



GUIDING SOLUTIONS IN THE
NATURAL ENVIRONMENT

Geomorphic Assessment

Kennedy Road from Major Mackenzie Drive to Elgin Mills Road City of Markham

Prepared For:

Regional Municipality of York

Prepared By:

Beacon Environmental Limited

Date: *Project:*

June 2021 **220329**

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1. Introduction

Beacon Environmental Limited (Beacon) has been retained by the Regional Municipality of York to undertake a geomorphic assessment to inform the Class Environmental Assessment (Class EA) process for improvements to Kennedy Road from Major Mackenzie Drive (Y.R. 25) to Elgin Mills Road in the City of Markham. It is our understanding that the Class EA Study Area includes all lands within the existing right-of-way (ROW) of Kennedy Road and extends 300 metres north of Elgin Mills Road, and 300 m south of Major Mackenzie Drive (**Figure 1**).

The Study Area is located within the North Markham Future Urban Area (FUA) and captures portions of the Bruce Creek and Robinson Creek subwatersheds; both watercourses are tributaries of the Rouge River. These subwatersheds are situated within the jurisdiction of the Toronto and Region Conservation Authority (TRCA). Beacon was involved extensively in the *Berczy, Bruce, Eckardt and Robinson Creeks Subwatershed Study (SWS)*, servicing and planning studies completed in support of the FUA. The purpose of this geomorphic assessment is to summarize available background information and confirm existing conditions for watercourses relevant to the Kennedy Road Class EA Study Area to inform the road widening design process.

2. Policy Context

The following policies were reviewed as they relate to the Class EA Study Area:

2.1 Federal *Species at Risk Act*

The federal *Species at Risk Act* (SARA; 2002) is intended to prevent federally Endangered or Threatened wildlife (including plants) from becoming extinct in the wild, and to help in the recovery of these species. The Act is also intended to help prevent species listed as Special Concern from becoming Endangered or Threatened. To ensure the protection of Species at Risk (SAR), SARA contains prohibitions that make it an offence to kill, harm, harass, capture, take, possess, collect, buy, sell or trade an individual of a species listed in Schedule 1 of SARA as endangered, threatened or extirpated.

The federal SARA applies primarily to lands under federal jurisdiction and relies on Provincial laws to protect federal SAR habitat. On private land, SARA prohibitions apply only to aquatic species and migratory birds that are also listed in the *Migratory Birds Convention Act* (1994). The intent of SARA is to protect critical habitat as much as possible through voluntary actions and stewardship measures.

Redside Dace (*Clinostomus elongatus*) was uplisted in May 2017 to Schedule 1 of SARA meaning its status is confirmed as federally endangered.

Regulations of SARA (2002) also apply to the Subject Lands property in relation to the *Migratory Birds Convention Act* (1994).

2.2 Federal Fisheries Act

Fish and fish habitat are protected under the federal *Fisheries Act* (1985) which was last amended on August 28, 2019 and is administered by Fisheries and Oceans Canada (DFO). The protection provisions of the *Fisheries Act* apply to all fish and fish habitat throughout Canada and the Act sets out authorities for the regulation of works, undertakings or activities that risk harming fish and fish habitat. Specifically, the protection provisions include two core prohibitions. One is against persons carrying on works, undertakings or activities that result in the “death of fish by means other than fishing” (subsection 34.4[1]), and the other is “harmful alteration, disruption or destruction of fish habitat” (subsection 35[1]; also referred to as “HADD”). The protection provisions are applied in conjunction with other applicable federal laws and regulations related to aquatic ecosystems, including the federal *Species at Risk Act*.

Fish habitat is defined in subsection 2(1) of the *Fisheries Act* to include all waters frequented by fish and any other areas upon which fish depend directly or indirectly to carry out their life processes. The types of areas that can directly or indirectly support life processes include, but are not limited to, spawning grounds and nursery, rearing, food supply and migration areas.

Under subsection 35(1) a person may carry on such works, undertakings or activities without contravening this prohibition, provided that they are carried on under the authority of one of the exceptions listed in subsection 35(2), and in accordance with the requirements of the appropriate exception. In most cases, this exception would be Ministerial authorizations granted to proponents in accordance with the Authorizations Concerning Fish and Fish Habitat Protection Regulations under the *Fisheries Act*.

Proponents are responsible for planning and implementing works, undertakings or activities in a manner that avoids harmful impacts, specifically the death of fish and HADD. Where proponents believe that their work, undertaking or activity will result in harmful impacts to fish and fish habitat, DFO will work with proponents to assess the risk of their proposed work, undertaking or activity resulting in the death of fish or HADD of fish habitat and provide advice and guidance on how to comply with the *Fisheries Act*.

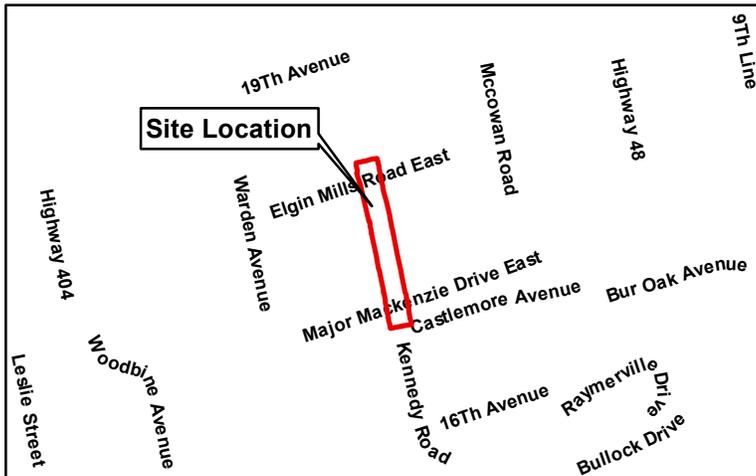
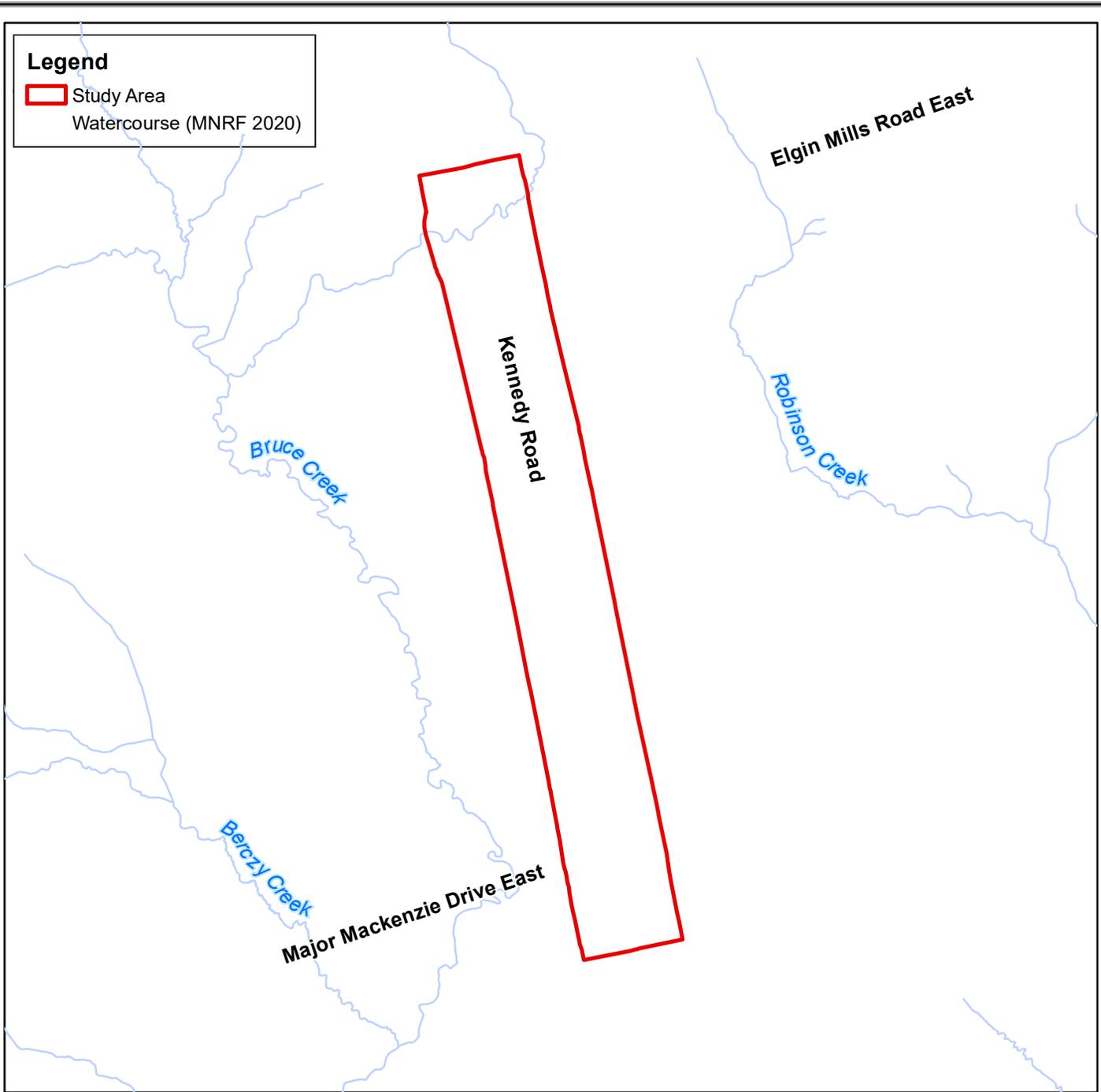
2.3 Provincial Policy Statement (2014)

Policy 2.1 of the Provincial Policy Statement (PPS; MMAH 2014) provides direction to regional and local municipalities regarding planning policies for the protection and management of natural heritage features and resources. The PPS defines seven natural heritage features and provides planning policies for each. The *Natural Heritage Reference Manual* (OMNR 2014) is a technical document used to help assess the natural heritage features listed below:

- a) Significant wetlands;
- b) Significant coastal wetlands;
- c) Significant woodlands;
- d) Significant valleylands;
- e) Significant Areas of Natural and Scientific Interest (ANSIs); and
- f) Significant wildlife habitat.

Legend

- Study Area
- Watercourse (MNRF 2020)



Site Location	Figure 1
Kennedy Road Geomorphic Assessment	
	Project: 220329.1 Last Revised: May 2021
Client: Regional Municipality of York	Prepared by: DU Checked by: SG
 1:20,000	Inset Map: 1:120,000
Contains information licensed under the Open Government License— Ontario Orthoimagery Baselayer: 2020 (FBS)	

Each of these features is afforded varying levels of protection subject to guidelines, and in some cases, regulations. Of these features, significant wetlands and ANSIs are designated by the Ministry of Natural Resources and Forestry (MNR). MNR also provides criteria for the determination of Significant Woodlands, which may also be identified by the municipality. Habitat of Endangered or Threatened species is governed by Ministry of Environment, Conservation and Parks (MECP) and is addressed through the *Endangered Species Act* (ESA). Fish habitat is governed by DFO. The identification and regulation of the remaining features is the responsibility of the municipality or other planning authority.

2.4 Provincial Greenbelt Plan (2017)

Portions of the Subject Lands lie within the Protected Countryside designation of the *Greenbelt Plan* area. Protected Countryside areas are those lands outside of Settlement Areas which are not prime agricultural areas and generally consist of a mixture of agricultural lands, natural features and recreational and historic rural land uses. Portions of the Subject Lands are also located within the Natural Heritage System (NHS) area as defined in Section 3.2 of the *Greenbelt Plan*.

The NHS policies protect areas of natural heritage, hydrologic and/or landform features to support biodiversity and overall ecological integrity. Section 3.2.2.3 of the *Greenbelt Plan* states that:

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 effects on Key Natural Heritage Features (KNHFs) or Key Hydrologic Features (KHF) or their functions;*
- b. Connectivity along the system and between KNHFs and KHF located within 240 m 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 KNHFs and KHF should be avoided. Such features should be incorporated into the planning and design of the proposed use wherever possible; and*
- d. The disturbed area, including any buildings and structures, of the total developable will not exceed 25 percent, and the impervious surface of total developable area will not exceed 10 percent, , except for uses described in and governed by Section 4.1.2 and 4.3.2.*

With some exceptions, the *Greenbelt Plan* prohibits development or site alteration in KNHFs and KHF within the NHS, including any associated Vegetation Protection Zone (VPZ). In accordance to Section 4.2.3.3, "...naturalized stormwater management systems may be permitted within the VPZ of a significant valleyland, provided they are located a minimum of 30 m from the river or stream, and they are located outside of the VPZ of any KNHFs and KHF."

The Key Natural Heritage Features and Key Hydrologic Features Policy identified in section 3.2.2.3 of the *Greenbelt Plan* also identifies new development or site alteration in the NHS (as permitted by the policies of this Plan) shall demonstrate that:

- a. There will be no negative impacts on KNHF or KHF or their functions;*
- b. Connectivity along the system and between KNHFs or KHF located within 240 m of each other is maintained or possible enhanced for the movement of native plants and animals across the landscape;*

- c. *The removal of other natural features not identified as KNHF and KHF should be avoided. Such features should be incorporated into the planning and design of the proposed use wherever possible;*
- d. *Except for uses described in and governed by the polices of sections 4.1.2 and 4.3.2; and*
- e. *At least 30 per cent of the total developable area will remain or be returned to natural self-sustaining vegetation, recognizing that section 4.3.2 establishes specific standards for the uses described there.*

Policies outlined in both section 3.2.2 relating to NHS Polices and Section 3.2.5 KNHF and KHF polices apply. As such, development or site alteration is not permitted in KHF and KNHF within the NHS, including the associated MVPZ with certain exceptions including infrastructure in accordance with Section 4.2.

2.5 Provincial Endangered Species Act

Ontario's ESA came into effect on June 30, 2008, with over 200 species in Ontario identified as extirpated, endangered, threatened, or of special concern. The MECP provides oversight of the ESA for the regulation of SAR in Ontario. Under the ESA, native species that are in danger of becoming extinct or extirpated from the province are identified as being extirpated, endangered, threatened and special concern. These designations are defined as follows:

- Extirpated – a species that no longer exists in the wild in Ontario but still occurs elsewhere;
- Endangered – a species facing imminent extinction or extirpation in Ontario which is a candidate for regulation under Ontario's ESA;
- Threatened - a species that is at risk of becoming endangered in Ontario if limiting factors are not reversed; and
- Special Concern – a species with characteristics that make it sensitive to human activities or natural events.

Under the ESA, protection is provided to threatened or endangered species and their habitat, as well as providing stewardship and recovery strategies for species. Permitting is required to conduct works within habitat regulated for threatened or endangered species.

Within the Study Area, the Bruce Creek valley corridor provides direct habitat for the Endangered Redside Dace.

2.6 Regional Municipality of York Official Plan – Office Consolidation (2019)

The York Region Official Plan (YROP) is a document that outlines the policies of the Regional Municipality of York to guide economic, environmental and community building decisions which inform the strategic decisions of York Region and its nine local municipalities. The basis of the natural environment protection system in York Region is the Regional Greenlands System. This system is comprised of KNHFs KHF. The function of the Greenlands System is to protect these features and appropriate adjacent lands, corridors and linkages.

Map 1 Regional Structure and *Map 2 Regional Greenlands System* designates the main branch valley corridors of Berczy Creek and Bruce Creek as part of the Regional Greenlands System. Lands designated as Regional Greenlands System (Greenlands) in the YROP are subject to development constraints. Development applications within or on lands close to the Greenlands must be accompanied by an environmental evaluation of impacts the development will have or is expected to have on the environmental functions, attributes, or linkages of the Greenlands System. The evaluation must also provide the details of any mitigation measures that will ensure that the Greenlands features will not be adversely impacted.

The boundaries and extent of the Greenlands identified on YROP Map 2 are approximate. Specific delineation or clarification of Greenlands boundaries may be undertaken when applications for development are received. Refinements to the boundaries may occur through environmental evaluation, and do not require an amendment to the plan.

YROP Map 4 identifies KHF, including wetlands and watercourses. YROP Map 4 identifies the portion of Bruce Creek Tributary within the Study Area as a permanent or intermittent watercourse.

2.7 City of Markham Official Plan (2014)

The City of Markham Official Plan (MOP) was approved on June 12, 2014 and was subject to appeals. On November 24, 2017, the Ontario Municipal Board issued a Partial Approval Order which was updated on April 9, 2018 by the Local Planning Appeal Tribunal. *Map 3 – Land Use* designates the majority of the Subject Lands as Future Neighbourhood Area and Greenway System.

In accordance with section 3.1.2.10 of the MOP is largely approved and identifies key natural heritage features and key hydrologic features as the following:

- a) *Wetlands;*
- b) *Habitat of threatened and endangered species;*
- c) *Significant portions of the habitat of:*
 - i. *Special concern species in the Oak Ridges Moraine Conservation Area and Greenbelt Plan Area; and*
 - ii. *Provincially rare species in the Oak Ridges Moraine Conservation Plan Area;*
- d) *Fish habitat;*
- e) *Life Science Areas of Natural and Scientific Interest;*
- f) *Significant valleylands;*
- g) *Significant woodlands;*
- h) *Significant wildlife habitat;*
- i) *Sand barrens, savannahs and tallgrass prairies;*
- j) *Permanent and intermittent streams; and*
- k) *Seepage areas and springs.*

The MOP designates the portion of Bruce Creek valley corridor within Study Area as Greenway System. Generally, development, redevelopment and site alteration are prohibited within key natural heritage features and key hydrologic features and their vegetation protection zones. The extent of features and their protection zones are to be determined through an environmental impact study. Prescribed vegetation zones and definitions of “significant” features (e.g., woodlands and valleylands) are provided in Chapter 3 of the OP.

2.8 Conservation Authorities Act (Ontario Regulation 166/06)

The TRCA regulates land use activities in and adjacent to wetlands, watercourses and valleylands under Ontario Regulation 166/06 (*Regulation for Development, Interference with Wetlands and Alterations to Shorelines and Watercourses*) made under the *Conservation Authorities Act*.

Subject to conformity with the municipality's Official Plan, the completion of appropriate studies and application for Conservation Authority permits, TRCA may grant permission for development within these areas if it can be proven that control of flooding, erosion, pollution or the conservation of land will not be affected by the development.

2.8.1 The Living City Policies (2014)

The TRCA's Living City Policy (LCP) was approved in November 2014 and replaced the Valley and Stream Corridor Management Program (1994). The LCP document, among other matters, implements current federal, provincial and municipal legislation, policies and agreements affecting conservation authorities; and implements the policies for TRCA's updated section 28 of Ontario Regulation 166/06. For purposes of implementing TRCA's Environmental Management Policies:

- Confined River or Stream Valleys are considered Valley Corridors; and
- Unconfined River or Stream Valleys are considered Stream Corridors.

According to the LCP, the boundaries of a valley or stream corridor generally require a minimum 10 m setback from the greater of:

- Physical top of the valley feature;
- Long term stable top of slope, where geotechnical concerns exist (which must be confirmed through an appropriate geotechnical analysis);
- Regulatory floodplain;
- Meander belt; and
- Limits of significant vegetation which is contiguous with the valley corridor.

It is the policy of TRCA:

That erosion hazard limits will be determined through site specific field investigations and technical reports where required, in accordance with the text of TRCA's Regulation and Provincial and TRCA standards. Where erosion hazard limits are required and not available, or where existing erosion hazard information does not meet current Provincial or TRCA standards, TRCA may require the erosion hazard to be determined by a qualified professional, at the expense of the proponent, to the satisfaction of TRCA.

The Belt Width Delineation Procedures (TRCA 2004) document outlines standards for delineating the meander belt in TRCA jurisdiction.

3. Background Review

As noted, the Study Area has been studied extensively as part of the Berczy, Bruce, Eckardt and Robinson Creeks SWS, as well as the Angus Glen and Robinson Glen Master Environmental Servicing Plan studies. Fluvial geomorphology background information was obtained from the following documents:

- *Berczy, Bruce, Eckardt and Robinson Creeks Subwatershed Study – Final Reports (Phases 1, 2 and 3)*, prepared by AMEC Foster Wheeler SWS Study Team (2019);
- *Robinson Glen Master Environmental Servicing Plan* (Robinson Glen MESP), prepared by WSP Global Inc. *et al.* (2020); and
- *Angus Glen Master Environmental Servicing Plan* (Angus Glen MESP), prepared by SKA, *et al.* (2017).

As the Class EA Study Area does not include watercourse crossings of Robinson Creek, the Robinson Glen MESP was not reviewed as part of this study.

3.1 Berczy, Bruce, Eckardt and Robinson Creeks SWS (AMEC Foster Wheeler 2019)

The SWS, undertaken by the AMEC Foster Wheeler (now Wood) Study Team was initiated in 2014 and was completed in three phases.

Phase 1 characterized natural resources within each of the subwatersheds in the FUA, addressing hydrology, hydraulics, groundwater, water quality stream morphology, aquatic and terrestrial ecology. Studies submitted by the Landowner consultants were reviewed, and supplemental field investigations were completed to identify the form, function and linkages of environmental resources, environmental constraints and opportunities and establish criteria and constraints for the formulation of management strategies supporting the proposed future development of the FUA lands. Preliminary goals, objectives and targets were defined for all subwatersheds. This work was used as input for the formulation of management strategies supporting the proposed future development of the FUA lands.

Phase 2 of the SWS involved testing of the Preliminary Land Use concepts through two iterations, to determine if these met various preliminary subwatershed targets identified in the Phase 1 report. Testing included the completion of hydrology, hydraulics, and groundwater modelling, as well as aquatic, fluvial geomorphic, and terrestrial evaluations to formulate preliminary management strategies to avoid, minimize, and mitigate potential impacts. This included assessment and recommendations related to watercourses and headwater drainage features, stormwater management, LID measures, fisheries, aquatic and terrestrial mitigation and management, fluvial geomorphology assessments, SAR, identification of meander belts, and preliminary road crossing alignment reviews.

Phase 3 of the study utilized findings from the impact assessment to refine/define a set of preferred management strategies, address future study requirements, environmental monitoring recommendations, and MESP requirements.

As Elgin Mills Road generally represents the northerly limit of the Future Urban Area, the Angus Glen MESP study area did not include lands north of Elgin Mills Road. Consequently, the portion of Bruce Creek north of Elgin Mills Road and the Kennedy Road crossing of Bruce Creek was not assessed through the SWS.

3.2 Robinson Glen Master Environmental Servicing Plan (WSP Global Inc. *et al.* 2020)

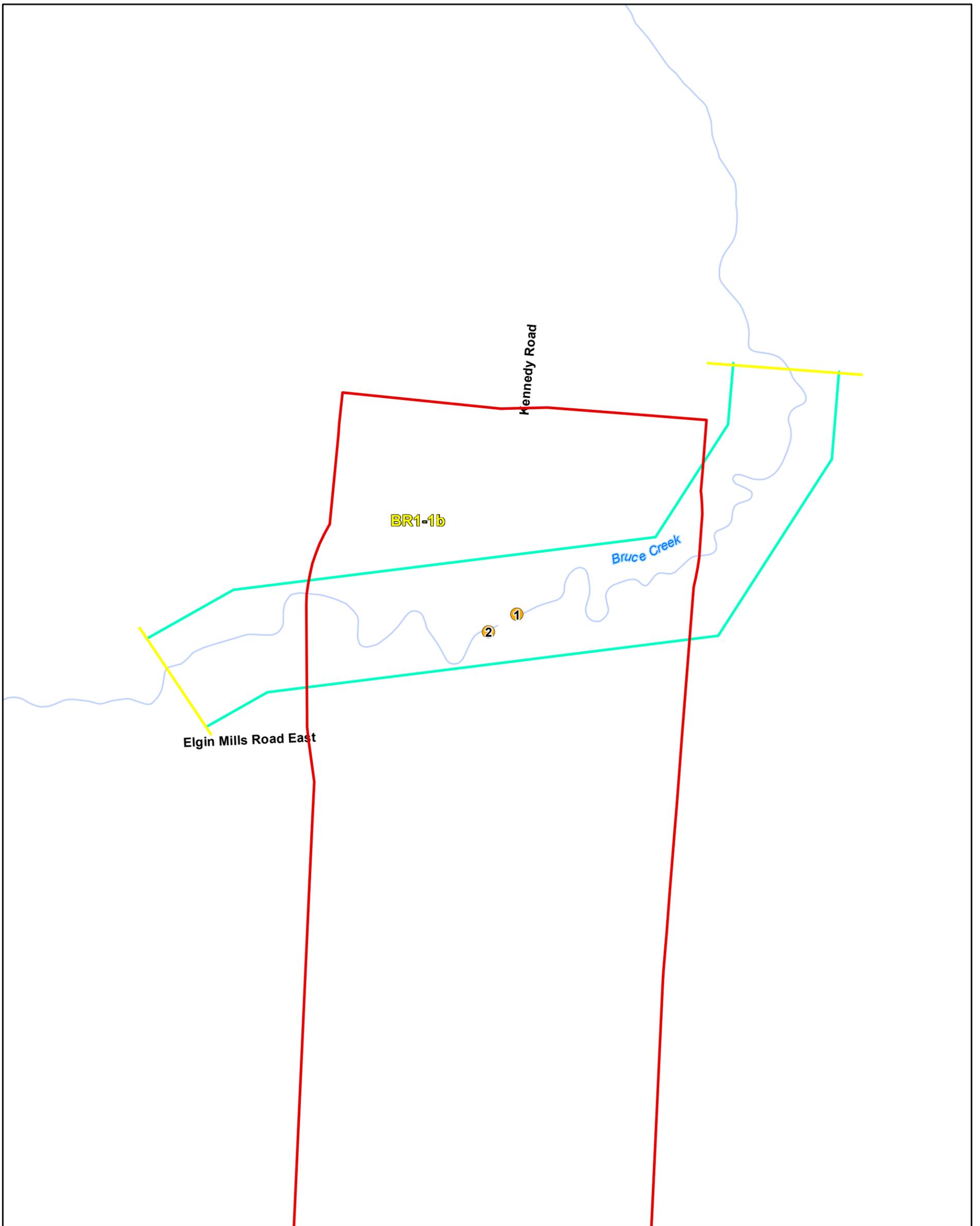
The Robinson Glen MESP was prepared in support of an Official Plan Amendment (OPA) application to permit urban residential land uses to allow the development of a residential community within the Robinson Glen Block. Building on the findings of the SWS, additional fieldwork was completed by the Robinson Glen MESP study team to address any identified data gaps. The Robinson Glen MESP outlined existing conditions relating to surface water, groundwater, terrestrial and aquatic resources, defined the Robinson Glen Greenway System, and recommended stormwater management, grading, transportation, water and wastewater servicing requirements. It also identified potential impacts and mitigative measures, including conceptual design requirements for SWM ponds, LID measures, site grading, management of headwater drainage features, wetland water balance and restoration/enhancement opportunities.

The Kennedy Road Class EA Study Area does not include any watercourse reaches of Robinson Creek as delineated through the MESP (**Figure 2**).

3.3 Angus Glen Master Environmental Servicing Plan (Sabourin Kimble & Associates Ltd. *et al.* 2017)

The Angus Glen MESP was prepared in support of an OPA application to permit urban residential land uses to allow the development of a residential community within the Angus Glen Block. Building on the findings of the SWS, additional fieldwork was completed by the Angus Glen MESP study team to address any identified data gaps. The MESP outlined existing conditions relating to surface water, groundwater, terrestrial and aquatic resources, defined the Greenway System, and recommended stormwater management, grading, transportation, water and wastewater servicing requirements. It also identified potential impacts and mitigative measures, including conceptual design requirements for SWM ponds, LID measures, site grading, management of headwater drainage features, wetland water balance and restoration/enhancement opportunities.

As Elgin Mills Road generally represents the northerly limit of the Future Urban Area, the Angus Glen MESP study area did not include lands north of Elgin Mills Road. Consequently, the portion of Bruce Creek north of Elgin Mills Road and the Kennedy Road crossing of Bruce Creek was not assessed through the MESP.



Legend

- Study Area
- Photo Location
- Reach Break
- Meander Belt
- Watercourse

Fluvial Geomorphology Existing Conditions		Figure 2
Kennedy Road Geomorphic Assessment		
[Redacted]		Project: 220329.1 Last Revised: March 2021
Client: Regional Municipality of York	Prepared by: DU Checked by: SG	
	1:3,500	
Contains information licensed under the Open Government License— Ontario Orthoimagery Baselayer: 2020		

3.4 Data Gaps

Based on a review of the available background reports, the following data gaps were identified in relation to the Kennedy Road Class EA Study Area:

- Watercourse reach delineation along Bruce Creek north of Elgin Mills Road; and
- Characterization of existing geomorphic conditions and meander belt recommendation for the Kennedy Road crossing of Bruce Creek north of Elgin Mills Road.

The following section documents existing watercourse conditions and addresses data gaps within the Study Area.

4. Existing Conditions

In support of the Class EA, a scoped field assessment was conducted on March 9, 2021 within the ROW. A photographic record of watercourse conditions at the time of assessment is provided in **Appendix A**. Rapid assessments were conducted to characterize existing geomorphic conditions.

4.1 Reach Delineation

To facilitate a systematic evaluation of the portion of the Bruce Creek relevant to the Class EA Study Area, the watercourse was delineated into reaches. Reaches are sections of channel with similar characteristics in regard to hydrology, slope, boundary materials, and vegetation, therefore, be expected to behave consistently along their length to changes in the geomorphic function and sediment inputs, as well as to other modifying factors (Montgomery and Buffington 1997; Richards *et al.* 1997).

For the purposes of this study, the section of the Bruce Creek upstream and downstream of Kennedy Road, north of Elgin Mills Road was delineated as a single reach (Reach BR1-1b, see **Figure 2**). The determination of reach extents was based on a desktop assessment of transitions in riparian vegetation, degree of valley confinement and meander geometry (channel planform) using available aerial imagery and topographic mapping.

4.2 Rapid Assessments

4.2.1 Methods

The following standardized rapid visual assessment methods were applied:

i. Rapid Geomorphic Assessment (RGA – MOE 2003)

The RGA documents observed indicators of channel instability by quantifying observations using an index that identifies channel sensitivity. Sensitivity is based on evidence of aggradation, degradation,

channel widening and planimetric form adjustment. The index produces values that indicate whether the channel is stable/in regime (score <0.20), stressed/transitional (score 0.21-0.40) or in adjustment (score >0.41).

ii. Rapid Stream Assessment Technique (RSAT – Galli 1996)

The RSAT uses an index to quantify overall stream health and includes the consideration of biological indicators (Galli 1996). Observations concerning channel stability, channel scouring/sediment deposition, physical in-stream habitat, water quality, and riparian habitat conditions are used to calculate a rating that indicates whether the channel is in poor (<13), fair (13-24), good (25-34), or excellent (35-42) condition.

iii. Downs Classification Method (Downs 1995)

The Downs (1995, outlined in Thorne *et al.* 1997) classification method infers present and future potential adjustments based on physical observations, which indicate the stage of evolution, and type of adjustments that can be anticipated based on the channel evolution model. The resultant index classifies streams as stable, laterally migrating, enlarging, undercutting, aggrading, or recovering.

4.2.2 Results

Rapid assessment results are summarized below.

4.2.2.1 Reach BR1-1b

Reach BR1-1b was characterized as a well-defined, sinuous channel flowing through a confined valley setting. Riparian vegetation consisted of trees, grasses and herbaceous plants. Riffle substrate consisted predominantly of gravel and cobble, while pool substrate consisted of sand, gravel and cobble with areas of exposed underlying clay till. Within the ROW, bankfull dimensions ranged 5.3-7.2 m in width and 0.40-1.40 m in depth. Existing channel disturbances included the Kennedy Road crossing. Channel morphology was influenced locally by the road crossing and presence of instream wood debris.

Within the extent assessed, the RGA scored the reach as being in a state of transition (0.21) with widening noted as the dominant mode of adjustment. The RSAT score of 29 indicated that the channel was in good ecological health, with channel stability noted as the primary limiting factor. The Down's model scored this reach "U – undercutting", based on the presence of erosion along outer banks, deposition along inner banks and a low degree of substrate embeddedness.

4.3 Meander Belt Analysis – Reach BR1-1b

4.3.1 Historical Assessment

In support of the meander belt analysis, historical black and white aerial imagery from 1966 was reviewed and compared to recent imagery to obtain evaluate the degree of land use and channel

planform change over time. Results of this comparison indicated that land use has changed very little along Reach BR1-1b over the available historic record. Particularly west of Kennedy Road, along the north side of Elgin Mills Road, the existing residential homes appear to have been constructed prior to 1966. While the density of riparian tree cover made it difficult to discern changes in channel planform, a backwater influence (ponding water) upstream of the Kennedy Road crossing could be observed in 1966. Post-1966, both Kennedy Road and Elgin Mills Road have been widened.

4.3.2 Meander Belt

To inform the delineation of Redside Dace occupied habitat as defined under Ontario Regulation 242/08, the meander belt was delineated for Reach BR1-1b using a desktop approach. As Reach BR1-1b is situated within a confined valley setting, the procedure to determine the meander belt referenced historic and current channel processes, but also considered valley floor (floodplain) dimensions.

As noted in Section 4.3.1, the 1966 historic watercourse planform could not be traced due to dense tree cover. A 100 m meander belt dimension was recommended for Reach BR1-1b based on the lateral extent of the outermost meander bends and evidence of lateral occupation of the floodplain at the reach scale. This dimension was then reviewed within the context of available topographic mapping to ensure that the dimension was sufficient to capture the valley floor. This procedure is considered to be in accordance with applicable guidelines (TRCA 2004).

Figure 2 illustrates meander belt limits for Reach BR1-1b.

5. Impact Assessment and Mitigation Measures

5.1 Geomorphic Impacts

Potential impacts on channel form and function associated with the proposed widening of Kennedy Avenue include the following:

- Temporary disturbance to the watercourse within the limits of grading due to replacement of the crossing structure, formalization of the low flow channel and road widening activities;
- Release of sediment during and immediately following construction; and
- Modified hydraulic conditions under certain storm events due to the influence of the crossing structure on flows.

5.2 Geomorphic Mitigation Measures

The following measures should be considered to avoid and mitigate potential impacts during construction:

- Undertake in-water works during the appropriate window (July 1 – September 15);
- Minimize duration of in-water work to the greatest extent possible;

- Undertake in-water work during periods of low flow;
- Isolate work area and implement appropriate dewatering;
- Implement a phasing, sediment and erosion control plan to avoid the release of sediment or contaminants to the watercourse;
- Monitor erosion and sediment control measures during construction to ensure performance;
- Disturbed areas should be stabilized immediately to prevent erosion and/or sedimentation through re-vegetation with native species suitable for the site;
- All machinery should arrive on site in a clean condition and be maintained for the duration of the works;
- Whenever possible, machinery should be operated above the high water mark; and
- Wash, refuel and service of machinery should be undertaken in such a way as to prevent any deleterious substances from entering the water.

6. Conclusions

Beacon was retained by the Regional Municipality of York to undertake a geomorphic assessment to inform the Class EA process for the improvements to Kennedy Road from Major Mackenzie Drive (Y.R. 25) to Elgin Mills Road in the City of Markham. The Class EA Study Area is located within the North Markham FUA and includes a crossing of Bruce Creek (a tributary of the Rouge River). The purpose of this geomorphic assessment was to summarize available background information and confirm existing conditions for watercourses relevant to the Class EA Study Area.

The following points summarize the findings of this study:

- Available background studies including the North Markham FUA SWS and Berczy Glen and Angus Glen MESP were reviewed to summarize geomorphic information in relation to watercourses within the Study Area.
- A scoped field investigation was undertaken within the Kennedy Road ROW to confirm existing geomorphic conditions along Reach BR1-1b of Bruce Creek. Rapid assessment results indicated that:
 - The reach was in a state of transition (RGA score of 0.21) with widening noted as the dominant mode of adjustment.
 - The channel was in good ecological health (RSAT score of 29), with channel stability noted as the primary limiting factor.
 - Down's model scored this reach "U – undercutting".
- A 100 m meander belt dimension was recommended for Reach BR1-1b using a desktop approach. This analysis was undertaken to address a data gap in the background studies and inform the determination of Redside Dace occupied habitat limits within the Class EA Study Area.

Should you have any questions or require any additional information please contact the undersigned.

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Appendix A

Photographic Record



Photograph 1. (Location 1)
Bruce Creek Reach BR1-1b
Looking upstream from Kennedy Road at general conditions.



Photograph 2. (Location 1)
Bruce Creek Reach BR1-1b
Looking downstream towards Kennedy Road crossing.



Photograph 3. (Location 1)
Bruce Creek Reach BR1-1b
Looking downstream towards Kennedy Road crossing.



Photograph 4. (Location 2)
Bruce Creek Reach BR1-1b
Looking upstream towards Kennedy Road crossing.



Photograph 5. (Location 2)

Bruce Creek Reach BR1-1b

Localized bank erosion downstream of Kennedy Road crossing.



Photograph 6. (Location 2)

Bruce Creek Reach BR1-1b

Looking downstream from Kennedy Road. Note: presence of instream wood debris.