the preliminary SABE concept, the SABE testing areas, and the BRES ROPA 30 and Mayfield West Phase 2 Lands (lands in recently approved settlement areas). The Part B report also included an assessment of environmental planning requirements taking into account the presence of the currently identified GTA West Transportation Corridor and the implications for Water Resource System Management, natural heritage system and water resource system planning in the adjacent FSA lands. A further assessment of the final recommended SABE boundary will be undertaken in order to address changes to the SABE that are recommended in response to Regional Council directions including those related to the GTA West Highway. The Part B report provides general guidance for management opportunities and requirements for future environmental studies to support subsequent stages of land use planning for the SABE.

Subsequent iterations of this Part B report will be refined to provide a more focused discussion and assessment of anticipated impacts associated with future development within the SABE specifically which will 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 Final Draft Part C: Implementation Plan report provides an overview of the management recommendations, guidance for future monitoring programs, and general requirements for future studies at subsequent stages of planning and design. Similar to the Final Draft Part B report, this Part C report has initially been completed for the preliminary SABE concept and the SABE testing areas to further inform refining the Region's SABE, and will be updated as part of subsequent iterations to focus specifically on the SABE. Key deliverables and outcomes from the Part C report include:

- a comprehensive implementation plan outlining recommendations, strategies, and measures to address environmental planning and management requirements for the SABE,
- integrated natural heritage and Water Resource System Management recommendations demonstrating that the settlement expansion will be planned to avoid, minimize, and mitigate potential negative impacts,
- identification of a preliminary stormwater management strategy to avoid and manage impacts on watershed conditions including water quantity and quality,
- preliminary stormwater management facility sizing criteria to mitigate off-site flooding and erosion hazards including the identification of where Regional Storm (Regulatory) flood control is needed for each subwatershed,
- identification of a conceptual water resource system and natural heritage system with targets for enhancement and establishment of linkages,
- a recommended framework to implement monitoring and adaptive management planning, and
- guidance to implement the management recommendations through local level environmental studies.

2.0 Part C: Implementation Plan

2.1 Summary of Recommendations, Strategies and Management Measures

The Part B report provides the results of the impact assessment for the FSA, preliminary SABE concept and SABE testing areas and general recommendations and strategies for managing impacts to the NHS, watercourses, and water resources systems. The derivation of the FSA, preliminary SABE concept and SABE testing areas map has considered the high constraint natural features and systems within the FSA, preliminary SABE concept and SABE testing areas, as well as the existing communities of Bolton, Mayfield, Tullamore and other smaller hamlets, and the currently planned orientation/alignment of the proposed GTA West Highway. 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 to the preliminary SABE boundary based on various constraints and opportunities related to environmental management and other technical study input. The FSA has been evaluated based upon a generic impervious coverage without considering for constraints and opportunities associated with land use type (i.e. residential, employment, mixed), or any specific detail on supporting infrastructure associated with new roads (arterial and collectors) or any major servicing corridors. The preliminary SABE concept and SABE testing areas distinguish between “community” and “employment” land uses within the areas under consideration for the final SABE, and provided further detail regarding location and extent for conducting more detailed analyses of impacts and consideration for management requirements and opportunities. The management recommendations and guidance vary across the subwatersheds encompassing the FSA and other land classifications, due to the unique environmental features and systems within the respective subwatersheds, as well as the location and extent of potential future development associated with the FSA.

The following sections provide a summary of the management guidance advanced in the Part B report related to the preliminary SABE concept and SABE testing areas for the NHS, watercourses, and water resource systems. The recommendations and guidance have been organized according to study discipline, and by subwatershed. In addition, detailed guidance for the SABE will be provided once the draft recommended SABE boundary has been identified based upon the refined land use plan and the general guidance advanced below and in the Part B report.

2.1.1 Water Resource System Management (Surface and Ground)

2.1.1.1 Subwatershed-Scale Guidance for the Preliminary SABE Concept and Testing Areas

The Part B report provides an overview of the characteristics of the preliminary SABE concept and SABE testing areas within each subwatershed, and general guidance for managing the impacts related to flooding, watercourse erosion, water quality, and managing water budget. The guidance has been developed with consideration for the key hydrologic features and key hydrologic areas within the preliminary SABE concept and testing areas. The following summarizes the characterization and stormwater management guidance for the preliminary SABE concept and testing areas, addressing stormwater management facility sizing and design requirements including provision of flood control, erosion control, and groundwater recharge, by subwatershed to ensure no negative impacts to downstream flooding and erosion, including within designated flood vulnerable areas (FVAs).

Subwatershed: Main Humber River Subwatershed	
Subwatershed Characterization:	
Total Subwatershed Drainage Area:	35781 ha
Predominant Soil Group:	Clay Loam
Predominant Grades:	<2%
Downstream FVA:	Yes (Bolton, Vaughan, Confluence of Main Humber and West Humber)
# of Structures within Bolton FVA:	Unknown
# of Structures within Vaughan FVA:	Unknown
# of Structures within Main Humber FVA:	3 Miscellaneous/Institutional; 63 Residential
Flood Frequency for Bolton FVA:	Unknown
Flood Frequency for Vaughan FVA:	Unknown
Flood Frequency for Main Humber FVA:	>100 Year
Redside Dace Habitat:	No
Land Classification Characterization:	
Area of FSA Within Subwatershed:	438 ha
FSA As Proportion of Subwatershed:	1.2 %
Assumed Imperviousness of FSA:	51%
Receiving System:	Confined and Regulated Watercourses
Area of Preliminary SABE Concept Within Subwatershed:	150.89 ha Community
Preliminary SABE Concept As Proportion of Subwatershed:	0.4 %
Assumed Imperviousness of Preliminary SABE Concept:	70%
Receiving System:	Confined and Regulated Watercourses
Area of SABE Testing Area Within Subwatershed:	138.34 ha Community
SABE Testing Area As Proportion of Subwatershed:	0.4 %
Assumed Imperviousness of SABE Testing Area:	70%
Receiving System:	Confined and Regulated Watercourses
Range of Stormwater Management Sizing and Design Criteria	
Extended Detention Storage/Erosion Control:	150 m^3/imp. ha – 500 m^3/imp. ha
100 Year Flood Control:	400 m^3/imp. ha – 1250 m^3/imp. ha
Regional Storm Control:	0 m^3/imp. ha – 1200 m^3/imp. ha
Water Budget:	1 mm/imp. ha – 6 mm/imp. ha
Water Quality Criteria:	Enhanced Standard of Treatment Thermal Mitigation

Subwatershed: West Humber River Subwatershed	
Subwatershed Characterization:	
Total Subwatershed Drainage Area:	20223 ha
Predominant Soil Group:	Clay Loam
Predominant Grades:	<2%
Downstream FVA:	Yes (Confluence of Main Humber and West Humber)
# of Structures within Main Humber FVA:	3 Miscellaneous/Institutional; 63 Residential
Flood Frequency for Main Humber FVA:	> 100 Year
Redside Dace Habitat:	Yes
Land Classification Characterization:	
Area of FSA Within Subwatershed:	5335 ha
FSA As Proportion of Subwatershed:	26.4 %
Assumed Imperviousness of FSA:	51%
Receiving Systems:	Mixed (Confined and Unconfined Watercourses, HDFs)
Area of Preliminary SABE Concept Within Subwatershed:	1824 ha Community 879 ha Employment
Preliminary SABE Concept As Proportion of Subwatershed:	13.4 %
Assumed Imperviousness of Preliminary SABE Concept:	70% Community 90% Employment
Receiving Systems:	Mixed (Confined and Unconfined Watercourses, HDFs)
Area of SABE Testing Area Within Subwatershed:	305 ha Community 317 ha Employment
SABE Testing Area As Proportion of Subwatershed:	3.1 %
Assumed Imperviousness of SABE Testing Area:	70% Community 90% Employment
Receiving Systems:	Mixed (Confined and Unconfined Watercourses, HDFs)
Range of Stormwater Management Sizing and Design Criteria	
Extended Detention Storage/Erosion Control:	150 m^3/imp. ha – 500 m^3/imp. ha
100 Year Flood Control:	400 m^3/imp. ha – 1250 m^3/imp. ha
Regional Storm Control:	0 m^3/imp. ha – 1200 m^3/imp. ha
Water Budget:	1 mm/imp. ha – 6 mm/imp. ha
Water Quality Criteria:	Enhanced Standard of Treatment Discharge temperatures below 24°C Dissolved oxygen concentrations of at least 7 mg/L TSS levels less than 25 mg/L above background conditions

Subwatershed: Upper Etobicoke Creek Subwatershed	
Subwatershed Characterization:	
Total Subwatershed Drainage Area:	9978 ha
Predominant Soil Group:	Clay Loam
Predominant Grades:	<2%
Downstream FVA:	Yes (Downtown Brampton)
# of Structures within FVA:	110 Commercial; 13 Miscellaneous/Institutional; 68 Residential
Flood Frequency for FVA:	> 50 Year
Redside Dace Habitat:	No
Land Classification Characterization:	
Area of FSA Within Subwatershed:	2027 ha
FSA As Proportion of Subwatershed:	20.3 %
Assumed Imperviousness of FSA:	51%
Receiving Systems:	Mixed (Confined and Unconfined Watercourses, HDFs)
Area of Preliminary SABE Concept Within Subwatershed:	731 ha Community 146 ha Employment
Preliminary SABE Concept As Proportion of Subwatershed:	8.8 %
Assumed Imperviousness of Preliminary SABE Concept:	70% Community 90% Employment
Receiving Systems:	Mixed (Confined and Unconfined Watercourses, HDFs)
Area of SABE Testing Area Within Subwatershed:	72 ha Community 136 ha Employment
SABE Testing Area As Proportion of Subwatershed:	2.1 %
Assumed Imperviousness of SABE Testing Area:	70% Community 90% Employment
Receiving Systems:	Mixed (Confined and Unconfined Watercourses, HDFs)
Range of Stormwater Management Sizing and Design Criteria	
Extended Detention Storage/Erosion Control:	325 m^3/imp. ha
100 Year Flood Control:	400 m^3/imp. ha – 1250 m^3/imp. ha
Regional Storm Control:	0 m^3/imp. ha – 1200 m^3/imp. ha
Water Budget:	1 mm/imp. ha – 6 mm/imp. ha
Water Quality Criteria:	Enhanced Standard of Treatment Thermal Mitigation

Subwatershed: Fletcher's Creek Subwatershed		
Subwatershed Characterization:		
Total Subwatershed Drainage Area:	4169 ha	
Predominant Soil Group:	Clay Loam	
Predominant Grades:	<2%	
Downstream FVA:	No	
Redside Dace Habitat:	No	
Land Classification Characterization:		
Area of FSA Within Subwatershed:	186 ha	
FSA As Proportion of Subwatershed:	4.5 %	
Assumed Imperviousness of FSA:	51%	
Receiving Systems:	Mixed (Unconfined Watercourses, HDFs)	
Area of Preliminary SABE Concept Within Subwatershed:		126 ha Community 1 ha Employment
Preliminary SABE Concept As Proportion of Subwatershed:		3.1 %
Assumed Imperviousness of Preliminary SABE Concept:		70% Community 90% Employment
Receiving Systems:	Mixed (Unconfined Watercourses, HDFs)	
Range of Stormwater Management Sizing and Design Criteria		
Extended Detention Storage/Erosion Control:	250 m^3/imp. ha	
100 Year Flood Control:	600 m^3/imp. ha - 1250 m^3/imp. ha	
Regional Storm Control:	0 m^3/imp. ha - 1225 m^3/imp. ha	
Water Budget:	1 mm/imp. ha – 6 mm/imp. ha	
Water Quality Criteria:	Enhanced Standard of Treatment Thermal Mitigation	

Subwatershed: Huttonville Creek Subwatershed		
Subwatershed Characterization:		
Total Subwatershed Drainage Area:	1510 ha	
Predominant Soil Group:	Clay Loam	
Predominant Grades:	<2%	
Downstream FVA:	No	
Redside Dace Habitat:	No	
Land Classification Characterization:		
Area of FSA Within Subwatershed:	43 ha	
FSA As Proportion of Subwatershed:	2.8 %	
Assumed Imperviousness of FSA:	51%	
Receiving Systems:	HDFs	
Area of Preliminary SABE Concept Within Subwatershed:		2 ha Community 36 ha Employment
Preliminary SABE Concept As Proportion of Subwatershed:		2.5 %
Assumed Imperviousness of Preliminary SABE Concept:		70% Community 90% Employment
Receiving Systems:	Mixed (Unconfined Watercourses, HDFs)	
Range of Stormwater Management Sizing and Design Criteria		
Extended Detention Storage/Erosion Control:	200 m^3/imp. ha - 325 m^3/imp. ha	
100 Year Flood Control:	550 m^3/imp. ha - 1150 m^3/imp. ha	
Regional Storm Control:	975 m^3/imp. ha - 1200 m^3/imp. ha	
Water Budget:	1 mm/imp. ha – 6 mm/imp. ha	
Water Quality Criteria:	Enhanced Standard of Treatment Thermal Mitigation	

Subwatershed: Main Credit River Subwatershed		
Subwatershed Characterization:		
Total Subwatershed Drainage Area:	2353 ha	
Predominant Soil Group:	Clay Loam	
Predominant Grades:	<2%	
Downstream FVA:	No	
Redside Dace Habitat:	No	
Land Classification Characterization:		
Area of FSA Within Subwatershed:	23 ha	
FSA As Proportion of Subwatershed:	1.0 %	
Assumed Imperviousness of FSA:	51%	
Receiving Systems:	HDFs	
Area of Preliminary SABE Concept Within Subwatershed:		10 ha Community 6 ha Employment
Preliminary SABE Concept As Proportion of Subwatershed:		0.7 %
Assumed Imperviousness of Preliminary SABE Concept:		70% Community 90% Employment
Receiving Systems:	Mixed (Unconfined Watercourses, HDFs)	
Range of Stormwater Management Sizing and Design Criteria		
Extended Detention Storage/Erosion Control:	150 m^3/imp. ha – 500 m^3/imp. ha	
100 Year Flood Control:	400 m^3/imp. ha – 1250 m^3/imp. ha	
Regional Storm Control:	0 m^3/imp. ha – 1200 m^3/imp. ha	
Water Budget:	1 mm/imp. ha – 6 mm/imp. ha	
Water Quality Criteria:	Enhanced Standard of Treatment Thermal Mitigation	

2.1.1.2 Application of Subwatershed-Scale Guidance to Preliminary SABE Concept

Subwatershed-Scale guidance presented in the preceding section have been applied to the preliminary SABE concept and SABE testing areas, with consideration to variation in the land use type (i.e. community area or employment area) and corresponding location. This information has been used to determine the range of storage volume requirements within the required stormwater management facilities, as well as corresponding estimates of the facility footprints proportional to the SABE within the respective subwatersheds and associated outlets, based upon the preliminary stormwater management facility locations established as part of the Part B report. The preliminary stormwater management facility location plan is presented on Drawing WR-6 of the Part B report; a copy of this drawing is included in Appendix A for ease of reference. The stormwater management facility footprints have been estimated assuming that all facilities would be constructed as wet pond end-of-pipe facilities, and assuming the following geometry:

- Length:width ratio of 4:1 at permanent pool
- 5:1 side slopes
- 2.5 m maximum 100 year operating elevation above permanent pool (including extended detention)
- 1 m operating elevation above the 100 year operating elevation for Regional Storm control

The range of combined extended detention and 100 year storage volumes have been calculated based upon maximum and minimum unitary values from the background information, and the storage volumes for Regional Storm control have been calculated based upon the maximum values provided for each subwatershed within the background information. The following summarizes the characterization and management guidance for the preliminary SABE concept and testing areas, by subwatershed. Supporting calculations are included in Appendix A.

Subwatershed: Main Humber River Subwatershed		
Subwatershed Characterization:		
Total Subwatershed Drainage Area:	35781 ha	
Predominant Soil Group:	Clay Loam	
Predominant Grades:	<2%	
Downstream FVA:	Yes	
Redside Dace Habitat:	No	
Preliminary SABE Concept Characterization:		
Area Residential Land Use:	151 ha	
Area of Employment Land Use:	0 ha	
Weighted Imperviousness:	70 %	
# of Outlets at SABE Boundary:	10	
Stormwater Management Sizing Estimates for Preliminary SABE Concept		
Total Permanent Pool Volume:		33,999 m^3
Total Extended Detention + 100 Year Storage:		95,198 – 148,086 m^3
Regional Storm Control:		126,931 m^3
Estimated Area for SWM Facilities (100 Year):		6.7 – 9.7 ha 5 – 7 % of SABE
Estimated Area for SWM Facilities (Regional):		16.6 ha 11 % of SABE
SABE Testing Area Characterization:		
Area Residential Land Use:	138 ha	
Area of Employment Land Use:	0 ha	
Weighted Imperviousness:	70 %	
# of Outlets at SABE Boundary:	10	
Stormwater Management Sizing Estimates for SABE Testing Areas		
Total Permanent Pool Volume:		31075 m^3
Total Extended Detention + 100 Year Storage:		87,011 – 135,351 m^3
Regional Storm Control:		116,015 m^3
Estimated Area for SWM Facilities (100 Year):		6.3 – 9.0 ha 5 – 7 % of SABE[1.]
Estimated Area for SWM Facilities (Regional):		15.3 ha 11 % of SABE

NOTE: 1. Comments provided by TRCA (ref. personal communication Chekol-Farrell/Scheckenberger, July 27, 2021) indicate facility footprints compromising 11% of the development area would be required to achieve 100 year flood control due to current requirements from TRCA to provide over-control of storm runoff within the upper reaches of the Main Humber Subwatershed.

Subwatershed: West Humber River Subwatershed		
Subwatershed Characterization:		
Total Subwatershed Drainage Area:	20223 ha	
Predominant Soil Group:	Clay Loam	
Predominant Grades:	<2%	
Downstream FVA:	Yes	
Redside Dace Habitat:	Yes	
Preliminary SABE Concept Characterization:		
Area Residential Land Use:	1825 ha	
Area of Employment Land Use:	879 ha	
Weighted Imperviousness:	76.5 %	
# of Outlets at SABE Boundary:	114	
Stormwater Management Sizing Estimates for Preliminary SABE Concept		
Total Permanent Pool Volume:		627,079 m^3
Total Extended Detention + 100 Year Storage:		1,830,389 – 2,847,272 m^3
Regional Storm Control:		2,440,519 m^3
Estimated Area for SWM Facilities (100 Year):		119.9 – 176.1 ha 5 – 7 % of SABE
Estimated Area for SWM Facilities (Regional):		314 ha 12 % of SABE
SABE Testing Area Characterization:		
Area Residential Land Use:	305 ha	
Area of Employment Land Use:	317 ha	
Weighted Imperviousness:	80.2 %	
# of Outlets at SABE Boundary:	33	
Stormwater Management Sizing Estimates for SABE Testing Areas		
Total Permanent Pool Volume:		150,509 m^3
Total Extended Detention + 100 Year Storage:		455,198 – 708,086 m^3
Regional Storm Control:		606,930 m^3
Estimated Area for SWM Facilities (100 Year):		30.3 – 44.3 ha 5 – 8 % of SABE[1.]
Estimated Area for SWM Facilities (Regional):		78.4 ha 13 % of SABE

NOTE: [1.] Comments provided by TRCA (ref. personal communication Chekol-Farrell/Scheckenberger, July 27, 2021) indicate facility footprints compromising 11% of the development area would be required to achieve 100 year flood control due to current requirements from TRCA to provide over-control of storm runoff within the upper reaches of the West Humber Subwatershed.

Subwatershed: Upper Etobicoke Creek Subwatershed		
Subwatershed Characterization:		
Total Subwatershed Drainage Area:	9978 ha	
Predominant Soil Group:	Clay Loam	
Predominant Grades:	<2%	
Downstream FVA:	Yes	
Redside Dace Habitat:	Yes	
Preliminary SABE Concept Characterization:		
Area Residential Land Use:	731 ha	
Area of Employment Land Use:	146 ha	
Weighted Imperviousness:	73.3 %	
# of Outlets at SABE Boundary:	50	
Stormwater Management Sizing Estimates for Preliminary SABE Concept		
Total Permanent Pool Volume:		209,257 m^3
Total Extended Detention + 100 Year Storage:		604,915 – 940,979 m^3
Regional Storm Control:		806,553 m^3
Estimated Area for SWM Facilities (100 Year):		41.2 – 60.0 ha 5 – 7 % of SABE
Estimated Area for SWM Facilities (Regional):		104.7 ha 12 % of SABE
SABE Testing Area Characterization:		
Area Residential Land Use:	72 ha	
Area of Employment Land Use:	136 ha	
Weighted Imperviousness:	83.1 %	
# of Outlets at SABE Boundary:	12	
Stormwater Management Sizing Estimates for SABE Testing Areas		
Total Permanent Pool Volume:		53,347 m^3
Total Extended Detention + 100 Year Storage:		161,189 – 250,738 m^3
Regional Storm Control:		214,918 m^3
Estimated Area for SWM Facilities (100 Year):		10.7 – 15.7 ha 5 – 7 % of SABE[1.]
Estimated Area for SWM Facilities (Regional):		27.7 ha 13 % of SABE

NOTE: [1.] Comments provided by TRCA (ref. personal communication Chekol-Farrell/Scheckenberger, July 27, 2021) indicate facility footprints compromising 11% of the development area would be required to achieve 100 year flood control due to current requirements from TRCA to provide over-control of storm runoff within the upper reaches of the Upper Etobicoke Creek Subwatershed.

Subwatershed: Fletcher's Creek Subwatershed		
Subwatershed Characterization:		
Total Subwatershed Drainage Area:	4169 ha	
Predominant Soil Group:	Clay Loam	
Predominant Grades:	<2%	
Downstream FVA:	No	
Redside Dace Habitat:	No	
Preliminary SABE Concept Characterization:		
Area Residential Land Use:	126 ha	
Area of Employment Land Use:	1 ha	
Weighted Imperviousness:	70.2 %	
# of Outlets at SABE Boundary:	6	
Stormwater Management Sizing Estimates for Preliminary SABE Concept		
Total Permanent Pool Volume:		29,218 m^3
Total Extended Detention + 100 Year Storage:		77,266 – 136,352 m^3
Regional Storm Control:		111,354 m^3
Estimated Area for SWM Facilities (100 Year):		5.2 – 8.5 ha 4 – 7 % of SABE
Estimated Area for SWM Facilities (Regional):		14.4 ha 11 % of SABE

Subwatershed: Huttonville Creek Subwatershed		
Subwatershed Characterization:		
Total Subwatershed Drainage Area:	1510 ha	
Predominant Soil Group:	Clay Loam	
Predominant Grades:	<2%	
Downstream FVA:	No	
Redside Dace Habitat:	No	
Preliminary SABE Concept Characterization:		
Area Residential Land Use:	2 ha	
Area of Employment Land Use:	36 ha	
Weighted Imperviousness:	89.0 %	
# of Outlets at SABE Boundary:	6	
Stormwater Management Sizing Estimates for Preliminary SABE Concept		
Total Permanent Pool Volume:		9,707 m^3
Total Extended Detention + 100 Year Storage:		29,434 – 45,412 m^3
Regional Storm Control:		40,366 m^3
Estimated Area for SWM Facilities (100 Year):		2.4 – 3.3 ha 7 – 9 % of SABE
Estimated Area for SWM Facilities (Regional):		5.5 ha 14 % of SABE

Subwatershed: Main Credit River		
Subwatershed Characterization:		
Total Subwatershed Drainage Area:	2353 ha	
Predominant Soil Group:	Clay Loam	
Predominant Grades:	<2%	
Downstream FVA:	No	
Redside Dace Habitat:	No	
Preliminary SABE Concept Characterization:		
Area Residential Land Use:	10 ha	
Area of Employment Land Use:	6 ha	
Weighted Imperviousness:	77.8 %	
# of Outlets at SABE Boundary:	2	
Stormwater Management Sizing Estimates for Preliminary SABE Concept		
Total Permanent Pool Volume:		3,609 m^3
Total Extended Detention + 100 Year Storage:		10,578 – 16,455 m^3
Regional Storm Control:		14,104 m^3
Estimated Area for SWM Facilities (100 Year):		0.8 – 1.2 ha 6 – 8 % of SABE
Estimated Area for SWM Facilities (Regional):		1.9 ha 13 % of SABE

The information presented in the above tables indicates that the stormwater management facility footprints required for erosion and flood protection to the 100 year operating condition represent, on average, 5% of the area for the preliminary SABE concept and testing areas, and range from representing between 4% and 8% of the area for the land classifications. A closer review of the results has indicated that the stormwater management facility footprints for the community land uses generally lie toward the lower end of the range, with the stormwater management facilities for the employment land uses requiring relatively more land due to the storage volumes required for the higher impervious coverage.

The information presented above further indicates that the inclusion of Regional Storm controls within the end-of-pipe facilities would require between 11% and 16% of the area of the preliminary SABE concept and SABE testing areas, and would occupy on average 12% of the area. These results are inclusive of the footprint requirements for the 100 year storage, and are premised upon the assumed operating depth of 1 m above the 100 year operating condition. At present, no guidance has been provided by the Province regarding the permissible depth for Regional Storm control, hence this is frequently at the discretion of the municipality having jurisdiction and generally assuming ownership of the stormwater management facilities. The storage volumes and sizes are to be confirmed as part of future studies, and in consultation with the Town of Caledon, and relevant approval and permitting authorities (i.e. CVC/TRCA, MECP) to determine the permissible operating conditions for Regional Storm control within the end-of-pipe facilities.

2.1.1.3 General Practices

The Part B report provided an overview of various stormwater management practices which may be implemented to achieve the requirements outlined in the foregoing. Residential land uses within the FSA are anticipated to afford the opportunity to implement centralized stormwater management systems along with public and private realm LID BMPs to provide the requisite stormwater quality and quantity control for multiple landownership, although centralized systems should be encouraged as a preferred approach in employment areas where feasible or necessary. On this basis, stormwater management is anticipated to be provided in the form of wet pond, wetland, or hybrid facilities, designed in accordance with the current Provincial standards for an *Enhanced* standard of treatment. Employment land uses within the FSA may afford limited opportunity to implement centralized stormwater management systems to provide the requisite stormwater quality and quantity control for multiple landownership. On this basis, stormwater management for employment land use conditions is anticipated to be provided for each site within the FSA. It is generally preferred to provide the requisite stormwater quality and quantity control in the form of wet facilities (i.e. wet pond, wetland, hybrid facilities), designed in accordance with the current Provincial standards for an *Enhanced* standard of treatment, where drainage areas are sufficient to support wet end-of-pipe facilities (i.e. drainage areas greater than 5 ha); depending upon the proximity of the stormwater management facilities to the airport, dry ponds may be required in order to avoid attracting birds and waterfowl. In some instances, however, the development drainage area may be less than the 5 ha minimum required to support a wet end-of-pipe facility, and it may be infeasible to convey the runoff from the site to a multi-party facility. In these instances, alternative approaches (i.e. vegetated technologies, oil/grit separators, bioswales/biofilters, underground storage facilities) may be considered. In all areas, LID BMPs and green infrastructure are to be implemented to the greatest extent possible, particularly within employment areas with large warehousing uses and more intense coverage, to support a robust, resilient, and sustainable natural heritage system.

Where Regional Storm controls are required for employment lands, efforts should be made to implement centralized dry pond facilities at strategic locations adjacent to regulated watercourses, rather than integrating Regional Storm control requirements into source controls for employment land use conditions. For community land uses, Regional Storm controls may be integrated into the end-of-pipe facility, particularly where the stormwater management facility serves multiple landowners and developments. In addition, and as noted previously, stormwater management for the main watercourses through the West Humber Subwatershed are required to address 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 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. Consequently, all developments within those areas will be required to incorporate best practices including LID BMPs as part of the formal stormwater quality management strategy, to mitigate thermal impacts and to manage water budget. The acceptable practices vary according to land use, and are subject to approval by the municipality and Conservation Authority having jurisdiction. While the final recommendations for acceptable management practices are to be determine as part of future studies, the following table provides an overview of acceptable practices by land use:

Overview of Generally Accepted Stormwater Management Practice By Land Use		
Practice/Technology	**Land Use**	
	Residential	***Employment***
End-of-Pipe (Wet Pond/Wetland/Hybrid)	X	X
Dry Pond	X	X
Oil/Grit Separator	X	X
Rooftop Storage		X
Parking Lot Storage		X
Green Roofs		X
Rainwater Harvesting	X	X
Downspout Disconnections	X	X
Pervious Pipes	X	X
Oversized Pipes	X	X
Permeable Pavement	X	X
Soakaway Pits	X	X
Infiltration Trenches	X	X
Bumpouts	X	X
Grassed Swales	X	X
Increased Topsoil Thickness	X	X
Biofilters	X	X

The specific measures applied in the SABE will need to be established as part of future detailed studies, based upon the land use condition of the contributing drainage area, and subject to approval by Caledon and the respective approval authority (i.e. CVC/TRCA, MECP). In addition, given the small size of the FSA 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-of-pipe facilities, thus requiring source controls for stormwater quality, quantity, and erosion control.

2.1.1.4 Groundwater and Baseflow Management

Potential reductions in groundwater recharge are addressed through the various storm Water Resource System Management practices discussed above. The maintenance of groundwater recharge is important related to the functional nature of the Significant Groundwater Recharge Areas (SGRAs, ref. Drawing GW-9), the Ecologically Significant Groundwater Recharge Areas (ESGRAs, ref. Drawing GW-9) and Highly Vulnerable Aquifers (HVA, ref. Drawing GW-12). It is expected that various storm Water Resource System Management considerations may generally apply through the SABE given the relatively consistent nature of surficial geology and subsequent potential recharge across the undeveloped lands. It is generally expected that the overall unmitigated reduction in recharge to the underlying aquifers within the SABE may be a relatively smaller portion of regional recharge contributing to those aquifers.

In addition to the reduction in recharge other considerations for potential groundwater quantity impacts and associated general management strategies are presented below.

Various types of subsurface infrastructure and the related construction activities 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.

Groundwater interception 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 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 are presented in the Areas of Concern (AOC) groundwater mapping (ref. Drawing GW-8a, Appendix B). These areas may present an increased potential for groundwater interception, groundwater discharge impacts and geotechnical issues.

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. Groundwater quality protection should be considered in relation to the location of the HVA locations (ref. Drawing GW-12, Appendix B). 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 2.1.1.3. 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.

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 SABE. 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. 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.

Based on the above discussion and related drawings the following provides the potential hydrogeologically sensitive areas on a subwatershed basis.

Main Humber Subwatershed

There is one minor HVA and a number of ESGRAs.

West Humber Subwatershed

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

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

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.

2.1.2 Stream Morphology

2.1.2.1 Watercourse Management Summary (Stream Morphology)

For stream morphology, the overall goal of the Scoped Subwatershed Study has been to define the conditions and parameters to accommodate natural, dynamically stable stream channels and associated corridors that tolerate the natural and future managed range of stream flow patterns, functions, and processes, all while supporting a diverse aquatic habitat. Stream management has been approached on the basis of protecting stream channels and their corridors, in order to maintain or improve the present condition of the area watercourses. In cases where protection in-place is not feasible, opportunities for realignment and enhancement can be evaluated and recommended accordingly, depending on the feature type and its constraint ranking and management recommendations.

The management considerations to maintain natural channel processes and functions include: the identification of erosion control targets (erosion thresholds) designed to reduce critical flow exceedances at key locations along receiving watercourses, maintaining pre-development runoff volume to mitigate impacts to flow regime (i.e. runoff volume management), stream corridor protection to minimize or eliminate risk to public and private property from channel erosion and evolution, and consideration of erosion hazards when siting and designing stream crossings. Table 2.1.2.1 summarizes these management considerations and goals for developing the watercourse management strategy.

Table 2.1.2.1. Management Considerations and Goals – Stream Morphology

Management Considerations	Management Goals
Hazard corridors (meander belt width)	Natural cover maintained in stream corridors
	Minimize or eliminate risk to public and private property from channel erosion and evolution
Watercourse form and function	Maintain natural channel structure and rates of morphologic change. If watercourse alteration is proposed, stream length should be maintained where possible. Where stream length cannot be maintained, and watercourse alteration is proposed, natural channel design principles will be implemented to enhance hydrological and ecological processes.
Road crossings	Maintain natural channel structure and rates of morphologic change
	Minimize or eliminate risk to public and private property from channel erosion and evolution
Stormwater management facilities siting and sizing	Maintain natural channel structure and rates of morphologic change
	Maintain critical flow exceedance, especially for sensitive reaches
Erosion thresholds	Work toward maintaining pre-development runoff volume
	Minimize or eliminate risk to public and private property from channel erosion and evolution
	Maintain natural channel structure and rates of morphologic change
	Maintain critical flow exceedance at governing locations

In addition to the considerations in Table 2.1.2.1, there are also ecological functions that should be considered in developing the watercourse management strategy, such as maintaining/enhancing a terrestrial or aquatic linkage, and/or enhancing riparian habitat.

Management strategies for area watercourses will need to correspond to the feature classification as a high or medium constraint feature. Low geomorphic constraint features documented in this study will require re-classification in future studies to evaluate whether the feature is a watercourse or a Headwater Drainage Feature (HDF), then follow the appropriate evaluation and management accordingly. HDFs are only identified at a preliminary level in this desktop analysis, and thereby will require field confirmation of their presence and seasonally based field evaluations following the guidelines prepared by TRCA and CVC (2014). The identification of HDF and watercourse features will be confirmed and / or refined in consultation with TRCA in future studies and will consider TRCA's HDF identifications.

High constraint features are to be protected in place with appropriate setbacks and ecological buffers. Medium constraint features are to remain open and protected with appropriate setbacks and ecological buffers, however, they may undergo partial to full realignment, provided sufficient rationale is given to the satisfaction of approval agencies, the current function is maintained or enhanced, and restoration works are considered in each realignment design. Areas for enhancement include impacted, channelized reaches within historically agricultural lands, and upgrades to existing watercourse crossings. Refer to Table 2.1.2.2.

Preliminary geomorphic constraint rankings for each reach within the preliminary SABE concept and the SABE testing areas are presented in Table 1 of Appendix E to the Phase 2, Part A report; a copy is included in Appendix C of this report for ease of reference. The preliminary geomorphic constraint rankings presented are subject to further refinement in future studies following completion of geomorphic field assessments. As well, the ultimate management recommendations for watercourses and HDFs should incorporate an integrated assessment of aquatic habitat, riparian habitat, surface water and groundwater considerations which are to be completed as part of future works. As these have not yet been evaluated, the preliminary geomorphic constraints should be considered minimum constraints until future studies and integrated constraints analyses have been completed. It is furthermore recommended that stream management options be developed on a reach or feature basis as part of future studies, as these units display relative homogeneity with respect to form, function, and habitat. Table 2.1.2.2 summarizes proposed management strategies for watercourses constraint rankings within the preliminary SABE concept and the testing areas.

Erosion hazards have been mapped for watercourse reaches within and downstream of the FSA. These hazards and their setbacks should be protected from development as per the Provincial Policy Statement. Additionally, SAR legislation to protect contributing habitat to occupied and recovery Redside Dace Habitat, (a 30 m buffer from the erosion hazard limits) has been mapped and has been incorporated into the NHS. This management approach will mitigate urban impacts to the natural features, reduce issues of erosion and sedimentation, and reduce erosion risk to property and infrastructure. An assessment of updated mapping revealed that erosion hazards (meander belt and long-term stable top of slope) are not inherently protected by the NHS in several locations throughout the FSA. Similarly, the FSA take-out areas generally encompass most but not all erosion hazard areas.

The scoped nature of this Subwatershed Study is based on preliminary, high-level observations and mapping which does not lend to specific, detailed recommendations for watercourse and headwater drainage feature management. As discussed, field assessments are required to confirm and/or update the current reach delineation to ensure that features are characterized accurately and that appropriate evaluations may be completed (e.g. HDF assessments). Rapid Geomorphic Assessments or other similar methodologies to characterise channel form, function, and stability should be completed along every watercourse reach within, and downstream of, the proposed area(s) of development in the SABE. During rapid assessments, the results of the erosion hazard delineation may be confirmed, and sites selected for detailed geomorphic analysis (surveys) in support of developing erosion threshold values for SWM (quantity), Additionally, further characterization through field surveys can refine preliminary results of watercourse constraint analyses and develop more specific recommendations for management or enhancement based on reach/site level nuances. This should be completed at the local subwatershed study level, with confirmation and/or refinement in subsequent studies.

Stormwater management criteria (quantity-based) will need to be developed to reduce the potential for increased risk to erosion due to potential changes in runoff regime, within receiving watercourses. At present, existing erosion thresholds from prior subwatershed studies may be used in a preliminary assessment of channel sensitivity, however, detailed fieldwork will be required to select and assess sensitive and/or representative reaches for erosion potential. This should be completed at the local subwatershed study level, with confirmation and/or refinement in subsequent studies as stormwater management plans are refined and discharge locations are more resolute.

Headwater Drainage Feature (HDF) assessments are an essential exercise to undertake through detailed subwatershed planning. These surface water features are often first and zero order, ephemeral depressions, but individually and collectively they play a vital role in maintaining physical and ecological function of receiving stream systems. Prior to application of TRCA/CVC guidelines to assess HDFs (2014), environmental planning studies in Peel Region determined management opportunities for low order surface water features through the completion of watercourse constraint ranking analyses, coupled with drainage density analyses. Watercourse constraint rankings would often classify HDFs as having a low constraint, whereby they may essentially be removed from the surface, provided drainage density targets were met/compensated. The recent application of the TRCA/CVC guidelines provides a structured methodology to specifically characterize the physical and ecological form and function of HDFs, allowing practitioners to develop specific management opportunities to maintain the feature function, whether protected in place or mitigated through SWM practices. An HDF assessment should be completed during local subwatershed studies, and if necessary, confirmed and updated in subsequent planning studies. The identification of HDF and watercourse features will be confirmed and / or refined in consultation with TRCA in future studies and will consider TRCA's HDF identifications. The identification of HDFs in the current study is considered preliminary, as only limited fieldwork has been completed to confirm results from the mapping exercise. No management recommendations are provided for implementation, as this is not considered appropriate at this scale. Possible management recommendations as per the CVC / TRCA (2014) protocol are presented in Table 2.1.2.3. However, some HDFs may fall within the NHS and therefore become protected by virtue of location within a larger terrestrial or other key feature.

Table 2.1.2.2. Preliminary SABE Concept and SABE Testing Areas Watercourse Management Strategies

Integrated Constraint Ranking	Management Classification	Proposed Management Strategy
High	**Protect in place**	***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.*** Minor (local) rehabilitation or enhancement could include such works as replacement of perched culverts with new structures that follow CVC or TRCA crossing guidelines, removal of old farm crossings, re-naturalization of armoured channel banks (where appropriate), or local riparian plantings.
Medium	**Protect in place, channel/corridor modification & enhancement may be considered**	***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.*** **Local Realignment/Relocation & Enhancement** Local watercourse realignment/enhancement areas may include impacted, channelized reaches within historically agricultural lands, and upgrades to existing watercourse crossings. Local watercourse

Integrated Constraint Ranking	Management Classification	Proposed Management Strategy
		realignment/enhancement areas may also be required for portions of some reaches to accommodate new road alignments, to facilitate flood mitigation, or to address a need for enhancement. **Substantial Realignment/Relocation & Enhancement** Complete watercourse relocation or realignment from its current position on the landscape may be considered in some cases to enhance impacted, channelized reaches within historically agricultural lands or to facilitate flood mitigation.
Low	**Re-evaluate classification, determine management in future studies. HDF management may apply**	***Low constraint watercourses should be re-evaluated as part of future studies to confirm their constraint ranking. Features may be redesignated as HDFs.*** 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. Should a low constraint reach be reclassified as an HDF, the feature should be assessed and managed following the CVC / TRCA (2014) protocol. HDF management recommendations from the CVC/ TRCA (2014) protocol are provided in Table 2.1.2.3.

Localized realignment through Natural Channel Design should result in an overall enhancement of the watercourse corridor(s) from existing conditions and may be considered when future development or infrastructure projects are occurring within proximity to features requiring enhancement. Sufficient justification of the need for realignment must be provided to the satisfaction of approval authorities. Floodplain and valley slope modifications may be considered at select locations and attempts to minimize disturbance to the channel and meander belt should be made to the greatest extent possible. Where disturbance is anticipated, channel and riparian/floodplain improvements are to be investigated.

Where localized realignment or floodplain modification is anticipated, design meander belts and adjustments to the regulatory floodplain based on channel realignment will need to be included in the NHS.

- Incorporate the meander belt width, regulatory floodplain, and regulatory setbacks to the greatest hazard limit into NHS. Enhance existing conditions: maintain the present location of the corridor with feature enhancements (e.g. bank stabilization, re-establish a meandering or variable planform, connect channel to functioning floodplain). Natural channel design principles to be implemented for any adjustments.
- Re-locate and enhance existing conditions (locally): many of the reaches within the study area have undergone extensive straightening and modification for agricultural drainage purposes. As such, they are not considered as sensitive to re-location and would benefit from enhancements such as the re-establishment of a variable planform with functioning floodplain and development of pools and runs (i.e. natural channel design). Sinuosity should be maintained at a minimum, and

enhancements to channel sinuosity and meander planform geometry should allow for improved sediment transport compared to existing conditions. In the event that these reaches are re-located, the corridor width (meander belt width/hazard corridor) associated with each reach must be designed appropriately. Natural channel design principles are to be implemented for any realignment or adjustments.

Substantial realignments would require sufficient justification of the need for realignment to the satisfaction of approval authorities and should result in an overall enhancement of the watercourse corridor(s) from existing conditions. Substantial horizontal and vertical realignments should also consider local groundwater-surface water conditions to mitigate potential impacts and enhance hydrological functions where possible.

- Re-locate and enhance existing conditions: many of the reaches within the study area have undergone extensive straightening and modification for agricultural drainage purposes. As such, they are not as sensitive to re-location and would benefit from enhancements such as the re-establishment of a variable planform with functioning floodplain and development of pools and runs (i.e. natural channel design). Sinuosity should be maintained at a minimum, and enhancements to channel sinuosity and meander planform geometry should allow for improved sediment transport compared to existing conditions. Natural channel design principles are to be implemented for any realignment or adjustments. Meander belt widths should be verified at detailed design to confirm that the erosion hazard is appropriate for the type and geometry of the restored channel.
- Where existing meander belt cannot be accommodated, the erosion hazard may be mitigated through design-appropriate meander belt widths, with appropriate setbacks based on channel bankfull geometry and planform, and anticipated stability.

Design meander belts and adjustments to the regulatory floodplain based on channel realignment will need to be included in the NHS.

Table 2.1.2.3. 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.
Conservation	Valued Functions: e.g. seasonal fish habitat with woody riparian cover; marshes with amphibian breeding habitat; or general amphibian habitat with woody

HDF Classification	Description/Management
	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	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

HDF Classification	Description/Management
recommends that terrestrial linkages are incorporated into the 'Conservation' classification)	• 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.
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.

a. Natural Channel Design

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. SWM). In the case of 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 that have 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, potentially replenishing wetlands and 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.

In addition to the watercourse management considerations provided Table 2.1.2.2, the following guidance for road crossings should be considered when managing area watercourses:

b. Road Crossings and Alignments

Road crossings are an integral part of urbanization and an important consideration in terms of impacts to watercourses, as well as potential hydraulic (flooding) impacts and providing passage for aquatic and terrestrial wildlife. 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. While the lowest risk option is for crossing structures to span the meander belt, accounting for the 100-year lateral erosion rate and local channel sinuosity may provide acceptable criteria to reduce the crossing spans for low risk features. At a minimum, it may be acceptable to utilize a span of three times the existing or design bankfull channel width to determine spans for channels that are low gradient in nature and the risk to erosion is minimal, however this minimum criterion is least preferred. For active channels the crossing sizing should be confirmed as appropriate through a risk-based assessment. The following presents several risk factors which have been considered for the individual crossings with respect to geomorphic function, at the local, site-specific scale. These risk factors have been used elsewhere to assess both crossing locations and determine appropriate structure spans and alignment these may be considered recommendations, from a risk perspective:

- **Channel Size:** The potential for lateral channel movement and erosion tends to increase with stream size. For instance, 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 is used by regulatory agencies for corridor delineation associated with natural hazards. For large watercourses; the meander belt width is typically of a similar dimension to the Regulatory floodplain; for smaller watercourses, the Regulatory floodplain is typically substantially larger than the meander belt width. The meander belt width is sometimes referenced in establishing the span of hydraulic structures, however the application of the meander belt width to size hydraulic structures may not be practical for many smaller watercourses and HDF features.
- **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 upstream vicinity of the crossing, which may migrate through the structure, that can be used as a guide to determine the relative risk to the structure. The application of meander amplitude for structure sizing would depend on the downstream migration rate of the meander relative to the crossing location (i.e. probability of the channel to migrate through 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.
- **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, hydraulic structures spanning large watercourses would ideally span the meander belt width in order to accommodate the downstream migration of meander features. For hydraulic structures spanning smaller watercourses, structures sized to span three times the bankfull width is often sufficient to limit local velocity impacts, address risk to infrastructure and maintain sediment transport, especially in low gradient/energy systems. From a geomorphic perspective, larger structures are favored in certain settings to minimize the long-term risk and maintenance associated with natural channel adjustment.

2.1.2.2 Land Use -Specific Management Recommendations for Stream Morphology

Management recommendations are provided in the following sections for watercourse and HDF features within the preliminary SABE concept and SABE testing areas. Management recommendations tailored to specific features cannot be provided at this stage due to the high-level nature of this scoped subwatershed study.

Table 2.1.2.4 provides a summary of the various site observations that were made during the windshield assessment grouped by the preliminary geomorphic constraint ranking assigned to the reach. Reaches in any given column were observed to have either one or several of the characteristics listed, but not all. The summary is based on the notes provided in Table 1 of the Phase 2, Part A – Appendix E report. The summary does not provide a complete inventory of site conditions as reaches could only be observed from road crossings, and not all reaches could be observed, however it provides some indication of the type of features found within the study area.

Reaches with high preliminary geomorphic constraints are to be protected in place. Where local issues have been noted, high constraint reaches may benefit from watercourse crossing improvements to address channel incision or scour at existing crossings. Local bank stabilization works which incorporate plantings or other "soft" treatments such as bioengineering may also be beneficial where further assessment indicates the rate of bank erosion is excessive. Reaches with medium preliminary geomorphic constraints may similarly benefit from watercourse crossing improvements, local "soft" bank stabilization works, local works or realignment to provide an appropriately sized channel corridor for previously straightened reaches, improve channel form and function (reduce sedimentation and vegetation encroachment, and improve aquatic habitat), and establish naturalized riparian corridors. Piped reaches may be considered for realignment or daylighting as appropriate. Low geomorphic constraint reaches were typically small, modified tributaries, and were dry or contained standing water at the time of the windshield assessment. These reaches should be re-evaluated in future studies to confirm if they are HDFs, in which case management should follow recommendations provided in the CVC / TRCA (2014) HDF protocol.

A brief description of the preliminary SABE concept and SABE testing areas is provided below. Sections a) and b) outline natural channel and watercourse crossing design recommendations which would apply to both the preliminary SABE concept and the SABE Testing areas.

Table 2.1.2.4. Summary of Site Observations from Windshield Assessment by Preliminary Geomorphic Constraint Ranking

High Constraint	Medium Constraint	Low Constraint
Common Features • sinuous • confined or partially confined • wide floodplain present • forested / well shaded • minor erosion and deposition • minor bank erosion Variable Features • bank erosion or incision near culverts • culverts cracking • manicured landscaping (grass) • cattails Special Features • ongoing road construction • perched culvert bottom • channel realignment recently completed • debris jams	Common Features • slightly to moderately sinuous • appears to be straightened (sometimes parallel to or across roadways) • partially confined or unconfined • poorly defined channel • well defined channel • armouring at culverts (new or old) • flows through farm fields • deposition • cattails in channel • gentle banks Variable Features • locally confined • moderate bank erosion • stable banks • bank erosion or incision near culverts • culvert cracking • originates in farm field • forested • sinuous where forested • grassy floodplain • grass in channel • standing water • marshy / swampy Special Features • dredged channel • piped • channel realignment recently completed or in progress • receives flow from ponds	Common Features • slightly sinuous • appears to be straightened (sometimes parallel to or across roadways) • poorly defined • possible HDF or swale • small tributary • flows through farm field • grass lined channel • in-stream vegetation • cattails • deposition • gentle banks Variable Features • defined • armoured near crossing • steep banks • dry • standing water Special Features • piped • receives flow from ponds • drains into pond

Preliminary SABE Concept

The preliminary SABE concept is an extensive area which encompasses most of the FSA. It extends across portions of the Etobicoke Creek, Fletcher's Creek, West Humber River, Main Humber River, Huttonville Creek and Credit River (Glen Williams to Norval) subwatersheds. Watercourses and identified HDFs are mapped in all but the Huttonville Creek and Credit River (Glen Williams to Norval) subwatersheds. The preliminary SABE concept includes both community and employment areas, which are anticipated to have 70% and 90% impervious area, respectively, following development.

The preliminary SABE concept is traversed by numerous mainstem watercourse reaches, tributaries, HDFs and Potential HDFs. Most of these reaches and their associated erosion hazards are included in the Greenbelt, the current NHS and /or the FSA Take-out. Reaches within the preliminary SABE concept have High, Medium and Low preliminary geomorphic rankings. As noted in earlier sections, these preliminary rankings are to be verified and integrated with constraint rankings from other disciplines in future studies and should be considered minimum constraints integrated constraints analyses have been completed.

SABE Testing Areas

The SABE testing areas are relatively small, discrete and generally disconnected areas generally located northwest of the preliminary SABE concept. As subwatersheds within the area drain southeast toward Lake Ontario, the SABE testing areas are located upstream of the preliminary SABE concept areas. The SABE testing areas include both community and employment areas, which are anticipated to have 70% and 90% impervious area, respectively, following development. The SABE testing areas are located in the Etobicoke Creek, West Humber River and Main Humber River subwatersheds.

The westernmost SABE testing area is located north of the preferred GTA west corridor, primarily within the Etobicoke Creek subwatershed, and is traversed by two Etobicoke Creek tributaries. The eastern portion of this SABE testing area is within the West Humber River subwatershed and is intersected by the Campbell's Cross Creek erosion hazard area. Several other testing areas are located within the West Humber River subwatershed, located on either side of the preferred GTA West corridor. They are traversed by numerous tributaries to the West Humber River along with several potential HDFs. The easternmost SABE testing areas are located in the Main Humber subwatershed and are traversed by two tributaries with Low and Medium preliminary constraint ranking, as well as HDFs and potential HDFs. Most of the reaches within the SABE testing areas have a Medium preliminary geomorphic constraint ranking, and several reaches have High or Low constraints. As noted in earlier sections, these preliminary rankings are to be verified and integrated with constraint rankings from other disciplines in future studies and should be considered minimum constraints until integrated constraints analyses have been completed.

a. Design Recommendations – Natural Channel Design

Should future roadway alignments or urban development affect existing floodplain and watercourse corridors, channel re-alignment and/or redesign alternatives may be implemented along reaches that meet criteria (refer to Section 2.1.2.1 and to the Phase 2 Part B report, Section 2.5.2.1). Stream re-alignment and enhancement can provide a significant environmental benefit to important habitat, provided it occurs in a carefully studied, controlled and staged manner. Hydraulic and geomorphic functionality may be enhanced through channel design work if the following objectives are addressed as part of detailed studies:

i. Improved conveyance capacity
ii. Improved sediment transport through strategically designed planform geometry to maximize shear stress
iii. Maintaining stream length

Re-alignment of channel segments can lead to a reduction in overall stream length affecting the drainage density and the overall natural function of the system. Typically, the loss of stream length can be partially compensated by introducing a definite level of sinuosity or meandering pattern in the overall design. This can be a challenge for the channels in the study area, due to the low energy gradients. Channel planform design should seek to strategically maximize shear stress in support of enhancing sediment transport and mitigating impacts of the low-energy nature of the system. At a minimum, stream length should be maintained, and proposed realignments must demonstrate that stream function is maintained or enhanced.

Application of natural channel design techniques for stabilization may be inadequate in areas where excessive shading is expected. As a result, bank armouring may be required in areas, such as below some crossing structures, to provide effective long-term protection for proposed piers/abutments.

b. Design Recommendations – Watercourse Crossings

Existing watercourse crossings may be retained in many locations through the preliminary SABE concept and SABE testing areas. Should road widening be warranted, it is recommended that the crossing structures be assessed to verify that the proposed widening and associated extensions of hydraulic structures would not affect channel functions.

New crossings to support the construction of new roads or the replacement or widening of existing roads are anticipated to be required to accommodate the future land use plan. The ultimate planning and design of these crossings should accommodate existing watercourse alignments to the extent possible. It is anticipated that these details and requirements will be established as part of site-specific subwatershed studies or Class EA studies (refer to Section 2.4).

Watercourse crossing designs should be completed following a hazard-based approach as outlined earlier. Design of channel segments for crossing replacements should consider fish and wildlife passage and Redside Dace setbacks where applicable and should ensure a seamless connection with the watercourse upstream and downstream of the crossing. Channel design through the crossing should not impede flow, and should ensure that substrate is not entrained, providing a stable channel through the crossing that prevents the footings and abutments from eroding.

A list of watercourse crossing recommendations is provided below. Refer to TRCA's Crossings Guideline for Valley and Stream Corridors (2015), CVC's Technical Guidelines for Watercourse Crossings (2019) and CVC's Fish and Wildlife Crossing Guidelines (2017) for additional guidance.

Watercourse Crossing Recommendations

- Minimize number of crossings, particularly over sensitive reaches.
- Minimize crossing length unless it is more appropriate to skew the crossing structure to match the watercourse alignment.
- Full geomorphic assessment required to identify channel processes, erosion sensitivity, appropriate grades, substrate and channel form through crossing, as per TRCA and/or CVC requirements.
- Open foot structures are strongly preferred.
- Full spans with ample room for future channel adjustment (spanning the erosion hazard limits or at a minimum, the 100-year erosion distance plus bankfull width or local meander amplitude), wildlife passage, and considerations such as Redside Dace requirements
- Incorporate climate change considerations to mitigate potential changes in future hydrological regime and erosion susceptibility.
- Vertical scour assessment typically required unless structure spans the meander belt and floodplain.

2.1.2.3 Headwater Drainage Features

The work undertaken to date for this Scoped Subwatershed Study identified headwater drainage features (HDFs) at a high level and differentiated the features from watercourses. Future work through subsequent planning stages is required to confirm these features and evaluate them following the CVC/TRCA (2014) guidelines

The TRCA/CVC guidelines provide structure for the evaluation of HDFs, and results of the evaluation lead to one of several management recommendations for each feature. The management recommendations from the protocol are in order of importance (high to low), specifically Protection, Conservation, Mitigation, Maintain Recharge, Maintain or Replicate Terrestrial Linkage, and No Management Required. Of the management recommendations provided in the guidelines, four have been selected as relevant for the Scoped Subwatershed Study. The need to "maintain or replicate terrestrial linkage" has been incorporated into the *Conservation* classification. The management recommendations are provided in Table 2.1.2.2.

2.1.2.4 Preliminary Watercourse Corridor Sizing

Phase 2, Parts A and B of the Scoped Subwatershed Study characterized the meander belt for area watercourses. In future detailed studies, it is recommended that minimum recommended corridor widths be determined based on the existing erosion hazard limits as well as applicable buffers and setbacks. These minimum corridor widths may be evaluated based on existing channel form and geometry in the context of the proposed Land Use Plan. These recommended corridor widths should be applied in the refinement and sizing of the NHS. Additionally, CA regulatory policies apply to all works associated with the proposed NHS. If features are to be realigned, then a meander belt will need to be appropriately delineated in association with the design planform.

2.1.3 Natural Heritage System

The preliminary Natural Heritage System (NHS) has been defined through the Part A: Characterization Report (features and areas) and the Preliminary Environmental Management Strategy of the Part B: Impact Assessment Report (Buffers, Linkages, Enhancements). Identification of the NHS was guided by system-level goals and targets focused on creating a system that takes direction from policy, best practices, and good science and that is robust, resilient and connected. The preliminary NHS is shown on Figures in the Part B report including Features (Figures DA2-9a-c), Linkages (Figure DA2-10), and Enhancement Areas (Figures DA2-11a-c) and a summary figure illustrating the comprehensive system (Figure DA2-14).

Implementation of the NHS will focus on key strategies of protection and impact avoidance, impact minimization, mitigation and, in limited circumstances consider replication or compensation to support a net benefit to the system. Substantial net benefit will be achieved through the implementation of enhancements and linkages; these represent important strategies in establishing a robust NHS that can support and improve ecological function within an urbanizing landscape.

Through implementation of the NHS features and functions critical to maintaining biodiversity, movement of plants and animals across the landscape, support and interactions with the water resource system and, where possible, support for establishing resilience to a changing climate will be supported. Through implementation of the enhancement target and implementation of the net gain mitigation hierarchy, the objective is to create a system that will improve ecological form and function within the SABE.

Due to the scoped nature of the Scoped SWS, it is acknowledged that the areas mapped through this study may be refined or confirmed through more detailed local levels of study. This may include features confirmation (category – Key, Supporting, Other), refined boundary delineation, and detailed implementation of the linkages, enhancement and mitigation measures (e.g., buffers) as informed by site-specific study (i.e., field work) subject to the recommendations of this study. This report sets out the framework and targets for implementation for the NHS and provides guidance to support subsequent phases of work. System targets have a strong focus on enhancement through robust linkages and enhancement areas; these targets are to be implemented through detailed studies and through policy.

2.1.3.1 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.).

2.1.3.2 Managing Features of the NHS

Avoid (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. 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. Direction based on feature category type is provided below.

- All **Key Features** are to be retained in-situ. In very limited circumstances replication or compensation may be appropriate (see section below).
    - 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.
- Protection in-situ for **Supporting and Other Features** will be informed by detailed assessment and specifically in consideration of:
    - Species composition – moderate to high diversity relative to other similar habitats in the local landscape, presence of species of conservation concern, etc.
    - Relative representation – existing habitat representation within the NHS and the local landscape to support biodiversity and habitat diversity and availability in the system.
    - Role within the NHS (e.g., directly supports adjacent features and/or species).
    - Location relative to other features (e.g., as a stepping stone, etc.).
    - Opportunities to create habitat through enhancement area(s) (size, type, complexity and suitability for restoration / habitat creation).

Minimize and Mitigate

Implementation of minimize and/or mitigation strategies 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, but typically involves an intervention that is spatial and/or functional such that the factors that are expected to impact a features and/or species are sufficiently reduced in degree and/or frequency.

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 place further effort on weaving mitigation, net benefit and regenerative opportunities throughout the land planning and design process where possible. This approach will not remove the need for buffers; rather, it provides a complex suite of mitigation to support better outcomes for the protection of features and their functions.

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.

Upon implementation, buffers are considered a Supporting Feature in the NHS. As the primary function of buffers is mitigative, they are not counted towards the enhancement target (ha).

Recommendations for buffers – features to which they are to be applied, preliminary or minimum widths, etc. will be determined through a detailed subwatershed study or similar. Final recommendations and implementation will occur through site-specific study where refined details on proposed development, and its associated impacts, are known (e.g., an EIS). Guidance for the planning and design of buffers at future planning stages is provided below.

Application of Buffers

The Greenbelt Plan requires that buffers (called Vegetation Protection Zones) be applied to *key natural heritage* and *key hydrologic feature* of the NHS (i.e., Greenbelt NHS). This shall be applied in relevant areas within the FSA.

Outside of the Plan area(s), buffers shall be applied as part of a mitigation strategy for addressing impacts associated with development. Generally, this will include application to wetlands, woodlands, valleylands, watercourses and fish habitat and specialized habitats (e.g., sand barrens), and may include application to successional habitats.

Determination of which features and areas are to have buffers added as part of a mitigation strategy will be determined through a detailed subwatershed study and confirmed or refined (if / as appropriate) through site-specific study (e.g., an EIS).

Buffer Width

Buffer width(s) should be informed by sensitivity and significance of the natural heritage feature and its contribution to the long-term ecological functions of the FSA NHS, the type of development and its potential impacts. Specific recommendations for buffer widths, refined guidance for buffer design, etc. will be made through a detailed local subwatershed study or similar study which provides landscape context and is informed by site-specific information.

Within the Greenbelt Plan NHS, buffers are prescribed specific widths within its policies. VPZs shall apply within the applicable areas of the Plan. Recognizing direction provided by these plans and that protection zones in the form buffers will be applied to key features, a preliminary 30 m buffer has been applied to areas identified as Key Features in the NHS (Part B, Figures DA2-9a-c).

Guidance for the identification of buffers for areas outside of the Greenbelt Plan NHS should be taken from the Living City Policies (TRCA 2014), Regional and Local Municipal policies (as applicable), best practices and current literature, as appropriate. Buffers for features of the NHS will be established through detailed studies (e.g., detailed Subwatershed Study, Secondary Plan, etc.).

Features, even of a similar type (e.g., wetlands) can vary in their form, function, and level of sensitivity to different types of pressures. Similarly, position on the landscape and other factors can influence overall sensitivity of a feature or complex of features to changes on the lands which surround them. These considerations will support planning of buffer widths. Generally, considerations can include:

- **Feature Hydrology** – features of the NHS and the WRS interact, and dependencies occur between them. Water budget is important for the maintenance of many features and species. Features which rely heavily on groundwater contributions, support species or communities which depend on a narrow range of soil moisture levels, or presence and duration of water within pools (e.g., vernal pools for amphibian breeding) have a higher sensitivity to changes in hydrology.

Supporting water quantity to surface water fed features (e.g., wetlands, watercourses) is also critical to their form and function (e.g., baseflow conditions in a stream). Water quality can have direct and indirect influence on features and the species they support (e.g., egg development).

- **Habitat requirements** – species assemblage under existing conditions will inform habitat requirements of the species residing in or utilizing the feature (or complex of features). Species with specialist habitat requirements are generally more sensitive to changes in habitat conditions.
- **Species behavior** – species have different behavioral traits which can influence their sensitivity or tolerance to human activities. Behavioral traits that may be affected by changes in lands proximal to habitat include communication, altered patterns of movement (to or away from certain areas), subsidization of predators (e.g., raccoons), etc.
- **Fragmentation** – as fragmentation increases across a landscape, sensitivity to new pressures and impacts increases.

As noted, the type and form of development will determine the nature of potential impacts. Similarly, the type, magnitude, extent, duration, and frequency of impacts will vary based on the type and form of development being proposed. This information should also be used to inform buffer width. Potential sources of impacts include, but not limited to:

- **Impermeability** – amount of impermeable surface introduced to the landscape and resulting impacts to infiltration, feature hydrology, etc.
- **Stormwater management** – influenced by the type of development, stormwater management design can influence infiltration, water quantity and quality controls. These in turn influence receiving features based on the type of management used (e.g., end of pipe, at-source, etc.)
- **Occupancy Associated Impacts** – these can include light, noise, domestic pets, dumping and many others. The type of development can influence the magnitude of the impact, as well as its temporal impacts (e.g., time of day for high volume of traffic, etc.).

Buffer widths may vary across a site to respond to feature type and sensitivities, aspects of the proposed development design (e.g., adjacent uses with greater or lower impact potential), and similar factors. Recommendations for buffer widths will be development through subsequent detailed study (e.g., a detailed subwatershed study).

Buffer Design

Buffer design should consider physical and biological elements in supporting mitigation efforts and as opportunities to support the NHS. Some design considerations are briefly outlined below. The information presented is not an exhaustive list. Best practices, available research, and new and innovative ideas at the time of the proposed development should also inform the design process, as appropriate.

- Buffers should include some topographic variability to reflect a more natural condition. This may include:
    - Microtopographic elements (hummocks / rises, small depressions), or
    - Larger topographic elements depending on the local conditions, objectives for a specific buffer area, grade considerations, etc.
    - Where a buffer is proposed to integrate specific habitat features or vegetation communities, topographic design may be an important component (e.g., water retention, wetlands).
    - Use of topography to increase mitigation efficacy (e.g., light, noise) in some instances.

- Buffers will most often implement open, upland habitat types (e.g., meadows) or riparian habitats. Other community types may be considered on a site-specific basis where they best achieve avoidance and/or minimization of impacts.
- Buffers are to be established as self-sustaining vegetation, whether through planting or natural regeneration. Where buffer planting plans are required, they are to use species native to the area. A cover crop, or other restoration support methods may be required to facilitate establishment of vegetation. Many ready-made seed mixes are available for a range of habitat types (e.g., meadow, wet meadow, riparian) and may be suitable for application in restoration and buffer plantings.
    - TRCA has two guidelines which provide information useful to the implementation of buffers (and other features / areas): 'Post-Construction Restoration Guidelines' (July 2004) and 'Seed Mix Guidelines' (July 2004).
    - CVC has published 'Plant Selection Guideline: Species for Planting Plans within the Credit River Watershed' (April 2018) which should be used in planning buffers and other plantings (e.g., replication, compensation) within CVC jurisdiction.

Linkages

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 and are to be carried through to subsequent stages of planning:

- 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.
- Recognize known and potential impacts associated with Climate Change and the role of connectivity in system resilience to Climate Change. Realize co-benefits between NHS function, connectivity and the Region's climate adaptation goals and objectives.

An approach to achieving these objectives is presented in Part B with three linkage categories 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.

Minimum widths have been defined through this scoped subwatershed study. Corridor widths may exceed the minimums presented to support connectivity and habitat of the FSA NHS or may naturally be wider based on the boundaries of features of the NHS (e.g., valley, woodland, wetland, 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). Linkage widths are summarized in Table 2.1.3.1.

Table 2.1.3.1. FSA Linkage Types

Linkage Type	Minimum Vegetated Width	Permeable Landscape Zone (total width)	TOTAL
Major Landscape Linkage	100+ m	60+ m	160+ m
Minor Landscape Linkage	60+ m	30+ m	90+ m
Feature (or Site) Scale	30+ m	n/a	30+ m

The **Minimum Vegetated Width** (MVW) of a corridor represents the minimum width of natural, self-sustaining vegetation to be established within the linkage.

- Within any given corridor, no areas are to 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.) and applicable protections and policies afforded them, and 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 the following land uses / covers:

- Natural heritage features and areas
- Buffers to natural features of the NHS, as applicable
- Enhancement Areas
- Linkage compatible uses
- Development

Composition of land use(s) within the PLZ will be guided by the following:

- Natural heritage features to be retained as part of the NHS (as determined through a detailed subwatershed study or equivalent). Consideration is to be given to the role of natural cover in supporting the linkage functions of the PLZ. This will include all Key Features and may include Supporting and/or Other feature(s). Applicable protections and policies afforded them shall be applied and addressed accordingly.

- Buffers, as required, shall be applied to features occurring in the PLZ.

- A minimum of 30% of the PLZ outside of natural features comprising the NHS (i.e., outside of those identified for retention as part of the NHS through detailed study [e.g., a detailed subwatershed study]) is to be established as natural, self-sustaining vegetation. These 'Linkage Enhancements' are further discussed in the Enhancement Areas section below.
    - Establishment of buffers as natural self-sustaining vegetation within the PLZ is permitted to contribute to the 30% minimum enhancement identified above.
    - Opportunities for enhancements within the PLZ exceeding the 30% minimum are strongly encouraged. Specifically where 'discrete enhancements' have been identified. This is further discussed in the Enhancement Areas section below.
- Up to 30% of 'developable lands' in the PLZ may be used for general development and associated infrastructure (i.e., those portions not constrained by NHS features, buffers). The following guidance shall apply:
    - Low-rise structures are encouraged, where compatible with zoning and density requirements.
    - Low-impact development and design and mitigation measures should be employed to achieve compatibility with linkage function (e.g., dark-sky friendly lighting, bird-friendly designs / treatments).
    - Encourage nature-inclusive design opportunities to support sustainable or regenerative design.
- Linkage compatible uses are permitted to occupy the balance of the developable lands within the PLZ. If no 'general development or infrastructure' is proposed, this can occupy up to 70% of the developable lands within the PLZ (with the remaining 30% identified as enhancement).

Implementation of compositional requirement(s) may occur at different points through the planning process. For example, assessment and confirmation of the NHS, including enhancement areas will be completed through a detailed subwatershed study (or equivalent). Decisions regarding the balance of lands (linkage-compatible land uses, development) may occur through a secondary plan or subdivision planning process(es).

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

Major Landscape Linkages and Local Landscape Linkages were identified and mapped through Part B. These linkages are to be implemented through subsequent studies (e.g., a detailed subwatershed study). While their basic location and connections across the landscape are to be maintained, the exact alignment and any minor refinement to width (i.e., above the minimums identified) will be guided by the following:

- Wherever possible, linkages are to follow existing feature pathways.
- Where natural pathways are not available, minimum distance opportunities for connecting features / areas are to be used.
- Alignment and width are to be informed by site-specific study which considers target species, anticipated pathways of movement (e.g., using connectivity analysis and/or field evidence).
- Linkages are to be implemented with minimum widths as identified in this scoped Subwatershed Study. Final widths may be larger than the minimum based on site-specific condition (e.g., features, species, etc.)

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.

- Identifying Linkage Locations / Requirements
  - Key Feature(s) less than 240m of another Key Feature or the NHS (any retained feature) will be connected by a linkage.
  - Key Feature(s) less than 240m from and with functional connection(s) to feature(s) outside of the FSA will have a linkage to the boundary of the settlement area to prevent fragmentation / isolation.
  - Key Features greater than 240m from another Key Feature or the NHS are to be assessed for interactions with surrounding features to determine if a linkage is required to maintain its function. Linkages >240m apart may require the establishment of 'steppingstone habitats' or other similar habitats to accommodate longer residence times within a linkage.
  - To the extent possible, existing features will be strengthened to create linkages (e.g., a watercourse, HDF, hedgerow, etc.).
  - Linkages are to use the 'shortest path' suitable to connect features.
  - Where linkages must cross roads or other linear infrastructure which possess a barrier to movement, land use and infrastructure planning shall accommodate safe wildlife passage (see Infrastructure and Linkages below).

- Selecting an Appropriate Width and Design
  - Feature (or Site)-Scale Linkages will be a minimum of 30m in width.
  - Recommended width(s) shall consider:
    - Linkage length – longer linkages shall have increased widths and/or include 'steppingstone habitat'.
    - Residence time – species mobility and linkage length will influence residence time and therefore inform habitat requirements for the linkage.

    - Species biology – different target species have different behavioral patterns and requirements for linkages. Width shall be informed by target species for the linkage.
  - Recommended design(s) shall consider:
    - Species biology – habitat requirements or preferences for target species and their behavioral patterns.
    - Residence time – duration in the linkage will influence species habitat requirements to be met within the linkage.

Conceptual Linkages

Some linkages have been identified conceptually through this scoped NHS (Part B, Figure DA2-10) to reflect uncertainty in terms of location or alignment, and/or type of linkage that should be implemented. Specifically, 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.

Through detailed study (e.g., local subwatershed study), these conceptual linkages will be confirmed and/or refined. Specific direction for future study and linkage recommendation is provided in Part B, Table 2.5.2.6.

Infrastructure and Linkages

Crossings of linkages by infrastructure should be avoided. Where crossing(s) is required, efforts to minimize and mitigate potential impacts to the function of the linkage are to be considered. This may include:

- Minimized cross section(s) (e.g., narrowed road Right of Way).
- Modified construction methods, materials or design (e.g., lighting).
- Mitigation measures to maintain connectivity (e.g., culverts or crossing structures) or avoid impact (e.g., exclusion fencing at a road crossing)

Where crossings are required, relevant guidance documents (as may be prepared or updated from time to time) should be used to inform placement and design. These include, but are not limited to:

- TRCA Crossing Guidelines for Valley and Stream Corridors (2015); and
- CVC's Technical Guidelines for Watercourse Crossings (2019)

Enhance

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. A target to increase natural cover by 30% (based on existing natural cover within the FSA) was established through the scoped SWS and was used to inform the recommended direction on enhancements presented in Part B.

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. A detailed table of mapped defined enhancements is provided in the Part B report and includes a summary of supporting characteristics and overlapping areas (e.g., ESGRA, TRCA connectivity area, TRCA modeled enhancement area, etc.) to support and inform refinement and design through future studies.
- **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). For mapped un-defined enhancements a 30% enhancement target within these areas was set through the Part B report. 'Other enhancements' are unmapped and direction for their identification is provided through the Part B report (e.g., alignment with TRCA modeled enhancement areas, water resource system benefits, etc.).

Within these broad enhancement types, several enhancement categories were identified, representing different opportunities for enhancement across the system. These are described and mapped in Part B, including a summary of their occurrence, opportunities presented, etc. They are listed in Table 2.1.3.2 for reference.

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 2.1.3.2. Enhancement Types and Criteria

Enhancement Type	
Defined Enhancements	
Improved shape, size, contiguity[1]	Site-level infill efforts to fill gaps, bays and inlets to support overall shape, size and contiguity of the system. This is comprised of 'In-System' and 'Out of System' enhancements.
Floodplain[2]	Opportunities for enhancements presented within floodplains where development is generally restricted.
Linkage – MVW	Enhancements associated with the establishment of natural, self-sustaining vegetation to facilitate habitat connectivity for the FSA NHS linkages.
Un-Defined Enhancements	
Linkage – PLZ	Enhancements associated with the establishment of natural, self-sustaining vegetation to facilitate habitat connectivity for the FSA NHS linkages. Enhancements recommended for a portion of the lands occurring within the PLZ. 30% of the lands mapped in this enhancement type is recommended to be enhanced.
Provincial NHS	Enhancements within the Greenbelt Plan and Growth Plan NHS as directed by these provincial plans. 30% of the lands mapped in this enhancement type is recommended to be enhanced.
Other Enhancements	Where the enhancement target of 30% natural cover increase was not met through mapped enhancements, guidance is given to required 'other enhancements' in Part B. Other enhancements may also be used to refine or recommend alternative discrete enhancement areas than those preliminarily identified through this scoped SWS. 'Other Enhancement' are to be considered in the context of the overall enhancement targets presented in Part B. Guidance for identification of other enhancements is provided in Part B and include opportunities to improve shape, habitat diversity feature complexity, size, support broader objectives including climate change resilience, support for Species at Risk, etc. Very broad areas of potential consideration for 'other enhancements' are mapped; these represent potential areas for further consideration through future, detailed study only.

[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.

Through Part B, an enhancement target of increasing natural cover by 30% (based on existing natural cover and within the FSA / SABE boundary) was set. Mapped and unmapped enhancement opportunities and guidance provided in Part B demonstrate that the target can be achieved through enhancement within the NHS (unvegetated portions of key and supporting valleylands, linkages) and outside the NHS (e.g., lands within the provincial NHS, floodplains, other discrete enhancement areas). To ensure a distributed approach to enhancements across the subwatersheds consideration was given to enhancement area required to meet the target within each subwatershed.

As a very high-level summary of analyses associated with this target from Part B:

- Existing natural cover is approximately 1333 ha in the FSA.
- To achieve the 30% natural cover increase target, a total of ~400 ha of additional land must be established as self-sustaining vegetation.
- Mapped enhancements identify opportunities equaling ~389 ha, 99% of the target. Guidance is provided in Part B for the identification of additional or alternative enhancement opportunities to provide flexibility in how the target is achieved.
- Analyses presented in Part B illustrate that this target can be achieved:
    - Predominantly within the Preliminary NHS:
        - Approximately 60% of all mapped enhancements (by area) occur within the FSA NHS (within and outside of the Greenbelt Plan NHS).
    - Of the 40% that occur outside of the FSA NHS:
        - ~34% occur on partially or wholly constrained lands (floodplain, within the Greenbelt Plan NHS, but outside of naturally vegetated features)
        - ~6% occur on apparently unconstrained lands (outside the Greenbelt Plan NHS, FSA NHS, or floodplain).
    - With minimal additional areas identified to meet the 30% increase target (~11 ha).

It is recognized that components of the NHS will require refinement and confirmation through subsequent, detailed study (e.g., a detailed subwatershed study) and that through this process, enhancement opportunities will be refined (e.g., to reflect confirmed feature boundaries), confirmed or excluded (some areas may not be suitable based on site condition) and new areas identified to reflect new information (e.g., updated analyses, site specific conditions) and through other opportunities such as Indigenous Traditional Knowledge in order to meet the enhancement target. It is important to note that buffers and compensatory requirements (e.g., compensation planting for a Butternut Tree removal) are **not** counted towards the enhancement target. General guidance for refinement and implementation of enhancements is provided below.

Enhancement Benefits

Each enhancement category was identified independently; i.e., the criteria were applied to create individual 'enhancement opportunity layers' within the FSA. The output from this creates a series of enhancement overlays and demonstrates where areas can support multiple enhancement benefits / opportunities (e.g., a floodplain enhancement overlapping with an enhancement that will improve the shape of an NHS Key Feature). Where enhancement types overlap, they may add greater value to the system through enhancement (multiple benefits achieved). Discrete enhancement areas, by patch, have been overlain with the following indicators:

- Overlap with other enhancement type(s) or policy areas (e.g., Linkage, Province's NHS, CA NHS modelled enhancement areas)
- Ecologically Significant Groundwater Recharge Area (TRCA)
- Significant Groundwater Recharge Area (source)
- Climate Change Vulnerability (TRCA)
- Species at Risk Habitat (Redside Dace)
- Connectivity Areas – Forest-to-Forest, Forest-to-Wetland (TRCA)

The results of this overlay comparison are provided in Maps DA2-11a-c, Appendix E of the Part B Report; copies are provided in Appendix D of this report for ease of reference.

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.

Defined Enhancements

Defined enhancement areas will be further identified or refined through subsequent study. Generally, these refinements may include:

- Confirmation of feature boundary and status (e.g., Key, Supporting, Other; confirming stable top of slope for valleylands).
- Assessment of feature form, function and conditions within the potential enhancement area.
- Refinement to limits of potential enhancement area to reflect best opportunities presented for the system at refined scales of study.
- Additional information obtained through engagement and consultation (e.g., from Conservation Authorities, Indigenous Traditional Knowledge).

General opportunities have been identified through the scoped subwatershed study. Through subsequent stages of work, additional direction should be provided including:

- Identification of primary and, as appropriate, secondary objectives for enhancement within a given area.
- Type of recommended enhancement (e.g., meadow, riparian, woodland, wetland).

Un-Defined Enhancements

Through Part B, a preliminary enhancement target of 30% of the lands identified as mapped, 'un-defined enhancements' was given; for enhancements within the Provincial NHS, returning 30% of *developable lands* (inferred here to be outside of the NHS as confirmed through detailed study) shall be maintained or returned to self-sustaining vegetation. This 30% target is to be implemented within each of the enhancement types (i.e., PLZ linkage zones, province's NHS). Un-defined enhancements were mapped generally, refined boundaries for areas to be enhanced and opportunities presented within these refined areas is to be determined through detailed study (e.g., a detailed subwatershed study, or EIS, as appropriate). General identification through this study provides guidance to subsequent studies for this purpose.

For Linkage – Permeable Landscape Zone and Provincial NHS enhancement areas, refinement of enhancement opportunities to achieve the minimum 30% target will be informed by:

- Form and function of features within the Linkage (within the MVW and PLZ) and opportunities to strengthen their form and/or function.
- Opportunities to increase habitat diversity on the local landscape or support increases size of a habitat type.
- Maintenance or improvement to linkage function(s).
- Opportunities to achieve multiple system benefits through enhancement (see 'Achieving Multiple Enhancement Benefits' section above)

Refinements to these areas is to be informed by opportunities identified for each area (Part B, Section 2.5.2.1) and guided by the goals of the NHS.

'Other Enhancements' are to be identified in accordance with guidance provided in Part B. Identification of 'other enhancement' in some subwatersheds is required to meet the enhancement target of 30% natural cover increase. 'Other Enhancements' may be used in other watersheds to refine or identify alternative locations for Defined Enhancements based on detailed site-specific study. Through this refinement and identification process, the enhancement target is to be achieved and maintained through to final implementation.

Replicate

Replication is a 'like-for-like' re-creation of habitat 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. 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 in close proximity to its original location that will ensure its form and function and 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.

Not all feature types are appropriate to consider for replication. Preliminary guidance is provided below.

- Potentially suitable features:
    - Low hydrologic interactions and/or complexity (groundwater infiltration, contributions)
    - Low species diversity
    - Low wildlife habitat function(s)
    - Simple structure(s) (substrate, vegetation)
    - Short establishment period to replace function being replicated (<2 years)
    - Isolated or fragmented features, in addition to the characteristics described above
- Poor suitability features:
    - Complex hydrologic interactions and/or complexity
    - Receive or are dependent on groundwater for their composition or function
    - Moderate to high species diversity
    - Moderate to high wildlife habitat functions
    - Complex structures (substrate, vegetation)
    - Longer establishment period to replace function being replicated (>5 years)
    - Support specialized habitat or habitat for *significant* species

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. 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 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 (synonymous with replication).
- **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 ‘best available system opportunity’ for compensation will be informed by:

- Form and function of the habitat being impacted.
- System composition in the local landscape and consideration system targets, under-represented habitat types.
- Size and potential opportunities presented through compensation to achieve specific opportunities within the system (e.g., creation of a large grassland block).
- Site conditions for proposed compensation location(s) and habitat types which would best enhance or provide a net gain to the system.
- Site conditions for proposed compensation location(s) and suitability for habitat creation (e.g., what will the area support).

Location for the compensation area will be determined in consideration of system composition and best available opportunities to support the system. Location is more flexible than for replication, but in all cases is to occur within the subwatershed in which the impact occurs. To the extent practicable, preference is given to compensation activities being located at locations which provide the largest 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.

Depending on the feature to be impacted and the proposed compensation approach, a wide range of compensation ratios may occur. Compensation ratios should take into consideration:

- Duration / time lag for compensation plantings to reach functional maturity for the habitat type (e.g., meadow vs. forest).
- Risk of implementation failure and survivorship based on the habitat type being created (complexity, maintenance, etc.)
- Where compensation is intended to achieve a specific outcome, some size criteria may be required to ensure functional outcomes.

TRCA published ‘Guidelines for Determining Ecosystem Compensation (after the decision to compensate is made)’ (June 2018). These guidelines should be consulted in planning features compensation measures.

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.

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.).

Recommendations of ‘no management’ are to be considered in the context of system targets (‘No net loss of natural cover’, ‘30% increase of natural cover through enhancement’).

2.2 Long-Term Monitoring Plan

Monitoring and Adaptive Management Plans are generally developed as part of, or following Local Subwatershed Studies and associated Environmental Impact Studies, and as conditions of approval for stormwater management plans and watercourse reconstruction/realignment. The information collected as part of these plans is intended to verify the performance of the environmental and stormwater management system, advanced at the future local SWS scale, as well as to provide guidance for potential modifications to the management plan to satisfy the objectives of the local Subwatershed Study. Additional details regarding the framework for various components of the monitoring and adaptive management plan are provided in the following.

2.2.1 Components

2.2.1.1 Surface Water

Meteorology:

A summary of the current hydrometeorological datasets within the subwatersheds encompassing the FSA is provided in Section 2.3.2.2 of the Part A report. The available gauge locations with respect to the FSA have been summarized on Drawing WR7 in Appendix D of the Part A report; a copy is included in Appendix A of this report for reference. As indicated in the Part A report, the Toronto Pearson Airport gauge provides the longest period of record of all stations, and the period of record and timestep for this station are considered sufficient for continuous simulation and frequency analysis hydrologic modelling. Although the use of a single station would not account for the spatial and temporal variability of the rainfall within the study area, this is considered to be less significant for the purpose of conducting long term continuous simulation for subwatershed-scale analyses, recognizing the size of the study area.

As indicated in the Part A report, the majority of the rainfall data proximate to the FSA are available through the monitoring network maintained by TRCA. The period of record of this dataset is of relatively short duration and, although considered insufficient for conducting long-term continuous simulation, is, considered adequate for conducting hydrologic analysis for recent and shorter periods to support hydrologic model validation and refinement (pending confirmation of recorded time-step and quality of recorded data). Moreover, the number of stations available is considered to adequately address the spatial and temporal variability of rainfall, which is of potential importance for hydrologic model calibration and/or validation to observed streamflow data. Nevertheless, although a number of precipitation gauges are available throughout the subwatersheds, there are no climate stations gauges located within, or proximate to, the FSA in the Fletcher's Creek and Huttonville Creek Subwatersheds. Furthermore, although precipitation gauges are located proximate to the FSA within the Etobicoke Creek Watershed and the Humber River Watershed, additional monitoring is recommended as part of future studies local to, and preferably within, the FSA to collect local meteorological data for calibrating and validating hydrologic modelling of the FSA.

Streamflow:

Similar to the climate data, stream flow monitoring networks, operated by Environment Canada, TRCA and CVC, have been reviewed as part of the Part A report in order to assess the quality of the data source for future modelling exercises, and identify any gaps accordingly. The stream flow monitoring stations within CVC jurisdiction indicate reasonable spatial coverage within the headwaters, with two (2) stream flow and water level gauges within Huttonville Creek, capturing the two primary tributaries, and one (1) stream flow and water level gauge located within Fletcher's Creek, capturing four (4) tributaries. The small western portion of the FSA which drains to the Credit River (Glen Williams to Norval) does not appear to have a stream flow monitoring station, which would indicate a potential gap for characterizing the lands draining to this local tributary. Several stream flow monitoring locations are available within the Etobicoke Creek Watershed which are owned/operated by both TRCA and Environment Canada. The currently available flow data are sufficiently resolute to characterize the larger headwater system, however, are not sufficiently resolute to characterize the hydrology within the FSA or to parameterize the hydrologic model locally within the FSA. The monitoring stations within the Humber River Watershed, similarly, are primarily located further downstream, at larger confluence points and would be insufficient to characterize the hydrology or parameterize the hydrologic model locally within the FSA. Consequently, the collection of additional flow data is considered necessary along the local tributaries within the FSA, in order to characterize the hydrology within the FSA and parameterize the hydrologic modelling. Moreover, as part of holistic monitoring programs, surface water monitoring should include the collection of local stream flow and rainfall data. The selection of the appropriate gauge site should be completed in consultation with the Conservation Authority and municipal staff.

SWM Facilities:

Each stormwater management facility should be monitored, as part of local monitoring programs, for inflow and outflow and temperature. Given that the inlet and outlet control structures are generally well documented with well-defined hydraulic rating curves, continuous water level recording devices would be considered appropriate. Regular inspection of the inlets and outlets should be completed to ensure that they are free of debris and sediment, and are functioning in accordance with theory. As a minimum, inspections should be completed every month and following major storms for the first two years of operation. Any problems should be rectified or reported to the municipality for rectification, if special equipment is required. The gauges should be installed from April 1 to November 30 and be capable of providing data in a minimum of 5 minute increments. All data should be collected in digital format and processed into a tabular inlet/outlet hydrograph form. Depending on the results of the first year of monitoring, consideration should be given to monitoring the performance of the facilities year round (i.e. inclusive of the December 1 to March 31 period).

2.2.1.2 Groundwater

The extent and type of long-term groundwater monitoring will depend on the monitoring programs carried out for further baseline assessment of the groundwater characterization and the groundwater/surface water connections at pre-development through the local SWS. It is expected that there will be different spatial and temporal scales within these programs related to the location and type of development, the sensitivity of the groundwater function and the potential groundwater impacts. Site specific monitoring related to the long-term management of groundwater, as it relates to potential dewatering for subsurface infrastructure would also require a long-term groundwater monitoring program. The following provides a general groundwater monitoring program:

- A spatially representative network of water table monitors and multi-level monitoring wells to assess any potential change to the water table, vertical gradients and larger scale groundwater flow directions,
- A number of multi-level drive point piezometers to assess vertical gradient trends in wetland features and watercourses,
- Seasonal groundwater level measurements are likely adequate for monitoring locations intended to represent general conditions, with a number of other sites instrumented with data loggers to monitor shorter term trends,
- Groundwater level and vertical gradient monitoring at selected natural features where the need for post-construction mitigation is identified, such as the wetlands. Continuous data collection would also be important in these monitoring locations,

- Spot baseflow measurements,
- Assessing quantity and quality of flow from long term dewatering and
- Annual water quality sampling of selected monitoring wells and spot baseflow sites.

During development, groundwater monitoring associated with dewatering activities should consider monitoring of groundwater levels, groundwater discharge, hydraulic gradients, baseflow and discharge quantity and quality particularly as they relate to groundwater/surface water interaction.

Post-construction performance monitoring of hydrogeological conditions should focus on the performance of future LID BMPs that are intended to maintain the functional pre-development rate and distribution of groundwater recharge. Due to the potential widespread distribution of LID BMPs, the post-construction hydrogeological monitoring program will also necessarily be widespread in terms of the distribution of monitoring locations. An appropriate spatial discretization is needed to represent functional linkages and potential hydro-stratigraphic variation.

The long-term groundwater monitoring program is expected to incorporate representative monitoring sites installed pre-construction. Groundwater monitoring programs proposed within regulatory agency guidelines, where they exist, will likely advise the long-term groundwater program.

2.2.1.3 Watercourses

An overall, systems-based geomorphic monitoring program should be established for receiving, sensitive and/or representative sites downstream and within the anticipated development area. The collection of field data should establish a baseline condition from which continued monitoring during and post-development can determine channel response in terms of process and function, as upstream land use changes. Adaptive management strategies may be implemented when observations exceed targets, as determined during the baseline monitoring phase.

Despite typical water measures to maintain the hydrological regime and reduce impacts of impervious surfaces, there is the potential that a local land use change will result in some alteration in the hydrologic regime (i.e., increased flow volumes and/or altered seasonal timing) and sediment regime (i.e. initially more fine sediment being supplied to the channel followed by an overall decrease in loadings). These alterations can result in changes in the channel planform, bank erosion, cross sectional area and substrate composition, which, in turn, may locally affect aquatic habitat, riparian habitat and water quality.

Baseline monitoring should be established through local subwatershed studies, and as land use plans and designs evolve, additional monitoring locations should be established, and baseline surveys completed, for reaches downstream of headwater drainage features slated for removal and stormwater outfalls. Monitoring should subsequently take place annually to fulfill performance evaluation requirements through to the post-construction/development period. Specifically, the following steps should be taken to monitor development impacts:

- **Control Cross-sections**: Are to be monitored annually during periods of low flow. An additional site visit should be conducted at each site following a peak storm in excess of the 5 year storm event for the system. Cross section morphology from each visit should be overlaid and compared. Changes in cross-sectional area the context of acceptable ranges of adjustment will trigger a review of the need for mitigation in the form of restoration (based on professional review).
- **Substrate Composition**: A modified Wolman pebble count should be conducted at each control cross-section on an annual basis, the results of which will be tabulated in a particle size distribution chart. An additional site visit will be conducted at each site following a peak storm in excess of the 2 to 5 year storm event for the system. Grain size adjustments in excess of an order of magnitude will act as a trigger for investigation. Due to the dynamic nature of substrate composition, no action

should be taken until Year 5 unless the adjustment is identified as a potential risk to the function of the channel by a qualified geomorphologist.

- **Lateral Migration**: A series of erosion pins (minimum of 5) installed in areas of active bank migration, as well as areas of anticipated migration should be measured on an annual basis during low flow conditions to determine rates of bank adjustment. An additional site visit will be conducted at each site following a peak storm in excess of the 2 to 5 year storm event for the system. Annual migration rates in excess of 20 cm/year will trigger an assessment by a geomorphologist to determine whether the adjustment is localized or representative of broader site conditions. Mitigation measures would be recommended based on the extent and source of the issue.
- **Photographic Record**: Photographs from a known vantage point should be used to document general geomorphic site conditions on an annual basis. An additional site visit will be conducted at each site following a peak storm in excess of the 2 to 5 year storm event for the system. These photographs will be used as supplemental information to inform decisions regarding the need for mitigation.

Analysis of ongoing monitoring may be used for adaptive management of the study area; however, mitigation should only be applied following an investigation into the causes. The exception being major adjustments requiring immediate works where risk to property, human safety, or infrastructure is imminent. Mitigation measures would be recommended based on the extent and source of the issue. Table 2.2.1.1 summarizes monitoring parameters and example indicator thresholds for investigation.

Indicator targets should be developed appropriately based on existing/baseline conditions for each site. These targets and methods should be supported by a professional, qualified to practice fluvial geomorphology.

Table 2.2.1.1. Summary of Typical Fluvial Geomorphology Monitoring Targets

Monitoring Parameter	Indicator Monitoring Threshold*
Bankfull cross-sectional area (m^2)	Maintain bankfull cross-sectional area within acceptable tolerances based on continued measurements of the baseline condition.
Mean bankfull channel depth	Maintain bankfull depth within acceptable tolerances based on continued measurements of the baseline condition.
Bank migration rates (cm/yr.)	Normal migration rates within acceptable tolerances of bankfull width per year where migration is expected (i.e., cutbanks). As rates may vary due to extreme flood events; evaluate migration over the longer term (e.g., 3-5 years).
Substrate distribution, D_{50} and D_{90}	Maintain D_{50} and D_{90} particle sizes within acceptable tolerances based on continued measurements of the baseline condition . As sizes may vary due to extreme flood events; evaluate substrate trends over the longer term (e.g., 3-5 years).

Note: * Threshold exceedances, if documented, will require an interpretation of site conditions and trends by a qualified Professional Geomorphologist to explore if any adaptive management or remediation recommendations are appropriate.

This overall, system monitoring could be undertaken by a variety of parties, including the municipality or Conservation Authority. However, a fluvial geomorphologist should interpret the findings and assess whether substantial change has occurred. The geomorphologist should also be able to link any change with the causative factors and processes. For natural channel designs, it is recommended that the proponent responsible for the design develop and undertake an appropriate monitoring plan, similar to that proposed for overall system monitoring.

Additional consideration for new technologies and techniques can be made when developing and implementing a stream morphology monitoring program. New technologies, such as the use of UAV to capture aerial imagery of the watercourse for annual comparison, would enable for the capture of high resolution colour imagery or high definition video for analysis purposes.

2.2.1.4 Surface Water Quality

Surface Water Chemistry

Chemical sampling using grab sampling should be completed to characterize and verify the functionality of the stormwater quality management system. Instream monitoring to establish pre-development (i.e. baseline) conditions should be completed for two years prior to development; the location of instream water quality monitoring should be determined in consultation with the Conservation Authority and municipal staff.

Water chemistry monitoring of post-developed conditions should be completed for a minimum of three years post development, and should include monitoring of the inlet and outlet of each stormwater management facility after construction, as well as online the receiving watercourse at the same location identified for pre-development monitoring.

Grab sampling is recommended for collecting water quality samples from each facility for the monitoring program. Each site should have 3 events sampled per year, typically representative of an average spring, summer and fall event (rainfall event volumes of over 15 mm depth are preferable).

The following parameters are recommended for monitoring surface water chemistry and water quality:

- Oil and Grease
- Total Phosphorus
- Anions (Nitrate, Nitrite, Phosphate, Chloride)
- Ammonia
- Total Kjeldahl Nitrogen (TKN)
- Conductivity
- Total Solids (TS)
- Total Suspended Solids (TSS)
- Turbidity
- BOD5
- Dissolved Oxygen
- pH/alkalinity
- Salinity
- Total Coliforms
- Faecal Coliforms
- PAH
- Metals (Al, Sb, As, Ba, Be, B, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, P, K, Se, Si, Ag, Na, Sr, Tl, Sn, Ti, W, U, V, Zn, Zr).

Surface Water Temperature

Continuous temperature gauges should be installed from June 1 to September 30 at the outlet from all SWM facilities and both upstream and downstream of the facility outlets, to monitor the effectiveness of measures to cool the effluent and mitigate the impacts on stream temperature. Locations for online monitoring of water temperature should be determined in consultation with the Conservation Authority and municipal staff.

Monitoring Requirements for Redside Dace Habitat

As noted previously, various reaches of the FSA through the West Humber Subwatershed are Redside Dace habitat. As such, and in addition to the foregoing, continuous monitoring for instream dissolved oxygen, turbidity, and conductivity should be conducted. The TSS and turbidity results from the wet weather and dry weather grab sampling should be used to generate a mathematical relationship between the two parameters for each monitoring site; this relationship would be used to generate a continuous TSS dataset based on mathematical relationships between TSS and turbidity.

2.2.1.5 Aquatic Ecology

Monitoring of aquatic habitat is essential to ensure that created and altered systems perform as designed and intended. Monitoring may be triggered by requirements arising from aquatic habitat reconstruction or compensation, and/or site-specific development impacts to aquatic features. Specific effectiveness monitoring will need to be developed in consultation with the appropriate agencies following the detailed design of the subject development, which is a typical requirement of both federal and provincial regulatory agencies. Site specific monitoring of all constructed habitat is expected to be required to determine that the habitat is stable and functioning as intended. Additional monitoring may be required to determine the effectiveness of stormwater management facility design for both water quality and temperature mitigation (ref. Section 2.2.1.4).

The following conditions are anticipated for aquatic habitat monitoring to address the approval of any re-aligned channels:

- Pre-construction monitoring / baseline monitoring
  - Fish community
    - Completed for the existing channels to establish the existing fish community and species that habitat should be designed for, as well as to ensure the appropriate fish community returns to the watercourse post-construction.
    - Watercourse realignments and designs will need to incorporate aquatic habitat enhancement design features and need to be designed for the target fish community
    - Fish community assessments are required pre-construction to establish the existing community and to guide watercourse and aquatic habitat designs.
    - The methods chosen for the fish community assessments should remain consistent with the post-construction surveys. A standardized protocol, such as the Ontario Stream Assessment Protocol is recommended for both pre- and post- construction. A 3-pass method using block nets, as described by the Ontario Stream Assessment Protocol (Stanfield 2010) is recommended. However, the most appropriate methods at the time of pre-construction surveys should be selected, in consultation with the Conservation Authority
  - Aquatic Habitat
    - As part of the Fish Habitat Offsetting Plan, detailed habitat mapping of existing watercourses will be conducted as part of Fisheries Act approvals
    - To ensure consistency between pre- and post-construction assessments a standardized protocol, such as the Ontario Stream Assessment Protocol, is recommended
  - Benthic Invertebrates
    - An assessment of benthic invertebrates in the existing channels is recommended to establish baseline conditions in the watercourse and for comparison purposes following the channel realignment and construction

    - Benthic assessments are to follow approved methods and guidance documents, in consultation with the affected Conservation Authority, or other applicable agencies.

- Post-construction monitoring (re-aligned channels)

  The detailed design plans for any proposed development should outline the specific monitoring plan required for channel realignments; however, the following provides general guidance for post-construction monitoring activities for constructed and existing habitat features:

  - Aquatic Habitat
    - Detailed aquatic habitat assessments and habitat mapping of pools, riffles, and installed habitat features
    - Comparisons between constructed habitats and the detailed design plan will be needed to ensure that the constructed features are aligned with the design plan
    - The function of aquatic habitats should also be assessed post-construction.
    - Aquatic habitat monitoring should occur over a 10-year period to assess the stability of the designed system and ensure the system is functioning as intended and designed. The frequency of monitoring will be established as part of the local SWS, and in consultation with the affected Conservation Authority, and other applicable agencies.

  - Fish community assessments
    - Monitoring stations should be established in a diversity of locations that reflect the variety of habitat features and designed functions of the system
    - The objective is to ensure the fish community that the watercourse was designed for is establishing in the realigned system.
    - To ensure consistency with the pre-construction surveys, the same methodology should be applied to conduct the fish community assessments
    - Post-construction monitoring should occur over a 10-year period to assess the re-establishment, health, abundance and diversity of the fish community in the realigned channel. The frequency of monitoring within the 10-year period should be established as part of the local SWS, and in consultation with the affected Conservation Authority, and other applicable agencies

  - Benthic Invertebrates
    - An assessment of benthic invertebrates in the realigned and constructed channel is recommended to ensure the system is establishing and functioning as intended and designed. This is an effective way to assess aquatic health and water quality over time. The results of post-construction monitoring should be compared to pre-construction conditions to demonstrate if an improvement to the overall system has occurred based on the design.
    - Benthic assessments are to follow approved methods and guidance documents, in consultation with the affected Conservation Authority, and other agencies as applicable.

Development-related monitoring will be site-specific and determined as part of the local SWS and follow-on studies (neighbourhood/block plans) through the development application process. This will include review/input from the municipality and Conservation Authority, as well as other applicable agencies.

An adaptive management approach to the monitoring plan should be applied and detailed through the detailed design approvals process and the local SWS and future block plans. It is recommended that the detailed monitoring plans outline the specifics of the adaptive management approach, in particular when feedback and changes to the design will occur. Key milestones (e.g. end of year 1, 3, 5 and 10) should be established that allow for agency staff to evaluate the effectiveness and stability of overall system. This process will identify deficiencies in the function of the realigned channels and recommendations or requirements to remedy the deficiencies and design issues.

2.2.1.6 Terrestrial Ecology

Development-related monitoring (i.e. impact prediction validation) will be site-specific and determined as part of the local SWS and future block plans for development applications. This will be led by the municipality, with input and advice from the Conservation Authority.

The following are considerations for terrestrial and wetland monitoring. Monitoring will address and validate predicted effects and the early outcomes of any proposed NHS restoration, and may include:

- Pre-construction monitoring: establishment of monitoring stations/locations, baseline inventories, etc.
- Construction monitoring: environmental protection and mitigation measures effectiveness monitoring, which may include buffer/setback integrity monitoring
- Post-construction monitoring: assessment of early NHS restoration success, including addressing restoration planting establishment and installation warranties.

Monitoring will need to be practical and focused on areas where impact prediction validation and/or NHS restoration success information is deemed to be beneficial. The specific items included in the monitoring plan (e.g. vegetation, breeding birds, anuran call surveys, etc.) will be determined based on the overall objectives of the development application, the detailed design of the subject secondary plan area and the local block plans through the local SWS.

Parallel monitoring programs to assess the broader landscape conditions (holistic monitoring) and efficacy of localized mitigation interventions (effectiveness) monitoring are proposed. The scope of the holistic monitoring program should focus on long-term changes to the ecology of the study areas at the landscape scale; the scope of the effectiveness monitoring program should evaluate the efficacy of mitigation strategies at a local scale and identify BMPs for adaptive management. As the holistic monitoring program will be established ahead of the effectiveness monitoring program, key elements and considerations for the holistic program are summarized in the following. Details for the effectiveness monitoring program will require site-specific information regarding proposed land-use change and mitigation strategies, and therefore should be established as part of the MESP studies and refined through future functional servicing studies. As well, opportunities should be identified to utilize or combine data from the TRCA and CVC watershed monitoring programs, where available.

A summary of the proposed protocols and methods to be used to prepare the holistic monitoring program include the following elements:

a. Vegetation

The general objectives of the vegetation monitoring component include assessing i) the long-term condition and function of Key Feature vegetation communities, and ii) updating the boundary of vegetation feature defined using Ecological Land Classification protocols (Lee et al. 1998). For the first objective, the location of long-term monitoring plots should be identified, and should follow the standards associated with the Ecological Monitoring and Assessment Network Protocols (Roberts-Pichette and Gillespie 1999). The second component of vegetation monitoring will include periodic updates to the Ecological Land Classification (Lee et al. 1998) of the Natural Heritage System in order to maintain up-to-date coverage of vegetation communities within the SABE area; details regarding the timing and scope can be identified during subsequent technical studies.

b. Breeding Birds

The objective of breeding bird monitoring is to assess changes in bird communities and/or individual species within and outside of the SABE related to development. The location of monitoring stations associated with Key Feature areas should be established, with an emphasis on locations that occur within the development area, which will be used to detect changes within the avian community (i.e. treatment stations), as well as within comparable natural areas outside the study area for comparison (i.e. control stations). The approach to monitoring breeding birds should follow methodologies that have been used for other holistic monitoring programs that have been developed based on protocols established for the Ontario Breeding Bird Atlas for point counts (Cadman et al. 2007), Forest Bird Monitoring Program (FBMP 2008), and standard methods for monitoring songbird populations in the Great Lakes Region (Howe et al. 1997).

c. Calling Amphibians

The objective of amphibian monitoring is to assess changes in the occurrence and abundance of calling amphibian species that occur within and outside of the SABE related to development. As with the Breeding Bird Monitoring, the location of monitoring stations should be established to detect changes in amphibian communities within areas likely to be affected by development (i.e. treatment stations), and areas with comparable habitat in locations likely to be unaffected by development (i.e. control stations). In addition to identifying candidate locations, monitoring protocols should follow standard approaches identified in Marsh Monitoring Program protocol (BSC 2009).

d. Other Terrestrial Monitoring

Monitoring for other plant and wildlife groups may also be required based on site-specific conditions. This may include, for example, invasive species, regionally significant species, species within specific taxonomic groups such as bats, reptiles, Odonata, Lepidoptera, and/or Plethodontid and Ambystoma Salamanders, as required. Where monitoring of such groups is required, it is anticipated that the monitoring program will be site-specific, and therefore should be addressed as part of the effectiveness monitoring program scope that is prepared for features within the SABE. Species at Risk monitoring as required under the ESA permitting process could be completed in parallel with this monitoring program. Where applicable, monitoring protocols should follow existing standards.

As well, monitoring objectives and methods for existing terrestrial monitoring programs should be identified and implemented. For example, linkage monitoring may be required as part of the TRCA road ecology survey protocols.

Duration

The duration of the monitoring program will be determined based upon the timeframe for implementation, which is market-driven. Although no specific timeframe can be provided for completing the monitoring program, monitoring should be conducted at least two (2) years prior to construction (if not already accomplished through baseline data collection work for the local SWS), and should continue until at least 80 % build-out of the area.

For stormwater management facilities, the greater of a three (3) year monitoring program or post-construction monitoring to 80% build-out of the contributing drainage area to the stormwater management facility is recommended to verify facility performance prior to assumption by the municipality. The monitoring should include any other requirements or conditions on the part of the municipality and approval agencies (i.e. MECP), as pertaining to the approval and/or assumption of the facility.

For the purpose of monitoring any watercourse realignments and the NHS, as well as verifying stormwater management facility performance on a systems-basis for the future Secondary Plan Areas, a longer-term holistic monitoring program is recommended. This monitoring program should be led by the municipality and is recommended to include at least two (2) years of baseline data, and continue until the greater of 10 years or 80% build-out of the Secondary Planning Area.

2.2.2 Reporting

Annual reports are to be prepared for all monitoring programs. Annual monitoring reports to verify facility performance prior to assumption by the municipality should be submitted to the municipality and any other permitting agencies (i.e. MECP) per the conditions of approval. Annual monitoring reports for the holistic monitoring programs should be submitted to the municipality and Conservation Authority.

2.3 Policy Conformance

The SABE Study, being led by Hemson, and the associated Environmental Screening and Scoped SWS are Regional projects requiring conformity with, and are guided by, provincial and regional policies. In recognition that the next stages of the planning process will be led by local municipal policies (Caledon), the Wood Team has had regard for these policies and direction provided at the local municipal level to support alignment with, and provide preliminary direction for, future work. A list of key plans and policy documents, applicable to the current Scoped Subwatershed Study work, is provided in Table 2.3.1.1 and is briefly discussed in the subsequent sections.

Table 2.3.1.1. Summary of Key Statutes and Policies Applicable to the Current Study Stage

Legislation or Policy Document	Key Sections
Provincial Policy Statement (2020)	Section 2.1 (Natural Heritage) Section 2.2 (Water)
Growth Plan for the Greater Golden Horseshoe	Section 4.2.1 (Water Resource Systems) Section 4.2.2 (Natural Heritage System) Section 4.2.3 (Key Hydrologic Features, Key Hydrologic Areas and Key Natural Heritage Features)
Greenbelt Plan	3.2 (Natural System)
Region of Peel Official Plan (2018)	Chapter 2 (The Natural Environment) Chapter 3, Section 3.4 (Water Resources) Chapter 7, Section 7.10.2.12 (Expansion to the Urban Boundary)
Town of Caledon Official Plan (2018)	Section 3.2 Ecosystem Planning and Management Section 3.1 Sustainability Section 5.7 Environmental Policy Areas
Conservation Authorities Act (1990): O.Reg. 166/06 Toronto and Region Conservation Authority O.Reg. 160/06 Credit Valley Conservation Authority	Regulation of development, interference with wetlands and alterations to shorelines and watercourses.
Fisheries Act (2019)	Sections 34 and 35 (Fish and Fish Habitat Protection and Pollution Prevention)
Species at Risk Act (2002)	Section 32 (Measures to Protect Listed Wildlife Species)
Endangered Species Act (2007)	Section 10 (Prohibitions on damage to habitat, etc.)

Provincial Policy Statement

The Provincial Policy Statement (PPS) (2020) is issued under Section 3 of the *Planning Act*. The PPS provides direction on matters of provincial interest related to land use planning and development. The PPS provides for appropriate development while protecting resources of provincial interest, public health and safety, and the quality of the natural environment. The PPS recognizes the complex inter-relationships among economic, environmental and social factors in planning and embodies principles of good planning for the creation of complete, healthy, and liveable communities. All land use decisions (provincial and municipal) must be consistent with the PPS.

The PPS provides guidance for the long-term, wise use and management of resources including the protection and management of natural heritage and water resources (Section 2.0). The PPS provides specific policy direction on significant wetlands, endangered and threatened species, fish habitat, significant woodlands, significant valleylands, significant areas of natural and scientific interest (ANSI) and significant wildlife habitat. It also provides guidance for the protection, improvement and restoration of the quality and quantity of water resources. The PPS recognizes that the linkages and related functions among ground water features, hydrologic functions, natural heritage features and areas, and surface water features are to be maintained. It states that watersheds are the ecologically meaningful scale for integrated and long-term planning.

The PPS also provides direction relating to natural hazards, so as to ensure that development is directed away from areas of natural hazards where there is an unacceptable risk to public health or safety or property damage. It is also to ensure that development does not create new or aggravate existing hazards.

Growth Plan for the Greater Golden Horseshoe

The Growth Plan for the Greater Golden Horseshoe (the Growth Plan) was developed to respond to, and prepare for, challenges of continued rapid growth in this important geographic area of Ontario. First introduced in 2006 (The Growth Plan for the Greater Golden Horseshoe 2006), the current in-force Plan came into effect in 2019.

The Growth Plan recognizes the importance and values of growth and provides direction with respect to where and how growth should occur; it also provides structure to ensure that growth considers community health (e.g., complete communities), additional values and functions are protected, and resources used appropriately (e.g., Natural Heritage, Water Resources, Agriculture, etc.). To this end, the Growth Plan sets out guiding principles to inform how growth should occur, provide direction for protection and conservation, and embed climate change and alternative growth management approaches into land use planning for the Greater Golden Horseshoe.

The Growth Plan provides criteria (Section 2.2.8) for determining the feasibility and location of settlement expansions that must be demonstrated in municipal comprehensive reviews conducted by upper-tier municipalities. With respect to environmental criteria, the Growth Plan requires that settlement expansion areas be planned to avoid, and where avoidance is not possible, minimize and mitigate potential impacts on watershed conditions. It further requires the policies of Section 2 Wise Use and Management of Resources and Section 3 Protecting Public Health and Safety of the Provincial Policy Statement be applied. These policies require natural heritage and water resource systems to be identified, protected, restored or improved.

The Growth Plan provides direction for 'Protecting What is Valuable' (Section 4.2) within the Growth Plan Area. It is through the policies of the Growth Plan that municipalities are directed to undertake watershed planning to ensure a comprehensive and integrated approach to protecting, enhancing or restoring water quality and quantity; identify a Water Resource System (WRS) comprised of 'key hydrologic features' and 'key hydrologic areas'; and complete subwatershed studies to inform development planning (Section 4.2.1).

A Natural Heritage System has been mapped for the Growth Plan Area outside of settlement areas by the Province (the 'Regional Natural Heritage System for the Growth Plan for the Greater Golden Horseshoe'). Policies of the Growth Plan direct municipalities to incorporate the NHS into their Official Plans (Section 4.2.2) to protect the ecological and hydrologic functions of the features or areas. The Growth Plan provides policies for development and protection of 'key natural heritage features' (Section 4.2.3) within the Natural Heritage System and outside the Natural Heritage System (outside of Settlement Areas).

The Growth Plan states that if a settlement area is expanded to include the Natural Heritage System for the Growth Plan, the portion within the revised settlement area boundary will be designated in official plans and continue to be protected in a manner that ensures that connectivity between, and the diversity and functions of, the natural heritage features will be maintained, restored, or enhanced (Policy 4.2.2.7). Within settlement areas, municipalities are to identify an NHS (or similar system) and continue to protect natural heritage features and areas in a manner consistent with the PPS (Policy 4.2.3.6).

Greenbelt Plan

The Greenbelt was established in 2005 as part of the broader strategy of the Growth Plan (2006); the current plan was updated as part of a comprehensive provincial plan review process and came into effect in 2017.

The Greenbelt Plan identifies where development should not occur to ensure permanent protection of the agricultural land base, and the ecological and hydrological features and functions that occur in the rural landscape of the Greenbelt Plan Area. The Oak Ridges Moraine Conservation Plan (ORMCP) and the Niagara Escarpment Plan (NEP) similarly identify areas where development should not occur with a focus on areas defined by geologic and physiography that support agriculture, hydrologic and ecological form, function and value to Ontario in addition to their aesthetic and recreational values.

The Natural System within the Protected Countryside of the Greenbelt Plan Area is comprised of a Water Resource System and a Natural Heritage System. These two systems often overlap as a result of the interrelationship between hydrologic and ecological features and functions. The Natural Heritage System is made up of core areas and linkages and builds upon the natural systems of the NEP and the ORMCP. The Water Resource System is made up of groundwater and surface water features and areas which support ecological and human water needs.

The Greenbelt Plan provides policies specific to Natural Systems within the Protected Countryside (Natural Heritage System, Section 3.2.2; Water Resource System, Section 3.2.3), and polices which apply across the entire Greenbelt Plan Area for Key Hydrologic Features (Section 3.2.4) and Key Natural Heritage Features and Key Hydrologic Features (Section 3.2.5). Where settlement expansion is proposed to occur outside of the Protected Countryside, the Policies of Section 3.2.5 will apply.

The Natural Heritage System of the Greenbelt Plan Area connects to systems beyond the Greenbelt (e.g., the Growth Plan NHS); policies for these External Connections are also provided to ensure a connected landscape system (Section 3.2.6).

Conservation Authorities Act

The Conservation Authorities Act, R.S.O. 1990, c. C.27 was enacted by the Province to guide the conservation, restoration, development and management of natural resources in watersheds in Ontario. The legislation was recently modernized through changes introduced in Schedule 4 of the Building Better Communities and Conserving Watersheds Act, 2017.

Section 28 of the *Conservation Authorities Act* enables Conservation Authorities to develop and administer regulations relating to development and activities in, or adjacent to, river or stream valleys, Great Lakes and inland lakes shorelines, watercourses, hazardous lands and wetlands. In 2006, the Minister of Natural Resources and Forestry approved individual "Development, Interference and Alteration" Regulations for all Conservation Authorities consistent with Ontario Regulation 97/04 (i.e., Generic Regulation). It was at that time, that the Minister approved Toronto Region Conservation Authority's regulation, Ontario Regulation 166/06, and Credit Valley Conservation Authority's regulation, Ontario Regulation 160/06. Ontario Regulation 166/06 and Ontario Regulation 160/06 specify that permission is required from Toronto Region Conservation Authority and Credit Valley Conservation (respectively) to:

- Develop in river or stream valleys, wetlands and adjacent lands (i.e., other areas where development could interfere with the hydrologic function of a wetland), shorelines or hazardous lands and associated allowances;
- Alter a river, creek, stream or watercourse; or
- Interfere with a wetland.

The administration of the regulation is guided by Conservation Authority Board-approved policies of the respective Conservation Authorities. These policies complement the Natural Hazard policies of the PPS (Section 3.1 of the PPS).

If it can be demonstrated to the satisfaction of TRCA and CVC that the proposed work meets Board-approved policies and will not affect the control of flooding, erosion, dynamic beaches or pollution or the conservation of land, TRCA and CVC may grant permission for the proposed work.

The Policy documents also outline the Authority's plan input and review role.

Fisheries Act

The Fisheries Act protects fish and fish habitats, including prohibiting the deposit of deleterious substances into waters frequented by fish. This includes sedimentation of watercourses during construction activities. Projects or activities in or near water that support fish and fish habitat must be assessed to determine if the project or activity will result in Harmful Alteration, Disruption or Destruction (HADD) of fish habitat; where a HADD occurs, an authorization under the Act is required.

As defined in the Fisheries Act, **fish** includes parts of fish; shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals, and the eggs, sperm, spawn, larvae, spat; and juvenile stages of fish, shellfish, crustaceans and marine animals. **Fish habitat** means water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas.

Species at Risk Act

Enacted in 2002, the Species at Risk Act (SARA) provides legal protection for federally-listed species at risk (i.e., listed by the Committee on the Status of Endangered Wildlife in Canada; COSEWIC) on federally-owned and federally-funded lands. The Act helps to protect sensitive species from becoming extinct by securing actions for their recovery. Projects for which SARA applies are to assess the potential for the project or activities of the project to contravene the prohibitions of the Act. Where a contravention may occur, consultation with the appropriate federal agency is to be undertaken and an authorization or permit may be required.

Endangered Species Act

Sections 9 and 10 of the Endangered Species Act prohibit harming, harassing or killing individuals of provincially-listed endangered or threatened species at risk and their habitat. Special concern species do not receive the legal protections afforded to endangered and threatened species, however they are recognized under the Province's Significant Wildlife Habitat categories and protected through the Provincial Policy Statement. Projects or activities are to consider the potential presence of species at risk and assess their potential to impact individuals or habitats of the species in accordance with the requirements of the Act. Where a project or activity has the potential to impact a species, consultation with the Ministry of Environment, Conservation and Parks (MECP) is to be undertaken to determine mechanisms to avoid, mitigate impacts; where these cannot be achieved, a permit may be required.

Region of Peel Official Plan

The Region of Peel Official Plan ("ROP") is the key planning document guiding the long-term growth and development of the Region. It speaks to key systems (e.g., Greenlands, transportation) and lays out the framework for land use planning and implementation.

Several sections of the OP provide direction with respect to the natural environment and natural resources within the Region. Chapter 2 addresses the Natural Environment, providing goals and policies associated with large environmental systems (e.g., air quality, groundwater, watersheds, Niagara Escarpment), the Greenlands System in Peel, Hazards (human and natural), restoration, and management and stewardship of the Greenlands. This chapter sets the direction for protection of natural environment features and functions in the Region.

The Regional Official Plan implements the Provincial Policy Statement's (PPS) natural heritage system policies by providing policy direction for the protection of natural heritage and water resource features through the Greenlands System's Core Areas, Natural Areas and Corridors (NAC) and Potential Natural Areas and Corridors (PNAC) policy framework. Core Areas of the Greenlands System are identified and shown on Schedule A to the Region of Peel Official Plan. In accordance with the Plan, development and site alteration are not permitted within Core Areas with limited exceptions (Policy 2.3.2.6).

The Regional Official Plan directs the area municipalities to identify and protect Core Areas in conformity with the Plan and provincial policy and to further interpret, identify and protect NAC and PNAC features and areas in the local official plans in accordance with provincial policy (Policies 2.3.2.4 and 2.3.2.11).

Chapter 3 of the ROP sets policies related to resources (e.g., aggregate, agricultural). While much of this chapter does not have specific policies relating to the natural environment, the section on Water Resources (Section 3.4) has direct and important considerations for the water resource system of Peel and by extension, influence on some natural heritage features and functions.

Also of relevance to the current work, Chapter 7 (Implementation), Section 7.10.2.12 lays out the process through which settlement boundary expansions will be prepared. The SABE project, to which Phase 1 of the natural environment work contributes is being guided by these policies and contributions by the Wood team have been prepared to support their approach.

The ROP policies are being reviewed through the Peel 2051 Regional Official Plan Review. Policies specific to the natural environment are being updated to be consistent with and conform to provincial policy direction. Included in the review are recommended changes consolidating the environmental policies in the Plan to reflect a systems approach in line with provincial direction, including identification and updated policy requirements for the Regional Greenlands System and Water Resource System and to ensure that planning addresses the implications of climate change.

Town of Caledon Official Plan

The area municipal official plans in Peel further interpret, identify and protect natural heritage features and areas in accordance with provincial and regional policy direction.

Section 1.3.1 of the Caledon Official Plan states the following: *[The] Official Plan is a statement of principles, goals, objectives and policies intended to guide future land use, physical development and change, and the effects on the social, economic, and natural environment within the Town of Caledon*. General policies with respect to natural environment are presented in Section 3.2 (Ecosystem Planning and Management); Section 5.7 speaks specifically to Environmental Policy Areas identified in the Town. These sections set out objectives, a framework for system planning, identify key components of the system in Caledon and identify allowable uses. Water resources are addressed through Sections 3.1 (Sustainability) and Section 3.2 (Ecosystem Planning and Management).

The Town of Caledon Official Plan's Ecosystem Framework incorporates and refines the components of the Regional Greenlands System, as defined in the Region of Peel Official Plan, in a manner which conforms with the policy direction in the Regional Plan and in accordance with provincial policy. The Ecosystem Framework establishes policy requirements for Natural Core Areas, Natural Corridors, Supportive Natural Systems, and Natural Linkages. Natural Core Areas and Natural Corridors are designated Environmental Policy Area (EPA) on Schedule A to the Town of Caledon Official Plan. Development and site alteration are not permitted within the EPA designation with limited exceptions.

Ecosystem components which are not currently designated EPA, and which are identified through more detailed environmental studies as warranting protection, may be excluded from development in order to satisfy the Town's environmental policies and performance measures. The Town's Ecosystem Framework components identified through studies as warranting protection are generally placed in an EPA designation, subject to the policies of the Caledon Official Plan. The Town of Caledon Ecosystem Framework components are categorized in Table 3.1 of the Caledon Official Plan.

As the project is a Regional planning project, conformity with Town of Caledon policies is not directly required. However consideration has been, and will continue to be, given to the Town's policies to facilitate a smooth transition to the local municipal planning processes (e.g., a detailed subwatershed study, secondary plans, etc.).

2.4 Guidelines for Site Specific Environmental Studies

The Region's planning framework is being updated to provide direction for the implementation of planning approvals within the recommended SABE boundary at the local level. This will include identifying requirements for the identification, prioritization, sequencing and staging of secondary plans and identifying the hierarchy of study requirements corresponding to planning approval stages extending from the broader scale to site specific. Regional and local planning approval stages are identified within the framework, with corresponding environmental study requirements beginning at the local settlement boundary expansion/secondary plan approval stage.

Although different study requirements are identified for specific stages of the land use planning approvals process, the scope, level of detail and deliverables in each study stage may vary and overlap depending on the size and complexity of the area being planned (e.g. secondary plans and block plans may vary in size and complexity). The interrelationship between the municipal land use planning process and corresponding environmental study and planning is summarized in Figure 2.4.1.

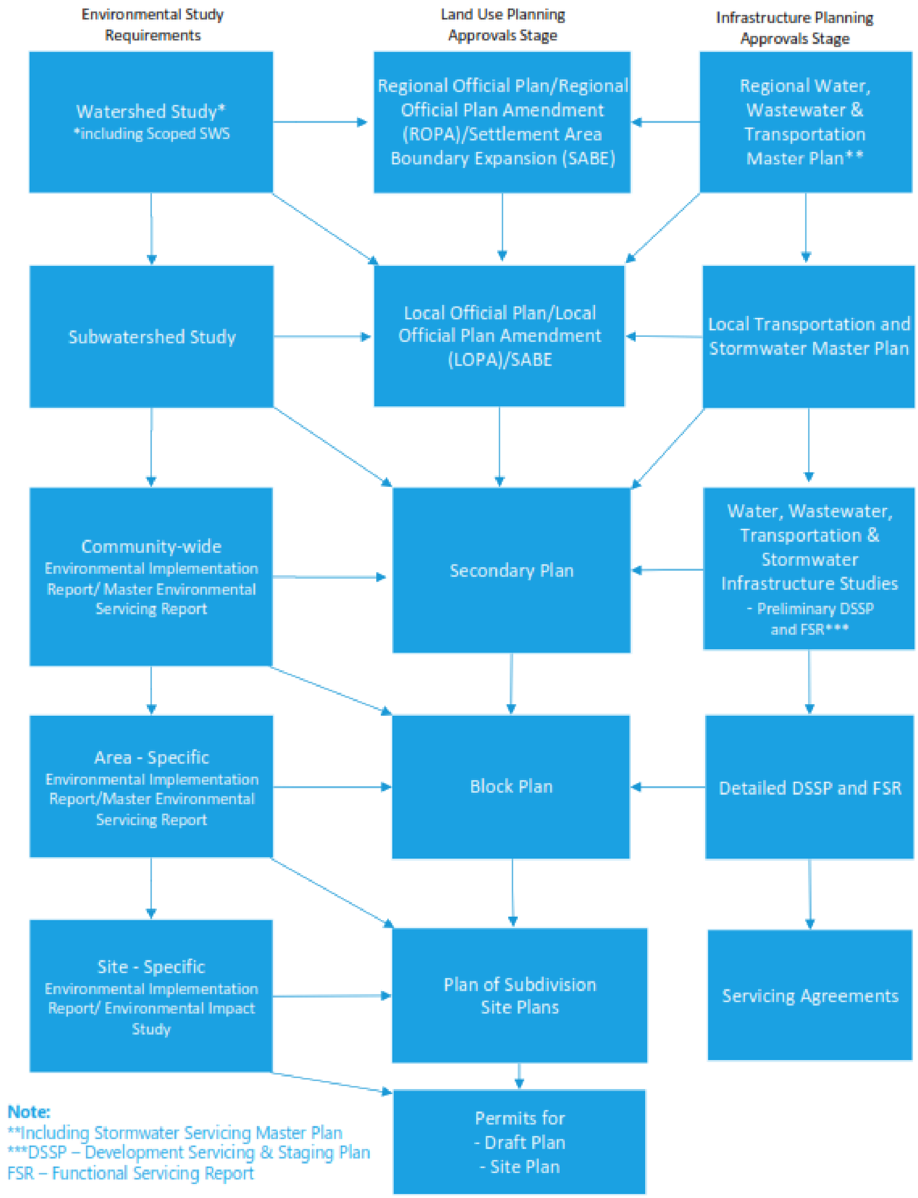

Figure 2.4.1. Environmental Planning Process and Interrelationship with the Municipal Land Use Planning Process

The higher level and broader scale studies typically provide guidance, direction, objectives, targets and deliverables, which are to be applied and refined at subsequent stages of planning and environmental study. Consequently, the process for planning and conducting environmental studies should be undertaken sequentially rather than concurrently, to achieve the most effective and efficient.

The implementation process over time should be guided by an adaptive environmental management and monitoring framework and program with funding so that subsequent cycles of planning can be informed by and adjusted to reflect outcomes and results of the previous implementation stages.

The SABE Study and corresponding Scoped Subwatershed Study presented herein have addressed requirements for Watershed Planning per the above framework. The following sections summarize the requirements of environmental studies to be undertaken at subsequent stages of planning.

2.4.1 Subwatershed Studies

Subwatershed studies are typically led by local municipalities in consultation with the Region and the relevant CA Technical clearance is required by the Region and CA. Subwatershed Studies are more detailed studies that implement and refine the goals, objectives, targets and recommendations of broader scale watershed plans, and identify the recommended water resource and natural heritage systems for protection and management for the study area. Subwatershed Studies establish refined targets and criteria for natural heritage system identification and enhancement, flood and stormwater management, including objectives and targets for flood control, erosion control, stream morphology, water balance, and water quality. They provide recommendations addressing: stormwater management facility sizing and location; low impact design and best management practices to be implemented in stormwater management plans.

Typically, natural heritage field studies, headwater drainage assessments, surface and groundwater monitoring are required study components. As such, 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. In addition, monitoring programs are to be implemented as part of Local Subwatershed Studies, to provide a more detailed characterization and assessment of the aquatic and terrestrial ecology and water resources systems, develop a refined constraint assessment of the natural features and systems within the respective Study Areas, and calibrate/validate the numerical models used for the hydrologic and hydraulic analyses and groundwater assessment.

Subwatershed studies also typically describe compliance requirements for fisheries and endangered and threatened species habitat compensation if needed. Depending on the scale of the subwatershed study, they may also identify or provide direction for phasing, financing and cost sharing of environmental, natural heritage and Water Resource System Management facilities and works.

Key deliverables are recommended direction, terms of reference, objectives and targets for the preparation of Master Environmental Servicing/Environmental Implementation Reports, Development Servicing and Staging Plans, Functional Servicing Reports, Stormwater Master Plans and Stormwater Management Plans.

Detailed subwatershed studies should be prepared for each of the major subwatershed catchments in the SABE in advance of secondary planning to provide broad guidance for the preparation of secondary planning studies and establishment of detailed land uses. Subwatershed studies/plans are recommended for the Etobicoke Creek Headwaters Subwatershed, West Humber River Subwatershed tributaries, Main Humber Subwatershed and Credit River Tributaries Subwatershed. The general management recommendations outlined in this Scoped Subwatershed Study are to be used as the basis for future detailed assessment and refinement as part of Local Subwatershed Studies. The Local Subwatershed Studies are to be completed in support of subsequent Local Official Plans/Local Official Plan Amendments. Terms of Reference for Local Subwatershed Studies are provided in the Part B report.

In the absence of detailed subwatershed plans, scoped comprehensive environmental impact study and management plans or their equivalent could be prepared to support smaller scale initial stage secondary plans for the SABE (e.g. for Mayfield West Phase 2 Stage 2 and Bolton ROPA 30 Lands)

Comprehensive EIS/MESPs could be considered for secondary plans in the Main Humber Watershed (e.g. for staged development of Option 1 and 2 lands) in the absence of a full subwatershed study for the Main Humber Subwatershed.

2.4.2 Master Environmental Servicing Plans (MESPs) /Environmental Implementation Reports (EIRs)

Broad scale Master Environmental Servicing Plans (MESPs) or Community-wide Environmental Impact Reports (EIRs) are generally required by municipalities to support new blocks of development, or comprehensive redevelopment, within a secondary plan area, but may also be identified as the key study deliverable to support a secondary plan. The MESPs/ Community-wide EIRs are typically led by local municipalities in consultation with the, Region and the relevant Conservation Authority, and technical clearance is required by the Region and Conservation Authority upon completion and prior to proceeding to the next stages of planning. The MESPs/EIRs implement the broad direction provided in the parent subwatershed studies and typically require detailed component studies to be completed including completion of field studies, natural heritage system feature and area assessment and delineation, identification of limits of development, and refinement of hydrologic, hydraulic and hydrogeologic modelling and impact assessment if not completed in the subwatershed study.

The recommendations provided in the MESPs and Community-wide EIRs identify the conceptual or detailed functional servicing requirements for infrastructure as a key study deliverable. These studies comprehensively set out environmental management requirements for development and infrastructure, identify the detailed natural heritage system and water resource system boundaries for protection and enhancement, and provide detailed direction for stormwater management facility function, sizing, and location. The MESPs and Community-wide EIRs also identify or provide direction for phasing, financing and cost sharing of environmental, natural heritage and stormwater management facilities and works.

The MESPs and Community-wide EIRs also provide direction for site-specific EIRs/EISs to support plans of subdivision and site plans if needed. In this regard, they provide direction for infrastructure planning requirements to be implemented in functional servicing reports.

The implementing planning framework for the SABE provides flexibility to require Community-wide MESPs/EIRs as the primary environmental study requirement to support secondary plans informed by broader scale subwatershed studies. The implementing framework also identifies more detailed MESPs/EIRs as the primary environmental study requirement to support block plan approvals if sufficient detail is not addressed at the secondary plan stage.

2.4.3 Area-Specific/Site-Specific Studies

2.4.3.1 Town of Caledon Environmental Impact Studies and Management Plans

Environmental Impact Studies (EIS) and Management Plans (MP) will be required to ensure the Town's environmental policies are satisfied where future development is proposed adjacent to Environmental Protection Areas.

As presented in the Town of Caledon Official Plan, the EIS and MP shall:

a) Identify existing ecosystem forms, functions and integrity within EPA, and further refine the limits of EPA, if appropriate, at a more detailed scale;

b) Identify and assess the existing and potential function and integrity of Supportive Natural Systems and Natural Linkages and existing and potential ecological linkages between EPA lands, adjacent lands, and broader ecological systems;

c) Assess the anticipated immediate and longer term environmental impacts of the proposal and to identify all mitigation measures necessary to satisfy the Town's environmental policies and performance measures;

d) Demonstrate how the proposed development satisfies the environmental policies and performance measures contained in the Town of Caledon Official Plan;

e) Recommend site-specific protection, enhancement, restoration and management programs necessary to satisfy the Town's environmental policies and performance measures, and to recommend appropriate mechanisms for implementing such programs; and,

f) To provide base line environmental data which will support environmental monitoring programs.

Where a Subwatershed Study, Secondary Plan, or other broader scale environmental study has been completed, the requirements of the EIS and MP maybe adjusted based on consultation with the Town and other responsible authorities.

2.4.3.2 Functional Servicing Studies

Functional Servicing Studies are typically prepared as part of the detailed site design process, in order to identify the manner in which water, sanitary, and storm servicing is to be provided for the site. The information provided within these documents generally includes, but is not limited to:

- Location and preliminary sizing of sanitary sewers.
- Location and preliminary sizing of storm sewers.
- Location and preliminary sizing of watermains.
- Preliminary site grading plan.
- Location and preliminary sizing of stormwater management facilities.
- Location and preliminary sizing of hydraulic structures (i.e. bridges and culverts).
- Preliminary channel grading plans and supporting analyses.
- Assessment of riparian storage for existing channel and preliminary channel designs.

Current practice also requires that these studies include an assessment of the impacts of the proposed servicing for the site, specifically related to potential impacts to groundwater systems and recommended mitigation strategies.

2.4.3.3 Stormwater Master and Management Plans

The Growth Plan provides direction for preparing Stormwater Master Plans. The preparation of a Stormwater Master Plan by the Town of Caledon should consider relevant environmental study inputs including watershed plans prepared by the Conservation Authorities and this Scoped Subwatershed Study.

Requirements for Stormwater Management Plans are outlined within the Stormwater Management Best Management Practices Guidelines (MOE, March 2003). Stormwater Management Plans are prepared in support of individual development applications and build upon guidance from higher level studies such as the Scoped SWS and Local SWS. The stormwater management plans complement the planning process associated with Draft Plans of Subdivision or individual Site Plans. Stormwater management reporting associated with this planning stage would be the "Functional Design" plan. Subsequently, in support of final subdivision design, a "Detailed Design" plan is prepared.

Functional Design

This level of design typically involves demonstrating the feasibility of providing stormwater management for a particular development. The intent of the Functional Design Stormwater Management Plan would focus on demonstrating compatibility and compliance with principles and requirements prescribed in the Local Subwatershed Study. This includes identifying specific stormwater management infrastructure which is to be implemented for the proposed development (i.e. type of LID BMP's, end-of-pipe facilities, thermal mitigation techniques such as cooling trenches and bottom draws, etc.).

Detailed Design

The detailed design submission is required to demonstrate how the required information, outlined in the Functional Design report, has been integrated, providing further details on the proposed stormwater management system (i.e. details related to minor system design details, landscaping, safety, and maintenance aspects of Stormwater Management Facility design), as well as outlining subsequent specific monitoring requirements.

2.4.3.4 Natural Channel Design Briefs

Natural Channel Design Briefs are prepared in support of any proposed realignment, alteration, or enhancement to a regulated open watercourse. These reports would provide the following information, specifically related to the detailed design of any proposed realignment, alteration, or enhancement to regulated watercourses.

- Details related to the natural channel design principles applied to the detailed design of the watercourse.
- Fluvial geomorphological analysis of the proposed watercourse design.
- Rationale for selection of plantings within the riparian zone and floodplain.
- Details regarding any enhancements proposed within the adjacent watercourse.
- Detailed hydrologic and hydraulic analyses of proposed watercourse and hydraulic structures to demonstrate impacts to floodplains, and freeboard under proposed conditions, maintenance of riparian storage post-development.
- Detailed assessment of impacts of proposed watercourse to aquatic habitat and fish species.
- Detailed design drainage for proposed watercourse and corridor.

2.5 Key Findings and Recommendations

2.5.1 Water Management (Surface and Ground)

- The SABE has been planned in a manner which avoids, minimizes, and mitigates potential negative impacts resulting from future development.
- A preliminary stormwater management strategy has been established to avoid and manage impacts on watershed conditions, including water quantity, quality and erosion control through the implementation of source controls and end-of-pipe facilities; this strategy is to be refined as part of future stages of planning and environmental study.
- Preliminary stormwater sizing criteria has been provided based upon guidance from studies within the respective watersheds and subwatersheds encompassing the SABE to mitigate off-site flooding and erosion hazards including application of Regional Storm (Regulatory) flood control for the West Humber, Etobicoke Creek, Fletchers Creek and Huttonville Creek subwatersheds;

- A conceptual water resource system and natural heritage system has been established with targets for enhancement and the establishment of linkages;
- In addition to stormwater management described above general groundwater management strategies have been presented to address potential groundwater quantity and quality impacts related to the subwatershed specific hydrogeologic sensitivities;
- Given the management issues related to the potential for strong upward hydraulic gradients, the high water and the associated dewatering a specific guidance document should be prepared to outline an investigative and management procedure;
- A recommended framework has been developed to implement monitoring and adaptive management planning; and,
- Guidance to implement the management recommendations through local level environmental studies.

2.5.2 Stream Morphology

Through the Scoped SWS, drainage features have been defined and identified as watercourses or HDFs at the desktop level through interpretation of topographic mapping, aerial imagery, available watercourse mapping, existing reporting, and Arc Hydro analysis to capture all potential HDFs. Field investigations were limited to roadside observations in an attempt to confirm feature presence/absence, and type. Detailed field studies are required to confirm desktop analyses and develop refined, specific management recommendations, and are anticipated to occur through Local Subwatershed Studies. As such, key findings and recommendations are preliminary:

- Erosion hazards associated with confined and unconfined watercourses were not entirely encompassed by the FSA take-out area. Confirmation of feature type and detailed field programs can be used to confirm or refine current mapping.
- 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.
- The stream power mapping provides an inventory of sensitive reaches within and immediately downstream of the FSA that should be prioritized and targeted for future field assessment and monitoring.
- 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 should be determined for sensitive, receiving watercourses in future studies to inform SWM quantity targets.
- Preliminary geomorphic constraint rankings for watercourses (high, medium, and low) have general management requirements. Low constraint features require confirmation of feature type (watercourse or HDF).
    - Integrated management recommendations for watercourses and HDFs will be advanced through the integration of study disciplines in Local Subwatershed Studies
- HDFs as identified are considered low constraint features in the context of the Scoped SWS.
- All HDFs require detailed, seasonal HDF assessments following CVC/TRCA Guidelines (2014) are required through future studies to determine appropriate feature-based management

recommendations. Higher constraint HDFs that are found to have a 'protection' or 'conservation' status are regulated within TRCA's jurisdiction.

2.5.3 Natural Heritage System

Key findings and recommendations to advance the implementation of the Natural Heritage System will be realized progressively through technical studies (local Subwatershed Studies, Master Environmental Servicing Plans/Environmental Implementation Reports, Functional Servicing Studies, and Environmental Impact Studies) that are conducted as complements to the respective planning studies (i.e. Secondary Plans, Tertiary Plans, and Draft Plans).

Key Findings from the Scoped SWS include:

- As the conceptual NHS is based on background data and aerial photo interpretation, field verification of feature characteristics and functions is required through future studies.
- The proposed NHS is comprised of features, linkages and enhancements to support a net gain outcome and achieve a 30% increase in natural cover within the NHS through enhancement. This enhancement target has been demonstrated as achievable, with much of the enhancement occurring within components of the NHS (unvegetated portions of valleylands, linkages) or on wholly or partially constrained lands (within the Provincial NHS, floodplains).
- Updates to the SABE will be required to reflect a recommended Take Out layer with appropriate allowances to facilitate the achievement of the recommended targets for the proposed NHS in conformity with requirements of the Growth Plan.
- Current understanding of the hydrological functions of features within the study area is based on regional/landscape scale models and will require updated based on higher-resolution information.
- Verification and/or validation of proposed NHS linkage and enhancement areas is required based on outcomes of site investigation results.
- The Scoped SWS provides rationale and direction for refinement through future stages of work to support the goals and targets set for the system.

The following outlines the key recommendations as they relate to the local Subwatershed Studies and other associated technical studies that will be undertaken to support future land use planning processes:

- Site investigations to confirm the characteristics and function of all key features, supporting features, and other features identified as part of the Sscoped Subwatershed Study (including documentation of features that exist, but were not identified during the Scoped Subwatershed Study)
- Site investigations to include, at a minimum, Ecological Land Classification, plant inventory, amphibian call surveys, breeding bird surveys, reptile surveys, and other site-specific surveys required to confirm feature and habitat significance.
- Verification of feature status based on site investigations, and refinement of Natural Heritage System where appropriate.
- Confirmation of buffer, linkage, and NHS key features and enhancement recommendations.
- Planning and consultation with the Region, Conservation Authorities, and/or the Province to confirm the appropriate overall benefit method if small/isolated features not included within the conceptual Natural Heritage System are candidates for removal and replication.

Appendix A

Surface Water

Appendix B

Ground Water

Appendix C

Stream Systems

Appendix D

Natural Heritage Systems