Attachment #1

Vaughan Humber Trail

Boyd Conservation Area to Steeles Avenue

September 2021

Feasibility Study

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VAUGHAN

Toronto and Region Conservation Authority

Prepared for:

City of Vaughan

Toronto and Region Conservation Authority

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Acronyms

ANSI - Areas of Natural and Scientific Interest

DFO – Department of Fisheries and Oceans

ELC – Environmental Land Classification

ESA – Environmentally Significant

MBCA – Migratory Birds Convention Act

MECP – Ministry of Environment and Climate

MHSTCI – Ministry of Heritage, Sport, Tourism and Cultural Industries

MTO – Ministry of Transportation

NWPA - Navigable Water Protection Act

OHA – Ontario Heritage Act

SARA – Species at Risk Act

SWH – Significant Wildlife Habitat

TRCA – Toronto and Region Conservation Authority

Executive Summary

In May of 2018, the Project Team led by Schollen & Company Inc. was retained by the City of Vaughan and co-partner the Toronto and Region Conservation Authority (TRCA), to assess landscape conditions and to identify potential trail alignments for the proposed Humber Trail between Boyd Conservation Area and Steeles Avenue West and to recommend a preferred alignment for this segment of trail. The Vaughan Humber Trail Feasibility Study is the first step in completing the gap in the Humber Trail system which extends northward through the William Granger Greenway to the Nashville Conservation Reserve and southward through the City of Toronto to Lake Ontario Waterfront.

The aim of the Study was to achieve a trail alignment that balances the current and future demand for recreational use within the Natural Heritage System of the Humber River Valley, ensuring the protection and enhancement of environmental features and functions. Moreover, the Study recognizes opportunities for trail connections with current and future multi-use trails and cycling facilities as identified in the TRCA Trail Strategy for the Greater Toronto Region (2019), City of Vaughan Pedestrian & Bicycle Master Plan (2020), Vaughan Official Plan (2010), and Woodbridge Centre Secondary Plan.

Commensurate with other municipal trail projects where TRCA is a key partner, the Project Team adopted the following 'systems' approach to facilitate the planning and development of the Humber Trail, placing importance on the complex interrelated ecological functions of the Natural Heritage System while optimizing the active transportation and experiential benefits that the larger trail system will afford:

- **Phase 1: Research, Inventory and Analysis -** site assessment and identification of opportunities and constraints, stakeholder, and agency consultation.

- **Phase 2: Alternative Designs, Preferred Design and Draft Master Plan -** development of preliminary alignment alternatives, cost-benefit analysis (feasibility) of varying options and refinement to establish a preferred trail alignment.

- **Phase 3: Final Feasibility Plan and Report -** development of a cost plan, Implementation Plan, priority projects for implementation, management and life cycle cost recommendations.

The Feasibility Study includes a high-level assessment of the cultural and natural features of the Humber River Valley corridor system. In order to determine trail options of "best fit" the Project Team, working with the various departments within the City of Vaughan and within the TRCA, first

gained a comprehensive understanding of the features of the Study Area and their respective environmental sensitivity through site investigation and analysis of site conditions. The protection and long-term sustainability of the Natural Heritage System was chief among considerations when reviewing potential alternative alignments for the Humber Trail, a key component of the Vaughan Super Trail.

To gain an understanding of the context of the Vaughan Super Trail concept as identified in the City of Vaughan's Pedestrian & Bicycle Master Plan 2020, the Project Team, engaged in the review of federal, provincial and municipal policies and regulations. The Team also reviewed background reports and technical investigations to gain a comprehensive understanding of the features of the Study Area and its respective environmental sensitivity. The type and quality of the habitats as well as significant wildlife species and vegetative communities along the River corridor are summarized in Section 4.0. The findings of this exercise provided a foundation that was supplemented by a series of site walks with the Project Team to better understand the range of potential issues and opportunities afforded by the site. The outcomes of the assessment were summarized and these laid the framework for developing and evaluating trail alignment options and associated costs, as well as informing recommendations to guide the long-term management of the trail within the natural environment. This exercise also provided direction to guide the phasing of implementation of the proposed preferred trail alignment.

Constraint Criteria

The identification of constraint criteria contributed to the development and evaluation of alternative trail alignments. In order to ensure a trail system that is well connected to surrounding neighbourhoods, along City streets and through open space lands along the Humber River Corridor, the following constraint criteria were considered:

- **Environmental Constraints** - Ensures the trail avoids 'highly' sensitive habitats and protects natural heritage features.
- **Natural Hazards** - A review of flood mapping and of river meander ensures avoidance of natural flood hazard.
- **Regulation and Landownership** - Ensures the trail prioritizes public land, avoids land acquisition and seeks to make connections to adjacent communities and proposed urban development. The analysis explored property ownership and land use and compared this information to the land required to develop a trail considering also the requirements as set out in various trail design guidelines.

- **Infrastructure** – An assessment of water management structures, utilities and creek crossings ensures that natural and man-made hazards are avoided while ensuring public safety.
    - **Access Routes** - A review of access routes and surrounding roadways ensures connectivity with the existing cycling routes and identification of important road crossings and underpasses.
    - **Underpasses** – Roadway bridges were evaluated for the potential to create in-channel underpasses that would maintain the trail in the corridor. Vehicular bridge structures were assessed for the ability to accommodate a trail underpass suitable for year-round pedestrian and bicycle passage excluding periods of Spring flooding. Conceptual engineering solutions for retrofitting the bridges to support underpasses and develop overcrossings are outside the scope of this Study.
    - **Cycling Routes** – A wide range of on-street routes as well as types of bicycle and pedestrian facilities were evaluated based upon the City of Vaughan Pedestrian & Bicycle Master Plan 2020.
- **Cost** –Trail routes were assessed based upon the relative cost of the option.

The range of criteria is discussed in detail in Sections 2.5 of the report and a summary of the evaluation of all trail options is documented in *Tables 3.1-3.5: Alignment Constraints Decision Making Matrix*.

Trail Development

In the trail development phase of the Study, various alignments for the trail were evaluated in consideration of the criteria, chief among them the avoidance of natural heritage features and hazards, to arrive at the most beneficial and cost-effective solution to suit the specific conditions and environmental sensitivities of the site. Base mapping, analysis and additional technical work were relied upon for the development of options. In some cases, due to the availability of public land or to make a key connection, certain trail segments encroached upon natural features or the flood zone. Environmental mitigation is required in these instances.

The evaluation process resulted in a detailed breakdown of the trail system into 5 component segments. Major arterial roads mark the division between the 5 segments which are organized from north to south and are identified as follows:

- Segment 1 – Pine Grove Road to Boyd Conservation Area
- Segment 2 – Thistlewood Avenue to Pine Grove Road
- Segment 3 – Highway 7 to Thistlewood Avenue

- Segment 4 – Highway 407 to Highway 7
- Segment 5 – Steeles Avenue West to Highway 407

Report Section 1.3 provides a detailed summary of the existing conditions for the area surrounding each segment of the Study.

Within each area, the trail segment is broken down further, characterized by changes in site conditions, specifically flood zones. The trail segments were most profoundly affected by the extent of the 2-year, 5-year and 100-year flood limits. This rationale was reinforced by consideration for construction logistics and cost as well as maintenance requirements which increase with vulnerability to flooding.

The outcome of the mapping and analysis tasks resulted in two sets of mapping. The first set (Figures 4, 8 through 11) depicts the outcome of trail alignment in relation to physical constraints, flood zones, land ownership and linkage opportunities and the second (Figures 21 through 25) provides the relationship of the trails to 'moderate' and 'high' environmental constraints. Both forms of mapping were used to determine trail feasibility.

The Project Team identified areas where only one route was possible and others in which there were opportunities for multiple alternatives. The alternate configurations are identified on Figures 4, 8 through 11 and are supported by a range of typical trail types (Figures 32-36) suited to various conditions.

Cost Development Plan

The Feasibility Study sets out an assessment of cost for implementing the trail. This is provided in Section 9.0 of the report. The costs account for construction, additional studies, permitting and design, the so called "soft costs" of trail implementation which are discussed further in the Implementation Plan in Section 10. Costs associated with the operation, maintenance and life cycle serviceability of the trail are not factored into the cost, although a framework is laid out for development of an LCC analysis in Section 13.0 of the report. The LCC considers the replacement value of the trail over its serviceable life up to 100 years.

The key components considered in the development of construction costs included:

- Trail Type
- Terrain/ gradient
- Requirement for retaining walls, guardrails or fences

- Trail Length and width
- Requirement for pedestrian bridges and boardwalks
- Temporary or permanent alternate secondary on-road routes
- Access points and amenities i.e. benches and garbage bins
- Environmental mitigation techniques and/ or landscape restoration
- Signage

Municipal trail projects were utilized as a basis of comparison to develop the estimated construction costs of various trail types. The research included a comparison of construction costs as well as implementation costs. The unit rates utilized in developing the costs are indicated in *Table 4: Cost Development - Unit Rates*.

Section 9.0 in the report identifies the costs for various trail options in each of the 5 trail segments in the Feasibility Study. The costs include a 40% mark up for site preparation, design and tendering and construction contingency. The costs are summarized as follows:

• Segment 1	- Fixed	$669,060	930 m
	- Option 1	$1,909,033	1377 m
	- Option 2	$535,710	485 m
	- Option 3	$1,448,048	516 m
• Segment 2 -	- Option 1	$2,990,015	1510 m
	- Option 2	$4,457,817	1105 m
• Segment 3	- Fixed	$881,965	770 m
	- Option 1	$1,485,330	387 m
	- Option 2	$448,945	505 m
	- Option 3	$266,700	300 m
	- Option 4	$284,480	320 m
• Segment 4	- Fixed	$1,471,540	825 m
	- Option 1	$1,749,265	1002 m
	- Option 2	$2,361,590	1495 m
	- Option 3	$2,408,735	798 m
	- Option 4	$823,200	832 m
• Segment 5	- Fixed	$362,355	345 m
	- Option 1	$2,322,145	1937 m
	- Option 2	$1,601,005	903 m

The costs vary by trail type (refer to Section 11.4) and are incumbent on construction access, depth of subbase and surfacing. For example, a trail constructed within the 2-year flood zone can expect seasonally wet soil conditions and additional costs to address this site condition as compared to a trail constructed outside of the flood plain. The construction of a boardwalk supported by a network of helical piles can be expected to cost two times or more than that of a traditional granular trail especially if it is designed to enable emergency and maintenance access. The cost to install pedestrian bridges assumed modularity enabling smaller equipment for installation thereby decreasing the potential footprint of disturbance.

Guidelines for Trail Development

The Feasibility Study includes a suite of Guidelines for Trail Development. In recognition that trail alignment is a balance between the environmental, practical, technical and experiential objectives of the trail, a suite of Guidelines was developed based upon the principles of natural feature protection and avoidance of hazards as were utilized in developing the framework for assessing alignment. Five key recommendations for trail design development were identified:

- **Flood Management** – The trail avoids flood hazards, adjusting the construction of the trail where this is not possible, mitigating with the emphasis of ensuring public safety.
- **Geotechnical Slope Stability** – The trail avoids steep slopes and mitigates against erosion.
- **Natural Hazards** – The trail avoids natural hazards to safeguard the public and minimize disturbance to the environment achieving this through setbacks and protecting sensitive features through restoration and buffers.
- **Natural and Cultural Heritage Features** – High quality habitats should be protected from undue deterioration from human use. Trail development should avoid Species at Risk habitat, swamps and wetlands, avoid existing trees and limit river crossings.
- **Landownership, Easements and Lease Agreements** - Reduce cost, and simplify the maintenance regime for the trail corridor by avoiding private land access where possible.

Life Cycle Cost Analysis (LCC)

The LCC is intended to provide capital guidance to municipalities related to the long-term operation and maintenance of the trail system with the objective of estimating the anticipated costs to carry out these activities based on a defined level of service determined by the City. The LCC prescribes the frequency for inspections as well as the anticipated costs to implement repairs or replace components of the trail system. The LCC also provides guidance to municipalities with respect to permits, regulatory bodies and governing by-laws that will require consideration and approval from various stakeholders during the planning and design processes for the trail.

An outline for a LCC is included in the Feasibility Study and identifies a proposed level of service for each trail type and considers the logistics of construction, the anticipated levels of use and environmental context. The recommended activities laid out in the plan include scheduled inspections, cleaning, remediation, temporary trail closures during maintenance activities, decommissioning and issue-response tracking. Maintenance activities aimed at maintaining the

trail surface and clearway in a safe operational manner are recommended to be implemented on a priority basis. The availability of capital and operating funding, availability of personnel resources, environmental considerations and regulations must also be assessed by the City when preparing a detailed LCC.

Phasing and Implementation Plan

The Feasibility Study is intended as a foundational plan to support an anticipated Municipal Class Environmental Assessment (EA) screening process to determine the next steps towards implementation of the trail. The Feasibility Study includes a Phasing Plan that is meant to provide high level guidance to the City of Vaughan in planning capital budgets going forward into the EA process.

The Plan identifies Phase 1 priority trail projects in relatively constraint free areas of the Study that could be implemented quickly providing meaningful trail enhancements within local contexts. Identification of Phase 1 priority sites was based upon the following criteria:

- Lacks requirement for additional studies
- Shorter length of trail segment considered
- Does not require approvals
- Accessibility to construct the trail
- Lower overall cost to construct and maintain the trail

The prioritization of future capital projects (phase 2) is incumbent on funding and permitting. Where there are multiple optional trail alignments proposed, it is anticipated that the EA process will result in a future in-depth evaluation of each alternative to further verify each option's potential to make key connections, protect natural heritage features and ensure public safety.

The Implementation Plan provides a summary of the landowners and stakeholders involved and their responsibilities as well as the coordination that would be required to implement various trail alignment options. The Plan sets out a catalogue of trail types as well as recommendations for trail designs that have been cross-referenced with City of Vaughan trail standards and details.

A key recommendation of the Implementation Plan is for a comprehensive signage strategy to be developed with the overall trail network that will provide an identity for the trail, help denote

hierarchical access points, reinforce community character and provide wayfinding. An interim signage and wayfinding solution should be developed and integrated with the phased implementation of individual trail segments.

1.0 Introduction

The Humber Trail, as part of the future Vaughan Super Trail, will be an important recreational amenity that will benefit the residents of Vaughan and that of neighbouring communities. The trail will establish an important link to the regional trail network and will afford the potential for users to enjoy and experience the unique natural and cultural heritage attributes within the Humber River watershed.

The Feasibility Study builds upon the City of Vaughan Pedestrian & Bicycle Master Plan 2020 and Woodbridge Centre Secondary Plan "to build support for walking, rolling and biking in the City." Completion of this 7 km section of trail is a key component in delivering the City of Vaughan's vision for a "Vaughan Super Trail", a bold 100 km city-wide loop trail contributing to the enhancement of quality of life of residents and visitors and a variety of nature-based experiences.

The Feasibility Study process reinforces this vision for the trail while setting clear objectives with respect to level of service, safety, accessibility, protection of natural and cultural heritage features and environmental restoration. The trail system is envisioned as a fully multi-modal trail network that will be accessible to all residents of the GTA as well as visitors from afar. Ultimately trail connectivity supports recreation, active transportation, local tourism, well-being and outdoor education.

Commensurate with other municipal trail projects where Toronto and Region Conservation Authority (TRCA) is a key partner, the Project Team had regard for the following considerations to develop the framework that guided the trail alignment and design:

- The majority of the Study Area is situated within the Regulated floodplain and is subject to periodic flooding;
- The need for safe practical local neighbourhood linkages;
- Consideration for various private landowners in which the trail may be located within;
- Physical and ecological factors, soil and groundwater conditions, slope stability, impacts of dynamic river processes (i.e., migration, erosion and widening) and flood plain;
- Recognition of the Natural Heritage resources and ecological attributes of the site; the sensitive nature of valleylands associated with the Humber River, areas of groundwater discharge and sensitive vegetation, habitats and soils;
- Significant vegetation, habitat and wildlife corridors and requirements for mitigation measures to protect significant vegetation/ recommend restoration;
- Accessibility and design consideration to ensure public safety, such as Crime Prevention Through Environmental Design (CPTED) principles;

- Demarcation of a multi-use trail width and surface that limits disturbance and integrates seamlessly within the valleyland setting;
- accommodates safe pedestrian and cyclist use and access;
- Seepage areas and drainage courses;
- Steep slopes including recommendations for further study and/ or options for bio-stabilization techniques to enhance long term stability; and,
- Existing policies and regulations.

In addition, to the practical alignment, linkage opportunities and design, a number of additional considerations informed trail alignment options including opportunities to:

- Build local stewardship
- Conserve, protect, regenerate and celebrate the natural, historical and cultural heritage values
- Promote nature-based recreation and education
- Utilize flexible management approaches
- Ensure net ecological and social benefits
- Manage public safety
- Mitigate and adapt to climate change

1.1 Purpose of the Study

The Study is the first step for the City of Vaughan, in partnership with TRCA, in the planning, design and construction of a multi-use trail between Boyd Conservation Area and Steeles Avenue West.

The purpose of this Study is to determine at a high-level, the feasibility of alternate trail routes through the natural heritage and open space system of the Humber River Valley corridor. Due to the size and scale of the proposed trail network, its estimated cost and the complexity of the planning environment with respect to land ownership, policies and regulations, etc., it is anticipated that a Municipal Class Environmental Assessment Schedule A+ process will be required in accordance with the Ontario Environmental Assessment Act, which states the following:

> *The purpose of Schedule A+ is to ensure some type of public notification for certain projects that are pre-approved under the Municipal Class EA. Schedule A+ activities may have been previously approved by a municipal council through annual budgets or specific mandates.*

The Feasibility Study will play an important foundational role in laying the groundwork for the EA which is the next important step in the design refinement and consultation process.

Beyond the EA process, it is anticipated that alternative trail segments identified in this Feasibility Study will further require the preparation of an Environmental Impact Statement (EIS) in order to facilitate detailed design and the construction of the trail.

The intent of this Feasibility Study is to identify issues and opportunities that will guide trail alignment options, and evaluate each option against a set of defined criteria. At this stage in the process, the optional trail alignments are conceptual and will be refined through the EA process, subsequent analysis, planning and detailed design.

The Feasibility Study represents an opportunity to responsibly plan, budget and build awareness and support for the Vaughan Super Trail. The product of the Feasibility Study is a number of "fixed alignments" and "optional alignments" for the Humber Trail. In some areas, site constraints posed limitations on the number of available options and sometimes only one 'fixed' option is possible. In other areas multiple options were identified with interim or temporary solutions and evaluated against the defined criteria.

Although each alignment was developed with careful consideration of the impacts and strives to avoid features where possible, it is anticipated that habitat encroachment and impacts will occur in some cases and that compensation will be required. A 'restoration/ compensation benefit package' will be required to offset the potential loss of habitat. This compensation strategy will form an important part of the next stage of trail development beyond this Feasibility Study.

The rationale for the municipality to develop the proposed trail is for the trail itself to act as a tool to mitigate anticipated future environmental impacts by affording users a defined route to accommodate recreational pursuits and ensure public safety. In this regard, the larger landscape context within which the trail is planned, as well as the potential linkages to surrounding urban communities are important to ensure a fully connected and accessible system.

The process of analysis, evaluation and preliminary design of the various conceptual trail alignments and Preferred Alignment included the development of a Phasing Plan to guide implementation and manage use over time. The management strategies that accompany the Implementation Plan set out the protection, restoration and future maintenance requirements for the trail. These recommendations are found in Section 11.0 of the report.

1.2 Study Area

The Study Area encompasses over 9.8 km of the Humber River and an additional 5.2 km of the East Humber River as well as the surrounding valley corridor as it meanders through the centre of Woodbridge.

The Study Area encompasses 1,060 ha spanning Boyd Conservation Area in the north to Steeles Avenue West in the south and is bounded by Pine Valley Road/ Islington Avenue on the east and Islington Avenue / Gamble Street/ Woodbridge Avenue/ Martin Grove Road to the west. As illustrated in Figure 1 below, the Study Area encompasses the East Humber River watershed as well as that of the Lower Humber River. The Lower Humber watershed extends south and east of Martin Grove Road and Woodbridge Avenue.

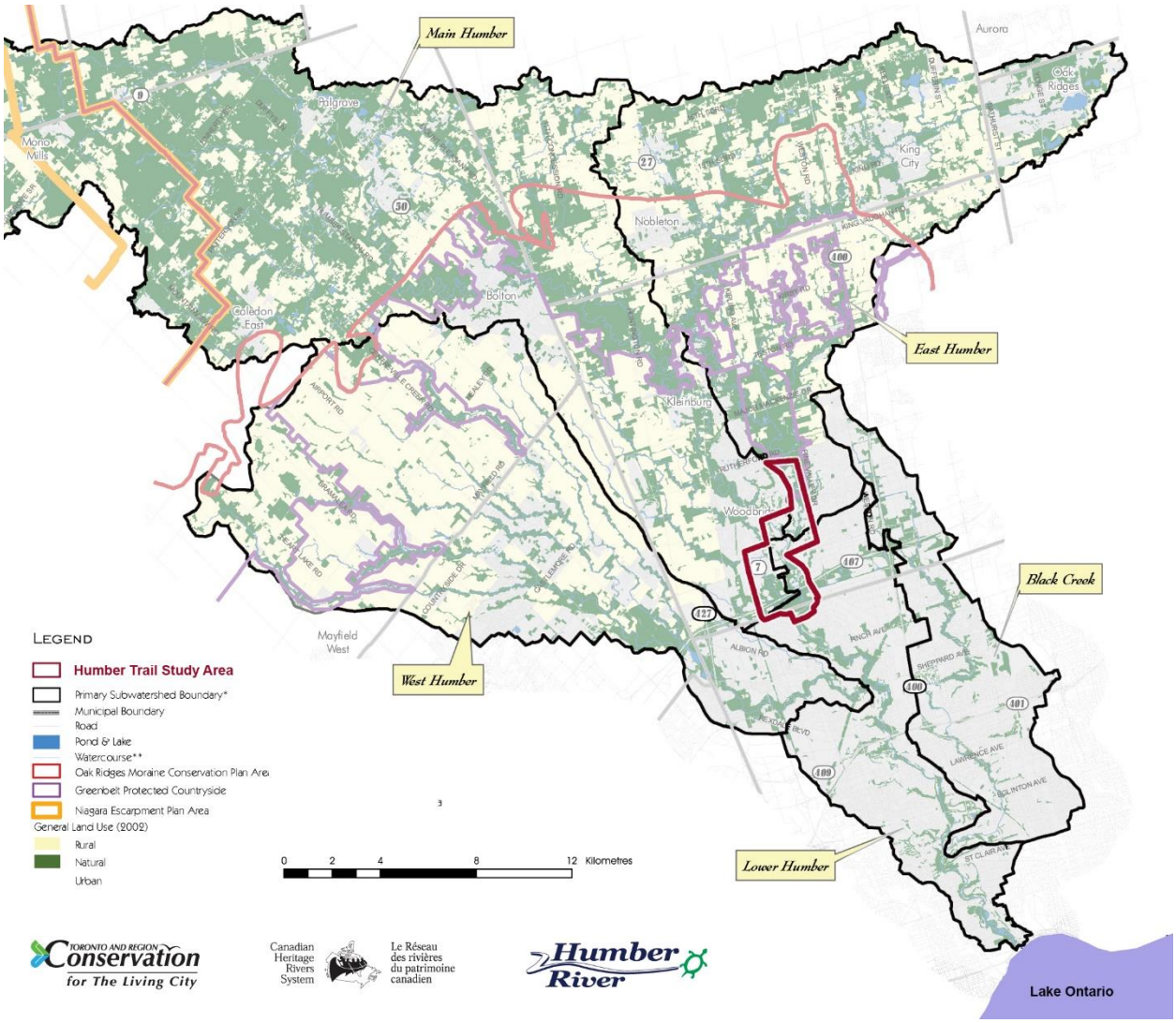


Figure 1: Watershed Map (TRCA)

For the purposes of establishing a feasible trail connection to the existing Humber Trail system within the City of Toronto, the Study Area includes a portion south of Steeles Avenue West which is located within the City of Toronto.

The majority of the properties within the Study Area are held in public ownership by either the Toronto and Region Conservation Authority (TRCA) or the City of Vaughan. Public road crossings that are owned by the Regional Municipality of York (York Region) or the Ontario Ministry of Transportation (MTO) cross the valley corridor in several places. Other public and private utilities that traverse the Study Area include a hydro-electric utility corridor, high-pressure gas pipeline and a railway (Refer Figure B.2, Appendix B).

A large parcel of publicly-held land that is situated south of Highway 7 is owned by Infrastructure Ontario (IO). At the time of writing this report, with exception to hydro corridor lands, discussions are underway between IO and the City related to the purchase of IO land.

All of the lands that are owned by the City of Vaughan within the Regulated flood plain are managed by the TRCA. TRCA manages land parcels that it owns within the Study Area. One land parcel, Thackeray Park, is owned by the TRCA but is managed by the City of Toronto Closed Landfill division.

A multitude of private lands extend into the valley corridor and these represent obstacles to trail continuity. In these instances, where routing the proposed trail to avoid the private lands is not feasible, land acquisition or lease agreements are options.

Several arterial roads, including Highway 407 (privately owned) include bridges that span over the Humber River. These bridges have suitable clear heights to accommodate a trail beneath. Further investigation and discussions with applicable owners will be required to confirm the requirements for design of the underpasses.

1.3 Study Area Characterization, Opportunities & Constraints

The landscape of the Humber River Valley corridor between Boyd Conservation Area and Steeles Avenue West varies and includes wide, flat expanses of flood plain in the south, and narrow sections in the north with steep valley slopes that are prone to potential erosion and slope stability issues. The landscape comprises open meadowlands in the south with tightly meandering river bends to forested sections north of Woodbridge Avenue. North of this juncture at Boyd Conservation Area, the valley landscape becomes incised and narrow, with sections of the corridor held in private ownership. The Humber River corridor within the Boyd Conservation Area, inclusive of Doctors McLean District Park, is designated as Redside Dace habitat which is regulated by the MECP under the Endangered Species Act (ESA). As a result, a permit from the MECP may be required to facilitate the development of a trail within the ESA regulated areas to ensure the protection of the species and contributing habitat.

Some other prominent characteristics of the Study Area are summarized below:

Recreation:

- 6 parks constituting 25 ha of Open Space;
- 10% of total Open Space; and,
- Includes 8km existing trails.

Cultural Heritage:

- The Humber River is designated as a Heritage River and, the river has played an important part in defining Vaughan's civic identity;
- The river served as the foundation for the community of Woodbridge, which is a Conservation Heritage District;
- Although lands are no longer occupied by Indigenous people, they hold traditional land rights; and,
- The area encompasses areas of both medium and high archaeological potential.

Natural Heritage:

- The area is located at the northern limit of the Carolinian Forest Zone;
- The area includes contiguous natural areas with connections to 3 watersheds;
- The area encompasses 54 identified flora, fauna and locally rare species;
- The area supports 7 provincially rare species and numerous Species at Risk (SAR); and,
- The area serves as a major migratory corridor for birds and mammals.

Fisheries:

- The area encompasses 5.2 km of Redside Dace protected habitat (north of Woodbridge Avenue); and,
- One fish ladder is located within the Study Area.

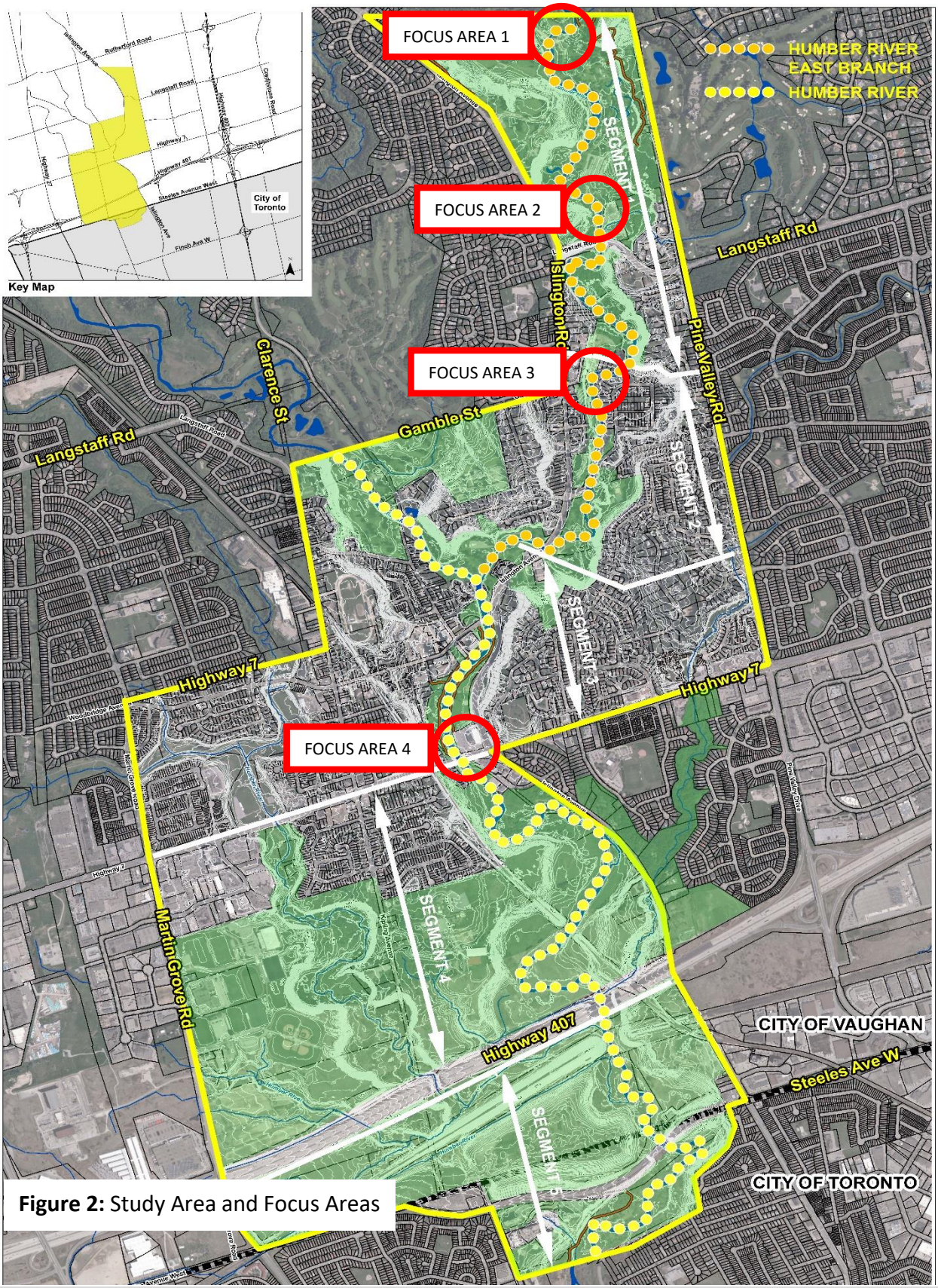


Figure 2: Study Area and Focus Areas

Regional Infrastructure:

A regional trunk sewer extends up the east side of the south extent of the Humber River, (refer Figure 3 below) from the Humber sewage pumping station near the boundary with the City of Toronto. The Pine Valley Village trunk sewer extends northward from Highway 407. Branching westward is the Rainbow Creek relief sanitary trunk sewer which crosses the river and runs parallel to the north side of Highway 407. An inactive sewer that runs parallel to the south side of Highway 407 is proposed to be abandoned in 2019 to make way for the future Transitway corridor.

York Region is planning to undertake an upgrade to the sanitary sewer pipes with an expansion project for the pumping station off Steeles Avenue. While this York Region project starts at Steeles and only goes to Highway 7, before turning west towards Highway 27, this potential work over the next 5 to 8 years creates an opportunity whereby potential construction access could be utilized as the base for the future trail. Any future trail alignments, south of Highway 7, should take note of utility or infrastructure improvement projects that may be considered by York Region or other Agencies in order to benefit from “scales of economy” and the restoration benefits of each potential project. This way, potential construction access routes can be utilized as the base for future recreational trail alignments to minimize the impacts of trail construction and assist with overall project restoration benefits within the Humber Valley System.

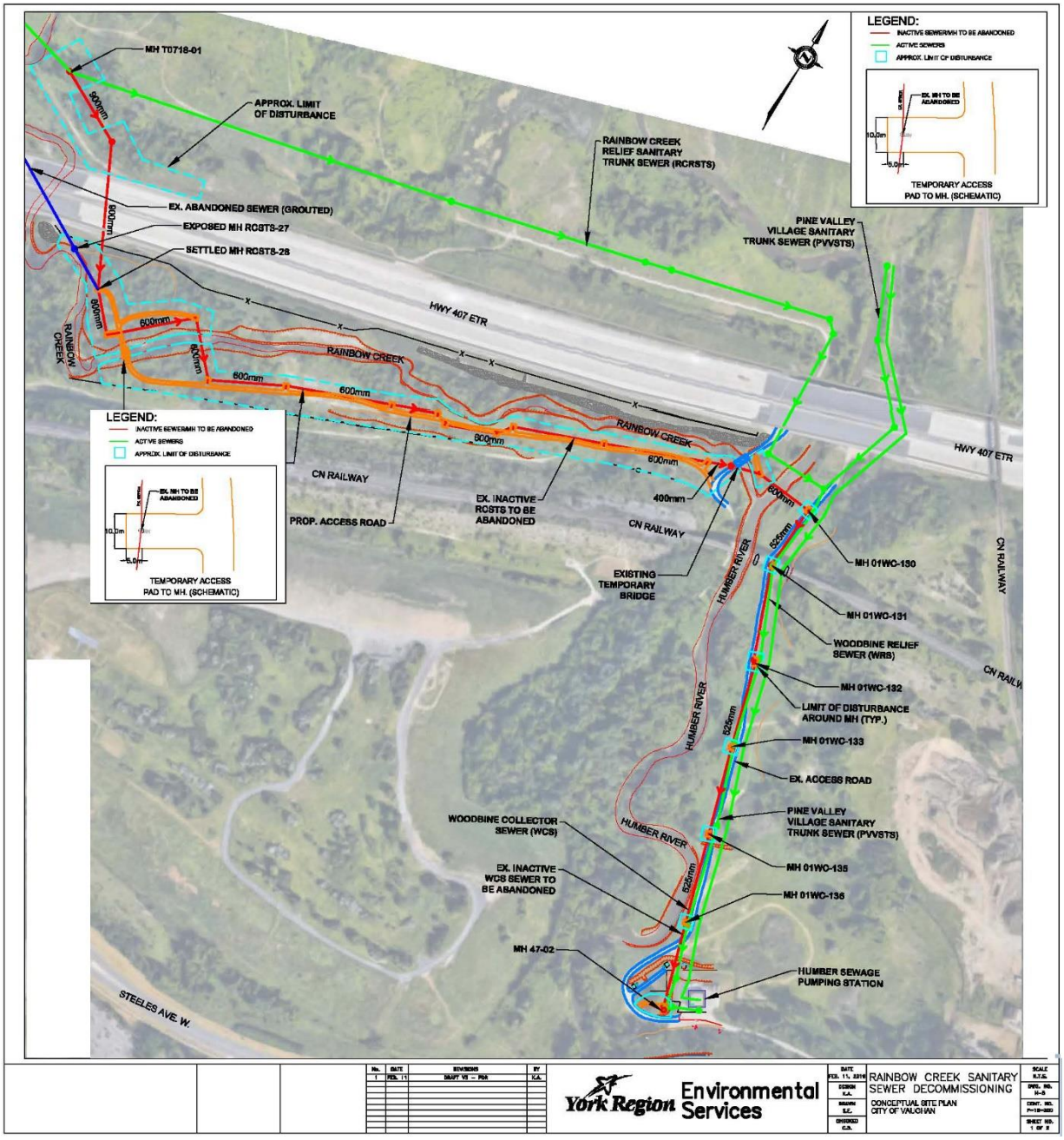


Figure 3: Regional Trunk and Local Sewer System

A number of public parks are located within the valley corridor. These represent opportunities to be positioned as destination points along the proposed trail, and provide additional opportunities for shared amenities to serve trail users, such as public washroom facilities. Since these areas are less sensitive from an ecological perspective, they offer more flexibility to accommodate a trail with less permitting constraints. Refer Appendix B, Figure B.1: 'Landownership Map' for the

relationship of lands in public and private ownership to alignment of the proposed trail system. This figure also identifies the location of public parks in order to illustrate them as potential nodes in proximity to the Humber Trail.

In order to explore the opportunities that exist in specific areas of the overall Study Area, the 7 km Humber River Valley corridor was divided into five trail segment sites as illustrated on Figure 2. A description of each segment is provided below.

In addition to the five trail segments, the Project Team reviewed specific areas of the Study Area that presented difficult challenges to trail routing. These 'Focus Areas' are illustrated on Figure 2. The challenges ranged from obstacles, such as infrastructure crossings which will require easements, to pinch points where privately-owned lands constrain trail development, requiring acquisition or easement. Other challenges included areas of environmental and/ or cultural significance requiring protection, to areas of severe erosion and/or bank destabilization.

The four 'Focus Areas' illustrated on Figure 2 have been integrated into the description of the five segments below. Trail development in the challenge sites are complex due to site conditions, permitting requirements and/or the presence of significant environmental features. Therefore, the timing for implementation of the proposed trail within these areas is likely to take more time in comparison to the Phase 1 projects (identified in Section 10.0 of the report). It is therefore recommended that the City and its partners prioritize the process of detailed investigation, consultation and design to determine which optional alignment identified for these 'Focus Areas' is the most viable. High-level recommendations for trail development are provided for each of the segments of the proposed trail.

1.3.1 Segment 1

This segment of the Study Area is illustrated in Figure 4 and falls within the Occupied Redside Dace (RSD) habitat constraint. All of the options for this segment of trail will require permits under the ESA from MECP. The area north of Langstaff Road is designated as Greenbelt in the Vaughan Official Plan 2010 (see Schedule 4, VOP 2010) and subject to the policies governing protection. Routing a trail through this section will also require consideration for the policies within the Islington Avenue Corridor Study (see Schedule 1 of Woodbridge Centre Secondary Plan).

The north portion of the Study Area which includes the Boyd Conservation Area, contains an Environmentally Significant Area (ESA) comprising high quality forest, as well as, open manicured picnic areas (see Appendix A, Photo 27, Figure A-1.1) and a large granular parking lot (see Appendix A, Photo 19-23, Figure A-1.1). Disturbance to this area is proposed to be avoided by

routing the trail along an underutilized existing granular maintenance road. This road is in good condition and presents a relatively low-cost opportunity for adaptation to trail use.

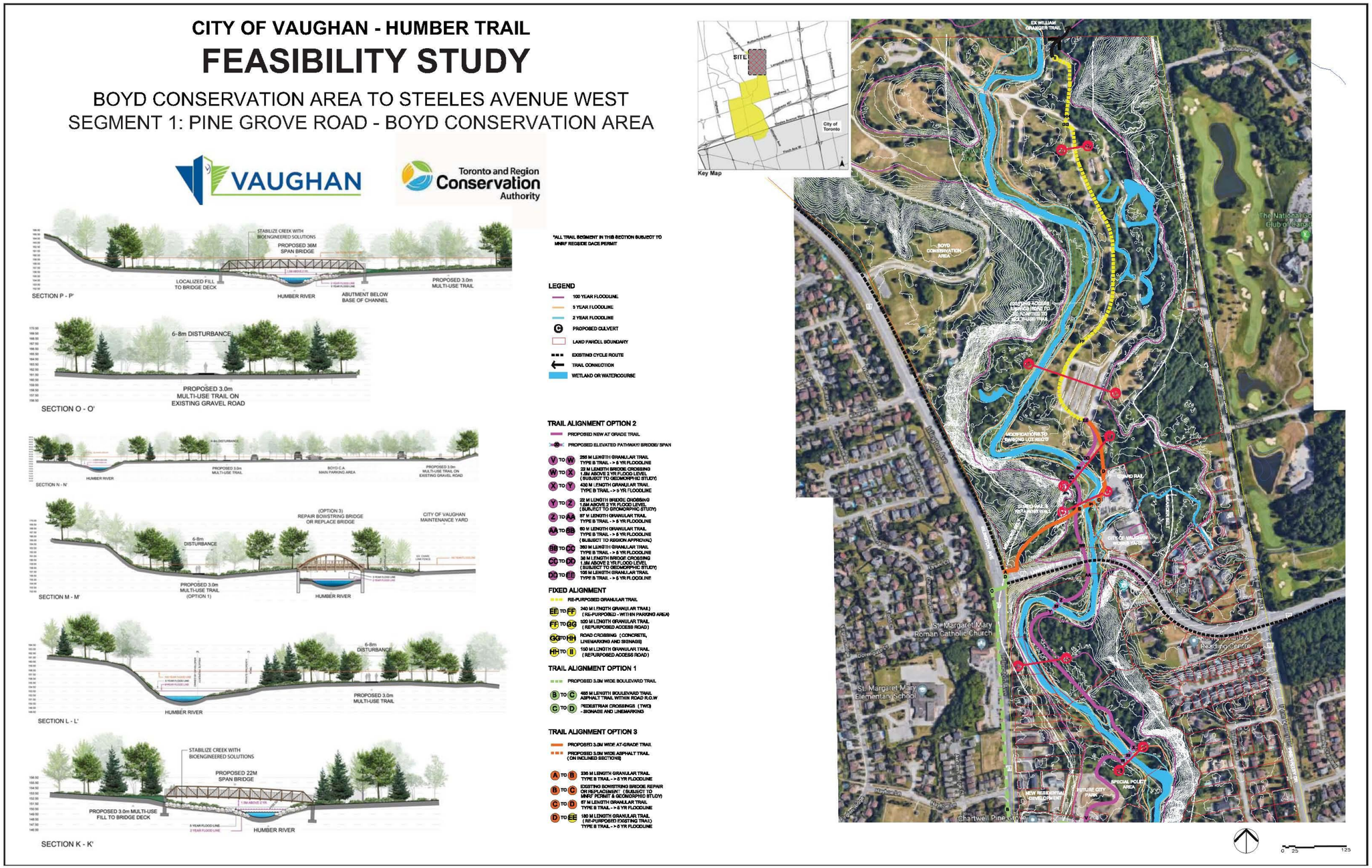


Figure 4 – Segment 1: Pine Grove Road – Boyd Conservation Area

The existing access road would require some minor repair work and will need to be topped up with granular surface material in order for it to be adapted for public trail use. (Refer Appendix A, Photos 1-8, Figure A-1.1). TRCA has also identified an opportunity for riparian enhancements along the east side of the Humber River (refer Appendix B, Figure B.4).

Within this segment of the proposed trail, an existing structure could be repurposed for future use (see Appendix A, Photo 9, Figure A-1.1). Routing the trail along the existing path would provide an additional opportunity to utilize the existing washroom as illustrated in Appendix A, Photo 12, Figure A-1.1.

The confluence of the William Granger Trail and the Humber River Trail represents the opportunity to link two important active transportation facilities. The vehicular turnaround area depicted in the photos could provide a gateway to both the Humber Trail and William Granger trail systems. However, recent storm activity has led to some bank failure (seen in the photo to the right) along the Humber River at this location and therefore this area has been identified as **Focus Area 1** on Figure 2. Remedial work on the bank should be considered a priority and the extent of this work may impact the alignment of the proposed Humber Trail as well as warranting potential reconsideration of realignment of a section of the William Granger Greenway trail.

Another challenging site with respect to trail alignment is located north of Langstaff Road at the south end of the Boyd Conservation Area. An historical bowstring bridge that crosses the Humber River has fallen into disrepair and has been barricaded to public access due to safety concerns (Refer to Photos 38-40, Figure A-1.1, Appendix A). The bridge is located within the TRCA owned and managed Boyd Conservation Area lands and is not a City of Vaughan asset. The bridge designed by Charles Mattaini in the 1920s is considered to be one of a remaining few good examples of bowstring bridge construction within the Greater Toronto Area (Brennan, 2018). A preliminary engineering review conducted as part of this Study is included at Appendix C. This study presents and sets out potential options for removal or rehabilitation of the bridge. This particular site is complex and this is the rationale for identifying this site as **Focus Area 2** as illustrated on Figure 2. A summary of the issues and opportunities for consideration in the process of generating the trail plan in this area was considered:

Issues and Constraints

- Structural deterioration
- Closed due to safety concerns
- Unsuitable crossing location (at bend in river side)
- Redside Dace habitat
- Bridge has cultural heritage value

Opportunities

- New bridge in a new position
- Existing cleared path provides a route with limited new disturbance
- Restoration to improve stability of the river is possible
- Direct connection to open spaces and main parking lot

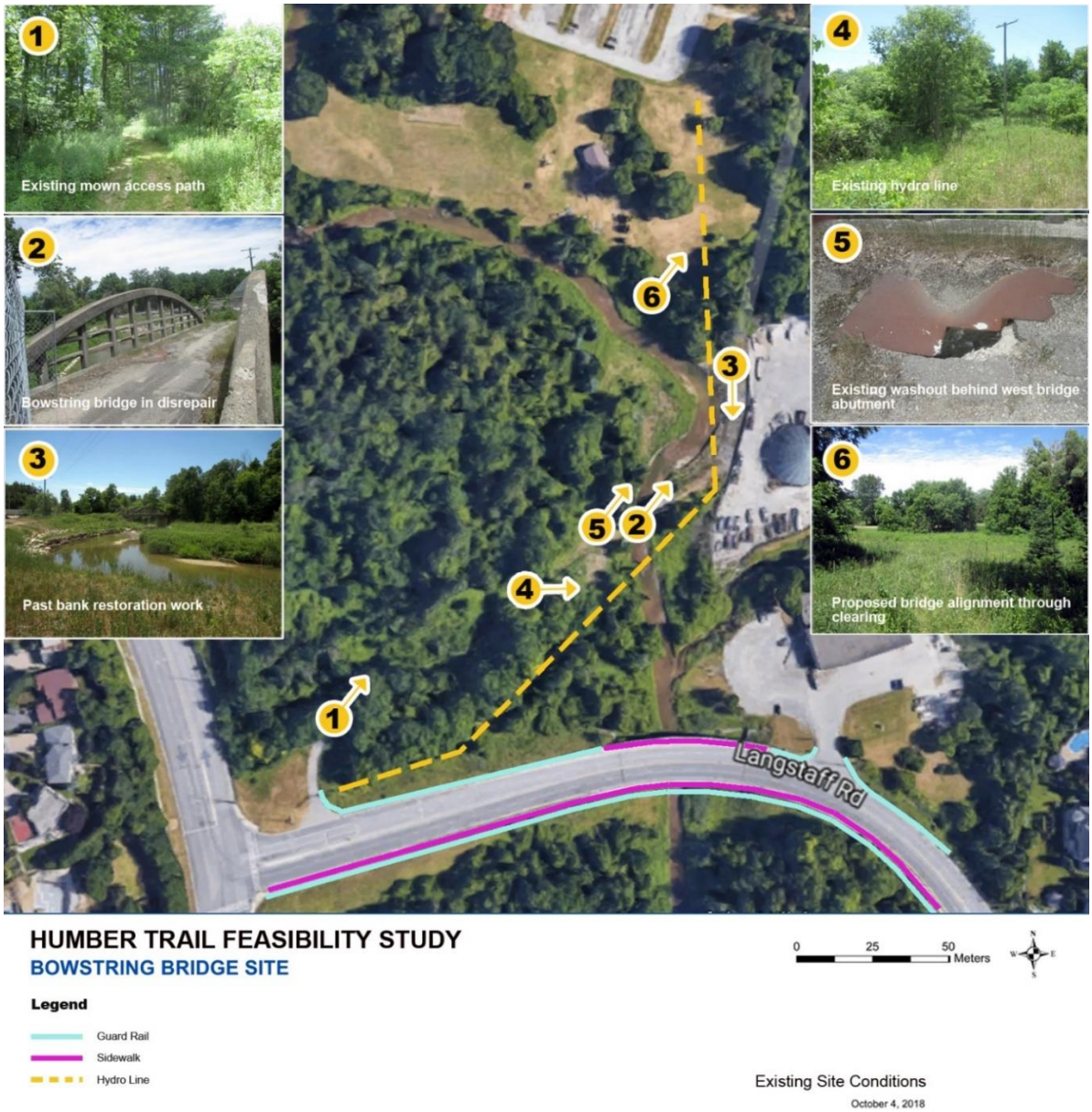


Figure 5: Focus Area 2 - Existing Conditions Plan Enlargement

Several potential opportunities were explored to re-use or close the bridge or to provide a new crossing at a different location. The following options are summarized in the investigation report as set out in Appendix C:

1. Retain the existing bowstring bridge as is and "do nothing".
2. Retain the existing bowstring bridge and perform emergency repairs, preventing public access to the bridge to safeguard the public.
3. Retain the existing bridge and perform enough repairs to enable the use of the structure as a platform from which to view the river.
4. Locate a new bridge upstream from the existing bowstring bridge and close it off from public access or remove the existing bridge.

An additional option discussed with the consulting geomorphologist on the Project Team, included developing a hybrid solution whereby the arches of the existing structure are retained and the deck and superstructure are replaced with a wider span bridge on new abutments set back from each river back to address long term erosion issues.

Each of these options will require further detailed engineering analysis and will need to be assessed in consideration of budget, timing and structural deterioration. Prior to proceeding with works related to the bridge, a Heritage Impact Assessment Report will be required to determine if the bridge retains cultural heritage value of interest under Regulation 9/06 of the *Ontario Heritage Act* based upon which to recommend an overall approach to a conservation strategy within the context of the proposed trail development options. Currently the bridge is included in the Vaughan Heritage Inventory, which is an inventory of resources of cultural heritage interest within the City of Vaughan. However, the bridge is not Listed under the Ontario Heritage Act registrar.

A preliminary structural engineering investigation conducted in 2008 determined two options for the bridge:

- Replacement with a new structure; or,
- Rehabilitation of the existing structure requiring careful demolition of the existing structure to minimize contamination of the river.

A further assessment conducted in 2018, as part of this Feasibility Study has determined that the bridge is in imminent need of repair to prevent undermining of the existing supports and that collapse is possible. Retaining the bridge in its current location, as it relates to the broader trail study, is desirable from the perspective of avoiding the requirement to attain costly and time-consuming permits with regulatory bodies. However, a replacement bridge may be required due

to the advanced state of deterioration in the current structure. A finding of the 2018 technical investigation confirmed that the bridge has continued to deteriorate since the 2008 investigation predominantly due to erosion. Therefore, the bridge in this location is no longer situated in an acceptable geometry across the river and it is recommended that a new bridge be constructed in a new location north from its current location (refer Figure 6). A bridge in the proposed new location provides several advantages including:

- A more direct connection to the picnic sites within the Conservation Area across the river;
- A favourable position away from the erosion-prone outer bend in the river, which is subject to greater erosion;
- Avoids potential conflict with the City Works Yard;
- Affords more space in which to adequately span the river to suit current regulations and best practices; and,
- Affords space in which to stabilize and restore the creek banks.

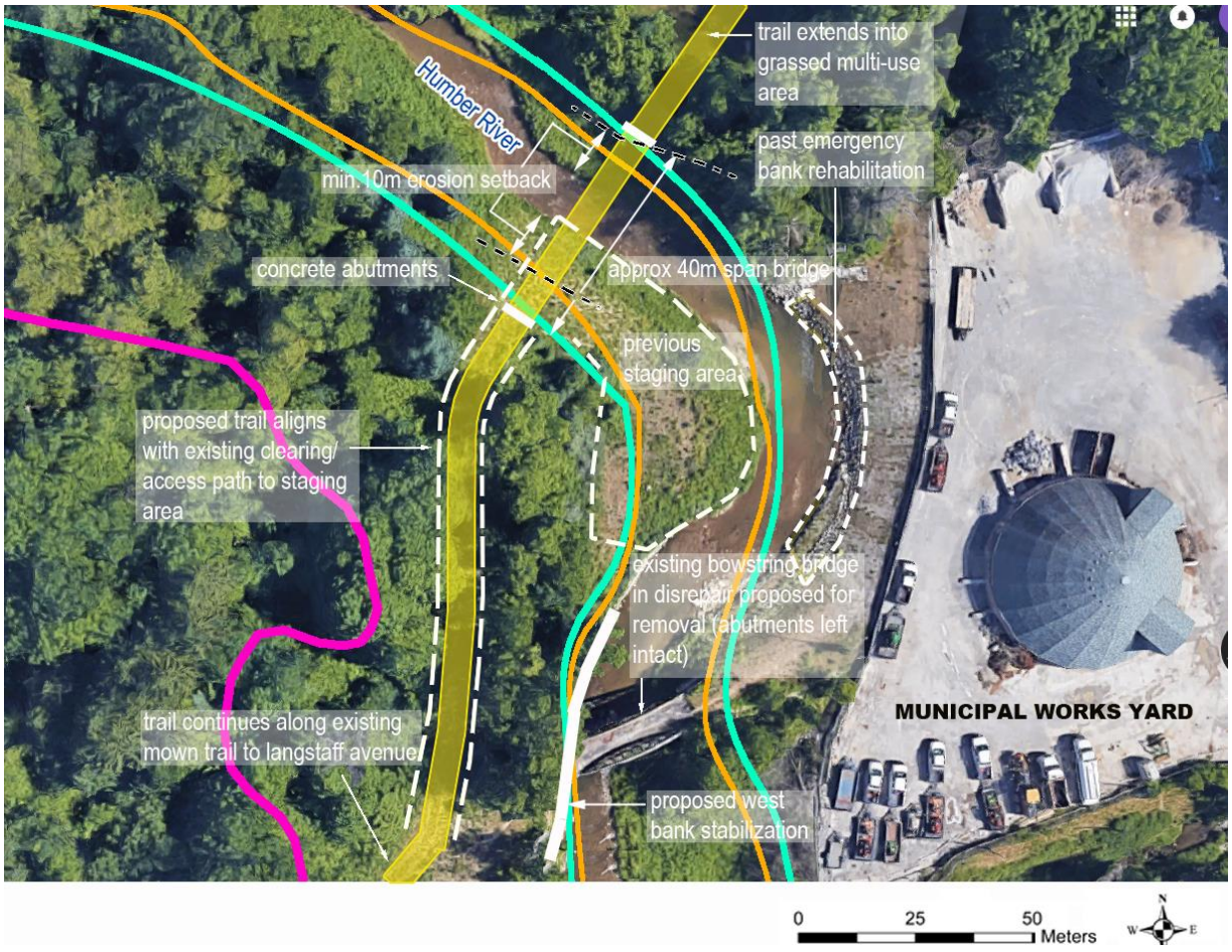


Figure 6: Focus Area 2 Concept Plan Enlargement

Proximate to the bowstring bridge site is an informal cleared trail that leads to the intersection at Langstaff Road and Islington Avenue. This intersection is considered to be a "Secondary Gateway" within the Woodbridge Centre Secondary Plan (Refer Schedule 8 of the Plan) and warrants enhancements to prioritize safe and convenient pedestrian and cyclist crossing, as well as signage to mark the Humber Trail access point. This site is also a confluence of established cycling routes along Langstaff Road and Islington Avenue (east side boulevard trail).

The segment south of Langstaff Road to Pine Grove Road encompasses significant natural heritage features including an area of interior habitat. The environmental constraints in this area are significant and trail development in this area could be a challenge therefore this site is identified as **Focus Area 3** as illustrated on Figure 2. The following challenges to trail development in this area include the following:

Issues and Constraints

- Trails traverse ESA
- Interior forest
- Bluff/ slope stabilization
- Pinch point on west side resulting in two river crossings

Opportunities

- Wide flood plain
- Connects new development to Boyd C.A.
- Boardwalk (to mitigate impact to sensitive features)
- Educational opportunities
- Experience of high-quality environment

The valley becomes more incised within this section of the valley with steep, eroded and impassible outer banks situated along the river. The regulated flood plain occupies much of the corridor in this section. On the east side of the river, a partially collapsed bluff dictates that the trail must hug the bank of the river, presenting an environmental constraint. Any proposed trail within the floodplain in this area would require special treatment such as a boardwalk and compensation planting to offset disturbance to the Natural Heritage System. This section of the river has been identified for riparian restoration (Refer to Appendix B, Figure B.4) by the TRCA.

This area was subject to a previous proposal for trail alignments in 2007 as indicated in Figure 7 below. However, due to the existing steep valley slope, a trail on the east side is not feasible. Private land ownership that extends to the edge of the river, approximately 300 m north of Pine Grove Road, makes a trail route on the west side challenging. Consequently, a river crossing is required along this stretch.

There is suitable clearance at Langstaff Road to accommodate a trail, however, the side slopes of the road embankment make this option unrealistic. Another approach is for an at-grade trail link with Langstaff Road at Islington Avenue with a trail access along the Right of Way to re-enter the

valley. This trail alignment option would require approval from the Region and additional detailing for implementation.

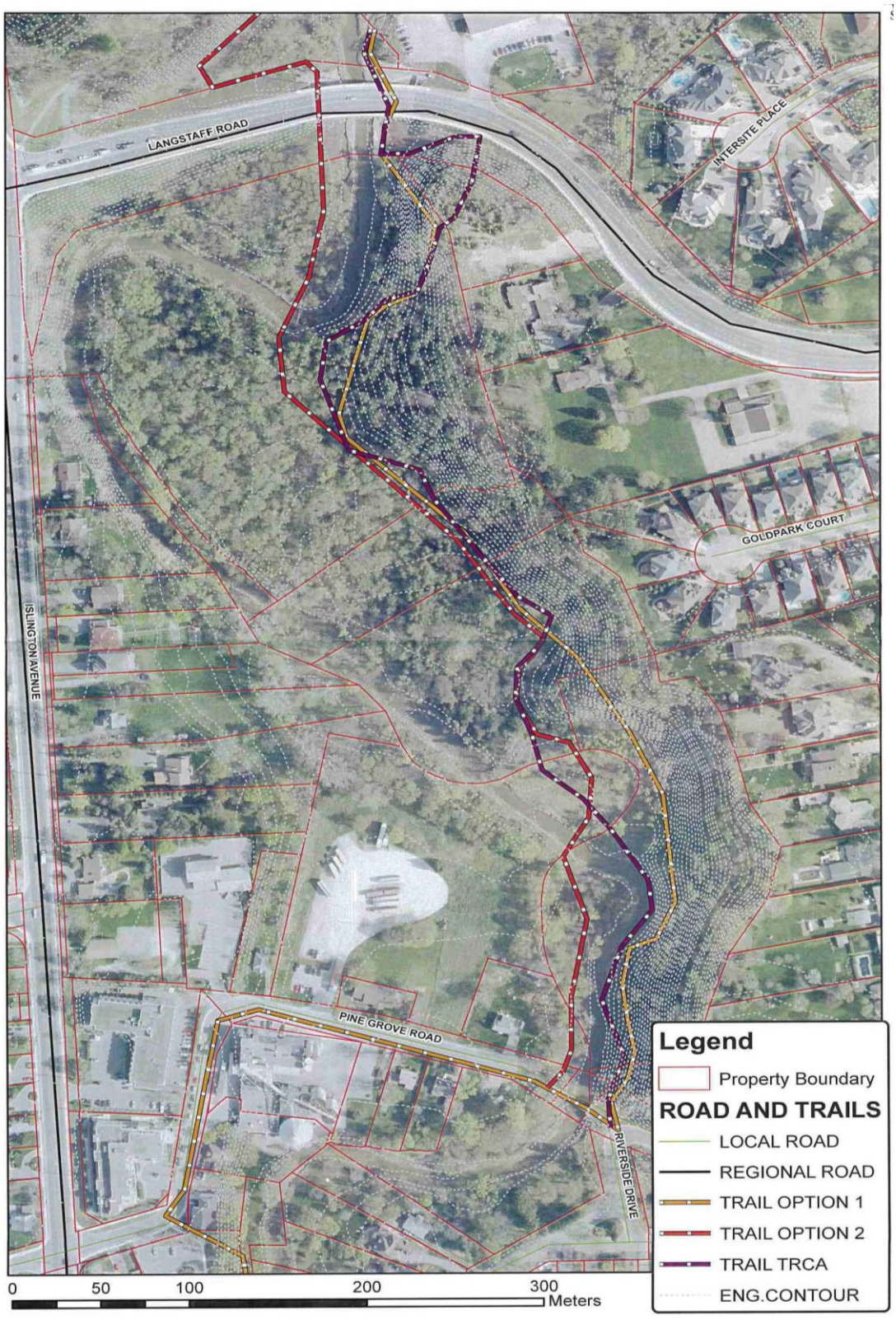


Figure 7: Previously Proposed Trail Alignments Langstaff Road and Pine Grove Road

1.3.2 Segment 2

This segment of the Study Area illustrated on Figure 8, includes regulated Redside Dace habitat. All options for trail routing may require an ESA from MECP. However, it is expected that where trail options are located within existing park areas or manicured lawns, a Letter of Advice from MECP would be likely necessary.

A piece of land that is denoted as a Special Policy Area (SPA) in the VOP (Refer to Schedule 8, VOP 2010) was conveyed to the City for the purposes of a neighbourhood park. This area is identified in Appendix A (Photos 2 & 7, Figure A-2.1). The park area which is located on the west side of the Humber River was under construction in 2018. The open space offers an area in which to potentially route the trail northward and southward, parallel to the river. This park could become a destination point along the trail.

Southward from Pine Grove Road there are limited opportunities to accommodate a trail since the valley narrows (as seen in Appendix A, Photos 1 & 3, Figure A-2.1). The land on the west side of the river is not within public ownership. The land comprises an old mill race which may have heritage value. Although the land could be acquired or leased, prior to proceeding with trail planning, a cultural heritage assessment should be completed on the mill race to determine if there is heritage value in the feature and if so, to seek recommendations on how to protect it. Furthermore, the mill race area will likely trigger a Phase 2 Archeological Assessment.

The TRCA owns a thin swath of land on the east side valley slope, however, due to the presence of significant habitat, environmental disturbance to this feature should be avoided.

Routing the trail through the valley will require property acquisition and result in potential impacts to the Natural Heritage System in this area. A staircase would also be required to provide access to Islington Avenue from the trail. To avoid this, a boulevard path within the Islington Avenue right-of-way provides an alternative through this stretch subject to approval from York Region (Refer to Appendix A, Photos 9-11, Figure A-2.1). If approved the boulevard trail could continue southward from Langstaff Road (Option 3). The feasibility for this option would require further study, especially the connection of this trail to the overall active transportation network within the boulevard, which should be reviewed and considered. For consistency, it is proposed that the design match the existing in-boulevard multi-use pathway extending north to Arista Gate from Langstaff Road on the east side of Islington Avenue.

An alternate on-road route that would follow Pine Grove Road (Refer to Photos 4 & 8) is an option to provide either a temporary or permanent access to the new neighbourhood park noted above. There may also be an opportunity for a future connection eastward from Pine Grove Road through

an open lot to Brougham Drive to serve as a connection to exiting neighbourhood trails within the Chancellor Community. The link is illustrated on Figure 8.

The proposed on-road route along Pine Grove Road would require line marking to facilitate safe pedestrian and cyclist use. The intersection of Pine Grove Road and Islington Avenue would also require enhanced line marking. This intersection is considered a “pedestrian priority” by the Woodbridge Centre Secondary Plan (Refer to Schedule 8 of the Plan). It should be noted that intersection improvements wherever identified in the Study as an opportunity, will require detailed review for appropriate crossing treatments and to ensure conformity with municipal standards and compliance with the Accessibility for Ontarians with Disability Act (AODA). In particular, the feasibility of converting crosswalks to ‘cross-rides’ needs to be considered at each location due to the multi-usability of the proposed Humber Trail.

Towards Willis Road on the west side of the river, there is an SPA that is vulnerable to flooding. While still held within private ownership, there may be an opportunity to acquire a narrow corridor of land within the floodplain, behind the existing building complex in order to implement this segment of the proposed trail. The landscape condition is depicted in Appendix A (Photos 12 & 13, Figure A-2.1). The presence of an old mill race would require a heritage assessment to determine heritage value. Some erosion from flooding is also present in this area and would need to be addressed with the design for the trail. Implementation of this option would be subject to negotiation and cost analysis. The estimated cost of land acquisition is not included in this Feasibility Study.

South of Willis Road there is a manicured parcel of TRCA-owned land located on the east side of Islington Avenue. The alignment of a trail in this location would need to factor in a crossing of the existing tributary of the Humber River or would need to consider a trail across the existing vehicular bridge. There may be a future opportunity to create a trail link that connects to Maxey Park in the long-term, if a trail is planned on this side of the river. This may be achieved from within the park and its existing walkway system.

Doctors McLean District Park is land owned by the TRCA under management agreement with the City of Vaughan. The park represents an opportunity in which to route a trail that takes advantage of existing open space resulting in two options in which to route the trail from Islington Avenue. Routing the trail on the west side of the river would enable a trail connection westward along the main branch of the Humber River towards Clarence Street. However, with this option a bridge is required to facilitate access to the east side of the river and to Nort Johnston Park. The east side provides adequate space to locate a 3.0 m wide trail as opposed to the west side, which is

narrower. The east side of the river is therefore the preferred side within the south section of the park to route a trail (Refer to Segment 3).

The land on both sides of the river at the north end of Doctors McLean District Park are owned by the TRCA and managed by the City of Vaughan under an agreement with the TRCA. On the east side of the river, the trail alignment coincides with that of the existing Riverwalk Trail further south. The vulnerability of the land to flooding on the east side of the river, presents a constraint to trail development (Refer to Special Policy Areas Schedule 8 in VOP 2010). However, flood mitigation can be addressed through detailed trail design.

It should be noted that the City is investigating opportunities to establish a formal trail entrance from Islington Avenue as part of Phase 2 of the Riverwalk Trail. Riparian habitat restoration opportunities have also been identified by the TRCA within this stretch of the river and, therefore, there is an opportunity to coordinate trail implementation with the habitat restoration efforts in order to achieve an overall environmental benefit.

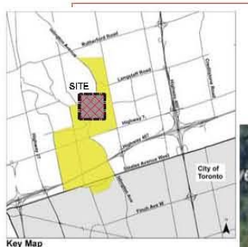
CITY OF VAUGHAN - HUMBER TRAIL

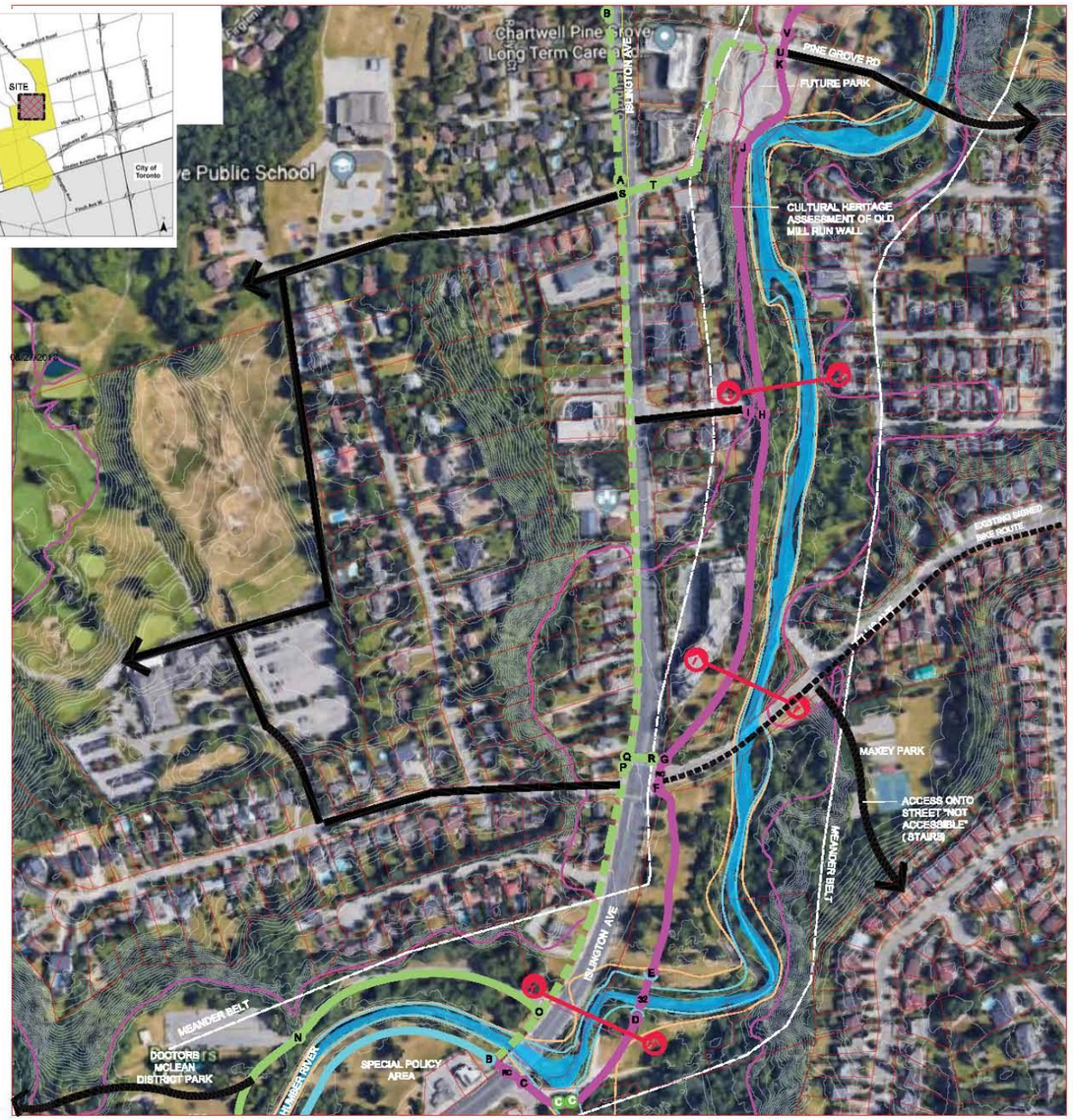
FEASIBILITY STUDY

BOYD CONSERVATION AREA TO STEELES AVENUE WEST
SEGMENT 2: THISTLEWOOD AVENUE - PINE GROVE ROAD

VAUGHAN

Toronto and Region Conservation Authority





TRAIL ALIGNMENT OPTION 1

- PROPOSED 3.0M AT GRADE TRAIL
- PROPOSED 3.0M BOULEVARD TRAIL (R.O.W)
- PROPOSED LINEMARKED TRAIL (ON ROAD)
- N TO O — 260 M LENGTH ASPHALT TRAIL TYPE B TRAIL -> 5 YR FLOODLINE
- B TO O — 68 M LENGTH ASPHALT BOULEVARD TRAIL (WITHIN R.O.W)
- O TO P — 260 M LENGTH ASPHALT BOULEVARD TRAIL (WITHIN R.O.W)
- Q TO R — PROPOSED PEDESTRIAN ACTIVATED SIGNAL CROSSING WITH LINEMARKING
- Q TO S — 540 M LENGTH ASPHALT BOULEVARD TRAIL (WITHIN R.O.W)
- S TO T — PROPOSED PEDESTRIAN ACTIVATED SIGNAL CROSSING (SUBJECT TO TRAFFIC ANALYSIS)
- T TO U — 22.6M ON ROAD ROUTE (LINEMARKING AND SIGNAGE)
- U TO V — PROPOSED SIGNED PEDESTRIAN CROSSING WITH LINEMARKING
- A TO B — 170 M LENGTH ASPHALT BOULEVARD TRAIL (WITHIN R.O.W)

TRAIL ALIGNMENT OPTION 2

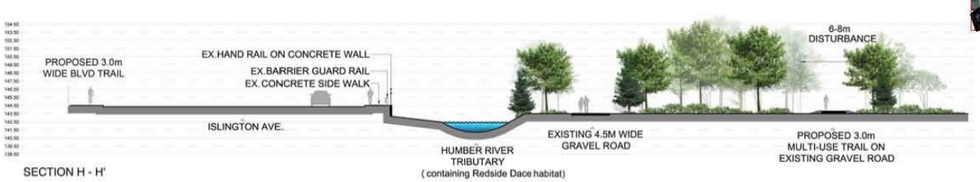
- PROPOSED NEW AT GRADE TRAIL
- PROPOSED ELEVATED PATHWAY BRIDGE
- PEDESTRIAN CROSSING ENHANCEMENTS
- E TO C — PROPOSED PEDESTRIAN ACTIVATED SIGNAL CROSSING
- C TO D — 150 M LENGTH GRANULAR TRAIL TYPE A TRAIL - < 5 YR FLOODLINE
- D TO E — 32 M LENGTH BRIDGE CROSSING (1.8M ABOVE 2 YR FLOOD LEVEL (SUBJECT TO GEOMORPHIC STUDY)
- E TO F — 195 M LENGTH GRANULAR TRAIL TYPE B TRAIL -> 5 YR FLOODLINE
- F TO G — PROPOSED PEDESTRIAN ACTIVATED SIGNAL CROSSING
- G TO H — 360 M LENGTH GRANULAR TRAIL TYPE B TRAIL - > 5 YR FLOODLINE SUBJECT TO EASEMENT APPROVAL OF PRIVATE LANDOWNER, A PORTION OF THE LAND OWED BY TRCA.
- I — STAIRWAY ON HELICAL PILES
- H TO J — 260 M LENGTH BOARDWALK OR GRANULAR TRAIL WITH DRAINAGE BENEATH TRAIL (REQUIRES LAND ACQUISITION) (SUBJECT TO CULTURAL HERITAGE AND STORMWATER MANAGEMENT STUDY)
- J TO K — 109 M LENGTH GRANULAR TRAIL TYPE B TRAIL -> 5 YR FLOODLINE (THROUGH CITY PARKLAND)

LEGEND

- 100 YEAR FLOODLINE
- 5 YEAR FLOODLINE
- 2 YEAR FLOODLINE
- PROPOSED CULVERT
- LAND PARCEL BOUNDARY
- EXISTING CYCLE ROUTE
- FUTURE NEIGHBOURHOOD CONNECTION
- WETLAND OR WATERCOURSE

SECTION J - J'

SECTION I - I'



SECTION H - H'

Figure 8: Segment 2: Thistlewood Avenue – Pine Grove

1.3.3 Segment 3

The main branch of the Humber River converges with the east branch of the river at this location as illustrated on Figure 9. The banks of the east branch are steep and the river is narrow. However, the floodplain widens south of the location of the confluence for a short section before becoming very narrow again south of Woodbridge Avenue. A trail through this section would traverse the Woodbridge Conservation Heritage District (Refer to Schedule 1 of Woodbridge Centre Secondary Plan) and would be required to conform with the policies that govern the protection of important cultural heritage structures and landscapes.

The intersection of Islington Avenue and Woodbridge Avenue is considered a "primary gateway" by the Woodbridge Centre Secondary Plan (Refer to Schedule 8 of the Plan). There is an opportunity to mark this location as a key entry point to the trail.

South of Woodbridge Avenue are narrow strips of land on either side of the river bound by Islington Avenue (see Photos 5-7, Figure A-3.1) to the east and private residential lots to the west. The strips of land are maintained as public open space and are owned and managed by TRCA, with exception of Nort Johnston District Park (Refer to Appendix A, Photo 4, Figure A-3.1), which the City maintains. There are existing pathways on either side of the river extending between Highway 7 to Woodbridge Avenue (Refer to Appendix A, Photo 2, Figure A-3.1). The concrete pathway on the west side of the river is 1.8 m wide and the asphalt pathway on the east (Riverwalk Trail) terminates at the Memorial Arena. As there is more open space on the east side of the river, there is an opportunity to widen the Riverwalk Trail from 2.0 m to 3.0m to accommodate a multi-use function. Furthermore, the Woodbridge Avenue Streetscape Design and Guidelines document approved by Council in 2018, illustrates a proposed trailhead at Woodbridge and Islington Avenues. The City is currently investigating improvements to this trail outside of this Study which includes improvements to this access point. The trail located on the east side would coincide with the location of the proposed trailhead improvements. However, it is recommended that the existing signals be upgraded to incorporate pedestrian activated signals to facilitate safe cyclist and pedestrian crossing of Woodbridge Avenue.

North of Woodbridge Avenue the trail could be located along either side of the river. However, there are fewer obstructions on the east side of the river (Option 1). With a shorter route and a limited number of trees on the east side, the route of the proposed trail would have a direct trajectory northward along the East Branch of the Humber River. As illustrated on Figure 9, a river crossing would be required to make the trail connection to Doctors McLean District Park. The final alignment to be determined at detail design will need to take into consideration circumventing

the private property straddling the open space and waterway should acquisition of the property not be viable.

By contrast, a trail routed on the west side of the river (Option 2) would lead westward along the main branch of the Humber River linking up with Meeting House Road. This route is not suitable and unlikely to gain approval as it would traverse a Special Policy Area (Refer to OPA Schedule 8) and would be vulnerable to flooding. This section of the trail would require several tree removals due to the dense tree canopy, while a crossing would be required to link the District Park to the trail. The constraints related to private land ownership along the trail alignment, available clear width to accommodate a desired setback of at least 10 m from existing private lots, and flood vulnerability and westward trajectory that the trail would take limit the design of Option 2. Therefore, Option 2 could be considered as a future trail link but not as a key segment of the preferred alignment.

To form a continuous trail along the east side of the river that connects south of Highway 7, a short span bridge over an existing drainage feature would be required at this location (Refer to Appendix A, Photo 1 & 3, Figure A-3.1). This section of trail would be subject to the Special Policy Area (refer OPA Schedule 8) policies. The banks of the river at this location are steep and are heavily overgrown. Restoration opportunities have been identified on both sides of the river by TRCA (Refer to Appendix B, Figure B.4). Opportunities exist for trail implementation and restoration efforts to be combined. Redside Dace habitat encroachment would necessitate land acquisition or an ESA permit from the MECP.

To establish a continuous trail in the valley at this location, provision of access across Woodbridge Avenue and Highway 7 will be required. While an at-grade link proposed for Woodbridge Avenue is discussed later in the report, an underpass at Highway 7 is possible but represents a challenge to trail development for the following reasons:

Issues and Constraints

- Trail enters underpass at east side (clearance height requires assessment)
- Steep side slopes
- Narrow corridor in which to locate the trail either side of river
- Private property straddling open space and river north of Woodbridge Avenue.
- Private property south of Hwy 7 requires an on-road cycling path solution

Opportunities

- Trail could traverse asphalt parking lot at the arena
- Possible routing of trail through unopened road allowance off Legion Road which could link to a boulevard trail along Islington Avenue.

Due to the challenges, this area is designated as **Focus Site 4** (refer to Figure 2). Based on initial site observation the clearance height at both the Woodbridge Avenue and Highway 7 underpasses appeared to be suitable to accommodate a trail, however, observations of river levels during recent storm events have confirmed that the conditions are unsuitable for an underpass at Woodbridge Avenue. An underpass at Highway 7 may be feasible and this should be confirmed through an engineering investigation. The underpass would also be subject to approval from York Region.

In the event an underpass is unlikely at Highway 7, an option to route the trail to the intersection of Islington Avenue and Highway 7 is a possibility, although this option is not preferred due to space constraints within the right-of-way and the high speed of traffic. As noted earlier, this intersection is considered a "secondary gateway" in the Woodbridge Centre Secondary Plan (Refer to Schedule 8 of the Plan).

Although there is an existing footpath extending northward from Highway 7 to Woodbridge Avenue on the west side of the river, the footpath is narrow and not consistent with the City of Vaughan standards for a multi-use pathway. An existing connection from the Woodbridge Avenue bridge deck to the existing footpath is located down a steep embankment on the west side of the river, however, the footpath is not accessible. Options to make this access path AODA compliant should be investigated in the near future.

In consideration of the foregoing, it is preferred to locate a new multi-use trail on the east side of the river as there is more space in which to construct a multi-use trail and there is opportunity for the trail to connect directly to Nort Johnston Park and the Memorial Arena. An engineering review of the clearance height beneath the Highway 7 bridge should be conducted to confirm the viability of accommodating a trail on the east side of the river.

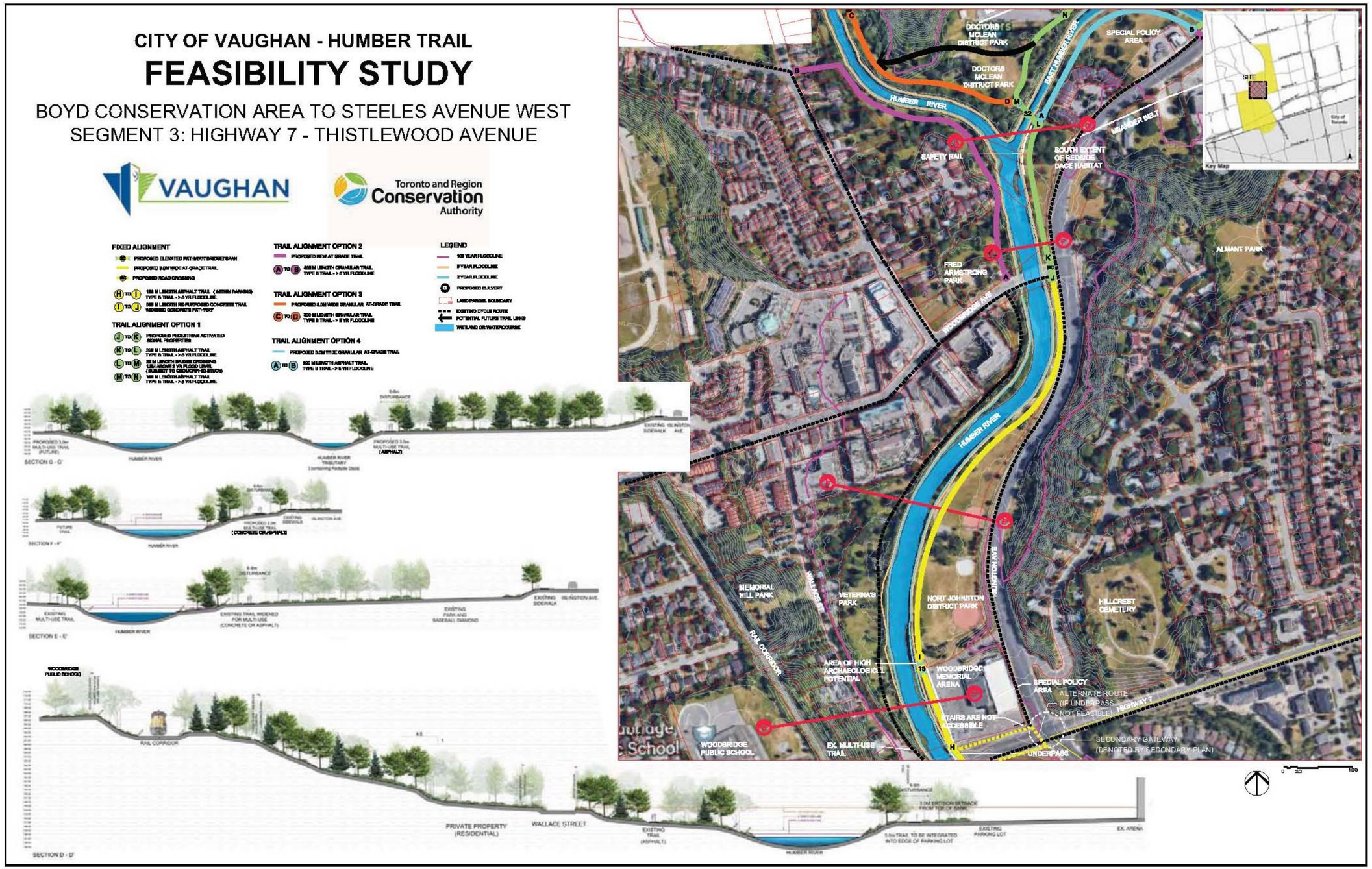


Figure 9: Segment 3: Highway 7 – Thistlewood Avenue

1.3.4 Segment 4

The lands that are located directly south of Highway 7 on the east side of the river are designated as a Special Policy Area (refer to Figure 12). A trail aligned within these lands would be flood vulnerable and would be subject to the policies that govern the SPA. Beyond the thin strips of public land that exist on both sides of the river, the valley corridor is constricted by existing developments. As illustrated in Figure 10, the landscape widens dramatically to the south into a vast flat plain where the river meanders broadly as it flows westward from Islington Avenue before it intersects an underpass at Highway 407.

The proposed trail would need to navigate a multitude of private properties in this segment of the Study Area. The most significant land parcel is owned by Infrastructure Ontario and comprises the hydro transmission corridor that bisects the land that is operated by Hydro One Networks Inc. (HONI).

South of Highway 7, the trail would traverse the 'Highway 7 Area' (Refer to Schedule 1 of the Woodbridge Centre Secondary Plan and OPA 240), and the design of the trail would need to consider of the policies in the Secondary Plan for this area. The lands on both sides of the river are owned by TRCA and consist of open space as seen in Photo 6, Figure A-4.1. South of this parcel, the lands on the west side of the river are privately held. The east side of the river is less constrained by private ownership as there is an unopened municipal road allowance that could be used to accommodate the trail. The challenge in utilizing the road allowance is that the allowance meets the river at a tight bend as seen in Photo 2, Figure A-4.1. Locating bridge crossings at bends in the river is not recommended due to erosive forces on the banks of the river during high flows.

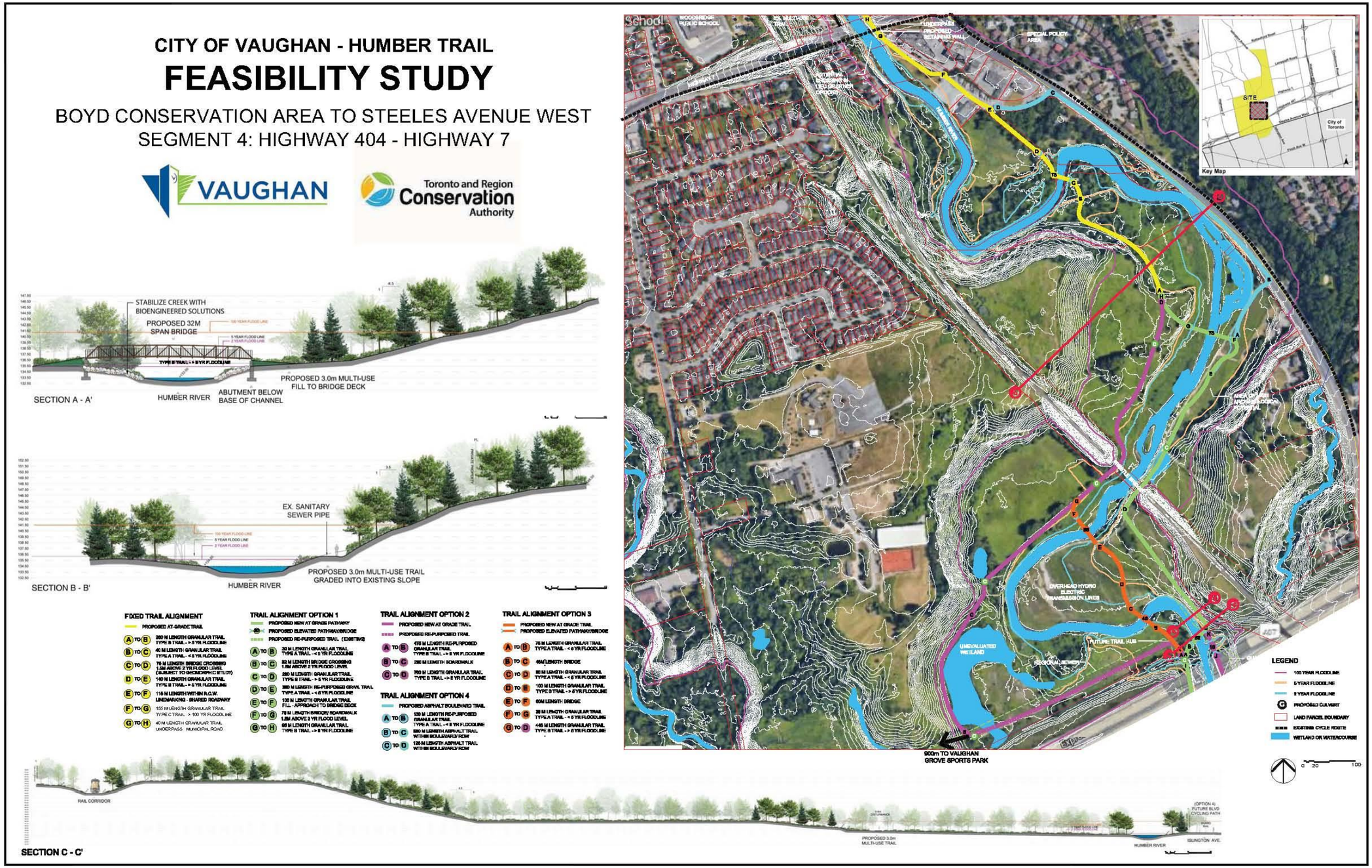


Figure 10: Segment 4: Highway 407 – Highway 7

In response, it is necessary that a small parcel of land (<0.5 ha) will need to be acquired to allow for the installation of a pedestrian bridge that would be located west of the bend in the river.

As illustrated on Figure B.1 in Appendix B, the lands that are located directly south of the road allowance are owned by TRCA. South of this, the parcels that are situated on both sides of the railway are owned by Infrastructure Ontario. In this stretch of the Study Area, wide-open flat meadowlands exist that present opportunities to locate a trail on either side of the river. Some significant species and habitat constraints were noted during the Feasibility Study but these do not preclude trail development. An EIS will be required to be completed to facilitate the detailed design development of this section of trail. Requirements for approval would involve a demonstration of no net loss of habitat and potentially require compensation/restoration planting either within or outside of the site.

Within the wide expanse of the river valley as illustrated in Figure 10, there are multiple opportunities to accommodate alternative routes for the trail. On the east side of the river, an existing gated access path leads from Islington Avenue westward beneath the railway trestle bridge to the hydro towers. The access path and trestle bridge can be seen in Photos 8, 11, 13 & 16, Figure A-4.1. The path extends from Islington Avenue (photo 1, Figure A-4.1) and is utilized by HONI to service the hydro transmission towers. Based on aerial photography, ATV activity is apparent in this area. The access path represents an opportunity to accommodate a trail without any additional impact on the landscape. However, a stormwater outfall and drainage feature that is located on the east side of the river, north of Highway 407 poses an impediment and would require the construction of a bridge crossing. A regional trunk sewer line also traverses the narrow strip of land that is located between the railway embankment and the east bank of the river. This sewer extends northward and westward across the river from this point as illustrated on Figure 3.

On the west side of the river, there are two opportunities to accommodate the alignment of a trail. One alternative would take advantage of an existing access road (assumed to be constructed to provide access to the regional storm sewer on the north side of Highway 407). This path would enable a future trail link to the Vaughan Grove Sports Park. Establishing a connection northward from this location is difficult since a number of environmental constraints exist. The route of the trail would be limited by the steep west valley slope and would traverse a large significant woodlot and several wetland-features, likely resulting in the need for boardwalks and culverts. This potential route is also longer than the other available options.

A potential second option located on the west side of the river, would be much shorter and would follow a direct alignment northward through the hydro corridor, as illustrated in orange in Figure

10. While this second option would require two additional bridges as part of its routing, approvals with Hydro One are required and this may limit where a functional crossing could take place.

The added advantage of positioning a trail on the west side of the river is the ability to utilize an existing temporary bridge that is located south of Highway 407. This bridge was constructed as part of past sewer works performed by York Region. York is obligated to remove this bridge under terms of its contract with the TRCA, however, an opportunity may exist to retain it and integrate it with the proposed trail. This opportunity should be discussed with York Region and the TRCA. The bridge may not achieve the typical span height requirements as set out by the TRCA and therefore detailed investigation would need to be carried out to confirm the feasibility of this bridge for re-use. Since the bridge was built to carry heavy equipment, its load rating is commensurate with that of emergency and maintenance vehicles, which would be a benefit to the operation of the trail system. This alternative may result in reduced environmental disturbance and cost.

1.3.5 Segment 5

As illustrated in Figure 11, the landscape south of Highway 407 is dominated by the closed former landfill site at Thackeray Park. As noted in Figure B.2, Appendix B, the park is owned by TRCA and managed by the City of Toronto Closed Landfill Division, which conducts methane leachate monitoring. Appendix A, Photo 7, Figure A-5.1 shows the methane stacks near the west bank on the north side of Steeles Avenue West. The landfill itself is fenced from public access. However, the City of Toronto and TRCA have expressed an interest in routing a trail up the slopes of the landfill, forming a loop around the tablelands and eventually making a connection to public transportation at the vehicular entry point to the park from Steeles Avenue West and Kipling Avenue. The top of the landfill site provides commanding views of the Humber Valley corridor and presents an opportunity to locate an outlook point and educational signage. Due to the landfill clay cap, there are some constraints to trail construction and the design of the trail must ensure that the cap is not penetrated. Therefore, the trail would need to be constructed on a fill condition only. Limited small-scale restoration planting may be permitted, as long as the landfill cap is not compromised.

Traversing the steep inclined slopes of the landfill site could present an impediment and may be a cost prohibitive proposition. Therefore, another trail route was identified for consideration. For example, an opportunity may be available to leverage funding from Section 37 funds (or leveraged community benefit charges as per COVID-19 Economic Recovery Act, 2020 (Bill 197) from development proposals to construct a trail on the east side of the valley, north of Steeles Avenue

West, and enable construction of a proposed bridge over the Humber River, north of Steeles Avenue West. This proposed bridge would only be required if the trail was located on the east side of the river and continued south of Steeles Avenue West on the west side of the river, to make a connection with an existing mowed/maintained trail, which extends southward, and eventually meets the City of Toronto portion of the Humber Trail as illustrated in Appendix A, Photos 10, 11, 13 & 14, Figure A-5.1. The proposed bridge should be positioned wholly within the City of Vaughan's jurisdiction to simplify the process of design and implementation and to avoid cross-jurisdictional ownership between the City of Toronto and the City of Vaughan. There is clearance beneath the Steeles Avenue West bridge on the west side as seen in photo 9, Figure A-5.1 to accommodate a trail. A meeting with the City of Toronto Cycling Infrastructure staff during the Study confirmed that there is a willingness for this connection to be made, confirming the viability of this option.

As illustrated on the aerial photo in Figure 11, an existing access path that extends northward from Steeles Avenue West along the east bank of the Humber River presents the opportunity to position the trail to make a connection with a future development proposed in this location. Positioning the trail along this alignment would will help reduce disturbance in the floodplain. The outer bend on the east side of the river is a concern that will need to be addressed at the detailed design stage. There is also an archaeological site and areas of archaeological potential located on both the west and east sides of the river in this location that will need to be addressed.

The bridge noted in the figure (Option 2 – D-E) would be necessary to connect this trail south into Toronto as there is no access available beneath Steeles Avenue West on the east side of the river. Locating a trail on the east side of the river presents an additional opportunity to link the trail to Steeles Avenue West via an existing asphalt service road as depicted in Appendix A, Photo 1, Figure A-5.1. The service road is owned and utilized by York Region to access the sewage pumping facility.

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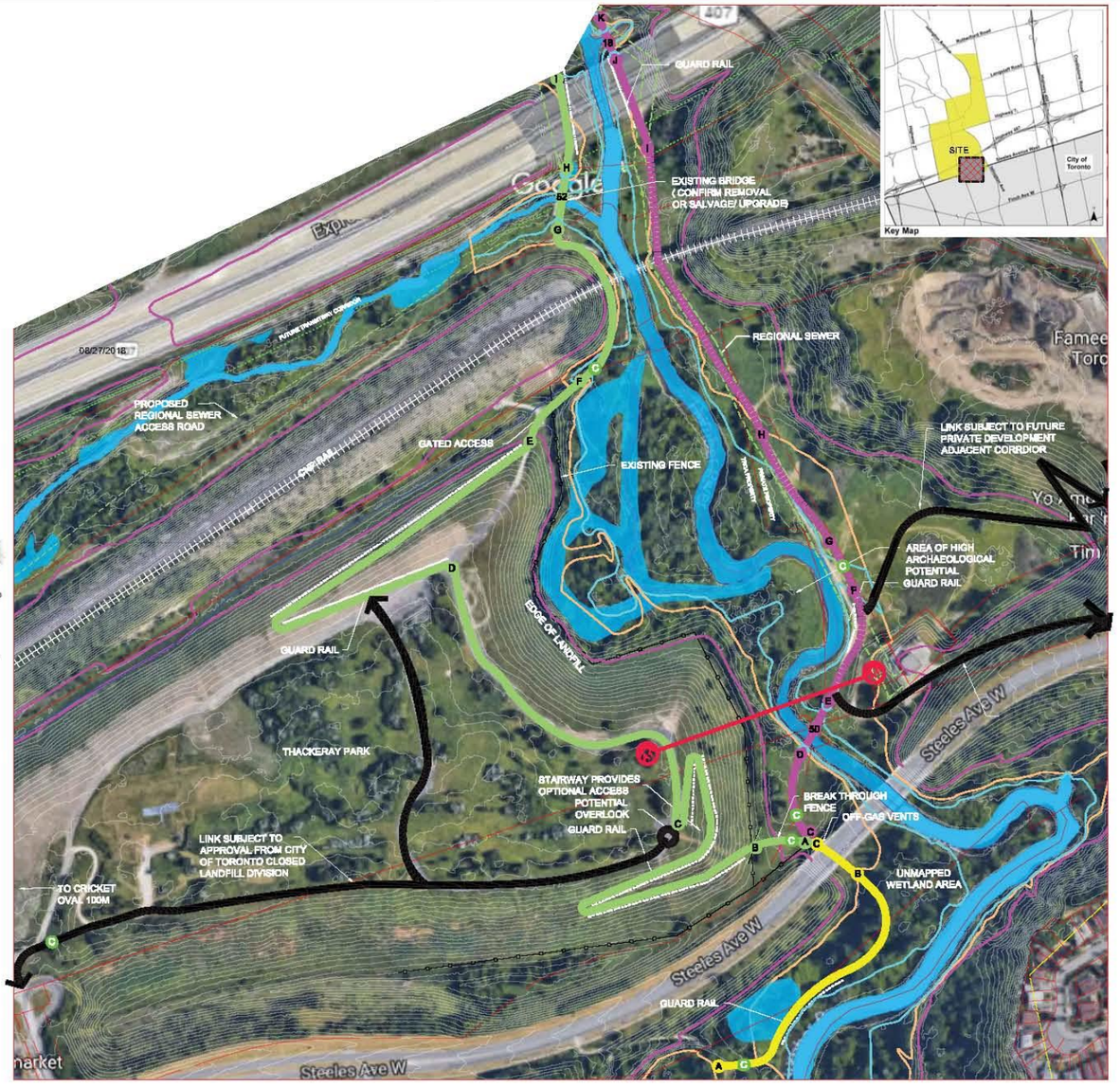
CITY OF VAUGHAN - HUMBER TRAIL

FEASIBILITY STUDY

BOYD CONSERVATION AREA TO STEELES AVENUE WEST
SEGMENT 5 : STEELES AVENUE WEST TO HIGHWAY 404

VAUGHAN

Toronto and Region Conservation Authority



FIXED ALIGNMENT

PROPOSED 3.0M WIDE AT-GRADE TRAIL

A TO B — 280 M LENGTH BRANULAR TRAIL TYPE A TRAIL - < 5 YR FLOODLINE
B TO C — 85 M LENGTH GRANULAR TRAIL TYPE B TRAIL - > 5 YR FLOODLINE

TRAIL ALIGNMENT OPTION 1

PROPOSED 3.0M WIDE AT-GRADE TRAIL
PROPOSED STAIRCASE

A TO B — 85 M LENGTH GRANULAR TRAIL TYPE B TRAIL - > 5 YR FLOODLINE
B TO C — STAIRWAY (85 STEPS) 9 LANDINGS
B TO C — 395 M LENGTH ASPHALT TRAIL FILL OR EMBANKMENT (MAX 10%) GUARD RAIL DOWNSLOPE SIDE
C TO D — 410 M LENGTH NEW GRANULAR TRAIL TYPE C TRAIL - > 100 YR FLOODLINE
D TO E — 618 M LENGTH NEW ASPHALT TRAIL FILL OR EMBANKMENT (MAX 10%) GUARD RAIL DOWNSLOPE SIDE
E TO F — 90 M LENGTH NEW GRANULAR TRAIL TYPE B TRAIL - > 5 YR FLOODLINE
F TO G — 205 M LENGTH GRANULAR TRAIL TYPE A TRAIL - < 5 YR FLOODLINE
G TO H — EXISTING 40 M SPAN BRIDGE REFURBISHMENT OR REPLACEMENT
H TO I — 110 M LENGTH GRANULAR TRAIL TYPE B TRAIL - > 5 YR FLOODLINE (SUBJECT TO APPROVAL BY 407 ETR)

CITY OF TORONTO LANDFILL SITE

TRAIL ALINGMENT OPTION 2

PROPOSED 3.0M WIDE AT-GRADE TRAIL
PROPOSED ELEVATED PATHWAY/ BRIDGE
PROPOSED 3.0M WIDE TRAIL (EXISTING RE-PURPOSED TRAIL)

C TO D — 410 M LENGTH GRANULAR TRAIL TYPE B TRAIL - > 5 YR FLOODLINE
D TO E — 50 M LENGTH BRIDGE DECK LEVEL + 5 YR FLOODLINE
E TO F — 130 M LENGTH RE-PURPOSED GRANULAR TRAIL TYPE A TRAIL - < 5 YR FLOODLINE
F TO G — 40 M LENGTH TRAIL (BOARDWALK) TYPE A TRAIL - < 2 YR FLOODLINE
G TO H — 135 M LENGTH RE-PURPOSED BRANULAR TRAIL TYPE A TRAIL - < 5 YR FLOODLINE
H TO I — 500 M LENGTH PROPOSED GRANULAR TRAIL TYPE B TRAIL - > 5 YR FLOODLINE
I TO J — 100 M LENGTH PROPOSED GRANULAR TRAIL TYPE B TRAIL - > 5 YR FLOODLINE (SUBJECT TO ETR APPROVAL)
J TO K — 18 M LENGTH PROPOSED GRANULAR TRAIL + BRIDGE TYPE B TRAIL - > 5 YR FLOODLINE

LEGEND

100 YEAR FLOODLINE
5 YEAR FLOODLINE
2 YEAR FLOODLINE
PROPOSED CULVERT
LAND PARCEL BOUNDARY
FUTURE NEIGHBOURHOOD CONNECTION
WETLAND OR WATERCOURSE

Figure 11: Segment 5: Steeles Avenue West – Highway 407

2.0 Background Review, Site Analysis and Consultations

2.1 Study Process

In order to determine the optional trail routes the Study Team, working with the various departments within the City of Vaughan and the TRCA, gained a comprehensive understanding of the features and the environmental sensitivity of the Study Area through site investigations and an analysis of site conditions The evaluation process included the identification of assessment criteria, the development and evaluation of trail alignment options for trail routing and determination of associated costs.

In order to explore the options for trail routing the following steps were taken during the Feasibility Study process:

Phase 1: Research, Inventory and Analysis

- Landscape and technical assessments and identification of opportunities and constraints including: natural heritage assessment, bowstring bridge assessment, landscape assessment and river meander belt study (for the purposes of establishing the limit of ESA habitat for Redside Dace;
- Stakeholder and Agency Consultation; and,
- Site Walks.

Phase 2: Alternative Designs, Preferred Design and Draft Master Plan

- Develop preliminary alignment alternatives to address site specific concerns;
- Identify various trail options;
- Perform a cost-benefit analysis (feasibility) of each option;
- Recommend a Preferred Trail Alignment; and,

Phase 3: Final Feasibility Plan and Report

- Finalize landscape and technical assessments and identify opportunities and constraints at site specific level;
- Refine the trail alignment through analysis and consultation;
- Recommend short-term implementation projects and management; recommendations;
- Prepare an implementation/phasing plan and refine cost estimate; and,
- Finalize Master Plan Report summarizing the design process, recommendations, alternative trail alignments and the Preferred Trail Alignment.

Through the review of mapping, supplemented by field review, the Project Team gained an understanding of the complex interrelated features and functions of the Natural Heritage System, as well as identifying pragmatic opportunities to establish linkages and provide experiential benefits for users.

The optional routes identified in each of the 5 segments illustrated in Figures 4 and 8 through 11, were developed and refined through an iterative process of discussion and technical review. The options included consideration of 'future connections' to neighbourhoods as well as key river crossings.

This process yielded a Preferred Trail Alignment that responds to the sensitivity of the Natural Heritage System while at the same time achieving practical objectives related to accessibility, active transportation, ease of implementation, cost, approval complexity, education and public enjoyment.

2.2 Background Review

The Project Team obtained a substantial amount of background data pertaining to the Study Area from the TRCA and the Land Information Ontario (LIO) from the Ministry of Environment Conservation and Parks (MECP). Hydro One, 407 ETR, Consumers Gas, the Region of York and City of Toronto were also contacted and provided relevant data to inform the Feasibility Study. However, it is assumed that during the future Environmental Assessment (EA) and detailed design phases of the project, more detailed discussions with MECP, Fisheries and Oceans Canada (DFO) and other relevant agencies and landowners will be undertaken.

The following data sets were provided by the City of Vaughan to the Project Team at the outset of the project:

- TRCA restoration sites;
- Archaeological resources;
- Cycling & Recreational Trail Network Plan
- York Regional Sanitary Sewer Network

A variety of other sources were explored with the objective of obtaining existing data to characterize the natural environment features and functions in the Study Area. These included:

- Information from the TRCA, MECP and Land Information Ontario (LIO) related to the following:
    - Ecological Land Classification (ELC);

  - Significant woodlots;
  - Provincially Significant Wetlands (PSW's), evaluated and unevaluated wetlands; and,
  - Regional flood limits/ Regional flood lines.
- Publicly accessible databases such as the Natural Heritage Information Centre (NHIC) natural areas mapping utility;
- Geospatial data provided by TRCA, which included locations of:
  - Rare vegetation communities;
  - Endangered and Threatened species;
  - Special Concern and provincially rare species;
  - Locally rare species;
  - Significant Wildlife Habitat (SWH); and,
  - Wetlands.
- Reports and survey data for the project provided by other consultants; and,
- Reports for other projects in and adjacent to the Study Area.
- City of Vaughan Natural Heritage Network Study (NHN)

This information, in addition to field reconnaissance visits as described below, was used to characterize existing conditions within the Study Area at a high level, as well as to identify locations of constraints to trail development and inform the constraints analysis.

Appendix D provides a complete list of data transferred and dates are included for accuracy. The figures contained in this report illustrate this data. In conjunction with the findings of aerial mapping review and ground-truthing exercises, all of the data informed the decision-making process with respect to defining alternate trail configurations.

2.3 Project Team and Partner Meetings

A series of site walks were conducted with members of the client team and partner agency staff throughout the study process. Gaps in information were able to be addressed and additional analyses were undertaken by members of the Project Team as necessary.

City of Vaughan Parks and Open Space Planning staff and members of the TRCA met with the Project Team several times during the Feasibility Study process to gain an understanding of site issues and to review site specific issues. Site investigations were conducted at different locations within the Study Area.

Table 1: Project Site Visits and Meetings

Project Team Meetings	Site Meetings
2018-06-11 – Refine schedule, define goals and objectives, review municipal trail and infrastructure plans and confirm TRCA requirements	**2018-06-07** – Technical investigation of bowstring bridge site
	2018-06-14– Site walk # 1 Steeles Ave West to Woodbridge Avenue (east side of river)
	2018-06-19– Site walk # 2 Trail segment from Langstaff Road to Boyd C.A.
2018-07-25 – Meeting to draft concept plans for segment 1-3	
	2018-08-16– Site walk # 3 Woodbridge Ave to Pine Grove Road (east and west sides of river)
2018-08-27 – Meeting to discuss preliminary trail alignments and site constraints	
2018-09-07 – Meeting # 1 - with City of Toronto trails and closed landfill staff; meeting # 2 – confirm approach to RSD permitting	**2018-09-18**– Site walk # 4 Thackeray Park north to Highway 407 (west side of river) with City of Toronto staff
2018-09-26 – Present optional trail alignment plans for five trail segments	
2018-10-09 – Internal City meeting with TRCA staff to discuss timing of RSD permit application with MECP	
2018-11-21 – Review environmental constraints mapping, preferred trail alignment and clarify RSD permitting requirements and next steps	
	2018-12-18 – Site walk # 5 Segment 5 Boyd C.A. link to Langstaff Rd

In addition to the site visits, the Project Team met regularly throughout the process to review the criteria that would be utilized to evaluate various trail options, to discuss refinements to the trail options based on the evaluation and to present the estimated costs. The meetings were held to maintain momentum in the process of developing the conceptual trail alignment options for discussion and internal circulation to municipal and agency staff for wider comment. The interim review of findings also enabled gaps to be detected in the data set and updated information to be acquired and integrated into the mapping.

The Project Team invited the City of Toronto Trails and Cycling Infrastructure staff, as well as City of Toronto Closed Landfill Division staff, to attend discussions. York Region Wastewater Division staff were also invited to join one of the Project Team site walks to discuss opportunities and constraints with respect to trail alignment in relation to municipal wastewater infrastructure.

Although no Public Meetings were conducted for this preliminary stage of the Feasibility Study, future engagement activities are planned by the City of Vaughan as part of the anticipated EA process. The consultant team has prepared materials for display and engagement of the Public by the City of Vaughan and TRCA in subsequent stages of study.

2.4 Site Analysis

The Consultant Team employed a multi-disciplinary approach to investigate, assess and ultimately propose and evaluate various trail configurations based upon a set of environmental and physical constraints, as well as cost considerations.

North-South Environmental Inc. (NSE), as a sub-consultant to Schollen & Company Inc., was retained to complete a review of natural heritage features in the Study Area for the proposed Humber Trail extension within the Study Area limits. The analysis work included review of mapping sourced from LIO and MECP databases in order to determine areas of high, medium and low environmental constraint. Natural Heritage features may pose constraints to trail development while in other circumstances they may present opportunities to protect or enhance natural features in conjunction with trail development.

Known natural heritage features are described in Section 4.0 of this report. Recommendations are also provided to guide trail development and management to address the sensitivity of natural heritage features. The analysis was supplemented with field verification.

A high-level analysis of the flood plain characteristics of the Study Area was carried out by Aquafor Beech Ltd. (ABL). ABL carried out a meander belt assessment for the purposes of determining

limits of Redside Dace habitat as is required to address ESA/ MECP permit requirements. The analysis also included the preparation of 2-year and 5-year flood mapping as illustrated on Figures 4 and 8 through 11. This information informed the landscape analysis that the design team performed.

The landscape assessment conducted by members of the Project Team described in more detail in the proceeding sections, was based on aerial photography, environmental data acquired by NSE from MECP and TRCA, as well as floodplain mapping developed by Aquafor Beech Ltd. The analysis of the inventory involved the identification of wet areas to avoid (i.e., within 30 m of a wetland, 10 m of top of bank (erosion setback), below the 2-year flood line, etc.), meander belt assessment (pertaining to the protection of Redside Dace habitat), as well as linkage opportunities identified by reviewing the City's Official Plan (VOP 2010) and Cycling Strategy, as well as the Regional Transportation Plan among various other reports. This review was supplemented by additional field verification as required.

The findings of the analyses assisted in the development of a framework for the site constraints that would influence trail development potential. The framework was developed in tandem with the Project Team and resulted in the exploration of trail options, from which a Preferred Alignment was selected. The selection was determined using a scoring system based upon the criteria (site constraints) as well as cost. The safest option with the lowest cost least potential impact to the environment and favourable conditions for staging and construction, was preferred over other options.

2.4.1 Field Investigations

The site conditions ascertained from the mapping exercise were verified in the field by members of the Project Team through site visits that addressed the full 7 km length of the Study Area. Observations were recorded by hydrological engineers, ecologists and landscape architects that visited the site several times independently to reconfirm and add context to observations.

Schollen & Company Inc. staff accompanied Brown & Company Inc./ Entuitive Engineering staff, as well as staff from Aquafor Beech Ltd, to review the condition of the bowstring bridge north of Langstaff Road and inspected the condition of the Humber River at this location. An engineering assessment of the condition of the bridge and the geomorphology of the river in this area was completed as was a general meander belt assessment of the Humber River East Branch for the purposes of supporting a future MECP permit under the ESA for Redside Dace habitat encroachment. The technical brief prepared as a result of this assessment can be found in Appendix E.

Staff from NSE visited the site several times in the summer of 2018, to photograph and note any Species at Risk (SAR), rare or noteworthy species, habitat features, or other features observed. Field investigations revealed enough information to describe existing conditions in the Study Area at a high level, including land cover, wetlands, hydrological features, SAR and rare species. The outcome of the assessment is summarized in the report sections below. The full report can be found in Appendix F.

The following Sections summarize the issues identified through site investigation.

2.5 Determining Options of Best 'Fit'

Based upon the site review and analysis, the Project Team's methodology for determining the options of "best fit" was aimed at characterizing the attributes of the landscape including hazards and impediments that represent challenges to trail construction and continuity. This information was compiled and assessed in the process of developing appropriate trail alignments that responded to site issues and opportunities.

To determine the trail alignment that is best suited to the existing site conditions, makes the practical connections and balances environmental benefits, a methodology based upon principles of Landscape Analysis was utilized as the foundation to evaluate trail routes. The design profile developed for each trail type that would best suit each site condition was later considered in the process of determining cost. The cost outcome was then fed back in through the analysis to verify which trail option was most suitable, since cost is a key decision-making factor in selecting the most appropriate trail alignment. For a full list of environmental criteria that were utilized to evaluate various trail alignments, refer to *Table 3: Alignment Constraints Decision-Making Matrix.*

2.5.1 Landscape Inventory and Assessment

The mapping and analysis completed in the early stages of the process, as verified in the field, informed various trail alignment options which were refined through discussions with the Project Team. These parameters, as well as policy and regulatory considerations were applied to a decision-making matrix to evaluate and 'score' the outcome of optional trail alignments. A more detailed summary of this process is described below.

Utilizing mapping gathered from various sources the Project Team prepared a base map, which documented the inventory of site conditions. Geographic Information Systems (GIS) data was utilized to organize and accurately portray the databases of information into base mapping. Refer to Appendix D for the sources of data compiled. The constraints analysis for this Study was

conducted at a high level and meant to represent “influencing factors” to trail development and not “determining factors” in the decision-making process for determining the most suitable trail alignment. As a component of the future assessment and design process for individual phases of trail implementation, the process of assessing specific gaps in data is anticipated to result in minor adjustments to trail alignment as defined from this Feasibility Study.

2.5.2 Technical Investigation

Two important technical components of the data that were generated by ABL during the analysis process, include the determination of the 2-year and 5-year flood line locations/ elevations. This information is an important consideration that may pose a constraint to trail development. The delineation of the meander belt line, particularly for the sections of the Study Area that encompass or contribute to habitat for Redside Dace is important and this analysis was also conducted as part of this Study (Refer the technical engineering brief included in Appendix F).

2.5.3 Development of Preliminary Trail Alignments

Based on the mapping, analysis and additional technical work that was carried out, proposed optional alignments for the trail were developed and evaluated utilizing a number of environmental criteria. The criteria were applied initially to define the appropriate route for the trail in the vicinity of significant environmental features. However, in many cases due to site limitations such as property ownership, the trail alignment encroached within setback zones of natural features and flood zones.

In order to fully understand how these encroachments could affect trail development, the evaluation process required a detailed breakdown of the overall trail system into component segments that were characterized by changes in site conditions dictated by the setbacks and flood zones. The evaluation considered that trail segments would most profoundly be affected by the extent of the 2-year, 5-year and 100-year flood limits. In other words, the dividing line between flood zones (2, 5 and 100-year) should result in the generation of the trail segments. This method was applied because it takes into account a number of factors including construction logistics construction cost as well as maintenance requirements which increase with vulnerability to flooding. Trails should therefore avoid the 2 and 5-year flood zones if possible. However, if unavoidable, trails to be constructed in these areas should be designed appropriately to accommodate seasonal flooding. In addition, with the increase in intensity anticipated in rainfall events as a result of climate change, it is prudent to make provisions for boardwalks or other construction enhancements for trails that are proposed to be situated below the 5-year flood line more resilient since these segments of trail are likely to be inundated more frequently over time.

Other constraints that were considered in the assessment and evaluation process of developing trail alignments included avoidance of steep slopes and outer banks of the river, limiting crossing points over the river and other drainage features, avoiding privately owned lands and areas identified as “high environmental constraint” as identified by NSE. These high environmental constraint areas include habitat of rare species including Redside Dace. However, where encroachment within these areas was unavoidable, mitigation measures including compensation planting and landscape restoration were considered in the evaluation process.

The outcome of the mapping, analysis and assessment tasks resulted in the production of two sets of mapping: one which depicts the potential impacts of trail alignment in relation to environmental constraints and a second which illustrates the relationship between the proposed trails and the flood zones (2 and 5-year), patterns of land ownership, management and linkage opportunities to other existing and proposed trails in the vicinity. Both map sets were relied upon to determine 'preferred' and ‘viable’ optional trail alignments defined by cost and the overall number of constraints encountered along the potential alignment of one particular trail segment.

The environmental constraints maps (refer to Figures 21 through 25) and concept plans (refer Figures 4 and 8-11) illustrate the trail alignment options for each of the segments based upon various criteria (refer Table 3.1-3.5) which conveys the ranking for the various trail alignment options. This framework was utilized to evaluate trail types based on trail design in response to site conditions. This evaluation exercise informed the cost analysis that was conducted during a subsequent stage of the Study process and assisted in development of the Implementation Plan. Refer Section 8.0 for the cost analysis and Section 10.0 for the Implementation Plan.

3.0 Policy Review

Several trail-related policy documents provided guidance to the Project Team in the process of exploring and assessing alternative trail route options by providing the Team with an understanding of key connections to local and regional trails and facilitating the integration of the Humber Trail with adjoining trail systems and future planned links. The following policies were reviewed and considered in the process of developing alignment options for the Humber Trail through Vaughan.

3.1 Federal Policies

3.1.1 Fisheries Act

Fisheries Act - R.S.C., 1985, c. F-14 (Amended 2016) referred to in this report as, the *Fisheries Act*, is administered by the Department of Fisheries and Oceans Canada (DFO) and regulates the protection of fish and fish habitat. As defined within the Humber River Fisheries Management Plan (TRCA, 2005), the Humber River supports a fishery that is an essential asset that contributes to the ecological health and sustainability of the watershed. The Humber River harbours several different species of fish despite being located within one of the largest urban centres in Canada. The *Fisheries Act* prohibits the "harmful alteration, disruption or destruction" (HADD) of fish habitat, with the long-term objective of achieving an overall net gain in fish habitat capacity. An "Authorization" from DFO is required before a project that may constitute a HADD can proceed. With respect to trail alignment, the *Fisheries Act* has implications on the positioning and number of bridge crossings and associated modifications to the river such as bank stabilization.

3.1.2 Canadian Navigable Waters Act

Navigable Waters Protection Act - R.S.C., 1985, c. N-22, henceforth referred to as *The Navigable Waters Protection Act*, is enforced by Transport Canada and ensures the public's right to navigate Canada's waters without obstruction. Moreover, the NWPP approves works such as bridges, weirs and dams that are located on navigable waters in Canada. The Humber River is designated as "Navigable Water" through the Act. Therefore, approval under this legislation will be required to facilitate the implementation of any structure or alteration to the river that may impede navigation.

3.2 Provincial Policies (Regional and Municipal)

Provincial initiatives, including the Niagara Escarpment Act, the Oak Ridges Moraine Conservation Act, the *Greenbelt Act*, the *Places to Grow Act*, the *Migratory Birds Convention Act*, the 2020 Ontario Provincial Policy Statement (PPS), the *Ontario Heritage Act* and Ontario Regulation 166/06 under the Con*servation Authorities Act*, provide increased protection for landforms, environmental and cultural resources and agricultural lands. Trail planning and management within the Humber River Study Area must adhere to the policies outlined within this legislation as well as municipal policies included in the York Region Official Plan (2010) and the City of Vaughan Official Plan (2010). In compliance with these regulations, and in determining the alignment and management objectives for the trail, avoidance and mitigation of ecological impacts must therefore be considered.

3.2.1 Provincial Policy Statement (2020)

The Provincial Policy Statement (PPS) is issued under the authority of Section 3 of the Planning Act and its purpose is to provide guidance on matters of Provincial interest related to land use planning. Section 3 of the Planning Act requires that planning authorities make decisions that are 'consistent' with the policy statements contained in the PPS. In carrying out the planning function, it is the responsibility of those involved and the decision-makers to balance these interests and, in the case of conflicts amongst them, determine what is in the best or greater public interest. Some of these matters include:

(a) the protection of ecological systems, including natural areas, features and functions;

(c) the conservation and management of natural resources and the mineral resource base;

(h) the orderly development of safe and healthy communities;

(I) the protection of the financial and economic well-being of the Province and its municipalities.

The PPS generally prohibits development or redevelopment below the Regulatory Flood Line as determined by the TRCA. However, the PPS also recognizes that parts of certain Urban Areas have historically developed within floodplains. In accordance with the SPA provisions of the PPS, certain lands within the Regulatory Floodplain of the Humber River in the Woodbridge community have been identified as an SPA on Schedule 8 of the VOP 2010. Particular importance should be placed of the PPS (Section 2.1.5), which notes that development and site alteration must demonstrate there will be "no negative impacts" on the listed natural features or their ecological functions.

The continued viability of these areas depends on a reasoned application of the Provincial standards for flood plain management. The PPS recognizes the concept of SPA status as a possible option for flood prone communities or portions thereof where the Province, Conservation Authority and the City agree to accept a higher level of risk to floodplain management. The implementation of flood proofing measures will be a condition of development approval by the City in co-operation with the TRCA. It is the policy of Council that the SPA boundaries are identified on Schedule 8 of the OPA and on Schedule 9 of the Woodbridge Centre Secondary Plan in Volume 2. The SPA policies form Section 7.3 of the Plan. The SPA policies and schedules were approved by the Ministry of Municipal Affairs and Housing and the Ministry of Natural Resources on November 3, 2014.

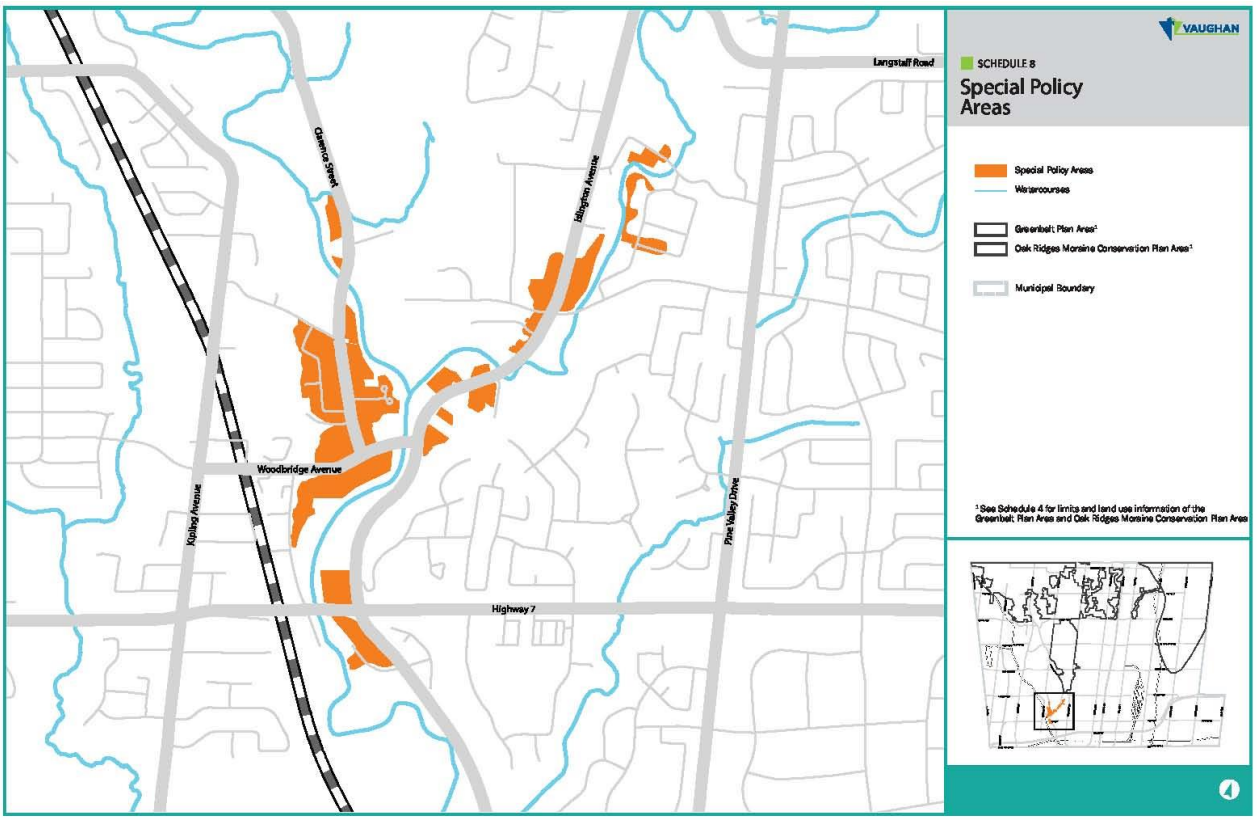


Figure 12: Schedule 8 – Special Policy Areas, VOP 2010

3.2.2 Growth Plan for the Greater Golden Horseshoe

The City of Vaughan is located in York Region and is part of the Greater Toronto Area (GTA). The GTA is forecast to receive considerable growth in population and employment by 2031. The build-out of the City of Toronto and rapid growth of the surrounding suburbs has had a significant impact on green space and the overall structure of the GTA. In response to this growth, the Province of Ontario issued a number of plans to protect green space and natural features and direct future growth toward more sustainable types of development. As such, municipalities across Ontario are reviewing their Official Plans to ensure that they are in conformity with the principles of provincial policies. For many, this means making significant changes to the way that growth is managed and planned in the city.

Figure 13 below illustrates the urban growth centres identified in Schedule 4 of the *Growth Plan for the Greater Golden Horseshoe, 2006*. The City of Vaughan growth centre is situated east and south of the Study Area as illustrated in Figure 14.

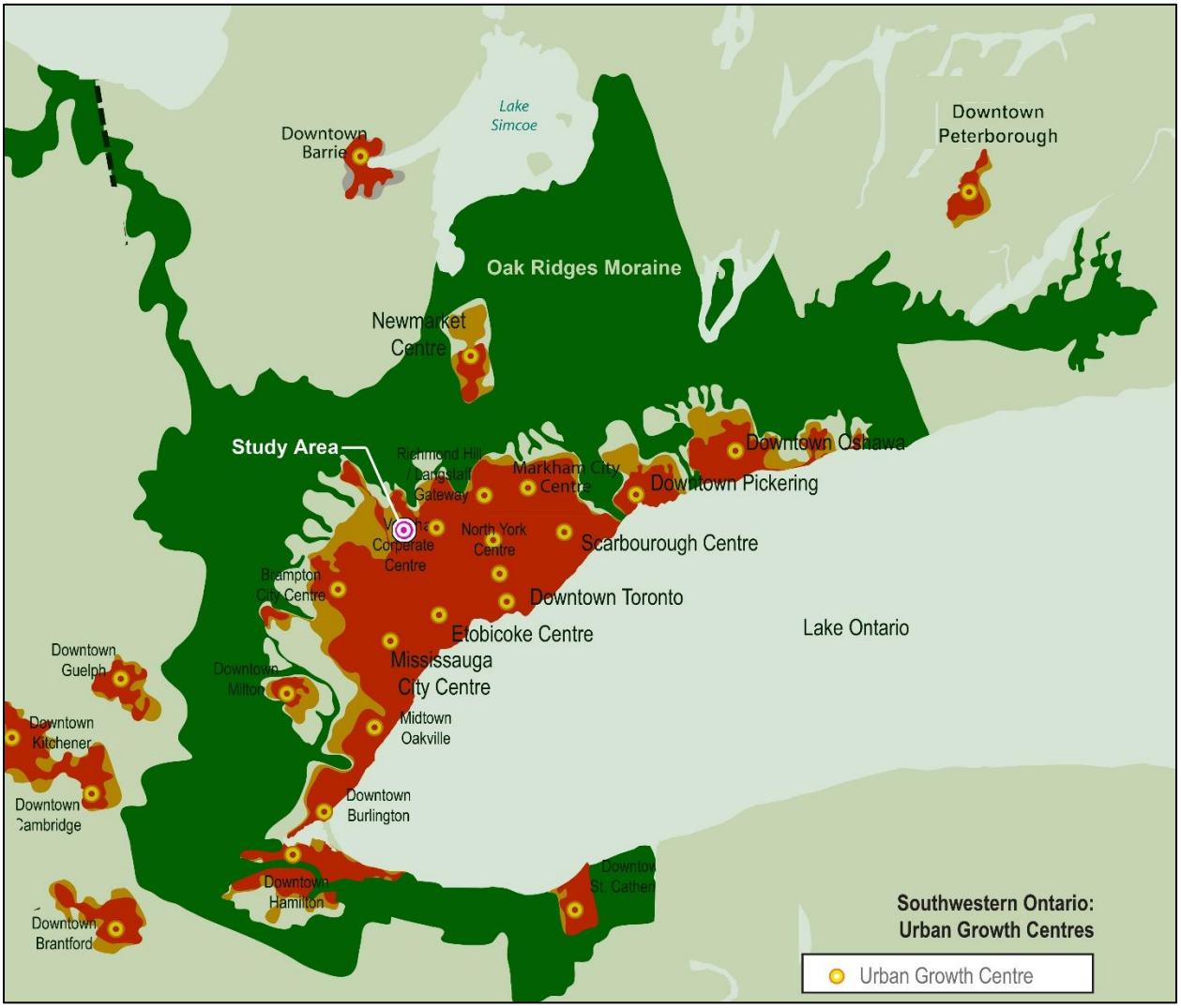


Figure 13: Ontario Growth Centres

The City of Vaughan faces many issues typical of suburban urban structures including auto-dependency, isolated single-purpose uses, sprawl that encroaches on the countryside and multiple centres. However, the build out of the Vaughan Metropolitan Centre (VMC) will establish a new 'downtown' that is supported by transit and will unify the city. Consistent with the *Growth Plan*, the City developed a Growth Management Strategy to guide future growth and planning in Vaughan in a sustainable, compact and intensified manner. The Strategy is considered in the development of the trail alignment options in relation to linkage opportunities and neighbourhoods beyond the Humber River corridor.

3.2.3 Places to Grow Act

The Places to Grow Act for the province sets out a number of growth-centres in Southern Ontario one of which is the VMC. As noted in Figure 14 below the VMC is a short 4 km distance from the Humber River and the route of the proposed Humber Trail. This proximity means that the trail will be easily accessed by residents of the VMC and will be served by public transportation. The *Places to Grow Act* encourages an increase in the population in the VMC and Vaughan in general which will exert additional pressure upon the natural resources of the Humber Natural Heritage System. Therefore, planning for this potential increase in use by delineating an appropriate alignment and location for the trail in order to encourage protection of the natural and cultural heritage features within the Humber River Valley is essential.

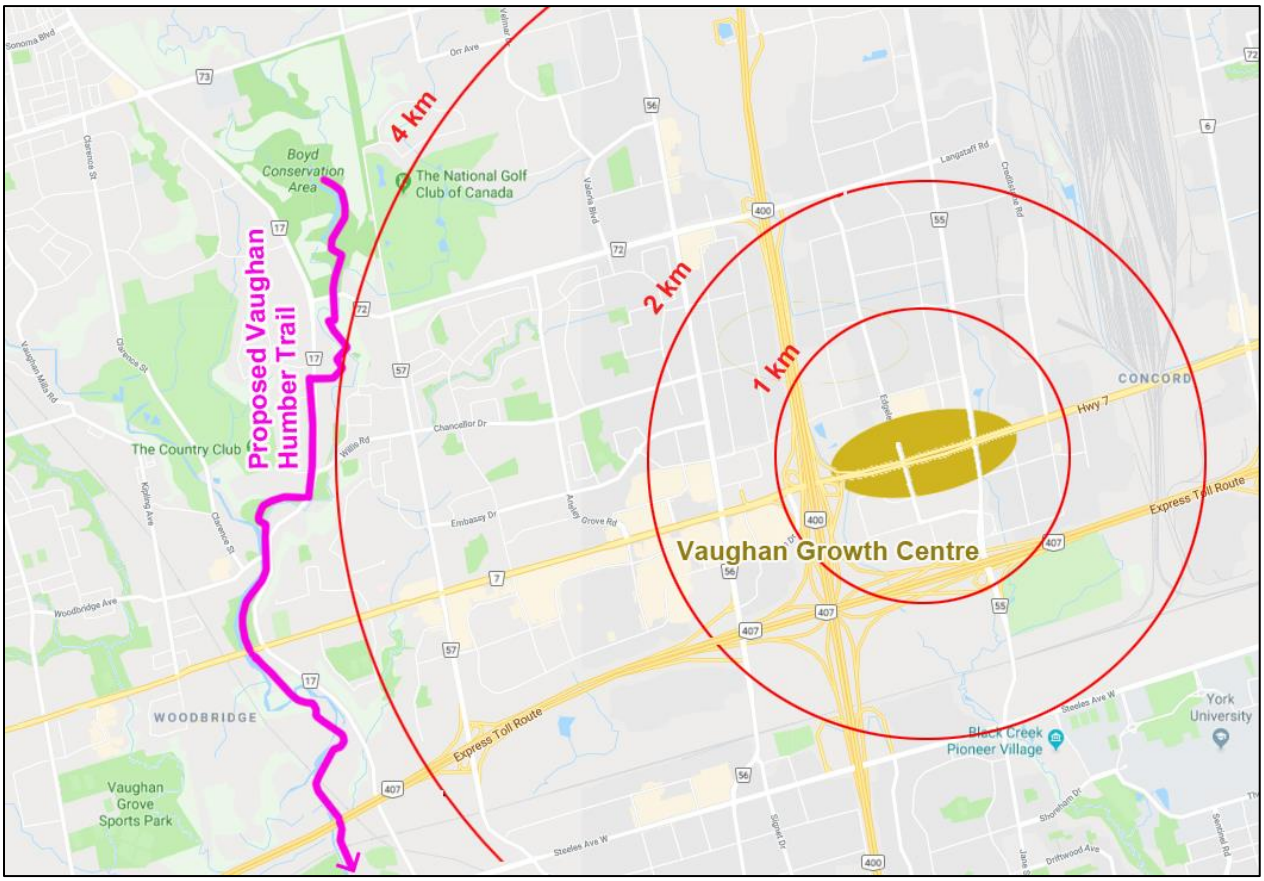


Figure 14: Relationship of Proposed Humber Trail to the VMC

3.2.4 Greenbelt Act and Plan

The overall intent of the Greenbelt Act and Plan is to identify and permanently protect lands from urban development so that significant natural heritage and hydrological features can be preserved and agricultural uses can persist on the lands affected. The Greenbelt encompasses the lands of the Boyd Conservation Area south to Langstaff Rd. These lands fall within the designation of 'Protected Countryside' and 'Natural Heritage System'.

Section 3.2.6 External Connection within the Greenbelt Plan (2017), pertains only to the Boyd Conservation Area portion of the Study and requires that planning and resource management decisions for lands contained within the 'Protected Countryside' shall comply with the provisions of the Greenbelt Plan. The following policies relate to trail planning and development in this area of the Study as follows:

3.2.2 Natural Heritage System Policies

For lands within the Natural Heritage System of the Protected Countryside, the following policies shall apply:

3. New *development* or *site alteration* in the Natural Heritage System (as permitted by the policies of this Plan) shall demonstrate that:

   a) There will be no *negative impacts* on *key natural heritage features* or *key hydrologic features* or their functions;

   b) *Connectivity* along the system and between *key natural heritage features* and *key hydrologic features* located within 240 metres of each other will be maintained or, where possible, enhanced for the movement of native plants and animals across the landscape;

   c) The removal of other natural features not identified as *key natural heritage features* and *key hydrologic features* should be avoided. Such features should be incorporated into the planning and design of the proposed use wherever possible.

3.2.5 Key Natural Heritage Features and Key Hydrologic Features Policies

For lands within a *key natural heritage feature* or a *key hydrologic feature* in the Protected Countryside, the following policies shall apply:

3.2.5.4 In the case of wetlands, seepage areas and springs, habitat, permanent and intermittent streams, lakes and significant woodlands, the

minimum vegetation protection zone shall be a minimum of 30 metres measured from the outside boundary of the key natural heritage feature or key hydrologic feature.

3.3.2 Parkland, Open Space and Trail Policies

Provision 3.3.2.2 of the Plan states:

"Encourage the development of a trail plan and a co-ordinated approach to trail planning and development in the Greenbelt to enhance key existing trail networks and to strategically direct more intensive activities away from sensitive landscapes."

3.3.3 Municipal Parkland, Open Space and Trail Strategies

For all lands falling with the Protected Countryside, Municipalities should:

Include the following considerations in municipal trail strategies:

a) Preserving the continuous integrity of corridors (e.g. abandoned railway rights-of-way and utility corridors);
b) Planning trails on a cross-boundary basis to enhance interconnectivity where practical;
c) Incorporating the existing system of parklands and trails where practical;
d) Restricting trail uses that are inappropriate to the reasonable capacity of the site (notwithstanding the ability to continue existing trails/uses);
e) Providing for multi-use trail systems which establish a safe system for both motorized and non-motorized uses;
f) Protecting farmland and supporting and ensuring compatibility with agriculture; and,
g) Ensuring the protection of the key natural heritage features and key hydrologic features and functions of the landscape.

The East Humber River valley is also considered an External Connection to the Greenbelt. External Connections are not within the regulated area of the *Greenbelt Plan*. Notwithstanding, the proposed Humber Trail was planned with consideration for these policies.

3.2.5 The Regional Transportation Master Plan

The Transportation Master plan establishes the vision for transportation services, assesses existing transportation system performance, forecasts future travel demand and defines actions and policies to access road, transit and active transportation needs in York Region to 2041.

3.2.6 Endangered Species Act, 2007

The Endangered Species Act regulates the habitat of "Species at Risk" (SAR) in Ontario. "Species at Risk" and/or their habitat that are of concern and which have been observed within the Vaughan Humber River Study Area are not identified in this report since disclosure of this information could pose a threat to these sensitive species and/or habitats. However, observations of species can be procured from MECP directly.

3.2.7 TRCA Regulated Area

The majority of the Study Area falls within TRCA's Regulated Area which includes the East Humber River floodplain. Boyd Conservation Area, a TRCA property, occupies much of the northern portion of the Study Area. TRCA also regulates wetlands and a permit may be required to allow for site alterations to be implemented within wetlands and adjacent lands within a prescribed distance from the boundary of the feature. A permit can be anticipated to be required from TRCA for site alterations within a minimum 30 m buffer around wetlands, but this buffer may change through more detailed field surveys.

3.3 Municipal Policies

3.3.1 York Region Official Plan

Much of the Study Area is designated as part of York Region's Greenlands System as illustrated on Map 2 of the Regional Official Plan. According to the Regional Official Plan:

> *The Regional Greenlands System…protects key natural heritage features and key hydrologic features and the adjacent lands necessary to maintain these features in a linked system.*

Key natural heritage features and key hydrologic features within the Regional Greenlands System that are present in the Study Area include Environmentally Significant Areas (ESAs), significant woodlands, significant valleylands, wetlands and significant wildlife habitat.

Construction of a new trail within the Regional Greenlands System will likely be subject to an EA or Environmental Impact Study (EIS) in order to satisfy the policies in Section 2.0 of the York Region Official Plan.

3.3.2 City of Vaughan Official Plan (VOP 2010)

Most of the Study Area is designated as part of the City of Vaughan's Natural Heritage Network as illustrated on Schedule 2 of the Vaughan Official Plan (VOP), 2010. The following ESAs as designated by the City and illustrated on Schedule 3 of the VOP are in the Study Area.

- Pine Grove Forest ESA (ESA #19)
- Boyd's Rock Cress ESA (ESA #20)
- Pine Valley Forest ESA (ESA #21)

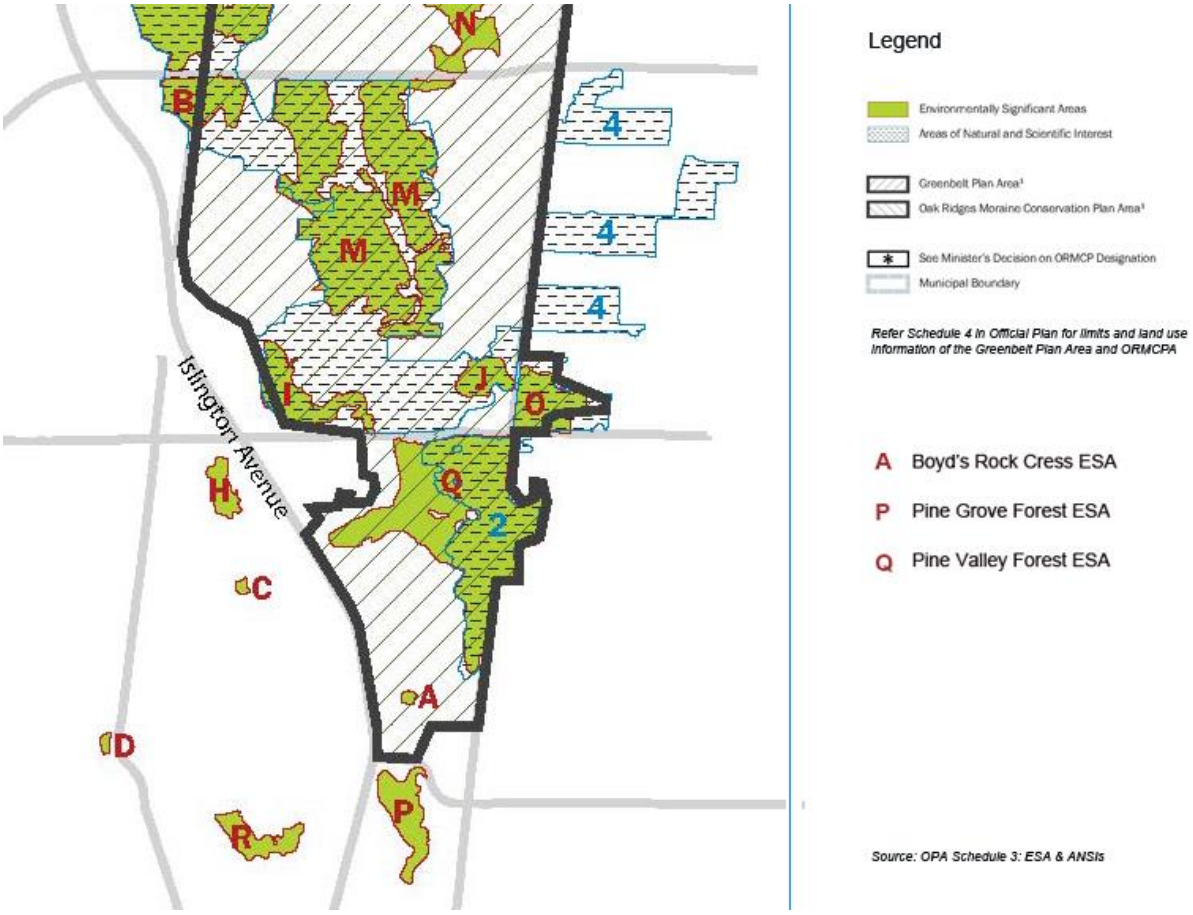


Figure 15: Schedule 2 – Environmentally Significant Areas, City of Vaughan OPA

Construction of a new trail within the Natural Heritage Network will likely be subject to an EIS to satisfy the policies in Section 3 of the City of Vaughan's Official Plan. Specifically, Section 3.2.3.7, part d) of the VOP, which states that low-intensity and passive recreational activities are generally permitted within "Core Features" of the Natural Heritage Network. However, the activities must not result in a negative impact on Core Features or ecosystem function.

The VOP also calls for a transportation transformation in how people move around Vaughan by establishing a comprehensive transportation network that allows a full range of mobility options, including walking, cycling and transit (Section 4.2.3.1), and provides opportunities for passive recreation and trails, where such activities will not have adverse impact on significant natural features and ecological functions (Section 7.3.1.3). The proposed Humber Trail is a key initiative to achieving this transformation.

3.3.3 Woodbridge Heritage Conservation District Study and Plan

Heritage Conservation Districts (HCD) are areas denoted for their cultural value. Part V of the Ontario Heritage Act enables designation of areas which as a whole retain cultural heritage value. As noted in the City of Vaughan Heritage District Plan a key purpose of the Woodbridge Heritage Conservation District is to:

"Support a welcoming, interesting pedestrian environment by encouraging pedestrian amenities and by maintaining human-scaled development and connections to adjacent neighbourhoods."

Landscapes within the Woodbridge HCD considered for their heritage significance include: the Fairgrounds and adjacent conservation lands east and south along James Street, Meeting House Road Memorial Parkette, Old Fire Hall Parkette, Memorial Hill Park, the Humber River Corridor and Parks, the southern portion of the Board of Trade Golf Course, and the ridge landscape east of Islington Avenue.

Figure 16 illustrates the proposed Humber Trail in relation to the Woodbridge Heritage Conservation District Study and Plan, 2009. The figure identifies the existing cultural heritage features and route of the existing watercourse through this area as potential narratives for interpretation.

Figure 16 depicts the historical location of bridges, and the old meander alignment of the Humber River in comparison to the present meander geometry. The map indicates the heritage landscapes within the context of the current open space system. The source of this map is a combination of Schedules 11 and 13 from the City of Vaughan Heritage Conservation District Study and Plan.

Planning the route for the Humber Trail through the Woodbridge HCD will require consideration of built heritage features and cultural heritage landscapes. The assessment of the features and consultation with various stakeholders may also be necessary.

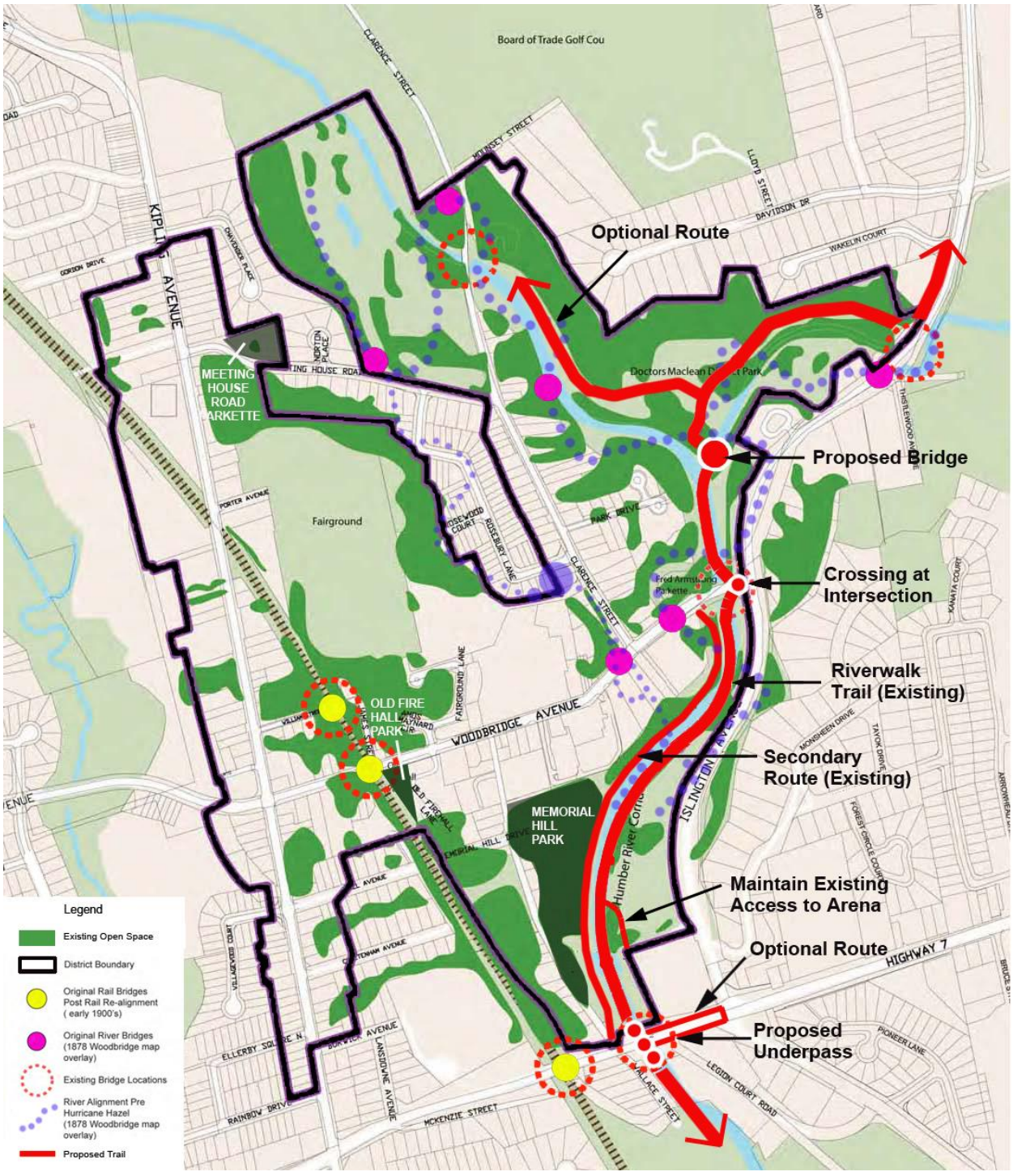


Figure 16: Proposed Humber Trail in relation to Woodbridge Heritage Conservation District

3.3.4 Areas of Natural and Scientific Interest (ANSI)

Two ANSIs are located in the Study Area: the Woodbridge Pleistocene Cut Earth Science ANSI, which is contained entirely within the extreme southwestern corner of the Study Area, and the Boyd Conservation Area and Adjacent Lands Life Science ANSI, a portion of which is located at the far northern end of the Study Area. The Ministry of Environment, Conservation and Parks (MECP) defines ANSIs as "areas of land and water containing unique natural landscape features. These features have been scientifically identified as having life or earth science values related to protection, scientific Study or education" (MECP, 2018). Under the PPS, any proposal for site alteration within ANSIs is required to demonstrate that there will be no negative impact to ecological features and functions.

3.4 Supporting Strategies, Plans and Guideline Documents

A number of studies have provided guidance to inform the trail planning process by affording an understanding of key existing and proposed connections with adjoining trail systems and future planned links. The following studies informed alignment options for the Humber Trail throughout Vaughan.

3.4.1 Vaughan Super Trail

The Vaughan Super Trail is an initiative to create a world-class, identifiable trail that connects a variety of off-road pathways and on-road pedestrian and cycling systems. A key goal of the Vaughan Super Trial is to link communities and people with local nature, cultural heritage, communities and special destinations throughout the City of Vaughan, and will be leveraged to promote the City, enhance civic pride and act as a platform for both economic and social opportunities.

The Vaughan Super Trail is envisioned to be a city-wide loop approximately 100 km in length of which 40% currently exists. The Vaughan Super Tail was included as one of the recommendations presented in the Cycling and Pedestrian Advisory Task Force Findings Report dated April 3, 2017 presented to the Finance, Administration and Audit Committee and endorsed by Council on April 19, 2017. Subsequently, the Vaughan Super Trail has been rolled into the 2020 Pedestrian & Bicycle Master Plan approved in principle by Council in December 2019, with notice of completion issued on October 29, 2020.

A key segment of the Vaughan Super Trail is the Humber Trail between Steeles Avenue West and William Granger Greenway. The project will provide a key missing link for one of the last remaining connections within the Humber Trail system (refer to Figure 17 below).

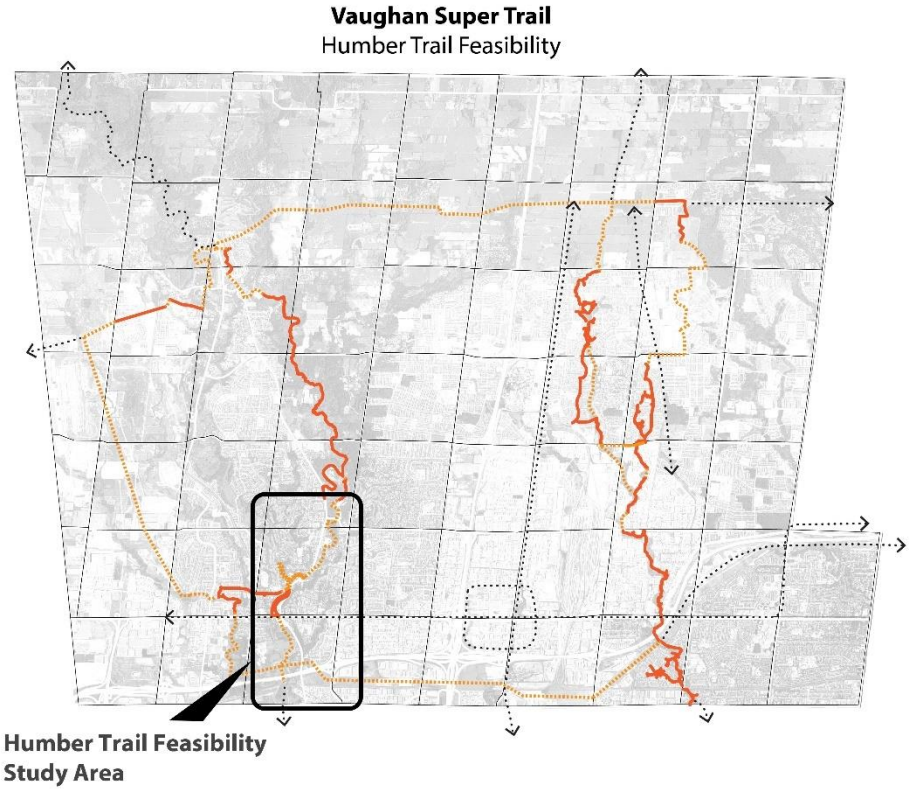


Figure 17: Humber Trail in relation to the Vaughan Super Trail

3.4.2 City of Vaughan Pedestrian and Bicycle Master Plan

The City of Vaughan 2007 Pedestrian and Bicycle Master Plan Study has identified the goal "To create new environments and enhance existing ones for both pedestrians and cyclists in the City of Vaughan. These environments should be supported by developing a visible and connected pedestrian and cycling network in Vaughan that integrates, enhances and expands the existing on and off-road pedestrian and cycling facilities." (Subsection 3.-1 Goals and Objectives). Recommendation 6-3 of the Pedestrian and Bicycle Master Plan 2020 update identifies the need to "Continue to implement stand-alone open space multi-use recreational trails in accordance with the Priority Multi-use Recreational Trail Network and other opportunities as they arise." Through the Pedestrian and Cycling Master Plan 2020 update, feedback from public surveys indicated that the use of recreational biking and walking within trails is the most popular type of active transportation. The opportunities for trail linkage with the proposed Humber Trail are already integrated into the City of Vaughan Pedestrian & Bicycle Master Plan 2020. The linkage opportunities relevant to the Humber Trail system are illustrated on Figures 4 and 8 through 11.

3.4.3 City of Vaughan Transportation Plan

The new plan will take a 20-year outlook to identify and highlight projects that will help meet transportation needs as Vaughan grows. This will include innovative, accessible and functional options that will guide change and support transit investments. To achieve this vision, the study is seeking input from residents, businesses and experts, who, together, will develop the future of transportation in Vaughan. The trails identified in the City's Pedestrian & Bicycle Master Plan 2020 2020 integrates the trail opportunities illustrated in the City of Vaughan Transportation Plan and incorporating the Vaughan Super Trail.

3.4.4 Woodbridge Centre Secondary Plan

The Plan was adopted by Council in 2014 with the objective of establishing a land use and urban design policy framework for Woodbridge. The scope of work of this Plan involved a thorough review of existing policies including the regional and local OPs, master plans, and the Woodbridge HCD. A transportation study, parks assessment, and a review of the SPA boundaries and policies were also components of the Plan. The Study Area for this project encompasses the following policy areas as per Schedule 1 in the Plan:

- Islington Avenue Corridor Study (OPA 597);
- Woodbridge Heritage District Conservation Area (OPA); and,
- Highway 7 Area (OPA 240).

The Secondary Plan identifies opportunities for trail linkages as illustrated in Figure 18 below. These potential connections were considered in the process of exploring the trail.

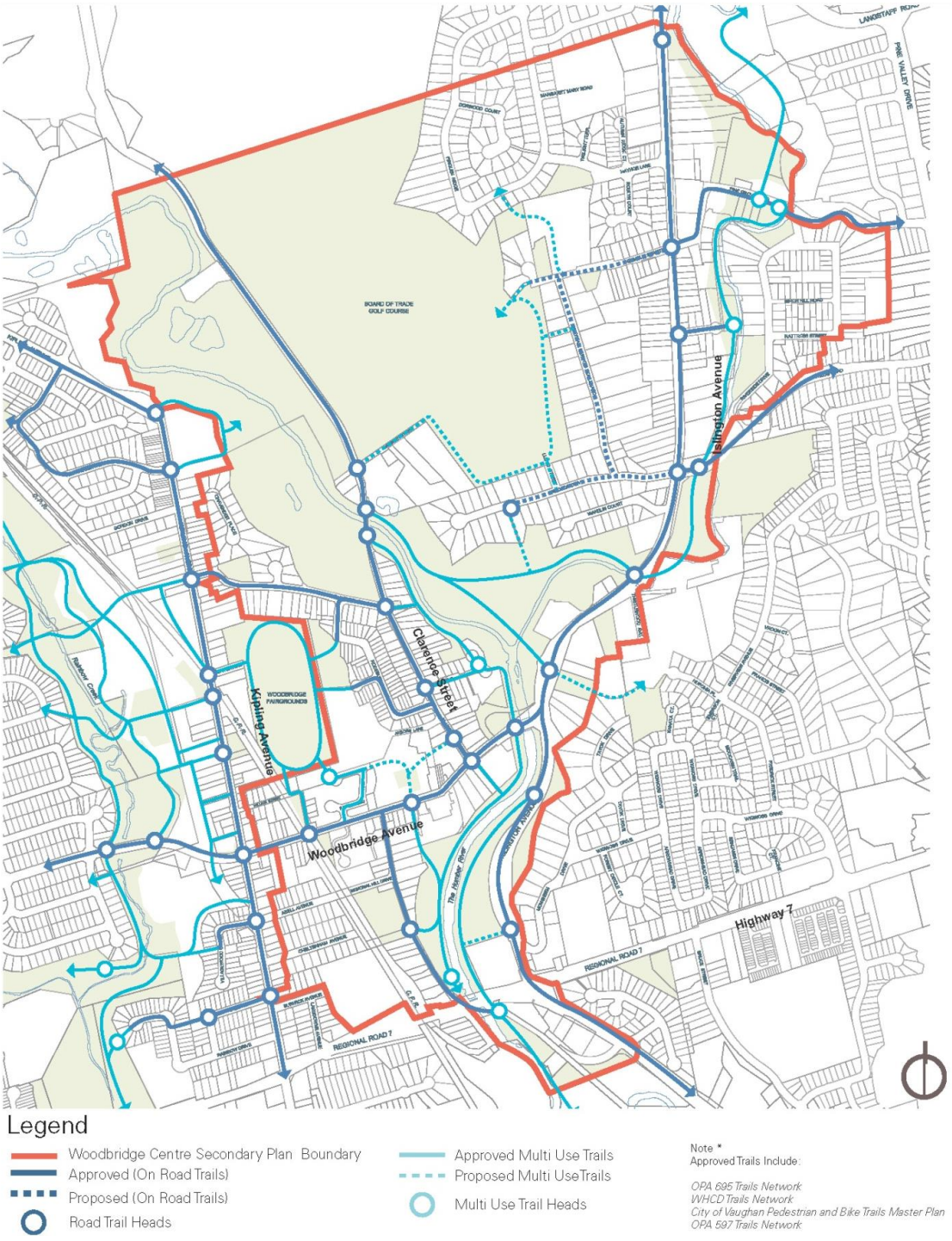


Figure 18: Pedestrian and Bicycle Trails Network – Schedule 7 (2009)

3.4.5 TRCA Living City Policies, 2014

TRCA plays a leadership role in moving the Greater Toronto Area toward the Living City Vision. TRCA's Living City Vision sets out comprehensive guidelines where site development is proposed within TRCA Regulated Areas with a goal to protecting the most vulnerable natural heritage features and species, while promoting restoration, education, recreation and well-being in natural areas within the GTA.

The Living City Policies consider trails as "minor recreational facilities that require very little modification of terrain or vegetation and few if any, buildings, structures and limited parking. They are of low intensity and a non-intrusive nature." The goal of trail design is **"**That the siting design and operation of recreational use avoid, *mitigate*, and/or compensate for impacts to the *Natural System*" the objective being "to promote and monitor the use and enjoyment of the *Natural System* for recreational use that minimizes impact to the natural environment by striving for a balance between conservation and appropriate public uses" and that the trail system should "promote the recognition and linkages between natural heritage and cultural heritage on recreational use lands in or adjacent to the *Natural System*."

With respect to trail development the following policies apply (refer also Section 3.4.9):

6.4.1 Policies for Sustainable Transportation

a) To continue to advocate for sustainable transportation through TRCA partnerships, programs, and operations.

b) To support municipalities in developing policies for implementing sustainable transportation into their Master Plans, planning documents and operations.

c) To encourage municipalities to explore opportunities for integrating TRCA trail systems into their active transportation plans.

7.4.4.1 General Policies for Infrastructure

2. iv. Maintain the *ecological* and *hydrological functions* of the *valley* or *stream corridor* by considering the following in accordance with *TRCA Standards*:

- pedestrian passage (e.g. trails).

7.4.5.1 Policies for Recreational Use

It is the policy of TRCA to "realize a linked regional open space system" which provides the basis for:

a) i) a coordinated network of landscape and nature-based accessible recreation areas.

vi) trail networks that connect communities, parks and greenspace through landscapes and landforms like the river valleys, the Lake Ontario waterfront and the Oak Ridges Moraine.

c) That *minor recreational uses* may be permitted in the *Natural System*, in accordance with the policies of the Living City Policies.

g) To adopt and implement best management practices and *TRCA Standards* for recreational uses on TRCA-owned lands including:

iv) Safety and accessibility of trails in accordance with *TRCA Standards*.

i) To recommend that trails be connected and accessible to the community or communities which they serve.

j) To recommend that the number of *watercourse* crossings for trails be minimized.

k) To recommend that all *major* and *minor* recreational use projects, where applicable, meet all of TRCA's stormwater management criteria.

l) To require *archaeological assessments* on any ground disturbance for any *minor* or *major recreational uses* proposed for TRCA-owned lands, in accordance with the procedures for *archaeological assessment in accordance with TRCA Standards.*

8.10 Recreational Use Policies

That *development*, *interference* and *alterations* associated with trails may be permitted within a *Regulated Area* where it has been demonstrated through appropriate technical reports to the satisfaction of TRCA that:

b) Generally, the trails be made of pervious surface material;

c) The riparian zone of *watercourses* is avoided;

d) The risk to public safety from natural hazards is not increased by avoiding active *erosion* zones, such as outside meander bends and *valley walls* where banks are eroding;

e) *Watercourse* crossings have their approaches at-grade and allow for conveyance of high flows;

f) The risk to public safety is not increased.

3.4.6 TRCA State of the Watershed Report, 2004

In 2004, the Toronto and Region Conservation Authority (TRCA), in partnership with watershed municipalities and the Humber Watershed Alliance initiated a study to develop an integrated watershed management plan for the Humber River. The watershed plan is intended to inform and guide municipalities, provincial and federal governments, TRCA, non-governmental organizations and private landowners regarding management actions that are aimed at maintaining and improving watershed health. The study tracks indicators of watershed health and associated targets which are used to rate conditions. The report provides an overview of current management strategies and introduces some innovative approaches to address key issues.

3.4.7 Vaughan City-Wide Urban Design Guidelines

As the process goes forward from trail planning into detailed design consideration for the City of Vaughan Urban Design Guidelines will be necessary.

3.4.8 Active Together Master Plan, 2018

Vaughan's 2018 Active Together Master Plan (update) sets out a vision for a healthier and more mobile community. The vision, goals and objectives of the Humber Trail Feasibility Study should reflect these that are set out in the Active Together Master Plan. The key recommendations that relate to Recreational Trails include:

27. Ensure that implementation of the City's proposed recreational trail network – including the Vaughan Super Trail – is reflected as a high priority through the proper allocation of capital and maintenance funding and resources.
28. Work with the development community, TRCA and other landowners to enhance connectivity of the recreational trail network by linking woodlots, open spaces, parks, schools, civic destinations, transit hubs, and residential and employment areas. The development of a comprehensive map identifying potential synergies may assist in this regard.
29. Evaluate trail and pathway requirements through the planning and development process. Encourage the conveyance of corridors of land (over and above parkland dedication, where applicable) using the various tools available to the City.

30. Seek opportunities to establish trail loops for walking and running (as well support amenities such as seating, shade, etc.) within new and redeveloped parks and open spaces.
31. Work with the TRCA and other City departments to explore options for addressing trail maintenance (e.g., management agreement) and opportunities for program and facility integration.
32. Continue efforts to improve the quality and quantity of signage (wayfinding and environmental education), mapping and promotion of recreational trails in Vaughan.

Furthermore, surveys conducted through the 2018 Vaughan Active Together Master Plan update, indicate that trail use for recreational purposes is the most desired type of activity residents identify with.

3.4.9 TRCA Trail Strategy, 2019

The TRCA Trail Strategy for the Greater Toronto Region was endorsed by its Board of Directors on September 27, 2019. The plan was conceived as a resource to encourage and assist partners to complete, expand, manage and celebrate a connected trail network in the regional greenspace system. It serves as a framework to protect potential trail alignments, and to guide the planning, development, and management of trails with the following key objectives:

- Protection of opportunities to achieve the regional trail network through the development review process;
- Protection of connected routes and corridors for wildlife, recreation, and active transportation;
- Provision of natural spaces for play, exploration, and recreation;
- Provision and protection of green infrastructure and ecosystem services;
- Protection of cultural heritage and promotion of its understanding;
- Creation of opportunities for land-based education;
- Enhancement of physical landscapes, to inform existing and future development;
- Encouragement of urban regeneration;
- Support for the economic potential of eco-tourism;
- Improvement of social inclusion, equity, and accessibility of greenspaces;
- Improvement of opportunities to enjoy and connect with nature; and,
- Reinforcement of our regional identity.

In working with City of Vaughan, the TRCA will leverage the Strategy to acquire, protect, and enhance natural assets, and to achieve new and upgraded trails, while connecting people to nature. In addition, many protection, stewardship and regeneration projects can be planned and/or implemented by the TRCA in association with trail implementation.

3.4.10 Accessibility for Ontarians with Disabilities Act

Detailed design work will require adherence to AODA design principles and guidelines to the development of the trail system. A site-specific suite of accessible trail design standards should be considered for the trail including:

- Identification of the design criteria for accessible trails (e.g. maximum running slope and cross slope, trail surface requirements, width);
- Development of standard drawings/ details and specifications for accessible trails;
- Provisions to meet or exceed the requirements of the AODA draft Design of Public Spaces Standards (Accessibility Standards for the Built Environment); and,
- Incorporation of best practices for accessible trails.

4.0 Natural Environment Feature Constraints

Within the extent of the Feasibility Study there exist numerous natural heritage features that warrant protection and enhancement and as such are constraints to trail development. At the outset of the Study, data was obtained and analyzed by the Project Team including: vegetation communities, vegetation quality indices, flora and fauna occurrences including Species at Risk, wetland locations, forest interior habitat, management issues and special features. The information provided an inventory of all natural heritage features and while NHS features within ESAs and the Greenbelt as well as features comprising SAR were considered more highly for protection and buffering over species and habitats that are less sensitive to disturbance for example, all natural heritage features were considered in forming the basis for decisions related to avoidance, minimization of impacts on vegetation communities of all types and mitigation and compensation where a natural feature's form and/ or function could be impacted.

The following provides a description of each natural feature considered in the constraint analysis utilized in developing trail alignment options.

4.1 Hydrology, Physiography and Wetlands

The dominant physiographic feature of the Study Area is the Humber River valley, a relatively steep and narrow ravine formed by the Humber River and its tributaries. The main branch of the Humber River meets the East Humber River to the north of Woodbridge Avenue. The Study Area includes the main branch of the Humber River to the south of Woodbridge Avenue and then follows the East Humber River north to Boyd Conservation Area. Several much smaller tributaries intersect the Humber River and East Humber River in the Study Area.

Soils in the Study Area consist mainly of sandy and gravelly loam. The Humber River valley occupies a glaciofluvial meltwater channel and surficial geology in most of the Study Area consists of Pleistocene glacial deposits (Chapman & Putnam, 1984). The Woodbridge Pleistocene Cut Earth Science Area of Natural and Scientific Interest (ANSI) is in the southern portion of the Study Area between Highway 407 and the Canadian National (CN) railway. The ANSI includes an excellent cross-section of Pleistocene glaciolacustrine deposits. The constructed berms and embankments that support the Canadian Pacific (CP) railway, Highway 407 and other infrastructure represent major modifications to the topography within the Study Area.

The river valley comprises wetlands of both regional and local significance contributing core habitat for area sensitive and Species at Risk birds, mammals, herptiles and amphibians. The study area encompasses wetlands of various sizes and relative significance. Wetlands classified by the Province of Ontario as Provincially Significant as well as those that have been evaluated by the Province of Ontario, but are not considered Provincially Significant, are present throughout the study area.

Wetlands are diverse and delicate ecosystems that are ecologically valuable from habitat and hydrological perspectives. Wetlands are currently protected by strong Provincial laws and policies protecting wetlands from environmental harm and setting a goal of restoration and protection. Existing requirements for protection are essentially “no impact” policies for most wetlands. This means that, no construction of any sort should impact the wetland. Where avoidance is not possible, a minimum of 10-30m setback must be provided to all wetland features and the construction of low impact structures such as a boardwalk, should be considered.

Wetlands also represent important opportunities for education and interpretation. Narratives may include protection of water quality, sensitive and unique habitats and species associated with wetlands, and the important ecological functions of wetlands.

4.2 Vegetation

TRCA has assessed vegetation communities throughout much of the Study Area using Ecological Land Classification (ELC) and the ecologists on the Study Team (North-South Environmental) confirmed the accuracy of these ELC designations in the field. Much of the natural and naturalized vegetation in the Study Area is associated with the East Humber River valley and consists of a mix of forest and open country habitat combined with a few wetlands. Intense anthropogenic disturbance in some areas has led to the formation of sparsely vegetated sand and clay barrens. Most of the forests in the Study Area are relatively young, but mature forests exist on the steeper valley slopes and within Boyd Conservation Area. Figure B.5, Appendix B illustrates the location of forested vegetation communities within the Study Area.

The following key features and functions were considered in the context of developing alternate trail alignments:

- Rare vegetation communities including one Provincially rare and at least 24 different locally rare vegetation communities;
- Rare plant species including two Provincially rare and 54 locally rare plant species; and,
- One area of interior forest habitat (forest over 200m from any edge), illustrated on Figure 25, within Segment 5 of the Study Area.

For further review of the specific features refer Appendix F – Natural Heritage Report.

4.3 Breeding Birds

Data from TRCA indicates that a variety of bird species use habitats within the Study Area for breeding and for other life processes. This habitat supports several SAR, provincially rare and locally rare bird species. Endangered and Threatened birds that have been recorded to be present within the Study Area include Bobolink (*Dolichonyx oryzivorus*), Barn Swallow (*Hirundo rustica*), Bank Swallow (*Riparia riparia*) and Eastern Meadowlark (*Sturnella magna*). These species are discussed in more detail Appendix F – Natural Heritage Report.

One 'Special Concern' bird species was observed by TRCA within the Study Area: Wood Thrush (*Hylocichla mustelina*). Because this species is listed as a "Special Concern" species under the provincial ESA, Wood Thrush does not receive the same regulatory protection as an Endangered and Threatened species would. However, its habitat is considered to be Significant Wildlife Habitat (SWH) as per the SWH Technical Criteria for Ecoregion 6E (MNRF, 2015). Wood Thrush nests in large, mature deciduous and mixed forests. This habitat covers an extensive amount of the Study

Area, primarily in the East Humber River valley. Mature forest habitat in the Study Area should therefore be considered habitat for Wood Thrush.

There are 16 locally rare bird species that have been observed and documented in the Study Area. For a list of these species refer Appendix F – Natural Heritage Report.

4.4 Other Wildlife

Data from TRCA indicates that a variety of reptiles, amphibians, mammals and other wildlife exist within the Study Area and make use of various habitats for breeding, foraging, overwintering and other life processes. This includes at least one provincially rare species, one of Special Concern (Snapping Turtle) whose habitat is considered "Significant Wildlife Habitat" warranting higher protection, and several locally rare species which are also indicators of important habitats for breeding and foraging. For additional information refer Appendix F – Natural Heritage Report.

4.5 Significant Wildlife Habitat

SWH was identified in the Study Area using the criteria in the SWH Criteria Schedules for Ecoregion 6E (MNRF, 2015). Some SWH has been mapped by TRCA, such as rare vegetation communities and significant bird breeding habitat types. Terrestrial crayfish were observed by TRCA, but their habitat was not mapped and NSE therefore estimated the extent of this SWH type. Other candidate SWH may be present in the Study Area based on the presence of certain indicator species as described below.

4.5.1 Seasonal Concentration Areas of Animals

Turtle Wintering Areas

TRCA has mapped several observations of Snapping Turtle within the Study Area and other turtle species may be present as well. The possibility that turtles overwinter in the Study Area should therefore not be ruled out. Suitable overwintering sites may be present in wetlands, ponds, slow-moving embayments of the East Humber River and other hydrologic features with soft substrates. More detailed surveys would be required to specifically identify the specific locations of turtle wintering areas.

4.5.2 Rare Vegetation Communities

One provincially rare vegetation community has been mapped by TRCA within the Study Area: Hemlock Mineral Coniferous Swamp (refer to Natural Heritage Report, Appendix F, Section 3.3.1).

4.5.3 Specialized Habitat for Wildlife

Turtle Nesting Areas

TRCA has several recorded observations of Snapping Turtle nests within the Study Area and other turtle species may also nest as well. Nesting sites for Snapping Turtle and other turtles could occur anywhere with sandy or gravelly soil, typically on south-facing slopes where the substrate is exposed for easy excavation. Nesting sites are likely to be near to the East Humber River and other hydrologic features, but Snapping Turtles are known to travel as far as several hundred metres from their habitat in search of nesting sites. More detailed surveys would be required to identify specific nesting areas.

Amphibian Breeding Habitat (Wetland)

Three indicator species for significant amphibian breeding habitat, wetland type, have been observed by TRCA in the Study Area: Grey Treefrog, Spring Peeper and Wood Frog. However, detailed frog call surveys have not been conducted and this SWH has not been confirmed. All of the wetlands that are located within the Study Area should be treated as candidate amphibian breeding habitat, wetland type.

Woodland Area-Sensitive Bird Breeding Habitat

Three area-sensitive bird species have been observed within the Study Area by TRCA: Pileated Woodpecker, Scarlet Tanager and Black-throated Green Warbler. Interior forest habitat has also been mapped in the Study Area by TRCA (Refer to Natural Heritage Report, Appendix F, Section 3.3.2) and there are several woodlands that are larger than 30 ha in size. The presence of three indicator species in forests larger than 30 ha containing interior habitat means that these forests are candidate woodland area-sensitive bird breeding habitat. In order to confirm that this SWH type is present in the Study Area, nesting pairs of these, or other indicator species would need to be identified in suitable habitat.

4.5.4 Habitat for Species of Conservation Concern

The habitats for the following species are considered a “moderate constraint” and will require a Letter of Advice from MECP for work in regulated habitat for Species at Risk (SAR). The constraint areas are illustrated on Figures 20-24). The trail design would have to demonstrate that no negative impact to the habitat results from the development.

Shrub/Early Successional Bird Breeding Habitat

TRCA has mapped shrub/early successional bird breeding habitat within the Study Area. This type of SWH represents habitat for bird species that require large field areas that are succeeding into shrub thickets for breeding and foraging. Three indicator species for this SWH type have been recorded in the Study Area by TRCA: Brown Thrasher, Field Sparrow and Black-billed Cuckoo. This SWH type is in the southern portion of the Study Area between Highway 7 and Steeles Avenue West.

Terrestrial Crayfish

Terrestrial crayfish or 'chimney crayfish' (Cambaridae spp.) are crayfish that live primarily in subterranean burrows. The burrows can be identified by the chimney-like structures at their openings. Two species are known to occur in Ontario: Digger Crayfish (*Fallicambarus fodiens*) and the provincially rare Devil Crayfish (*Cambarus diogenes*). Habitat for both species is considered SWH. TRCA has mapped one observation of a terrestrial crayfish in the Study Area and NSE staff found additional burrows during a field visit in 2018. Typical terrestrial crayfish habitat comprises treed or open lowland habitat with waterlogged sandy soil.

Habitat for Special Concern and Rare Wildlife Species

Two Special Concern species are present in the Study Area: Wood Thrush and Snapping Turtle. In addition, two provincially rare plant species are present in the Study Area: Hairy-fruited Sedge and Meadow Evening-primrose. Habitat for these species is considered SWH as per the SWH Criteria Schedules for Ecoregion 6E (MNRF, 2015a).

4.6 Fish and Aquatic Habitat

Aquatic Resource Areas (ARA) data from MECP indicates that the main branch of the Humber River within the Study Area is a warmwater system containing a diversity of fish species including minnows, suckers, catfish, sculpins and sunfish. The East Humber River is a cold-water system with a similar diversity of fish species. DFO aquatic SAR mapping indicates that the East Humber River is occupied by Redside Dace (*Clinostomus elongatus*), which is listed as Endangered under the provincial ESA and the federal *Species at Risk Act* (SARA), 2002.

The habitat for Redside Dace is considered a "high constraint" and will require a permit or approvals from regulatory agencies (e.g. MECP, DFO). A permit will be required to facilitate the implementation of trails that encroach within regulated habitat and/ or if the trail is anticipated to have a direct or an indirect impact on certain ecological features or functions of the Study Area.

4.7 Endangered and Threatened Species

4.7.1 Butternut

TRCA has mapped several Butternuts in the Study Area. Butternut is listed as Endangered under the provincial ESA and therefore receives regulatory protection under provincial legislation. Under the ESA, a protection zone of 25 m radius is applied to individual Butternuts. The locations of Butternut trees have been mapped by TRCA.

4.7.2 Bobolink and Eastern Meadowlark

TRCA has mapped several observations of Bobolink and Eastern Meadowlark within the Study Area and a Bobolink was also observed by NSE staff during a site visit in 2018. Bobolink and Eastern Meadowlark are both listed as Threatened under the provincial ESA and these species share similar habitat: both require extensive open grasslands for breeding and foraging. The General Habitat Descriptions for Bobolink (MNRF, 2013a) defines the following categories:

- **Category 1 Habitat** is the area within 10 m of a Bobolink nest.
- **Category 2 Habitat** is the are between 10 and 60 m of the next or approximate centre of defended territory.
- **Category 3 Habitat** is the area of continuous suitable habitat (i.e. open country habitat) within 300 m of the nest or approximate centre of defended territory.

The General Habitat Description for Eastern Meadowlark (MNRF, 2013b) is similar except that Category 2 habitat is the area within 100 m of the nest or approximate centre of defended territory. Habitat for Bobolink and Eastern Meadowlark species is located on the west side of the East Humber River between Highway 407 and Highway 7. The habitat is noted as an area of 'high environmental constraint' on Figure 24. Open country habitat in this area should be considered Category 3 habitat for these species.

4.7.3 Bank Swallow

Information from TRCA indicates that there is a Bank Swallow colony on a bluff that is located along the East Humber River between Highway 407 and Highway 7. Bank Swallow is a threatened species under the provincial ESA and alterations to its habitat may require a permit under the ESA. The General Habitat Description for Bank Swallows (MNRF, 2015b) defines the following categories:

- **Category 1 Habitat** is the breeding colony including burrows and the substrate around them.

- **Category 2 Habitat** is the area within 50 m of the front (bank face) of the colony.
- **Category 3 Habitat** is the area within 500 m of the colony.

Much of the area between Highway 407 and Highway 7 can be considered Category 3 habitat for Bank Swallow. The habitat is identified with a 500m setback on Figure 24. Refer Figure 24 to review trail alignment options in relation to this habitat.

4.7.4 Barn Swallow

Information from TRCA indicates that there are Barn Swallow nests on two structures in the Study Area. Neither of these structures is proposed to be modified as part of the trail construction project but foraging habitat for Barn Swallows could be affected. The General Habitat Description for Barn Swallows (MNRF, 2013c) defines the following categories:

- **Category 1 Habitat** is the Barn Swallow nest itself.
- **Category 2 Habitat** is the area within 5 m of the nest.
- **Category 3 Habitat** is the area between 5 and 200 m of the nest.

Category 3 habitat is the core foraging habitat for Barn Swallows and this type of habitat is present at two locations within the Study Area. The first is located along the East Humber River between Highway 407 and Highway 7 and is completely contained within Category 3 habitat for Bank Swallow. The second area of Category 3 habitat for Barn Swallows is located around a municipal salt dome on the north side of Langstaff Road. The habitat is identified with a 200 m setback on Figure 21 and Figure 24.

4.7.5 Endangered Bats

Four of Ontario's bat species are listed as Endangered under the provincial ESA:

- Eastern Small-footed Myotis (*Myotis leibii*)
- Little Brown Myotis (*M. lucifugus*)
- Northern Myotis (*M. septentrionalis*)
- Tricolored Bat (*Perimyotis subflavus*)

Within the Study Area, there is potential for these species to roost in cavities, under bark or on branches of mature trees, under bridges and culverts or inside human structures. Any mature trees, especially in forests, are potentially habitat for Species at Risk (SAR) bats. However, more detailed surveys will be required to determine if SAR bats are present in the Study Area and if so,

where critical habitat exists. Local modifications to trail alignment may result as an outcome of the surveys in order to avoid SAR bat habitat which could even be identified as an individual tree.

4.7.6 Redside Dace

DFO aquatic SAR mapping indicates that the East Humber River is occupied by Redside Dace, which is listed as Endangered under the ESA and the Species at Risk Act (SARA). Regulated habitat for Redside Dace under the ESA includes:

- Any watercourse currently occupied by Redside Dace;
- Any watercourse occupied by Redside Dace within the past 20 years or that contributes to habitat currently occupied by Redside Dace;
- Vegetated and agricultural areas within 30 m of the features described above;
- Headwater drainage features, groundwater recharge areas and/or wetlands that contribute to the features described above; and,
- The area encompassing the meander belt of streams described above.

The meander belt plus a 30 m buffer along occupied reaches of the East Humber River within the Study Area was modeled by Aquafor Beech Limited as part of this Study. This area represents the limit of regulated habitat for Redside Dace within the Study Area.

Figure 26 shows the extent of the designated Redside Dace habitat associated with the Humber River. The map is overlaid with the meander belt + 30m setback as determined through this Study process. A portion of the Lower Humber River is listed as Contributing Habitat which denotes reaches which previously sustained Redside Dace habitat but no longer do.

5.0 Cultural Heritage Resources

The Humber River has been home to human settlements for over 10,000 years, beginning with native inhabitants. During the 1800s, agricultural settlements became established. The river was populated with many mill sites during Vaughan's early industrial heyday including a cotton mill in Woodbridge. The Humber River was also the site of Étienne Brulé's travels along the Carrying Place Trail.

The Humber River was deemed a 'Canadian Heritage River' in 1999. This designation recognizes the Humber River's contribution to the development of the country and its importance in the history of Indigenous peoples and the early Euro-Canadian explorers and settlers of Upper Canada.

5.1 Archaeological Resources

There are relatively few known archaeological sites within the Study Area. However, much of the natural area to the west of the river, north of Pine Grove Road, and areas on both sides of the river south of Highway 7, are considered by the TRCA to possess "Medium Potential" for archaeological resources. The sites are in lands owned either by the City, TRCA or Infrastructure Ontario and are situated on the edges of the valley. There are two sites of "High Archaeological Potential", which present constraints to two of the potential trail routes. These are areas that could contain archaeological resources. Many of these areas are situated in forested and sloped sections of the valley landscape. Figure B.7, Appendix B, illustrates known archaeological sites as well as those with potential, in relation to optional alignments that are proposed for the trail. All development including trail development within 50m of a known site or within areas of high archaeological potential will require an Archaeological Assessment as per the *Ministry of Heritage, Sport, Tourism and Cultural Industries, Guidelines for Consulting Archaeologist*s. The TRCA carries out its own assessments on land within its ownership.

A complete description of the various archaeological sites that have been found within the Vaughan Humber Trail Study Area is contained within the City's Archaeological Master Plan.

5.2 Cultural Features and Landscape

There are numerous cultural heritage resources and landscapes located within and adjacent to the Study Area. These include agricultural and industrial artifacts and cemeteries or sacred landscapes. In addition, there are a number of Heritage properties that have been Designated or Listed under Part IV of the *Ontario Heritage Act*. A catalogue of Listed and Designated Heritage properties can be found in the City of Vaughan Cultural Heritage Landscape and Inventory and Policy Study that was conducted in 2010. Policies to protect cultural heritage features and landscapes are set out in the City's Official Plan.

Cultural heritage sites that are located within the Study Area include an old mill site and mill run that are located south of Pine Grove Road. Remnant abutments also exist from an old dam in the Boyd Conservation Area, across from the main parking lot on west side of the Humber River. This section of the river used to be dammed to create a swimming hole for residents.

On the north side of Langstaff Road in the southern extent of the Boyd Conservation Area, a concrete bowstring bridge crosses the Humber River. The bridge was designed by the architect Charles Mattaini (Brennan, 2018), and is considered by the City of Vaughan to have cultural value. The structure has fallen into decay and remains barricaded from public access due to safety concerns. While the bridge is not Listed or Designated under the *Ontario Heritage Act* as a cultural

resource, the decorative arches are unique to this style of bridge and thus merits consideration for its potential retention, repair or replacement with a bridge that reflects its historical character.

Built nearly a century ago, the bowstring bridge is a relatively recent example of 'period architecture' and is only one of six remaining examples of this type of bridge in the GTA. Of these, two remain within Vaughan. This particular bridge is a TRCA asset as it falls within the TRCA owned and managed Boyd Conservation Area lands. Prior to proceeding with works related to the bridge, it is recommended that the bridge undergo a Heritage Impact Assessment to confirm the potential heritage value of this structure. Please refer Appendix C for more details on the condition of this bridge and for the options for its retention, repair or replacement. Please also refer to Section 1.3.1 where optional trail alignments are considered in and around this bridge location.

Apart from the bowstring bridge, the optional trail alignments as proposed do not impact Listed and Designated Heritage properties, however, a section of the trail between Highway 7 and where the proposed trail meets Islington Avenue at Doctor Maclean District Park, falls within the Woodbridge Heritage Conservation District, which is described further in Section 3.3.3.

Opportunities to tell the stories associated with these cultural heritage features and landscapes and heighten public awareness of their importance were explored as a component of the process of determining potential alignments for the Vaughan Humber Trail.

6.0 Existing Trails and Linkages

The presence of existing trails within the Study Area, present opportunities for trail alignment. Informal trails are often indicative of the need for a connection between destinations or a 'desire line'. Aligning the trail with ad-hoc trails or access routes can reduce additional disturbance to the Natural Heritage System. Furthermore, the location of access points to these trails from the surrounding residential communities represent opportunities for linkages. The following opportunities were identified in the context of conducting the site walks.

6.1 Existing Trails

During the site walks the Study Team identified existing walking trails (earthen trails created by local residents), informal access paths created by vehicle use, to access a farm field for example, and constructed access routes utilized by various landowners to service infrastructure. Infrastructure Ontario, Enbridge, the City and York Region utilize various access routes to service hydro towers and lines, perform maintenance and upgrades to stormwater infrastructure and the sewage systems and high-pressure gas lines. Where possible, it is recommended that the trail be

aligned and to follow existing ad-hoc trails and service access routes to mitigate disturbance within the valley.

The following is a list of typical conditions that were observed within the Study Area during the site walks where informal trail use was evident:

- Erosion and soil compaction associated with foot traffic leading to impacts to tree roots, potentially compromising tree health and stability;
- Some trails present safety risks for users; (i.e. steep valley slopes, low bridges, pinch points of the river and wet areas);
- Sections of informal trails have become inpassible due to slope failure and erosion (due to natural river meander processes);
- In some areas informal trails intersect groundwater seepage zones resulting in wet trail conditions, trail widening and soil compaction;
- In some areas, riverbank and valley slope erosion are occurring due to foot traffic as well as mountain bike riding and off-leash dogs;
- Encroachment on vegetation is impacting understorey regrowth sometimes enabling invasive species to become established and outcompete native species; and,
- Trail creation can fragment natural ecosystems, disrupt wildlife, spread garbage and contribute to distribute invasive species.

It was identified during the investigations that many of the existing trails did not form loops. This is likely due to the wide meander of the river and the higher flow velocities which make crossing the river a challenge. It was also identified that informal trails flanked much of the river system and that access and egress points to the riverside trail system tended to be from vehicular bridges and the sidewalks along roadways. Limited ATV use was noted (refer to Section 1.3.4), where trails from this activity were noted).

6.2 Regional Trail Linkages

The Humber Trail through Vaughan will provide a continuation of a major north-south connector, eventually making a link between Lake Ontario Waterfront Trail and the Oak Ridges Moraine. An equally important opportunity exists to create an east-west linkage in the future Transitway trail link. Figure 19 below illustrates the Transitway study area and proposed Pine Valley Transitway station.

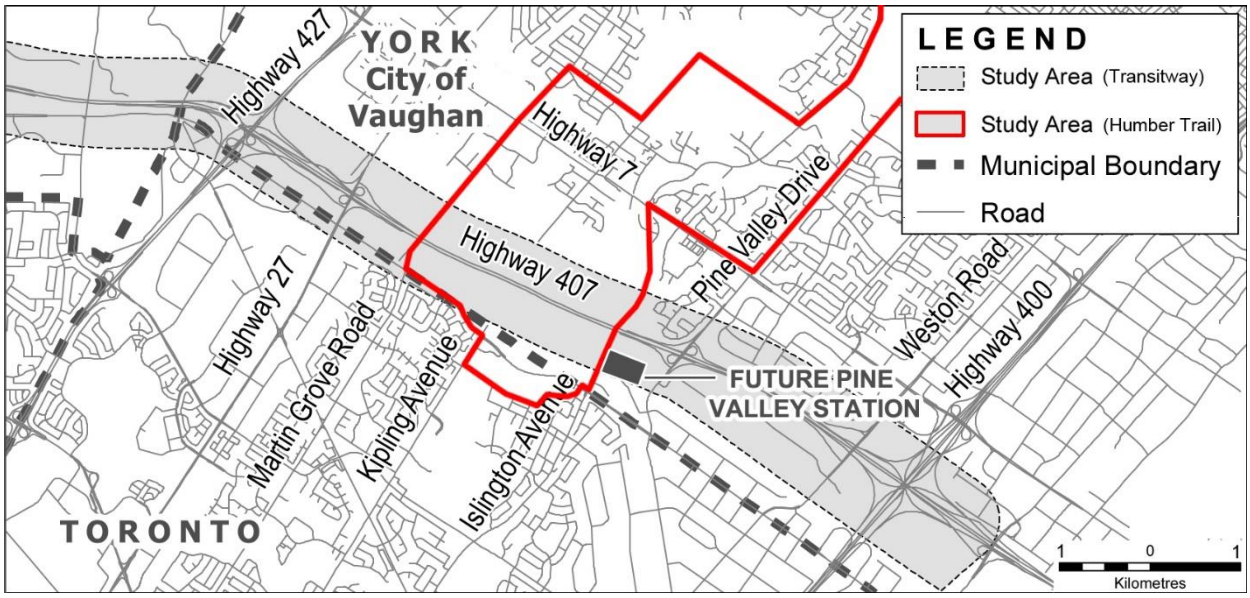


Figure 19: Transitway Study in relation to Humber Trail Study Area

A Transitway Trail Link (also referred to as the York South Greenway) located on the north side of Highway 407 within the Transitway Study Area, presents a major opportunity to create a hub at the confluence of two major regional trail routes. Figure 19 also identifies an opportunity to link the east-west trail with the of Vaughan Grove Sports Park which is a major regional recreational destination.

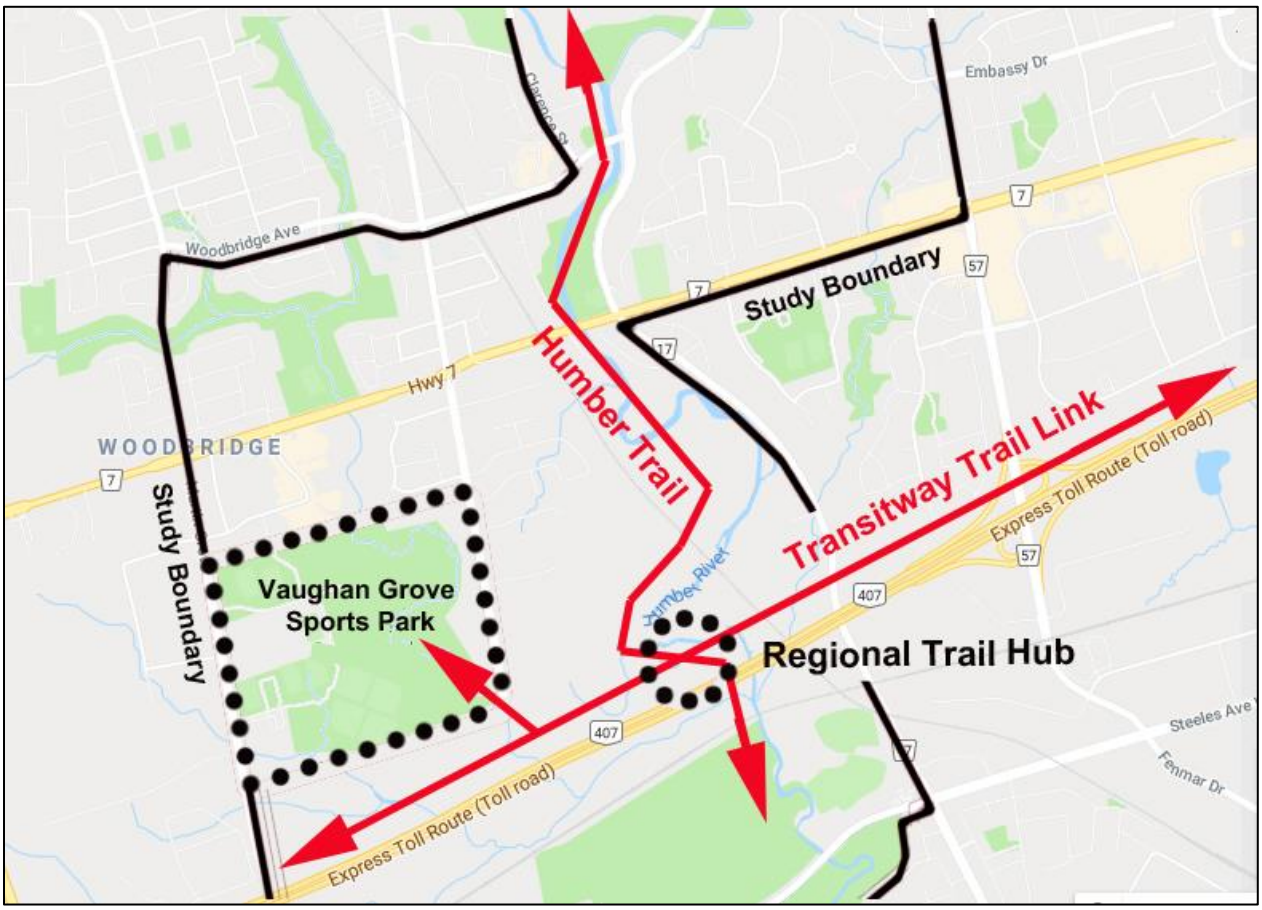


Figure 20: Regional Trail Links

6.3 Local Trail Connections

In the context of exploring optional trail routes, several opportunities to link neighbourhoods and connect to the existing and planned local trail networks were identified. Figure B.3, Appendix B, illustrates the City of Vaughan Pedestrian & Bicycle Master Plan 2020. Figures 4 and 8 through 11, illustrate how the proposed trail alignment options integrate with the City's plan.

7.0 Constraints to Trail Development

In addition to the various policies and regulations that need to be regarded and that influence trail alignment options, there are several physical, environmental and land use constraints that inform trail development options.

In the context of evaluating the planning framework and site conditions for the proposed Humber Trail the following constraints were analyzed for their potential affect on proposed trail alignments:

- Natural features such as wetlands, Environmentally Significant Areas and locally significant habitat supporting rare species;
- Natural hazards such as the flood plain;
- Physical barriers such as slopes, drainage features and watercourses;
- Privately-owned lands;
- Infrastructure underpasses such as roadways and railways (all crossings of Regional roads will require approval by the Region); and,
- Gas and hydro electric utility corridors (i.e. setbacks to hydro electrical transmission towers).

Protection of the Natural Heritage System is a fundamental consideration that influences trail alignment and design. Mitigating impacts to the ecological features and functions that make up the NHS is therefore a critical aspect of trail design. Potential trail alignments should avoid areas of high ecological sensitivity and should minimize fragmentation and isolation of existing features. Mitigation measures to protect natural heritage features from the impacts of construction will also be required to be implemented. However, trail development also presents opportunities to enhance and restore the NHS by creating wildlife habitat, restoring natural vegetation communities and restoring natural hydrology. Opportunities for ecological enhancement and restoration should be incorporated into trail design in order to achieve a net benefit to ecological features and functions.

With this in mind, and with the goal of avoiding impediments to trail development, various routes were evaluated against constraint criteria.

The individual constraints criteria are analyzed in the context of trail alignment and are assigned a value of 1, 2, 3 or “no” depending on whether the trail alignment is affected by the given constraint. Each criterion is meant to be “scored” in conjunction with other constraints and include environmental constraints related to natural heritage features as described above as well as flood hazards, river morphology, land ownership, topography and slope stability. These constraints relate to safety, accessibility, aesthetic and experiential objectives for the trail. Coupled with a comparison of the cost, the result is an overall score for each trail segment. The segments with the lowest constraint score and cost emerged as the “preferred trail alignments”.

Figures 20-24, illustrate the range of constraints identified for segments 1 through 5 of the Study Area.

The following Sections describe the parameters that were utilized to assess alternative trail alignment options.

7.1 Ecological Constraints

Since the majority of the Study Area is contained within the City's Natural Heritage and Open Space System and given the relative diversity of the natural features within the system, consideration for environmental sensitivity is a principal criterion.

Key ecological considerations for determining the feasibility of various alignments included:

- The ecological integrity of the East Humber River valley and associated designated areas should be maintained;
- Critical habitat for Species at Risk (SAR) should be avoided;
- Interior forest should be protected;
- Rare vegetation communities, Significant Wildlife Habitat (SWH), wetlands and habitat for locally rare species should be avoided;
- Tree removal and vegetation clearing should be minimized;
- Disturbance to valley walls and other slopes should be avoided, especially in areas with erosion-prone substrates;
- Disturbance to fish and aquatic habitat should be avoided and any crossings of the East Humber River must be reviewed for potential impacts to Redside Dace (*Clinostomus elongatus*) habitat; and,
- Trail development and management within the Greenbelt, Natural Heritage Network or other designated areas of environmental sensitivity, should have regard for provincial and municipal policies.

A constraints analysis was undertaken by NSE whereby designated areas, significant species occurrences, sensitive habitats and other features were identified as high, moderate or low constraint, as follows:

- **High Constraint Areas** were defined as areas with features which, if altered through trail development, would a) require permits and approvals from regulatory agencies and/or b) would directly result in negative impacts to the ecological features and functions of the

Study Area. Trails traversing high constraint sites were assigned a rating of '3' in the matrix (see *Tables 3.1-3.5*).

- **Moderate Constraint Areas** were defined as areas with features which, if altered through trail development, will not necessarily require permits from regulatory agencies but which still receive some protection under the PPS or other policies. Trail alignments within these areas would need to be selected based on demonstrating 'no negative impact' to these features. Trails traversing 'high constraint' sites were assigned a rating of '2' in the matrix (Refer to *Tables 3.1-3.5*). Moderate constraint areas may be protected under the PPS (e.g., Significant Wildlife Habitat) and the preferred trail alignment options would need to be selected based on demonstrating 'no negative impact' to these features.
- **Low Constraint Areas** were defined as area with features which, if altered through trail development, will a) not require permits and approvals from regulatory agencies and/or b) would not result in negative impacts to the ecological features and functions of the Study Area. Low Constraint Areas are not specifically identified as a constraint and are therefore not included in the Decision-Making Matrix. In other words, within "low constraint areas" there are few restrictions to trail alignment from a natural heritage perspective.

The following table (prepared by North-South Environmental Inc.) summarizes the data layers that were used to define each ecological constraint type.

Table 2: Ecological Constraint Categories and Criteria

HIGH CONSTRAINT	MODERATE CONSTRAINT	LOW CONSTRAINT
High constraint areas will require permits or approvals from regulatory agencies (e.g. MNRF, MECP, DFO) and/or the trail will likely have a direct impact on certain ecological features or functions of the study area. TRCA regulated areas are excluded from the high constraint category because virtually the entire proposed trail system falls within the regulatory floodplain.	Moderate constraint areas will not require permits or approvals from regulatory agencies (except for TRCA for work within their regulated area and Letter of Advice for work in regulated habitat for Species at Risk). Moderate constraint areas may be protected under the Provincial Policy Statement (e.g., Significant Wildlife Habitat) and therefore trail alignments would need to be selected based on demonstrating no negative impact to these features.	Low constraint areas will not require permits or approvals from regulatory agencies and/or the trail is not likely to have a significant negative impact on ecological features and functions in these areas.
LAYERS: • Wetlands * • Habitat for Eastern Meadowlark (Endangered) and Bobolink (Endangered) * • 25 m Buffer around Butternuts (Endangered) * • Habitat for Redside Dace (Endangered) * • Category 3 Habitat for Barn Swallow (Threatened) * • Category 3 Habitat for Bank Swallow (Threatened) * • Interior Forest (e.g. Woodland Area-sensitive Bird Breeding Habitat	LAYERS: • Greenbelt Plan Boundary * • Areas of Natural and Scientific Interest (ANSIs) – none within study area • TRCA Regulated Area * • TRCA Property (e.g., Boyd Conservation Area) • 30 m Buffer around Wetlands * • York Region Greenlands System • City of Vaughan Environmentally Significant Areas (ESAs) * • Provincially Rare Vegetation Community: Hemlock Mineral Coniferous Swamp (SWC2-2) * • Shrub/Early Successional Bird Breeding Habitat • Terrestrial Crayfish Habitat • Habitat for Hairy-fruited Sedge (Provincially Rare) • Habitat for Pilose Sundrops (Provincially Rare) • Habitat for Wood Thrush (Special Concern) • Forest/ Woodland Vegetation Communities	LAYERS: • Locally Rare Vegetation Communities (mapped by TRCA) • Habitat for Locally Rare Plant and Wildlife Species • All Other Areas
DATA SOURCES: • Land Information Ontario (LIO): Wetlands • TRCA: Habitat for Redside Dace, 25m Butternut Buffer • North-South Environmental Inc: Habitat for Eastern Meadowlark and Bobolink • City of Vaughan Natural Heritage Network	DATA SOURCES: • LIO: Greenbelt Plan Boundary, ANSIs • Schollen: 30 m Buffer around Wetlands (based on LIO layer), Category 3 Habitat for Barn Swallow (200 m Buffer), Category 3 Habitat for Bank Swallow (500 m Buffer) • TRCA: Regulated Area, Property Boundary, Provincially Rare Vegetation Community, Interior Forest, Shrub/Early Successional Bird Breeding Habitat • York Region: Greenlands System • City of Vaughan: ESAs • North-South Environmental Inc: Terrestrial Crayfish Habitat, Habitat for Provincially Rare/Special Concern Species	DATA SOURCES: • All other areas not already covered are Low Constraint

NOTE: For scoring related to constraints in this table refer to Table 3.1-3.5-Decision Making Matrix Trail.
Trail segments where one or more MODERATE or HIGH constraint appear are provided a value of 2 and 3 respectively (scored as a group).
** DENOTES constraint layer scored individually on Table 3.1-3.5. LOW constraints are scored as zero and included in this table for information only.*

A detailed summary of the significant features evaluated for their impact to trail development is provided below. The various constraints represented by each of the natural heritage features has been incorporated into the criteria ranking system described in the preceding sections. The natural heritage features that comprise High and Moderate Constraint Areas are identified in Figures 20-24 below. These habitats are much more sensitive to trail impacts.

7.1.1 High Constraint Areas

High Constraint Areas will require permits or approvals from regulatory agencies (e.g. MECP, DFO) and/or the trail is anticipated to have a direct impact on certain ecological features or functions within the Study Area. There are also areas where trail development should be avoided if possible. These include interior forest environments, Significant Wildlife Habitat and areas within buffers of Threatened and Endangered species. TRCA Regulated Areas are excluded from the high constraint category because virtually the entire proposed trail system falls within the Regulatory Floodplain. The following environmental features are considered 'high constraints' to trail development. The corresponding data sources mapped on Figures 20-24, located on page 105-109, are summarized below.

Layers

- Wetlands
- Interior Forest
- Habitat for Eastern Meadowlark (Endangered) and Bobolink (Endangered)
- (25 m Buffer) Habitat for Butternuts (Endangered)
- Habitat for Redside Dace (Endangered

Data Sources

- Land Information Ontario (LIO): Wetlands
- TRCA: Habitat for Redside Dace, 25 m Buffer around Butternuts
- North-South Environmental Inc: Habitat for Eastern Meadowlark and Bobolink

Wetlands

Wetlands pose major constraints to trail development from both the technical and environmental perspectives. Construction of a trail through a wetland would require significant funding for alternate methods of construction such as boardwalks in order to avoid grading and/ or fill placement (to build a trail) which could otherwise cause hydrological changes and affect the ecological functions. Several of the wetlands in the Study Area are candidate habitat for amphibians and turtles, including Snapping Turtle. Wetlands should therefore be avoided wherever possible. Site alteration in the vicinity of wetlands is not supported by the TRCA and minimum setbacks ranging from 10m-30m will be required depending on the sensitivity of the

wetland. Most wetlands in the Study Area are small and isolated and avoidance of these features should be feasible.

Habitat for Eastern Meadowlark and Bobolink

The southern portion of the Study Area, between Highway 407 and Highway 7, contains habitat for Eastern Meadowlark and Bobolink. Detailed surveys would be required to be completed to identify nests or to estimate the centre of defended territory in this area. For the purposes of this Feasibility Study, all open country habitat in this area was considered to be habitat for Eastern Meadowlark and Bobolink.

While recreational use of existing trails is generally compatible with Bobolink habitat (MNRF, 2013a), it is difficult to assess the potential impacts that could occur due to construction of a new trail within this habitat. A permit under the provincial ESA may be required to facilitate trail construction in Bobolink and/or Eastern Meadowlark habitat and therefore, it is recommended that this habitat be avoided wherever possible.

More detailed grassland bird surveys should be conducted as a component of the EA or during the detailed design phases of the project in order to refine the boundaries of Bobolink and Eastern Meadowlark habitat. MECP should be contacted to determine permitting, mitigation and/or compensation requirements for trail construction within this habitat.

Butternut

Several Butternuts have been mapped in the Study Area by TRCA and a 25 m radius protection zone has been applied to each Butternut tree identified by a Certified Butternut Health Assessor as required by provincial legislation. It should be feasible for the trail alignment to avoid the 25 m protection zones of one or more Butternut trees. However, if this is unavoidable, or if removal of one or more Butternut trees is required, the trees should be assessed by a Certified Butternut Health Assessor in order to determine permitting requirements or to obtain an exemption under Ontario Regulation (O. Reg.) 242/08 for harm to Butternut trees or their habitat.

Habitat for Redside Dace

As discussed in Section 3.8.6, above, Regulated Habitat for Redside Dace in the Study Area includes occupied reaches of the East Humber River plus 30 m outward from the meander belt. Any trail development that is proposed within Regulated Habitat can be expected to require permits from MECP and DFO, particularly where crossings of the East Humber River are proposed. Because trail development in Redside Dace habitat can be expected to require multiple permits, the Regulated Habitat has been identified as a High Constraint Area.

7.1.2 Moderate Constraint Areas

Moderate Constraint Areas are not likely to require extensive permit or approval processes to enable trail development. However, trail development in these areas will need to demonstrate that there will be 'no negative impact' to ecological features and functions. Most of the features categorized as 'moderate constraint' receive protection under the PPS, ESA, conservation authority policies or municipal policies.

Provincially Designated Areas and Features

Areas north of Langstaff Road are located within the Greenbelt Natural Heritage System and any trail development within this area will need to conform with the policies in Section 3.2.2 of the *Greenbelt Plan*. Specifically, trail development in this area will need to demonstrate that there will be no negative impacts to key natural heritage features or key hydrologic features, and that connectivity between these features will be maintained.

The East Humber River valley is considered an External Connection to the Greenbelt but is outside of the Greenbelt regulated area. Trail development within the valley should have regard for the policies in Section 3.2.6 of the *Greenbelt Plan*.

Municipally Designated Areas and Features

Construction of a new trail within the Regional Greenlands System and City of Vaughan's Natural Heritage Network will need to demonstrate that there will be no negative impact to key natural heritage and hydrologic features within the system. Construction of the trail will likely be subject to an EA or EIS in order to satisfy the policies in Section 2.0 and 7.2 of the York Region Official Plan as well as Section 3 and 4 of the City of Vaughan's Official Plan.

TRCA Regulated Areas

Permits under Ontario Regulation (O. Reg.) 166/06 for site alterations within the TRCA Regulated Areas may be required. The TRCA Regulated Areas includes the regulatory floodplain, wetlands and buffer zones around wetlands as determined by TRCA. Most of the trail is expected to fall within TRCA's Regulated Areas and permits will likely be required. However, because TRCA is a partner and property owner in the Humber Trail extension project, the permit approval process is anticipated to be expedited.

It should be recognized that trails within the regulatory floodplain may be subject to periodic flooding which could damage trail components. Granular surface treatments are discouraged within floodplains because they are easily eroded by floodwaters. Large flood events, such as during spring freshet, may require trail closure. Sediment that is deposited on trails during

flooding may need to be cleared once floodwaters have receded. For these reasons, it is recommended that the trail be located above the regulatory floodplain wherever possible.

Habitat for Bank Swallow

As discussed in Section 4.7.3, above, much of the area between Highway 407 and Highway 7 should be considered Category 3 habitat for Bank Swallow and most of the potential trail alignments proposed for this area will affect this habitat. Category 3 habitat is the most tolerant of disturbance and it is unlikely that a trail within this area would affect foraging success for Bank Swallows. Notwithstanding, potential bridge locations throughout the Study Area should be screened for the presence of Bank Swallows, since bridges will require construction of abutments that could directly impact Bank Swallow colonies, if these colonies are present.

Although Bank Swallow habitat has been noted as a high constraint due to the species' designation as a Threatened Species, it is unlikely that a permit under ESA policies will be required for trail development within the habitat. However, MECP should be contacted during the EA or detailed design phase of the project for direction related to permitting, mitigation and/or compensation requirements for trail development in this area.

Habitat for Barn Swallow

As discussed in Section 4.7.4, above, several potential trail alignments may affect Category 3 habitat for Barn Swallow. Category 3 habitat is the core foraging habitat for Barn Swallows and has a relatively high tolerance to disturbance. It is unlikely that a trail within Category 3 habitat would affect foraging success of Barn Swallows and it is unlikely that a permit under the ESA will be required for trail development within this habitat. As long as none of the structures containing Barn Swallow nests are modified as part of trail construction, Barn Swallow habitat is expected to be a moderate constraint to trail development. However, MECP should be contacted during the EA or detailed design phase of the project for direction related to permitting, mitigation and/or compensation requirements for trail development in Barn Swallow habitat.

Habitat for Endangered Bats

It is not possible at this stage of the planning process to identify specific habitat for Endangered bat species in the Study Area since detailed field surveys were not undertaken. However, forest habitat, mature trees outside of forests, bridges, culverts and other human structures could be habitat for Endangered bats. In general, tree removals in order to accommodate the trail should be avoided, whenever possible. If the trail traverses' woodlands, the width of the trail should be minimized to avoid fragmentation of the woodland and to minimize vegetation removals. It is

recommended that detailed bat surveys be conducted during the EA or detailed design phase of the project to determine whether Endangered bats are present and, if so, where. If Endangered bats are present in the Study Area, the MECP should be contacted to determine permitting, mitigation and/or compensation requirements.

Significant Wildlife Habitat

SWH is protected under the PPS and trail development within SWH will need to demonstrate, through an EIS or similar study, that there will be no negative impact to ecological function of SWH. The following SWH types may be present in the Study Area and may be affected by trail development.

Turtle Wintering and Nesting Areas

Turtle wintering areas, if present in the Study Area, are likely to be in wetlands, ponds and other hydrologic features with soft substrates. As long as a direct trail footprint is not proposed within these features, there will be no negative impacts to turtle wintering areas.

Turtle nesting areas, if present, are likely to occur in areas with easily excavated sandy or gravelly soil and often on south-facing slopes. They are most likely to be within approximately 100 m of the East Humber River and other hydrologic features. At this stage, it is not possible to evaluate whether any potential trail alignments would affect turtle nesting areas. More detailed surveys will be required during the EA or detailed design phase of the project to identify whether this type of habitat is a constraint to trail development.

It should also be noted that trails could separate turtles from their preferred nesting and overwintering habitats and that these animals may attempt to cross the trail while moving between habitats. As a result, turtles could then be directly harmed by bicycles, pets and other human activities. If concentrations of turtle movement or mortality are observed, consideration could be given to installing exclusion fencing or a wildlife passage beneath the trail.

Rare Vegetation Communities

The provincially rare Hemlock Mineral Coniferous Swamp community should be avoided if possible. If avoiding this vegetation community is not possible, it is recommended that the trail within this area consist of a boardwalk in order to minimize the trail footprint and enable wildlife movement beneath the boardwalk.

Amphibian Breeding Habitat (Wetland)

Wetland habitat in the Study Area is candidate amphibian breeding habitat. Avoidance of amphibian habitat should be emphasized, however, if encroachment is not avoidable, mitigation techniques, including the installation of a boardwalk, should be implemented to reduce the potential for impacts to amphibian habitat.

Woodland Area-sensitive Bird Breeding Habitat

Woodlands that are located within the Study Area that contain interior habitat constitute candidate woodland area-sensitive bird breeding habitat. Potential impacts of trail development on this habitat include: direct loss of woodland habitat resulting in a decrease in interior forest and overall habitat size; fragmentation of the woodland resulting in reduction or elimination of interior forest habitat; increased disturbance due to human intrusion into the woodland; loss of trees from within the woodland that are considered hazardous to trail users; and/or introduction of dogs and other domestic pets that could directly harm nesting birds.

In order to maintain interior forest habitat and the function of woodland features for breeding birds, it is important that fragmentation and/or a reduction in the size of these woodlands be avoided. Potential impacts can be minimized or avoided by:

- Avoiding woodlands containing interior forest habitat where possible;
- Minimizing the width of the trail (2.4 m) through these features to avoid fragmentation of the woodland; and,
- Avoiding encroachment into the edges of woodlands containing interior forest habitat in order to avoid a reduction in the amount of interior habitat.

Shrub/Early Successional Bird Breeding Habitat

The area mapped by TRCA as shrub/early successional bird breeding habitat covers an extensive portion of the Study Area and avoiding this feature will not be possible. Potential impacts of trail development on shrub/early successional bird breeding habitat include: a reduction in total available habitat; changes in vegetation composition and structure; and/or introduction of dogs and other domestic pets that could directly harm nesting birds.

However, trail development within this feature is unlikely to have a significant impact on the ecological function of the habitat for bird breeding due to its small footprint relative to the overall size of the feature. In general, vegetation removals within this feature should be minimized and proposed seed mixes and planted vegetation that may be installed to facilitate restoration should be selected based on existing vegetation.

Terrestrial Crayfish Habitat

Potential impacts of trail development on terrestrial crayfish habitat include direct harm to crayfish or destruction of burrows; hydrological changes resulting in flooding or drying out of burrows; and/or introduction of sediment into the habitat altering the suitability for burrows. These impacts can be eliminated or minimized by:

- Avoiding terrestrial crayfish habitat where possible;
- Situating the trail towards the edge of habitat to avoid impacts to the core of the feature;
- Using permeable surface treatments to avoid changes to site hydrology that could affect crayfish burrows.

Habitat for Special Concern and Rare Wildlife Species

There is habitat for Wood Thrush, a Special Concern species, in the northern portion of the Study Area in Boyd Conservation Area. The potential impacts and mitigation measures for Wood Thrush habitat are similar to those recommended for habitat of area-sensitive woodland birds. Mitigation measures include:

- Avoiding habitat for Wood Thrush;
- Minimizing fragmentation of Wood Thrush habitat by reducing the width of the trail; and,
- Avoiding the edges of Wood Thrush habitat to avoid reducing the overall area of habitat.

Snapping Turtle may be present throughout the Study Area. Mitigation measures to avoid or minimize impacts to Snapping Turtles have been provided above.

Habitat for the two provincially rare plant species in the Study Area – Hairy-fruited Sedge and Meadow Evening-primrose – should be avoided where possible. It may not be possible to avoid habitat for Meadow Evening-primrose due to property ownership and physical constraints. If this is the case, consideration could be given to transplanting them to a suitable location within the corridor outside of the trail footprint.

Forest/Woodlands

Woodlands are described in the Vaughan Official Plan as “Natural Areas of vegetation in the landscape and their associated wildlife populations”. Vaughan will “support the maintenance of important environmental functions, attributes and linkages of woodland resources, recognizing that this will lead to more stable, resilient systems of vegetation and wildlife.” The VOP also states that it is the policy of Council “to protect and enhance woodlands by:

- Prohibiting development or site alteration in woodlands and their minimum vegetation protection zones as permitted by the appropriate Regional or Provincial policies;
- Encouraging that minimum vegetation protection zones be restored; and,
- Using sound management practices to maintain or enhance existing functions."

In accordance with the York Region Official Plan and the VOP, a woodland is defined as an area of land at least 0.2 hectare in area with at least:

- 1,000 trees of any size per hectare, or
- 750 trees measuring over five centimetres in diameter, per hectare, or
- 500 trees measuring over 12 centimetres in diameter, per hectare, or
- 250 trees measuring over 20 centimetres in diameter, per hectare

The above does not include a cultivated fruit or nut orchard, or a plantation established and used for the purpose of producing Christmas trees or nursery stock. For the purposes of defining a woodland, treed areas separated by more than 20 metres will be considered a separate woodland. When determining the limit of a woodland, continuous agricultural hedgerows and woodland fingers or narrow woodland patches will be considered part of a woodland if they have a minimum average width of at least 40 metres and narrower sections have a length to width ratio of 3 to 1 or less. Undeveloped clearings within woodland patches are generally included within a woodland if the total area of each clearing is no greater than 0.2 hectares. In areas covered by Provincial Plan policies, woodland includes treed areas as further described by the Ministry of Natural Resources. For the purposes of determining the densities above for woodlands outside of Provincial Plan Areas, the following species are excluded: staghorn sumac, European buckthorn and common lilac.

Relevant to this study area, the York Region Official Plan requires that significant woodlands be verified on a site-by-site basis and shall include those woodlands meeting one of the following criteria:

a. is 0.5 hectares or larger and:

i. directly supports globally or provincially rare plants, animals or communities as assigned by the Natural Heritage Information Centre; or,

ii. directly supports threatened or endangered species, with the exception of specimens deemed not requiring protection by the Province; or,

iii. is within 30 metres of a provincially significant wetland or wetland, waterbody, permanent stream or intermittent stream;

b. is 2 hectares or larger and:

i. is located outside of the Urban Area and is within 100 metres of a Life Science Area of Natural and Scientific Interest, a provincially significant wetland or wetland, significant valleyland, Environmentally Significant Area, or fish habitat; or,

ii. occurs within the Regional Greenlands System;

The above criteria only apply to potential woodlands not located within the Greenbelt Plan area. For those potential woodlands within the boundaries of the Greenbelt Plan, the 'woodland' and 'significant woodland' definition identified in the plan and 2005 Technical Definition document shall apply. The Greenbelt Plan (2017) defines woodlands as significant to an area which is ecologically important in terms of features such as species composition, age of trees and stand history; functionally important due to its contribution to the broader landscape because of its location, size or due to the amount of forest cover in the planning area; or economically important due to site quality, species composition, or past management history.

The policies speak to the importance of woodland communities as a key part of a complex interconnected Natural Heritage System and place constraints to protect and mitigate against degradation and/ or fragmentation of this valuable natural resource. Therefore, planning for the appropriate trail alignment must have regard for the sensitivities of existing forest communities, avoid woodlands where possible, build mitigation techniques into the design of the trails to limit impacts where unavoidable, and promote restoration to restore impacted woodland features if disturbance occurs.

7.1.3 Low Constraint Areas

Habitat for Locally Rare Species

Locally rare plant and wildlife species are less sensitive than the species whose habitats that comprise 'moderate' and 'high' constraint areas. Therefore, these habitats are unlikely to be significantly impacted by trail development. Impacts to these species and their habitats can be avoided or minimized by:

- Reducing the trail footprint either by reducing trail width (2.4m) or constructing a boardwalk in place of an at-grade trail; and,
- Minimizing vegetation removals required to accommodate the trail.

Locally Rare Vegetation Communities

Locally rare vegetation communities are less sensitive than provincially rare communities and are unlikely to be significantly impacted by trail development. In general, impacts to these communities can be avoided or minimized by:

- Avoiding locally rare vegetation communities where possible;
- Implementing in a buffer of at least 10m to mitigate impacts to the feature if not avoidable;
- Reducing the trail footprint within locally rare vegetation communities either by reducing trail width (2.4m) or constructing a boardwalk; and,
- Minimizing vegetation removals within locally rare vegetation communities.

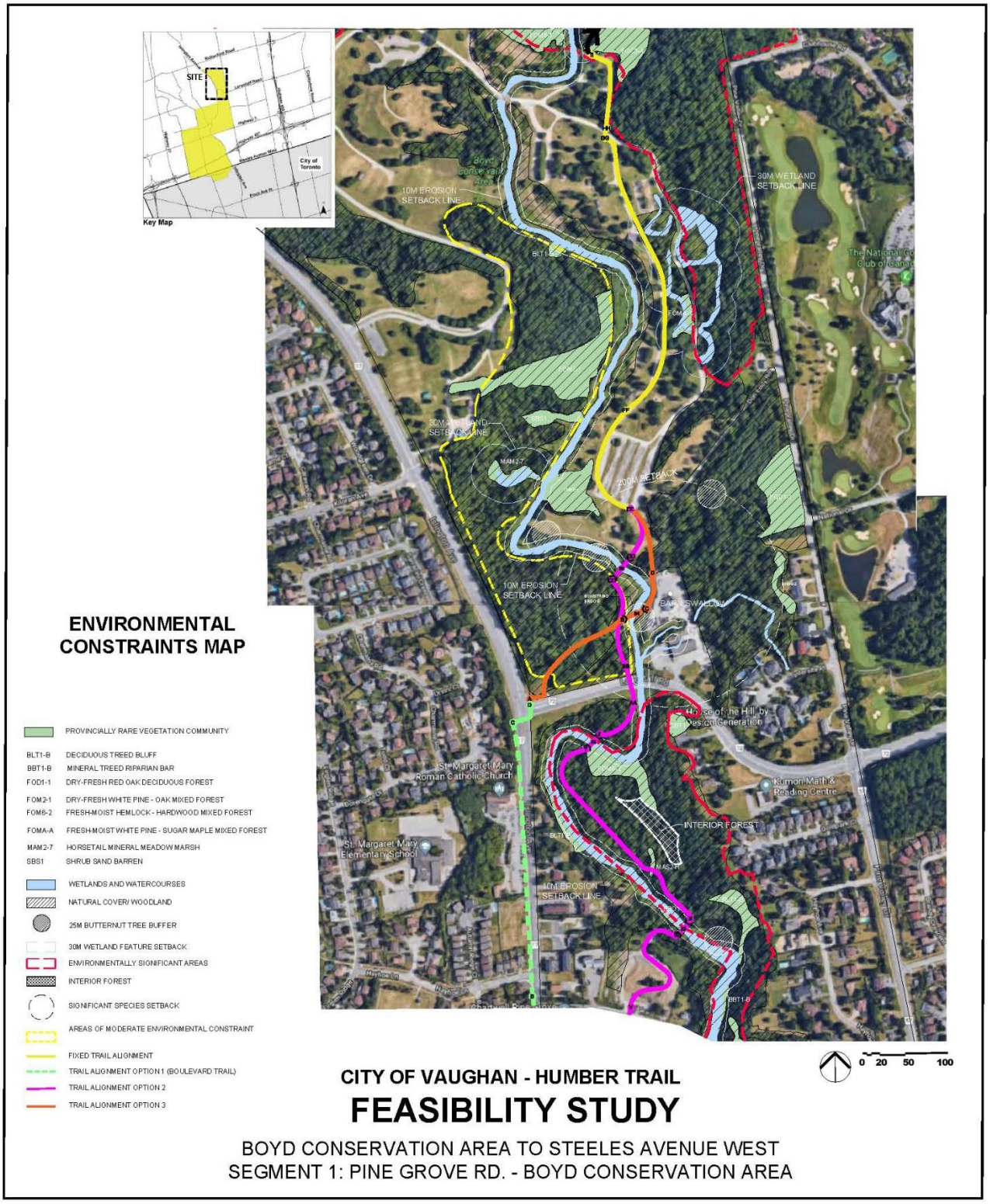


Figure 21: Segment 1 Environmental Constraints Map – Pine Grove Rd – Boyd Conservation Area

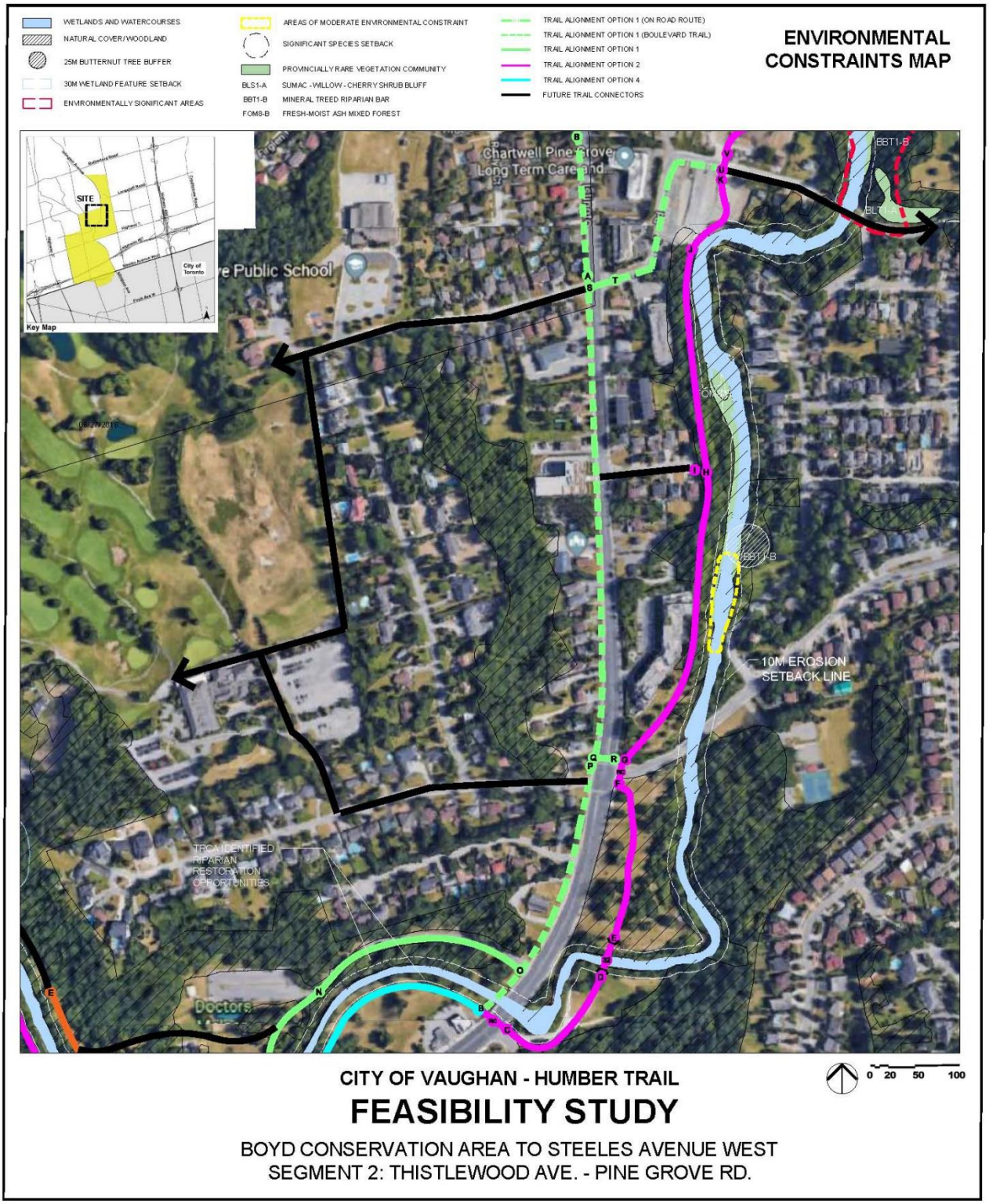


Figure 22: Segment 2 Environmental Constraints Map – Thistlewood Ave to Pine Grove Rd

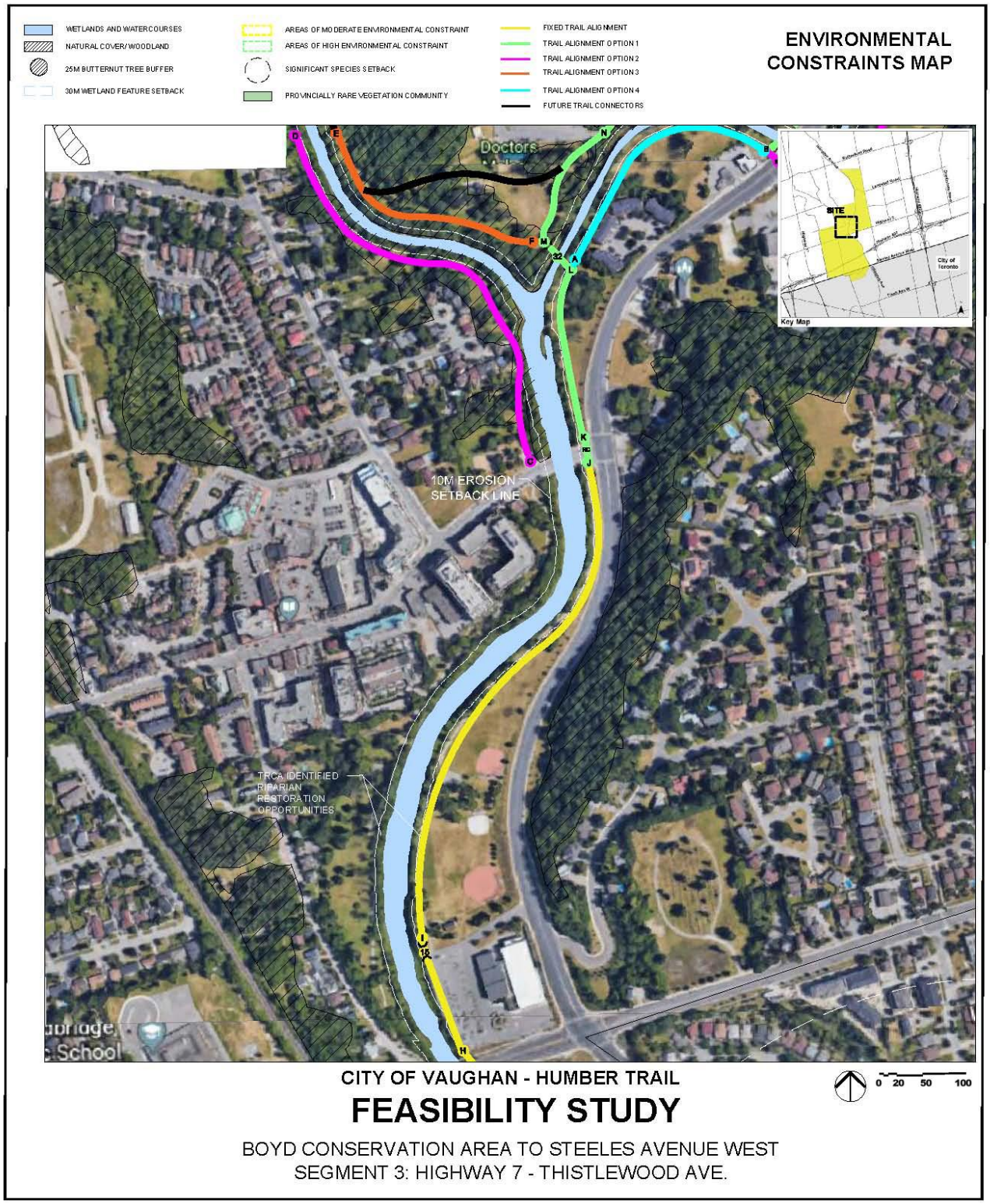


Figure 23: Segment 3 Environmental Constraints Map – Highway 7 to Thistlewood Ave

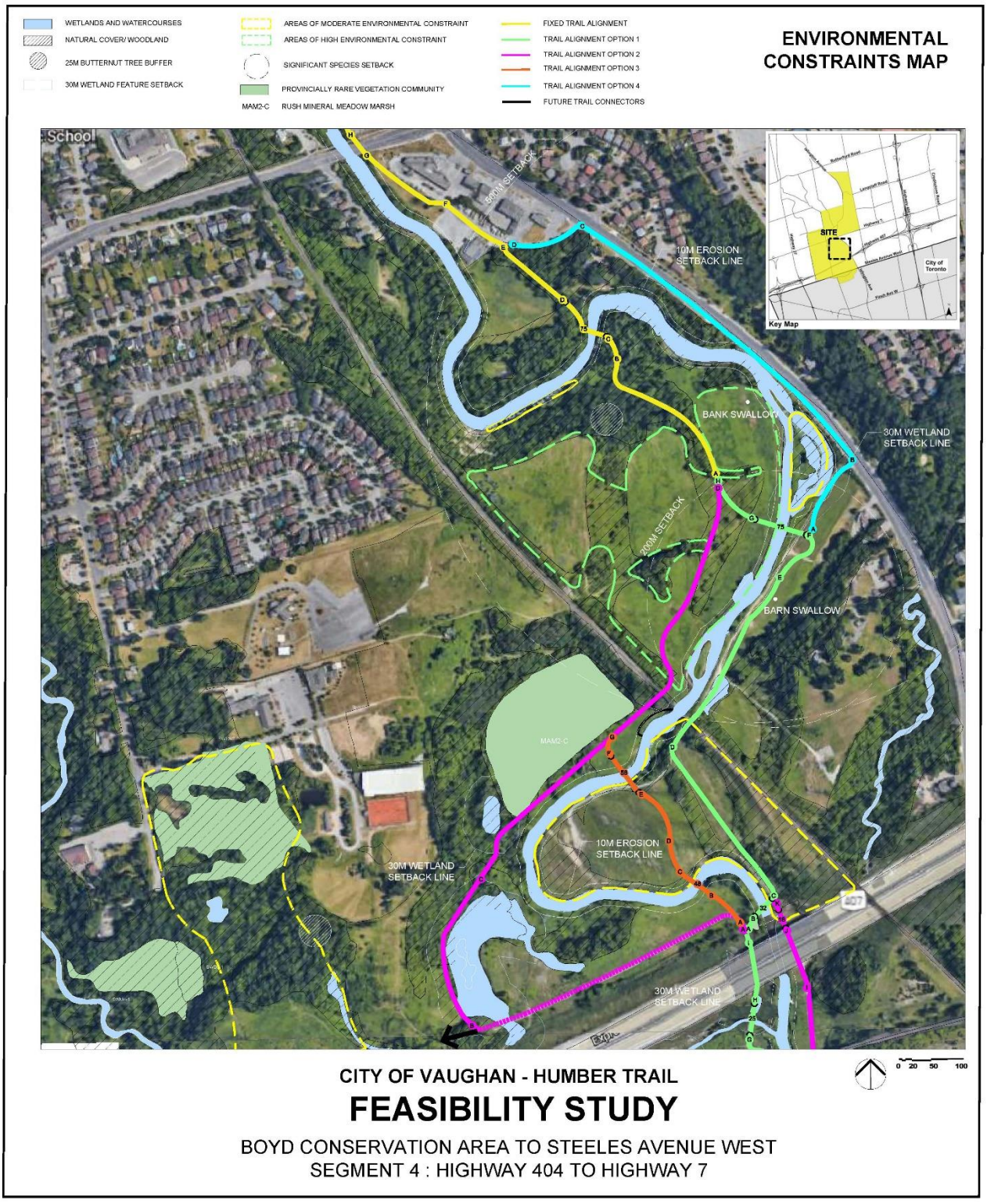


Figure 24: Segment 4 Environmental Constraints Map – Highway 407 to Highway 7

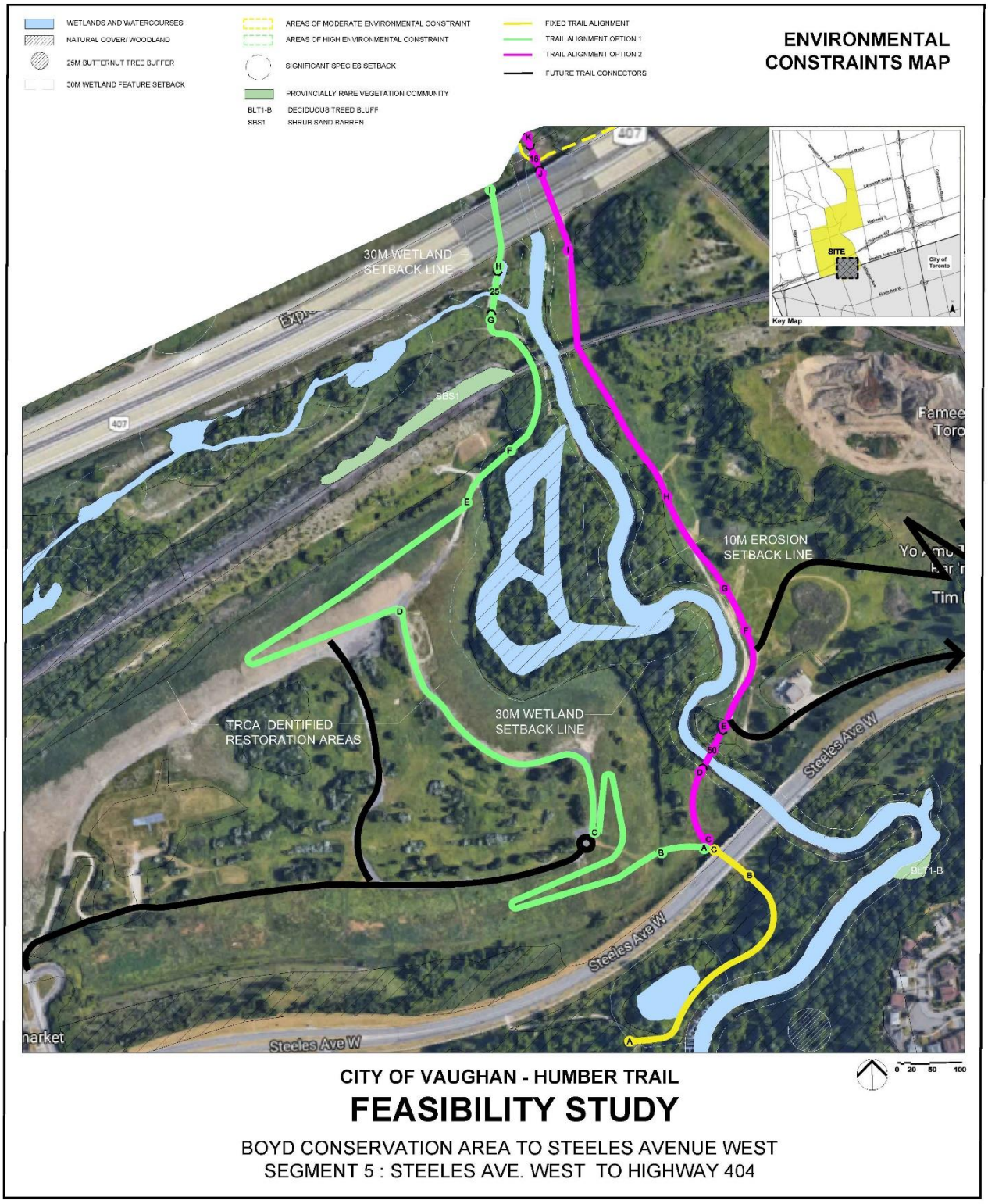


Figure 25: Segment 5 Environmental Constraints Map – Steeles Ave West to Highway 407

7.2 Floodplain Mapping

Regulatory Floodplain

Municipalities and the TRCA define flood risk assessment based on the Regulatory Storm Event. The Regulatory Flood corresponds with the flood impact that resulted from Hurricane Hazel (1954). However, several recent intense storm events in the GTA have resulted in erosion and flooding at extreme rates and affected how municipalities and the TRCA view trail location and design within the floodplain. At issue is the variability of flood events and risk to users that result in the need to consider appropriate margins of safety in the assessment of risk when planning trails.

To effectively manage risk on trails due to potential flooding, consideration for operational and geographic risk, as well as emergency preparedness to reduce risk to life are important. Adopting an approach that mitigates impacts to trails and public safety from flooding is prudent and was considered in the process of determining trail alignments and exploring trail design options.

Flood plain management is a fundamental objective of the TRCA, on lands owned by the agency or not, and this objective is achieved through policies that limit development within the flood plain. Virtually the entirety of the proposed trail system falls within the Regulatory Floodplain. Therefore, the floodplain context is considered to be a 'moderate constraint' to trail development. The Regulatory Floodplain is one of the criteria that was utilized to compare various trail alignment options (refer to Table 3.1-3.5). Refer also Figure B.2, Appendix B, that illustrates the 2-year, 5-year and Regulated Floodplain.

2-Year and 5-Year Flood Plain Mapping

The TRCA conducted a comprehensive update to the hydrologic modelling for the Humber River in 2014. Partial models were utilized by Aquafor Beech Ltd. to develop conservative estimates and to generate mapping for the 2-year and 5-year flood lines within the Study Area. The flood lines are illustrated on Figure B.2, Appendix B.

It is important to note that, the modeling prepared for this Study, including the hydraulic models for the Humber River system, are concurrently being updated. Aquafor Beech Ltd. is conducting this assessment for the TRCA and this exercise is in progress at time of writing this report.

7.3 River Processes

River Bed Migration

The "geomorphic" processes contributing to riverbed migration are dynamic and result in the erosion, scour and transport of soft easily erodible materials downstream in the river system. Over

time this activity contributes to the "meander" geometry of the river system. The migration extent within the flood plain in the area within which the river is expected to shift over a long period of time is called the "meander belt". There is a measure of uncertainty in consideration to effects of climate change on erosion and deposition processes as more frequent and intense rain events could lead to increased erosion and could amplify changes in meander geometry.

In response, the TRCA has developed a set of principles to guide trail development in the vicinity of erosion hazards and potentially instable riverbanks. A minimum setback of 10m from all top of banks has therefore been applied as a criterion for trail location. It should be noted that this is a high-level constraint that applies to the entire Study Area and that the erosion and slope stability setbacks will vary from site to site and should be determined based on detailed geotechnical and fluvial geomorphic investigations that will be conducted as part of the detailed design process.

Avoidance of outer meander bends in the river is a design priority since these sites are exposed to a higher amount of energy from flowing water and therefore a higher propensity for erosion and bank instability.

Since these considerations were already addressed in the process of exploring the optional trail alignments, these criteria were not incorporated into the overall scoring matrix. Trail alignments are not proposed to encroach within the 10 m bank erosion setback line and bridge spans have been positioned to avoid outer river bends.

Meander Belt Analysis

Trails that are proposed to be located within a meander belt are not a concern if erosion setbacks are respected. However, due to the presence of Redside Dace habitat within the Study Area and in order to satisfy provincial policies related to Redside Dace habitat, a technical investigation was conducted by Aquafor Beech Ltd. for the purposes of defining a "hypothetical meander belt" (HMB). The results of this investigation are included in Appendix E and are illustrated on the map provided below. As illustrated on the map, the meander belt encompasses the full extent of the valley corridor and encompasses the areas that are located beyond the valley walls of the valley

The meander belt as presented in Figure 26 does not represent an erosion hazard assessment. A detailed historic assessment and erosion rate calculations were not carried out as a component of this high-level meander belt assessment. The East Humber River within the Study Area is classified as a "confined system" and therefore the meander belt does not constitute an erosion hazard according to provincial guidelines (MNR, 2002).

The reach of the East Humber River is defined as a 'partially confined' valley setting based on the TRCA mapping protocols (2004). The high-level meander belt assessment that was completed as a component of this study, generally follows Procedure 2 from TRCA (2004) but was adapted to accommodate some aspects of the 'partially confined' setting. Consequently, it was assumed that meander belt criteria for regulated Redside Dace habitat essentially required that technical procedures be applied in reaches that do not match the technical and conceptual definitions as laid out in other provincial guidelines (MNR, 2002). For 'partially confined' settings, like the East Humber River, the erosion hazard is essentially defined by the entire valley bottom, plus geotechnical stable slope setbacks along both sides of the valley walls (MNR, 2002).

The findings of the high-level meander belt analysis, for the reaches of the East Humber River within the Study Area, verified that there is an overlap on Redside Dace habitat for all potential trail alignments proposed in the Study.

The recommended HMB widths for reaches 1 to 4 of the East Humber River are illustrated in Figure 7, in the Meander Belt Analysis Report as provided in Appendix E. The meander belt width varies from 154m to 323m across the valley. The MECP considers the area within the HMB + 30m to be regulated habitat for Redside Dace within which encroachments require a permit. Figure 26 below illustrates the area that comprises Redside Dace habitat.

In terms of a constraint to trail development the MECP and the DFO permits for encroachment within Redside Dace habitat are significant since the permit process is expected to slow the implementation process, require much more in-depth studies, add cost and potentially result in a less desirable route for the trail. All of the constraint criteria that were used to evaluate alternative trail alignments are provided in *Tables* 3*.1–3.5: Alignment Constraints Decision Making Matrix*.

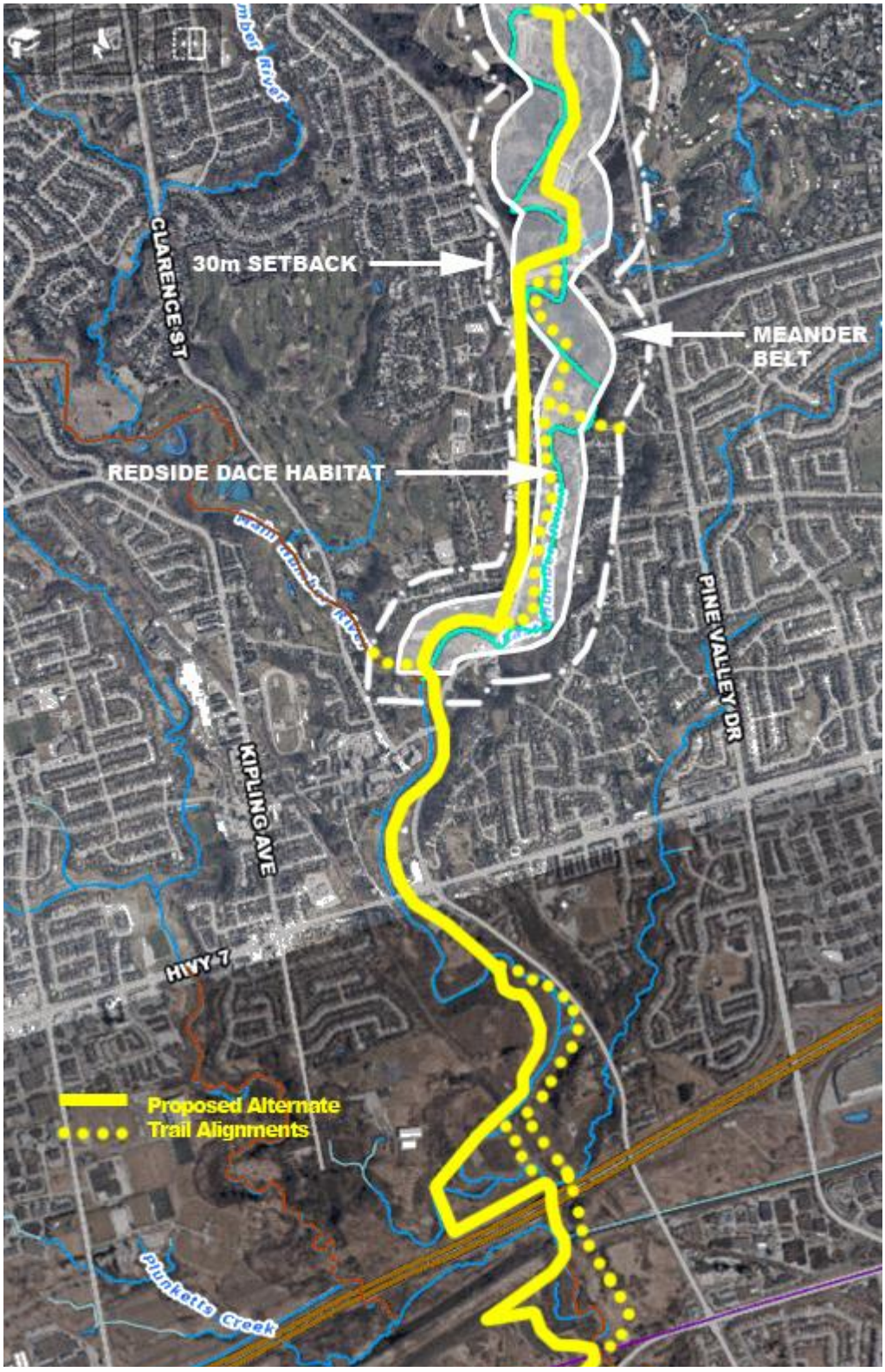


Figure 26: Meander Belt + 30m Setback (Regulated Habitat for Redside Dace)

Climate Change Adaptation

While climate change adaptation is not a measurable criterion itis an important consideration in the process of exploring alignment options. TRCA's climate change adaptation approach is focused on reducing harm to individuals, and building resilient natural systems and watersheds (https://trca.ca/conservation/climate-change/). According to the TRCA website, climate change researchers have predicted a global increase in the intensity of severe storms, leading to speculation that recent extreme storms are evidence of the effect of climate change

Intense storm events make stormwater infrastructure vulnerable. Therefore, adopting a pro-active approach to trail planning that has considered climate change influence will result in a durable, safe and accessible trail.

Changes resulting from climate change require consideration of potential increases including flooding and erosion (Auld et al. 2007). Environment Canada's Atmospheric Hazards Web Site (www.hazards.ca) was reviewed to determine likelihood of additional hazards that could occur within the Study Area. Hail, ice storms, windstorms, more frequent and intense rainstorms and tornados are natural hazards that should be considered in the process of determining the alignment of the proposed Vaughan Humber Trail. Wider margins of safety for flood events should be considered given forecasted storm events in the future. Given the lack of data regarding local variability for these future weather events, the Project Team has defaulted to establishing "margins of safety" with wider setbacks from potential hazards, based upon hydrologic modelling parameters employed by TRCA, which should be considered sufficient to address anticipated climate change influences on flood events.

7.4 Steep Slopes

As noted earlier in the report, portions of the Humber River valley contain steep, incised slopes. In places where these slopes meet the river, significant erosion has resulted. For example, a bluff was the location of a major slope collapse on the east side of the Humber River north of Pine Grove Road. This slope failure cut off access to informal trails in this area. Emergency restoration works were also recently completed by TRCA on the outer banks of the Humber River, north of Langstaff Road, adjacent to the City of Vaughan works yard.

The steep slopes along both sides of the valley present a challenge to trail development and constrain linkages to surrounding neighbourhoods. Particularly, steep slopes present a challenge to developing a fully accessible trail.

A constraints analysis was undertaken where steep slope sites, with gradients of 25% and greater were avoided.

7.5 Topographical and Flood Management Constraints

A constraints analysis was undertaken to address natural drainage corridors, bridges, boardwalks, culverts, topography and flood prone areas to assist in evaluating trail alignment options. Proposed alignments that avoided drainage features and which did not require the implementation of bridges, boardwalks or slope stabilization structures were favoured, as were trail alignments that were situated above the 5-year flood line (the elevation above which soil conditions tend to be drier and more suitable for trail construction and therefore tend to have a lower construction cost).

7.6 Regulation and Ownership

Potential trail routes were assessed based upon land ownership considerations. The greater the extent of lands held in private ownership along a potential trail alignment the more complex and challenging the process and the higher the anticipated projected cost. Figure B.1, Appendix B illustrates the ownership patterns within the Study Area. Proposed trail alignments that avoid privately-owned lands are preferred. However, it should be noted that alignments that favour publicly-owned lands do not always emerge as a preferred option as a result of the comparative evaluation (Refer to *Tables 3.1-3.5*), as it is the aggregated score from all constraints that determine the route's feasibility.

7.7 Infrastructure Barriers

There are several locations along the corridor where existing vehicular bridges and railway bridges create challenges to continuous trail design. A preliminary site inspection of bridges at Steeles Avenue West, Highway 407, Highway 7, Woodbridge Avenue and Langstaff Road all revealed that there is enough head clearance in which to position a trail. While underpasses at these locations may be technically feasible, it should be noted that detailed engineering analysis would be required to determine whether access could be accommodated in a safe and practical manner and especially whether the design of the trail could satisfy Accessibility requirements.

Railway, hydro and gas utility companies typically enable the construction of trails on their properties, however, the feasibility of achieving this will be determined through negotiation with the applicable utility. Permits and/or easements/lease agreements are necessary and can slow the process of implementation and adds cost.

7.8 Cost

The relative cost of the option was a key consideration in the process of assessing trail alignment options. It is important to note that the length of any given trail within a specific alignment option is not always proportional to cost since one option may comprise a short section of trail that may requires a boardwalk (at considerable cost), whereas a corresponding option may be much longer but that may be situated above the 5-year flood level. This option is anticipated to be less expensive to construct. A detailed assessment of construction costs is provided in Section 9.0. Cost estimates for additional studies, permitting and design, the so called “soft costs” of trail implementation also informed the Implementation Plan as set out in Section 10. In addition, consideration was given to the operating and maintenance (O&M) costs and Life Cycle Cost (LCC) which considered the replacement value of the trail over its serviceable life in comparison to a trail option that is expected to be flooded more frequently. While guidance is provided in the Feasibility Study to enable the City of Vaughan to develop its own O&M and LCC strategy for the trail system, an additional study is required to develop the strategy.

8.0 Analysis of Options

The constraints discussed above were amalgamated and organized into a matrix to enable the comparative evaluation of individual trail segments. Constraints were organized under the following categories:

- Environmental;
- Topographical and flood management;
- Regulation and land ownership; and,
- Cost.

Tables 3.1-3.5: Alignment Constraints Decision Making Matrix identify the evaluation criteria. Each criterion in the matrix was assigned a rating of at least ‘1’ for ’yes‘, when applicable. In instances where either environmental sensitivity, species protection or flood hazard is a concern, a rating of ‘2-3’ was applied whereby the higher number represents increased constraint relative to other criteria in the same category. The total number of ’yes‘ designations were tallied for each trail alignment option for each of the Study Area segments 1-5 identified in Figure 2. Cost was also considered as an evaluation criterion. Trail segments that scored an aggregated low score, as well as low cost, represented the Preferred Trail Alignment for each specific segment within the Study.

The matrix enables the reader to compare one trail alignment against another based upon the constraints that could result in an expenditure of time and/or money to resolve. For example, a trail alignment that requires access across private lands would score a ‘3’, as opposed to a trail

that traverses TRCA-owned lands. This score results because the negotiations with the private landowner are expected to result in delays or require long-term agreements, whereas the process would be relatively straight-forward for lands that are owned by the TRCA, the City or another public agency. In another example, a trail alignment that avoids a steep geologic feature but is forced into an area that is located below the 5-year flood level would score a '1' for slope and encroachment, and a '2' for flood management.

For certain sections of the Feasibility Study, evaluation of the planning context and site conditions revealed alignments that were relatively free from constraints, remain within publicly-owned lands and are less expensive to implement. In these instances, one proposed preferred alignment has been recommended subject to detailed design development in future. These preferred segments were identified as Phase 1 priorities in the Phasing Plan. In many other cases, due to the complex land use context, the narrow valley corridor and/or the presence of significant habitat, opportunities for multiple alignments were evaluated. In this case, each alignment was assessed against the evaluation criteria including estimated cost.

Table 3.1: Segment 1 Alignment Constraints Decision Making Matrix

SEGMENT 1	Topographical and Flood Management								Environmental														Cultural		Regulation & Landownership									
FIXED	Slope >10%		<5 yr Floodline		Culverts		Bridge/ Boardwalk		Significant Veg Com		Within 30m Wetland		Woodland		Moderate** Constraint Habitat		High Constraint Habitat*		RSD Habitat		Threatened Species		ESA		SAR		Endangered Species		Cultural Heritage		TRCA Regulated		Green Belt		Private Property		Cost	Score
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
EE-FF									2										3										1		2				$117,600	8
FF-GG													1						3				2						1		2				$254,800	9
GG-HH																			3										1		2				$32,000	6
HH-II									2				1						3				2						1		2				$73,500	11
																																			Total		$477,900	34
OPTION 1	Slope >10%		<5 yr Floodline		Culverts		Bridge/ Boardwalk		Significant Veg Com		Within 30m Wetland		Woodland		Moderate** Constraint Habitat		High Constraint Habitat*		RSD Habitat		Threatened Species		ESA		SAR		Endangered Species		Cultural Heritage		TRCA Regulated		Green Belt		Private Property		Cost	Score
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
V-W																			3									1	1						$161,925	5
W-X			2				3						1						3										1						$148,500	10
X-Y									2				1						3				2						1						$273,050	9
Y-Z			2				3		2				1						3										1						$148,500	12
Z-AA													1																1						$61,595	2
AA-BB											3								3		3								1						$38,100	10
BB-CC													1		2				3		3				2				1		2				$222,250	14
CC-DD			2				3		14										3		3								1		2				$243,000	14
DD-EE																			3		3								1		2				$66,675	9
																																			Total		$1,363,595	85
OPTION 2	Slope >10%		<5 yr Floodline		Culverts		Bridge/ Boardwalk		Significant Veg Com		Within 30m Wetland		Woodland		Moderate** Constraint Habitat		High Constraint Habitat*		RSD Habitat		Threatened Species		ESA		SAR		Endangered Species		Cultural Heritage		TRCA Regulated		Green Belt		Private Property		Cost	Score
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
B-C																															2				$334,650	2
C-D																															2				$48,000	2
																																			Total		$382,650	4

OPTION 3	Slope >10%		<5 yr Floodline		Culverts		Bridge/ Boardwalk		Significant Veg Com		Within 30m Wetland		Woodland		Moderate** Constraint Habitat		High Constraint Habitat*		RSD Habitat		Threatened Species		ESA		SAR		Endangered Species		Cultural Heritage		TRCA Regulated		Green Belt		Private Property		Cost	Score
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
A-B	1														2				3										1		2				$149,225	9
B-C			2				3												3				2				3		1		2				$600,000	16
C-D																			3				2						1		2				$46,295	8
D-EE					1														3				2						1		2				$238,800	9
																																			Total		$1,034,320	42

* **High Constraint Habitat**
** **Moderate Constraint Habitat**

- Habitat for Eastern Meadowlark (Endangered) and Bobolink (Endangered), Butternut
- Woodland Area-sensitive Bird Breeding Habitat (e.g., Interior Forest)
- Shrub/Early Successional Bird Breeding Habitat
- Terrestrial Crayfish Habitat
- Habitat for Hairy-fruited Sedge (Provincially Rare)
- Habitat for Pilose Sundrops (Provincially Rare)
- Habitat for Wood Thrush (Special Concern)

Refer Table 3.0 for definition of "Moderate" and "High" constraints.

* Species At Risk are included within High Constraint habitat sites
Trail alignments consider an erosion setback of min. 10m from top of bank
Trail length may impact decision making i.e. a shorter trail may cost more due to boardwalk whereas a longer trail may be cheaper to implement

Table 3.2: Segment 2 Alignment Constraints Decision Making Matrix

SEGMENT 2	Topographical and Flood Management								Environmental																Cultural		Regulation & Landownership							
OPTION 1	Slope >10%		<5 yr Floodline		Culverts		Bridge/ Boardwalk		Significant Veg Com		Within 30m Wetland		Woodland		Moderate** Constraint Habitat		High Constraint Habitat*		RSD Habitat		Threatened Species		ESA		SAR		Endangered Species		Cultural Heritage		TRCA Regulated		Approval/Lease/Easement		Private Property		Cost	Score
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
N-O																			3										1						$165,100	4
B-O																			3										1		1				$37,950	5
O-P																			3										1		1		2		$179,400	7
Q-R																			3										1		1				$600,000	5
Q-S																			3										1		1		2		$372,600	7
S-T																			3										1		1				$600,000	5
T-U																			3										1		1				$39,375	5
U-V																			3																$24,000	3
A-B																			3												1				$117,300	4
																																		Total	$2,135,725	45
OPTION 2	Slope >10%		<5 yr Floodline		Culverts		Bridge/ Boardwalk		Significant Veg Com		Within 30m Wetland		Woodland		Moderate** Constraint Habitat		High Constraint Habitat*		RSD Habitat		Threatened Species		ESA		SAR		Endangered Species		Cultural Heritage		TRCA Regulated		Approval/Lease/Easement		Private Property		Cost	Score
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
B-C																															1	Region			$600,000	1
C-D			2		1														3										1						$115,750	7
D-E			2				3												3										1						$216,000	9
E-F													1						3										1						$123,825	5
F-G																															COV				$600,000	0
I	1												1						3										1						$250,000	6
G-H													1						3										1				3	Acquire	$261,000	8
H-J													1		2				3						2		1		1		1		3	Acquire	$949,000	11
J-K			2				3						1						3										1						$68,580	10
																																		Total	$3,184,155	57

* **High Constraint Habitat**
** **Moderate Constraint Habitat**

- Habitat for Eastern Meadowlark (Endangered) and Bobolink (Endangered), Butternut
- Woodland Area-sensitive Bird Breeding Habitat (e.g., Interior Forest)
- Shrub/Early Successional Bird Breeding Habitat
- Terrestrial Crayfish Habitat
- Habitat for Hairy-fruited Sedge (Provincially Rare)
- Habitat for Pilose Sundrops (Provincially Rare)
- Habitat for Wood Thrush (Special Concern)

Refer Table 3.0 for definition of "Moderate" and "High" constraints.

* Species At Risk are included within High Constraint habitat sites
Trail alignments consider an erosion setback of min. 10m from top of bank
Trail length may impact decision making i.e. a shorter trail may cost more due to boardwalk whereas a longer trail may be cheaper to implement

Table 3.3: Segment 3 Alignment Constraints Decision Making Matrix

SEGMENT 3	Topographical and Flood Management																									
FIXED	Slope >10%		<5 yr Floodline		Culverts		Bridge/ Boardwalk		Significant Veg Com		Within 30m Wetland		Woodland		Moderate** Constraint Habitat		High Constraint Habitat*		RSD Habitat		Threatened Species		ESA		SAR		Endangered Species		TRCA Regulated		Approval/Lease/ Easement		Private Property		Cost	Score
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
H-I																													1						$191,825	1
I-J																													1						$438,150	1
																																		Total	$629,975	2
OPTION 1	Slope >10%		<5 yr Floodline		Culverts		Bridge/ Boardwalk		Significant Veg Com		Within 30m Wetland		Woodland		Moderate** Constraint Habitat		High Constraint Habitat*		RSD Habitat		Threatened Species		ESA		SAR		Endangered Species		TRCA Regulated		Approval/Lease/ Easement		Private Property		Cost	Score
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
J-K																													1						$600,000	1
K-L																													1						$141,450	1
L-M			1				3						1						3										1						$216,000	9
M-N													1						3										1						$103,500	5
																																		Total	$1,060,950	16
OPTION 2	Slope >10%		<5 yr Floodline		Culverts		Bridge/ Boardwalk		Significant Veg Com		Within 30m Wetland		Woodland		Moderate** Constraint Habitat		High Constraint Habitat*		RSD Habitat		Threatened Species		ESA		SAR		Endangered Species		TRCA Regulated		Approval/Lease/ Easement		Private Property		Cost	Score
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
A-B													1						3										1				2		$320,675	7
																																		Total	$320,675	7
OPTION 3	Slope >10%		<5 yr Floodline		Culverts		Bridge/ Boardwalk		Significant Veg Com		Within 30m Wetland		Woodland		Moderate** Constraint Habitat		High Constraint Habitat*		RSD Habitat		Threatened Species		ESA		SAR		Endangered Species		TRCA Regulated		Approval/Lease/ Easement		Private Property		Cost	Score
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	No	
C-D													1						3										1						$190,500	5
																																		Total	$190,500	5
OPTION 4	Slope >10%		<5 yr Floodline		Culverts		Bridge/ Boardwalk		Significant Veg Com		Within 30m Wetland		Woodland		Moderate** Constraint Habitat		High Constraint Habitat*		RSD Habitat		Threatened Species		ESA		SAR		Endangered Species		TRCA Regulated		Approval/Lease/ Easement		Private Property		Cost	Score
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
A-B													1						3										1						$203,200	5
																																		Total	$203,200	5

* **High Constraint Habitat**
** **Moderate Constraint Habitat**

- Habitat for Eastern Meadowlark (Endangered) and Bobolink (Endangered), Butternut
- Woodland Area-sensitive Bird Breeding Habitat (e.g., Interior Forest)
- Shrub/Early Successional Bird Breeding Habitat
- Terrestrial Crayfish Habitat
- Habitat for Hairy-fruited Sedge (Provincially Rare)
- Habitat for Pilose Sundrops (Provincially Rare)
- Habitat for Wood Thrush (Special Concern)

Refer Table 3.0 for definition of "Moderate" and "High" constraints.

* Species At Risk are included within High Constraint habitat sites
Trail algnments consider an erosion setback of min. 10m from top of bank
Trail length may impact decision making i.e. a shorter trail may cost more due to boardwalk whereas a longer trail may be cheaper to implement

Table 3.4: Segment 4 Alignment Constraints Decision Making Matrix

SEGMENT 4	Topographical and Flood Management								Environmental														Cultural		Regulation & Landownership			
FIXED	Slope >10%		<5 yr Floodline		Culverts		Bridge/ Boardwalk		Significant Veg Com		Within 30m Wetland		Woodland		Moderate** Constraint Habitat		High Constraint Habitat*		RSD Habitat		Threatened Species		ESA		SAR		Endangered Species		TRCA Regulated		Lease or Easement		Private Property		Cost	Score
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
A-B			2						2				1								3								1		1				$165,100	10
B-C			2				3						1								3								1						$27,400	10
C-D	1												1								3								1						$506,250	6
D-E			2		1						2										3								1						$88,900	9
E-F			2																		3								1						$20,125	6
F-G			2				3				2		1				3												1						$82,925	12
G-H													1				3												1						$160,400	5
																																		Total	$1,051,100	58
OPTION 1	Slope >10%		<5 yr Floodline		Culverts		Bridge/ Boardwalk		Significant Veg Com		Within 30m Wetland		Woodland		Moderate** Constraint Habitat		High Constraint Habitat*		RSD Habitat		Threatened Species		ESA		SAR		Endangered Species		TRCA Regulated		Approval/Lease/ Easement		Private Property		Cost	Score
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
A-B					1						3																		1				2		$20,550	7
B-C			2				3				3		1		2										2				1				2		$216,000	16
C-D	1								2		3				2						3				2				1				2		$184,150	16
D-E			2		1		3				3				2						3				2				1						$193,700	17
E-F											3										3								1						$68,500	7
F-G			2				3										3				3								1						$506,250	12
G-H	1												1				3				3								1						$60,325	9
																																		Total	$1,249,475	84
OPTION 2	Slope >10%		<5 yr Floodline		Culverts		Bridge/ Boardwalk		Significant Veg Com		Within 30m Wetland		Woodland		Moderate** Constraint Habitat		High Constraint Habitat*		RSD Habitat		Threatened Species		ESA		SAR		Endangered Species		TRCA Regulated		Approval/Lease/ Easement		Private Property		Cost	Score
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
A-B					1						3																		1		1				$232,750	6
B-C							3				3		1																1		1				$971,500	9
C-D			2		1				2		3		1				3				3				2				1		1		2		$482,600	21
																																		Total	$1,686,850	36
OPTION 3	Slope >10%		<5 yr Floodline		Culverts		Bridge/ Boardwalk		Significant Veg Com		Within 30m Wetland		Woodland		Moderate** Constraint Habitat		High Constraint Habitat*		RSD Habitat		Threatened Species		ESA		SAR		Endangered Species		TRCA Regulated		Approval/Lease/ Easement		Private Property		Cost	Score
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
A-B																													1		1				$ 51,375.00	2
B-C			2				3								2										2				1		1				$ 324,000.00	11
C-D															2										2				1		1				$ 38,100.00	6
D-E			2												2										2				1		1				$ 68,500.00	8
E-F			2				3								2										2				1		1				$ 405,000.00	11
F-G									2																				1		1				$ 528,475.00	4
G-D																													1		1				$ 305,075.00	2
																																		Total	$1,720,525	44
OPTION 4	Slope >10%		<5 yr Floodline		Culverts		Bridge/ Boardwalk		Significant Veg Com		Within 30m Wetland		Woodland		Moderate** Constraint Habitat		High Constraint Habitat*		RSD Habitat		Threatened Species		ESA		SAR		Endangered Species		TRCA Regulated		Approval/Lease/ Easement		Private Property		Cost	Score
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
A-B											2																		1						$89,050	3
B-C																													1	Region					$412,700	1
C-D																													1						$86,250	1
																																		Total	$588,000	5

* **High Constraint Habitat**
** **Moderate Constraint Habitat**

- Habitat for Eastern Meadowlark (Endangered) and Bobolink (Endangered), Butternut
- Woodland Area-sensitive Bird Breeding Habitat (e.g., Interior Forest)
- Shrub/Early Successional Bird Breeding Habitat
- Terrestrial Crayfish Habitat
- Habitat for Hairy-fruited Sedge (Provincially Rare)
- Habitat for Pilose Sundrops (Provincially Rare)
- Habitat for Wood Thrush (Special Concern)

Refer Table 3.0 for definition of "Moderate" and "High" constraints.

* Species At Risk are included within High Constraint habitat sites
Trail algnments consider an erosion setback of min. 10m from top of bank
Trail length may impact decision making i.e. a shorter trail may cost more due to boardwalk whereas a longer trail may be cheaper to implement

Table 3.5: Segment 5 Alignment Constraints Decision Making Matrix

SEGMENT 5	Topographical and Flood Management								Environmental														Cultural		Regulation & Landownership							
FIXED	Slope >10%		<5 yr Floodline		Culverts		Bridge/ Boardwalk		Significant Veg Com		Within 30m Wetland		Woodland		Moderate** Constraint Habitat		High Constraint Habitat*		RSD Habitat		Threatened Species		ESA		SAR		Endangered Species		High Arch Potential		TRCA Regulated		Approval/Lease/ Easement		Private Property		Cost	Score
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
A-B			2		1						3		1																1		1	Toronto			$217,400	9
B-C																													1		1	Toronto	2		$41,425	4
																																		Total	**$258,825**	**13**
OPTION 1	Slope >10%		<5 yr Floodline		Culverts		Bridge/ Boardwalk		Significant Veg Com		Within 30m Wetland		Woodland		Moderate** Constraint Habitat		High Constraint Habitat*		RSD Habitat		Threatened Species		ESA		SAR		Endangered Species		High Arch Potential		TRCA Regulated		Lease or Easement		Private Property		Cost	Score
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
A-B					1																								1		1	Landfill			$41,275	3
B-C (Stairs)																													1		1	Landfill			$146,250	2
B-C																													1		1	Landfill			$354,375	2
C-D	1																														1	Landfill			$219,350	2
D-E																													3		1	Landfill			$365,100	3
E-F	1																												3		1	Landfill			$54,800	5
F-G	1				1						3		1																		1		2		$137,675	9
G-H			2				3				3																				1		2		$270,000	11
H-I			2																										1		1		2		$69,850	6
																																		Total	**$1,658,675**	**43**
OPTION 2	Slope >10%		<5 yr Floodline		Culverts		Bridge/ Boardwalk		Significant Veg Com		Within 30m Wetland		Woodland		Moderate** Constraint Habitat		High Constraint Habitat*		RSD Habitat		Threatened Species		ESA		SAR		Endangered Species		High Arch Potential		TRCA Regulated		Approval/Lease/ Easement		Private Property		Cost	Score
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
C-D					1																								1		1	Toronto			$77,350	3
D-E			2				3						1																1						$337,500	7
E-F			2																										1						$88,800	3
F-G			2		1																								1						$146,000	4
G-H			2																										1						$85,725	3
H-I																													1		1		2		$213,200	4
I-J																													1		1		2		$73,500	4
J-K			2				3						1																1		1		2		$121,500	10
																																		Total	**$1,143,575**	**38**

* **High Constraint Habitat**
** **Moderate Constraint Habitat**

- Habitat for Eastern Meadowlark (Endangered) and Bobolink (Endangered), Butternut
- Woodland Area-sensitive Bird Breeding Habitat (e.g., Interior Forest)
- Shrub/Early Successional Bird Breeding Habitat
- Terrestrial Crayfish Habitat
- Habitat for Hairy-fruited Sedge (Provincially Rare)
- Habitat for Pilose Sundrops (Provincially Rare)
- Habitat for Wood Thrush (Special Concern)

Refer Table 3.0 for definition of "Moderate" and "High" constraints.

* Species At Risk are included within High Constraint habitat sites
Trail alignments consider an erosion setback of min. 10m from top of bank
Trail length may impact decision making i.e. a shorter trail may cost more due to boardwalk whereas a longer trail may be cheaper to implement

9.0 Cost Analysis

Cost is identified in the previous Section as a criterion for determining the feasibility of trail options for obvious reasons.

The sum of costs to implement a multi-use trail through the Humber River valleylands between Boyd Conservation Area and Steeles Avenue West is dependent on the following:

- Trail Type (refer Section 11.4)
- Trail Alignment
- Trail Length and Width
- Terrain i.e. gradient
- Requirement for pedestrian bridges and boardwalks
- Temporary or permanent alternate secondary on-road routes
- Requirement for retaining walls, guardrails or fences
- Access points and amenities i.e. benches and garbage bins
- Signage
- Environmental mitigation techniques and/ or landscape restoration

In order to account for the full costs associated for each trail segment, costs for: studies, permits, design, tendering, contract administration, construction and contingency costs are considered.
In order to develop the estimated construction costs of various trail types research and comparison of industry construction costs (current to the time of writing) as well as implementation costs on municipal trail projects was utilized as a basis of comparison. The rationale for cost development is described in the next Section.

9.1 Cost Development – Construction Costs

Depending on the trail type (Refer to Section 12.6 for trail types) costs per linear meter for trail development vary due to the logistics of construction, depth of subbase and surfacing for the trail based on expected site conditions. For example, a Type A trail to be constructed within the 2-year and 5-year flood zone can expect to be subject to seasonally wet soil conditions. Therefore, smaller tracked construction equipment must be considered to limit the footprint of compacted soils within the saturated environment. Trails built for these environments, if to be constructed as a traditional limestone trail with compacted subbase, will tend to require deeper excavation or geogrid or both. This adds to cost and potential creation of waste and greenhouse gas emissions generated from disposal. In addition, Type A trails would require a permeable granular base such as clearstone in order to convey cross drainage and/ or incorporate ditches and culverts at regular intervals. If, however, the trail is constructed as a boardwalk supported by a network of helical piles or similar to spread loading, the structure should be designed to a width to pass emergency

and maintenance vehicles and be capable of carrying such loads. To avoid handrails, boardwalks should be designed to maintain a 600 mm maximum fall height to adjacent grades as dictated by Building Code. Robust boardwalks and pedestrian bridges require steel superstructures which can be installed relatively quickly and conveniently in modules utilizing small equipment affixed with booms.

Considering the foregoing, the following table sets out anticipated unit rates for various trail related construction components based upon industry experience and an average price as derived from tendered trail projects as received from contractors up to 2018. The City of Vaughan Trail Details were also considered in determining cost. The rates build in the cost of all material, labour, equipment rental, overhead and mark up and are reflective of current unionized labourers' costs. It should be noted that an escalation of 2% per annum should be applied when utilizing these unit rates beyond the date that this Study was written.

Table 4: Cost Development - Unit Rates

Unit Rate (2018 rates)	Unit	Item	Description
$3,650.00	m	**Boardwalk**	Steel understructure, Douglas-fir deck, toe rail, helical pile footings (2.8 m spacing). Load capacity 8 ton. 3.0 m clear width. Includes rip rap beneath
$685.00	m	**Type A**	Clearstone in filter fabric (300 mm) or geogrid, Granular 'A' (150mm), limestone screenings (100 mm). 3.0m wide.
$635.00	m	**Type B**	Geogrid, Granular 'A' (150 mm), limestone screenings (100mm). 3.0m wide.
$535.00	m	**Type C**	Granular 'A' (200 mm), limestone screenings (100 mm). 3.0m wide.
$6,750.00	m	**Bridge**	Weathered understructure, guard rail, handrail, chords, douglas fir deck, concrete abutments with helical piles. Load capacity 10 ton. 3.0 m clear width. Local fill to deck approach, armourstone edging/ wall and rip rap in front of abutments

$690.00	m	**Type C - Asphalt/ Boulevard**	Granular 'B' (300 mm), granular 'A' (150 mm), HL3 (100 mm) and directional line marking
$7,500.00	ea	**Culvert**	300 mm CSP culvert (6 m long), trenching, backfill and armourstone ends with riverstone dissipator/ apron
$1800.00	face meter	**Wall**	Armourstone 2-4 course wall, 1.2 m L x 0.5 m H x 0.5 m D pcs, including geotechnical design, quality control, filter fabric, clearstone backfill and subdrain
$125.00	m	**Post Paddle**	Cedar post and paddle rail, 1350 mm height, concrete footings (every 5th posts)
$395.00	m	**Site Prep**	All trail types include $100/m silt sock, $40 tree protection, $100 grubbing/ tree removal, $75 excavation (200 mm depth), $80 import topsoil, fine grade to blend edges, $20 seed and planting
$175.00	m	**Share Rd**	Line marking and guardrail
$490.00	m	**Repurpose**	Scrape and blade existing surface, top up granular 'A', proof roof to 100 % and limestone screenings (100 mm). Widen to 3.0 m clear width where possible
$24,000.0	ea	**Rd Crossing**	Line marking, pedestrian activated signal button and signage
$1,625.00	m	**Stairway**	Weathering steel substructure, Douglas-fir deck, posts and rails, pine structural beams and joists, helical piles every 2.8 m, wire mesh on guards
$30,000	each	**Trailhead**	Includes unit paved area (approx. 5 m x 5 m), ornamental planting, trail map, bike parking, bike repair station, removable bollard or 'P'-gates and one to two benches

$1,850	each	**Signage**	Wayfinding, information, code of conduct and interpretive signage secured to powder-coated hollow structural steel posts embedded in concrete footings

The rates were applied in developing the overall costs per trail segment described below.

The following *Tables 5.1–5.5 Estimated Trail Design & Construction Costs* summarize the construction costs of the component parts (segments) of each trail alignment option utilizing the rationale described in the preceding Sections. A cost of 5% for site preparation and 10% for construction contingency have been added separately to account for unforeseen site conditions. An escalation rate on par with annual inflation shall be considered if utilizing the costs as a basis beyond 2020.

The tables set out the costs for "Fixed" trail alignments and "Optional" alignments. The "Fixed" costs are higher priority as these projects correlate with high priority trail projects in the Phasing Plan. It is important to point out that the implementation costs of a given trail alignment is anticipated to be higher depending on the number and type of constraint criteria the trail alignment encounters.

9.2 Cost Development – Soft Costs

The construction costs are only one part of the cost to implement a trail. Depending on the number of constraints a trail encounters, costs to conduct additional studies, seek permit approval, acquire land or sign lease agreements will impact the relative feasibility of the trail. *Tables 5.1–5*.5 *Estimated Trail Design & Construction Costs* factor in the projected costs for design and engineering development, tender and contract documentation and contract administration costs. This is estimated at 25% of the total construction cost. It is important to note that these costs do not include the cost to carry out design studies, surveys and permit approval processes.

The so called "soft costs" include the cost to carry out studies, secure permits, develop detailed designs, prepare contract documentation and complete contract administration. It is essentially the costs to design the trail, gain approval and oversee implementation (administrative costs).

An estimate of these costs has been integrated into Tables 5.1-5.5 and summarized on the Phasing Plans, Figures 26 through 30.

9.3 Cost Development - Land Acquisition Costs

As it is currently unknown, the costs for potential future landowner agreements and land acquisition costs are not included in this Study. However, it is recommended that land acquisition opportunities that benefit trail implementation be identified in the short-term in order to set aside appropriate funds in advance. Refer to the City's Land Acquisition Strategy 2020 for guidance on land acquisition related to trails.

9.4 Cost Development - Life Cycle Costs

The anticipated costs associated with operating and maintaining the completed trail system over the long-term is an important consideration to ensure that the trail remains in a perpetual state of good repair ensuring public safety. The cost estimate addresses all the anticipated maintenance and inspection requirements and establishes overall potential Life Cycle costs for a 100-year horizon. The various maintenance, monitoring, repair and replacement activities that are required to accommodate the various levels of service afforded by the trail system, are outlined in detail in Section 13.0 and should be included in an Operations and Maintenance Plan prepared for the trail. Maintenance activities aimed at maintaining the trail surface and clearway are proposed to be implemented on a priority basis and in a cost-effective manner, with consideration for safety, availability of funds, availability of personnel resources and environmental considerations.

Table 5.1: Segment 1 Estimated Trail Design & Construction Costs

FIXED ALIGNMENT

Segment	Trail Type	Segment Type & Cost										Segment Subtotal
		< 5yr FL	Cost (lm)	5-100yr FL	Cost (lm)	>100yr FL	Cost (lm)	Bridge	Cost (lm)	Culvert	Cost (ea)	
EE-FF	Re-purposed Granular			240	$ 490.00							$ 117,600.00
FF-GG	Re-purposed Granular			520	$ 490.00							$ 254,800.00
GG-HH	Concrete Crossing			20	$ 1,600.00							$ 32,000.00
HH-II	Re-purposed Granular			150	$ 490.00							$ 73,500.00

All trail types assumed 3.0m wide
** Site Preparation includes clearing, ESC and tree protection*

Subtotal	**$ 477,900.00**
* 5% Site Preparation	**$ 23,895.00**
25% Design & Engineering	**$ 119,475.00**
10% Construction Contingency	**$ 47,790.00**
Total (excl HST)	**$ 669,060.00**

OPTION 1

Segment	Trail Type	Segment Type & Cost										Segment Subtotal
		< 5yr FL	Cost (lm)	5-100yr FL	Cost (lm)	>100yr FL	Cost (lm)	Bridge	Cost (lm)	Culvert	Cost (ea)	
V-W	Type B			255	$ 635.00							$ 161,925.00
W-X	Bridge							22	$ 6,750.00			$ 148,500.00
X-Y	Type B			430	$ 635.00							$ 273,050.00
Y-Z	Bridge							22	$ 6,750.00			$ 148,500.00
Z-AA	Type B			97	$ 635.00							$ 61,595.00
AA-BB	Type B			60	$ 635.00							$ 38,100.00
BB-CC	Type B			350	$ 635.00							$ 222,250.00
CC-DD	Bridge							36	$ 6,750.00			$ 243,000.00
DD-EE	Type B			105	$ 635.00							$ 66,675.00

All trail types assumed 3.0m wide
** Site Preparation includes clearing, ESC and tree protection*

Subtotal	**$ 1,363,595.00**
* 5% Site Preparation	**$ 68,179.75**
25% Design & Engineering	**$ 340,898.75**
10% Construction Contingency	**$ 136,359.50**
Total (excl HST)	**$ 1,909,033.00**

OPTION 2

Segment	Trail Type	Segment Type & Cost												Segment Subtotal
		< 5yr FL	Cost (lm)	5-100yr FL	Cost (lm)	>100yr FL	Cost (lm)	Bridge	Cost (lm)	Culvert	Cost (ea)	Crossing	Cost (ea)	
B-C	Boulevard Trail - Asphalt			485	$ 690.00									$ 334,650.00
C-D	Pedestrian Crossings (2)											2	$ 24,000.00	$ 48,000.00

All trail types assumed 3.0m wide
** Site Preparation includes clearing, ESC and tree protection*

Subtotal	**$ 382,650.00**
* 5% Site Preparation	**$ 19,132.50**
25% Design & Engineering	**$ 95,662.50**
10% Construction Contingency	**$ 38,265.00**
Total (excl HST)	**$ 535,710.00**

OPTION 3

Segment	Trail Type	Segment Type & Cost												Segment Subtotal
		< 5yr FL	Cost (lm)	5-100yr FL	Cost (lm)	>100yr FL	Cost (lm)	Bridge	Cost (lm)	Culvert	Cost (ea)	Wall/ Fence	Cost (lm)	
A-B	Type B			235	$ 635.00									$ 149,225.00
B-C	Bridge (Bowstring)**							34	$ 600,000.00					$ 600,000.00
C-D	Type B			67	$ 635.00							30	$ 125.00	$ 46,295.00
D-EE	Type B			180	$ 635.00					1	$ 7,500.00	65	$ 1,800.00	$ 238,800.00

All trail types assumed 3.0m wide
** Site Preparation includes clearing, ESC and tree protection*
*** Represents maximum cost estimated - Refer Appendix C = Bowstring Bridge Condition Report - Option 3*

Subtotal	**$ 1,034,320.00**
* 5% Site Preparation	**$ 51,716.00**
25% Design & Engineering	**$ 258,580.00**
10% Construction Contingency	**$ 103,432.00**
Total (excl HST)	**$ 1,448,048.00**

Table 5.2: Segment 2 Estimated Trail Design & Construction Costs

OPTION 1

Segment	Trail Type	Segment Type & Cost											Segment Subtotal
		< 5yr FL	Cost (lm)	5-100yr FL	Cost (lm)	>100yr FL	Cost (lm)	Bridge	Cost (lm)	Culvert	Cost (ea)	Signal Crossing	
N-O	Type B			260	$ 635.00								$ 165,100.00
B-O	Boulevard - Asphalt			55	$ 690.00								$ 37,950.00
O-P	Boulevard - Asphalt			260	$ 690.00								$ 179,400.00
Q-R	Pedestrian Activated Signal											$ 600,000.00	$ 600,000.00
Q-S	Boulevard - Asphalt			540	$ 690.00								$ 372,600.00
S-T	Pedestrian Activated Signal											$ 600,000.00	$ 600,000.00
T-U	Road Linemarking			225	$ 175.00								$ 39,375.00
U-V	Pedestrian Crossing/ Linemarking											$ 24,000.00	$ 24,000.00
A-B	Boulevard - Asphalt			170	$ 690.00								$ 117,300.00

All trail types assumed 3.0m wide

** Site Preparation includes clearing, ESC and tree protection*

Subtotal	$ 2,135,725.00
* 5% Site Preparation	$ 106,786.25
25% Design & Engineering	$ 533,931.25
10% Construction Contingency	$ 213,572.50
Total (excl HST)	$ 2,990,015.00

OPTION 2

Segment	Trail Type	Segment Type & Cost											Segment Subtotal
		< 5yr FL	Cost (lm)	5-100yr FL	Cost (lm)	>100yr FL	Cost (lm)	Bridge	Cost (lm)	Culvert	Cost (ea)	Crossing/ Stairway	
B-C	Pedestrian Activated Signal											$ 600,000.00	$ 600,000.00
C-D	Type A	150	$ 685.00							2	$ 6,500.00		$ 115,750.00
D-E	Bridge							32	$ 6,750.00				$ 216,000.00
E-F	Type B			195	$ 635.00								$ 123,825.00
F-G	Pedestrian Activated Signal											$ 600,000.00	$ 600,000.00
I	Stairway											$ 250,000.00	$ 250,000.00
G-H	Type B + Remove Existing Trail			360	$ 725.00								$ 261,000.00
H-J	Boardwalk			260	$ 3,650.00								$ 949,000.00
J-K	Type B			108	$ 635.00								$ 68,580.00

All trail types assumed 3.0m wide

** Site Preparation includes clearing, ESC and tree protection*

Subtotal	$ 3,184,155.00
* 5% Site Preparation	$ 159,207.75
25% Design & Engineering	$ 796,038.75
10% Construction Contingency	$ 318,415.50
Total (excl HST)	$ 4,457,817.00

Table 5.3: Segment 3 Estimated Trail Design & Construction Costs

FIXED ALIGNMENT

Segment	Trail Type	Segment Type & Cost											Segment Subtotal
		< 5yr FL	Cost (lm)	5-100yr FL	Cost (lm)	>100yr FL	Cost (lm)	Bridge	Cost (lm)	Guardrail	Cost (ea)	Pedestrian Crossing	
H-I	Type B - Asphalt			120	$ 635.00			15	$ 6,750.00	115	$ 125.00		$ 191,825.00
I-J	Concrete or Asphalt Path			635	$ 690.00								$ 438,150.00

All trail types assumed 3.0m wide
TRCA Restoration planting opportunities not included in cost estimate

Subtotal	**$ 629,975.00**
* 5% Site Preparation	$ 31,498.75
25% Design & Engineering	$ 157,493.75
10% Construction Contingency	$ 62,997.50
Total (excl HST)	**$ 881,965.00**

OPTION 1

Segment	Trail Type	Segment Type & Cost											Segment Subtotal
		< 5yr FL	Cost (lm)	5-100yr FL	Cost (lm)	>100yr FL	Cost (lm)	Bridge	Cost (lm)	Guardrail	Cost (ea)	Pedestrian Crossing	
J-K	Pedestrian Activated Signal											$ 600,000.00	$ 600,000.00
K-L	Type B - Asphalt			205	$ 690.00					70	$ 125.00		$ 141,450.00
L-M	Bridge							32	$ 6,750.00				$ 216,000.00
M-N	Type B - Asphalt			150	$ 690.00								$ 103,500.00

All trail types assumed 3.0m wide
TRCA Restoration planting opportunities not included in cost estimate
** Site Preparation includes clearing, ESC and tree protection*

Subtotal	**$ 1,060,950.00**
* 5% Site Preparation	$ 53,047.50
25% Design & Engineering	$ 265,237.50
10% Construction Contingency	$ 106,095.00
Total (excl HST)	**$ 1,485,330.00**

OPTION 2

Segment	Trail Type	Segment Type & Cost											Segment Subtotal
		< 5yr FL	Cost (lm)	5-100yr FL	Cost (lm)	>100yr FL	Cost (lm)	Bridge	Cost (lm)	Culvert	Cost (ea)	Signal Crossing	
A-B	Type B			505	$ 635.00								$ 320,675.00

All trail types assumed 3.0m wide
** Site Preparation includes clearing, ESC and tree protection*

Subtotal	**$ 320,675.00**
* 5% Site Preparation	$ 16,033.75
25% Design & Engineering	$ 80,168.75
10% Construction Contingency	$ 32,067.50
Total (excl HST)	**$ 448,945.00**

OPTION 3

Segment	Trail Type	Segment Type & Cost											Segment Subtotal
		< 5yr FL	Cost (lm)	5-100yr FL	Cost (lm)	>100yr FL	Cost (lm)	Bridge	Cost (lm)	Culvert	Cost (ea)	Signal Crossing	
C-D	Type B			300	$ 635.00								$ 190,500.00

All trail types assumed 3.0m wide
** Site Preparation includes clearing, ESC and tree protection*

Subtotal	**$ 190,500.00**
* 5% Site Preparation	$ 9,525.00
25% Design & Engineering	$ 47,625.00
10% Construction Contingency	$ 19,050.00
Total (excl HST)	**$ 266,700.00**

OPTION 4

Segment	Trail Type	Segment Type & Cost											Segment Subtotal
		< 5yr FL	Cost (lm)	5-100yr FL	Cost (lm)	>100yr FL	Cost (lm)	Bridge	Cost (lm)	Culvert	Cost (ea)	Signal Crossing	
A-B	Type B			320	$ 635.00								$ 203,200.00

** Site Preparation includes clearing, ESC and tree protection*
** Site Preparation includes clearing, ESC and tree protection*

Subtotal	**$ 203,200.00**
* 5% Site Preparation	$ 10,160.00
25% Design & Engineering	$ 50,800.00
10% Construction Contingency	$ 20,320.00
Total (excl HST)	**$ 284,480.00**

Table 5.4: Segment 4 Estimated Trail Design & Construction Costs

FIXED ALIGNMENT

Segment	Trail Type	Segment Type & Cost											Segment Subtotal
		< 5yr FL	Cost (lm)	5-100yr FL	Cost (lm)	>100yr FL	Cost (lm)	Bridge	Cost (lm)	Culvert	Cost (ea)	Retaining Wall	
A-B	Type B			260	$ 635.00								$ 165,100.00
B-C	Type A	40	$ 685.00										$ 27,400.00
C-D	Bridge							75	$ 6,750.00				$ 506,250.00
D-E	Type B			140	$ 635.00								$ 88,900.00
E-F	Share Road			115	$ 175.00								$ 20,125.00
F-G	Type C					155	$ 535.00						$ 82,925.00
G-H	Type B			40	$ 635.00						75	$ 1,800.00	$ 160,400.00

*All trail types assumed 3.0m wide

Subtotal	**$ 1,051,100.00**
* 5% Site Preparation	**$ 52,555.00**
25% Design & Engineering	**$ 262,775.00**
10% Construction Contingency	**$ 105,110.00**
Total (excl HST)	**$ 1,471,540.00**

OPTION 1

Segment	Trail Type	Segment Type & Cost											Segment Subtotal
		< 5yr FL	Cost (lm)	5-100yr FL	Cost (lm)	>100yr FL	Cost (lm)	Bridge	Cost (lm)	Culvert	Cost (ea)		
A-B	Type A	30	$ 685.00										$ 20,550.00
B-C	Bridge							32	$ 6,750.00				$ 216,000.00
C-D	Type B			290	$ 635.00								$ 184,150.00
D-E	Re-purposed Granular	380	$ 490.00							1	$ 7,500.00		$ 193,700.00
E-F	Type A	100	$ 685.00										$ 68,500.00
F-G	Bridge							75	$ 6,750.00				$ 506,250.00
G-H	Type B			95	$ 635.00								$ 60,325.00

*All trail types assumed 3.0m wide

Subtotal	**$ 1,249,475.00**
* 5% Site Preparation	**$ 62,473.75**
25% Design & Engineering	**$ 312,368.75**
10% Construction Contingency	**$ 124,947.50**
Total (excl HST)	**$ 1,749,265.00**

OPTION 2

Segment	Trail Type	Segment Type & Cost											Segment Subtotal
		< 5yr FL	Cost (lm)	5-100yr FL	Cost (lm)	>100yr FL	Cost (lm)	Bridge	Cost (lm)	Culvert	Cost (ea)		
A-B	Re-purposed Granular			475	$ 490.00								$ 232,750.00
B-C	Boardwalk			260	$ 3,650.00					3	$ 7,500.00		$ 971,500.00
C-D	Type B			760	$ 635.00								$ 482,600.00

All trail types assumed 3.0m wide
**Site Preparation includes clearing, ESC and tree protection*

Subtotal	**$ 1,686,850.00**
* 5% Site Preparation	**$ 84,342.50**
25% Design & Engineering	**$ 421,712.50**
10% Construction Contingency	**$ 168,685.00**
Total (excl HST)	**$ 2,361,590.00**

OPTION 3

Segment	Trail Type	Segment Type & Cost											Segment Subtotal
		< 5yr FL	Cost (lm)	5-100yr FL	Cost (lm)	>100yr FL	Cost (lm)	Bridge	Cost (lm)	Culvert	Cost (ea)		
A-B	Type A	75	$ 685.00										$ 51,375.00
B-C	Bridge							48	$ 6,750.00				$ 324,000.00
C-D	Type A	60	$ 635.00										$ 38,100.00
D-E	Type B			100	$ 685.00								$ 68,500.00
E-F	Bridge							60	$ 6,750.00				$ 405,000.00
F-G	Type A	35	$ 635.00					75	$ 6,750.00				$ 528,475.00
G-D	Type B	445	$ 635.00							3	$ 7,500.00		$ 305,075.00

All trail types assumed 3.0m wide
**Site Preparation includes clearing, ESC and tree protection*

Subtotal	**$ 1,720,525.00**
* 5% Site Preparation	**$ 86,026.25**
25% Design & Engineering	**$ 430,131.25**
10% Construction Contingency	**$ 172,052.50**
Total (excl HST)	**$ 2,408,735.00**

Table 5.4: Segment 4 Estimated Trail Design & Construction Costs, Continued

OPTION 4

Segment	Trail Type	Segment Type & Cost											Segment Subtotal
		< 5yr FL	Cost (lm)	5-100yr FL	Cost (lm)	>100yr FL	Cost (lm)	Bridge	Cost (lm)	Culvert	Cost (ea)	Fence	
A-B	Type A	130	$ 685.00										$ 89,050.00
B-C	Boulevard - Asphalt			580	$ 690.00						100	$ 125.00	$ 412,700.00
C-D	Boulevard - Asphalt			125	$ 690.00								$ 86,250.00

All trail types assumed 3.0m wide

** Site Preparation includes clearing, ESC and tree protection*

Subtotal	**$ 588,000.00**
* 5% Site Preparation	**$ 29,400.00**
25% Design & Engineering	**$ 147,000.00**
10% Construction Contingency	**$ 58,800.00**
Total (excl HST)	**$ 823,200.00**

Table 5.5: Segment 5 Estimated Trail Design & Construction Costs

FIXED ALIGNMENT

Segment	Trail Type	Segment Type & Cost												Segment Subtotal
		< 5yr FL	Cost (lm)	5-100yr FL	Cost (lm)	>100yr FL	Cost (lm)	Bridge	Cost (lm)	Culvert	Cost (ea)	Guardrail	Cost (lm)	
A-B	Type A	290	$ 685.00							1	$ 7,500.00	90	$ 125.00	$ 217,400.00
B-C	Type B			55	$ 635.00					1	$ 6,500.00			$ 41,425.00

All trail types assumed 3.0m wide
** Site Preparation includes clearing, ESC and tree protection*

Subtotal	$ 258,825.00
* 5% Site Preparation	$ 12,941.25
25% Design & Engineering	$ 64,706.25
10% Construction Contingency	$ 25,882.50
Total (excl HST)	$ 362,355.00

OPTION 1

Segment	Trail Type	Segment Type & Cost												Segment Subtotal
		< 5yr FL	Cost (lm)	5-100yr FL	Cost (lm)	>100yr FL	Cost (lm)	Stairway	Cost (lm)	Culvert	Cost (ea)	Guardrail	Cost (lm)	
A-B	Type B			65	$ 635.00									$ 41,275.00
B-C	Stairway							90	$ 1,625.00					$ 146,250.00
B-C	Type C - Asphalt					500	$ 690.00					75	$ 125.00	$ 354,375.00
C-D	Type C					410	$ 535.00							$ 219,350.00
D-E	Type C - Asphalt					515	$ 690.00					78	$ 125.00	$ 365,100.00
E-F	Type B			80	$ 685.00									$ 54,800.00
F-G	Type A	205	$ 635.00							1	$ 7,500.00			$ 137,675.00
G-H	Bridge							40	$ 6,750.00					$ 270,000.00
H-I	Type B			110	$ 635.00									$ 69,850.00

All trail types assumed 3.0m wide
** Site Preparation includes clearing, ESC and tree protection*

Subtotal	$ 1,658,675.00
* 5% Site Preparation	$ 82,933.75
25% Design & Engineering	$ 414,668.75
10% Construction Contingency	$ 165,867.50
Total (excl HST)	$ 2,322,145.00

OPTION 2

Segment	Trail Type	Segment Type & Cost												Segment Subtotal
		< 5yr FL	Cost (lm)	5-100yr FL	Cost (lm)	>100yr FL	Cost (lm)	Bridge	Cost (lm)	Culvert	Cost (ea)	Guardrail	Cost (lm)	
C-D	Type B			110	$ 635.00					1	$ 7,500.00			$ 77,350.00
D-E	Bridge							50	$ 6,750.00					$ 337,500.00
E-F	Type A	130	$ 635.00									50	$ 125.00	$ 88,800.00
F-G	Boardwalk	40	$ 3,650.00											$ 146,000.00
G-H	Type A	135	$ 635.00											$ 85,725.00
H-I	Type B			320	$ 635.00							80	$ 125.00	$ 213,200.00
I-J	Type B			100	$ 635.00							80	$ 125.00	$ 73,500.00
J-K	Bridge							18	$ 6,750.00					$ 121,500.00

All trail types assumed 3.0m wide
** Site Preparation includes clearing, ESC and tree protection*

Subtotal	$ 1,143,575.00
* 5% Site Preparation	$ 57,178.75
25% Design & Engineering	$ 285,893.75
10% Construction Contingency	$ 114,357.50
Total (excl HST)	$ 1,601,005.00

10.0 Implementation

It is recommended that the City further evaluate priorities on trail implementation as guided by the 2020 Pedestrian & Bicycle Master Plan. The Pedestrian & Bicycle Master Plan speaks to allowing for flexibility in the active transportation planning and implementation programs in response to active transportation needs and gaps within the pedestrian, cycling and multi-use recreational trails networks as they are identified. When considering standalone multi-use recreational trail projects, the plan provides a framework on the Network Implementation Process, with specific focus on priorities guided by the following:

- Strategic gaps within the Vaughan Super Trail Network; and,
- Multi-use Recreational Trail Secondary Routes connecting to:
    - The Vaughan Super Trail;
    - Intensification Areas (Urban Growth Areas, Primary Centres Regional Intensification Corridors, and Local Centres); and,
    - Major destinations/transit/community facilities.

Furthermore, the Pedestrian & Bicycle Master Plan recommends that prioritization be informed by connections that will provide connectivity to trail facilities identifying missing linkages which provide direct access to major destinations, to existing or planned places of intensification, and that demonstrate a benefit to the local population. Proposed prioritization should not preclude implementation of local trails through development or opportunities where capital infrastructure works and related environmental assessments advanced by other agencies or parties may allow for implementing larger municipal key connections. Specifically, the following recommendations should be noted:

1. Identify and leverage larger capital projects and development to expand active transportation infrastructure (i.e. routine accommodation);
2. Identify, prioritize and incorporate infrastructure gaps not addressed through routine accommodation into the annual active transportation planning and implementation programs; and,
3. Prioritize the development of local networks and loops within existing neighbourhoods and communities.

Priorities should also be informed by recommendations of the Active Together Master Plan and the Parks Redevelopment Strategy, which are both updated every 5 years or as part of comprehensive capital infrastructure projects.

The Implementation Plan set out as part of this Feasibility Study is designed to lay out short-term and long-term priorities for trail implementation based upon a balance of: community and environmental quality, mobility, and cost as well as affordability opportunities. Utilizing the breakdown of the Study Area into 5 segments, the Phasing Plan sets out short-term projects or Phase 1 projects with a timespan of 1 to 5 years. All other trail projects are noted as long-term or Phase 2 projects with a timespan of 6 and greater years.

Identification of Phase 1 priority trail projects was based upon the following criteria:

- Does not require additional studies;
- Does not require approvals;
- Trail segment does not include major infrastructure;
- Good access to construct the trail with limited disturbance to Natural Environment; and,
- Lower overall cost to implement, operate and maintain the trail segment.

The Implementation Plan also provides high-level guidance to assist the City of Vaughan in planning capital budgets and to establish the EA and detailed/functional design processes. *Tables 6.1-6.5: Implementation Responsibilities*, provides a summary of the landowners and stakeholders involved in the trail planning process and set out their respective responsibilities. The Implementation Plan also identifies the coordination efforts that would be required to implement various trail alignments. The tables describe the type of trail facility (e.g. Type A trail) that is proposed with each segment of the Study Area. A catalogue of trail types is included in Section 12.6 below, however, it must be clarified that the trail types illustrated provide recommendations for trail design that are to be cross-referenced with City of Vaughan trail standards and details.

The Phase 1 projects as identified were determined based upon relatively low numbers of constraints to trail development projects that could be implemented quickly and with a relatively small capital budget providing meaningful trail enhancements within local contexts. These projects are illustrated on Figures 26-30 below. For longer-term initiatives and projects where there are multiple optional trail alignments proposed, it is anticipated that an EA process will be required to support an in-depth evaluation of each alternative, to further verify the merits, for timing and cost of implementation.

Although outside the scope of this Feasibility Study, it is recommended that a comprehensive signage and wayfinding strategy be developed with the overall trail network that will provide an identity for the trail, denote hierarchical access points, reinforce community character and local history and provide wayfinding. An interim signage and wayfinding solution should be developed and integrated with the phased implementation of individual trail segments.

10.1 Phasing - Segment 1

The adaptation of the existing granular maintenance access path within the Boyd Conservation Area is recommended as a Phase 1/short-term construction initiative. This recommendation is made based on the fact that, although it is located within the regulated Redside Dace habitat, the trail already exists, making a key connection to the William Granger trail to the north and enabling access to existing facilities, such as a washroom, parking lot and playground. The cost to upgrade this existing trail would be relatively low. It is anticipated that a Letter of Advice would be required from the MECP (instead of an Overall Benefit Permit). The estimated construction cost to complete the Phase 1 short term trail (930 m length) is estimated to be $477,900 (plus additional estimated soft costs of 40% - $191,160). This estimate does not account for the cost of studies and permits that may be required to implement this section of trail, which may include geotechnical analyses and a TRCA permit.

A Phase 1/expanded option may include continuing the trail from Boyd Conservation Area to Langstaff Road and developing an appropriate crossing as identified in Figure 4 and formalizing an access from Langstaff Road. This expanded phase should include addressing the bowstring bridge assessment recommendations as part of this study and conducting the necessary cultural heritage studies to investigate opportunities to celebrate the bowstring bridge. The estimate additional costs of continuing the trail connection (515 m length) to Langstaff is estimated to be $1,493,220 (plus additional estimated soft costs of 40% - $597,288) excluding costs related to cultural heritage recommendations related to the bowstring bridge. Both Phase 1/short-term and expanded option segment of the trail are identified on Figure 27 below and the stakeholder implementation responsibilities are identified on Table 6.1.

Subject to discussions with York Region, an existing multi-use asphalt paved boulevard trail on the east side of Islington Avenue between Langstaff Road and Arista Gate, could provide a by-pass utilized during the construction of the Phase 1/short-term trail improvement within Boyd Conservation Area. Intersection improvements are required to the north side pedestrian crossing of the intersection of Langstaff Road and Islington Avenue. The crossing is proposed where currently cross-walk and cross-ride facilities do not exist. As part of these improvements AODA standards are to be implemented, including but not limited to line marking, a sound-emitting push button and accessible signage.

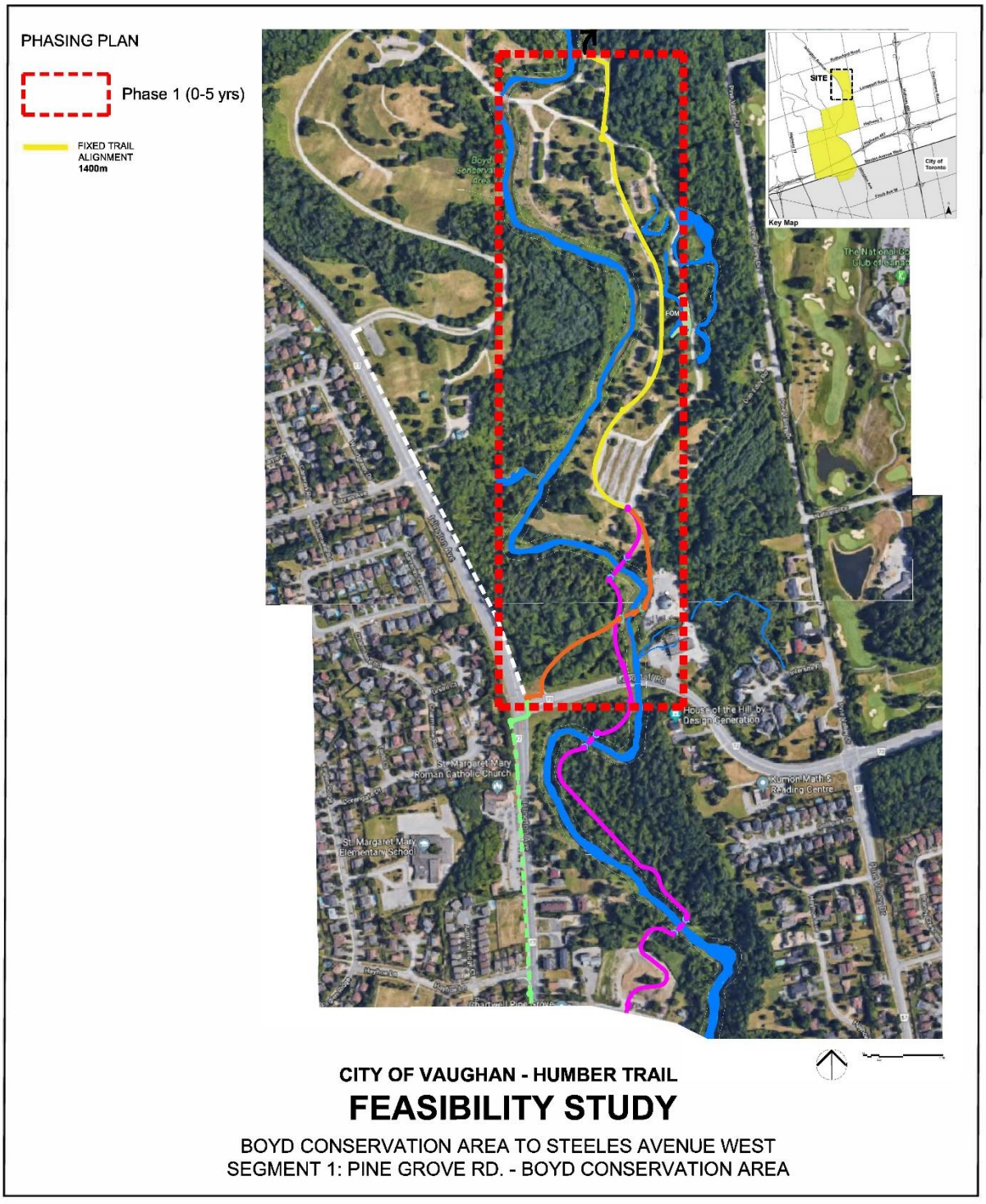


Figure 27: Segment 1, Phase 1 Plan

Table 6.1: Segment 1 Implementation Responsibilities

FIXED ALIGNMENT

Segment	Length (m)	Type	Culvert	Ownership	Notes	Approvals / Permits	Cost
EE-FF	240	Granular		TRCA	Repurposed access road to trail	TRCA; MNRF; DFO; City of Vaughan	$117,600
FF-GG	520	Granular		TRCA	Repurposed access road to trail	TRCA; MNRF; DFO; City of Vaughan	$254,800
GG-HH	20	Crossing		TRCA	Repurposed access road to trail	TRCA; MNRF; DFO; City of Vaughan	$32,000
HH-II	150	Granular		TRCA	Repurposed access road to trail	TRCA; MNRF; DFO; City of Vaughan	$73,500

OPTION 1

Segment	Length (m)	Type	Culvert	Ownership	Notes	Approvals / Permits	Cost
V-W	255	Type B		City of Vaughan	Land acquisition required	TRCA; MNRF; DFO; City of Vaughan	$161,925
W-X	22	Bridge		City of Vaughan / TRCA	Subject to geomorphic study	TRCA; MNRF; DFO; City of Vaughan	$148,500
X-Y	430	Type B		TRCA	Within ESA	TRCA; MNRF; DFO; City of Vaughan	$273,050
Y-Z	22	Bridge		TRCA	ESA; Subject to geomorphic study	TRCA; MNRF; DFO; City of Vaughan	$148,500
Z-AA	97	Type B		TRCA		TRCA; MNRF; DFO; City of Vaughan	$61,595
AA-BB	60	Type B		City of Vaughan	City transportation approval; code	TRCA; MNRF; DFO; City of Vaughan	$38,100
BB-CC	350	Type B		TRCA		TRCA; MNRF; DFO; City of Vaughan	$222,250
CC-DD	36	Bridge		TRCA	Subject to geomorphic study	TRCA; MNRF; DFO; City of Vaughan	$243,000
DD-EE	105	Type B		TRCA		TRCA; MNRF; DFO; City of Vaughan	$66,675

OPTION 2

Segment	Length (m)	Type	Culvert	Ownership	Notes	Approvals / Permits	Cost
B-C	485	Boulevard Trail		Region of York	Remove and widen existing path	Community liaison committee meetings; Region of York	$334,650
C-D	2	Pedestrian Crossing		City of Vaughan / Region of Y	Utilize existing linemarking, add signage		$48,000

OPTION 3

Segment	Length (m)	Type	Culvert	Ownership	Notes	Approvals / Permits	Cost
A-B	235	Type B		City of Vaughan / TRCA	Potential short term solution while waiting for land acquisitions and permit	TRCA; MNRF; DFO; City of Vaughan	$149,225
B-C	34	Bridge Bowstiring		TRCA	Engineering review; geomorphic s	TRCA; MNRF; DFO; City of Vaughan	$600,000
C-D	67	Type B		TRCA	City of Vaughan review (works yar	TRCA; MNRF; DFO; City of Vaughan	$46,295
D-E	180	Type B	1	TRCA	Repurposed, existing trail	TRCA; MNRF; DFO; City of Vaughan	$238,800

10.2 Phasing - Segment 2

The trail that is proposed to be aligned parallel to the driveway that leads from Islington Avenue into Doctors McLean District Park is recommended as a Phase 1/short-term project and forms part of the Riverwalk Trail. This initiative can be viewed as a park improvement project. Although located within the regulated habitat for Redside Dace, this trail would be situated within a manicured landscape and adjacent the roadway that leads into the park. In response, the encroachment within the regulated habitat should not pose a significant concern and therefore re a Letter of Advice from the MECP would likely be required.

The possibility to implement a second trail project in this segment exists in the short-term. A trail through the new City-owned park at Pine Grove Road linking up to on-road route from Islington Avenue to the park, is a project that would benefit the surrounding community, and would provide safe access to the park. The project would afford the opportunity for a future linkage east and west within the local neighbourhood including a connection to Pine Valley Drive through Brougham Drive and into the Jersey Creek Park trail network. The proposed trail segment would be an important asset, regardless of whether it ultimately would connect to the Humber Trail.

The proposed trails are identified on Figure 28 below and the stakeholder implementation responsibilities are illustrated on Table 6.2. The estimated costs to construct the Phase 1 trail project (442 m length) is estimated to be $484,600 (plus additional estimated soft costs of 40% - $193,840) inclusive of a new pedestrian bridge if Option 1 was to be implemented. The cost is estimated to be $190,500 (plus additional estimated soft costs of 40% - $76,200) if Option 3 (300 m length) was to be implemented. Trail alignment option 3 occurs in segment 3, however, should be considered with phase 1 of segment 2 to limit the potential for future disturbance to this area. It should also be clarified that the estimated costs identified for this segment do not account for the cost of studies and permits that may be required to facilitate the implementation of this section of trail. For example, a geotechnical assessment and MECP and TRCA permits will likely be required.

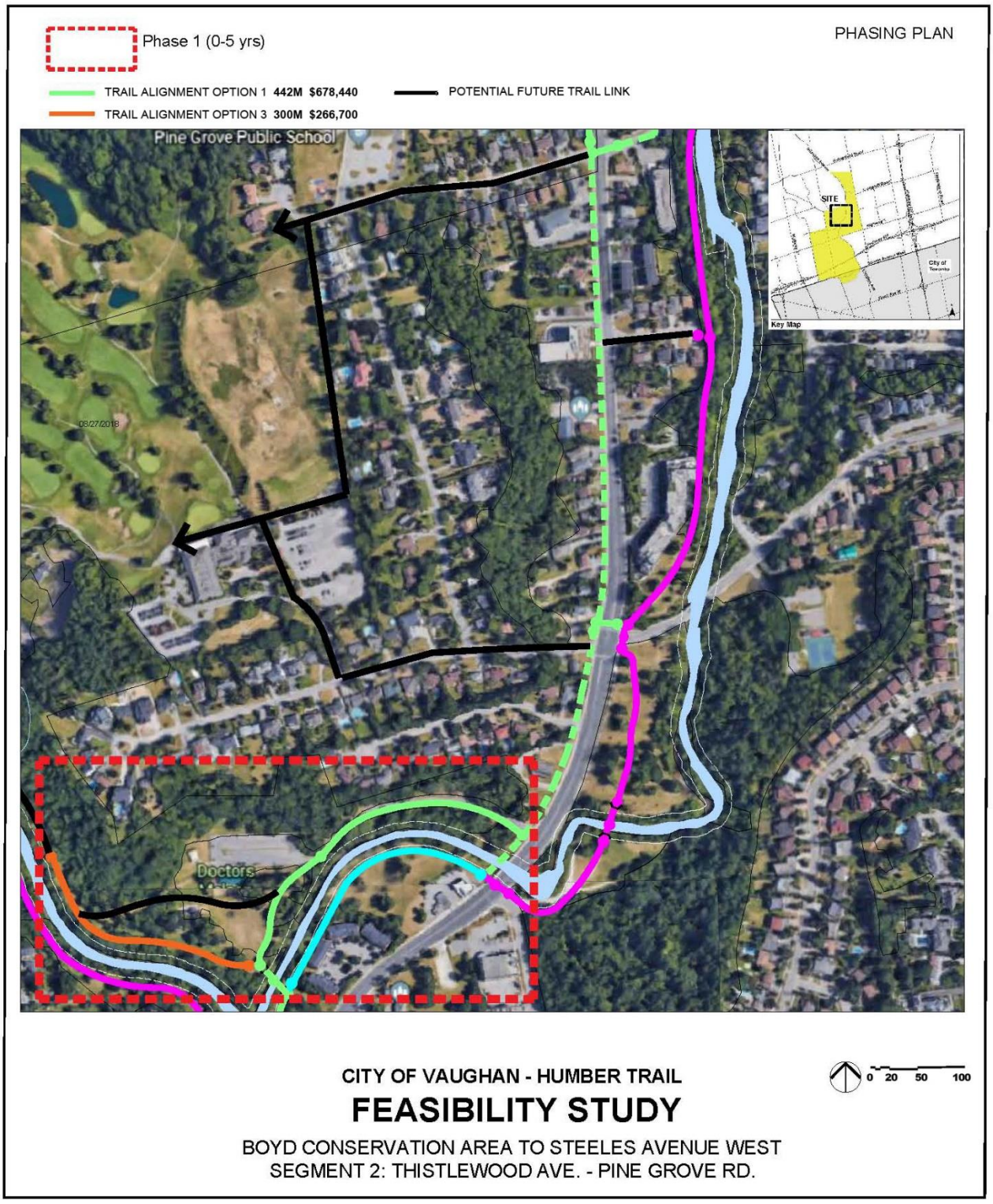


Figure 28: Segment 2, Phase 1 Plan

Table 6.2: Segment 2 Implementation Responsibilities

OPTION 1

Segment	Length (m)	Type	Culvert	Ownership	Notes	Approvals / Permits	Cost
N-O	260	Type B		TRCA	Subject to traffic analysis	TRCA	$165,100
B-O	55	Boulevard - Asphalt		Region of York		Region of York	$37,950
O-P	260	Boulevard - Asphalt		Region of York		Region of York	$179,400
Q-R	-	Pedestrian Crossing		Region of York	Subject to geomorphic study	Region of York	$600,000
Q-S	540	Boulevard - Asphalt		Region of York		Region of York	$372,600
S-T	-	Pedestrian Activated Signal		Region of York	Subject to traffic analysis	Region of York	$600,000
T-U	225	Road Linemarking		City of Vaughan	Subject to traffic analysis, City transportation approval	City of Vaughan	$39,375
U-V	-	Pedestrian Crossing		City of Vaughan/ TRCA	Subject to traffic analysis, City transportation approval	City of Vaughan	$24,000
A-B	170	Asphalt Boulevard Trail		City of Vaughan / Region of Y	Community liaison committee meetings	Region of York	$117,300

OPTION 2

Segment	Length (m)	Type	Culvert	Ownership	Notes	Approvals / Permits	Cost
B-C	-	Pedestrian Crossing		Region of York	Subject to traffic analysis	Region of York	$600,000
C-D	150	Type A		TRCA	Subject to borehole analysis	TRCA	$115,750
D-E	32	Bridge		TRCA	Subject to geomorphic study	TRCA	$216,000
E-F	195	Type B		TRCA		TRCA	$123,825
F-G	-	Pedestrian Crossing		City of Vaughan	Subject to traffic analysis	City of Vaughan	$600,000
I	-	Stairway		City of Vaughan	Subject to geotechnical slope stability study	City of Vaughan	$250,000
G-H	360	Type B + Remove Existing Trail		City of Vaughan/ TRCA	Subject to approval of 3 separate private land owners	City of Vaughan/ TRCA	$261,000
H-J	258	Boardwalk		Private Property	Requires land acquisition, subject to Cultural	Easement/ lease agreement	$949,000
J-K	108	Type B		City of Vaughan	Through City Parkland	City of Vaughan	$68,580

10.3 Phasing - Segment 3

This component of the Study Area prioritizes trail connections of the Riverwalk Trail on the east side of the river in combination with potential future improvements to widen the trail on the west bank in order to provide a multi-use trail and to extend this trail along the main branch of the Humber Valley.

This section of trail that parallels the river adjacent to Nort Johnston District Park exists as a narrow concrete pathway (Riverwalk Trail). It is recommended that this pathway be replaced with a 3.0 m clear width asphalt multi-use pathway. This segment of trail is free from constraints and a permit for construction will not be required since the work can be regarded as an improvement project to the existing trail. In response, this trail improvement initiative is recommended as a Phase 1/short-term project. Widening the existing Riverwalk would improve the utility of the existing trail. Given that pedestrian traffic is anticipated to increase to Woodbridge centre with planned improvements outlined in the Woodbridge Centre Secondary Plan, the improvement of this trail is a priority.

The Phase 1 project would also include a proposed extension of the trail south and under Highway 7 if possible. Further engineering verification is required to confirm this option. In the event that an underpass is unlikely at Highway 7, an option to route the trail to the intersection of Islington Avenue and Highway 7 may also be possible although not preferable due to space constraints within the right of way and the high speed of traffic. This option would enable an accessible entry to the trail on the north side of Highway 7 gradually descending from the sidewalk to meet the trail through the Woodbridge Pool and Memorial Arena parking lot. This option may be considered in conjunction with an underpass or as an alternative. The intersection at Islington Avenue and Highway 7 is considered a “secondary gateway” by the Woodbridge Centre Secondary Plan (Refer to Schedule 8 of the Plan).

This trail segment is identified on Figure 29 below and the proposed stakeholder implementation responsibilities are set out on Table 6.3. The cost to complete the Phase 1 trail project (635 m length) is estimated to be $438,150 (plus additional estimated soft costs of 40% - $175,260). The estimate does not include the cost of studies and permits that may be required to complete this section of trail. For example, a geotechnical assessment and TRCA permit would likely be required.

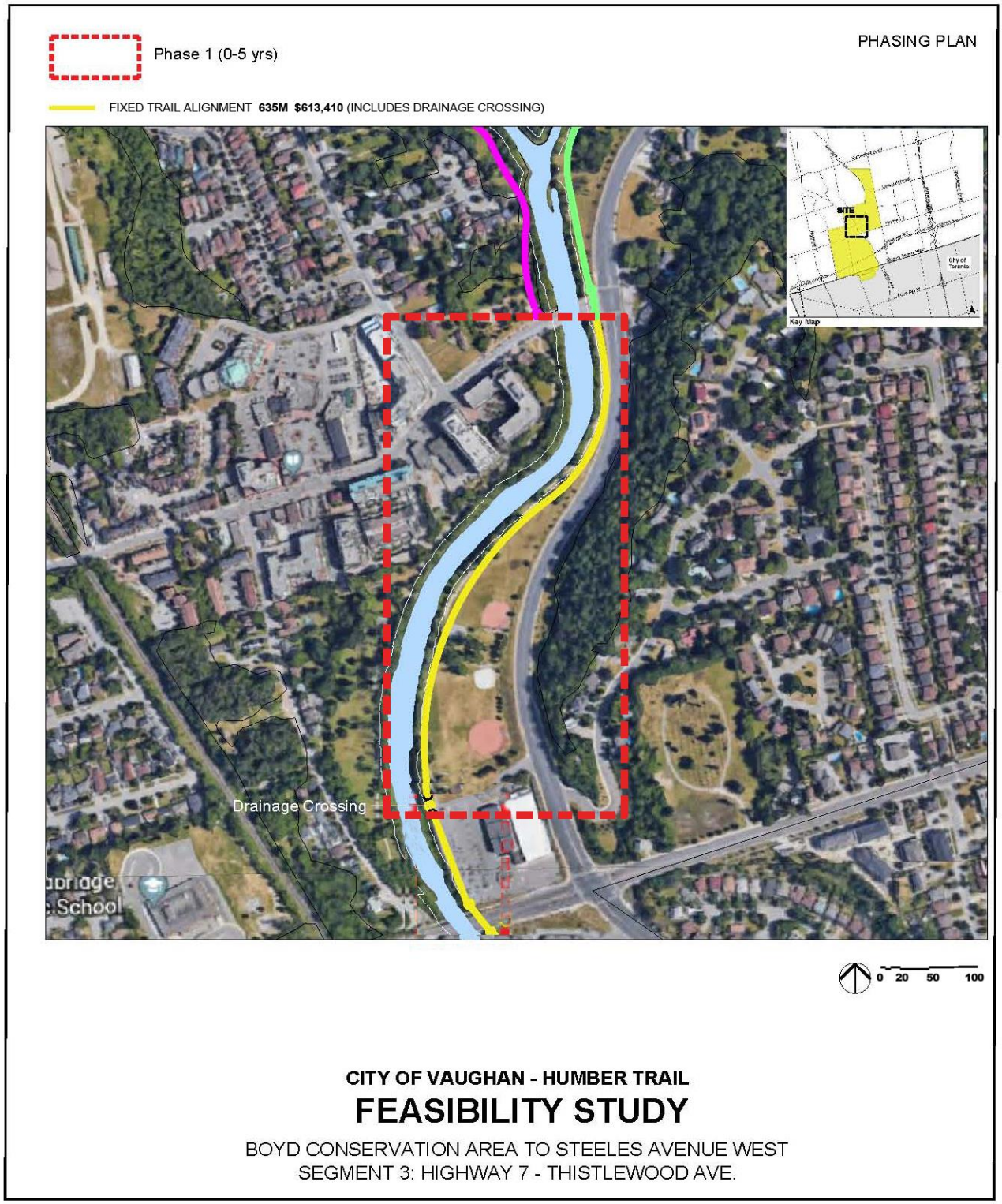


Figure 29: Segment 3, Phase 1 Plan

Table 6.3: Segment 3 Implementation Responsibilities

FIXED ALIGNMENT

Segment	Length (m)	Type	Culvert	Ownership	Notes	Approvals / Permits	Cost
H-I	120	Type B		City of Vaughan / TRCA		City of Vaughan / TRCA	$191,825
I-J	635	Type B		TRCA		TRCA	$438,150

OPTION 1

Segment	Length (m)	Type	Culvert	Ownership	Notes	Approvals / Permits	Cost
J-K	-	Pedestrian Signal Crossing		TRCA	Traffic analysis required/ signal warrant	TRCA	$600,000
K-L	205	Type B		TRCA		DFO/ MMRF (Redside Dace)	$141,450
L-M	32	Bridge		TRCA		DFO/ MMRF (Redside Dace)	$216,000
M-N	150	Type B		TRCA		DFO/ MMRF (Redside Dace)	$103,500

OPTION 2

Segment	Length (m)	Type	Culvert	Ownership	Notes	Approvals / Permits	Cost
A-B	505	Type B		TRCA	TRCA Restoration opportunity	DFO/ MMRF (Redside Dace)	$320,675

OPTION 3

Segment	Length (m)	Type	Culvert	Ownership	Notes	Approvals / Permits	Cost
C-D	300	Type B		TRCA	TRCA Restoration opportunity	DFO/ MMRF (Redside Dace)	$190,500

OPTION 4

Segment	Length (m)	Type	Culvert	Ownership	Notes	Approvals / Permits	Cost
A-B	320	Type B		TRCA	TRCA Restoration opportunity	DFO/ MMRF (Redside Dace)	$203,200

10.4 Phasing - Segment 4

A short section of proposed trail 155 m in length ('fixed trail' segment F-G illustrated on Figure 10) that is accessible from Highway 7 extends southward through the TRCA lands on the east side of the river though Legion Park and terminates at Legion Court Road. The site is relatively constraint free and is situated in an area of existing mowed area within Legion Park. It is recommended as a Phase 1/short-term project since access to the site and the construction of this short section of trail would be logistically straight-forward and cost effective and would not require permits. The section of trail makes provision to link to the trail at the intersection of Highway 7 and Islington Avenue and/or an underpass at Highway 7 but does not include the construction of the underpass (Refer section 10.3).

This segment of the trail is identified on Figure 30 below and the stakeholder implementation responsibilities are recommended on Table 6.4. The estimated costs to construct the Phase 1 trail project is estimated to be $82,925 (plus additional estimated soft costs of 40% - $33,170). This estimate does not account for the cost of studies that may be required to facilitate the construction of this section of trail. For example, a geotechnical assessment and TRCA permit may be required.

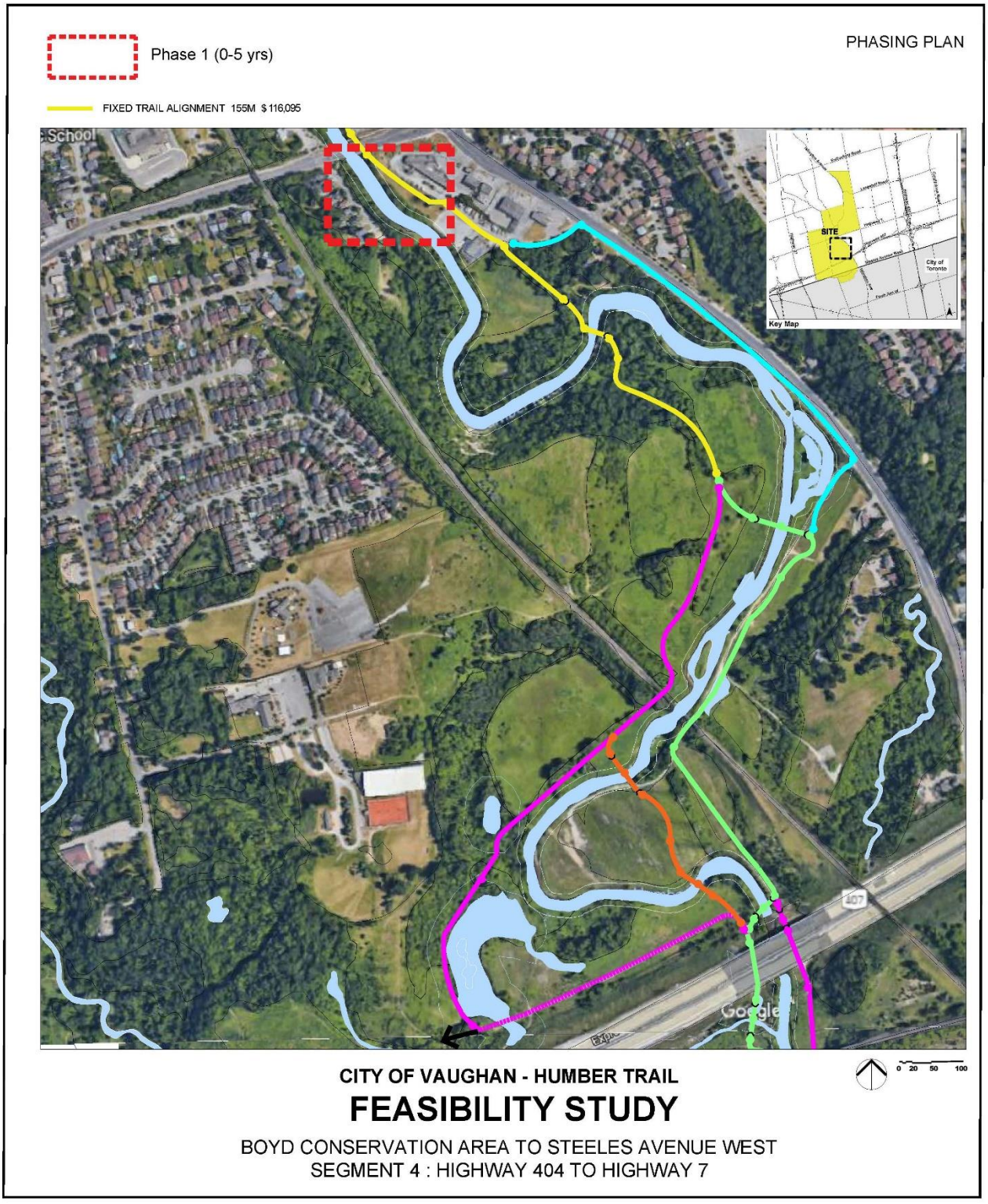


Figure 30: Segment 4, Phase 1 Plan

Table 6.4: Segment 4 Implementation Responsibilities

FIXED ALIGNMENT

Segment	Length (m)	Type	Culvert	Ownership	Notes	Approvals / Permits	Cost
A-B	260	Type B		Province of ON / TRCA		Infrastructure Ontario	$165,100
B-C	40	Type A		Province of ON / TRCA		Infrastructure Ontario	$27,400
C-D	75	Bridge		City of Vaughan / TRCA	Subject to Geomorphic	DFO	$506,250
D-E	140	Type B		City of Vaughan			$88,900
E-F	115	Share Road		City of Vaughan	Linemarking; Subject to traffic analysis		$20,125
F-G	155	Type C		City of Vaughan / Province of ON / TRCA		Infrastructure Ontario	$82,925
G-H	40	Type B		Province of ON	Underpass, municipal road	Infrastructure Ontario	$160,400

OPTION 1

Segment	Length (m)	Type	Culvert	Ownership	Notes	Approvals / Permits	Cost
A-B	30	Type A		Province of ON	Subject to borehole	Infrastructure Ontario	$20,550
B-C	32	Bridge		Province of ON	Subject to geomorphic/ bank stability	Infrastructure Ontario/ DFO	$216,000
C-D	290	Type B		Province of ON		Infrastructure Ontario	$184,150
D-E	380	Re-purposed Granular	1	Province of ON / Railway Company	Repurposed granular trail; borehole analysis	Railway company/ Infrastructure Ont	$193,700
E-F	100	Type A		Province of ON	Approach to bridge deck	Infrastructure Ontario	$68,500
F-G	75	Bridge		Province of ON	Subject to geomorphic/ bank stability	Infrastructure Ontario/ DFO	$506,250
G-H	95	Type B		Province of ON		Infrastructure Ontario	$60,325

OPTION 2

Segment	Length (m)	Type	Culvert	Ownership	Notes	Approvals / Permits	Cost
A-B	475	Repurposed		Province of ON	Repurposed granular trail	Infrastructure Ontario	$232,750
B-C	260	Boardwalk	3	Province of ON / Railway		Railway company	$971,500
C-D	760	Type B		Province of ON	Repurposed granular trail	Infrastructure Ontario	$482,600

OPTION 3

Segment	Length (m)	Type	Culvert	Ownership	Notes	Approvals / Permits	Cost
A-B	75	Type A		Province of ON		Infrastructure Ontario	$ 51,375.00
B-C	48	Bridge		Province of ON		Infrastructure Ontario	$324,000.00
C-D	60	Type A		Province of ON		Infrastructure Ontario	$ 38,100.00
D-E	60	Type B		Province of ON		Infrastructure Ontario	$ 68,500.00
E-F	75	Bridge		Province of ON		Infrastructure Ontario	$405,000.00
F-G	35	Type A		Province of ON		Infrastructure Ontario	$528,475.00
G-D	445	Type B	3	Province of ON		Infrastructure Ontario	$305,075.00

OPTION 4

Segment	Length (m)	Type	Culvert	Ownership	Notes	Approvals / Permits	Cost
A-B	130	Type A		Province of ON	Follows existing	Infrastructure Ontario	$89,050
B-C	580	Boulevard - Asphalt		Region of York		Region of York	$412,700
C-D	125	Boulevard - Asphalt		City of Vaughan			$86,250

10.5 Phasing - Segment 5

A short section of trail that is proposed to lead south from Thackeray Park and connect with the Humber Trail in the City of Toronto is recommended to be implemented as a component of Phase 1. The implementation of this section of would link with the existing asphalt trail in City of Toronto's jurisdiction and would require coordination with the City of Toronto Cycling Infrastructure Division. There may be the possibility for cost-sharing as the proposed trail will benefit both municipalities. The link would provide a connection into Thackeray Park. Although it is proposed that the route of the trail would follow an existing mown trail, further study would be required to ensure that public safety is not compromised due to the relative proximity to the riverbank and flood risk. Permits are not expected although approval from TRCA, York Region and City of Toronto Cycling Infrastructure and Closed Landfill Divisions are anticipated to be required to implement this section of the trail.

This segment of proposed trail included in Phase 1 is illustrated on Figure 31 and the stakeholder implementation responsibilities are set out on Table 6.5 below. The trail is proposed to complete a link between Thackeray Park and the existing City of Toronto trail network south of Steeles Avenue West. The proposed trail includes an accessible pathway up the slope of the former (closed) landfill, the design for which requires additional investigation. The project is not anticipated to include the overlook shown for reference on Figure 31.

The construction costs to complete the Phase 1 trail project is estimated to cost $654,475 (910 m length) plus additional estimated soft costs of 40% - $261,790. This includes construction of guard rails and installation of culverts, where necessary. This also includes an accessible switchback connecting the trail to Thackery Park. This estimate does not include the cost of studies and permits that may be required to implement this section of trail such as a geotechnical assessment and possible TRCA permit.

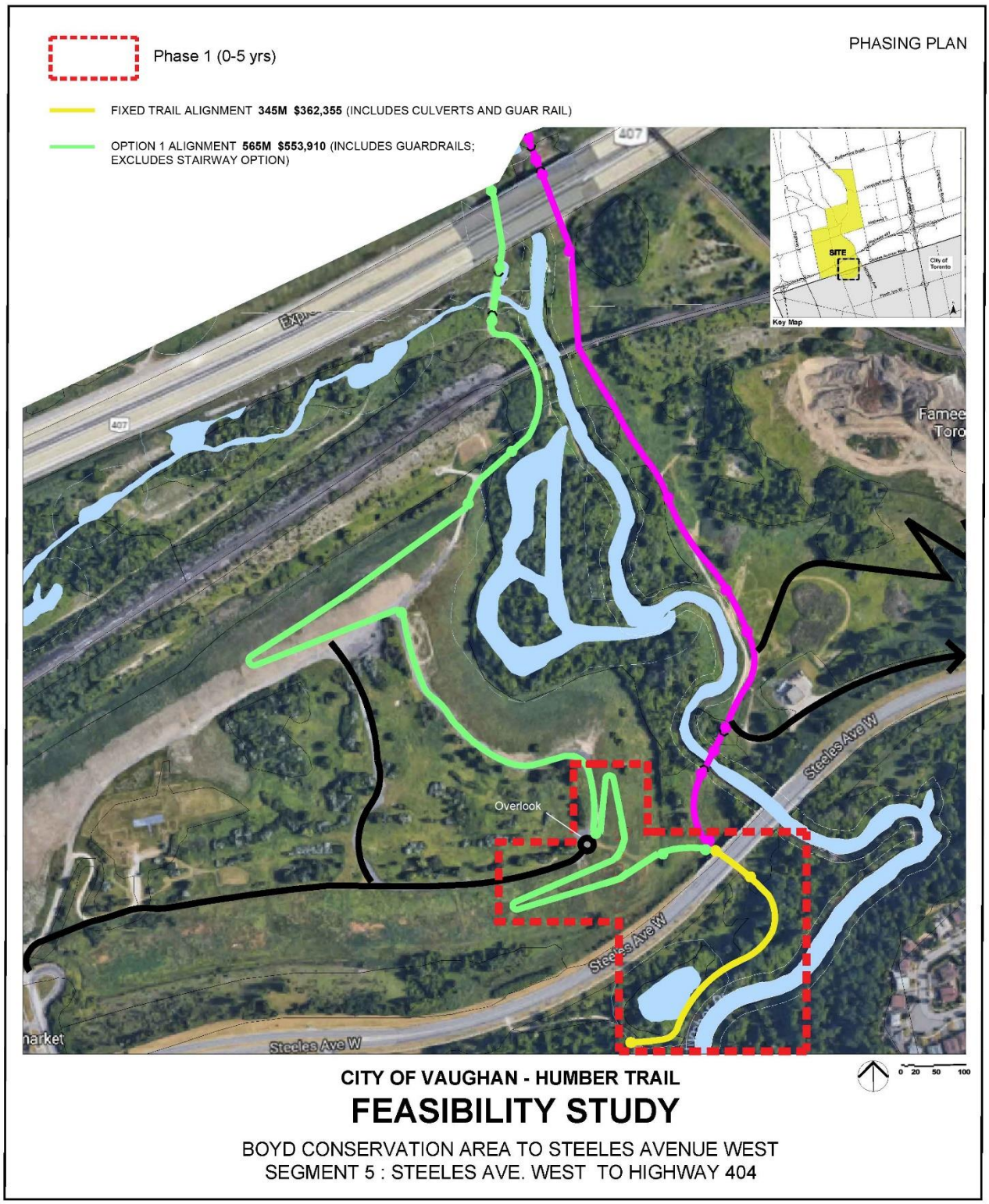


Figure 31: Segment 5, Phase 1 Plan

Table 6.5: Segment 5 Implementation Responsibilities

FIXED ALIGNMENT

Segment	Length (m)	Type	Culvert	Ownership	Notes	Approvals / Permits	Cost
A-B	290	Type A	1	Region of York / TRCA		Region of York / TRCA	$217,400
B-C	55	Type B	1	Region of York / TRCA		Region of York / TRCA	$41,425

OPTION 1

Segment	Length (m)	Type	Culvert	Ownership	Notes	Approvals / Permits	Cost
A-B	65	Type B		TRCA/ Managed City of Toronto		Management agreement	$41,275
B-C	90	Stairway		TRCA/ Managed City of Toronto	Steel Stairway	Management agreement	$146,250
B-C	500	Type C		TRCA/ Managed City of Toronto	Asphalt Switchback Trail	Management agreement	$354,375
C-D	410	Type C		TRCA/ Managed City of Toronto		Management agreement	$219,350
D-E	515	Type C		TRCA/ Managed City of Toronto	Asphalt Switchback Trail	Management agreement	$365,100
E-F	80	Type B		TRCA/ Managed City of Toronto			$54,800
F-G	205	Type A	1	Railway Company		Management agreement	$137,675
G-H	52	Bridge		Hwy 407 ETR		Hwy 407 ETR	$270,000
H-I	110	Type B	1	Hwy 407 ETR		Hwy 407 ETR	$69,850

OPTION 2

Segment	Length (m)	Type	Culvert	Ownership	Notes	Approvals / Permits	Cost
C-D	110	Type B		Region of York / TRCA	Easement required	Region of York / TRCA	$77,350
D-E	50	Bridge		Region of York / Private Property	Easement required	DFO	$337,500
E-F	130	Type A		Private Property	Repurposed granular trail		$88,800
F-G	40	Boardwalk		Private Property	Trail on grade raised fill		$146,000
G-H	135	Type A		Private Property	Repurposed granular trail		$85,725
H-I	320	Type B		Private Property / Province of ON / Railway Company / TRCA	Easement required	Infrastructure Ontario/ Railway Company/ TRCA	$213,200
I-J	100	Type B		Private Property	Easement required	Subject to ETR Approval	$73,500
J-K	18	Bridge		Private Property	Easement required	DFO	$121,500

11.0 Recommendations

The implementation of the Humber Trail through Vaughan will infill the missing links between the Humber Trail south of Steeles Ave West and William Granger Greenway. The completion of the trail will provide a connected recreational trail system from Lake Ontario to the Oak Ridges Moraine, affording trail users experiences of nature through the Humber River valley corridor.

The various biophysical and regulatory constraints that influence trail location and design within the Study Area provided a foundation for the exploration of alternate trail alignments and the recommended trail alignment. Mitigating impacts to natural and cultural heritage features especially in areas of 'highest constraint', is recommended in determining a preferred trail alignment. The general premise of the Study is that a planned trail is preferred to an ad-hoc trail as controlled public access is less detrimental to the environment over time. The creation of multiple trails and access points can eventually leads to fragmentation of natural heritage features and can potentially lead to erosion, proliferation of invasive species and overall potential degradation of the natural heritage features within the Humber River valley. The forested areas and the banks of the Humber River are attractive destinations for recreation. Without properly designed and located access points and trails, informal trail creation throughout the natural areas could, potentially lead to environmental impacts, such as soil erosion and compaction and the inadvertent spread of invasive species.

Once the trail is implemented, there may be new opportunities for the public to gain access to the river by creating new trails through natural features or low-lying areas. This is the paradox associated with creating a defined trail system. While on the one hand, trail development confines users to a defined path and away from natural heritage features, new ones can easily form as there is a new path in which to create new ones from. Therefore, new trails based on desire lines can be formed. It should be anticipated that management and monitoring of informal trail creation will be an on-going consideration.

With this context in mind, the following section sets out recommendations and guidelines that should be considered in the process of advancing the preferred trail alignment to the detailed design stage.

11.1 Recommendations for Trail Development

Overall, trail alignment options have been designed to avoid natural features and low-lying areas and minimize the number of river crossings to the greatest extent possible. The avoidance of hazards, natural features and important habitats should continue to be the main focus of future

trail development studies., with landownership, connectivity to adjacent destinations and future trail systems, partnership building, user experience, enjoyment and education also playing a key role in the consideration of future trail options and alignments.

The following ecological mitigation recommendations are set out for consideration during the future trail design process.

11.1.1 Mitigation Measures of Water Features

1. Avoid wetland areas and provide buffers (as determined by an EIS) between the outer extent of the wetland and proposed site alteration;
2. Consider boardwalks to traverse wet areas, to reduce off-trail use and soil compaction;
3. Provide a setback from the top-of-bank of the river, especially in areas at outer meander bends which are the most erosion-prone, and consider the addition of deep-rooted vegetation between the proposed trail and the water's edge;
4. Focused viewpoints to provide visual access;
5. Minimize trampling and native vegetation removal;
6. Design trail alignments in such a way as to reduce the number of bridge crossings required;
7. Locate crossings to be perpendicular to the watercourse;
8. Ensure watercourse crossings span the full width of the watercourse and avoid the need for abutments at or below the top of bank;
9. Bridge abutments should be set back from the top of bank of the watercourse. Fluvial geomorphology assessments may be required for any abutments proposed within the watercourse;
10. Fisheries timing restrictions should apply to all work in and near water;
11. Trail (and adjacent graded/manicured strips) should be located a minimum of 30 m from any Provincially Significant Wetland, and a minimum of 10 m from any other wetlands; and,
12. MNRF should be consulted regarding requirements associated with Redside Dace habitat, or any other Species at Risk.

11.1.2 Mitigation Measures of Terrestrial Ecological Resources

The following ecological mitigation recommendations, generally supported by TRCA, should be considered going forward into an EA assessment process or for any upgrades outside of an EA process:

1. Utilize existing infrastructure such as access roads, existing trails, parkland, parking lots, mowed or non-treed areas, and regional and local roads wherever feasible; From an ecological perspective, the use of existing roads is almost always preferable to the establishment of a new trail in a natural area. This greatly reduces the potential for environmental impact;
2. Avoid treed slopes and ravines wherever possible;
3. Avoid heavily treed or mature treed areas;
4. Skirt edges of forested areas avoiding alignments directly through natural heritage features, and generally avoid removing trees wherever possible;
5. Avoid interior forests or encroachment into the edges of forests which would impact the size and configuration of an existing interior forest;
6. A restoration opportunity benefit package will be required to offset loss of habitat. Report should indicate that habitat compensation loss will be required.
7. Hardening of surfaces within or adjacent to the watercourse is discouraged;
8. Vegetation removals should be avoided to the greatest extent possible, and minimized where necessary;
9. Vegetation removals may require compensation according to TRCA guidelines, which will include requiring basal area calculations be collected;
10. Migratory Birds Convention Act timing windows should apply to any vegetation removals;
11. The use of impervious surfaces is encouraged wherever possible;
12. The areas maintained along the edges of trails are encouraged to be planted with native species, used for pollinator areas, etc. as opposed to lawn grass; and,
13. Erosion and sediment control measures and detailed staging for trails, and for bridges in particular, must be done so in accordance to TRCA guidelines.

11.1.3 Partnership Building

The implementation of the trail will rely in part upon successful partnership-building amongst stakeholders and the local community to remove planning obstacles and/ or acquire lands in order to route the trail and its future alignments. The following recommendations provide some context

surrounding potential land acquisition, easements and/or agreements to facilitate the future connection:

1. There are a number of locations where the trail will require coordination and approval from private and public stakeholders. Discussions with stakeholders are encouraged to occur as early as possible;
2. Multiple benefits should be realized from collaboration between City departments, landowners and agencies to deliver coordinated improvements in areas where trail development may occur. For example, where there are opportunities for restoration or slope stabilization during infrastructure improvements;
3. Leverage financial support from partners and private developments where opportunities for linkages exist resulting in mutual benefit;
4. Seek opportunities for long term lease arrangements where private land poses an obstacle to trail development and alternate trail routing is not a feasible option;
5. Leverage opportunities through new developments to develop segments of the recommended trail alignment though local improvements, cash contributions, or leveraged community benefit charges as per COVID-19 Economic Recovery Act, 2020 (Bill 197)); and,
6. Promote the trail plan through various federal, provincial and local government programs and grants seeking available funding sources and reaching out to local Councillors and community leaders to establish local champions.

The following experiential qualities should be considered going forward in trail design and planning:

1. Utilize the opportunity in trail development to incorporate interpretive and educational opportunities to celebrate the natural and cultural heritage attributes unique to the watershed;
2. Develop a trail wayfinding strategy for the entire Vaughan Super Trail; and,
3. Develop an interpretive signage strategy for the Vaughan Super Trail in which to develop and share the narratives of this unique watershed within the region.

11.2 Next Steps

The Humber Trail Feasibility Study has been undertaken to assess the potential for a trail system through the Humber River Valley. The study determines that a trail is possible and identifies potential trail alignment options accompanied by opportunities and constraints. In order to determine the preferred trail route, further investigations and environmental studies are

recommended through comprehensive planning and design as part of an Environmental Assessment (EA) Schedule A1 process which is expected to result from this Study. To the extent possible, the studies are anticipated to carry out EA's, and detailed designs accordingly (Refer Figures 26-30 Phasing Plans).

Community feedback will be a key component throughout the EA process. The EA process will facilitate approvals from the Ministry of Environment, Conservation and Parks (MECP) to help proceed with the project, allowing detailed designs for suggested Phase 1 segments of the Humber Trail to commence.

With this trail planning context in mind, the following recommendations are proposed:

1. It is recommended that the City of Vaughan contact Ministry of Environment, Conservation and Parks (MECP) to confirm municipal EA requirements for implementing this project and/or any Phase 1 alignments moving forward to verify Feasibility Study Report recommendations regarding next steps; and,
2. Beyond the preliminary Phasing Plans provided in this Study, update trail projects as opportunities arise i.e. land acquisition, easements, long-term leases etc.

12.0 General Guidelines for Trail Development

Avoiding 'high and 'moderate' constraint areas should be a primary consideration when evaluating potential trail alignments. However, the objective of avoiding flood hazards and sensitive natural heritage features must be balanced with the technical and experiential objectives of the trail. For example, constructing extensive boardwalks may be technically and financially infeasible and situating the trail outside the river valley may detract significantly from positive user experience. Much research shows that enabling trail users to experience natural habitats can have positive effects on public health. Trail alignments that traverse natural heritage features can present opportunities for improving both natural habitats and public health.

The following Sections provide some general guidelines for refining and evaluating trail alignments going forward.

12.1 Flood Management

Considers the geomorphological impacts of river meander on the positioning of trails with respect to flood hazards especially avoiding:

- The 'bank full' width of the river plus an erosion setback of approximately 10m as dictated by the TRCA);
- Steep slopes, bluffs and outside bends of the river due to their susceptibility to erosion and scour (erosion of soils from high velocity flows);
- Flood zones where possible especially below the 2-year flood level which requires boardwalks and pedestrian bridges and additional maintenance and monitoring protocols; and,
- Implements flood management techniques i.e. biotechnical engineering, to protect public safety where it does encroach within the 5-year flood level or below.

12.2 Geotechnical Slope Stability

Steep slopes represent a constraint to trail development and should be avoided where possible. However, in order to make key connections especially local connections to neighbourhoods adjacent to the valley corridor, traversing slopes may be necessary. The following consideration should be taken when planning trails on slopes:

- The stability of the slope should be confirmed prior to making the final decision to route a trail along/ up a slope;
- The design of the trail should ensure soil erosion is not exacerbated;
- The trail is designed to accommodate the underlying soils and convey drainage;
- Where possible the gradient of the trail should not exceed 5% in order to meet Provincial accessibility requirements (Refer to Section 3.4.10);
- If the gradient exceeds 5% a handrail and landings at regular intervals is required; and,
- If the gradient exceeds 8% the surface of the trail is required to be hardened for erosion.

12.3 Natural Hazards

To ensure public safety trail alignments should avoid known hazards and to the extent possible, anticipate potential hazards by applying generous buffers and setbacks to avoid natural and geological hazard sites. This can be achieved by considering the following:

- The trail should avoid high environmental constraint areas wherever possible;
- The trail should be located above the 100-year flood line (regional storm event) wherever possible;
- The trail should avoid traversing steep slopes;

- The trail should be set back a minimum of 10 m from the top of bank of watercourses in order to maintain safe distance from potential bank erosion/ instabilities and enable riparian vegetation establishment;
- The trail should avoid outside bends of watercourses where possible; and,
- Restoration should consider use of species native to the local area and should reflect the vegetation structure in the surrounding habitat, especially in significant wildlife habitat as described in this report.

Consideration for avoidance of natural hazards will protect public safety, infrastructure and reduce cost in the long-run.

12.4 Natural and Cultural Heritage Features

To protect high quality high habitat from undue deterioration from human use trail development should consider the following:

- The trail should be routed to avoid sites with known Species at Risk and locally rare species or if unavoidable, implement robust environmental mitigation techniques including restoration with native specie and carry out follow up monitoring to ensure the success of the restoration efforts;
- Avoid vegetation removals, especially of trees, but especially within the Natural Heritage System;
- If necessary, vegetation removal should be conducted outside of the Migratory Birds Convention Act breeding bird window (generally April 1 – September 15);
- The trail should avoid marsh, swamps and wetland areas avoiding an area of 30m setback to unevaluated features and Provincially Significant Wetlands (although MECP requirements enable larger setbacks in some cases); and,
- New crossings of the Humber River and East Humber River should be minimized to reduce permitting requirements, especially in areas of Redside Dace habitat which is assessed on meander belt widths plus 30 m setback (refer to Section 7.3 for further details).

12.5 Landownership, Easements and Lease Agreements

In order to streamline implementation and reduce cost, and simplify the maintenance regime for the trail corridor, the route for the trail should:

- Remain within public land parcels and avoid access to private lands where possible;

- Minimize the need for land acquisition unless essential to make key connections, complete a segment of trail through a pinch-point constrained by private property and for which other constraints preclude another alignment; and
- Where necessary, public land acquisition is preferred over lease agreements or permanent easements.

12.6 Catalogue of Trail Types

The following Section provides guidance for the design of various trail types suited to various site conditions. The suite of recommended trail types and structures were developed in consideration of City of Vaughan Trail Design Guidelines and Details, the TRCA Trail Strategy, Accessibility Design Guidelines for York Regional Forest Trails, City of Toronto Multi-use Trail Standards, AODA, CPTED and principles of Universal Accessibility. It is important to note that the recommendations provide preliminary design considerations for trails that are anticipated to traverse a range of site conditions and site constraints discussed earlier in this report. As the trail is situated predominantly within floodplain and prone to floods the range in trail type, while essentially envisaged as a consistent 3.0 m wide granular limestone multi-use trail, each trail type responds to the nuances anticipated within different sections of the floodplain. For example, trails situated with the zone between the 2-year and 5-year flood zones can anticipate experiencing regular inundation of flood waters in spring and summer as opposed to trails situated within the zone above the 5-year flood level. Correspondingly, these trails will need to be designed to a standard to ensure durability notwithstanding that they will be flooded. Trails in these environments could be elevated above the flood condition, built to withstand the condition i.e. incorporate geogrid, integrate drainage best management practices or avoid these areas if other alignment options are available. Trails constructed in areas below the 2-year flood condition require an elevated structure such as a boardwalk or pedestrian bridge. Refer Figures 31-35 which denote trail type by site flood condition.

12.6.1 Trail Type A – Boardwalk

Where an important trail connection is to be made through areas below the 5-year flood limit and the benefits of the alignment outweighs the impacts of another solution, a boardwalk should be considered. Boardwalks should be considered where the trail alignment crosses within 30 m of a wetland thereby avoiding impacting the sensitive soils and vegetation while avoiding any impacts to the hydrology of the wetland. As boardwalks are expensive compared to constructing granular and asphalt trails, this use of sections of boardwalk should be limited to shorter lengths where possible. If the decision has been made to construct a boardwalk it should be designed with

suitable width capable of accepting the loading of small maintenance or emergency vehicles (8 ton). The designs for boardwalks, railings and educational signage are to comply with AODA requirements.

Figure 32: Typical Boardwalk Cross Section

12.6.2 Trail Type A – Raised Granular Trail

A raised granular trail supported up a 'clearstone' gravel (20-50 mm diameter angular stone free from fines) base to convey drainage beneath the trail surface is a relatively low-cost solution in low-lying environments where a boardwalk may not be the best solution. This type of solution applies where natural heritage feature constraints are not present, and the existing subgrade is relatively "capable" to take the loading of compacted granular material. Should the sub soils be determined through geotechnical engineering to be "soft" a geogrid product can be installed over the subgrade prior to installing the clearstone to provide the necessary support and reduce the amount of excavation. Detailed design for trail Type A is to be AODA compliant where achievable.

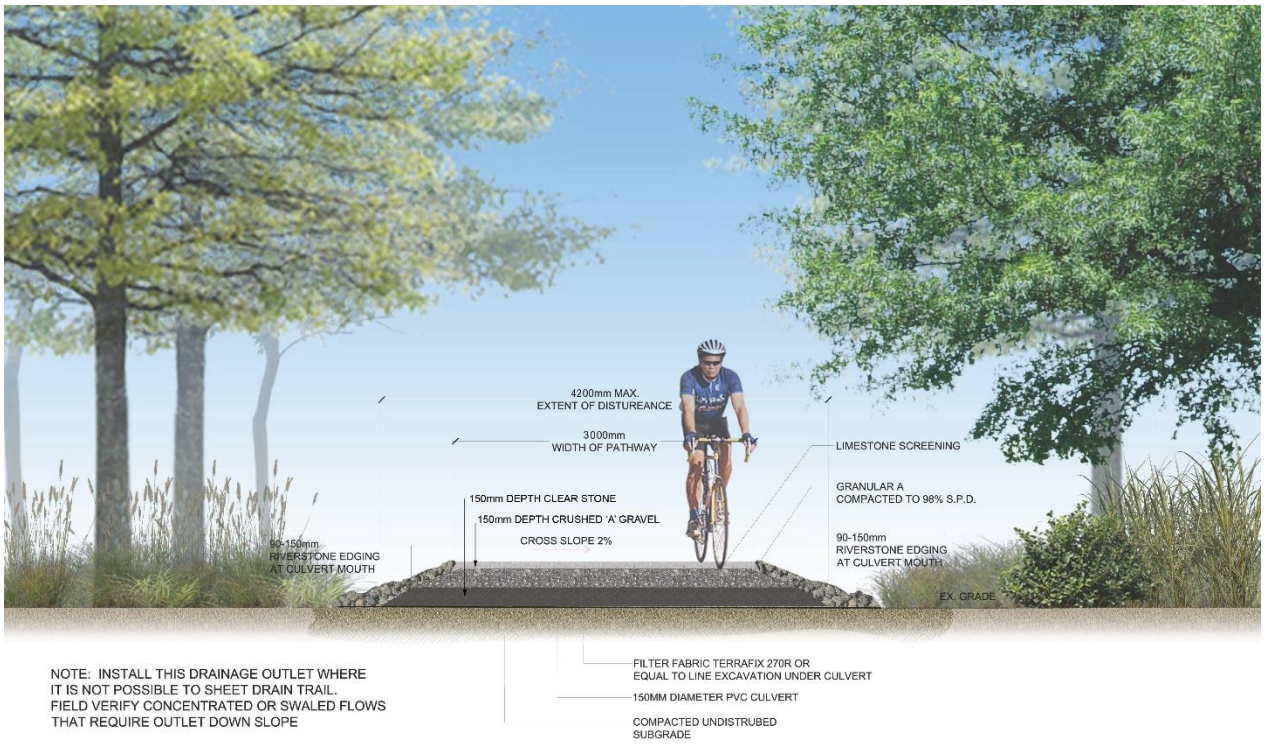


Figure 33: Typical Raised Trail Cross Section

12.6.3 Trail Types B & C

Type B trails are designed for environments between the 5-100-year regional flood lines which will not be impacted by flooding very often and thus can be constructed with traditional construction techniques and minimal enhancements to the trail substructure. However, soft soils may be encountered more often within this environment than would be expected in areas above the 100-year flood extent where Type C trails apply. Type B trails may require sections of deeper excavation or geogrid for stabilization, whereas Type C trails can be expected to be built to traditional methods. Detailed design for trail Types B and C are to be AODA compliant where achievable.

Description	Permitted Uses	Base Condition	Granular Free Drainage	Granular Course Graded	Granular Culverts	Pavement Surface	Stairs	Handrails	Trail Delineation
Provide accessible loops within open space. Links to multi-use trails with hard surface. Low to moderate challenge	Hiking	Tread Width: 2.0m Cleared Width: 3.0m Cleared Height: 2.5-3.0m Trail Surface: Granular Sub Base Depth: 0.45m (0.6m in wet areas or geogrid)	ALL	Slope Gradients: >5%/<8% and / or areas subject to periodic flooding	All slope gradients in areas traversing intermittent swales	Slope gradients exceeding 8% Areas exhibiting impact from high levels of use	N/A	N/A	Orientation Signs Marker Posts

Figure 34: Typical Granular Nature Trail Cross Section

12.6.4 Asphalt Trail

Trails within the river valley corridor are intended to remain as granular trails with exception of short sections of hard surface trails where slopes of 8% (10% as noted in the Accessibility Design Guidelines for York Regional Forest Trails) or greater are unavoidable or in areas where erosion of the surface is anticipated. Where trails terminate at road crossings or travel parallel to roads within the boulevard/ right-of-way, trail surfaces are to be asphalt and AODA compliant.

Description	Permitted Uses	Base Condition	Granular Free Drainage	Granular Course Graded	Granular Culverts	Pavement Surface	Stairs	Handrails	Trail Delineation
Provide connectivity between bike routes and support off-road cycling. Enables accessible use ▪ Low challenge	Hiking Running Off-Road Cycling X-Country Skiing Snowshoeing	Tread Width: 3.0m Cleared Width: 4.0m Cleared Height: 3.0m Trail Surface: Hard surface Sub Base Depth: 0.30m Asphalt Thickness: 0.08m (medium duty), 0.12m (heavy duty)	Slope Gradients: >5%/<8% and /or areas with poor drainage/erosion prone soils	Slope Gradients: >5%/<8% and /or areas subject to periodic flooding or traversing intermittent drainageways on unconsolidated soils	All slope gradients in areas traversing intermittent swales	Slope gradients exceeding 8% Areas exhibiting impact from high levels of use	N/A	Slope gradients exceeding 10%	Orientation Signs Marker Posts Log/Rock Edges (when required)

Figure 35: Typical Asphalt Multi-Use Trail Cross Section

12.6.5 Pedestrian Footbridges

Bridges are to be clear spans constructed using a metal frame, wooden or metal decking and concrete abutments that spans a watercourse with a typical clear width of 3.0 m and a minimum 10 tonne structural capacity. Bridge positioning and spans are required to be determined by a geomorphological engineer and designed to respond to geotechnical and soil investigations. As a general guide, spans are generally determined based upon channel width plus an erosion setback to achieve a 50-year erosion threshold. This principle endorsed by the TRCA, applies to positioning bridge abutments beyond the channel top of bank to allow for natural watercourse tendencies such as erosion, migration, or enlargement. Additional constraints relative to each location may be required to be accounted for when recommending span and placement of bridges. For example, consideration needs to be given to the impact of the structure on resultant hydraulic conditions within the channel during a range of flow events. Channel scour potential on riverbanks as well as navigability beneath the bridge are further considerations as result of geomorphological and creek meander studies.

It is also important to note that concrete ballast walls anchored by helical piles often results in the smallest footprint for installation.

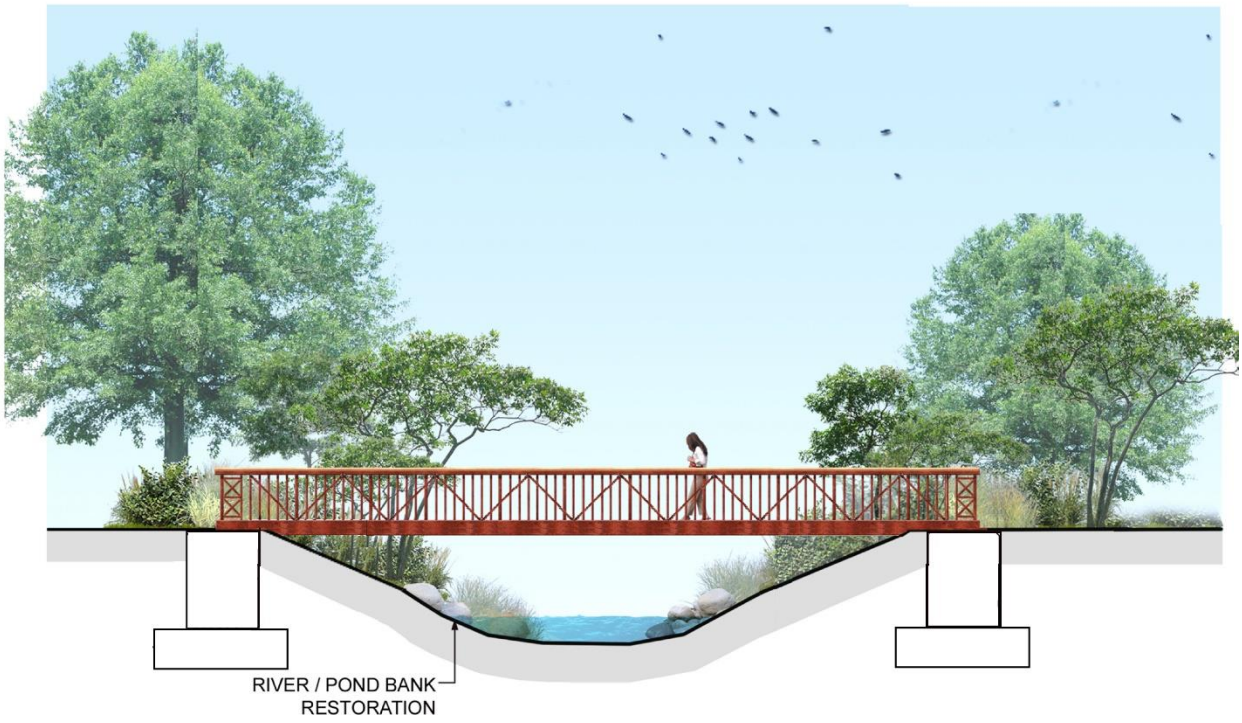


Figure 36: Typical Pedestrian Bridge Cross Section

13.0 Life Cycle Cost Analysis

The implementation of the Vaughan Humber Trail between Boyd Conservation Area and Steeles Avenue West represents a significant capital investment for the City of Vaughan. In order to ensure that the trail system continues to provide benefits to the residents of Vaughan over the long term, the various components of the system will require ongoing maintenance to ensure that they function as intended and that the safety of trail users is ensured.

The following information is intended to provide general guidance and associated cost consideration for capital, Operations and Maintenance, and life cycle aspects of implementing and maintaining the trail system. A proposed framework is outlined below which the City of Vaughan can use to develop a Life Cycle Costs (LCC) strategy for the trail system. LCC should be considered in addition to the implementation costs identified earlier in the report.

This Section provides recommendations to guide the long-term Operation and Maintenance of the trail system. The recommendations can be extrapolated to address other future segments of the Vaughan Super Trail. The LCC estimation framework has been generated to relate generically to any trail system.

The proposed Operations and Maintenance framework prescribes the proposed maintenance, monitoring, repair and replacement activities that are required to accommodate the various levels of service of the trail system. The level of service identified for each trail type was determined based upon surface treatment, presence of structures such as bridges, boardwalks and retaining walls, as well as anticipated levels of use and environmental context.

Maintenance responsibilities will include but will not be limited to scheduled inspections, cleaning, remediation, temporary trail closures during maintenance activities, decommissioning and issue-response tracking. Maintenance activities aimed at maintaining the trail surface and clearway are proposed to be implemented on a priority basis and in a cost-effective manner, with consideration for safety, availability of funds, availability of capital and operating funding, availability of personnel resources and environmental considerations and regulations.

This document also provides a guide as how to conduct a detailed estimate for the anticipated costs associated with the Operation and Maintenance of the trail system over the long-term. Performing a Life Cycle Cost Analysis (LCC) is a large task outside the scope of this Study and requiring an assessment of all trail assets and associated amenities. The following sub-sections set out recommendations to guide the development of a LCC and the anticipated maintenance and inspection requirements for a 100-year horizon.

Objectives

The objectives of the Life Cycle Cost Plan are to:

(1) To illustrate and describe the trails that are to be subject to maintenance on a routine basis and to assign maintenance prescriptions to each respective trail segment;

(2) To define appropriate levels of service and establish the anticipated costs for maintenance for each component of the trail system;

(3) To describe and set out a schedule for the implementation of specific maintenance tasks to address the designated service levels; and,

(4) To provide an estimate of the cost of implementation the proposed suite of maintenance activities over the Life Cycle of the trail system.

Capital Guidance

Capital guidance includes the various elements such as permits, regulatory bodies and governing by-laws that will require consideration and approval from various stakeholders during the planning and design process of an urban trail system. Regulatory body involvement may include:

York Region

- Transportation
- Trunk Sewers
- Waste Water

City of Toronto

- Closed Landfill Department (Thackeray Park)
- Water Treatment Facility
- Cycling infrastructure
- Permit under Ravine and Natural Feature Protection Bylaw

Other

- Toronto and Region Conservation Authority
- Infrastructure Ontario/Hydro One
- Metrolinx
- 407 ETR Canadian Pacific Rail
- Enbridge Gas

City of Vaughan Departments

- Parks Planning
- Parks Delivery
- Environmental Services
- Infrastructure Planning and Corporate Asset Management
- City Solicitor
- Policy Planning and Environmental Sustainability
- Development Planning
- Real Estate
- Recreational Services
- Transportation Services, Parks and Forestry Operations
- Financial Planning

Expected Permit Compliance:

- Regulatory - MECP, MHSTCI, DFO, MTO
- Legislation - Navigable Water Protection Act, ESA, OHA, MBCA, SARA

Refer Table of Contents for description of acronyms.

Operation & Maintenance Guidance

To ensure public safety and maximize enjoyment on the trail system, the following operational management and maintenance recommendations should complement the design of the trail:

- Develop a comprehensive operations and maintenance plan to respond to increasing intensity and frequency of storm events;
- Develop an emergency response protocol in response to climate change;
- Ensure an evacuation route exists;

- Branding and wayfinding signage strategy consistent with local and city-wide strategies;
- Codes of conduct that respect all types of users on the trail including those with visual and physical impairments;
- Protocols and enforcement of dogs on a leash;
- Provision of looped trails that avoid dead ends;
- Prohibit uses on trails which are not compatible with the natural environment;
- Ensure noxious weeds, hazardous plants and structurally deficient trees near the trail are managed; and,
- Consideration for maintenance and expenditure related to leases and easements.

A level of monitoring and maintenance should also be assigned to each class of trail and trail component. The following 'Operations and Maintenance Task Catalogue' provides a detailed description of specific monitoring and maintenance tasks that are proposed to comprise the overall Operation and Maintenance program for the trail system. The description provided below sets out specific recommendation related to each type of trail.

Trail Types A, B, and C and Asphalt Trails

Monitoring:

- Inspect three times per year (July/October) and after major storm events throughout the year. Inspections are to include a review of trail for overall safety including:
    - Degradation of trail surface (rutting/rilling);
    - Formation of potholes;
    - Presence of overhanging limbs within the clearway;
    - presence of hazard trees and/or debris;
    - Areas of poor drainage;
    - Vandalism to site furnishings, signage and other trail features;
    - Deterioration of structural elements or technical trail features such as drainage conveyance systems i.e., water bar, or erosion prevention devices i.e., geogrid
    - Deterioration of finishes and surface materials;
    - Erosion or excessive soil loss around abutments/footings due to large storm events;
    - Proactive tree management and hazard tree removal; and,
- Record locations of concerns, extent of issue, management actions required.

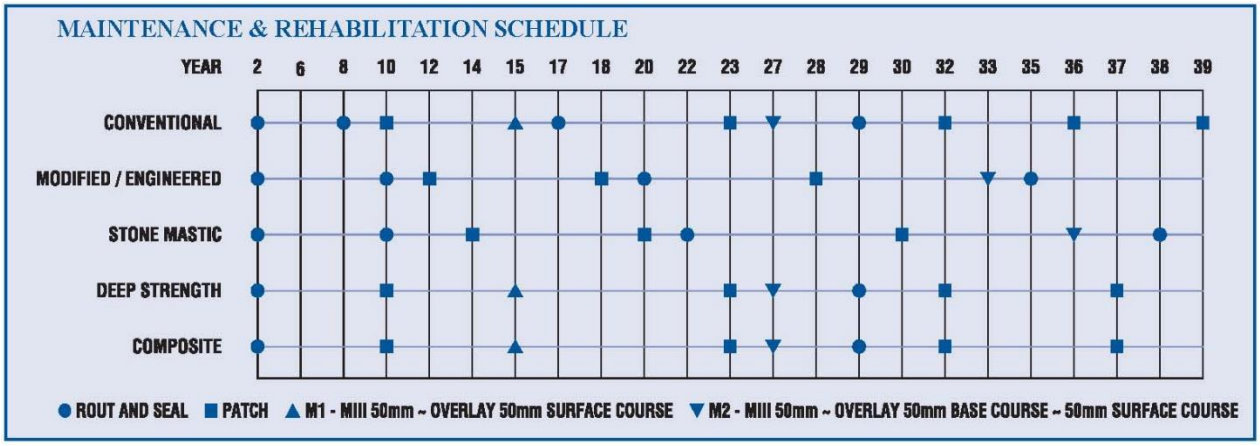
- Invasive and/or noxious vegetation adjacent to trails.

Maintenance:

- During months of operation, maintenance activities will include the following:
    - Repair/maintenance of asphalt or limestone surface;
    - Periodic monitoring of vegetation within the clearway including mowing regime;
    - Periodic pruning of tree limbs that encroach within the clearway;
    - Removal of accumulated litter/debris;
    - Repair of vandalized signs/amenities especially near trail edges;
- Inspection reports to be prepared to City standards by certified engineers and follow up actions to be documented by municipal operations staff;
- Replacement of individual deck boards (bridges, stairways) or sections of trail surface finishing where in disrepair;
- Substructure reinforcement or substructure replacement as required;
- Replacement of retaining walls; and,
- Invasive species management/ removal and native restoration planting.

An example, of a maintenance schedule for asphalt trails is provided below. A similar schedule can be modelled for other trail types based upon similar year on year maintenance activities.

Table 7: Life Cycle Maintenance Schedule for Asphalt Trails



Bridges, Boardwalks and Stairway Structures

Monitoring:

- Inspect annually at the beginning or end of use season (May/October) as well as after storm events throughout the year. Inspection to include review of structure for overall condition and safety of decks, substructure, abutments, walls and railings and all structural connections;
- Record locations of concerns, extent of issue, management actions required; and,
- Consider/ plan for budgets requirements for structural assessments.

Maintenance:

- Bridges and boardwalks are not anticipated to be maintained during the winter months (November to April);
- Routine removal of debris from bridge/boardwalk deck;
- Removal of graffiti or other forms of vandalism;
- Eventual replacement of bridge deck surface (approx. 25/50 years wood/metal); and,
- Site reports to be filed and follow up actions to be documented.

Underpass

Monitoring:

- Inspect annually at the beginning or end of use season (May/October) as well as after storm events throughout the year. Inspection to include review of structure for overall condition and safety, lighting and review of constructed features; and,
- Record locations of concerns, extent of issue, management actions required.

Maintenance:

- Repair retaining walls and overpass decks as required and in addition/ separate to public works' inspections;
- Repair of vandalism;
- Cleaning and removal of accumulated silt and debris from trail segments at underpass structures; and,
- Review and maintenance of underpass lighting systems, if required.

Drainage Structures:

Monitoring:

- Inspect swales once per year at the beginning or end of use season (May/October) as well as storm events throughout the year; and
- Inspect, catch basins, culverts and subdrains annually.

Maintenance:

- Repair/replace broken structures;
- Remove debris from swales seasonally, and dig out accumulated sediments as required to enable positive drainage;
- Flush out culverts and subdrains bi-annually; and,
- Remove accumulated silt and debris from catch basins and in front of culverts.

Additional Maintenance:

Trails and related structures such as bridges, boardwalks, stairways, underpasses and switchback trails may require additional maintenance if one or more of the following occurs:

(1) Deterioration of structural elements or technical trail features.

(2) Erosion or excessive soil loss around abutments/footings due to large storm events.

(3) Hazard tree removal / tree management.

(4) Deck replacement as a result of wear.

Exclusions

This Operations and Maintenance Plan excludes the following:

(1) Trails not identified as 'Preferred Trail';

(2) Sidewalks and walkways located within public rights-of-way;

(3) Structural components of roads, bridges and underpasses;

(3) Trails that are located within parks and open spaces that exist and that the Humber Trail connects to; and,

(4) Utilities and service infrastructure located along the alignment of the Humber Trail.

Private lands over which the Humber Trail may be constructed under lease or management agreements may require provisions in the Operations and Maintenance plan which adhere to terms of the lease or management agreement.

Repair of Damage Caused by Vandalism

Repair of damage to trails, bridges, boardwalks, stairways, entry nodes and signage caused by vandalism is to be carried out immediately in order to maintain a sense of pride, to minimize recurrence and to ensure public safety. Repair of damage caused by vandalism is required to be undertaken on a year-round basis.

Summary of Life Cycle Costs

The Vaughan Humber Trail system will be a significant public asset that will accrue numerous benefits to the citizens of Vaughan and beyond including enhancing non-motorized mobility options and providing opportunities for recreation as well as opportunities to experience the natural beauty of the valleylands associated with the Humber River system. The 7 km trail link once it is implemented will require ongoing maintenance to ensure that it remains functional and safe for public use over the long term. The following 'Operations, Maintenance and Life Cycle Costs' summary Table 7 below provides an example of how a detailed breakdown of anticipated costs associated with the operations and maintenance of the trail can be laid out.

Table 8: Hypothetical Operations, Maintenance and Life Cycle Cost Analysis

Name of Trail Segment
Operation, Maintenance and Life Cycle Costs

	Quantity	Capital Cost	YEAR 1-4	YEAR 5-9	YEAR 10-19	YEAR 20-29	YEAR 30-39	YEAR 40-49	YEAR 50-59	YEAR 60-69	YEAR 70-79	YEAR 80-89	YEAR 90-99	YEAR 100	Total	Annual Average
1.1.1 - Type II Trail - Limestone	2387m	$ 238,700.00	$ 14,203	$ 56,811	$ 71,013	$ 142,027	$ 238,700	$ 142,027	$ 142,027	$ 238,700	$ 142,027	$ 142,027	$ 238,700	$ 142,026	$ 1,710,285	$ 17,103
1.1.2 - Type II Trail - Asphalt	147m	$ 59,535	$ 875	$ 3,499	$ 4,373	$ 59,535	$ 8,746	$ 59,535	$ 8,747	$ 59,535	$ 8,747	$ 59,535	$ 8,746	$ 59,535	$ 341,407	$ 3,414
1.2.1 - Boardwalk 1-1 (BW02)	110m	$ 227,900.00	$ 1,800	$ 6,100	$ 41,200	$ 46,700	$ 46,700	$ 46,700	$ 237,900	$ 46,700	$ 46,700	$ 46,700	$ 46,700	$ 237,900	$ 851,800	$ 8,518
1.2.2 - Boardwalk 2-1 (BW03)	10m	$ 20,300.00	$ 165	$ 1,465	$ 3,865	$ 4,365	$ 4,365	$ 4,365	$ 25,300	$ 4,365	$ 4,365	$ 4,365	$ 4,365	$ 25,300	$ 86,650	$ 867
1.2.3 - Boardwalk 2-2 (BW04)	113m	$ 233,000.00	$ 1,840	$ 6,239	$ 43,369	$ 49,019	$ 49,019	$ 49,019	$ 243,000	$ 49,019	$ 49,019	$ 49,019	$ 49,019	$ 243,000	$ 880,587	$ 8,806
1.2.4 - Boardwalk 2-3 (BW05)	50m	$ 118,320.00	$ 850	$ 3,350	$ 19,350	$ 21,850	$ 21,850	$ 21,850	$ 123,320	$ 21,850	$ 21,850	$ 21,850	$ 21,850	$ 123,320	$ 423,140	$ 4,231
1.2.5 - Boardwalk 2-4 (BW06)	6.4m	$ 11,258.00	$ 106	$ 938	$ 2,462	$ 2,782	$ 2,782	$ 2,782	$ 11,258	$ 2,782	$ 2,782	$ 2,782	$ 2,782	$ 11,258	$ 45,496	$ 455
1.2.6 - Boardwalk 2-5	134m	$ 196,160.00	$ 2,180	$ 7,200	$ 51,790	$ 58,490	$ 58,490	$ 58,490	$ 206,160	$ 58,490	$ 58,490	$ 58,490	$ 58,490	$ 206,160	$ 862,920	$ 8,629
1.3.1 - Underpass 1-1	1	$ 18,280.00	$ 13,385	$ 53,540	$ 66,925	$ 133,725	$ 18,280	$ 133,725	$ 133,725	$ 18,280	$ 133,725	$ 133,725	$ 18,280	$ 139,820	$ 997,135	$ 9,971
1.3.2 - Underpass 2-1	1	$ 18,280.00	$ 13,385	$ 53,540	$ 66,925	$ 133,725	$ 18,280	$ 133,725	$ 133,725	$ 18,280	$ 133,725	$ 133,725	$ 18,280	$ 139,820	$ 997,135	$ 9,971
1.4.1 - Bridge 2-1 (P073)	35m	$ 190,000.00	$ 2,530	$ 9,120	$ 12,650	$ 39,300	$ 22,800	$ 39,300	$ 200,000	$ 20,300	$ 41,800	$ 20,300	$ 41,800	$ 200,000	$ 649,900	$ 6,499
1.4.2 - Bridge 2-2 (P074)	26m	$ 160,000.00	$ 2,440	$ 8,760	$ 12,200	$ 35,400	$ 21,900	$ 35,400	$ 170,000	$ 19,400	$ 37,900	$ 19,400	$ 37,900	$ 170,000	$ 570,700	$ 5,707
1.4.3 - Bridge 2-3 (P053)	14m	$ 100,000.00	$ 2,320	$ 7,380	$ 9,400	$ 28,200	$ 18,500	$ 28,200	$ 105,000	$ 18,200	$ 28,500	$ 18,200	$ 28,500	$ 105,000	$ 397,400	$ 3,974
1.5.1 - Retaining Wall 1-1	26m	$ 7,800.00	$ 735	$ 2,940	$ 3,675	$ 12,550	$ 7,350	$ 12,550	$ 7,350	$ 12,550	$ 7,350	$ 12,550	$ 7,350	$ 7,800	$ 63,550	$ 636
1.5.2 - Retaining Wall 2-2	74m	$ 22,200.00	$ 2,425	$ 9,700	$ 12,125	$ 18,070	$ 24,250	$ 18,070	$ 24,250	$ 18,070	$ 24,250	$ 18,070	$ 24,250	$ 22,000	$ 206,650	$ 2,067
1.5.3 - Retaining Wall 2-1	20m	$ 6,000.00	$ 690	$ 2,760	$ 3,450	$ 5,100	$ 6,900	$ 5,100	$ 6,900	$ 5,100	$ 6,900	$ 5,100	$ 6,900	$ 6,000	$ 58,500	$ 585
1.6.1 - Culvert 1	300D	$ 3,050.10	$ 400	$ 1,600	$ 2,000	$ 4,153	$ 3,050	$ 4,153	$ 4,000	$ 3,050	$ 4,000	$ 4,153	$ 3,050	$ 4,153	$ 37,760	$ 372
1.6.2 - Culvert 2	300D	$ 3,050.10	$ 400	$ 1,600	$ 2,000	$ 4,153	$ 3,050	$ 4,153	$ 4,000	$ 3,050	$ 4,000	$ 4,153	$ 3,050	$ 4,153	$ 37,760	$ 372
1.6.3 - Culvert 3	300D	$ 3,050.10	$ 400	$ 1,600	$ 2,000	$ 4,153	$ 3,050	$ 4,153	$ 4,000	$ 3,050	$ 4,000	$ 4,153	$ 3,050	$ 4,153	$ 37,760	$ 372
1.6.4 - Culvert 4	300D	$ 3,050.10	$ 400	$ 1,600	$ 2,000	$ 4,153	$ 3,050	$ 4,153	$ 4,000	$ 3,050	$ 4,000	$ 4,153	$ 3,050	$ 4,153	$ 37,760	$ 372
1.6.5 - Culvert 5	300D	$ 3,050.10	$ 400	$ 1,600	$ 2,000	$ 4,153	$ 3,050	$ 4,153	$ 4,000	$ 3,050	$ 4,000	$ 4,153	$ 3,050	$ 4,153	$ 37,760	$ 372
Subtotal 100 Year Total Phase 1															$ 9,332,056	$ 93,290

The cost summary chart provides a summary of the Life Cycle costs for the 100-year horizon, including provisions for the replacement of the various components of the trail system based on their respective anticipated service life. For example, for asphalt trails this is expected to be 15 years, for granular trails 20 years and for pedestrian and vehicular bridges it is 35 years. Adequate funding is required to address long term monitoring, maintenance and operational requirements as set out in this document in order to ensure that the trail system continues to function safely and effectively over the long term.

In determining the relative maintenance costs per linear meter of trail/ boardwalk/ bridge to be inspected annually an hourly rate of $125/hr was used to determine Labour Costs.

The table identifies various trail segments broken down by trail type i.e. surface type, width and depth of material over a maintenance period of 100 years per 5-year increments for the first 10 years then 10-yr increments thereafter to 99 years. The final year of maintenance assumes the full replacement cost of all assets.

Maintenance costs begin with low costs per linear meter of trail in the first year 5 years of maintenance (average $6-8 per metre) due to initial durability of the newly constructed asset. The next 5-year increment in maintenance will see some deterioration in trail substructure and wearing of the surface condition due to increased use as the trail gains popularity and due to exposure to flood conditions and climate variations i.e. spring thaw, storm events, overwintering etc. Typical maintenance costs can range from $20-30 per linear metre of trail in this period. From this 5-year maintenance period onwards, maintenance periods can take a 10 year cycle up to 100 years where 10 year periods will alternate between partial and full trail replacement costs of between $50-60 per linear metre for partial replacement and up to $100 per linear meter for full replacement (which includes replacement of existing compacted aggregate substructure if the conditions are deemed unsatisfactory i.e. due to contamination, by an engineer).

Typical Trail Monitoring Requirements

With the future benefit to its residents and to visitors, the City, TRCA and its partners will have the responsibility to manage, maintain, monitor and restore the local environment that may be affected by undesirable/ informal trail use.

The following table lists several on-going management tasks that if implemented will ensure that the asset is kept in good repair to offer the highest level of safety, access and quality of experience to end users.

Table 9: Prioritization & Timing of Management Activities for the Vaughan Humber Trail

TRAIL MONITORING					
Management Activity	**Organization Responsible**	**Frequency**	**Reporting/ Data Storage**	**Response/ Cost**	**Requirements**
hazard tree management near private property and along trail route	municipality	once annually	report risks to municipality	manage accordingly	• monitor edges near private property and along trails • record condition of hazard trees noting defects and management action required (pruning, removal), record location (GPS) • summarize findings in report
monitor integrity of asphalt trail edges and surfacing	municipality	seasonally; after major storm events	report risks to municipality	promptly repair damage to reduce risk	• monitor full extent of trail system for potential issues • record issue type, location (GPS), required management action, potential source of disturbance • summarize findings in report
monitor slope stability of trails located on slopes	municipality	during implement ation; once annually in spring	report risks to municipality	implement measures identified in report	• monitor steep slopes in spring for stability • record issue type, location (GPS), source of issue, extent, possible management action • summarize findings in report

TRAIL MONITORING CONT'D					
Management Activity	**Organization Responsible**	**Frequency**	**Reporting/ Data Storage**	**Response/ Cost**	**Requirements**
inspect granular trails for rutting and loss of granular material	municipality	seasonally; after major storm events	report to municipal operations staff	promptly repair damage to reduce risk	• monitor full extent of trail surface • record issue type, location (GPS), cause of issue, management recommendation • summarize findings in report
remove litter from trails and trail heads	municipality	bi-weekly	none	evaluate need for additional refuse bins	evaluate need for additional refuse bins
erect and maintain trail closure barriers and fencing	municipality	monthly for first year	through municipality and TRCA operations staff	repair/add temporary fencing and other barriers to discourage access to closed trails as required	repair/add temporary fencing and other barriers to discourage access to closed trails as required
status of trail closure and restoration plantings	advisory committee (partner agencies and municipal departments)	monthly for first year	through advisory committee	adjust/add temporary fencing and other barriers to discourage access to restoration sites, replace failed plantings	• monitor on an on-going basis • identify problem areas • summarize findings in report

TRAIL MONITORING CONT'D					
Management Activity	**Organization Responsible**	**Frequency**	**Reporting/ Data Storage**	**Response/ Cost**	**Requirements**
off-leash dog use and fencing	advisory committee (partner agencies and municipal departments) and users	on an *ad hoc* basis	report infractions to municipalities	initiate education program, deliver flyers to adjacent residents, by-law enforcement	• monitor full extent of trail system (open and closed) • identify issues, access points, potential solutions • Consider other dedicated systems for controlling off-leash dog use
site-lines along trails at trail intersection points and road crossings	local and regional municipalities	annually	none	prune vegetation to maintain heights of 3.0 m above trails and where sight-lines are required for safe use	• monitor trails, trail intersection points and road crossings • record locations of concern, extent of issue, management action required • summarize findings in report
legibility and content of signage	municipality	annually	none	update signage as part of on-going operations	• monitor on an on-going basis while undertaking other maintenance/monitoring • record locations of concentrated use, common access points • summarize findings in report

14.0 References

Auld, H., D. MacIver, J. Klaasen, N. Comer and B. Tugwood. 2007. *Planning for atmospheric hazards and disaster management under changing climate conditions*. Occasional Paper 12, Adaptation and Impacts

Brennan, Patrick. (2018, October 27). *Historic Mattaini bridges to be demolished. Toronto Star*. Retrieved from https://www.thestar.com/life/travel/2018/10/15/historic-mattaini-bridges-to-be-demolished.html.

City of Vaughan, Policy Planning, Emergency Planning, Information and Technology Management, and Development Engineering (April 2014), Woodbridge Special Policy Area Justification Report.

Ontario Ministry of Environment, Conservation and Parks (MECP). (2018). *Ontario's parks and protected areas.* Retrieved 10 January, 2018, from https://www.ontario.ca/page/ontarios-parks-and-protected-areas

Ontario Ministry of Natural Resources and Forestry (MNRF). 2000. *Significant Wildlife Habitat Technical Guide, Appendix G*. Ontario Ministry of Natural Resources and Forestry, Peterborough, Ontario, Canada.

Ontario Ministry of Natural Resources and Forestry (MNRF). (2013a). *General Habitat Description for Eastern Meadowlark (Dolichonyx oryzivorus*).

Ontario Ministry of Natural Resources and Forestry (MNRF). (2013b). *General Habitat Description for Eastern Meadowlark* (*Sturnella magna*).

Ontario Ministry of Natural Resources and Forestry (MNRF). (2013c). *General Habitat Description for Barn Swallow* (*Hirundo rustica*).

Ontario Ministry of Natural Resources and Forestry (MNRF). (2015a). *Significant Wildlife Habitat Criteria Schedules for Ecoregion 6E. Ontario Ministry of Natural Resources and Forestry*, Peterborough, Ontario, Canada.

Ontario Ministry of Natural Resources and Forestry (MNRF). (2015b). *General Habitat Description for Bank Swallow* (*Riparia riparia*).

Research Division (AIRD), Environment Canada. 16 pp. City of Vaughan. 2009. *City-wide Drainage and Stormwater Management Criteria Study*. Prepared by Clarifica Inc.

Toronto and Region Conservation Authority (TRCA). (2008). *Humber River Watershed Plan*.

Toronto and Region Conservation Authority (TRCA). (2005). *Humber River Fisheries Management Plan.* (2005).