

Northgate & Erbsville Kartway Subdivisions
Beaver Creek Meadows District
Waterloo

Environmental Impact Study

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Northgate & Erbsville Kartway Subdivisions
Beaver Creek Meadows District, Waterloo

Environmental Impact Study

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1.0 Introduction

Natural Resource Solutions Inc. (NRSI) was retained as part of a team by Northgate Land Corporation and Erbsville Kartway to prepare an Environmental Impact Study (EIS) for the proposed combined development of the above noted subject properties located on Conservation Drive in north Waterloo, Ontario.

The total subject property is approximately 55.746ha in area and is bounded to the north by Conservation Drive, Beaver Creek Road to the east, and natural features to the south and west (Map 1). The majority of the lands are owned by Northgate Land Corp. (49.29ha) with Erbsville Kartway being 6.456ha in area. Habitats within the subject property are comprised of agricultural fields, with wetlands and woodlands associated with Beaver Creek within the central and west portions of the property.

The City of Waterloo formally refers to this area as the Beaver Creek Meadows District. The woodland/wetland complex is part of Environmentally Sensitive Policy Area (ESPA) 80 known as Laurel Creek Forest (Region of Waterloo 2015) and is a Core Natural Feature in the City of Waterloo's Official Plan (2014), while Beaver Creek is identified as a Supporting Natural Feature. Wetlands are part of the Laurel Creek-Sunfish Lake Provincially Significant Wetland (PSW). The low-lying habitats along Laurel and Beaver Creeks are floodplain. The PSW, watercourses and their associated floodplain are regulated by the Grand River Conservation Authority (GRCA) and are subject to Ontario Regulation 150/06. The presence of these natural features, in addition to lands containing known and potential habitat for Species At Risk (SAR) that are afforded protection under the Ministry of Natural Resources and Forestry (MNRF) *Endangered Species Act* (2007), have triggered the requirement for an EIS.

Technical studies, relevant to other aspects of the project such as planning, stormwater management, engineering, etc., have been prepared by the study team and have been used to supplement the natural feature characterization and assess potential impacts to the natural features. The study team includes:

- MHBC (Planning)
- MTE Consulting Inc. (Servicing, Stormwater Management, Hydrogeology, Noise)
- Natural Resource Solutions Inc. (Terrestrial, Wetland and Aquatic Biology).

The natural features in the area have been well studied through the North Waterloo Scoped Subwatershed Study (NWSSS, Ecoplans et al. 2013), 3 years of pre-construction biological monitoring by NRSI (NRSI 2016, 2017), and 3 years of pre-construction surface water and groundwater monitoring by Stantec (2016). Pre-construction monitoring was completed as per the City of Waterloo's Development Monitoring Protocol (1999).

This report contains the detailed findings of the EIS, including the characterization of existing natural features based on the results of a thorough background review, as well as original field surveys from the above noted monitoring. The report identifies natural feature constraints in association with the land use policy designations, assesses potential impacts and provides mitigation measures to reduce or eliminate potential impacts from the proposed development. This EIS has been prepared in accordance with the City of Waterloo's OP (2014), Region of Waterloo's OP (2015), Greenlands Network Implementation Guidelines (2010), Section 15 – 17 of the North Waterloo Scoped Subwatershed Study (Ecoplans et al. 2013), GRCA EIS Guidelines and Submission Standards for Wetlands (2005).

For the purposes of this report, the term 'subject property' refers to the lands owned by the clients, including the area where the development is proposed to occur. The term 'study area' refers to the subject property plus the surrounding area up to 1km, for which additional information was collected and reviewed (as could be gathered without direct access to these areas). Legacy data collected from agencies and wildlife atlases was gathered for the study area to ensure that all natural features were considered.

1.1 Proposed Undertaking

The proposed development is a mixed use neighbourhood, including an internal road network, a mixture of residential density types, stormwater management facilities (3) and pumping stations, trails and parkland as shown on the consolidated plan with the Draft Plans of Subdivision and Draft Plans of Vacant Land Condominium prepared by MHBC Planning (2017); Map 2. The development plan follows the land use structure of the Beaver Creek Meadows District Plan (TPP 2016).

1.2 Project Scoping

In order to determine a study approach for this EIS, existing natural heritage information was gathered and reviewed to identify key natural heritage features and species that are known or have the potential to occur within the study area. Background information on the natural heritage features within the study area was gathered from the NWSSS (Ecoplans et al. 2013) and the pre-construction biological monitoring reports prepared by NRSI (NRSI 2016, 2017).

NRSI completed a preliminary screening of SAR and Species of Conservation Concern (SCC) for the subject property based on the known available habitats. The following information sources were referenced to develop the list of SAR and SCC known and having the potential to be present in the subject property:

- Aerial photography of the site (2012),
- Species lists, vegetation community mapping, study methods and management recommendations contained in the NWSSS (Ecoplans et al. 2013), and
- Correspondence received from the GRCA, Region of Waterloo, City of Waterloo and the MNRF

The SAR/SCC screening was completed by comparing the habitat requirements for significant species that are known from the vicinity of the study area against the ELC communities and habitats known to occur within and adjacent to the subject property. This comparison determined which species have potential to occur within habitats in the subject property, and identify those species with potential to be impacted by the proposed development. Those species identified and an appropriate survey methodology was provided to the MNRF for review and approval.

Based on the findings of the background review and pre-construction monitoring surveys, including the SAR/SCC screening, a Terms of Reference (TOR) for the EIS was prepared by NRSI and submitted on January 15, 2016 to the City of Waterloo, and distributed to the Region of Waterloo, GRCA, and the Ministry of Natural Resources and Forestry (MNRF). The TOR was edited based on the comments received from reviewers and finalized on January 19, 2017. A copy of the final TOR for the EIS is appended to this report (Appendix I).

1.3 Relevant Policies, Legislation, and Planning Studies

Information on the natural heritage features within the subject property was collected and assessed for significance by evaluating them against relevant policies, legislation, and planning studies as outlined in Table 1. Features which are significant or sensitive were identified to the study team to help inform suitable land-use concepts, guide the layout of development, and identify areas to be protected. Table 1 provides an overview of the policy legislation and planning studies that were considered and which informed the field program and analysis.

Table 1. Relevant Policies, Legislation and Planning Studies

Policy/Legislation	Description	Project Relevance
City of Waterloo Official Plan (2014)	• Commits to maintain, enhance, and restore the City's Natural System through land-use planning policies, restoration initiatives, sound management, stewardship, education, and acquisition. • The City's Natural System consists of Landscape Level Systems, Core Natural Features, Supporting Natural Features, Fish Habitat, Restoration Areas, and Linkages. The Natural System forms part of the broader Greenlands Network identified through the Region of Waterloo Official Plan. • As outlined in Section 8.2 of the OP, development or site alteration may occur on lands contiguous to the Natural System if it is demonstrated through an EIS that there will be no adverse impacts on the feature or its ecological functions. • It should be noted that portions of the Official Plan related to the Natural System are under appeal as it relates to the Northgate lands. It is understood the City and Northgate are working to a resolution.	• The subject property is primarily designated as Low Density Residential. • The natural features within the central and west portions of the property are designated as Open Space, containing both Core Natural Feature and Supporting Natural Feature which are afforded protection under the City's OP.
Endangered Species Act (OMNR 2007)	• The original ESA, written in 1971, underwent a year-long review which resulted in a number of changes which came into force in 2007. • The ESA prohibits killing, harming, harassing, or capturing SAR and protects their habitats from damage and destruction.	• Based on information available through background documents and field surveys, including the SAR/SCC screening, several SAR and SCC were identified as having suitable habitat within the study area.
Fish and Wildlife Conservation Act (OMNR 1997)	• The FWCA provides protection for certain bird species, not protected under the MBCA (e.g., raptors), as well as furbearing mammals and their dens or habitual dwellings, asides from the Red Fox (*Vulpes vulpes*) and Striped Skunk (*Mephitis mephitis*).	• The timing of construction activities, especially vegetation clearing and site grading must have consideration for bird nesting and den sites for fur-bearing mammals.
GRCA Ontario	• Regulation issued under *Conservation Authorities*	• The proposed development footprint location is

Policy/Legislation	Description	Project Relevance
Regulation 150/06 (2013)	*Act,* R.S.O. 1990. • Through this regulation, the GRCA has the responsibility to regulate activities in natural and hazardous areas (i.e. areas in and near rivers, streams, floodplains, wetlands, and slopes). • GRCA requires that an EIS be undertaken in accordance with their *EIS Guidelines and Submission Standards for Wetlands* where development is proposed within 120m of PSW or 30m of non-PSW (GRCA 2005). • Section 7.0 of the Regulation identifies the general policies associated with the CA's 'Regulation Area'. • The Regulation identifies that Development, interference or alteration within a Regulated Area may be permitted, where it can demonstrated, through an EIS that "*there are no negative or adverse hydrological or ecological impacts on the wetland."*	adjacent to the GRCA regulated Sunfish Lake – Laurel Creek PSW Complex (Map 1). • A regulation limit of 120m from the GRCA confirmed wetland boundaries apply. • In accordance with this policy, the proposed development must demonstrate no negative impacts to the regulated natural features or their ecological functions.
Migratory Birds Convention Act (CWS 2013)	• The MBCA protects migratory game birds, insectivorous birds, and several other migratory non-game birds from persecution in the form of harassment. • The schedule of on-site work must consider MBCA windows, with timing of breeding bird season typically occurring between May 1 and July 31, however, this is a guideline, since the MBCA applies to nesting bird species. • "Incidental take" is considered illegal, with the exception of a permit obtained by the Canadian Wildlife Service (CWS).	• The timing of construction activities, especially vegetation clearing and site grading must have consideration for the MBCA timing windows.
Provincial Policy Statement (OMMAH 2014)	• Issued under the authority of Section 3 of the Planning Act and came into effect on April 30, 2014, replacing the 2005 PPS (OMMAH 2005). • One of the key goals of the PPS is the *"effective use of land and resources, with development primarily*	• Based on the background review and detailed information from the NWSSS, pre-construction monitoring reports and SAR/SCC screening, several natural features afforded consideration within the PPS have been identified in the stud area, including:

Policy/Legislation	Description	Project Relevance
	focused in settlement areas." • Section 2.1 of the PPS – Natural Heritage establishes clear direction on the adoption of an ecosystem approach and the protection of resources that have been identified as 'significant'. This section also identifies that natural features are to be protected for the long term. • Section 2.1.5 of the PPS identifies that development and site alteration shall not be permitted within the area outlined in sub-sections a) – f) *"unless it has been demonstrated that there will be no negative impacts on the natural features or their functions."* • The Natural Heritage Reference Manual (OMNR 2010) and the Significant Wildlife Habitat Technical Guide (OMNR 2000, MNRF 2015a) were prepared by the MNRF to provide guidance on identifying natural features and in interpreting the Natural Heritage sections of the PPS.	o Significant Wetland, o Significant Woodland, o Significant Wildlife Habitats, and o Habitat for endangered and threatened species
Regional Municipality of Waterloo Tree By-Law Number 08-026	• The by-law regulates the destruction or injuring of trees within woodlands, • Enactment of this by-law is aimed at sustaining a healthy natural environment within the Region, while also having regard for good forestry practices, • Statutes of protection aims that no person shall destroy or injure a tree, or cause another person to destroy or injure a tree, of a protected species that is located in a woodland	• The proposed development area contains only planted isolated trees, therefore, trees within development envelope are not protected under the Regions By-Law, • The development proposal will be maintained outside of the adjacent natural feature containing any woodland habitat.
Regional Municipality of Waterloo Official Plan (2015)	• The updated Regional Official Plan (ROP) includes policies related to the natural environment. • It provides a much more detailed policy framework than the previous ROPP that protects environmental features; therefore, the ROP 2015 is referred to throughout this report as the most current guidance for delineating and protecting Core Environmental Features within the study area.	• The Regions OP identifies the natural features within the central and western portions of the subject property to be 'Core Environmental Features' • Beaver Creek (or its tributaries), which flow through the central and western portions of the subject property, is associated with the Core Environmental Features. • The Region's OP permits infrastructure within and

Policy/Legislation	Description	Project Relevance
		adjacent to 'Core Environmental Features". Infrastructures includes municipal services and private and public roads.
North Waterloo Scoped Subwatershed Study (Ecoplans et al. 2013)	• The Subwatershed Study provides recommendations on conservation, enhancement, mitigation measures, and management practices of natural features and functions that have the potential to be impacted by development. • Core Areas and Watercourses are to be retained in their entirety, with no alterations to watercourses. • Development setbacks and buffers are recommended, to be confirmed during the EIS phase.	• Core Natural Areas and Watercourses exist within the central and western portions of the subject property.

2.0 Field Methods

The pre-construction biological monitoring program that was undertaken by NRSI within the study area, including the Northgate and Erbsville Kartway subject property, encompassed a number of survey components which were detailed and agreed upon in a Terms of Reference (TOR) at the outset of the study. The terrestrial and aquatic field surveys were undertaken to characterize the natural heritage features and identify significant and sensitive features and species that have potential to be adversely affected by the proposed development. The methods dates and times of each monitoring program component are described in detail below and are summarized in Table 2. Vegetation communities identified in the subject property are shown on Map 3, with specific biological monitoring locations shown on Map 4.

During the field work program, all incidental observations of wildlife were documented, including actual direct observations, as well as signs (i.e. tracks, scat, dens, nests, etc.). In addition to NRSI's characterization of natural heritage features, 3 years of pre-construction surface and groundwater monitoring in the subwatershed study area has also been completed by Stantec (2016) as well as site specific monitoring of groundwater by MTE (2017).

Table 2. Field Survey Summary

Survey Type	Protocol	Date			
		2014	2015	2016	2017[1]
Badger Survey	NWSSS (Ecoplans et al. 2013)	N/A	October 23	N/A	ongoing
Barn Swallow Habitat Investigation & Descriptions Surveys	MNRF Guelph District Guidance (G. Buck, pers. comm. 2012a)	N/A	July 2	June 23	
Bat Habitat Assessments (cavity trees and structures)	MNRF 2015c	October 17	N/A	N/A	
Benthic Sampling	Ontario Benthos Biomonitoring Network (OBBN) Protocol Manual (Jones et al. 2007)	May 22[1]	May 20	June 2	
		October 9	September 30	October 24	
Breeding Bird Surveys	OBBA 2001	June 12[1]	June 5	June 6	
		June 26[1]	June 23	June 17	
Ecological Land Classification (verification and refinement)	Lee et al. 1998	September 29	June 5	June 6	
			September 28	September 12	
Evening Calling Anuran Surveys	BSC 2009	April 21[1]	April 16	April 18	
		May 12[1]	May 25	May 17	
		June 10[1]	June 16	June 21	
Nocturnal Bird Surveys	Common Nighthawk Survey Protocol (G. Buck, pers. comm. 2012b)	N/A	May 28	May 26	
			June 4	June 23	
			June 30	N/A	
Pre-Construction Monitoring & Disturbance Data Sheet	City of Waterloo Pre-Construction Monitoring (City of Waterloo 1999)	N/A	June 5	June 6	
		September 29	September 28	September 12	
Turtle Nest and Nesting Surveys	OMNR 2013a; MNRF 2016b	N/A	May 25	May 28	
			June 16	May 30	
				June 2	
				June 4	
				June 7	
				June 9	
				June 11	
				June 13	
				June 16	
				June 18	
				June 20	
				June 22	

				June 23	
Turtle Emergence/Overwintering Surveys	MNRF 2015d	N/A	N/A	N/A	March 29
					April 9
					April 10
					April 17
					April 18
Vegetation Plot Monitoring	NRSI Vegetation Plot Monitoring standardized methods (GRCA approved, K. Smith, pers. comm. 2014b), adapted from Terrestrial Monitoring – Plot Establishment & Data Collection (City of Waterloo 2002)	June 23[1] August 11	July 23	August 2	N/A
Road Crossing Mortality Surveys[1]	NWSSS (Ecoplans et al. 2013)	May 1	N/A	N/A	
		May 13			
		May 27			
		June 3			
		June 12			

[1]Pre-construction monitoring program field surveys to be completed in 2017; survey details not available at time of EIS submission
[2]Survey(s) completed by MMM Group prior to NRSI's involvement in the project; methods detailed in NWSSS

2.1 Vegetation

2.1.1 Vegetation Communities

Vegetation communities within and adjacent to the subject property were characterized as per the Ecological Land Classification System (ELC) for southern Ontario (Lee et al. 1998) and presented in the NWSSS (Ecoplans et al. 2013). Vegetation community boundaries were verified and refined during the pre-construction monitoring program conducted by NRSI (2014-2016). ELC mapping is shown on Map 3.

2.1.2 Vascular Flora

Detailed vegetation inventories within the subject property were conducted during the NWSSS (Ecoplans et al. 2013). Comprehensive summer-season vegetation inventories were completed by NRSI biologists during the pre-construction biological monitoring (NRSI 2016, NRSI 2017) within 5 vegetation monitoring plots (Map 4). All species of flora including any federally, provincially, or regionally significant vascular flora observed during any visits to the property were documented. A complete list of plant species observations within the vegetation monitoring plots is appended to this report (Appendix II) while a full list of plants in the subwatershed study area can be found in the NWSSS (Ecoplans et al 2013).

2.1.3 Vegetation Surveys for Enhancement / Management Needs

Wandering transects were established within and adjacent to the natural features on the subject lands to assess enhancement and/or management needs as development proceeds. Transects surveys were conducted during spring and fall (2014-2016) to document the presence of litter, footpaths, and any other forms of disturbance (i.e. dumping of yard waste, forts, invasive species establishment, etc.) using a standardized form to collect data. This information will inform the baseline condition of the interior and buffering habitats of the natural features to be used as a comparative condition for future monitoring. It will also be used to identify areas for refuse removal and enhancement or restoration activities. In addition, the vegetation surveys identified provincially and regionally significant plant species (Richardson and Martin 1999) (Map 3).

The results of the vegetation surveys for enhancement/management needs are discussed in Section 3.4.3 in this report with monitoring locations shown on Map 4.

2.1.4 Vegetation Monitoring Plots

As requested by the GRCA, permanent plot vegetation monitoring was completed within the subject property during the summer season (2014-2016). Following the methods for vegetation monitoring taken from the City of Waterloo's *Terrestrial Monitoring – Plot Establishment & Data Collection* (2002), monitoring was carried out at 5 locations within the subject property as shown on Map 4. Data recorded included species, size, abundance, and health of canopy trees, understorey trees, shrubs, and herbaceous plants.

A list of species observed within each monitoring plot is provided in Appendix II and results are discussed in Sections 3.4.2 and 3.4.4.

2.1.5 Fixed Photo Plot Monitoring

A total of 17 fixed photo monitoring plots were established throughout and adjacent to the natural features within the subject property (Map 4). Each plot was assessed by NRSI (2014-2016) through a qualitative photo inventory method. In order to facilitate comparison of baseline conditions with future conditions, the same orientation was used in each year of subsequent monitoring. The photo monitoring was conducted in accordance with the City of Waterloo's Development Monitoring Protocol guidance document for pre-construction monitoring of terrestrial features (1999). This guidance document specifies spring and fall photo plot monitoring.

Photos documented the current condition of the natural features and their edges to record the health and character of the vegetation, presence of any refuse, footpaths, erosion, or other forms of disturbance. These photos will help establish baseline conditions and document future disturbances, restoration success, or other changes over time.

2.1.6 Dripline and Wetland Boundary Flagging and Survey

Dripline flagging and surveying of the Core Environmental Feature boundaries was done during the NWSSS and generally did not change during the pre-construction monitoring program. One exception is a portion of the woodland dripline boundary of the Core

Environmental Feature within the Northgate property which was flagged by NRSI on December 9, 2014 and subsequently surveyed by MTE on January 14, 2015. This dripline boundary is consistent with the vegetation community boundaries as shown within this report on Map 3, and was used on all plans.

2.2 Avifauna

2.2.1 Breeding Birds

Breeding bird surveys were completed within the existing Wildlife Survey Units (WSUs) as defined in the NWSSS (Ecoplans et al. 2013) as well as within the agricultural and cultural areas on the subject property (Map 4). Surveys were conducted during the peak breeding bird season, consistent with the NWSSS (Ecoplans et al. 2013) methods, and the Ontario Breeding Bird Atlas (OBBA) Guide for Participants (OBBA 2001) standardized protocol.

Following the standardized protocol, point counts for breeding birds were completed twice each breeding season and timed at least 10 days apart in 2014, 2015 and 2016. Random wandering transect surveys were also completed in between point count stations. Point counts were completed during the early morning between sunrise and 1000hrs, for a length of 10 minutes. Supplementary data was also recorded at each station, including the survey time, air temperature, wind speed (as per Beaufort Wind Scale), cloud cover, and precipitation.

2.2.2 Barn Swallow

Barn Swallow (*Hirundo rustica*), a provincially Threatened species, was noted as occurring within the study area in the NWSSS (Ecoplans et al. 2013). Barn swallow surveys were conducted in 2015 and 2016 according to the Guelph District MNRF Barn Swallow Survey Protocol (G. Buck, pers. comm. 2012a) which includes a third targeted survey during the breeding bird season. A third survey visit was conducted within the cultural areas of the subject property to determine if any Barn Swallows were nesting in the existing structures on-site. Structures proposed for removal within the proposed development scenario are shown on Map 2. Specific Barn Swallow surveys were conducted within WSU 11 as shown on Map 4.

2.2.3 Common Nighthawk

GRCA correspondence indicated that Common Nighthawk (*Chordeiles minor*), a SCC, has been observed in the local Waterloo area (K. Smith, pers. comm. 2014a). Suitable habitat for this species, albeit marginal, is present in the subject property; therefore, surveys were conducted in 2015 and 2016 according to MNRF guidance including up to 3 evening surveys, spaced 7 days apart, on evenings during the appropriate lunar phase, between late May and early July (G. Buck, pers. comm. 2012b). Monitoring locations are shown on Map 4.

Monitoring results from avifauna surveys, including incidental observations are provided in Appendix III and are discussed in Section 3.6.

2.3 Amphibians

Evening amphibian call surveys were completed at the 5 permanent monitoring stations located at wetland units within the subject property (Map 4). Surveys were conducted on 3 separate dates during the amphibian breeding season, in April, May, and June (2014, 2015 and 2016), consistent with the Marsh Monitoring Program (MMP) amphibian monitoring standardized protocol (BSC 2009). A minimum of 15 days between visits was coordinated to correspond with peak vocalization periods for early, mid, and late-season breeding species. Surveys occurred between one half-hour after sunset and midnight, on evenings with appropriate weather conditions, as specified in the protocol. Surveys were not conducted during rain events (light rain is acceptable) (BSC 2009).

Following this protocol, 3 minute point counts were conducted at each monitoring station to identify presence and relative abundance (based on calling intensity) of anuran (frog and toad) species within each wetland unit. A three-level calling code system was utilized to record relative levels of calling intensity for each identified species:

- Calling Code 1 is used when number of calling males can be estimated and calls do not overlap,
- Calling Code 2 is used when some calls overlap but number of calling males can still be estimated, and
- Calling Code 3 is used when males are calling at full chorus and it isn't possible to estimate the number of individuals.

Supplementary data was also recorded at each station, including the survey time, air and water temperature, pH, wind speed (as per Beaufort Wind Scale), cloud cover, direction surveyors were facing, and background noise levels.

Western Chorus Frog (*Pseudacris triseriata* pop. 2), a provincially Threatened species, was recorded within the study area during the NWSSS (Ecoplans et al. 2013). The anuran call surveys described above are adequate to monitor for the presence and abundance of Western Chorus Frog.

Anuran call count monitoring results are in Appendix IV and discussed in Section 3.7.

2.4 Reptiles

Extensive surveys for snake species using cover boards were undertaken during the NWSSS (Ecoplans et al. 2013). No significant species were observed during these surveys; therefore, no further surveys were conducted in 2014-2016.

Significant turtle species with the potential to be using the habitats within the study area include Snapping Turtle (*Chelydra serpentina*) (SCC) and Blanding's Turtle (*Emydoidea blandingii*) (Threatened) as described in the NWSSS (Ecoplans et al. 2013). Numerous targeted visual surveys for turtle SAR and SWH related to turtles (potential turtle nesting and overwintering areas) were conducted according to recent MNRF guidance for turtle nest and nesting surveys (OMNR 2013a; MNRF 2016b), and overwintering/emergence surveys (MNRF 2015d). Any sightings of snakes or turtles were photographed and mapped, as well as any evidence of hibernation, nesting, or basking areas.

<u>Blanding's Turtle</u>

The NWSSS (Ecoplans et al. 2013) reports that Blanding's Turtle was observed in the Laurel Creek Reservoir and to the west of the reservoir in 2009 and 2013 respectively. As well, Blanding's Turtle have been reported within the Laurel Creek Nature Centre property in 2013 and 2016. The reservoir is managed as a flood control reservoir, where water from the spring freshet is stored to reduce flood peaks. Water in the reservoir is drawn-down during the late fall to early spring, generally corresponding to the turtle

overwintering period. As such, the reservoir is unsuitable for Blanding's Turtle overwintering.

Category 1 habitat is defined as any nest or overwintering sites and adjacent lands within 30m (OMNR 2013). Targeted nesting surveys and emergence/overwintering surveys were completed as part of the pre-construction monitoring program, to determine the presence of Category 1 habitat. Potential Category 1 overwintering habitat includes off-site wetland habitats associated with Laurel Creek to the west of the Laurel Creek Reservoir and Beaver Creek Road, however this is unconfirmed to-date. Potential overwintering sites for Blanding's Turtle within the subject property were surveyed and are limited to Laurel Creek on the Erbsville Kartway lands. Beaver Creek within the subject property is not suitable for Blanding's Turtle overwintering due to its shallow depth and lack of organic substrates.
Category 2 habitat is defined as the wetland complex (i.e. all suitable wetlands or waterbodies within 500m of each other) extending up to 2km from an occurrence, and the area within 30m around those suitable wetlands or waterbodies. Category 2 habitats are present within the study area and include the wetlands plus 30m.

Category 3 habitat is defined as areas between 30m and 250m around suitable wetlands and waterbodies identified in Category 2, within 2km of an occurrence. Category 3 habitats provide movement corridors between wetlands essential for carrying out life processes within Category 1 and 2 habitats (OMNR 2013b).

2.5 Mammals and Other Wildlife

The isolated landscape trees and buildings within the subject property were considered for their suitability to provide roosting habitat for the following SAR bats: Little Brown Myotis (*Myotis lucifugus*), Northern Long-eared Bat (*Myotis septentrionalis*), Eastern Small-footed Myotis (*Myotis leibii*), and Tri-colored Bat (*Perimyotis subflavus*). Isolated trees and existing buildings are proposed for removal under the existing development concept shown in Map 2. As such, a detailed bat habitat assessment was conducted on October 17, 2014 within the subject property.

American Badger (*Taxidea taxus jacksoni*) (Endangered) was surveyed for in the NWSSS (Ecoplans et al. 2013) with no sightings or evidence found. During the monitoring program, the MNRF requested targeted den surveys for American Badger, as time had passed since the NWSSS American Badger surveys were completed in 2010-2011, and the species has the potential to move into the site (D. Marriott, pers. comm. 2015). A targeted American Badger den survey was conducted by NRSI within the subject property on October 23, 2015 as per the NWSSS methods (Ecoplans et al. 2013), focusing on the edges of natural features abutting agricultural areas.

Incidental observations of all mammals, insects, and any other wildlife species were recorded during all field visits. This included direct observations, as well as observations of tracks, scat, vocalizations, etc. Habitat features that may qualify as SWH according to the Significant Wildlife Habitat Technical Guide (SWHTG, OMNR 2000) and criteria tables (MNRF 2015a) were documented, evaluated and confirmed as SWH. Confirmed SWH are shown on Map 5.

2.6 Road Crossing Mortality Monitoring

Road crossing mortality monitoring was completed by MMM Group during spring 2014. Monitoring events occurred in May and June and generally focused on Conservation Drive from Beaver Creek to WSU-7. Methods implemented were consistent with the NWSSS (Ecoplans et al. 2013).

2.7 Terrestrial Feature Monitoring

As outlined in the City of Waterloo's Development Monitoring Protocol document (1999) for pre-construction surveys, terrestrial feature monitoring was conducted within the subject property in spring and fall (2014-2016). NRSI biologists walked through the natural features within the subject property and documented the following:

- General health of vegetation and trees
- Evidence of soil movement
- Evidence of human disturbance or encroachment
- General fish and wildlife observations
- Overall conditions

The components of the terrestrial feature monitoring are addressed in the vegetation related components of this report.

2.8 Aquatic Habitat Assessment

Beaver Creek was well studied and documented in the NWSSS (Ecoplans et al 2013) with targets and thresholds provided for its protection and enhancement. That information was relied upon to provide a description of the aquatic habitat, fish and benthic communities in the creek for this EIS. The local aquatic habitat features within both Beaver and Laurel Creeks were characterized as part of the North Waterloo Scoped Subwatershed Study (Ecoplans et al 2013). This characterization was performed through a multi-season approach to assess the following parameters:

- Flow condition;
- Channel dimensions and general character;
- Morphology (e.g. riffles, pools);
- Instream and overhead cover opportunities (i.e. woody debris, undercut banks, boulders, aquatic vegetation);
- Substrate type;
- Bank height, character and stability/evidence of erosion;
- Riparian vegetation;
- Physical barriers to fish movement;
- Evidence of groundwater discharge; and
- Disturbances, habitat limitations and potential habitat enhancement opportunities.

Fish community sampling was performed as part of the North Waterloo Scoped Subwatershed Study (Ecoplans et al 2013) using a multi-pass sampling approach following the sampling protocols described by the Ministry of Transportation Environmental Guide for Fish and Fish Habitat (2009) and the fish community composition assessment protocol as described in the Ontario Stream Assessment Protocol (Stanfield 2013). These results of these fish sampling events were incorporated into assessment of the local fish community for this EIS the full list of fish species known from within Laurel and Beaver Creek is provided in Appendix V.

Benthic Macro-Invertebrate monitoring was performed at three stations within Beaver and Laurel Creeks as part of the North Waterloo Scoped Subwatershed Study (Ecoplans

et al 2013) BTH-001, BTH-002, and BTH-003 (Map 4). These stations were established in accordance with the *Ontario Benthos Biomonitoring Network Protocol Manual* (OBBN) protocol (Jones et al. 2007). Each station comprised 3 sub-stations: 2 from riffle habitat and 1 from pool habitat. For wadeable streams, such as the areas of Beaver Creek and Laurel Creek within the subject lands, the OBBN protocol employs a "Travelling Transect Kick and Sweep" method, where each sub-sample is made up by sampling 10 linear meters of stream transect over a 3 minute period (Jones et al. 2007; EC 2011). A 500 µm mesh D-net is held downstream of the substation transect to capture invertebrates dislodged by vigorous kicking within the transect area. Samples were then preserved in a buffered 70% ethanol solution for identification. Spring sampling for benthic invertebrate monitoring was performed by MMM Group on May 22, 2014 and by NRSI on May 20, 2015 and June 2, 2016. Fall sampling was conducted by NRSI on October 9, 2014, September 30, 2015, and October 24, 2016. Benthic samples were then identified to the lowest practical taxonomic level. Each monitoring station sub-sample was identified and the results of this identification were pooled for analysis. For the identification of the benthic macro-invertebrates within each sub-station, small randomly selected portions were taken for identification as representative samples of the sub-station. Successive portions were removed and fully analyzed until a minimum of 100 organisms were collected as per the requirements of the OBBN protocol (Jones et al. 2007). After the collection of the 100th organism, the portion being sampled is completed in order to facilitate the measurement of the proportion of the total sample that was sub-sampled and identified. The sub-sample proportion is determined by measuring the total sample weight before identification and the remaining sample weight after identification. The difference between these 2 measurements represent the proportion sampled which is a percentage of the total sample (EC 2011).

Benthic organisms which do not fall within the 27 groups of benthic invertebrates outlined in the OBBN protocol were not included in the tally (Jones et al. 2007). The benthic invertebrate data was analyzed using a number of metrics in order to characterize the general condition of the watercourse. The metrics used for the assessment of watercourse condition were selected to reflect the metrics and indices used for the NWSSS (Ecoplans et al. 2013) and recommended by the OBBN Protocol.

A total of 11 metrics and indices were calculated in order to assess the water quality within each monitoring station. These metrics include:

- Taxa Richness – the number of taxa generally increases with habitat diversity and water quality (Jones et al. 2007),
- EPT Taxa Richness – the number of taxa from orders sensitive to pollution, specifically the orders Ephemeroptera, Plecoptera, and Tricoptera (Barbour et al. 1999; Weber 1973),
- Percent EPT – percent composition of a community by taxa from orders sensitive to pollution, specifically the orders Ephemeroptera, Plecoptera, and Tricoptera (Barbour et al. 1999; Weber 1973),
- Percent *Oligochaetes* – percent composition of a community by aquatic worms, a group tolerant to pollutants (Jones et al. 2007),
- Percent Diptera – percent composition of a community by fly larvae which provides a context for other analysis (Jones et al. 2007),
- Percent *Chironomidae* – percent composition of a community by larval midges, a highly tolerant family (Jones et al. 2007),
- Dominant/Subdominant Taxa – highest and second highest number of taxa sampled,
- Percent Functional Feeding Groups – the percent composition of a community by Collector-filterers, Collector-gatherers, Predators, Scrapers, and Shredders. Feeding groups can provide an indication of habitat conditions (Merritt et al. 2008),
- Shannon Wiener Index (H') – an index used to measure the diversity in categorical data, taking into account the number of species and evenness of the species. Calculated as:

  $$H' = -\sum(p_i)\,(lnp_i)$$

  Where "p_i "is the proportion of individuals in the i^{th} taxon (EC 2011),
- BI – a measure of water quality based on the species-level "tolerance values" and the number of individuals of each species and the total number of individuals within the sample. Calculated as:

  $$BI = \sum \frac{x_i t_i}{n}$$

Where "x_i" is the number of individuals within the i[th] taxon, "t_i" is the tolerance value of the i[th] taxon, and n is the total number of individuals within the sample (Hilsenhoff 1987).

- FBI – a measure of water quality based on the family-level "tolerance values" and the number of individuals within each family and the total number of individuals within the sample. Calculated as:

$$FBI = \sum \frac{x_i t_i}{n}$$

Where "x_i" is the number of individuals within the i[th] family, "t_i" is the tolerance value of the "i[th]" family, and n is the total number of individuals within the sample (Hilsenhoff 1988).

3.0 Existing Conditions

3.1 Soils, Terrain and Drainage

The study area is located in the physiographic region known as the Waterloo Moraine or the Waterloo Sand Hills (Chapman and Putnam 1984). This region is characterized by irregular hummocky to steeply rolling land comprised of a number of layers of ice contact and glacial outwash sands and gravels, separated by layers of silt and clay rich tills. These soils were deposited over the course of numerous advances and retreats of glacial ice lobes during the Wisconsinian glacial period. As the glacial ice melted and retreated, melt water eroded and cut through the layers. Modern action and erosion by watercourses and the deposition of wetland organic soils further created a complex pattern of surficial soils in the study area.

The tills in the study area are dominated by silts and clays in variable compositions and also with sand. In general, the tills are described as hard and dense with low permeability and are known as aquitards, forming a barrier protecting the underlying aquifer layers of water bearing sand and gravel layers or bedrock. The aquifer layers of the Waterloo moraine are important in Waterloo Region as a water supply for the Cities of Kitchener and Waterloo.

The subject property soils and groundwater conditions were investigated by MTE and are described in their Hydrogeology Study (2017). The subject lands gradually increase in topography from west to east (Elevation 350m amsl to Elevation 358m amsl), with a relatively flat topography from north to south along the Beaver Creek corridor (Elevation 346m amsl). The borehole drilling program identified the subsurface stratigraphy to be comprised of topsoil material consisting of some organics and silty sand up to 1m bgs. Fine sand with till and/or clay silt materials underlay the topsoil layer up to 17m bgs. Fine-textured glaciolacustrine sediments of primarily silty clay interpreted as the Lower Maryhill Till occur between 17-25m bgs. Refer to the Hydrogeological Study report for further details (MTE 2017).

3.2 Groundwater

Stantec Consulting carried out the pre-construction monitoring of groundwater and surface water across the North Waterloo study area (Stantec 2016) while MTE completed site specific groundwater monitoring and prepared the Hydrogeological Study (MTE 2017). The results of the Stantec monitoring report conclude that in general, groundwater and surface water observations from 2011-2015 were consistent with the overall results and interpretations as presented in the NWSSS with respect to groundwater flow, levels, chemistry, and surface flow conditions (Stantec 2016). Stantec found that groundwater levels at the monitoring wells varies seasonally and responds synchronously (all at once) across the site to precipitation events. The flow of groundwater is interpreted to be generally directed to and associated with Beaver Creek and Laurel Creek (Ecoplans et al. 2013). Based on the permeability of the surficial soils, the majority of the subject property is identified as a groundwater recharge area, where precipitation can infiltrate to the shallow groundwater layer, and potentially to the deeper aquifers where there is no intervening layer of impermeable till. Figure 5.8 of the NWSSS (Ecoplans et al. 2013) indicates that approximately the western half of the subject property is a Potential Groundwater Recharge Area, and approximately the eastern half of the subject property is a Significant Groundwater Recharge Area. As reported in the NWSSS, groundwater discharge occurs within the subject property in the lower reaches of Beaver Creek just above its confluence with Laurel Creek, as well as into Laurel Creek within the Erbsville Kartway property (Ecoplans et al. 2013). The NWSSS indicated variable hydraulic gradients along both Beaver Creek and Laurel Creek and did not consistently indicate areas of groundwater recharge or discharge. This observation was substantiated during the 2012 groundwater and surface water monitoring year, which was a below average precipitation year. In 2012, groundwater levels were lower than those previously measured and accompanied by a lack of groundwater discharge within Laurel and Beaver Creeks during that time of drought (Stantec 2016).

MTE (2017) determined that the regional groundwater flow direction is inferred to be from the northwest to southeast, and is influenced primarily by Laurel Creek. Depth to water table is approximately 2m bgs to 7m bgs from west to east, but is close to the ground surface (1m bgs) along the Beaver Creek corridor from north to south. During

on-site investigations, depth to groundwater was identified at depths ranging from 0.3m to 7.4m bgs in the boreholes and at the installed standpipes. The greatest depth to groundwater occurs near the topographic high in the northeast, whereas the shallowest depth occurs adjacent to Beaver Creek and the wetlands in the central portion of the subject property. Along the Beaver Creek corridor and within the adjacent wetlands, groundwater seepage was noted in the NWSSS and confirmed by MTE field staff, which contributes to baseflow discharge into Beaver Creek. However, the overall conclusions presented in the NWSSS suggest that groundwater recharge or discharge along Beaver Creek was at best minimal or negligible (Ecoplans et al. 2013). MTE (2017) concluded that during certain times of the year, groundwater supports the wetlands in the central portion of the subject property. Further details are provided in the Hydrogeological Study report (MTE 2017).

3.3 Aquatic Habitat – Beaver and Laurel Creeks

Both Beaver and Laurel Creeks are well described in the North Waterloo Scoped Subwatershed Study (Ecoplans et al. 2013). Beaver Creek crosses Conservation Drive along the north-west side of the subject property (BTH-003) flowing in a gentle meandering course across the subject property exiting on the south-east side of the subject property at BTH-001.

Immediately downstream of Conservation Drive, Beaver Creek flows through a narrow riparian corridor within open agricultural fields (BTH-003). Bankfull widths are in the range of 4.0m to 7.0m, and bank height is between 1.0m and 2.0m. The banks have mostly moderate slopes with some evidence of erosion. Wetted widths were noted to be in the range of 2.8m to 4.5m, and flows had a low velocity over a low gradient. Water depths ranged from 0.1m to 0.4m. Morphology is described as predominantly flats with some small pools and short riffles. Substrates comprise mostly sand and silt, with some coarser substrates in the riffles. Wood debris and some cobble and boulders provide cover and filamentous algae was noted (Ecoplans et al. 2013). During benthic invertebrate sampling the substrates within this reach of Beaver Creek were found to be predominantly gravel, with patches of cobble and sand with traces of silt throughout.

The downstream portion of Beaver Creek (BTH-001) exits the subject property on the southeast side immediately upstream of the confluence of Beaver Creek and Laurel

Creek. The creek flows through a mature cedar-hardwood mixed swamp. Bankfull widths within this reach range from 5.0m to 9.0m, and bank height is between 0.3m and 1.5m. The banks were observed to mostly have high slopes with significant erosion observed and failing banks near the south-east edge of the subject property. Remnants of failed bank stabilization and bank hardening efforts were observed along the outside edges of meander bends. Channel flows were observed to be high velocity flows with water depths ranging from 0.1 to 0.3m throughout this reach. Channel morphology throughout this reach is dominated by riffles with isolated pools and long flat sections. Substrates within this reach are comprised predominantly of sand and silt with deposits of cobble throughout. Instream fish habitat is provided by deposits of woody debris along banks and patches of cobble and boulder debris (Ecoplans et al. 2013). During benthic invertebrate sampling the substrates within this reach of Beaver Creek were identified as predominantly gravel, with patches of cobble and sand throughout.

A collective total of 14 species of fish were captured in this reach of Beaver Creek during sampling in 2006 and 2009 for the North Waterloo Scoped Subwatershed Study (Ecoplans et al. 2013). These species are listed in Appendix V. The species captured were all common and secure in Ontario, and 12 of the 14 species can be considered habitat generalists. Rainbow darter (*Etheostoma caeruleum*) is considered a habitat specialist, preferring fast-flowing gravel and cobble riffles of creeks and small rivers with a preferred water temperature of 19.8°C (Eakins - OFFLHD as cited in Ecoplans et al. 2013). Longnose Dace (*Rhinichthys cataractae*) also prefers fast-flowing riffles. While some of the fish captured prefer cool water temperatures, none are indicative of coldwater habitat.

Laurel Creek flows through the subject property along the south-west edge immediately adjacent to the Erbsville Kartway (BTH-002). This reach flows through a dense cedar-hardwood mixed swamp habitat, and during the NWSSS was characterized by significant flooding resulting from beaver dam construction downstream (Ecoplans et al. 2013). This beaver dam remained in place through the 2014 monitoring period but by the time of the 2015 benthic sampling, the beaver dam was no longer in place, and flooding had subsided. Wetted widths and maximum depths in the vicinity of BTH-002 were observed to be 2.85m and 0.18m on average prior to beaver dam construction,

with a substrate of Sand and Cobble. After the beaver dam failed, the average wetted width was observed to have increased to 3.9m while the maximum water depth increased to 0.33m and substrates were observed to be Sand and Silt. Bankfull widths within this reach of Laurel Creek range from 0.7 to 12.0m, with bank heights ranging between 0.8 to 1.5m. The banks were observed to have a low to moderate slope with some traces of erosion. The channel morphology is predominantly a mix of flat and pool habitats with isolated portion of short riffles. Significant instream fish habitat is provided by dense woody debris and undercut banks throughout the cedar-hardwood mixed swamp (Ecoplans et al. 2013).

A collective total of 10 species of fish were captured in this reach of Laurel Creek during sampling in 2006 and 2009 for the North Waterloo Scoped Subwatershed Study (Ecoplans et al. 2013). These species are listed in Appendix V. The species captured were all common and secure in Ontario, and 8 of the 10 species can be considered habitat generalists. Rainbow darter (*Etheostoma caeruleum*) is considered a habitat specialist, preferring fast-flowing gravel and cobble riffles of creeks and small rivers with a preferred water temperature of 19.8°C (Eakins - OFFLHD as cited in Ecoplans et al. 2013). Longnose Dace (*Rhinichthys cataractae*) also prefers fast-flowing riffles. While some of the fish captured prefer cool water temperatures, none are indicative of coldwater habitat.

Brown Trout spawning was previously documented from 1984 to 1994 by the MNRF and GRCA in the lower reaches of Laurel Creek and in Beaver Creek near the confluence immediately southeast of the subject property. Since that observation, there have only been observations of potential adult trout and 'scrapes' that may or may not be redds. The NWSSS (Ecoplans et al. 2013) indicates that there appears to be suitable habitat for Brown Trout (*Salmo trutta*) and Brook Trout (*Salvelinus fontinalis*) in Beaver Creek. The lower reaches of Laurel Creek were also identified as potentially suitable based on instream temperatures, substrates of gravel that are suitable for spawning, and observations of local groundwater discharge. No evidence of trout activity has been observed, and the soft substrates within the on-site portion of Laurel Creek are not suitable for Brook Trout spawning.

3.3.1 Benthic Invertebrate Community Composition Summary

The taxomonic richness of the benthic community remained relatively consistent between years and seasons within all three monitoring stations, ranging from 16-27 taxa within Laurel Creek (BTH-002), 22-27 taxa within the upper reaches of Beaver Creek (BTH-003) and 27-38 taxa immediately upstream of the confluence of Laurel and Beaver Creeks (BTH-001). The richness of sensitive taxa (EPT taxa richness) showed considerably more variation between each monitoring station and between seasons within each monitoring station. The proportion of sensitive Taxa within Laurel Creek was observed to be substantially lower (1-10) than the richness observed within Beaver Creek (4-11 and 6-14). This result corresponds generally to the trends observed in the richness of sensitive taxa in the NWSSS. The average proportion of sensitive taxa within Laurel Creek was observed to be 14.07% comprising a relatively small proportion of the overall community, the proportion of sensitive taxa within Beaver Creek ranged considerably from 40.27% at BTH-001 and 10.96% at BTH-003 across all years of monitoring.

The tolerant taxa were observed in much higher proportions in both Beaver and Laurel Creeks, with the Family Chironomidae observed to make up a large proportion of the benthic community ranging in composition from 36.71% and 76.3% within Laurel Creek and between 10.6% and 82.91% within Beaver Creek. This corresponds with the high proportions observed in the findings of the NWSSS (Ecoplans et al. 2013).

Various taxa belonging to the highly tolerant Order Diptera (True Flies) were dominant across all years of monitoring within both Laurel and Beaver Creeks, with few exceptions. Occasional fluctuations in dominant taxa were observed throughout the years and also included dominance by some sensitive and highly sensitive taxa such as from the Order Trichoptera and Ephemeroptera.

The Shannon Wiener Diversity Index falls within the typical range of values, 1.5-3.5 across all monitoring stations. The average index value within Laurel Creek was 2.77 while the average index values within Beaver Creek were 2.84 (BTH-001) and 2.81 (BTH-003) this result is generally consistent with the results of the North Waterloo

Scoped Subwatershed Study and indicates a moderately high diversity of benthic taxa with an abundance balanced between multiple taxa (Ecoplans et al. 2013).

The Family Biotic Index (FBI) results were on average *good* within Laurel Creek and from *fair* to *good* at Beaver Creek. This shows a slight improvement in FBI water quality when compared to the FBI range observed during the NWSSS (Ecoplans et al. 2013). This slight improvement is similarly seen in the results of the Biotic Index (BI) which shows an average quality of *Fair* across all monitoring stations in both Laurel and Beaver Creeks.

3.4 Vegetation

3.4.1 Vegetation Communities

Existing ELC mapping was field verified by NRSI and refined during the 2014-2016 pre-construction monitoring program. ELC in the study area is largely the same as reported in the NWSSS. A summary of ELC communities identified within the subject property is provided in Table 3 and shown on Map 3.

Table 3. Vegetation Communities Identified within the Study Area (adapted from Ecoplans et al. 2013)

ELC Ecosite Type	ELC Description	Environmental Characteristics
Wetland		
SWM4-1	White Cedar – Hardwood Organic Mixed Swamp	This mixed swamp community is associated with low-lying areas of Beaver and Laurel Creek, and occurs on both the Northgate and Kartway properties. The canopy is comprised of Eastern White Cedar (*Thuja occidentalis*), Black Ash (*Fraxinus nigra*), Trembling Aspen (*Populus tremuloides*), Yellow Birch (*Betula alleghaniensis*), and Eastern Hemlock (*Tsuga canadensis*). The sub-canopy and understorey layers consist of Eastern White Cedar, European Buckthorn (*Rhamnus cathartica*) and Glossy Buckthorn (*Frangula alnus*), Black Ash, and Common Elderberry (*Sambucus canadensis*). Groundcover flora is characterized by Spotted Jewelweed (*Impatiens capensis*), Sensitive Fern (*Onoclea sensibilis*), sedges (*Carex* spp.), Wild Black Currant (*Ribes americanum*), Dwarf Raspberry (*Rubus pubescens*), Bulblet Fern (*Cystopteris bulbifera*), Bitter Nightshade (*Solanum dulcamara*), Rough-leaved Goldenrod (*Solidago patula*), Woodbine (*Parthenocissus vitacea*), and Fowl Meadow Grass (*Glyceria striata*). Several regionally significant plant species were observed within this community: Rough Sedge (*Carex scabrata*), Golden Alexanders (*Zizia aurea*), Virginia Stickseed (*Hackelia virginiana*), and Soft-leaved Sedge (*Carex disperma*). As well, a single Butternut (*Juglans cinerea*), a SAR (Endangered), was observed within the FOD8-1 habitat inclusion (see below). A habitat inclusion was identified within this vegetation community on the Kartway property, Fresh-Moist Poplar Deciduous Forest (FOD8-1), and is dominated by Trembling Aspen, Manitoba Maple (*Acer negundo*), Green Ash (*Fraxinus pensylvanica*), and European Buckthorn.
SWM6-1	Birch – Conifer Organic Mixed Swamp	This mixed swamp community is dominated by Yellow Birch, Black Ash, Eastern Hemlock, White Elm (*Ulmus americana*), Red Maple (*Acer rubrum*), and Eastern White Cedar in the canopy. The sub-canopy and understorey are comprised of Eastern Hemlock, Eastern White Cedar, and Yellow Birch. Groundcover flora is characterized by sedges, Dwarf Raspberry, Northern Lady Fern (*Athyrium filix-femina var. angustum*), False Mitrewort (*Tiarella cordifolia*), Bulblet Fern, Bitter Nightshade, Spotted Jewelweed, Sensitive Fern, Coltsfoot (*Tussilago farfara*), and Wood Nettle (*Laportea canadensis*). Two regionally significant plant species were observed within this community, Northern Beech Fern (*Phegopteris connectilis*), and Rough Sedge. A habitat inclusion was identified within this vegetation community, Mineral Meadow Marsh (MAM2), and is dominated by Phragmites (*Phragmites australis ssp. australis*).

ELC Ecosite Type	ELC Description	Environmental Characteristics
SWD7-1	White Birch – Poplar Organic Deciduous Swamp	This deciduous swamp community is associated with Beaver Creek, and is dominated by Balsam Poplar (*Populus balsamifera*), Green Ash, White Elm, and Trembling Aspen in the canopy. The sub-canopy and understorey are comprised of Balsam Poplar, European Buckthorn and Glossy Buckthorn, and Choke Cherry (*Prunus virginiana*). Groundcover flora is characterized by Lake-bank Sedge (*Carex lacustris*), Canada Goldenrod (*Solidago canadensis*), Wild Red Raspberry (*Rubus idaeus ssp. melanolasius*), Field Horsetail (*Equisetum arvense*), Ciliate Willow-herb (*Epilobium ciliatum*), Bitter Nightshade, Woodbine, Canada Anemone (*Anemone canadensis*), Spotted Jewelweed, and American Stinging Nettle (*Urtica dioica ssp. gracilis*). A habitat inclusion was identified within this vegetation community, Mineral Cultural Woodland (CUW1), and is dominated by White Poplar (*Populus alba*).
SWT2	Mineral Thicket Swamp	This thicket swamp community is associated with Beaver Creek and is dominated by willows (*Salix* spp.), Red-osier Dogwood (*Cornus stolonifera*), Silky Dogwood (*Cornus amomum ssp. obliqua*), Riverbank Grape (*Vitis riparia*), Narrow-leaved Meadowsweet (*Spiraea alba*), and Balsam Poplar. Groundcover flora is characterized by Spotted Jewelweed, Reed Canary Grass (*Phalaris arundinacea*), Canada Anemone, Hog Peanut (*Amphicarpaea bracteata*), Wild Red Raspberry, Canada Goldenrod, and Spotted Joe-pye-weed (*Eupatorium maculatum*).
Forest		
FOM6-1	Fresh – Moist Sugar Maple – Hemlock Mixed Forest	This mixed forest community occurs in 3 locations within the Northgate property. The canopy is dominated by Sugar Maple (*Acer saccharum ssp. saccharum*), Eastern Hemlock, White Ash (*Fraxinus americana*), Black Cherry (*Prunus serotina*), American Beech (*Fagus grandifolia*), American Basswood (*Tilia americana*), and Eastern White Pine (*Pinus strobus*). The sub-canopy and understorey layers consist of Sugar Maple, Bitternut Hickory (*Carya cordiformis*), White Ash, Eastern Hemlock, and European Buckthorn. Groundcover flora is characterized by sedges, Evergreen Wood Fern (*Dryopteris intermedia*), Herb Robert (*Geranium robertianum*), Coltsfoot, Allegheny Blackberry (*Rubus allegheniensis*), Enchanter's Nightshade (*Circaea lutetiana ssp. canadensis*), Woodland Strawberry (*Fragaria vesca ssp. americana*), Spinulose Wood Fern (*Dryopteris carthusiana*), Lady Fern, Blue Cohosh (*Caulophyllum giganteum*), and Sugar Maple. A single regionally significant plant species was observed within this community, Virginia Stickseed. A habitat inclusion was identified within this vegetation community, White Cedar – Hardwood Organic Mixed Swamp (SWM4-1), and is dominated by Eastern White Cedar.
FOC4-1	Fresh – Moist	This coniferous forest community is dominated largely by Eastern White Cedar, with lesser quantity of

ELC Ecosite Type	ELC Description	Environmental Characteristics
	White Cedar Coniferous Forest	Green Ash, Trembling Aspen, Black Cherry, Sugar Maple, and American Basswood in the canopy. The sub-canopy and understorey are comprised of European Buckthorn and hawthorns (*Crataegus* spp.). Groundcover flora is characterized by Bitter Nightshade, European Buckthorn, sedges, Herb Robert, Common Speedwell (*Veronica officinalis*), Tall Hairy Agrimony (*Agrimonia gryposepala*), Spinulose Wood Fern, and Enchanter's Nightshade.
FOC3-1	Fresh – Moist Hemlock Coniferous Forest	This coniferous forest community occurs on the Northgate property and extends off-property to the southwest. It is dominated by Eastern Hemlock, Eastern White Pine, Sugar Maple, Black Cherry, and American Basswood in the canopy. The sub-canopy and understorey layers consist of American Beech, Sugar Maple, and European Buckthorn. Groundcover flora is characterized by sedges, Evergreen Wood Fern, Coltsfoot, Zig-zag Goldenrod (*Solidago flexicaulis*), Herb Robert, Woodland Strawberry, and Wild Ginger (*Asarum canadense*). A single regionally significant plant species was observed within this community, Virginia Stickseed.
FOD3-1	Dry – Fresh Poplar Deciduous Forest	This deciduous forest community is dominated by Balsam Poplar, White Ash, Sugar Maple, and Black Cherry in the canopy. The sub-canopy and understorey layers consist of European Buckthorn and Choke Cherry. Groundcover flora is characterized by Wild Ginger, Herb Robert, Bitter Nightshade, Wild Red Raspberry, Tall Hairy Agrimony, Woodland Strawberry, and sedges. A single regionally significant plant species was observed within this community, Virginia Stickseed.
FOD7-2	Fresh – Moist Green Ash – Harwood Lowland Deciduous Forest	This coniferous forest community occurs on the Northgate property and extends off-property to the south, and is dominated by Green Ash, Trembling Aspen, Bitternut Hickory, and American Basswood in the canopy. The sub-canopy and understorey layers consist of Black Maple (*Acer saccharum ssp. nigrum*), European Buckthorn, Sugar Maple, Green Ash, Ironwood (*Ostrya virginiana*), and Choke Cherry. Groundcover flora is characterized by Zig-zag Goldenrod, sedges, Spotted Jewelweed, Woodbine, Riverbank Grape, European Buckthorn, Blue Cohosh, Herb Robert, False Solomon's Seal (*Maianthemum racemosum*), Ostrich Fern (*Matteuccia struthiopteris var. pensylvanica*), Woodland Strawberry, and Panicled Aster (*Symphyotrichum lanceolatum*).
Plantation		
CUP3	Coniferous Plantation	This plantation community is dominated by Red Pine (*Pinus resinosa*), Norway Spruce (*Picea abies*), White Spruce (*Picea glauca*), and Eastern White Cedar. The sub-canopy and understorey layers consist of White Ash and European Buckthorn. Groundcover flora is characterized by European Buckthorn, Wild Red Raspberry, Bitter Nightshade, Herb Robert, Enchanter's Nightshade, Canada Goldenrod, Common Burdock (*Arctium minus*), Poison-ivy (*Toxicodendron rydbergii*), Black Raspberry (*Rubus occidentalis*), Upright Yellow Wood-sorrel (*Oxalis stricta*), sedges, and Prickly Cucumber (*Echinocystis lobata*).

ELC Ecosite Type	ELC Description	Environmental Characteristics
		A single regionally significant species was observed within this community, White Spruce.
Hedgerow		
HR4	Deciduous Hedgerow	This deciduous hedgerow is dominated by White Ash, American Basswood, European Buckthorn, Manitoba Maple, and Sugar Maple in the canopy. The sub-canopy and understorey layers consist of Wild Red Raspberry and European Buckthorn. Groundcover flora is characterized by Garlic Mustard (*Alliaria petiolata*), Coltsfoot, Herb Robert, Field Horsetail, Canada Thistle (*Cirsium arvense*), New England Aster (*Symphyotrichum novae-angliae*), Daisy Fleabane (*Erigeron annuus*), and Common Helleborine (*Epipactis helleborine*).

3.4.2 Vascular Flora

A total of 160 vascular plant species were documented within the vegetation monitoring plots (Appendix II) during the pre-construction monitoring. Approximately 13% of the vascular plant species observed are considered non-native species.

NRSI biologists documented and mapped all regionally, provincially, and federally significant plant species observed during the pre-construction biological monitoring program in 2014-2016. Significant species observed within the subject property are shown on Map 3. Several regionally significant plants (Richardson and Martin 1999) were observed including: Black Walnut (*Juglans nigra*), Northern Beech Fern, Virginia Stickseed, Rough Sedge, Soft-leaved Sedge, and Golden Alexanders. Of these, Rough Sedge and Soft-leaved Sedge were not previously identified in the NWSSS (Ecoplans et al. 2013). Black Walnut was not mapped due to its prolific presence throughout suitable habitats within the subject lands. White Spruce individuals are planted specimens given the coniferous plantation context, as reported in the NWSSS (Ecoplans et al. 2013) and confirmed by NRSI biologists. In the context of this study, Black Walnut and White Spruce are not considered regionally significant due to the anthropogenic origin of their presence.

A single provincially and federally Endangered species, Butternut, was observed within the Erbsville Kartway property (Map 3). This species prefers rich-moist woodlands, stream banks and swamps, as well as upland beech-maple, oak-hickory, and mixed hardwood stands (Reznicek et al. 2011). Butternut was not previously identified in the NWSSS (Ecoplans et al. 2013). Testing for hybridity and a formal Butternut Health Assessment will be completed according to MNRF protocol. The location of the Butternut tree is within the limits of the Natural Heritage System as presented in the NWSSS (Ecoplans et al. 2013) and will be adequately protected and buffered from development.

3.4.3 Vegetation Surveys for Enhancement / Management Needs

Results of the vegetation surveys for enhancement and management needs are presented in the Pre-Construction Biological Monitoring Program reports (NRSI 2016, NRSI 2017). Notable disturbances within the subject property include tree cutting,

refuse dumping, and invasive species establishment. Refer to the above-referenced reports for further details, mapping and discussion. The following Table 4 provides a high-level summary of findings. Refer to Section 5.0 of this report for recommendations to address the identified disturbances.

Table 4. Disturbance Areas and Management/Enhancement Recommendations

Wildlife Survey Unit(s)	Disturbance Identified	Description of Disturbance	Management/Enhancement Recommendations
Erbsville Kartway Property			
11	Invasive species (European Buckthorn)	Dense thicket of European Buckthorn at far northeast corner of natural feature. This thicket exists predominantly off-property to the north.	This concentration area will be a challenge to control in the long-term unless a coordinated effort among landowners is initiated. Removal of European Buckthorn through cutting and herbicide application if possible. Edge management and buffer recommendations are included in this EIS.
11	Refuse dumping	Storage of old tires along edge, and old metal storage drum were found in watercourse.	Removal of refuse and proper disposal.
11	Land use encroachment	Steel drainage pipe (approximately 4" diameter) directing flows from low-lying area of the race track into adjacent creek. A basin has been dug within the race track to collect surface water and is periodically drained by sump pump.	Drainage will be rectified as development proceeds.
11	Tree cutting	Cutting of trees along property line.	Avoid tree cutting along the edge unless necessary for safety concerns. Edge management, buffer, and tree protection recommendations are included in this EIS.
Northgate Property			
10, 12, 13, 15	Invasive species (European Buckthorn)	Although European Buckthorn is present throughout the subject lands, dense Concentration Areas have been identified.	Removal of European Buckthorn through cutting and herbicide application if possible. Edge management and buffer recommendations are included in this EIS.
12, 14, 15	Invasive species (Phragmites)	Stands of Phragmites exist in several locations in edge habitats.	Removal of Phragmites through herbicide application if possible. A coordinated effort should be initiated among local landowners for successful long-term control. It is anticipated that Phragmites invasion along

Wildlife Survey Unit(s)	Disturbance Identified	Description of Disturbance	Management/Enhancement Recommendations
			Conservation Dr. will be removed by the proposed road improvements. A management plan for Phragmites will be developed for the property.
12, 14	Invasive species (White Poplar)	An established stand of White Poplar exists adjacent to Conservation Drive.	It is anticipated that these areas of trees will be removed by the improvements to Conservation Drive. Removal of young and mid-aged White Poplar by cutting. Girdling of mature trees is recommended. Replacement of White Poplar with suitable native species such as Trembling Aspen or Balsam Poplar.
14, 15	Soil erosion	Soil erosion along riparian area of Beaver Creek alignment (Wildlife Survey Unit 14). Mineral soils in these areas of the property are being deposited into the adjacent vegetated area and subsequently into Beaver Creek. Soil erosion along southwest edge of Wildlife Survey Unit 15. Surfacewater flows in this area are eroding mineral soils and depositing into the adjacent treed area. Native edge vegetation in this area is struggling to remain established, with early invasion of Phragmites and Coltsfoot (*Tussilago farfara*).	Provide a buffer and plantings with native species in area experiencing erosion to stabilize soils.
13, 15	Tree cutting	Tree cutting and pruning along the edges of the agricultural fields was carried out in 2014 under the approval of the Region of Waterloo Forester and Principal Planner (A. Hovingh, pers. comm. 2014). Additional tree cutting along eastern edge of Wildlife Survey Unit 13 observed in 2016, leading to aggressive buckthorn growth.	Avoid tree cutting along the edge unless necessary for safety concerns. Edge management, buffer, and tree protection recommendations are included in this EIS.
11, 13, 15	Refuse dumping	Plastic and metal debris, old tires, old metal storage drums, and old overgrown passenger vehicle were found.	Removal of refuse and proper disposal.

3.4.4 Vegetation Monitoring Plots

Habitats within the subject property are comprised mainly of agricultural fields, with wetlands and woodlands associated with Beaver Creek and Laurel Creek. A total of 5 vegetation monitoring plots were established within the subject property and surveyed in summer 2014-2016. The purpose of the pre-construction biological monitoring was to establish baseline conditions, for comparison with subsequent monitoring events (i.e. during and post-construction monitoring). The results were found to be generally consistent with the detailed vegetation community characterization reported in the NWSSS (Ecoplans et al. 2013). Refer to the Pre-Construction Biological Monitoring Program reports (NRSI 2016, NRSI 2017) for further details and discussion.

Within Vegetation Monitoring Plot #3, no significant plant species were observed. This monitoring plot was noted as having a relatively open canopy, supporting a variety of open habitat and closed canopy species, with noticeable iron staining in the groundwater seepage areas.

Within Vegetation Monitoring Plot #4, a single regionally significant plant species was observed, Rough Sedge. No other significant plant species were observed within the monitoring plot. This monitoring plot was noted as a mature organic swamp with a relatively open understorey layer, and a water table just beneath the ground surface.

Within Vegetation Monitoring Plot #5, no significant plant species were observed. This monitoring plot was noted as a mature forest dominated by Eastern Hemlock with a rolling micro-topography, and limited groundcover vegetation throughout most of the plot.

Within Vegetation Monitoring Plot #6, no significant plant species were observed. This monitoring plot was noted as a mature forest with notable regeneration of White Ash and Sugar Maple, and limited groundcover vegetation throughout most of the plot.

Within Vegetation Monitoring Plot #7, no significant plant species were observed. This monitoring plot was noted as a mid-aged mixed cedar swamp, with limited groundcover vegetation and gentle hummocky topography.

In order to evaluate the quality of the vegetation communities on-site, the Floristic Quality Index (FQI) was calculated for each vegetation plot and is shown in Table 5 below (NRSI results in bold font). These results have been aggregated for vegetation monitoring plot surveys completed by NRSI from 2014-2016. The same analysis was completed in the NWSSS (Ecoplans et al. 2013) by entire ELC community and is shown for comparison.

Refer to the Pre-Construction Biological Monitoring Program reports (NRSI 2016, NRSI 2017) for further details and discussion of the vegetation monitoring plots results.

Table 5. Floristic Quality Index by Vegetation Plot and Community

	VEG-003 (SWM4-1)	SWM4-1 (NWSSS)	**VEG-004 (SWM6-1)**	SWM6-1 (NWSSS)	**VEG-005 (FOC3-1)**	FOC3-1 (NWSSS)	**VEG-006 (FOM6-1)**	FOM6-1 (NWSSS)	**VEG-007 (SWM4-1)**	SWM4-1 (NWSSS)
Total species	**105**	101	**76**	89	**38**	66	**34**	65	**48**	75
FQI (native species)	**31.92**	38.29	**34.66**	38.64	**24.70**	37.29	**21.17**	30.59	**27.49**	35.34
FQI (incl. non-native)	**28.89**	31.94	**33.27**	36.04	**23.36**	32.50	**18.86**	26.92	**25.40**	31.87
Wetness index	**-0.64**	-0.67	**-0.58**	-0.39	**1.74**	2.71	**1.97**	1.75	**-0.88**	-1.12

3.4.5 Fixed Photo Plot Monitoring

No notable changes in the pre-construction conditions were documented during the fixed photo plot monitoring (2014-2016). Photographic documentation of the fixed photo plot monitoring on the subject property is provided in the Pre-Construction Biological Monitoring Program reports (NRSI 2016, NRSI 2017). Refer to the above-referenced reports for further details and discussion.

3.5 Wildlife

A number of regionally, provincially and federally significant species of wildlife have been documented on the property during the current and past studies. For the purposes of this report, SAR are those listed on the Species at Risk in Ontario List (MNRF 2016a). These include species identified by the Committee on the Status of Species at Risk in Ontario (COSSARO) as provincially Endangered, Threatened, or Special Concern. Species listed by COSSARO as Endangered or Threatened are protected by the *Endangered Species Act* (*ESA)*, 2007, which includes protection to their habitat, and are referred to herein as regulated SAR.

Species considered Special Concern are included in the definition of SCC, which includes the following:

- species designated provincially as Special Concern,
- species that have been assigned a conservation status (S-Rank) of S1 to S3 or SH by the NHIC, and
- species that are designated federally as Threatened or Endangered by the Committee for the Status of Endangered Wildlife in Canada (COSEWIC) but not provincially by the COSSARO. If these species are listed under the *Species at Risk Act* (SARA) under Schedule 1 they are protected by the federal Act but not provincially by the ESA.

3.6 Avifauna

During the monitoring program conducted throughout the subject property in 2014-2016, a total of 61 bird species were documented. Of the 61 species documented, 49 exhibited signs of breeding, such as males singing, females/males carrying food or nest

materials, and the presence of fledged young. Refer to Appendix III for a list of bird species documented during the breeding bird surveys in 2014-2016.

A total of 1 bird regulated SAR, 3 bird SCC, and 15 regionally significant bird species (Martin 1996) were observed within the subject property during the breeding bird and other wildlife surveys conducted during the pre-construction monitoring program and are discussed in further detail below.

Eastern Wood-pewee (*Contopus virens*)

Eastern Wood-pewee, a SCC, is listed as Special Concern both provincially and federally (MNRF 2016a, Government of Canada 2016). Breeding habitat for this species includes open, deciduous, mixed or coniferous forest predominated by oak with little understorey, forest clearings, edges, farm woodlots, and parks (OMNR 2000). Eastern Wood-pewee was documented displaying breeding evidence within 4 Wildlife Survey Units (WSU-11, WSU-13, WSU-14 and WSU-15) during 2014-2016. The highest breeding evidence was recorded as 'T' (permanent territory), suggesting a probable breeding status.

Wood Thrush (*Hylocichla mustelina*)

Wood Thrush, a SCC, is listed as Special Concern provincially, and Threatened federally (MNRF 2016a, Government of Canada 2016). Breeding habitat for this species includes Carolinian and Great Lakes-St. Lawrence forest zones; undisturbed moist mature deciduous or mixed forest with deciduous sapling growth; near pond or swamp; hardwood forest edges (OMNR 2000). A single Wood Thrush individual was heard on May 17, 2016 (i.e. outside of breeding bird survey period), within Wildlife Survey Unit 13. As it was not documented by NRSI on any subsequent visits it is likely that this observation was a migrant and not breeding within the subject lands. Wood Thrush was not documented within the subject lands in the NWSSS, nor by NRSI prior to this observation. Suitable breeding habitat for this species is present within the subject lands.

Common Nighthawk (*Chordeiles minor*)

Common Nighthawk, a SCC, is listed as Special Concern provincially (MNRF 2016a), and Threatened federally (Government of Canada 2016). This species breeding habitat includes open ground, clearings in dense forests, ploughed fields, gravel beaches or barren areas with rocky soils, open woodlands, and flat gravel roofs (OMNR 2000). Common Nighthawk was documented displaying breeding evidence within 2 Wildlife Survey Units (WSU-9, WSU-12) during 2014-2016, with the highest breeding evidence recorded as 'T' (permanent territory), suggesting a probable breeding status. Suitable nesting habitat for this species on-site is limited to forest edges only, with other suitable nesting habitat found off-site within the local area (i.e. Creekside Church to the north of study area). It is expected that any local breeding individuals are nesting on properties with permanent areas of bare soil or flat roofs, such as the Creekside Church or elsewhere within the general vicinity. Further discussion relating to Common Nighthawk is provided in Section 4.4 of this report.

Barn Swallow (*Hirundo rustica*)

Barn Swallow, a regulated SAR, is listed as Threatened provincially, affording individuals and their habitat protection under the *Endangered Species Act*. Barn Swallow has also been listed as Threatened federally by COSEWIC; however, they are not listed under Schedule 1 of the federal *Species at Risk Act* and therefore are not afforded protection under federal legislation.

Barn Swallows can be found in farmlands or rural areas near bodies of water and nest in buildings or other man-made structures (OMNR 2000). Barn Swallow was documented foraging during breeding bird and other wildlife surveys at 2 Wildlife Survey Units (WSU-10, WSU-12), during 2014-2016. Observations were documented incidentally (i.e. no breeding evidence) as no suitable nesting habitat exists within those units. During breeding bird surveys conducted in 2016 and 2017, one pair was documented attending a nest in one of the building associated with the Erbsville Kartway. Foraging habitat for Barn Swallow exists throughout the majority of the study area.

In addition to the species discussed above, a total of 15 regionally significant bird species were observed within the subject property (Appendix III). Of the 15 species

observed, 10 exhibited signs of breeding: Green Heron (*Butorides virescens*), Common Nighthawk, Red-bellied Woodpecker (*Melanerpes carolinus*), Least Flycatcher (*Empidonax minimus*), Brown Creeper (*Certhia americana*), Veery (*Catharus fuscescens*), Brown Thrasher (*Toxostoma rufum*), American Redstart (*Setophaga ruticilla*), Chestnut-sided Warbler (*Setophaga pensylvanica*), and Pine Warbler (*Setophaga pinus*).

Of the significant bird species listed above, several had previously been reported as breeding or potentially breeding on the subject lands during the background studies in support of the NWSSS (Ecoplans et al. 2013), with the following species being newly recorded; Least Flycatcher, American Redstart, and Common Nighthawk.

3.7 Amphibians

No amphibian breeding evidence was documented during the call surveys conducted in 2014. Amphibian call surveys were completed by MMM Group during spring 2014 which predated NRSI's involvement in the project.

In 2015, calling amphibians were identified at each of the 5 monitoring stations. Spring Peeper (*Pseudarcris crucifer*) and Gray Treefrog (*Hyla versicolor*) were the most frequently documented species, occurring at 4 and 5 of the monitoring stations, respectively. The highest breeding evidence recorded was full choruses (Call Level Code 3) of Spring Peeper at ANR-004, ANR-005, ANR-006, and ANR-008. Limited calling amphibians were documented during the June survey.

In 2016, calling amphibians were heard at each of the 5 monitoring stations. Spring Peeper, Wood Frog, and American Toad were the most frequently documented species. The highest breeding evidence recorded was full choruses (Call Level Code 3) of Spring Peeper at ANR-007 and ANR-008. Limited calling amphibians were documented during the June survey.

Appendix IV summarizes the results of the evening amphibian call surveys by maximum calling code for stations within the subject property. Incidental amphibian observations made by NRSI biologists during all other field surveys conducted throughout the study

area during the pre-construction monitoring program in 2014-2016 are listed in Table 6. No federally, provincially, or regionally significant amphibian species were documented during the pre-construction monitoring program. All amphibian species recorded during this study were previously documented in the NWSSS (Ecoplans et al. 2013).

Table 6. Incidental Amphibian Observations (2014 - 2016)

Scientific Name	Common Name	Location(s) Observed
Anaxyrus americanus	American Toad	Wildlife Survey Units 11, 13, 15
Hyla versicolor	Gray Treefrog	Wildlife Survey Units 11, 13, 14, 15
Lithobates clamitans melanota	Northern Green Frog	Wildlife Survey Units 11, 13, 14
Lithobates pipiens	Northern Leopard Frog	Wildlife Survey Units 11,12,13,14,15
Lithobates sylvatica	Wood Frog	Wildlife Survey Units 11, 12, 15
Plethodon cinereus	Eastern Red-backed Salamander	Wildlife Survey Unit 13
Pseudacris crucifer	Spring Peeper	Wildlife Survey Units 11, 13, 14, 15

3.8 Reptiles

Eastern Gartersnake (*Thamnophis sirtalis sirtalis*) and snapping turtle were the only reptile species observed on the subject property during the pre-construction monitoring program and during the NWSSS (Ecoplans et al 2013). Eastern Gartersnake was observed incidentally within the wooded edge habitats during the pre-construction ecological monitoring surveys conducted by NRSI biologists in 2014-2016. Snapping turtle is a species of Special Concern both provincially and federally. Special Concern means a species with characteristics that make it sensitive to human activities or natural events (COSSARO), and a wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats (COSEWIC).

Based on the extensive pre-construction monitoring program survey efforts for turtle nesting, it has been determined that it is highly unlikely that Snapping Turtle or Blanding's Turtle are nesting within the subject property. MNRF correspondence concurs with this finding (D. Marriott, pers. comm. 2017).

Turtle emergence/overwintering surveys were conducted in early spring 2017 to determine if Blanding's Turtle known from the general study area are overwintering within the Erbsville Kartway property in Laurel Creek. In late winter of 2017, Beaver Creek and Laurel Creek were investigated to determine if either has suitable habitat conditions for Blanding's Turtle overwintering. Suitable overwintering habitat for Blanding's Turtle is defined in the General Habitat Description (OMNR 2013b) for the species as permanent bogs, fens, marshes, ponds, channels or other habitats with free (unfrozen) shallow water depths ranging from 7-50cm. Blanding's Turtle may also hibernate within graminoid shallow marsh areas of larger marsh complexes by burying into substrates in areas of pooled water, or in seasonal pools or small excavated areas with standing water (OMNR 2013b). It was found that Beaver Creek and Laurel Creek do have sufficient depth and substrate for Snapping Turtle overwintering, but Beaver Creek was too shallow and without suitable substrates for Blanding's Turtle overwintering. No other habitats within the subject property are suitable for Blanding's Turtle overwintering.

Emergence surveys were carried out in early spring 2017 on March 29, April 9, April 10, April 17, and April 18 according to the MNRF protocol (MNRF 2015d). During these surveys, a single Snapping Turtle individual was observed within the Erbsville Kartway property in Laurel Creek. This sighting is at the appropriate time of year to indicate emergence from an overwintering site, thereby meeting the criteria to confirm that this part of Laurel Creek is turtle overwintering habitat SWH. Refer to Section 4.4.1 and 4.4.3 for further discussion of SWH relating to Snapping Turtle.

3.9 Mammals and Other Wildlife

According to the Mammal Atlas of Ontario (Dobbyn 1994), 40 mammal species are reported from within 10km of the study area. Direct or indirect evidence of 9 mammal species were observed during the field surveys: Virginia Opossum (*Didelphis virginiana*), Eastern Cottontail (*Sylvilagus floridanus*), Meadow Vole (*Microtus pennsylvanicus*), Eastern Gray Squirrel (*Sciurus carolinensis*), Red Squirrel (*Tamiasciurus hudsonicus*), Eastern Chipmunk (*Tamias striatus*), Coyote (*Canis latrans*), Northern Raccoon (*Procyon lotor*), and White-tailed Deer (*Odocoileus virginianus*). Appendix VI provides a complete list of mammal species reported and observed from the study area.

The detailed bat habitat assessment completed by NRSI in 2014 did not identify any habitat features or structures suitable for bat use.

As a result of the targeted American Badger den survey completed by NRSI in 2015, no candidate dens were observed within the subject property.

During the June 5, 2015 field survey, a Virginia Opossum was observed dead alongside Conservation Drive at the Beaver Creek crossing. Virginia Opossum is a regionally significant mammal species (RMOW 1985). Virginia Opossum was not documented elsewhere within the subject lands by NRSI during the pre-construction monitoring program. This species was documented within the Primary Study Area of the NWSSS during the road mortality surveys. This species prefers lowland to upland deciduous wooded areas, preferably near water and farmland (OMNR 2000); therefore, suitable habitat for this exists throughout the subject property.

3.10 Wildlife Road Crossing Mortality Monitoring

Road crossing mortality monitoring conducted by MMM Group in 2014 at Conservation Drive resulted in relatively few documented mortalities, consisting entirely of frogs. Non-identifiable frogs were the most abundant mortality observation (n=11), followed by Northern Leopard Frog (n=6). Non-identifiable frogs are defined as individuals that could not be identified from mortality remains, or where an observation of a frog was made at a distance, but species could not be determined (i.e. existing roadway too far away to identify).

4.0 Functional Analysis

In this section the findings of the ecological, hydrological, hydrogeological studies are compiled to provide an understanding of the quality and sensitivity of the ecosystems present on the property and the interactions between the biological and physical environment. The physical processes contributing to the maintenance of the natural features and their functions are discussed at the subject property scale, with reference to the subwatershed study for landscape level context. This description takes into account the current quality and condition of the natural features based on land management practices and existing impacts such as clearing, grading, tree cutting, trails, dumping, filling and invasive plant and insect species.

4.1 Quality and Sensitivity of Ecosystems

The study area landscape is typical of rural southern Ontario; dominated by agricultural lands with natural features, primarily watercourses and wetlands, retained in blocks where land was unsuitable for farming. On the subject property, natural features include woodlands, and wetlands in the low-lying parts of the site that were not cleared or drained historically for agriculture. This fragmented landscape pattern has remained unchanged for over 80 years, as far back as aerial photographs could be obtained, and likely much longer. The wetlands in the west and central portions of the subject property are primarily forested with mixed swamp vegetation on organic soils. The upland woodlands adjacent to the wetlands are generally mixed upland communities that are comprised of Sugar Maple and Eastern Hemlock (and their common associates), which is representative of the dominant forest type in Waterloo Region pre-European settlement.

ESPA 80 (WSU-11, WSU-13, WSU-15)

The large woodland and wetland complex in the central portion and along the western boundary of the subject property is a significant natural area and has been recognized as such through the designations of ESPA, PSW and Core Environmental Feature and as part of the larger natural heritage system in the NWSSS and the City of Waterloo Official Plan. This large forested block contributes a number of important ecological functions in the local landscape. The NWSSS details the significance of this feature including its role in providing forest cover in the watershed and forest interior habitat for

sensitive bird species. The woodlands on the subject property are approximately 16.3 ha in size and represent the majority of the forest cover in the urban portion of the NWSSS primary study area. The overall forest cover in the North Waterloo subwatershed is 21% which is higher than the forest cover in the Laurel Creek subwatershed (20%) and the Grand River watershed (19%) as a whole (Ecoplans et al 2013). The on-site woodlands therefore are a significant contribution to forest cover locally and at the subwatershed scale.

The presence of forest interior habitat (forested area that is more than 100m from any edge) is one important ecosystem function of woodlands and is often used as a measure of woodland significance in a planning area. Forest interior habitat is important for certain bird and wildlife species that are sensitive to disturbances that are associated with the edges of woodlands. Currently, the central part of the woodland wetland complex of ESPA 80 provides a very small area of forest interior habitat (0.27ha) and, the woodland is not large enough to provide any deep forest interior habitat (more than 200m from any edge). It is the only woodland in the NWSSS primary study area that contains forest interior habitat. The woodlands on-site are contiguous with the woodlands outside of the NWSSS, on GRCA owned lands to the south, which provides a significant local area of forest interior habitat (approx. 3.6ha).

A number of interior/edge bird species were documented within the habitats of ESPA 80 during the pre-construction biological monitoring program, as well as 5 species with area sensitivity or interior habitat requirements (veery, white-breasted nuthatch, pine warbler, brown creeper and hairy woodpecker). These sensitive species were documented sporadically during the years of monitoring, in low numbers (1 or 2), and may or may not have shown evidence of nesting. These species require woodlands 10-30ha in size (OMNR 2000) which is provided by the combined extent of woodland on the subject property as well as the off-site portion on GRCA land to the south.

The wetland and upland forest communities that make up the majority of ESPA 80 on the subject property include White Cedar Organic Mixed Swamp wetland (SWM4-1), Yellow Birch – Conifer Organic Mixed Swamp (SWM6-1), Fresh – Moist Sugar Maple – Hemlock Mixed Forest (FOM6-1) and Fresh – Moist Hemlock Coniferous Forest (FOC3-

1).Collectively these vegetation communities contain a relatively rich and diverse plant community, with a relatively high FQI, ranging from 30.59 to 38.64 for all native species as reported in the NWSSS. Generally an FQI of 20-35 indicates high vegetative quality and above 35 indicates “Natural Area” quality (Swink and Wilhelm 1994). . In addition to their floristic quality, the central forested communities contain some old growth attributes as determined through an analysis of tree and forest stand age in the NWSSS. Several trees over 100 years in age are found in the central woodlands, particularly the white pine, hemlock and sugar maple greater than 40cm in diameter, although these forests are for the most part regenerating from past disturbance and are much younger than can be considered old growth. The woodlands on the western side of the subject property are also of a younger age and are not expected to be considered old growth.

The southern portion of the central forest extending off-site to the south is relatively free of signs of recent disturbance. It consistently contains large tree specimens and had the greatest number of old growth trees, including the large trees along the edges of the linear cultivated strip accessing the internal field. This portion of the woodland is contiguous with a large tract of upland forest to the south of the Northgate property and provides forest interior habitat.

The smaller vegetation communities and inclusions, primarily along the edges of the ESPA were of lower quality and diversity such as Dry – Fresh Poplar Deciduous Forest (FOD3-1), Fresh – Moist Green Ash – Hardwood Lowland Deciduous Forest (FOD7-2), Coniferous Plantation (CUP3), White Cedar Coniferous Forest (FOC4-1), and Mineral Thicket Swamp (SWT2). These communities contain a low diversity of plant species, with low to moderate FQI values (ranging from 10.82 to 24.32 for all native species as reported in the NWSSS). It is likely that these communities have arisen following a disturbance and are a result of cultural influences which is reflected in their younger age and reduced quality and complexity.

Existing impacts within the interior of the central woodland/wetland were generally absent, although disturbances were found along the outer edges such as tree cutting, invasive species establishment and some brush pile and refuse dumping. Particularly, European Buckthorn concentration areas were identified as problematic in the pre-

construction monitoring program (NRSI 2016, NRSI 2017) along the east and west edges of the woodland. Recent tree cutting along the edges has temporarily grubbed some of the European Buckthorn, however the stumps were not treated with herbicide which will encourage aggressive re-growth (Anderson 2012). Agricultural tilling occurs up to the natural feature edge. Disturbance within the wooded wetland on the Erbsville Kartway property is low and is limited to invasive species establishment, minor historic refuse dumping, and minor land-use encroachment from the go kart facility.

The woodland/wetlands of the ESPA function as habitat for a number of regionally and provincially significant plant and wildlife species, as well as a variety of other common local plants and wildlife.

The central wetland communities within the ESPA are directly connected to Beaver Creek and function as an interface with the shallow groundwater table, as observed through evidence of groundwater discharge. This groundwater is important in supporting the wetlands and providing cool, clear baseflow to the creek, although the NWSSS and current groundwater monitoring indicates that this is minimal or negligible (MTE 2017). It would appear that there is some groundwater supporting the wetland and the creek at certain times of the year, although it is minimal in the overall water balance. The hummocky terrain functions to slow down and store surface and groundwater while the and overhead canopy shades the creek. Similarly, on the west side of the subject property, the mixed swamp wetland is directly adjacent to and connected to Laurel Creek as it flows south through the edge of the property. The deep organic soils here are saturated and very poorly drained. In contrast to Beaver Creek, groundwater seepage was consistently observed in the wetland and Laurel Creek including a notable upwelling along the east side of the creek. Together the wetlands and the upland forest communities provide a wide dense vegetated buffer to enhance the aquatic habitat. The lower reaches of Laurel Creek may be potentially suitable for trout species based on instream temperatures, substrates of gravel that are suitable for spawning, and observations of local groundwater discharge. However, no evidence of trout activity has been observed and the substrates within Laurel Creek on-site are too soft to be suitable for their spawning.

Beaver Creek Riparian Corridor (WSU-14)

The White Birch – Poplar Organic Deciduous Swamp (SWD7-1) along the northern portion of Beaver Creek contains a low diversity of plant species, with a corresponding moderate FQI (20.07 for all native species as reported in the NWSSS). A Mineral Cultural Woodland (CUW1) habitat inclusion occurs adjacent and to the north of SWD7-1. Disturbance within these communities includes invasive species establishment and soil erosion and sediment loading into Beaver Creek, which is associated with agricultural tilling up to the natural feature edge and close to Beaver Creek within the CUW1 community. As a relatively young community, poplars (*Populus* spp.) and willows (*Salix* spp.) are the dominant woody species. These communities form a vegetated riparian corridor along Beaver Creek, of varying width. Beaver Creek and its wooded corridor north of ESPA 80 were evaluated in the NWSSS to determine if it met the criteria to be included in the ESPA. The analysis showed that the creek and associated habitats do not meet the criteria for designation as an ESPA. The corridor is identified in the NWSSS as the primary existing linkage between habitats north and south of Conservation Drive, but this is obstructed by the major barrier present at Conservation Drive.

4.2 Wetland Water Balance

Groundwater and surface water flow patterns are influenced by the local topography and soil conditions. The subject property surface drainage is divided into catchments based on topography by MTE in their Preliminary Stormwater Management Report (2017). The majority of the site flows towards the central wetland and Beaver Creek, with the eastern portion flowing toward Beaver Creek Road and the Laurel Creek Reservoir, while the western portion flows west into Laurel Creek. Groundwater flow direction was interpolated to flow from northwest to southeast beneath the site toward Beaver Creek and ultimately toward the Laurel Creek Reservoir.

The surface soils on-site are primarily sands and some clay/silt till, which have a high capability for infiltration of rainfall. The groundwater monitoring completed by MTE (2017) showed that recharge and discharge of groundwater varied across the site depending on topography. The high regions of the site showed downward hydraulic

gradients indicating recharge, while the low topographic areas showed upward hydraulic gradients, or discharge of groundwater, coinciding with the wetlands and Beaver Creek.

The NWSSS prepared a water balance for each of the catchments on the subject property under the existing condition, and are shown in Table 7 below.

Table 7. Existing Water Balance for on-Site Catchments (NWSSS)

Catchment	Area (ha)	Precipitation (mm)	ET (mm)	Runoff (mm)	Infiltration (mm)
3914	12.7	844.8	553.0	79.9	211.9
3915	4.2	844.8	551.9	69.9	222.9
3917	2.7	844.8	551.0	116.7	177

Under the current agricultural land use, the majority of precipitation which falls on the site during the growing season is taken up by evapotranspiration (64% on average), with a smaller component infiltrating into the soil (23% on average), and a relatively low amount of surface runoff (13% on average). The wetlands on-site are supported through a combination of groundwater discharge and surface water runoff as well as direct rainfall. Areas of groundwater seepage were observed within the swamp wetland communities during the pre-construction monitoring program surveys as was reported in the findings of the NWSSS (Ecoplans et al 2013). While seepage was consistently noted throughout these wetlands, the NWSSS (Ecoplans et al 2013) found that groundwater expression into Laurel Creek and Beaver Creek was occasional and minor, and that groundwater does not represent a significant portion of the flow volume within these watercourses. This was further substantiated by the pre-construction groundwater monitoring by Stantec (2016) and the site specific monitoring completed by MTE (2017). It appears that the primary hydrologic function of these wetlands is the storage and evaporation of water and a moderate expression of groundwater into the creeks.

In the future development scenario, evapotranspiration will decrease significantly due to the change in ground cover, resulting in more water being available to the system in the form of runoff and/or infiltration. The NWSSS predicted future infiltration estimates that are above existing conditions (increase of 17%-87%), recognizing that the agricultural land use results in much of the water being lost to evapotranspiration. Increasing

infiltration post-development will have benefits for the wetland and watercourse in improving groundwater discharge to these features, as well as to the deeper groundwater and Regional water supply. In considering the water balance to the wetland and watercourse, the NWSSS established that both infiltration and surface water inputs are to be maintained or enhanced in the post-development condition.

4.3 Species At Risk

Through the field surveys and analysis in the NWSSS (Ecoplans et al 2013) and the pre-construction monitoring program supporting this study, the following regulated SAR were found within the subject property: Butternut and Barn Swallow. The subject property also contains protected general habitat for Blanding's Turtle. Further discussion for each of these species is provided below.

Butternut

Butternut was not previously identified in the NWSSS (Ecoplans et al. 2013), although one was found on-site. This tree is within the limits of the Natural Heritage System as presented in the NWSSS (Ecoplans et al. 2013) and as such will be adequately protected and buffered from development. A genetic hybridity test will be completed in order to determine its eligibility for protection under the ESA. Hybrid Butternut trees are not protected under the ESA. A formal Butternut Health Assessment will be completed according to MNRF protocol once the hybridity test results are available, if the tree is found to be a pure butternut.

Barn Swallow

Barn swallow was confirmed nesting in one of the Erbsville Kartway buildings during the 2017 spring monitoring. NRSI understands that this facility will remain operational until the time when development proceeds. Barn Swallow monitoring will be continued during the future pre-construction monitoring program and will document the continued presence and use by this species to further inform management considerations. At the time when building demolition is to occur, Barn Swallow nesting will be addressed according to the ESA, and in consultation with MNRF, where appropriate.

Blanding's Turtle

NRSI is involved in ongoing consultation and field data information sharing with MNRF relating to Blanding's Turtle throughout the pre-construction monitoring program and this study in order to make a determination of protected general habitat presence and its extent within the subject property.

The most sensitive category of habitat for Blanding's Turtle is Category 1, which includes the nest or overwintering sites. Since Blanding's Turtle requires organic substrates and water depths of approximately 0.9m for overwintering sites (Ernst and Lovich 2009), suitable overwintering habitat for this species is limited within the subject lands. Wetlands within the subject lands do not contain sufficient permanent water for overwintering and depths within Beaver Creek are also too shallow. Findings from the Groundwater and Surface Water Monitoring Program report prepared by Stantec (2016) indicate that surface water levels of 0.9m or greater are rare, but do occur occasionally during this species overwintering period (i.e. October to April) within Laurel Creek on the Erbsville Kartway property. Turtle emergence surveys are being carried out at this location during the spring of 2017 to attempt to document any overwintering habitat use of the site by turtles.

No nesting by Blanding's Turtle or any other turtles has been documented within the subject property as confirmed through targeted turtle nest and nesting surveys completed in 2015 and 2016 according to MNRF protocol (OMNR 2013a, MNRF 2016b). In consultation with MNRF, nesting habitat was determined not to be present on the subject property (Marriot, D. pers. comm. 2015c).

An Information Gathering Form (IGF) is being prepared to submit to MNRF with regards to SAR on-site including Blanding's turtle. Category 2 habitat includes the wetland complex extending up to 2km from a known occurrence, and an area of 30m beyond those wetlands. The wetlands on-site plus 30m are Category 2 habitat. Category 3 habitat is the area between 30m and 250m around suitable wetlands/waterbodies identified as Category 2 and provides movement corridors between wetlands.

Based on past experience, MNRF response comments are expected to include items to be addressed in the impact analysis including location and design of the stormwater management facilities, wetland buffer dimensions, wetland water balance and potential for conflict with SWM pond clean out (G. Buck pers comm 2016).

A number of Species of Conservation Concern (SCC) were documented on the subject property and these have been used to inform the analysis of significant wildlife habitat (refer to Section 4.4).

4.4 Significant Wildlife Habitat

Within the NWSSS (Ecoplans et al. 2013), confirmed and candidate SWH were identified following guidance within the Natural Heritage Reference Manual (NHRM) (OMNR 2010), the SWHTG (OMNR 2000) and the SWH Ecoregion Criteria Schedules (MNRF 2015a). In the SWHTG, SWH is grouped into 5 broad categories: i) seasonal concentration areas, ii) rare vegetation communities, iii) specialized wildlife habitat, iv) habitats of species of conservation concern, and v) animal movement corridors. The following 3 SWH types were confirmed within the NWSSS (Ecoplans et al. 2013) based on the site-specific field surveys for the subject property; specialized wildlife habitat (amphibian breeding habitat (woodland), and woodland area-sensitive bird breeding habitat), and habitat for species of conservation concern (special concern and rare wildlife species). Bat maternity colonies, and turtle wintering areas were identified as candidate SWHs within the NWSSS (Ecoplans et al. 2013). A more fulsome assessment of SWH within the subject property is provided in the 2016 Pre-construction Biological Monitoring Program report (NRSI 2017).

Findings from the detailed field surveys conducted in 2014-2016 (and early spring 2017) were used to further identify confirmed and candidate SWH within the subject property. Confirmed SWH identified by NRSI within the subject property during 2014-2016 (and early spring 2017) are shown on Map 5 of this report and include:

- Turtle Wintering Area
- Seeps and Springs (not previously reported in NWSSS)
- Special Concern and Rare Wildlife Species

Woodland area-sensitive bird breeding habitat was identified in the study area during the NWSSS in WSU-13 and WSU-15. This type of SWH has not been confirmed during the 2014-2016 pre-construction monitoring due to the lack of woodland area-sensitive bird species found during breeding bird surveys. The criteria for this SWH type list a number of woodland area-sensitive bird species and abundance that are required to confirm this type of SWH. To be considered SWH, the presence of nesting or breeding pairs of 3 or more of the criterion species must be present, or any site with breeding Cerulean Warbler (*Setophaga cerulea*) or Canada Warbler (*Cardellina canadensis*) (MNRF 2015b). During this monitoring program, a single woodland area-sensitive bird species was observed, Veery in WSU-15. No other woodland area-sensitive bird species were observed or documented within any other wildlife survey units. Refer to Appendix III for more detailed results of avifauna observed within the subject property.

Similarly, amphibian breeding habitat (woodland) SWH was identified in the study area during the NWSSS in WSU-11 and WSU-15. This type of SWH has not been confirmed during the 2014-2016 pre-construction monitoring due to the lack of woodland breeding amphibians and their relative abundances as documented during amphibian call surveys. The criteria for this SWH type list a number of woodland breeding amphibian species and abundance that are required to confirm this type of SWH. To be considered SWH, 2 or more of the criterion frog species with Call Level Codes of 3 must be present (MNRF 2015a). During the pre-construction monitoring program (2014-2016), Spring Peeper was the only species documented with a Call Level Code 3. Refer to Appendix III for more detailed results of anuran monitoring data from within the subject property.

Candidate SWHs are not included in Map 5 of this report and are discussed below and are limited to:

- Bat Maternity Colonies
- Turtle Wintering Area (in-part)

Bat maternity colonies candidate SWH occurs within the following vegetation communities (Map 3): SWM4-1, FOD8-1, FOC3-1, SWM6-1, FOM6-1, FOC4-1, SWD7-1, FOD3-1, and FOD7-2. Since all treed areas will be retained and buffered under the proposed development scenario, candidate SWH has been maintained. Similarly, turtle

wintering areas SWH was confirmed in Laurel Creek, but is still maintained as candidate for Beaver Creek.

4.4.1 Seasonal Concentration Areas

Turtle Wintering Area

Based on the results of the early spring 2017 turtle emergence/overwintering surveys, turtle wintering area SWH has been confirmed on Laurel Creek within the Erbsville Kartway portion of the subject property. A single juvenile/sub-adult snapping turtle was observed within Laurel Creek on the subject property on April 10, 2017 and was expected to have overwintered within the creek. One or more overwintering Snapping Turtle is considered SWH, and since the hibernation site appeared to be associated with the creek, the areas with deep-water pools have been identified as SWH (MNRF 2015a).

4.4.2 Specialized Wildlife Habitat

Seeps and Springs

Seeps and Springs SWH has been confirmed within the subject property. Seepage areas were observed within the following vegetation communities: SWM4-1 and SWM6-1, and are associated with groundwater discharge in the wetlands. Seeps and Springs occur regularly within low-lying wooded areas in the study area.

4.4.3 Habitat for Species of Conservation Concern

Special Concern and Rare Wildlife Species

Confirmed habitat for Species of Conservation Concern may be considered Significant Wildlife Habitat (OMNR 2000). Based on the results of wildlife-specific field surveys, habitat for 2 SCC, Eastern Wood-pewee and Snapping Turtle, was confirmed within the subject property and therefore this type of SWH is confirmed. Refer to Sections 3.6 and 3.8 for discussion. Given the observations of probable breeding evidence of Eastern Wood-peewee in suitable wooded habitat within the subject property, this is confirmed habitat for SCC. Similarly, the presence of Snapping Turtle within the SWM4-1 community of the Erbsville Kartway property qualifies as confirmed habitat for SCC SWH.

Common Nighthawk is a SCC which was observed performing territorial displays over the subject property during the targeted field surveys for this species. Primary nesting habitat for Common Nighthawk includes coastal sand dunes and beaches, logged or slash-burned areas of forest, woodland clearings, prairies and plains, sagebrush and grassland habitat, open forests, rock outcrops, and flat gravel rooftops (Brigham et al. 2011). The subject property may provide marginal nesting habitat for Common Nighthawk along the edges of wooded features, however, in the local landscape, preferred nesting habitat is expected to include flat rooftops such as that of the Creekside Church, approximately 350m north of the subject property. Common Nighthawk in urbanized areas of southern Ontario are readily found nesting on flat rooftops, as noted from The Atlas of Breeding Birds of Ontario (Sandilands 2007, Peck and James 1983), and The Birds of North America (Brigham et al. 2011).

Common Nighthawk SWH (i.e. Special Concern and Rare Wildlife Species) has been considered for the subject lands based on these observations, however due to the presence of more suitable breeding habitat availability off-property, SWH for Common Nighthawk has not been identified within the subject lands.

4.5 Key Wildlife Habitat Functions

A summary of the findings of the wildlife surveys and wildlife use of the subject property is provided in Table 8, by wildlife survey unit. This table is based on Table 4.20 presented in the NWSSS (Ecoplans et al 2013), and builds on the findings and analysis of key wildlife habitat attributes based on the pre-construction monitoring program and this study.

Table 8. Summary of Wildlife Habitat and Findings (2014 – 2016)

Wildlife Survey Unit (NRSI)	Wildlife Survey Unit (NWSSS)[1]	Habitat Description[1]	Species Notes
9	N/A	Agricultural field actively planted with row crops. Limited wildlife function. Notable wildlife habitat elements: • Common Nighthawk observed in general area, not SWH	Birds[2] • Low diversity (14 species documented) • 1 SCC: Common Nighthawk 1 Regionally Significant: Common Nighthawk Amphibians • No species documented
10	N/A	Agricultural field actively planted with row crops, surrounded by woodland/wetland ESPA #80. Notable wildlife habitat elements: • None	Birds[2] • Low diversity (8 species documented) Amphibians • No species documented
11	10	Block of mixed swamp and thicket swamp, riparian habitat along unnamed tributary to Laurel Creek. Contiguous with and riparian linkage to Laurel Creek and ESPA 80 woodland to the southeast. Notable wildlife habitat elements: • SWH – Turtle Wintering Area • SWH – Seeps and Springs • SWH – Special Concern and Rare Wildlife Species • Habitat/structural diversity • Riparian linkage to large ESPA woodland • Terrestrial crayfish burrows observed adjacent, not SWH • Cavity trees and downed woody debris	Birds[2] • Moderate-high diversity (42 species documented) • 1 SCC: Eastern Wood-pewee • 6 Regionally Significant: Green Heron, Red-bellied Woodpecker, Least Flycatcher, Brown Thrasher, Pine Warbler, Chestnut-sided Warbler • Predominantly edge or interior/edge species Amphibians • 1 SCC: Snapping Turtle • 5 common species: American Toad, Green Frog, Northern Leopard Frog, Spring Peeper, Gray Treefrog Plants • 1 regulated SAR: Butternut • 1 Regionally Significant: Rough Sedge Insects • 1 SCC: Monarch Butterfly

Wildlife Survey Unit (NRSI)	Wildlife Survey Unit (NWSSS)[1]	Habitat Description[1]	Species Notes
12	N/A	Agricultural field actively planted with row crops. Limited wildlife function. Notable wildlife habitat elements: • Common Nighthawk observed in general area, not SWH	Birds[2] • Low diversity (11 species documented) • 1 SCC: Common Nighthawk • 1 Regionally Significant: Common Nighthawk Amphibians • 2 common species: Northern Leopard Frog, Wood Frog
13	4	Mosaic of mixed swamp, mixed forest, deciduous forest and coniferous plantation, with small inclusions thicket and cultural woodland. Part of broader ESPA woodland. Notable wildlife habitat elements: • SWH – Seeps and Springs • SWH – Special Concern and Rare Wildlife Species • Habitat diversity and size • Very small forest 'interior' habitat component (0.27ha) (NWSSS) • Old growth attributes (NWSSS) • Cavity trees and downed woody debris	Birds[2] • Moderate-high diversity (41 species documented) • 1 SCC: Eastern Wood-pewee • 4 Regionally Significant: Red-bellied Woodpecker, Brown Creeper, Brown Thrasher, Pine Warbler • Predominantly edge or interior/edge species with a few interior species Amphibians • 6 common species: American Toad, Gray Treefrog, Northern Leopard Frog, Spring Peeper, Green Frog, Eastern Red-backed Salamander Plants • 3 Regionally Significant: Virginia Stickseed, Golden Alexanders, Soft-leaved Sedge Insects • 1 SCC: Monarch Butterfly
14	5	Narrow deciduous swamp and thicket swamp with small inclusions of cultural woodland/meadow/thicket and marsh. Notable wildlife habitat elements: • SWH – Special Concern and Rare Wildlife Species	Birds[2] • Moderate diversity (29 species documented) • 1 SCC: Eastern Wood-pewee • Predominantly edge or interior/edge

Wildlife Survey Unit (NRSI)	Wildlife Survey Unit (NWSSS)[1]	Habitat Description[1]	Species Notes
		• Riparian corridor along Beaver Creek • Some specialized habitat for Lepidoptera/Odonata (sedge meadow) (NWSSS) • Movement area for wildlife between ESPA 80 and natural areas to the north • Conservation Drive is a barrier/hazard to wildlife movement	species <u>Amphibians</u> • 4 common species: Spring Peeper, Gray Treefrog, Northern Green Frog, Northern Leopard Frog <u>Insects</u> • 1 SCC: Monarch Butterfly
15	3	Mixed swamp, mixed forest and coniferous forest, with some thicket/marsh inclusions in gaps and at edges. Bisected by access lane/agricultural field (the 'gap'). Part of broader ESPA woodland. Notable wildlife habitat elements: • SWH – Seeps and Springs • SWH – Special Concern and Rare Wildlife Species • Forest 'interior' habitat component (NWSSS) • Cavity trees and downed woody debris	<u>Birds[2]</u> • Moderate diversity (37 species documented) • 1 SCC: Eastern Wood-pewee • 6 Regionally Significant: Red-bellied Woodpecker, Veery, Chestnut-sided Warbler, Pine Warbler, American Redstart, Brown Creeper • Predominantly edge or interior/edge species with a few interior species <u>Amphibians</u> • 5 common species: American Toad, Spring Peeper, Gray Treefrog, Northern Leopard Frog, Wood Frog <u>Plants</u> • 1 Regionally Significant: Rough Sedge, Northern Beech Fern <u>Insects</u> • 1 SCC: Monarch Butterfly

Source: [1]NWSSS (Ecoplans et al. 2013) where applicable

[2]Bird diversity is characterized by qualitative descriptors of richness (i.e. low/moderate/high), relative to other habitats in the NWSSS and relative to what would be expected in a habitat of similar size/composition within the Region; there are no numeric thresholds, rather these are qualitative rankings based on professional judgement and experience (J. Gross, pers. comm. 2017). For the purposes of this report, diversity thresholds are defined as follows: Low (0-20 species), Moderate (21-38 species), Moderate-High (39-49 species), High (50+ species) and is general consistent with thresholds as reported in the NWSSS.

4.6 Ecological Linkages

As part of identifying the Natural Heritage System in the study area, the NWSSS (Ecoplans et al 2013) identifies the Beaver Creek corridor as the primary existing ecological linkage. The main function of this corridor is to provide wildlife movement opportunities along Beaver Creek between the wetland/woodlands north of Conservation Drive and the wetland/woodlands on the subject property, and beyond. The current vegetated zone along Beaver Creek is variable in width, being wide (up to 300m) and well-shaded with forest and wetland vegetation on-site, but with gaps and narrow disturbed sections (<20m and ploughed), notably at the north portion of the subject property near the Conservation Drive crossing.

Opportunities for linkage enhancement, namely along the north portion of Beaver Creek (i.e. wildlife survey unit 14), exists within the context of improvements to Conservation Drive during its reconstruction and widening, and the management of the corridor through the development of the subject property. The Beaver Creek linkage corridor will be maintained and protected with a buffer as well as other management and enhancement actions which will retain and enhance its linkage function. Based on the Draft Plan (Map 2), ecological linkages within the subject property identified on Figure 14.4 of the NWSSS (Ecoplans et al. 2013) will be maintained, protected, and buffered appropriately. Refer to Section 5.6 of this report for further discussion of enhancement opportunities.

The Class EA for Beaver Creek Road and Conservation Drive Upgrades reported that although the NWSSS identified a high abundance of amphibian road mortality along Conservation Drive at the Beaver Creek crossing, this area was not considered to be a significant amphibian movement corridor since the Beaver Creek corridor is quite narrow and surrounded by agricultural lands (Stantec 2015). The existing crossing structure at Conservation Drive is a large corrugated steel pipe encased in concrete (3.1m wide x 1.8m high) which conveys flows and provides aquatic connectivity but there is no terrestrial wildlife movement opportunity. The preferred design alternative for transportation improvements along Conservation Drive requires the installation of a longer and larger culvert structure at Beaver Creek to accommodate road widening and

regional flood levels, which will also provide an opportunity to include a terrestrial wildlife crossing including wildlife funnel walls, as recommended in the NWSSS (Stantec 2015).

4.7 Physical Constraints

The Regional floodline for Laurel Creek and Beaver Creek was provided in the NWSSS (Ecoplans et al 2013) and is shown on the Draft Plan (Map 2). The floodline is mostly contained within the natural features and extends minimally into the agricultural fields on the Northgate property, and somewhat into the actively used area of the Erbsville Kartway property. There were no other physical constraints present on the subject property such as steep slopes or erosion prone areas.

4.8 Aquatic Habitat

Beaver Creek has been previously classified as a potential coldwater stream, although it has been degraded in a number of areas (Ecoplans et al. 2013). Through the subject property Beaver Creek provides habitat for a variety of fish species including eight minnow species, two darter species, two sunfish species, as well as Brook Stickleback (*Culaea inconstans*) and White Sucker (*Catosomus commersonii*). Most of these fish species prefer a cool-water thermal regime, while the two sunfish and Fathead Minnow (*Pimephales promelas*) prefer warm water.

Only one reach of Laurel Creek falls within the subject property; immediately to the west of the Erbsville Kartway. The lower reaches of Laurel Creek are considered to be impaired by the backwater and warming effect of the Laurel Creek Reservoir, but it is classified as a coldwater system with 9% relatively unimpaired coldwater habitat and 21% potential coldwater habitat. Fish community management objectives include extending and supporting coldwater fish habitat and important groundwater discharge sources as well as providing potential for Brown Trout spawning within Laurel Creek (Ecoplans et al 2013; GRCA 1993; GRCA 2006). As direct fish habitat, both Beaver Creek and Laurel Creek are protected under Canada's *Fisheries Act*, and the *Planning Act* per the Provincial Policy Statement and the City of Waterloo Official Plan.

Both Beaver Creek and Laurel Creek provide a range of aquatic habitat functions making both creeks significant natural features. The majority of the length of Beaver Creek occurs within treed corridors and wetlands, with some encroachment by existing

agricultural land use. Laurel Creek falls almost exclusively within heavily treed forest and wetland habitats. The NWSSS (Ecoplans et al. 2013) includes management objectives to protect and enhance the riparian attributes along both Beaver and Laurel Creeks, and to create a wider riparian corridor and linkage along Beaver Creek. Both creeks are sensitive to development and rely on an intact vegetated riparian corridor to provide shading and temperature mitigation, a source of large woody debris that adds complexity to the aquatic habitat, and is a source of allocthonous inputs (organic material such as leaves) that support the stream ecosystem. Although the creeks are primarily supported by surface water from the subject property, they will be sensitive to any activities which affect recharge of shallow groundwater that contributes to baseflow and water temperature mitigation. Maintaining a 30m buffer as recommended in the subwatershed study will largely avoid these impacts (Ecoplans et al. 2013).

Land use changes anywhere within the Laurel Creek and Beaver Creek subwatersheds can affect the hydrology of the creeks, and stormwater management measures must have regard for such potential impacts. The NWSSS provides recommendations for maintaining and enhancing groundwater recharge and the control and treatment of surface water runoff for water quantity and quality. Beaver Creek is a small watercourse system and is sensitive to increased flows which can cause erosion and alter habitat. Implementation of best practices for construction is also key to avoiding impacts.

4.9 Buffers

Buffers are required for natural features such as woodlands, wetlands and watercourses to protect them from impacts during development. As described above in Section 1.0, the natural features located on the subject property have a number of designations including PSW, Core Environmental Feature, and Significant Woodland. These will be retained and adequately buffered during development. NRSI identified several confirmed SWH types associated with these retained natural features as well. These features are afforded protection under the Provincial Policy Statement, the Regional Official Plan, the City of Waterloo Official Plan, and are regulated by the GRCA under Ontario Regulation 150/06. Development or alteration of these areas is prohibited, unless otherwise provided for by the policies, such as the provision of infrastructure

.

The NWSSS provides recommendations on development setbacks and buffer management measures for the natural features in the study area. The rationale for these measures is based on:

- Functional analysis of natural heritage features and functions, including considerations of the specific requirements and sensitivities of: vegetation communities and flora, wildlife breeding, foraging and movement habitat, and aquatic resources.
- Anticipated land uses in a future urban context, including roads, trails, development and required infrastructure.
- Relevant policy guideline documents (i.e. Natural Heritage Reference Manual (OMNR 2010); Greenlands Network Implementation Guideline. IV. Guideline for Determining Buffers around Environmental Features (Region of Waterloo 2010); How Much Habitat is Enough? (Environment Canada 2013)).
- Relevant scientific literature regarding potential impacts (i.e. abiotic and direct/indirect biological 'edge effects', occupancy related effects) and functional buffer widths.

The NWSSS recommended the following development setbacks for features present on the subject property:

- PSW wetland: 30m
- Upland Woodlands: 10m
- Beaver Creek and Laurel Creek: 30m
- Hedgerows: 5m

The future development setback is to be the greater of the combined recommended setbacks.

The NWSSS provides guidance on how and when reduced buffers may be considered, as described in Section 14.2.2 which states "There is potential for minor deviation in the recommended setbacks, where it is demonstrated through an EIS that: on average, the recommended setback width is met; and that the recommended setback/buffer in a proposed development or land use change will achieve the intended buffer objectives and appropriate level of environmental protection. This approach is supported in the

Region of Waterloo Official Plan policy 7.C.10, “The location, width, composition and use of buffers will be in accordance with the approved EIS, with buffers being a minimum of 10 meters…” The final setback (and buffer management recommendations) will be determined via site-specific EIS work, with further consideration into the following:

- Species composition and diversity
- Species sensitivity and requirements
- Habitat sensitivity, including dependence on surface or groundwater inputs
- Feature form and function
- Enhancement opportunities (i.e. corridor widening)

Section 14.2.2.1 of the NWSSS indicates that development and site alteration within buffer areas is to be limited and is to be subject to detailed study in an EIS as follows:

- Part of SWM facilities and associated grading
- Recreational trails and associated grading
- Site alteration associated with grading incursions to transition natural topography as required to achieve sound engineering practice and design

These are to be restricted to areas where the existing land use is active agriculture (i.e. crop lands).

These recommended buffers and site specific considerations were used to inform the limits of development as shown on Map 6 and are discussed further in the impact analysis section of this report.

5.0 Impact Analysis and Recommendations

5.1 Approach to Impact Analysis

The boundaries of significant natural features, sensitivities and buffer recommendations were provided to the study team to guide the development layout. This information was combined with other physical and planning constraints to come up with a suitable development plan for the property which respected the natural environment. The details of the undertaking are shown on Map 2, Draft Plan of Subdivision prepared by MHBC Group (2017). Further details of the proposed development, including stormwater management, preliminary grading and servicing is provided by MTE (2017) under separate cover.

Potential impacts arising from the proposed undertaking are determined by comparing the layout and details of the proposed undertaking with the existing natural features, buffers and their ecological functions. Where the development proposal overlaps with the natural features or their buffers, impacts may arise. The following is a description of the types of impacts which will be discussed:

- Direct impacts to the natural features on the subject lands associated with disruption or displacement caused by the actual proposed 'footprint' of the undertaking.
- Indirect impacts associated with changes in site conditions such as drainage and water quantity/quality. Potential sources of indirect impacts associated with the proposed development include:
    - Encroachment into Buffers. The proposed development has regard for the recommended woodland dripline and wetland setbacks/buffers throughout the entire Draft Plan (Map 2), with the exception of 3 areas, discussed below.
    - Changes to water balance. The SWM Report prepared by MTE provides an analysis of water balance to show how this is being maintained.
    - Water quality. The SWM Report prepared by MTE describes the approach to protecting water quality.
    - Erosion of Watercourses. The erosion thresholds for Beaver Creek were utilized in designing the approach to SWM, as reported by MTE.

    - Sedimentation and Erosion During Construction. A sediment and erosion control plan will be required, preliminary measures are included in the EIS and MTE's SWM Report.
    - Indirect impacts to wildlife habitat. The natural features will be retained in large blocks and buffered such that they will be protected from potential impacts of the new land uses, and opportunities for restoration and habitat enhancement are described.
- Induced impacts are those associated with post-development activities such as subsequent demand on the resources created by increased habitation/use of the area and vicinity.

The sections below describe the impact anticipated and the corresponding avoidance and mitigation measures.

5.2 Description of the Proposed Undertaking

The development of the subject property was guided by a number of planning and engineering studies over the past many years. The Beaver Creek Meadows District Plan (TPP 2016) informed land use and community design at a block plan level including transportation network, servicing and institutional uses. The Class Environmental Assessment for Conservation Drive and Beaver Creek Road (Stantec 2015) provides planned upgrades to the major roads in the study area as well as a preferred option for servicing and stormwater management. The NWSSS (Ecoplans et al. 2013) established the natural environment existing conditions and sensitivities and recommended buffers, environmental targets and land management activities to protect and enhance the natural heritage system in the study area. Within the framework of these overarching studies, the details of the development proposed on the subject property were refined and focused by the study team through a number of iterations of the draft plan and servicing concepts.

The study team worked together to design the layout of the proposed development within the complexity of the physical, natural and servicing constraints of the subject lands and taking into account connections to the adjacent lands. The resulting proposal has been designed to avoid any direct impacts to natural environment features. The

developed areas of the subdivisions have been placed in the actively farmed portions of the properties, outside of the wetlands, woodlands, tributaries and their buffers.

The proposed mixed use development includes a variety of residential densities, internal road network, parks, trails, open space and stormwater management facilities as shown on the Draft Plan (Map 2). Access to the site will be from several entrances along Conservation Drive and Beaver Creek Road, with a roundabout planned at the intersection of these two roads. The proposed development will occur in phases as shown on the Draft Plans with site preparation and construction starting on the Northgate lands at the northeast corner of the subject property at the intersection of Conservation Drive and Beaver Creek Road, and progressing south along Beaver Creek Road, before expanding to the west side of Beaver Creek and south along the western portion of the property. The Erbsville Kartway lands will be developed in combination with the Northgate lands and will proceed from north to south. The timing of the phasing is dependent upon the installation of roads, water and wastewater services.

Details of lots, road layout, stormwater management, grading and servicing have been prepared for the Erbsville Kartway and Northgate Subdivision. The development is to be staged through the Plans of Subdivision and Plans of Condominium. There are areas within the Plans of Subdivision that are shown as blocks and will be developed through a Site Plan Approval process including detailed stormwater management plan to show how the NWSSS criteria are being adhered to and implemented.

Water and wastewater servicing will be through connections to proposed infrastructure in Conservation Drive and Beaver Creek Road. This infrastructure was assessed through the Class Environmental Assessment process prepared by Stantec (2015). Two wastewater pumping stations are required on the subject lands, as shown on the Draft Plan; one adjacent to Beaver Creek at Conservation Drive and one at the southeast corner of the property adjacent to Beaver Creek Road.

The natural features and their buffers have been retained in large blocks, identified as Open Space on the Draft Plan, or as additional lands owned by the applicant and to be retained in private ownership by the applicant. Other open space land uses include

stormwater management, community trail and parks as shown on Map 2. There are some Open Space blocks (Stages 1 and 2 of the Northgate Plan) including environmental lands and their buffers that will be dedicated to the City free of charge and without any encumbrances. Other portions are proposed to remain in private ownership and form part of the common area for the Plan of Condominium. In these areas, there could be discussion of a conservation easement.

Three stormwater management facilities are proposed on-site; two at the north portion of the property on the east and west sides of Beaver Creek, to service the eastern and western portions of the property, and a series of Low Impact Development (LID) features within the condominium block in the central field which will service the proposed access road and lots of the condominium development (see Map 2). The stormwater management facilities adjacent to Beaver Creek will be traditional detention ponds with controls to manage water quality and quantity. The local condominium stormwater management approach is to use LID practices. A fourth SWM facility is proposed off-site to the east at the southwest corner of the Green Acres RV Park property to receive flows from the eastern portion of the development as well as flows from other properties in the local catchment area. This community stormwater management facility will outlet to the Laurel Creek Reservoir and is being designed and assessed under a separate study process. These SWM facility locations are relatively consistent with those presented in the NWSSS (Ecoplans et al. 2013) and the Beaver Creek Meadows District Plan (BCMDP) (TPP 2016).

Buffers have been provided from the wetland and woodland boundary to the limits of the development including the stormwater management facility. Standard measures to maximize infiltration of surface water have been provided throughout the site.

An impact analysis has been prepared for the proposed development, broken down according to the stages of development, as shown on the Draft Plan. Stages are grouped together where the impact analysis is similar, as follows:

- Stages 3 and 4 (West of Beaver Creek),
- Stages 1 and 2 (East of Beaver Creek),
- Stage 5 (southwest, internal field and access road), and,

- Erbsville Kartway Property.

5.3 Stages 3 and 4 (West of Beaver Creek)

These stages of the development consist of single and multiple residential lots, an internal road network with entrances from Conservation Drive, parks, a pumping station and stormwater management facility 5914 located adjacent to Beaver Creek.

5.3.1 Direct Impacts and Mitigation Measures

There development has been located entirely within the active agricultural lands and there are no direct impacts to natural features in Stages 3 and 4.

5.3.2 Indirect Impacts and Mitigation Measures

Encroachment into Buffers

Stages 3 and 4 of the proposed development have respected the recommended woodland dripline and wetland setbacks/buffers, with the exception of 2 areas:

- Stormwater management Block 23 in Stage 3, where there is an approximately 6m encroachment into the 30m wetland setback. This encroachment will consist of grading to create the bank of SWM facility 5914, as well as the creation of a shallow outlet ditch and subsurface cooling trench which will extend towards the wetland boundary. The encroachment is all contained within the outer 15m of the wetland buffer, as permitted in the NWSSS. This totals 0.051ha of encroachment by an embankment in an area that is currently tilled agricultural field.
- Grading at rear of Blocks 4 and 15 Residential in Stages 3 and 4. Due to natural slopes in this area, grading will extend in a thin sliver into the buffer up to approximately 5.1m in order to match existing grades. This will result in an area of 0.056ha of encroachment into the wetland buffer.

These encroachments into the outer fringe of the buffer have been limited as much as possible in the proposed development layout and are only located in areas where it is necessary in order to achieve sound engineering practice and design. This will result in a slight filling of an area of 0.1ha of current tilled agricultural land. The NWSSS indicates the main potential impacts to wetlands in a development scenario to be addressed by

buffers are protection of vegetation, wildlife habitat, occupancy related effects, water balance and water quality.

This encroachment is considered minor in area and in level of disturbance. The encroachment area is currently tilled agricultural land which will be filled to form a slope to transition from the developed portion and the vegetated/naturalized buffer at existing grades. The infiltration function of the buffer will remain while the habitat and riparian protection value of the buffer will be improved through vegetated cover. In all cases the separation distance between the wetland and residential lots will be 30m or greater.

There are several areas where additions are made to the buffer due to line smoothing, which will off-set these intrusions or more, such as at the corner of Block 15 in Stage 3. Permanent fencing will be installed at the rear of the lots and around the SWM facility to demarcate the limit of development and to prevent any encroachment by residents into the buffer and the natural features.

The proposed reduced buffers are considered adequate to protect the form and function of the adjacent wetland community based on the following factors:

- The vegetation form of the wetland will be directly protected. The buffer provided always meets or exceeds the minimum Region of Waterloo recommended buffer of 10m from dripline for Core Environmental Features,
- Buffer width overall is sufficient to increase natural cover area through the cessation of agriculture and proposed buffer plantings,
- Naturalization of the buffer will improve the riparian corridor of Beaver Creek by increasing its width and filling in gaps in the vegetation of an area that is currently tilled,
- naturalization of the buffer provides an opportunity to create adjacent upland habitat for wildlife such as foraging habitat for snakes, mammals, Lepidoptera and birds,
- Stormwater management plan will provide surface water treatment to address potential for water quality impacts and will maintain and improve the existing water balance,

- Sediment and erosion control plan will be prepared to prevent impacts to the natural features and buffers.
- Rear yard fencing along the development limit will minimize and prevent human encroachment.

Based on the analysis provided above for the proposed minor encroachments into the recommended 30m wetland buffer, the following criteria are satisfied which meets the City of Waterloo OP policy 8.2.4(9) regarding encroachment into buffer zones for Core Natural Features:

- the adjacent Core Natural Feature is enhanced above the existing condition,
- no other alternative location is feasible (Draft Plan adheres to recommended SWM facility locations, as shown in Figure 16.1 Implementation Plan of the NWSSS),
- Low Impact Development (LID) measures are implemented to the extent feasible outside of the buffer,
- root zones of adjacent natural features are not impacted, and,
- the SWM facility replicates or compliments an existing function of the buffer lands.

Mitigation: Implement stormwater management plan to address water quality and quantity and erosion potential impacts. Clearly demarcate the limits of grading in the field and install sediment barrier/protection fence. Enhance the function of the buffer through fencing and a planting plan.

Species At Risk

Blanding's Turtle

The wetlands on-site plus the adjacent 30m lands are Category 2 habitat for Blanding's Turtle. This category of habitat is considered to have a moderate level of tolerance to alteration before its function is compromised (OMNR 2013b). The encroachments by grading into the wetland buffer are minor encroachments within this regulated habitat. The details of the SWM pond design prepared by MTE (2017) show that the open water portion of the pond itself is well outside of the 30m buffer, but the outer bank, outlet ditch

and underground cooling trench are within the outer portion of the wetland buffer (see MTE SWM report Figure 4.1) as is the grading at the rear of Lots in Blocks 4 and 15. These areas will be naturally vegetated and will enhance the extent of vegetation associated with the wetland and the creek as compared to the current condition.

Correspondence with MNRF regarding potential impacts to Blanding's turtle and its habitat indicate that their main concern is related to maintaining the water balance to the wetland such that the habitat for Blanding's turtle is not negatively impacted. The placement and construction of the forebay and permanent pool of the stormwater management pond adjacent to the wetland buffer is not anticipated to impact Blanding's Turtle as it is outside of the Category 2 habitat, and slight grading, ditch and subsurface galleries within the habitat is not anticipated to be a negative impact. This will be confirmed with MNRF through the submission of an Information Gathering Form (IGF) and accompanying reports.

Mitigation: maintain the water balance to the wetland such that the habitat for Blanding's turtle is not negatively impacted. Continue to correspond with MNRF on Blanding's turtle and submit IGF.

Changes to Water Balance

One of the potential sources of impact to natural features as a result of development is the increase in impervious cover in the catchment which can alter the pattern, volume and flow of groundwater and surface water to natural features. The increase in impervious cover prevents water from soaking into the ground and can speed up the rate at which surface runoff flows across the site. In accordance with the NWSSS, the existing infiltration rates are predicted to increase to ensure there is no reduction in base flow to Laurel Creek or Beaver Creek, no change in existing aquifer recharge, and no disruption in the pattern of groundwater recharge. This section of the impact analysis will focus on the potential changes to the flow patterns and quantity of groundwater and surface water flows that currently supply wetlands and Beaver Creek in Stages 3 and 4. The Preliminary Stormwater Management Report (MTE 2017) shows how the proposed development will meet the stormwater management criteria of provincial and local policies (MOE, GRCA, City of Waterloo) and the NWSSS for quantity, quality, erosion control, infiltration and thermal mitigation, and the reader is referred to that report for

further details. Stormwater management facility (5914) will provide water quality and quantity control as required for flows directed to Beaver Creek.

In order to manage water quantity and to control erosion in the post-development scenario, MTE designed the stormwater management strategy following the target unit flow rate approach (as documented in the NWSSS) for the catchment which covers the majority of the site and contributes to Beaver Creek (Subwatershed 391 in MTE's report). The intent of this approach is to manage development within the subwatershed in a manner that does not cause an increase to flows in Beaver Creek. This approach was used in the NWSSS as it was found that the typical post-to-pre SWM strategy would increase the magnitude of flows in the lower reaches of Beaver Creek. Beaver Creek is a small watercourse system and is sensitive to increased flows which can cause erosion and alter habitat. This method aligns with the thresholds for erosion and duration of flows for the sensitive reaches of the creek as determined in the NWSSS.

In order to gain an understanding of potential water balance impacts it is important to understand more detail on how and where water will be delivered to the wetland and watercourses in the post-development scenario. MTE conducted a water balance analysis in their report (see section 5.5). In the analysis, they delineated in greater detail the existing surface water catchments that contribute to the central wetland and compared that to the proposed condition. The proposed grading of the site and the stormwater management strategy were reviewed and refined to create a plan which allows the surface water contribution to the wetland to be matched almost exactly in the post-development scenario (slight decrease to the western lobe of the wetland of 0.3% average annually). This was accomplished by maintaining runoff to the wetland from the buffers and the open space areas adjacent to the wetland (outside of the buffers) as well as directing roof and rear yard runoff from adjacent lots (43 lots in Stages 3 and 4).

MTE's report indicates that the infiltration strategy for the subject development is an enhancement over the current average annual volumes for the respective catchments. This increase in infiltration will be achieved through a number of SWM practices at the lot level, conveyance level and end-of-pipe controls. Lot level enhancements include amended topsoil (450mm depth proposed) over the majority of single family lots and roof

leaders connected to infiltration galleries on the multi-residential blocks. Conveyance measures will include an infiltration facility located in the park block (Block 21). The predicted infiltration value for this portion of the development is shown in the Table 9 below.

Table 9. Infiltration in Catchment 3914

Catchment	Precipitation (mm/yr)	Existing Condition (mm/yr)	NWSSS Predicted Infiltration (mm/yr)	Proposed Infiltration (mm/yr)
3914	844.8	211.9	262.2	280.3

Mitigation Measures: Implement the SWM strategy and design from MTE's report for Stages 3 and 4. Measures are recommended to promote infiltration in order to enhance groundwater recharge above the existing condition and to meet the objectives of the NWSSS.

Thermal Impacts to Beaver Creek

A number of stormwater management measures are provided in the SWM report to avoid and mitigate the potential for thermal impacts to natural features which could arise as a result of the outlet of warmed stormwater runoff. Thermal impacts are primarily avoided by infiltrating all runoff from rain events up to a 25mm storm, either at the lot level or through the conveyance infiltration chamber in Park Block 21. In addition, the outlet pipe from SWM pond 5914 is an inverted bottom draw pipe, accessing cooler waters from the bottom of the pond. This water will flow to a subsurface cooling trench constructed in the shallow groundwater table which will allow the treated storm water to be effectively cooled before being discharged to the wetland/watercourse buffer. SWM facility plantings will be important for shading of the pond to further reduce thermal impacts. The NWSSS recommended in-stream target temperatures for Beaver Creek of less than 22^{o}C from April 1 to October 31, and between 4^{o}C and 14^{o}C from November 1 to March 31.

Mitigation: Implement cooling measures and monitor to determine their functioning and success.

Erosion Exceedance

According to the fluvial geomorphology assessment in the NWSSS, the banks of Beaver Creek are more sensitive to erosion than the creek bed. In designing the SWM facility and outlet, MTE used the threshold for bank destabilization as a target for flow volume, rather than the creek bed threshold, as this was a more conservative and sensitive approach. Based on their modelling this will result in slight lowering of the erosion exceedance duration as predicted and accepted in the NWSSS.

Mitigation: Monitor creek bed and bank to determine if the erosion thresholds are being exceeded.

5.4 Stages 1 and 2 (East of Beaver Creek)

Stages 1 and 2 of the development includes blocks for single detached and street townhouse units, multiple residential blocks, a multiple residential/mixed use block and SWM facility 5915 on the east side of Beaver Creek, with a pumping station at the southeast corner of the property. This part of the development has been designed to the block level including preliminary servicing, grading and stormwater analysis to ensure that all targets are being met and the development is feasible. Details will be determined at a future Site Plan Approval process for these blocks.

5.4.1 Direct Impacts and Mitigation Measures

The development has been located entirely within the active agricultural lands and there are no direct impacts to natural features in Stages 1 and 2.

5.4.2 Indirect Impacts and Mitigation Measures

Encroachment into Buffers

- Grading at rear of Block 2 in Stage 1 adjacent to the Core Environmental Feature. Due to natural slopes in this area, grading will extend to a maximum of approximately 4.2m into the 10m dripline buffer in order to match existing grades. Grading has been minimized as much as possible but is required to achieve sound engineering practice and design. At this location, the adjacent woodland is comprised of coniferous plantation which was given a low-moderate quality and sensitivity rating in the NWSSS due to is anthropogenic origin and presence of non-native species. This encroachment into the buffer is entirely within

currently tilled agricultural land and will result in a slight filling of an area of 0.0275ha.

- There are no encroachments into Blanding's turtle habitat in Stages 1 and 2.

Mitigation: Clearly demarcate the limits of grading in the field and install sediment barrier/ tree protection fence.

Additions to Buffers/Reforestation

Due to the topography in the northwest part of Stage 2, adjacent to Beaver Creek, an embankment will be created to provide a level surface for the placement of the SWM facility 5915, and residential lots. This bank is outside of the proposed buffer, but will be naturally vegetated and will add another 16-20m to the buffer separation distance from the wetland/Beaver Creek/dripline in this area, bulking up the creek riparian corridor and natural heritage system. A portion of the bank is recommended to be re-forested in conjunction with the buffer to enhance forest habitat in ESPA 80 such that forest interior habitat can be created and expanded. See Section 6.10 for more details.

Changes to Water Balance

Stormwater management facility 5915 is proposed on the east side of Beaver Creek (see Map 2). A detailed SWM plan will be prepared at the Site Plan Approval stage showing how the proposed strategy will adhere to the NWSSS criteria and be implemented. Water quality and quantity control are required for flows directed to Beaver Creek and a summary of the approach is provided in MTE's report. Water quantity control will be achieved through a volume reduction pond and multi-stage outlet structure.

MTE conducted a water balance analysis in their report (see section 5.5). In the analysis, they delineated in greater detail the existing surface water catchments that contribute to the central wetland and compared that to the proposed condition. The proposed grading of the site and the stormwater management strategy were reviewed and refined to create a plan which allows the surface water contribution to the wetland to be matched almost exactly in the post-development scenario (slight increase to the eastern lobe of the wetland of 0.3% average annually). This was accomplished by

maintaining runoff to the wetland from the buffers and the open space areas adjacent to the wetland (outside of the buffers) as well as directing roof and rear yard runoff from adjacent lots (minimum of 8 lots in Stage 1 and 2). Infiltration will be maintained or enhanced by infiltrating all rainfall up to the 25mm event, although suitable soils must be provided. A comparison of infiltration values for this portion of the development is shown in Table 10 below.

Table 10. Infiltration in Catchment 3915.

Catchment	Precipitation (mm/yr)	Existing Condition (mm/yr)	NWSSS Predicted Infiltration (mm/yr)	Proposed Infiltration (mm/yr)
3915	844.8	222.9	266.7	371.4

The comparison in Table 10 indicates that the infiltration strategy for the subject development will result in an enhancement of infiltration over the current average annual volumes and the predicted rate from the NWSSS. This increase in infiltration will be achieved through a number of SWM practices, which will be detailed at the Site Plan Approval step for Stages 1 and 2.

Mitigation: Implement recommendations from MTE's SWM report in the detailed design of the SWM strategy for Stages 1 and 2. LID measures are recommended to promote infiltration in order to enhance groundwater recharge above the existing condition and to meet the objectives of the NWSSS.

Thermal Impacts to Beaver Creek

The focus on infiltration will achieve mitigation of any thermal impacts. If this method changes during the detailed design, then cooling measures will be required such as a bottom draw outlet and cooling trench to mitigate any potential impacts to Beaver Creek due to heated water entering it from the SWM pond.

Mitigation: Implement cooling measures and monitor to determine their functioning and success.

Erosion Exceedance

Post-development peak flows to Beaver Creek will be controlled to unit flow rates for the 2yr, 5yr and 100yr storm events.

Mitigation: Monitor creek bed and bank to determine if the erosion thresholds are being exceeded.

5.5 Stage 5 (Southwest, Internal Field and Access Road)

Stage 5 includes the development of a 15 unit vacant land condominium and an access road as well as provision of municipal services and LID stormwater management measures.

5.5.1 Direct Impacts and Mitigation Measures

There are no direct impacts to natural features in Stage 5.

5.5.2 Indirect Impacts and Mitigation Measures

Access Road

The development of Stage 5 includes the construction of an access road and other services (water, sewer) into the internal field. This road and servicing will be located along the existing agricultural access to the field which was determined to be an allowable approach through discussion with the Region, subject to the completion of an EIS. This access is approximately 35m in width from dripline to dripline and accommodates large farming equipment. The area is actively cultivated and is currently planted in corn.

The woodland edge has been disturbed over the years through tree removal for agricultural purposes, removal of trees damaged by ice, wind and emerald ash borer. All tree removals were overseen by Region of Waterloo staff. A 10m buffer to the woodland dripline has been applied on both sides at this location which is an opportunity to rehabilitate the edge of the woodland with tree and shrub plantings. The application of the buffer results in a relatively narrow gap to accommodate the access road, grading and services. The access road will be constructed as a private road which allows a

narrower cross-section, using a minimum width of 7.3m. The narrow road footprint and detailed grading analysis allow the road and banks to be constructed outside of the woodland buffers. Detailed grading analysis by MTE shows how the road can be constructed without encroachment into buffers. Road surface runoff will be managed within Stage 5 and will be reduced through the use of permeable pavement as shown on Figures 5.1 and 5.2 in MTE's report. The need for extensive grading has been minimized to the extent possible through road design and the use of a small section of retaining wall on the north side. MTE has prepared a preliminary design sketch as shown on Map 7.

The proposed design will result in the road being elevated above the existing topography. This is necessary for a number of reasons, including the need for separation of underground services from the groundwater table and to control road runoff such that it can be accommodated by the stormwater management strategy for Stage 5. Two culverts are proposed under the access road to provide appropriate drainage. These culverts are also an opportunity to provide wildlife passage, which is discussed below in Section 6.9.

Mitigation: minimize road footprint and grading as much as possible to maintain 10m dripline buffer, buffers to be naturalized and planted with trees to stabilize forest edge and create additional forest habitat, install culverts as shown by MTE for proper drainage and wildlife passage.

Changes to Water Balance

The SWM strategy for this stage has been conceptually modelled but is expected to be detailed as part of a future Site Plan Approval process for this block. The approach to SWM in this Stage focuses on the use of Low Impact Development (LID) measures in order to promote infiltration and eliminate the need for a traditional SWM pond facility. MTE has incorporated the use of permeable pavement along the access road and cul-de-sac and a bioswale end-of-pipe facility. The road will have a permeable surface over a reservoir of graded stone that will store and infiltrate precipitation into the soil. Contamination of the groundwater by road pollutants is not a significant concern due to the very low volume of traffic anticipated on this road (15 lots). The large lots of the condominium development will primarily infiltrate runoff in the rear yards or flow overland

to the buffer and adjacent natural features. Any excess runoff from the front yards and driveways will be directed to the bioswale for infiltration and to be taken up by vegetation.

Based on these LID measures, infiltration in Stage 5 is expected to be above current and the predicted infiltration rate from the NWSSS. See Table 11.

Table 111. Infiltration in Catchment 3917.

Catchment	Precipitation (mm/yr)	Existing Condition (mm/yr)	NWSSS Predicted Infiltration (mm/yr)	Proposed Infiltration (mm/yr)
3917	844.8	177.0	240.8	306.6

This increase in infiltration will be achieved through a number of LID practices at the lot level, conveyance level and end-of-pipe controls which will be detailed at the Site Plan Approval step for Stage 5.

Mitigation: Implement recommendations from MTE's SWM report in the detailed design of the SWM strategy for Stage 5. LID measures are recommended to promote infiltration in order to enhance groundwater recharge above the existing condition and to meet the objectives of the NWSSS.

Thermal or Erosion Impacts to Beaver Creek

There will be no impact to the thermal regime or erosion sensitive banks of Beaver Creek as all rainfall will be infiltrated.

Mitigation: Implement LID measures and monitor to determine their functioning and success.

Field Restoration and ESPA 80

The Region of Waterloo's Ecological and Environmental Advisory Committee (EEAC) scoped the TOR for this EIS and asked that it include "*consideration of the ecological implications of ecologically restoring the agricultural field inside the northern lobe of ESPA 80 as an alternative to residential development*."

The study team considered several options for development of Stage 5. The proposed plan was created with several environmental considerations:

- Condominium development. The condominium approach allows unique standards to be applied to all lots that will restrict activities in order to protect and enhance the natural area. The natural areas will be governed by the condominium corporation.
- Large lots – A total of 15 lots are proposed, ranging in size from approximately 0.07ha to 0.1ha with about 20m in frontage. Large size lots will provide space for infiltration and vegetation cover in addition to the buffer lands.
- Central island – The access road will circle a central island which has been proposed to perform several functions, both aesthetic and ecological. The island will be landscaped and planted with native trees, shrubs and herbaceous plants to provide some privacy screening between lots, but will also increase tree cover, vegetation and provide some wildlife habitat. The island will also perform a LID stormwater management function in receiving and infiltrating precipitation particularly by the constructed bioswale feature.
- Bioswale – A bioswale is a stormwater filter and infiltration measure and will temporarily store, treat and infiltrate runoff. It will be constructed as a depression with filtering materials at the base, mulch and vegetation cover adapted to the hydrologic conditions as predicted by the SWM strategy. It will capture small rain events from a drainage area of 0.224ha and provide a storage volume of 202m^3. An overflow path is provided to the north and into the open space area in the event of a major storm.
- Buffers – will be naturalized to protect and enhance forest edge and will bulk up the size of the Core Environmental Feature.
- Restoration area – A portion of the field has been identified as additional Open Space and will be planted with trees to enhance forest cover and bulk up the size of the Core Environmental Feature, creating forest interior habitat. This restoration area is located in the northern portion of the field, corresponding to the narrowest point of the ESPA forest. Restoration will create forest habitat that matches the existing adjacent forest community using similar species that are suited to the soil and environmental conditions, and will widen the forest in conjunction with reforestation on the northern side of the forest. This block is a

natural low point on the property and will continue to receive surface runoff from the adjacent lots. See section 6.10 for further details.

The proposed plan for the internal field provides a combination of large lot development with environmental considerations including partial restoration of the field to enhance the form and ecological function of the ESPA 80 woodland.

5.6 Erbsville Kartway Property

The Erbsville Kartway property is in separate ownership and the development of this parcel will be through a separate application. This property and the Northgate lands have been studied together throughout the pre-construction monitoring program and characterization report. The draft plan, servicing and stormwater management planning and reports incorporated both parcels for an efficient planning approach. It is expected that these lands will be developed at a later stage, as development progresses from east to west. A large part of the Erbsville Kartway property consists of provincially significant wetlands, a portion of Laurel Creek, natural feature buffers and floodplain, with residential development and vacant land condominium proposed outside of those constraints. The property is actively used as a go kart facility and contains a paved track, buildings and mown lawn as well as the owner's private residence. The business will continue to operate until development begins. The impact analysis is included in this combined report.

5.6.1 Direct Impacts and Mitigation Measures

Vegetation Removal

The only direct impacts will be the removal of vegetation associated with the existing residence, the go-kart facility and outbuildings. Limited landscape plantings and ornamental trees in and around these buildings and facilities will be removed at the time of development as these are demolished. These trees and plantings surrounding the existing residence are not significant and no significant species use this area.

Bird Nest Destruction

The *Migratory Birds Convention Act* (MBCA) protects migratory birds, their eggs and nests from being harmed or destroyed. The core nesting period for migratory birds in the study area for open habitats is May 1 to July 31(CWS 2016a).

Mitigation: During the time period from May 1 to July 31 it is recommended that no clearing of vegetation occur within the Erbsville Kartway property. The Canadian Wildlife Service (CWS) advises that, nest searches, as a means of mitigating nest destruction during the core breeding period, may be undertaken in "simple" habitats such as isolated landscape trees, bridges, or other constructed features where the potential to observe all active nests is relatively high (CWS 2016b). If required at the time of development, nest searches are a feasible on this property due to the simplicity of the habitats to be removed.

Species At Risk

Barn Swallow

Barn swallow was confirmed nesting in one of the Erbsville Kartway buildings during the 2017 spring monitoring. Barn swallows and their nests are protected under the ESA. These buildings will require removal at the time of development.

Mitigation: Nesting will be monitored during future years of the pre-construction monitoring program and will be addressed according to the ESA at the time when building demolition is proposed, and in consultation with MNRF, as appropriate.

Bats

During field surveys, bats were observed exiting one of the Erbsville Kartway buildings. Recent guidance from MNRF recommends that the buildings proposed for removal be surveyed visually for bats, as per standardized protocol (D. Marriott, pers. comm. 2015b). Since it will be several years before the development of this subject property, these buildings will be re-assessed at that time to ensure compliance with the *Endangered Species Act* (2007) and any updated guidance on SAR bats.

Mitigation: SAR Bat use of the buildings will be monitored and will be addressed according to the ESA at the time when building demolition is proposed, and in consultation with MNRF, as appropriate.

5.6.2 Indirect Impacts and Mitigation Measures

Encroachment into Buffers

No encroachment into natural feature buffers is proposed in this portion of the development.

Species At Risk

Butternut

One butternut tree is located along the edge of the wetland on the Erbsville Kartway property. If the tree is found to be a pure butternut through the genetic testing, a BHA will be carried out to determine if it is a retainable specimen. The tree is within the 30m buffer of the wetland and no disturbance is proposed. No significant grading is required for the lots backing onto this area and the tree is expected to be adequately protected and buffered from development. If the tree is a pure butternut, and activities are proposed that may affect it, the landowner will follow the requirements of the ESA at the time of the Site Plan application.

Mitigation: Butternut will be addressed according to the ESA, if it is found to be a pure specimen.

Changes to Water Balance

All of the Erbsville Kartway property currently drains to Laurel Creek, as shown on Figure 2.0 of MTE's report. As indicated in their report (MTE 2017) and approved in the NWSSS, some of the land which currently drains to Laurel Creek will be redirected to Beaver Creek during development in order to consolidate the number of stormwater management facilities required and to limit the number of outlets to watercourses (NWSSS). Of the 4.4 additional hectares predicted in the NWSSS, only 2.2ha are proposed to be redirected to Beaver Creek in the post-development drainage analysis. The remainder of the Erbsville Kartway property will continue to discharge surface runoff overland through rear yards towards Laurel Creek and the wetlands. Details of catchments are shown on Figures 3.1 and 3.2 of MTE's report. No impacts to Laurel Creek are anticipated as a result of this minor change.

5.7 Stormwater Management – Water Quality (All Stages)

The potential for impacts to water quality may arise as a result of the proposed development from sediment and contaminants which can be transported by water into natural features and have negative effects on fish, aquatic habitats, plants and wildlife. Impacts to in-stream water temperature are also included in this section. Treatment of water from the site for quality improvements is provided mainly through the SWM facility 5914 which services Stages 3 and 4 and a portion of the Erbsville Kartway property. This facility will be a wet pond and will incorporate a sediment forebay which will encourage dilution and settling of sediment for the more frequent and smaller storms (<25mm). Larger storms will be separated and enter the main pond directly so as to avoid re-suspending accumulated sediment and creating washouts.

Water quality treatment in the facility is based on a drainage area of 12.088ha with 61.9% imperviousness. Clean flows such as from roofs and rear yards will be directed overland through grassed areas and buffers toward the wetland, Laurel Creek and Beaver Creek. This measure will improve water quality by filtering and infiltrating clean flows wherever possible.

In Stages 1 and 2, the preliminary SWM design and approach includes an oil-grit separator prior to SWMF 3915 to provide an enhanced level of water quality control.

Mitigation – implement stormwater management strategy and design details as provided by MTE.

5.8 Sedimentation and Erosion During Construction

During construction, areas of bare soil will be exposed which have the potential to erode during rainfall events and impact adjacent natural features. In the event of a heavy rain, sediment laden runoff can enter adjacent natural areas by way of overland flow. In order to protect on-site and off-site natural features from potential impacts due to sediment, a sediment and erosion control plan should be developed. MTE provides a number of recommendations regarding construction staging and site erosion and sedimentation control in their report (2017). The details of the erosion and sediment control plan will follow the Erosion and Sediment Control Guidelines for Urban Construction which will be

provided during final design. The recommendations include consideration of best management practices listed in the NWSSS such as sequencing of works, rock check dams, sediment control fencing, sediment basins, management of topsoil or fill storage piles and regular monitoring and inspection of these measures, as well as reporting to the City of Waterloo and the GRCA.

Mitigation – An Erosion and Sediment Control Plan should be prepared and implemented taking into account the best management practices recommended in the NWSSS and the details provided by MTE.

5.9 Indirect Impacts to Wildlife

Potential indirect impacts to wildlife may arise from noise and dust associated with construction activities as well as unnatural lighting associated with the development. During construction activities such as tree clearing and grubbing, dust can be created which can have a harmful effect on wildlife and vegetation, while excessive noise and human activity can cause wildlife to temporarily avoid the area.

Mitigation: Dust and noise associated with construction is anticipated to be temporary. Best practices for limiting dust should be employed. Construction activity should be limited on a daily basis to daytime hours. Significant effects on wildlife and vegetation from dust and noise are not expected. Lighting designs should include shielding and directional lighting on roads and buildings to avoid lightwash impacts on wildlife.

Maintenance of the stormwater management ponds has the potential to impact wildlife such as amphibians and turtles which may take up residence in the pond. It is well documented that Painted Turtles (*Chrysemys picta marginata*) and Snapping Turtles move into man-made ponds after construction, and it is possible that the pond may attract Blanding's Turtles as well. The wet cells of the pond have been placed outside of the Category 2 habitat of Blanding's Turtle which will avoid the need for registering any maintenance works for an exemption under the ESA, but best management practices should be employed when planning pond clean out. Timing windows to avoid the active turtle season as well as wildlife salvage prior to activities will help avoid impacts to wildlife.

Mitigation: Install permanent fencing around the SWM pond to effectively exclude turtles from the infrastructure. Assess wildlife use of the pond prior to clean-out. Avoid in-water maintenance of SWM pond during the summer season when turtles may be using the pond (ie. avoid work during May 1 to August 31). Implement wildlife and fish salvage immediately prior to maintenance work, as required.

5.10 Induced Impacts and Mitigation Measures

Induced impacts are described as those that are not directly related to the construction or operation of the facilities in question, but rather arise from the increased use of the natural areas by humans as a result of the development. The simplest example is occupancy effects such as increased use of a natural area by residents and their pets resulting in impacts such as unauthorized trail construction, garbage dumping and wildlife disturbance and mortality. Once the development is completed, subsequent use of the natural areas by residents is difficult to control.

A number of options are available to help mitigate potential impacts of human occupancy as discussed in the NWSSS. These include permanent fencing at the development/natural area interface to prevent uncontrolled access and rear lot encroachment into buffer and sensitive areas. It is a requirement of the City of Waterloo that standard chain-link fencing be installed along the private-public interface to prevent encroachment. Fencing is to be located at the limit of the buffer, or allowed encroachment such as for public trails or SWM facility. A chain link permanent fence is also recommended along the property boundary with the GRCA owned lands to the south, to prevent trespassing. GRCA property fencing is to be 1.2m high with details provided in OPSS-541 and OPSD-900.01 specifications using Class A fencing fabric with no gates permitted (NWSSS).

The provision of a formal trail system is important to focus residents' access along the outer limits of the natural heritage system. No trails within the sensitive core areas are recommended (ie. provincially significant wetlands, forests, groundwater seepage areas, significant species locations, etc.). The NWSSS provides guidance as to locating trails to avoid impacts to natural features but allowing a recreational and nature viewing experience and the BCMDP provided a general layout for a community trail system (TPP 2016) which has been adopted in this proposal. This study has located a trail system

within the outer 5m of the buffer to wetlands and forests and is shown on Map 2. The trail provides an east-west connection for residents by a crossing of Beaver Creek in the recommended location, at the narrowest portion of the corridor. At this time, the general location of the trail has been determined in order to ensure that appropriate grading can be provided, as many areas contain steep slopes. A 3.0m wide, stone dust surfaced trail is proposed, but will be linked to parks and paved pathways and sidewalks of on-street pedestrian travel routes. Signage identifying sensitive natural areas is recommended at regular intervals along the natural area buffer portion of the trail system.

Mitigation: Education with respect to the values and appropriate stewardship of the neighbouring natural areas through signage and environmental brochures. The City of Waterloo has a brochure entitled "Naturally Your Waterloo" that can be purchased and provided to homeowners as a condition of approval. Rear lot fencing and fencing at the development/natural area interface will be constructed including along the GRCA property boundary.

A focused trail system that allows recreation and nature viewing but avoids sensitive natural areas is recommended. The details of the trail design, location and signage are to be determined at the Site Plan Approval stage.

6.0 Enhancement of Natural Features

A basis for ecological enhancements in the study area is provided in the NWSSS in Section 14.4. This section indicates that the primary ecological enhancements in the study area include linkages, buffer management (including habitat creation – general and specialized) and specific wildlife passage measures to reduce roadkill at the Conservation Drive crossing of Beaver Creek. Recommendations for restoration and enhancement measures on-site are provided in this section using the general objectives provided in the NWSSS but tailored to the site conditions, species and habitats present, and opportunities within the development plan. The combined enhancement opportunities are shown on a Stewardship Management Plan (Map 8). This plan shows how open space land uses have been placed adjacent to the natural features and their buffers which provide expansion of the contiguous green space area and connectivity between naturalized and natural features.

6.1 Wetland/Woodland Edge Buffer Enhancement

Pre-development monitoring of the wetland/woodland edges showed that these are generally in good condition within the Erbsville Kartway property, with disturbances or damage to the edge noted within the Northgate property. Agricultural tilling occurs right up to the natural feature edges and tree removal and brush cutting along the woodland edges within the Northgate property, resulting in these edges being fairly open and susceptible to impacts of erosion, sun, invasive species and windthrow. A few locations of erosion from runoff from the fields were observed with sandy soils being deposited into the adjacent natural features.

Through the proposed development, the edges will be stabilized and protected through the implementation of buffers. Buffers are an opportunity to enhance the wetland/woodland features and provide a transition zone between the natural communities and the development, thereby protecting them from the influences of the built-up areas. Buffer enhancement may include the planting of large caliper trees or smaller tree ‘whips’ and shrub plantings, all of which will serve to expand the size of the existing woodland and create more closed and stable/resilient edges. The selection of species for edge plantings should reflect the native species composition of adjacent natural areas. The natural regeneration that currently occurs at woodlot edges should

be considered as well; left alone, the natural succession of trees and shrubs will lend itself to the buffering effect. Due to the presence of Emerald Ash Borer (*Agrilus planipennis*) (EAB), within southern Ontario, the use of ash trees (*Fraxinus* spp.) for restoration plantings are not recommended. Trees in poor health may be recommended for removal from woodland edges.

Planting of the buffers with trees and shrubs is recommended in a few key locations (as opposed to just relying on natural regeneration). These include small areas of erosion along Beaver Creek, the woodland buffer along the access road in Stage 5 and the areas proposed for re-forestation to enhance forest interior habitat.

Where the buffer is adjacent to a wetland boundary, the focus should be on restoring desirable native wetland species and providing a vegetated buffer to the wetland. The moisture regime of these areas requires careful selection of appropriate species of trees, shrubs and herbaceous vegetation, with a mixture of all three vegetation types being desirable. It is noted that tree cover may not be necessary for buffering all of the wetland areas. Restoring open meadow on the buffer lands may be important for wildlife species such as snakes, birds, small mammals, insects (Lepidoptera and Odonata), and other edge species which are known to use open areas in conjunction with wooded and thicket habitats. In these situations, node plantings of shrubs or trees, in addition to herbaceous ground cover will be the best approach. The establishment of dense shrub areas around the wetland edge will provide refuge for wildlife and is generally an aesthetically appealing approach to enhancement plantings, as well as deterring human encroachment through a 'living fence' approach.

Some minor refuse dumping has been noted within the wetlands/woodlands throughout the subject property, having been discarded there in the past. To improve conditions in these areas, it is recommended that removal of refuse by hand is undertaken throughout the subject property.

6.2 Aquatic Habitat Enhancement

The primary management recommendation for the watercourses in the study area in the NWSSS is to retain in full, with no alterations, all watercourses on the subject property. In addition, two opportunities for improvement are mentioned which include; 1) the

removal of a “knick point” on Laurel Creek, created by a large woody debris jam on the GRCA lands, downstream of the subject lands; and 2) consider removing the beaver dam on Laurel Creek at the downstream end of the Kartway property. The proposed development will retain the watercourses in full and no alterations to any parts of the watercourses are proposed. The recommended buffer widths have been applied and will be naturalized which will be an improvement in riparian cover for both Beaver and Laurel Creeks.

During our pre-construction monitoring on Laurel Creek, the beaver dam was observed to have been removed through natural processes of flooding and storm flow, so no longer creates a backwater effect. The channel is currently in a transitional stage and is in the process of re-aligning itself through natural stream processes. The knick-point (abrupt drop/pool) is located off-site, on GRCA lands and is an opportunity for restoration to improve channel connectivity with the upstream reaches.

6.3 Naturalization of Stormwater Management Areas

The effective naturalization of stormwater ponds can hold value in providing native vegetation in proximity to natural areas, while connecting and enhancing ecological linkages. The naturalization approach should reflect the native species composition of nearby natural areas. Native species present at wetland edges will serve as good indicators for what species would naturalize well in stormwater management ponds.

A diverse mix of trees, shrubs and herbaceous species with appropriate tolerances for hydrologic regime, will enhance the aesthetics of these features, in addition to providing wildlife cover and reducing slope erosion. Woody plant material should be planted in a manner that provides at least a 3.0m clearance on either side of access roads for maintenance purposes.

As a mitigative measure to enhance water temperature conditions at the stormwater ponds, where feasible, tree, shrub and herbaceous plantings are recommended to provide shading to the ponds and along the outlet ditch and cooling trench.

6.4 Invasive Species Removal

Stands of White Poplar (*Populus alba*) and nodes of Phragmites were identified during the pre-construction monitoring (NRSI 2016, NRSI 2017), namely along the natural features edges. White Poplar trees exist adjacent to Conservation Drive only and not elsewhere within the subject property. Areas with White Poplar are well-established within the north portions of WSU-12 and WSU-14. White Poplar is a non-native tree species that is particularly aggressive and spreads by root suckers. Dense thickets can form along roadsides, fields, forest edges, and other disturbed habitats (Reznicek et al. 2011). The proposed improvements to Conservation Drive are an appropriate opportunity to control the roadside stands of White Poplar. As shown in the Environmental Assessment for the proposed infrastructure improvements to Conservation Drive, the proposed road right-of-way will widen into existing roadside areas where White Poplar has been identified (Stantec 2015), providing an opportunity to remove this species and control any remaining individuals.

Phragmites exists throughout the subject property and is generally characterized as an early establishment. Phragmites is found in disturbed habitats, such as roadside ditches, and edges, preferring mesic to hydric soils, and is salt tolerant. Dense stands form through aggressively spreading rhizomes, out-competing native wetland vegetation such as cattails (*Typha* spp.). Phragmites identified at the southern subject property boundary that separates the Erbsville Kartway and Northgate properties extends off-property to the south into the Laurel Creek Nature Centre lands. This node will be a challenge to control in the long-term unless a coordinated effort among landowners is initiated. Given the early onset of establishment, opportunities are present to remove this species and enhance habitats before it becomes fully established. Removal of Phragmites through herbicide application should be considered, if possible.

Invasive species, such as Garlic Mustard (*Alliaria petiolata*) and Glossy Buckthorn (*Frangula alnus*) exist occasionally throughout the subject property and are not identified as problematic at this time.

It is recommended that an invasive species management plan be prepared during detailed design as a condition of approval and implemented at an appropriate project development phase.

6.5 Parks and Trails

Open and “green” land uses such as parks and stormwater management ponds have been placed adjacent to the natural features and provide an opportunity for open space in conjunction with the identified significant natural features. The Draft Plan (Map 2) shows a park block (Block 21, Stage 4) located adjacent to the 30m setback to the wetland and Beaver Creek. Similarly, park Block 6 (Stage 1) is located adjacent to the 10m woodland dripline setback. The remaining parks (Blocks 4 and 20) have been integrated into the residential areas to provide amenities for future neighborhood residents, such as recreation and nature appreciation, within short distances for the majority of residents, which is a guiding principle of the Beaver Creek Meadows District Plan (TPP 2016).

The proposed trail will be located outside of the natural features and their buffers or will be located within the outer 5m of the buffer where appropriate. The buffers are currently open agricultural land and together with the parks provide opportunities for ecological enhancements such as plantings, water retention and infiltration. The trail placement follows the guidance of the NWSSS in that trails are not adjacent to the natural heritage system for lengthy stretches, but instead are loops which provide access for nature viewing and connect back into the developed on-street/park trail network. An east-west trail connection is located outside of the wetland, and takes advantage of the narrowest point along the Beaver Creek riparian corridor.

6.6 Wildlife Passage at Conservation Drive

As described in the EA for the improvements to Conservation Drive prepared by Stantec (2015) for the City of Waterloo, the crossing of Beaver Creek requires the construction of a larger culvert structure to accommodate regional flood levels. This is an opportunity to enhance the connectivity for wildlife along the Beaver Creek corridor and may include a terrestrial wildlife crossing and barriers to prevent road mortality such as wildlife funnel walls, as recommended in the NWSSS (Ecoplans et al. 2013). The details of these enhancements will be considered and undertaken by others.

See Section 6.7 below for discussion of wildlife passage at the access road to the central field.

6.7 Access Road to Central Field

Although there was no evidence of any significant wildlife crossing at this location, the placement of a road through this section between two woodland areas is seen as an opportunity to provide measures for safe wildlife passage. Given the low number of lots in the central field (15), the volume of traffic travelling the access road will be quite low, and so too is the risk to wildlife.

In the current condition, wildlife moves diffusely through the landscape and tends to follow the edges of the woodland and wetland. When constructed, the road will be setback from the current dripline of the woods by a 10m buffer or more. However, in the future scenario, the surrounding open agricultural fields will be developed which will result in focusing wildlife movement along edges and buffers and toward this crossing. This area may become more frequently used for passage by wildlife. The restoration of the woodland edge and buffers along the access road will make this a very narrow crossing (approximately 15m in width) and it will likely not be seen as a gap to wildlife moving through the area.

As the road will be elevated through this section, and partially contain a retaining wall, it may pose a barrier to small wildlife travelling from one side to the other. Installation of 2 culverts for drainage is proposed, and these are an opportunity to provide passage for small wildlife under the access road. The details of the design and placement of these culverts are recommended to be completed at the detailed design stage as a condition of approval. In general as shown on MTE drawing, there will be 2 culverts installed under the access road; one 375mm diameter, 13m long, and a second; a box culvert 2.4mx1.2m, 28m long are recommended and will provide an openness ratio of 0.1, which is conducive to use by small wildlife.

6.8 Ecological Linkages

The NWSSS identifies the Beaver Creek corridor as an existing movement and connection within or between natural areas in the local landscape. The woodland and wetland Core Environmental Features on the subject lands are also identified as

linkages with connections to off-site natural areas and are to be enhanced. Measures to enhance the quality of existing linkages include the provision of buffer zones to increase the size and width of natural areas, provide additional habitat diversity, visual screening and protection from edge effects. The control of invasive vegetation, infilling of gaps, and maintenance of vegetation structure in combination with buffer plantings/natural regeneration will assist in improving the quality and function of the existing linkage areas.

6.9 Beaver Creek Riparian Corridor

The length of Beaver Creek from Conservation Drive to ESPA 80 is the main ecological linkage and primary focal area to establish a broader, enhanced ecological corridor, to improve connectivity to ESPA 80 and lands to the north. The main strategies to achieve this goal are widening of the corridor and improving wildlife passage at Conservation Drive (see Section 5.6.7 above).

The NWSSS identifies herpetofauna as the group of wildlife to use as a target when considering options for improvements to the riparian corridor. Based on this wildlife group, the following design considerations are provided for improvements to the corridor:

- Increase to a minimum width of 60m,
- Native species plantings which are low maintenance, provide shading, cover and refuge from predators,
- Improve soil moisture, but avoid creation of ponded areas that could become breeding sinks,
- Provide hard cover elements such as rootwads, woody debris and stone piles,
- Manage construction timing to protect wildlife,
- Provide signage and homeowner education, and,
- Exclude humans through fencing, and avoid or minimize and separate any trails.

Given the open “green” space associated with park and stormwater management blocks on both sides of Beaver Creek, opportunities are provided for enhancement of the riparian corridor according to the recommendations of the NWSSS. The placement of the Pumping Station, SWM Blocks and Park Block all along the narrowest part of the Beaver Creek corridor, in addition to implementing the 30m buffer is an opportunity to

restore the width and quality of this riparian area and to enhance its function as a linkage. The SWM Block on the eastern side of Beaver Creek will require an embankment of approximately 16-20m in width, which will be vegetated and re-forested. Naturalization of part or all of these blocks will result in an increase in corridor width to a range of between 125m and 250m. A restoration plan detailing enhancements to this area is recommended to be a condition of approval.

6.10 Forest Interior

As described in the NWSSS (Ecoplans et al. 2013), a component and indicator of significant habitat within overall forest cover targets is the presence of 'interior' forest habitat (i.e. forested habitat >100m from forest edge), and 'deep interior' forest habitat (i.e. >200m from forest edge, as per OMNR 2010). Forest interior habitat has been identified as an enhancement opportunity in the NWSSS (Ecoplans et al. 2013), since interior and deep interior forest habitats are below recommended thresholds for the watershed and these types of habitats are limited in the NWSSS study area. Interior forest habitats are important to the integrity of biodiversity at the landscape scale, particularly for area-sensitive species such as Wood Thrush, which was documented incidentally within the subject property with no breeding evidence. The current size and shape of the forested areas on the subject lands provides a very small amount of forest interior habitat, as described in Table 8 for WSU-13 and WSU-15 totaling 0.569ha. During the pre-construction monitoring, only a few bird species with forest interior habitat affinities were documented sporadically and this is seen as an important function to be improved and restored within the development process. Increased forest interior habitat will benefit area-sensitive breeding bird species, for example, in an increasingly fragmented urban landscape.

A mapping exercise was completed to compare the existing amount of forest interior habitat to the future scenario, based on the restoration of the recommended buffer zones. In addition to restoring buffer lands, a portion of the central field and an area along the northern woodland edge, have been proposed for re-forestation in order to further augment the forest interior function of the ESPA. These areas of reforestation will help to bulk up the overall forest size, as well as filling in "bays" and decreasing edge. Based on this approach, forest interior habitat in the post-development condition

will increase to approximately 1.58ha in total within the subject property. Existing forest interior habitat will be expanded/enhanced in WSU-13 (to 1.44ha), and will be created in WSU-15 (0.14ha) where there is none provided in the existing condition (refer to Map 8, Stewardship Plan).

7.0 Monitoring Plan

Pre-construction monitoring in the study area is ongoing and will continue through the construction and post-construction stages at two levels of study; the system-wide subwatershed level monitoring and the site level monitoring. The pre-construction monitoring program was described in a Terms of Reference (TOR) dated January 21, 2015 (NRSI 2016) and includes biological, surface water and groundwater components. A TOR for during and post-construction monitoring stages will be prepared and submitted for agency review at the time of transition to those stages.

7.1 Pre-Construction Monitoring (Stage I)

The pre-construction monitoring program has been carried out for the past 3 years (2014, 2015 and 2016) and includes biological, surface water and groundwater components across the subwatershed and at specific sites. The monitoring program methods were developed according to the City of Waterloo Development Monitoring Protocol (1999), Sections 14 to 17 of the NWSSS (Volume 1, November 2013) and was revised and updated based on comments received from the City of Waterloo, Grand River Conservation Authority (GRCA), and the Region of Waterloo as well as results of the Species At Risk (SAR) screening, prepared separately, which was reviewed and approved by MNRF on December 15, 2014 (G. Buck, pers. comm. 2014).

The pre-construction monitoring program results for the first three years are provided in the *North Waterloo Subwatershed Lands Pre-Construction Biological Monitoring Program 2014-2015* (and 2016) *r*eports prepared by NRSI (NRSI 2016, NRSI 2017). Pre-construction monitoring is continuing in 2017. Stantec is reporting on the surface water and groundwater monitoring programs for the subwatershed study area under separate cover, while MTE has carried out the site specific groundwater monitoring and reporting. These programs will continue to be carried out until the start of site grading which is the first activity in preparing the site for development and is anticipated to be in 2018.

7.2 During Construction Monitoring (Stage II)

The works associated with construction such as vegetation removal and earth grading have the potential to result in impacts to adjacent natural features. Prior to the onset of area grading, site specific measures will be put in place to control runoff, limit the work

zone and ensure that equipment is operated and maintained in an environmentally safe manner. During construction monitoring is anticipated to focus on implementing and monitoring the controls to protect surface water and groundwater as well as buffers to the adjacent woodland/wetland and will include sediment and erosion control measures as well as functioning of the stormwater management facilities.

The during-construction biological monitoring program is modelled after the pre-construction monitoring program and includes the same biological, hydrological and hydrogeological monitoring conducted previously as well as compliance monitoring and will be prepared in accordance with the City of Waterloo's Development Monitoring Protocol (1999). The details of during construction biological monitoring program will be refined following the outcome of this EIS, but are anticipated to follow the same general intent and methods as the pre-construction monitoring. Stormwater management, erosion and sediment control and groundwater monitoring recommendations during construction are provided by MTE in their reports. The results of the monitoring will be reported annually to the City and GRCA.

7.3 Post Construction Monitoring (Stage III)

Post-construction monitoring begins once the site development is mostly completed and the site is generally stable. The City of Waterloo Development Protocol indicates this should start once the project reaches 90% buildout. Monitoring frequency is reduced to reflect the stability and maturity of the site. The purpose of this stage of the monitoring is to ensure that the watershed targets are being met with respect to ecological health of the natural features. Areas where it may be necessary to provide any additional mitigation measures will be identified and also the effectiveness of the controls put in place for the operational phase of the development will be monitored.

At this point the natural features will have been well-documented by the monitoring program over many years. The original surface water, groundwater and biological monitoring programs will be continued at the subwatershed scale and the site scale, but the frequency will be decreased for each component:

- Surface water: subwatershed scale,
- Groundwater: subwatershed scale and site specific,

- Erosion: site specific scale,
- Aquatic habitat: one benthic invertebrate sample during the year (fall), every three years.
- Terrestrial habitat: confirmation of vegetation community condition twice per year, every three years.
- Stormwater Management Facilities: monitoring of SWM facilities as recommended by MTE.
- Erosion and sedimentation control measures: inspections of control measures are to continue quarterly and at the time of removal.

The results of the post-construction monitoring programs will be reported to the City and the GRCA, being submitted on their own schedules which range from annually to every three years.

8.0 Summary and Recommendations

This EIS builds on the characterization of natural features presented in the NWSSS (Ecoplans et al 2013), and incorporates the findings of the 3 years of pre-construction biological and water monitoring that has been completed specifically on the subject property. The analysis of natural feature significance and ecological functions in the NWSSS is further substantiated by this most recent work. The woodlands and wetlands on the subject property contain relatively good quality habitats with some areas of rich and diverse species communities. The wetlands are supported by groundwater discharge as well as surface water runoff and direct rainfall to a lesser extent. There are areas which have experienced past impacts but these are regenerating and naturalizing. Butternut and Barn Swallow, both Species at Risk, were observed within the subject property and will be addressed according to the ESA. Wetland features on-site plus 30m is Category 2 protected general habitat for Blanding's Turtle, a provincially Threatened species. Eastern Wood-pewee, Snapping Turtle and Common Nighthawk, all Species of Conservation Concern were documented within the property, and their habitats have been retained and protected. Regionally significant birds and plant species have been documented in the woodlands and wetlands as well. Woodlands and wetlands within the subject property are significant natural features and have a number of designations such as PSW, Significant Woodland, SWH, and are part of ecological linkages providing travel routes for wildlife along the Laurel Creek and Beaver Creek corridors to off-site habitats to the north and south. Conservation Drive is a barrier to wildlife movement which is being addressed through road improvements as part of a Class EA. Laurel Creek is classified as an existing coldwater system that flows through the west portion of the Erbsville Kartway property and is a headwater tributary of the Grand River. Beaver Creek is a coolwater/warmwater stream that flows through the central portion of the property and drains into Laurel Creek, the Laurel Creek Reservoir, and eventually into the Grand River.

The NWSSS provides recommendations on management, development setbacks and buffers and these were relied on in order to design the layout of the proposed development in addition to other physical constraints as well as planning, transportation, grading and servicing considerations. The development layout adheres to the natural

feature buffers recommended in the NWSSS (Ecoplans et al. 2013), with the exception of minor encroachment into the outer 15m of the wetland buffer, or the outer 5m of the woodland buffer for stormwater management, transition grading and trails. Total encroachment into buffers is 0.12ha. This encroachment is considered minor and is not anticipated to be a negative impact to the wetland/woodland and creeks, their functions or wildlife species. There are additional lands to be added to the buffers that more than off-set this encroachment. Buffers will be allowed to naturalize and will be supplemented with plantings in areas where there is soil erosion (adjacent to Beaver Creek), where buffer width has been reduced adjacent to residential lots, as well as along the access road in Stage 5. Rear lot fencing, a designated trail system and homeowner education are further methods of mitigating the potential for impacts due to residents.

A stormwater management report has been prepared by MTE that shows how the design meets the criteria of provincial and local policies (MOE, GRCA, City of Waterloo) and the NWSSS for quantity, quality, erosion control, infiltration and thermal mitigation. The forebay and wetland of the SWM facility are outside of the protected general habitat for Blanding's Turtle. Infiltration is a key part of the stormwater management design which incorporates a mix of lot-level, conveyance and end of pipe techniques and facilities to maintain and enhance infiltration occurring on-site. LID measures including permeable pavement and a bioswale are proposed in the central field to enhance infiltration. Post-development infiltration is expected to exceed pre-development infiltration which will be a benefit and enhancement to the wetlands, Laurel Creek and Beaver Creek and their habitats.

Mitigation and compliance monitoring measures are provided by the team of MTE and NRSI to avoid, minimize and alleviate any potential impacts during construction and occupancy. An outline of a during and post-construction monitoring program has been provided which includes biological, surface water and groundwater monitoring as well as performance monitoring of the stormwater management facilities. This program will aim to track and compare the environmental conditions during and post-development and compare those to the pre-development monitoring results and the targets set in the NWSSS to identify any changes that may be related to the development and are not due to weather patterns or other natural cycles.

The Stewardship Plan as described in Section 6.0 and shown on Map 8 demonstrates the commitment of the applicants to protecting natural areas, and enhancing and restoring ecological functions on the subject property to the benefit of the subwatershed study area. The plan shows how the development will provide a buffer between natural features and the development and places open space land uses such as stormwater management and parks adjacent to the natural areas. The riparian corridor of Beaver Creek will effectively be widened to over 125m and forest interior habitat in ESPA 80 will be more than doubled to 1.58ha on-site. Taking into account the layout of the development, the stormwater management plan, the monitoring program and the stewardship plan, and assuming the recommendations in this EIS and the reports of the study team are implemented no significant negative impacts to natural features are anticipated as a result of the proposed development.

9.0 References

Anderson, Hayley. 2012. Invasive Common (European) Buckthorn (Rhamnus cathartica): Best Management Practices in Ontario. Ontario Invasive Plant Council, Peterborough, ON.

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid bioassessment protocols for use in streams and wadeable rivers: periphyton, benthic macroinvertebrates and fish, second edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

Bird Studies Canada (BSC). 2009. Marsh Monitoring Program Participant's Handbook for Surveying Amphibians. 2009 Edition. Published by Bird Studies Canada in Cooperation with Environment Canada and the U.S. Environmental Protection Agency. February 2009.

Bouchard, Jr. R.W. 2004. Guide to aquatic invertebrates of the Upper Midwest. Water Resources Center, University of Minnesota, St. Paul, MN. 208 pp.

Brigham, R. M., Janet Ng, R. G. Poulin and S. D. Grindal. 2011. Common Nighthawk (*Chordeiles minor*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/213 doi:10.2173/bna.213

Canadian Wildlife Service (CWS). 2016a. Core Nesting Periods of Migratory Birds in Canada. Last updated May 19, 2016.. https://www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=4F39A78F-1#_fig04_1

Canadian Wildlife Service (CWS). 2016b. Migratory Birds Convention Act (MBCA) and Regulations. Last updated March 14, 2016. http://www.ec.gc.ca/nature/default.asp?lang=En&n=7CEBB77D-1

Chapman, L.J. and D.F. Putnam. 1984. The Physiography of Southern Ontario 3rd Edition. Ontario Ministry of Natural Resources. Toronto, Ontario. Ontario Geological Survey, Special Volume 2.

City of Waterloo. 2014. City of Waterloo Official Plan – Office Consolidation. October 2014.

City of Waterloo. 2002. Terrestrial Monitoring - Plot Establishment & Data Collection.

City of Waterloo. 1999. City of Waterloo Development Monitoring Protocol. Development Services Department. July 16, 1999.

Dobbyn, J.S. 1994. Atlas of the Mammals of Ontario. Don Mills, Federation of Ontario Naturalists.

Eakins, R. J. 2013. Ontario Freshwater Fishes Life History Database. Version 4.68. Online database. (http://www.ontariofishes.ca).

Ecoplans, MHBC, and Stantec. 2013. North Waterloo Scoped Subwatershed Study. Volume 1. November 2013.

Environment Canada. 2013. How Much Habitat is Enough? Third Edition. Environment Canada, Toronto, Ontario.

Environment Canada. 2011. 2011 Metal mining environmental effects monitoring (EEM) technical guidance document. Chapter 4; pp. 29 – 53.

Ernst, C.H., and J.E Lovich. 2009. Turtles of the United States and Canada, Second Edition. The John Hopkins University Press, Baltimore, Maryland.

Federation of Ontario Naturalists. 1999. Woodland Heritage of Southern Ontario. A Study of Ecological Change, Distribution and Significance.

Government of Canada. 2016. Species at Risk Public Registry: Species Index. Last updated December 23, 2016. http://www.sararegistry.gc.ca/sar/index/default_e.cfm (Accessed January 2017)

Grand River Conservation Authority (GRCA). 1993. The Laurel Creek Watershed Study. Waterloo, Ontario: City of Waterloo.

Grand River Conservation Authority (GRCA). 2005. GRCA's EIS Guidelines and Submissions Standards for Wetlands. August 26, 2005.

Grand River Conservation Authority (GRCA), 2006. Grand River Fisheries Management Plan. Waterloo, Ontario: City of Waterloo.

Grand River Conservation Authority (GRCA). 2013. Policies for the Administration for the Development Interference with Wetlands and Alterations of Shorelines and Watercourses Regulation: Ontario Regulation 150/06. January 25, 2013.

Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. The Great Lakes Entomologist. Vol. 20, No. 1. Pg 31 – 39.

Hilsenhoff, W.L. 1988. Rapid field assessment of organic pollution with a family-level biotic index. J. N. Am. Benthol. Soc. 7(1):65-68.

Jones, C., K.M. Somers, B. Craig and T. Reynoldson. 2007. Ontario Benthos Biomonitoring Network Protocol Manual. Ontario Ministry of the Environment, Environment Canada, National Water Research Institute.

Lee, H.T., W.D. Bakowsky, J. Riley, J. Bowles, M. Puddister, P. Uhlig and S. McMurray. 1998. Ecological Land Classification for Southern Ontario: First Approximation and its Application. Ontario Ministry of Natural Resources, Southcentral Science Section, Science Development and Transfer Branch. SCSS Field Guide FG-02.

MacNaughton, A., R. Layberry, C. Jones and B. Edwards. 2016. Ontario Butterfly Atlas Online. http://www.ontarioinsects.org/atlas_online.htm (Accessed January 2017).

Martin, V. 1996. Revisions to Waterloo Region's Significant Species List: Breeding Birds Component. Report to the Regional Municipality of Waterloo, April 16, 1996.

Merritt, R.W., K.W. Cummins, and M.B. Berg. 2008. An introduction to the aquatic insects of North America – fourth edition. Kendall Hunt Publishing Company. Dubuque, IA.

Ministry of Natural Resources and Forestry (MNRF). 2016a. Species at Risk in Ontario (SARO) List. Last updated June 20, 2016. http://www.ontario.ca/environment-and-energy/species-risk-ontario-list (Accessed January 2017)

Ministry of Natural Resources and Forestry (MNRF). 2016b. Blanding's Turtle Nest and Nesting Survey Guidelines. Guelph District MNRF. May 2016, Version 1.

Ministry of Natural Resources and Forestry (MNRF). 2015a. Significant Wildlife Habitat Ecoregion 6E Criterion Schedule: Addendum to Significant Wildlife Habitat Technical Guide. MNRF, January 2015.

Ministry of Natural Resources and Forestry (MNRF). 2015b. Natural Heritage Information Centre (NHIC): Biodiversity Explorer, Land Information Ontario: http://www.giscoeapp.lrc.gov.on.ca/web/MNR/NHLUPS/NaturalHeritage/Viewer/Viewer.html (Accessed January 2017).

Ministry of Natural Resources and Forestry (MNRF). 2015c. Technical Note: Species At Risk Bats. Regional Operations Division. MNRF, June 2015.

MTE Consultants Inc. 2017. Northgate and Erbsville Kartway Subdivions, Beaver Creek Meadows District, Waterloo: Hydrogeology Study. Prepared for 1017081 Ontario Limited and Gabriella Elizabeth Groff (Northgate Subdivision), 1455136 Ontario Inc (Erbsville Kartway Subdivison) c/o Mr. Paul Grespan, 675 Riverbend Drive, Kitchener, ON N2K 3S3. July 5, 2017.

MTE Consultants Inc. 2017. Northgate and Erbsville Kartway Subdivions, Beaver Creek Meadows District, Waterloo: Preliminary Stormwater Management Report. Prepared for 1017081 Ontario Limited and Gabriella Elizabeth Groff (Northgate Subdivision), 1455136 Ontario Inc (Erbsville Kartway Subdivison) c/o Mr. Paul Grespan, 675 Riverbend Drive, Kitchener, ON N2K 3S3. July 5, 2017.

MTE Consultants Inc. 2017. Northgate and Erbsville Kartway Subdivions, Beaver Creek Meadows District, Waterloo: Functional Servicing Report. Prepared for 1017081 Ontario Limited and Gabriella Elizabeth Groff (Northgate Subdivision), 1455136 Ontario Inc (Erbsville Kartway Subdivison) c/o Mr. Paul Grespan, 675 Riverbend Drive, Kitchener, ON N2K 3S3. July 5, 2017.

Natural Resource Solutions Inc. (NRSI). 2016. North Waterloo Subwatershed Lands: Pre-Construction Biological Monitoring Program (2014-2015). Prepared for Northgate Land Corporation, 2115881 Ontario Ltd., and Erbsville Kartway. April 22, 2016.

Natural Resource Solutions Inc. (NRSI). 2017. North Waterloo Subwatershed Lands: Pre-Construction Biological Monitoring Program (2016). Prepared for Northgate Land Corporation, 2115881 Ontario Ltd., and Erbsville Kartway. March 7, 2017.

Ontario Breeding Bird Atlas (OBBA). 2001. Guide for Participants. Atlas Management Board, Federation of Ontario Naturalists, Don Mills.

Ontario Ministry of Municipal Affairs and Housing (OMMAH). 2014. Provincial Policy Statement.

Ontario Ministry of Natural Resources (OMNR). 1997. Fish and Wildlife Conservation Act.

Ontario Ministry of Natural Resources (OMNR). 2000. Significant Wildlife Habitat Technical Guide. October 2000.

Ontario Ministry of Natural Resources (OMNR). 2007. Endangered Species Act, 2007, S.O. 2007, CHAPTER 6.

Ontario Ministry of Natural Resources (OMNR). 2010. Natural Heritage Reference Manual for Natural Heritage Policies of the Provincial Policy Statement, 2005. Second Edition. Toronto: Queen's Printer for Ontario. 248 pp. March 2010.

Ontario Ministry of Natural Resrouces. 2013a. Draft Occurrence Survey Protocol for Blanding's Turtle (*Emydoidea blandingii*) in Ontario. Ontario Ministry of Natural Resources, Species at Risk Branch. Peterborough, Ontario. ii + 17 pp.

Ontario Ministry of Natural Resources (OMNR). 2013b. General Habitat Description for the Blanding's Turtle (*Emydoidea blandingii*). July 2, 2013. http://files.ontario.ca/environment-and-energy/species-at-risk/mnr_sar_ghd_bln_trtl_en.pdf

Peck, G.K., and R.D. James. 1983. Breeding birds of Ontario: nidiology and distribution, Vol.1: nonpasserines. Life. Sci. Misc. Publ., R. Ont. Mus., Toronto.

Regional Municipality of Waterloo (RMOW). 1985. Appendix 4: Mammals in Environmentally Sensitive Policy Areas Technical Appendix. Approved by Council: 1986.

Region of Waterloo. 2015. Regional Official Plan 2031. As approved with modifications by the Ontario Municipal Board on June 18, 2015.

Region of Waterloo. 2010. Region of Waterloo Greenlands Network Implementation Guideline. January 26, 2010.

Reznicek, A.A., E.G. Voss, and B.S. Walters. 2011. Michigan Flora Online. University of Michigan, February 2011. Accessed January 2017. http://www.michiganflora.net/home.aspx

Richardson, W. and V. Martin. 1999. Regional Municipality of Waterloo. Revisions to Waterloo Region's Significant Species List: Native Vascular Plant Component.

Sandilands, A. 2007. Common Nighthawk, pp. 308-309 in Cadman, M.D., D. A. Sutherland, G.G. Beck, D. Lepage, and A.R. Couturier, eds. Atlas of the Ontario Breeding Birds of Ontario, 2001-2005. Bird Studies Canada, Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources, and Ontario Nature, Toronto, xxii + 706pp.

Stantec. 2015. Beaver Creek Road and Conservation Dr. Upgrades and Extension of Municipal Services Class Environmental Assessment. Final Report. Prepared for City of Waterloo. Dated December 14, 2015.

Stantec. 2016. North Waterloo, Phase 1 Groundwater and Surface Water Monitoring Program. Prepared for Northgate Corporation, 2115881 Ontario Ltd., Activa Holdings and Erbsville Kartway. April 15, 2016.

The Planning Partnership (TPP). 2016. City of Waterloo Beaver Creek Meadows District Plan, Final Report. January 8, 2016. Approved by City Council January 25, 2016.

Stanfield L. (Editor) 2013. Ontario Stream Assessment Protocol. Version 9.0, Fisheries Policy Section. Ontario Ministry of Natural Resources. Peterborough, Ontario. 505 pages.

Swink, F., & Wilhelm, G. (1994). Plants of the Chicago region: Indiana Academy of Science.

Weber, C.I. 1973. Biological field and laboratory methods for measuring the quality of surface waters and effluents. Cincinnati, Ohio, U.S. Environmental Protection Agency. EPA-670/4-73-001.WESA. 2010. Surface Water Quality Monitoring Program Serpent (McCarthy) Ontario. February 2011.

Wedgwood, J. 1992. Common nighthawks in Saskatoon. Blue Jay, 50, pp.211-217.

Authorities Consulted

Buck, Graham. 2012a. Management Biologist, Ontario Ministry of Natural Resources and Forestry, Guelph District. Personal Communication (email correspondence regarding Barn Swallow monitoring guidelines), June 29, 2012.

Buck, Graham. 2012b. Management Biologist, Ontario Ministry of Natural Resources and Forestry, Guelph District. Personal Communication (email correspondence regarding Common Nighthawk survey protocol), May 23, 2012.

Buck, Graham. 2014. Management Biologist, Ontario Ministry of Natural Resources and Forestry, Guelph District. Personal Communication (email correspondence regarding 2115881 Ontario Ltd. property, SAR Screening memo approval), December 15, 2014.

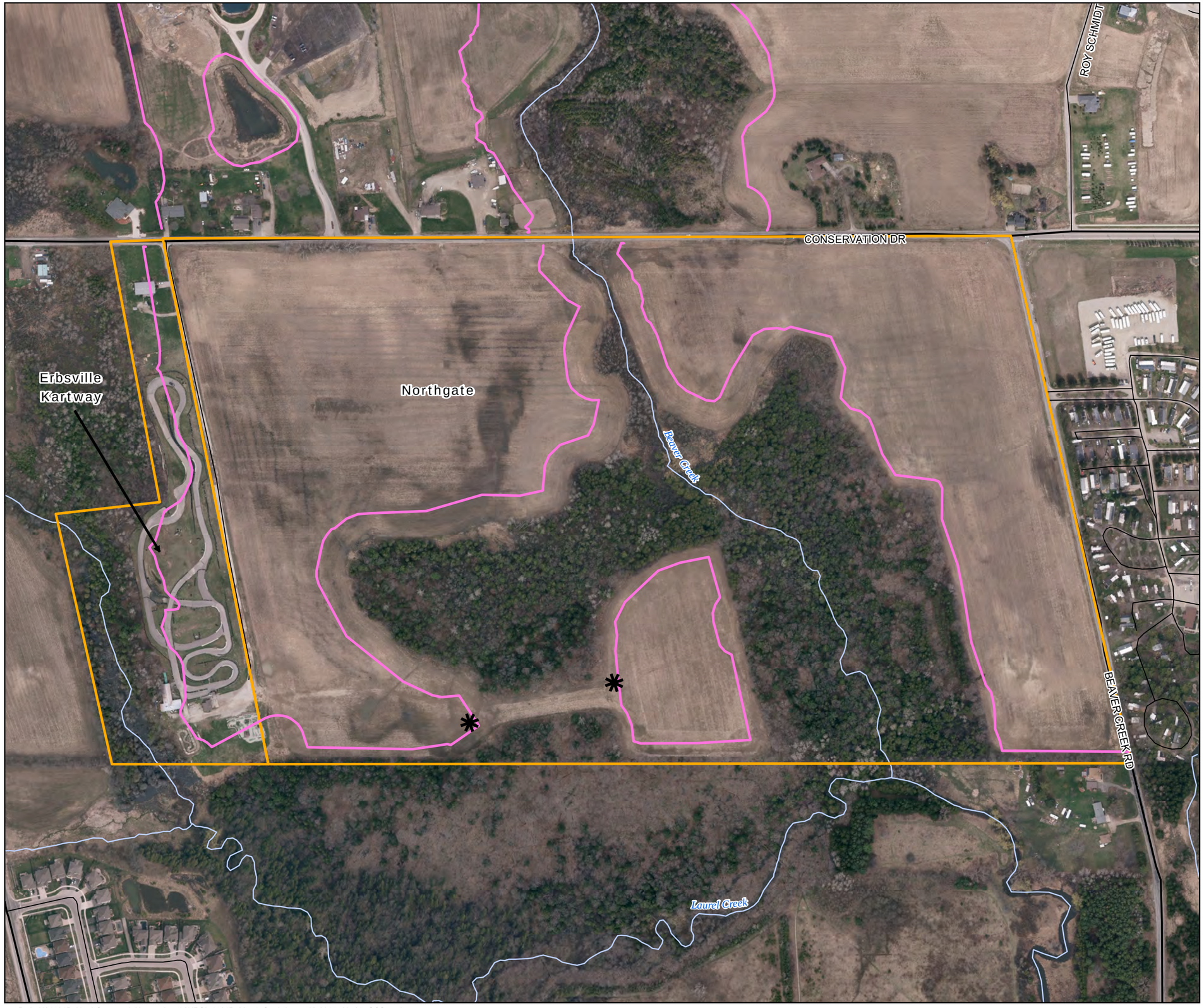
Marriott, David. 2017. District Planner, Ontario Ministry of Natural Resources and Forestry, Guelph District. Personal Communication (email correspondence regarding Blanding's Turtle nesting surveys for the Northgate/Kartway EIS), April 10, 2017.

Marriott, David. 2015. District Planner, Ontario Ministry of Natural Resources and Forestry, Guelph District. Personal Communication (email correspondence regarding EIS Terms of Reference for the 2115881 Ontario Ltd. property, American Badger), October 13, 2015.

Smith, Kaitlyn. 2014a. Resource Planner, Grand River Conservation Authority. Personal Communication (email correspondence regarding confirmed sightings of Common Nighthawk in City of Waterloo), July 2, 2014.

Smith, Kaitlyn. 2014b. Resource Planner, Grand River Conservation Authority. Personal Communication (email correspondence regarding vegetation plot monitoring), July 29, 2014.

MAPS



Map 1

Northgate and Kartway Lands

Environmental Impact Study
Study Area

Legend

- Subject Property
- Future Study Area (from NWSSS 2013)
- Natural Heritage System (from NWSSS 2013, updated 2016)
- Primary Road
- Secondary Road
- Permanent Watercourse

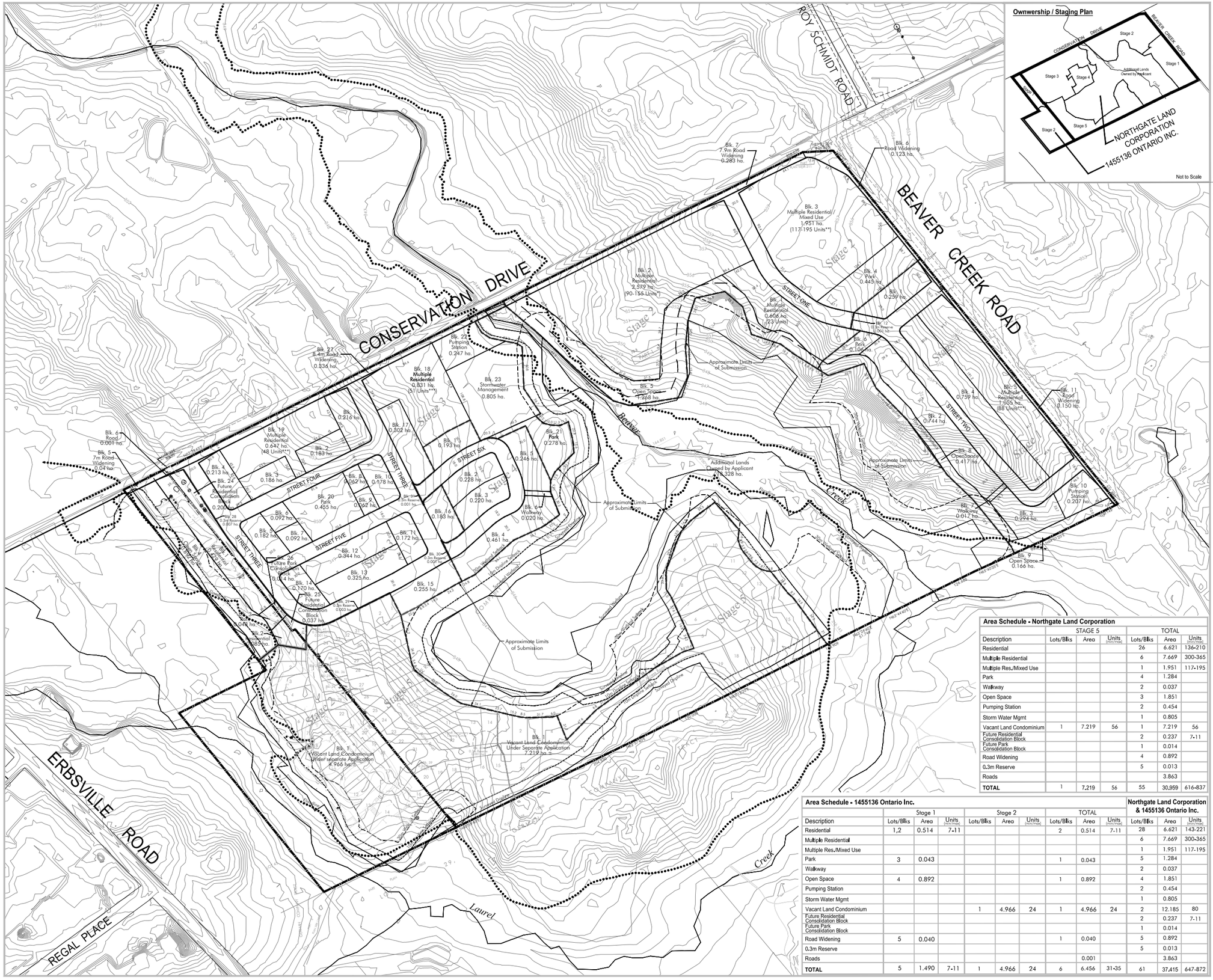
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Project: 1531B Date: June 29, 2017	NAD83 - UTM Zone 17 Size: 11x17" **1:4,000**

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Legal Description

PART OF LOT 28, GERMAN COMPANY TRACT,
(GEOGRAPHIC TOWNSHIP OF WATERLOO),
CITY OF WATERLOO,
REGIONAL MUNICIPALITY OF WATERLOO

Additional Information Required Under Section 51(17) of the Planning Act R.S.O. 1990, c.P,13 as Amended

A. As Shown	B. As Shown	C. As Shown
D. Residential, Park, Open Space, Stormwater Management		
E. As Shown	F. As Shown	
G. As Shown	H. Municipal Water Supply	I. Sandy Loam
J. As Shown	K. All Services As Required	L. As Shown

Area Schedule - Northgate Land Corporation 30T - _____

	STAGE 1			STAGE 2		
Description	Lots/Blks	Area	Units (min/max)	Lots/Blks	Area	Units (min/max)
Residential	1-4	2.056	45-67			
Multiple Residential	5	1.055	88	1,2	3.185	113-178
Multiple Res./Mixec Use				3	1.951	117-195
Park	6	0.106		4	0.445	
Walkway	7	0.017				
Open Space	8, 9	0.583		5	1.268	
Pumping Station	10	0.207				
Storm Water Mgmt						
Road Widening	11	0.150		6, 7	0.406	
0.3m Reserve	12	0.001				
Roads		0.878			0.461	
TOTAL	12	5.053	133-155	7	7.716	230-373

	STAGE 3			STAGE 4		
Description	Lots/Blks	Area	Units (min/max)	Lots/Blks	Area	Units (min/max)
Residential	1-17	3.217	64-100	1-5	1.348	27-43
Multiple Residential	18,19	1.478	99			
Park	20,21	0.733				
Walkway				6	0.020	
Open Space						
Pumping Station	22	0.247				
Storm Water Mgmt	23	0.805				
Future Residential Consolidation Block	24,25	0.237	7-11			
Future Park Consolidation Block	26	0.014				
Road Widening	27	0.336				
0.3m Reserve	28-31	0.012				
Roads		1.992			0.532	
TOTAL	31	9.071	170-210	6	1.900	27-43

Area Schedule - Northgate Land Corporation

	STAGE 5			TOTAL		
Description	Lots/Blks	Area	Units (min/max)	Lots/Blks	Area	Units (min/max)
Residential				26	6.621	136-210
Multiple Residential				6	7.669	300-365
Multiple Res./Mixed Use				1	1.951	117-195
Park				4	1.284	
Walkway				2	0.037	
Open Space				3	1.851	
Pumping Station				2	0.454	
Storm Water Mgmt				1	0.805	
Vacant Land Condominium	1	7.219	56	1	7.219	56
Future Residential Consolidation Block				2	0.237	7-11
Future Park Consolidation Block				1	0.014	
Road Widening				4	0.892	
0.3m Reserve				5	0.013	
Roads					3.863	
TOTAL	1	7.219	56	55	30.959	616-837

Area Schedule - 1455136 Ontario Inc.

	Stage 1			Stage 2			TOTAL			Northgate Land Corporation & 1455136 Ontario Inc.		
Description	Lots/Blks	Area	Units (min/max)	Lots/Blks	Area	Units (min/max)	Lots/Blks	Area	Units (min/max)	Lots/Blks	Area	Units (min/max)
Residential	1,2	0.514	7-11				2	0.514	7-11	28	6.621	143-221
Multiple Residential										6	7.669	300-365
Multiple Res./Mixed Use										1	1.951	117-195
Park	3	0.043					1	0.043		5	1.284	
Walkway										2	0.037	
Open Space	4	0.892					1	0.892		4	1.851	
Pumping Station										2	0.454	
Storm Water Mgmt										1	0.805	
Vacant Land Condominium				1	4.966	24	1	4.966	24	2	12.185	80
Future Residential Consolidation Block										2	0.237	7-11
Future Park Consolidation Block										1	0.014	
Road Widening	5	0.040					1	0.040		5	0.892	
0.3m Reserve										5	0.013	
Roads								0.001			3.863	
TOTAL	5	1.490	7-11	1	4.966	24	6	6.456	31-35	61	37.415	647-872

Notes:

- Boundary information provided by MacDonald Tamblyn Surveying Ltd., February 5,2008, Plan 58R-16404.
- Topographic information provided by Stantec Consulting. Contour Interval - 0.5m.
- * BCM District Plan, Low Density Residential 2 calculated at 35-60 Units per Hectare
- ** BCM District Plan, Mixed Use Medium Density Residential calculated at 60-100 Units per Hectare
- *** Multiple Block Unit Yield based on Conceptual Site Plan prepared by MHBC Planning.
- VLC - denotes Vacant Land Condominium.
- Floodline mapping obtained from North Waterloo Scoped Subwatershed Study, November 2012 and GRCA Developement Resource On-Line Mapping, January 23,2017.

MHBC PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE
200-540 BINGEMANS CENTRE DR. KITCHENER, ON. N2B 3X9 | P: 519.576.3650 F: 519.576.0121 | WWW.MHBCPLAN.COM

Approval Stamp

Date July 4,2017

File No. 14148A

Plan Scale 1:1,250

Drawn By L.H.B. / G.M.C.

Checked By P.B. / D.A.

Northgate Land Corporation & 1455136 Ontario Inc.
Conservation Drive
Waterloo, Ontario

North

File Name

DRAFT PLAN CONSOLIDATION

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Map 3

Northgate and Kartway Lands

Vegetation Communities and Significant Plant Species

Legend

- Subject Property
- Watercourse

Nationally/Provincially Siginificant Species

- 0 Butternut (*Juglans cinerea*)

Regionally Significant Plant Species

- 3 Northern Beech Fern (*Phegopteris connectilis*)
- 5 Virginia Stickseed (*Hackelia virginiana*)
- 6 White Spruce (*Picea glauca*)
- 7 Rough Sedge (*Carex scabrata*)
- 8 Soft-Leaved Sedge (*Carex disperma*)
- 9 Golden Alexanders (*Zizia aurea*)

Ecological Land Classification (ELC)

(CUP3) Coniferous Plantation

(CUW1) Mineral Cultural Woodland

(FOC3-1) Fresh-Moist Hemlock Coniferous Forest

(FOC4-1) Fresh-Moist White Cedar Coniferous Forest

(FOD3-1) Dry-Fresh Poplar Deciduous Forest

(FOD5-2) Dry-Fresh Sugar Maple-Beech Deciduous Forest

(FOD7-2) Fresh-Moist Green Ash-Hardwood Lowland Deciduous Forest

(FOD8-1) Fresh-Moist Poplar Deciduous Forest

(FOM6-1) Fresh-Moist Sugar Maple -Hemlock Mixed Forest

(HR4) Deciduous Hedgerow

(MAM2) Mineral Meadow Marsh

(SWD7-1) White Birch-Poplar Organic Deciduous Swamp

(SWM4-1) White Cedar-Hardwood Organic Mixed Swamp Ecosite

(SWM6-1) Yellow Birch-Conifer Organic Mixed Swamp

(SWT2) Mineral Thicket Swamp

(SWT3) Organic Thicket Swamp

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Map 4

Northgate and Kartway Lands

Biological Monitoring Locations

Legend

- Subject Property
- Photo Vegetation Plot Station Location
- Permanent Watercourse

Biological Monitoring (NRSI)

- Vegetation Station (VEG)
- Common Nighthawk Station (CNH)
- Benthic Sampling Station (BTH)
- Anuran Call Station (ANR)
- Wildlife Survey Unit (Approx)
- Road Mortality Monitoring (MMM Group)

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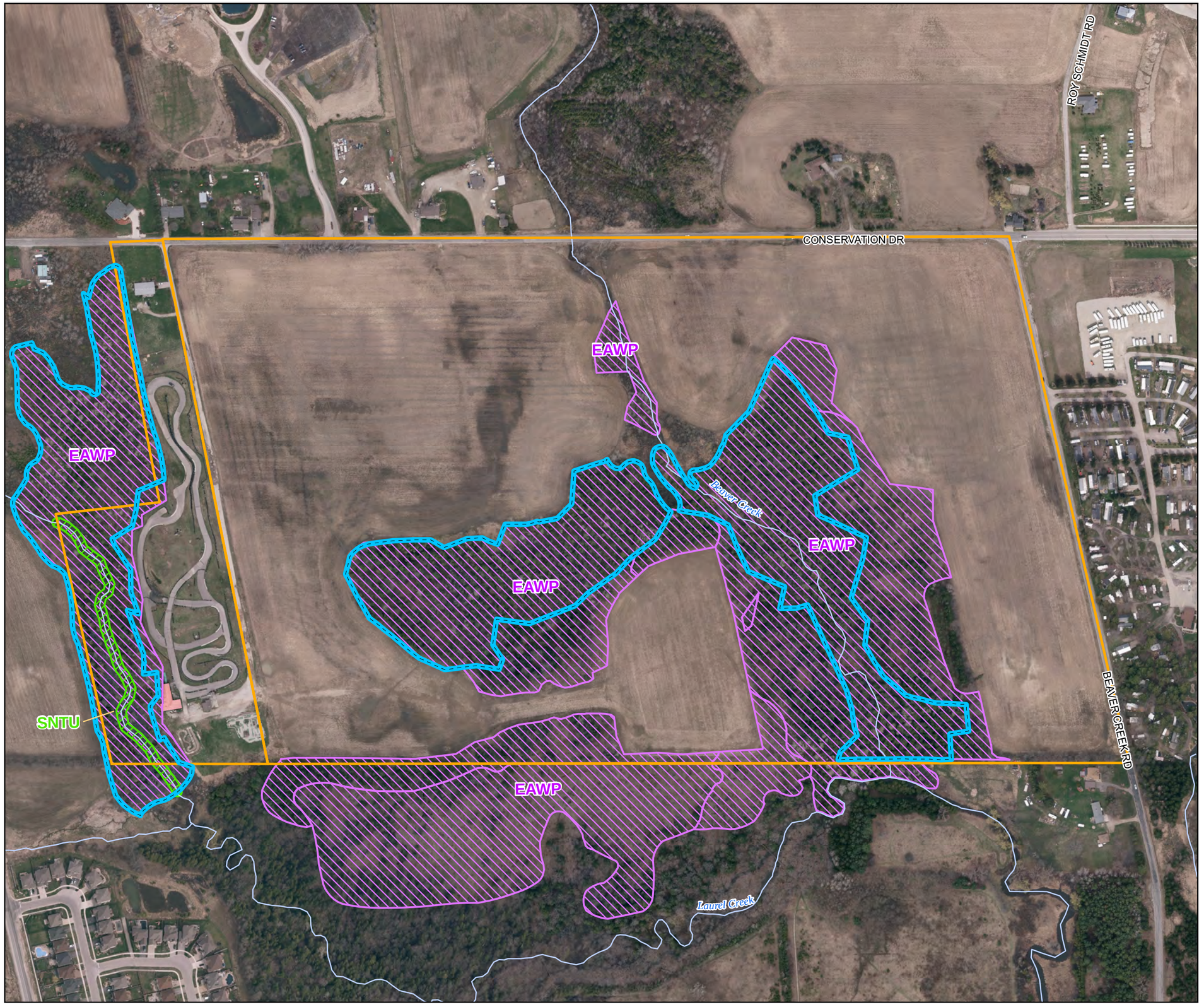
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Map 5

Northgate and Kartway Lands

Wildlife Findings and Significant Habitats

Legend

- Subject Property
- Permanent Watercourse

Species at Risk

- Barn Swallow (Nesting Unconfirmed)

Significant Wildlife Habitat

- Seeps and Springs

Special Concern and Rare Wildlife Species

- Eastern Wood-Peewee (EAWP)
- Snapping Turtle (SNTU)

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Project: 1531B
Date: June 29, 2017

NAD83 - UTM Zone 17
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Map 6

Northgate and Kartway Lands

Natural Feature Buffers

Legend

- Subject Property
- Significant Wetland
- Wetland Boundary
- Significant Wetland Buffer (30m)
- Significant Woodland
- Surveyed Dripline
- Significant Woodland Buffer (10m)
- Hedgerow Buffer (5m)
- Watercourse Buffer (30m)
- Watercourse
- Floodplain
- Ecological Land Classification (ELC)

(CUP3) Coniferous Plantation
(CUW1) Mineral Cultural Woodland
(FOC3-1) Fresh-Moist Hemlock Coniferous Forest
(FOC4-1) Fresh-Moist White Cedar Coniferous Forest
(FOD3-1) Dry-Fresh Poplar Deciduous Forest
(FOD5-2) Dry-Fresh Sugar Maple-Beech Deciduous Forest
(FOD7-2) Fresh-Moist Green Ash-Hardwood Lowland Deciduous Forest
(FOD8-1) Fresh-Moist Poplar Deciduous Forest
(FOM6-1) Fresh-Moist Sugar Mapl -Hemlock Mixed Forest
(HR4) Deciduous Hedgerow
(MAM2) Mineral Meadow Marsh
(SWD7-1) White Birch-Poplar Organic Deciduous Swamp
(SWM4-1) White Cedar-Hardwood Organic Mixed Swamp Ecosite
(SWM6-1) Yellow Birch-Conifer Organic Mixed Swamp
(SWT2) Mineral Thicket Swamp
(SWT3) Organic Thicket Swamp

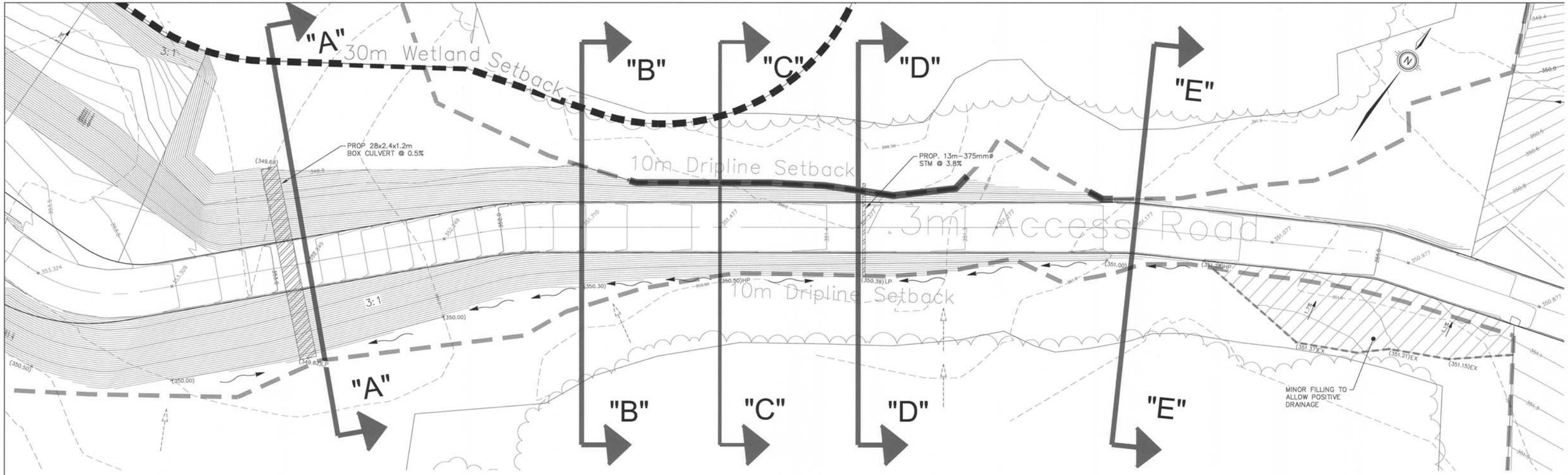
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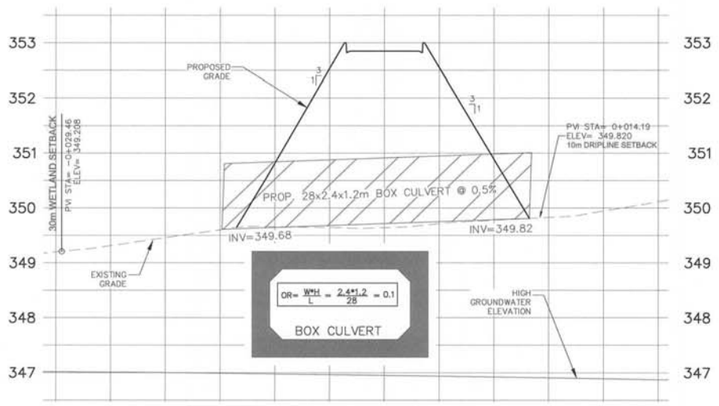
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Project: 1531B
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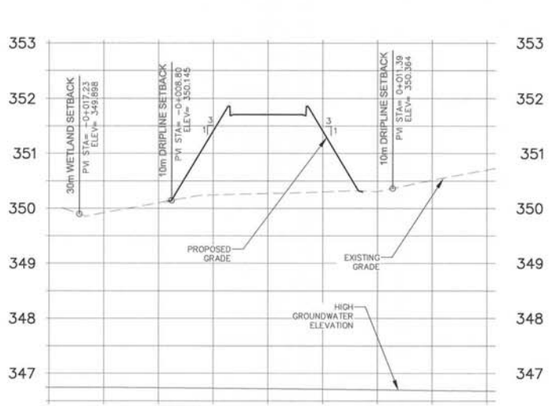
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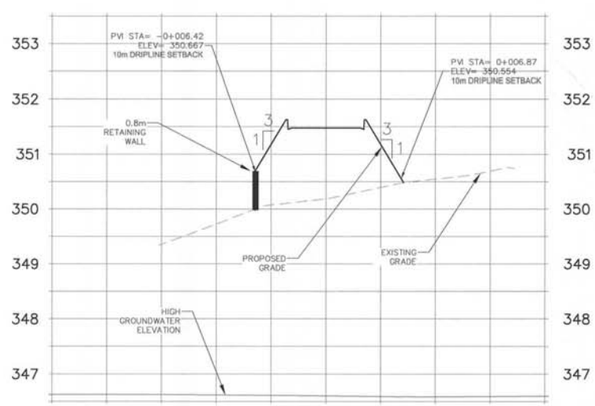




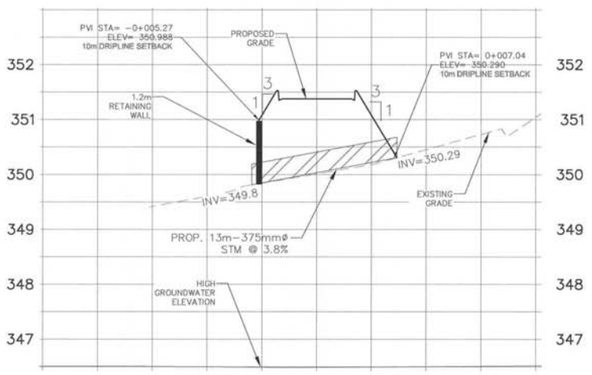
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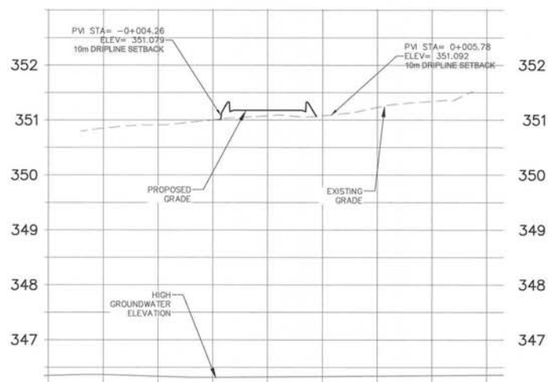
SECTION B-B



SECTION C-C



SECTION D-D



SECTION E-E

MTE

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DATE	Jun.20/17
SCALE	H-1:250 V-1:50
BY	Kenneth A. Taylor
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Map 8

Northgate and Kartway Lands

Stewardship Plan

Legend

- Subject Property
- Knickpoint
- Watercourse
- Floodplain
- Proposed Development
- Ecological Linkage
- Wildlife Passage Culvert
- Existing Natural Features
- Buffers to be Naturalized
- Additional Areas to be Naturalized
- SWM to be Naturalized
- Reforestation Area
- Forest Interior Habitat (5.46ha)
- Invasive Species Management
- Park

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Project: 1531B
Date: January 15, 2017

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APPENDIX I

Terms of Reference

NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists

January 19, 2017 Project No. 1531B

Robyn McMullen
Environmental Policy Planner, City of Waterloo
100 Regina Street South
PO Box 337, Station Waterloo
Waterloo, ON, N2J 4A8

Dear Ms. McMullen,

Re: Northgate South, and Erbsville Kartway Lands, North Waterloo
Environmental Impact Study - Terms of Reference

Natural Resource Solutions Inc. (NRSI) has been retained as part of a team by Northgate Land Corporation and Erbsville Kartway to prepare an Environmental Impact Study (EIS) for the proposed development of the above noted property located on Conservation Drive in north Waterloo, Ontario. The City of Waterloo formally refers to this area as the Beaver Creek Meadows District. An EIS is required as the lands contain woodlands, watercourses and provincially significant wetlands which are designated and protected as:

- Core Environmental Features in the Region of Waterloo's Official Plan (2015),
- Core Natural Features, and Supporting Natural Features in the City of Waterloo's Official Plan (2014),
- Wetlands and watercourses in GRCA's Policies (2013).

In addition, the lands contain known and potential habitat for Species At Risk (SAR). These species and their habitat are protected under the Endangered Species Act through the Ministry of Natural Resources and Forestry (MNRF).

The EIS will be prepared in collaboration with the study team which includes NRSI (biology), MTE (engineering, stormwater management, surface and groundwater monitoring), and MHBC (planning). The natural features have been well studied through the North Waterloo Scoped Subwatershed Study (Ecoplans et al. 2013) and two years of pre-construction biological monitoring completed by MMM Group (formerly Ecoplans), and NRSI as per the City of Waterloo's Development Monitoring Protocol (1999). Pre-construction surface water and groundwater monitoring has been completed by Stantec.

This Terms of Reference (TOR) has been prepared in accordance with the City of Waterloo Official Plan, Region of Waterloo Official Plan, Greenlands Network Implementation Guidelines, Sections 15 to 17 of the North Waterloo Scoped Subwatershed Study (Ecoplans et al. 2013), GRCA EIS Guidelines (2005) and consultation with the MNRF. The details of the TOR are attached for your review and comment. Please feel free to contact me if you have any questions or comments.

Sincerely,
Natural Resource Solutions Inc.

Elaine Gosnell

M. Elaine Gosnell, B.Sc.
Senior Terrestrial and Wetland Biologist

Northgate South, and Erbsville Kartway Lands, North Waterloo
Environmental Impact Study Terms of Reference
January 19, 2017

Introduction

The subject property is approximately 54ha in area and is bounded to the north by Conservation Drive, Beaver Creek Road to the east, and natural features to the south and west (Map 1). Habitat within the subject property is comprised of agricultural fields, with wetlands and woodlands associated with Beaver Creek within the central and west portions of the property. The woodland/wetland complex on-site is part of Environmentally Sensitive Policy Area (ESPA) 80 known as Laurel Creek Forest (Region of Waterloo 2015) and is a Core Natural Feature in the City of Waterloo's Official Plan (2014), while Beaver Creek is identified as a Supporting Natural Feature. Wetlands are part of the Laurel Creek-Sunfish Lake provincially significant wetland.

Proposed Undertaking

The proposed development is a mixed use neighbourhood including an internal road network, a mixture of residential density types, stormwater management, trails and parkland. The development plan will follow the land use structure of the Beaver Creek Meadows District Plan (TPP 2016, approved by City Council January 25, 2016) (Map 2).

Characterization of Natural Features

The natural features have been well studied through the North Waterloo Scoped Subwatershed Study (NWSSS) (Ecoplans et al. 2013) and two years of pre-construction biological monitoring completed by MMM Group and NRSI as per the City of Waterloo's Development Monitoring Protocol (1999). Two years of pre-construction surface and groundwater monitoring has been completed by Stantec. For details of the pre-construction monitoring programs please refer to the Terms of Reference prepared for that study (NRSI 2015).

The natural features on the subject property will be characterized based on the background information in the NWSSS and the pre-construction monitoring reports. The EIS will refer to the data in the existing reports but will provide a summary of site conditions. The following key components will be included in the site characterization:

- Summary of and mapping of vegetation communities using the Ecological Land Classification system for southern Ontario,
- Plant and wildlife species diversity and habitats,
- There have been no significant changes to any of the wetland boundaries and Core Environmental Feature boundaries as identified in the NWSSS on the subject property. These boundaries will continue to be used and will be shown on all maps,
- Summary of wildlife species known to use the site including birds, mammals, reptiles and amphibians,
- Ecological function of agricultural area intersecting wooded habitat of ESPA 80 in the south-central portion of the subject property (referred to herein as the 'gap'),
- Description of aquatic habitat, fish and benthic communities in Beaver Creek,
- Key findings of the surface water and groundwater monitoring.

Species At Risk (SAR) and Species of Conservation Concern (SCC) Screening
A SAR and SCC screening was completed by comparing the habitat requirements for significant species that are known from the vicinity of the study area (i.e. within Waterloo Region) against the ELC communities and habitats within the subject property. This comparison allowed it to be determined which species have potential to occur within the subject property, and identify those species with potential to be impacted by the proposed undertaking.

Species which could be present within the immediate vicinity of the proposed development and are thought to have potential to be impacted by the proposed undertaking were surveyed for including American badger (*Taxidea taxus jacksoni*), butternut (*Juglans cinerea*), barn swallow (*Hirundo rustica*), common nighthawk (*Chordeiles minor*), wood thrush (*Hylocichla mustelina*), Eastern wood-pewee (*Contopus virens*), Western chorus frog (*Pseudacris triseriata*), Blanding's turtle (*Emydoidea blandingii*), snapping turtle (*Chelydra serpentina*), as well as potential roosting sites for SAR bats. Surveys were carried out according to MNRF guidance. This screening was originally provided to MNRF in July 2014 and was agreed to at that time (G. Buck, pers. comm. 2014). The SAR/SCC screening was updated for the submission of this TOR, and is appended (Appendix I).

The following surveys related to SAR/SCC and SWH have been conducted:

- Breeding bird surveys within existing wildlife survey units as well as additional surveys in the agricultural and cultural areas of the properties, consistent with the NWSSS methods and standardized Ontario Breeding Bird Atlas protocol (OBBA 2001). Surveys included random (wandering) transects and 10 minute point counts. Surveys were conducted three times during peak breeding bird season (May 15 to July 31) to account for barn swallow (see below).
- Breeding bird monitoring with targeted surveys for barn swallow according to the MNRF protocol for barn swallow surveys (OMNR 2012), which included a third visit during breeding season,
- GRCA correspondence indicated that common nighthawk has been observed in the local Waterloo area (K. Smith, pers. comm. 2014). As habitat for this species may be present in the study area, surveys were conducted according to MNRF guidance (G. Buck, pers. comm. 2012) including 3 evening surveys, 7 days apart, depending on the lunar cycle, between late May and early July.
- Marsh Monitoring Program (BSC 2009) anuran call surveys to monitor Western chorus frog and to identify amphibian SWH,
- Targeted visual surveys for turtle SAR/SCC and SWH related to Blanding's turtle and snapping turtle including potential turtle nesting and overwintering areas (to confirm that the habitat conditions for this species is unchanged). Surveys were conducted as per standardized protocol (OMNR 2013).
- Bat habitat assessments at buildings proposed for removal. Surveys were conducted as per MNRF guidance document (MNRF 2015c). There are no trees proposed for removal within the subject property. Compliance with the *Endangered Species Act (2007)* as it applies to SAR bats will be ensured at the time of the removal of buildings within the subject property.
- Any butternut observed within the proposed construction footprint and adjacent lands will be assessed by a certified butternut health assessor, and,
- Targeted den surveys for American badger were completed on October 23, 2015. American badger was surveyed for in the NWSSS with no sightings or evidence found. Recently MNRF requested targeted den surveys on-site, as time had passed since the

NWSSS American badger surveys (2010-2011) and this species has potential to move into the site.

Functional Analysis

The findings of the ecological, hydrological, hydrogeological studies will be compiled to provide an understanding of the interactions between the biological and physical environment. The processes contributing to the maintenance of the natural features and their functions will be discussed at the subject property scale, referring to the subwatershed study for landscape level context. This description will take into account the current quality and condition of the natural features based on land management practices and existing impacts such as clearing, grading, tree cutting, trails, dumping, filling and invasive plant and insect species. As provided in Section 17.0 of the NWSSS, this analysis will include the discussion of the following:

- Quality and sensitivity of terrestrial, aquatic and wetland ecosystems,
- Species at Risk and other significant species at the local, provincial and national level. The subject property includes known Category 2 and Category 3 habitats for Blanding's turtle, which are afforded protection under the *Endangered Species Act* (2007). An Information Gathering Form (IGF) for Blanding's turtle will be completed and submitted to the MNRF for review when more information on the proposed development becomes available.
- Significant wildlife habitat according to the MNRF's Significant Wildlife Habitat Technical Guide (MNRF 2000) and Ecoregion 6E criteria (MNRF 2015b),
- Ecological linkage associated with the Conservation Drive crossing of Beaver Creek. Any linkage enhancements will be recommended in corroboration with the detailed design of eco-passage features in the Class Environmental Assessment for Conservation Drive (Stantec 2016; approved by City Council January 25, 2016).
- Stormwater impacts on wetland water balance will be assessed,
- Physical constraints i.e. floodplain, top of bank, etc.,
- Ecological enhancements will be recommended, such as the Beaver Creek riparian corridor south of Conservation Drive. This area has been identified as an ecological linkage within the NWSSS due to its relatively narrow width (Ecoplans et al. 2013). Recommendations in the NWSSS are to provide for a future restored/naturalized corridor width ranging from 80m to over 100m (Ecoplans et al. 2013). In order to achieve this, it is anticipated that the development scenario will include stormwater management facilities within the 80-100m corridor.
- Setbacks and buffer management. Minimum development setbacks are recommended in the subwatershed study (Section 14.2), to be confirmed or adjusted as may be appropriate through the EIS. Avoidance of the Core Natural Features and recommended setbacks is recommended wherever possible, and options to minimize encroachment into these areas will be discussed with the landowner and study team. Additional guidance for development setbacks adjacent to Core Natural Features and Supporting Natural Features is provided in Section 8.2.4(9) and 8.2.5 in the City of Waterloo's Official Plan (2014). Setbacks will take into account the potential for "averaging" (minor deviations from the recommended minimum distance), specific site conditions, the type of adjacent development, and the need for infrastructure, trails, SWM facilities and grading within the buffer. The management approach for the buffer lands will be finalized considering fencing or other barriers/boundary treatment, signage location and details, planting plans/vegetation management (i.e. invasive species control); and target habitat creation.

In addition to the above listed items, an analysis of Special Policy Area 2 (TPP 2016) will be provided for the agricultural area that is surrounded by wooded habitat within the subject property. Access to SPA 2 is by way of a 'gap' (roughly 30-35m width) of agricultural land. The woodland dripline of the 'gap' was flagged by NRSI biologists on December 9, 2014, and subsequently surveyed by MTE Inc. on January 14, 2015, as this dripline was not delineated during the NWSSS. The surveyed dripline of the 'gap' will be shown on the EIS mapping. The NWSSS identifies the 'gap' as a 'Future Study Area' which will be addressed in this EIS.

Assessment of Potential Impacts

The analysis of impacts will be divided into:

- Direct impacts associated with disruption or displacement caused by the actual proposed 'footprint' of the undertaking.
- Indirect impacts associated with changes in site conditions such as drainage.
- Induced impacts associated with impacts after the development is constructed such as subsequent demand on the resources created by habitation/use of the area and vicinity.

The EIS will make recommendations to avoid, change, minimize and mitigate potential impacts.

Direct Impacts

The identification and delineation of core natural features will be used to avoid direct impacts from the development on important natural features. No direct impacts to significant natural features are anticipated and therefore the EIS will focus on analysing and avoiding indirect and induced impacts.

Indirect Impacts

The analysis of potential indirect impacts is anticipated to include the following:

Encroachment into Buffers

It is recognized in the NWSSS that there may be areas where encroachment into the recommended buffer width occurs. These will be identified and mitigation measures including buffer management (i.e. fencing, planting) will be determined.

Changes to groundwater and surface water flow patterns

This section of the impact analysis will focus on the potential changes to the flow patterns, quality and quantity of groundwater and surface water flows that currently supply wetlands and Beaver Creek. This section will include information from the Stormwater Management Strategy and a wetland water balance analysis. The development is anticipated to be designed in a manner using storm water management and Low Impact Development (LID) measures such that pre-development surface and groundwater patterns will be maintained in the post-development scenario. The maintenance of pre-development surface water and groundwater infiltration pattern and rates will be key to maintaining the water balance in the on-site wetlands. During and post-development monitoring data will be analyzed on a monthly or seasonal basis.

Sedimentation and erosion

During construction, areas of bare soil will be exposed which have the potential to erode during rainfall events and impact adjacent natural features. In the event of a heavy rain, sediment laden runoff can enter adjacent natural areas by way of overland flow. In order

to protect on-site and off-site natural features from potential impacts due to sediment, a sediment and erosion control plan will be developed.

Indirect impacts to wildlife habitat

Indirect impacts to wildlife can occur during construction due to the increased noise, dust and human activity on the site, but are generally temporary in duration.

Induced Impacts

Induced impacts are described as those that are not directly related to the construction of the proposed development, but rather arise as a result of the use of the natural areas or pressure on them following the development. In this case, potential induced impacts could include increased use of the natural features and buffers by residents, both authorized use (i.e. trails) and unauthorized (i.e. dumping).

Recommendations for Restoration and Enhancement

A basis for ecological enhancements in the study area is provided in the NWSSS in Section 14.4. This section indicates that the primary ecological enhancements in the study area include linkages, buffer management (including habitat creation – general and specialized) and specific wildlife passage measures to reduce roadkill at the Conservation Drive crossing of Beaver Creek. Recommendations for restoration and enhancement measures on-site will be provided using the general objectives provided in the NWSSS but tailored to the site conditions, species and habitats present and opportunities within the development plan and will be shown on a Stewardship Management Plan. Any linkage enhancements will be recommended in corroboration with the detailed design of eco-passage features in the Class Environmental Assessment for Conservation Drive (Stantec 2016, approved by City Council January 25, 2016).

Monitoring

Pre-construction monitoring will continue until the start of construction (i.e. site grading) as per the City of Waterloo Development Monitoring Protocol (1999). Recommendations will be provided in the EIS for during- and post-construction monitoring of biological features, surface water and groundwater, mitigation measures and compliance, as per the City's protocol. The basics of the during- and post-construction monitoring plan will be prepared during the EIS and may include the installation of piezometers to assist in the monitoring of wetland water balance. During and post-construction monitoring data related to wetland water balance will be analyzed on a monthly/seasonal basis.. Prior to the initiation of the during-construction phase, the pre-construction monitoring methods will be revised to incorporate the recommendations of the EIS and new components related to stormwater management and erosion and sediment control. The study design of the pre-construction monitoring plan will be replicated to provide consistency between the pre-, during- and post-construction monitoring plan. Further details of the monitoring program will be refined at the detailed design stage and will be provided in a TOR for agency review and approval at that time.

Recommendations and Conclusions

A summary of the findings, conclusions and recommendations in the EIS will be provided.

Reporting

The EIS report will be prepared in digital and hard copy format including appropriate mapping (study area, existing conditions, monitoring locations, development plan and stewardship plan) and appendices (final TOR, species lists, pertinent agency correspondence, analysis tables, etc.).

References

Bird Studies Canada (BSC). 2009. Marsh Monitoring Program Participant's Handbook for Surveying Amphibians. 2009 Edition. Published by Bird Studies Canada in Cooperation with Environment Canada and the U.S. Environmental Protection Agency. February 2009.

City of Waterloo. 2014. Official Plan. City of Waterloo Office Consolidation October 2014.

City of Waterloo. 1999. City of Waterloo Development Monitoring Protocol. Development Services Department. July 16, 1999.

Government of Canada. 2015. Species at Risk Public Registry: Species Index. Last updated December 30, 2015. http://www.sararegistry.gc.ca/sar/index/default_e.cfm (Accessed 2015)

Grand River Conservation Authority (GRCA). 2013. Policies for the Administration for the Development Interference with Wetlands and Alterations of Shorelines and Watercourses Regulation: Ontario Regulation 150/06. January 25, 2013.

Grand River Conservation Authority (GRCA). 2005. GRCA's EIS Guidelines and Submissions Standards for Wetlands. August 26, 2005.

Ecoplans, MHBC, and Stantec. 2013. North Waterloo Scoped Subwatershed Study. Volume 1. November 2013.

Layberry, R.A., P.W. Hall, and J.D. Lafontaine. 1998. The Butterflies of Canada. University of Toronto Press, Toronto, Canada.

Ministry of Natural Resources and Forestry (MNRF). 2014. Waterloo Region Species At Risk List. September 25, 2014.

Ministry of Natural Resources and Forestry (MNRF). 2015a. Species at Risk in Ontario (SARO) List. Accessed December 2015. http://www.ontario.ca/environment-and-energy/species-risk-ontario-list

Ministry of Natural Resources and Forestry (MNRF). 2015b. Significant Wildlife Habitat Ecoregion 6E Criterion Schedule: Addendum to Significant Wildlife Habitat Technical Guide. January 2015.

Ministry of Natural Resources and Forestry (MNRF). 2015c. Technical Note: Species at Risk Bats. Regional Operations Division. June 2015.

Natural Resource Solutions Inc. 2015. North Waterloo Subwatershed Lands Pre-Construction Monitoring Program - Terms of Reference. January 21, 2015.

Ontario Breeding Bird Atlas (OBBA). 2001. Guide for Participants. Atlas Management Board, Federation of Ontario Naturalists, Don Mills.

Ontario Ministry of Natural Resources (OMNR). 2000. Significant Wildlife Habitat Technical Guide. October 2000.

Ontario Ministry of Natural Resources (OMNR). 2012. Guelph District Barn Swallow Survey Protocol. July 2012.

Ontario Ministry of Natural Resources (OMNR). 2013. Draft Occurrence Survey Protocol for Blanding's Turtle (*Emydoidea blandingii*) in Ontario. Ontario Ministry of Natural Resources, Species at Risk Branch. Peterborough, Ontario. ii + 17 pp.

Region of Waterloo. 2015. Regional Official Plan 2031. As approved with modifications by the Ontario Municipal Board on June 18, 2015.

Region of Waterloo. 2010. Region of Waterloo Greenlands Network Implementation Guideline. January 26, 2010.

Reznicek, A.A., E.G. Voss, and B.S. Walters. 2011. Michigan Flora Online. University of Michigan, February 2011. Accessed December 2015. http://www.michiganflora.net/home.aspx

Stantec Consulting Ltd. 2015. Beaver Creek Road and Conservation Dr. Upgrades and Extension of Municipal Services Class Environmental Assessment. Prepared for the City of Waterloo. December 14, 2015.

The Planning Partnership (TPP). 2016. City of Waterloo Beaver Creek Meadows District Plan, Final Report. January 8, 2016. Approved by City Council January 25, 2016.

Authorities Consulted

Buck, Graham. 2012. Management Biologist, Ontario Ministry of Natural Resources and Forestry, Guelph District. Personal Communication (email correspondence to Jessica Linton regarding Common Nighthawk survey protocol), May 23, 2012.

Buck, Graham. 2014. Management Biologist, Ontario Ministry of Natural Resources & Forestry, Guelph District. Personal Communication (e-mail correspondence to Andrew Dean regarding Pre-construction Ecological Monitoring Program), December 15, 2014.

Smith, Kaitlyn. 2014. Resource Planner, Grand River Conservation Authority. Personal Communication (e-mail correspondence to Elaine Gosnell regarding recommended crepuscular bird surveys), July 2, 2014.

MAPS



Map 1

Northgate and Kartway Lands

Environmental Impact Study - Study Area

Legend

- Subject Property
- Future Study Area (from NWSSS 2013)
- Natural Heritage System (from NWSSS 2013, updated 2016)
- Primary Road
- Secondary Road
- Permanent Watercourse

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Project: 1531B
Date: February 25, 2016

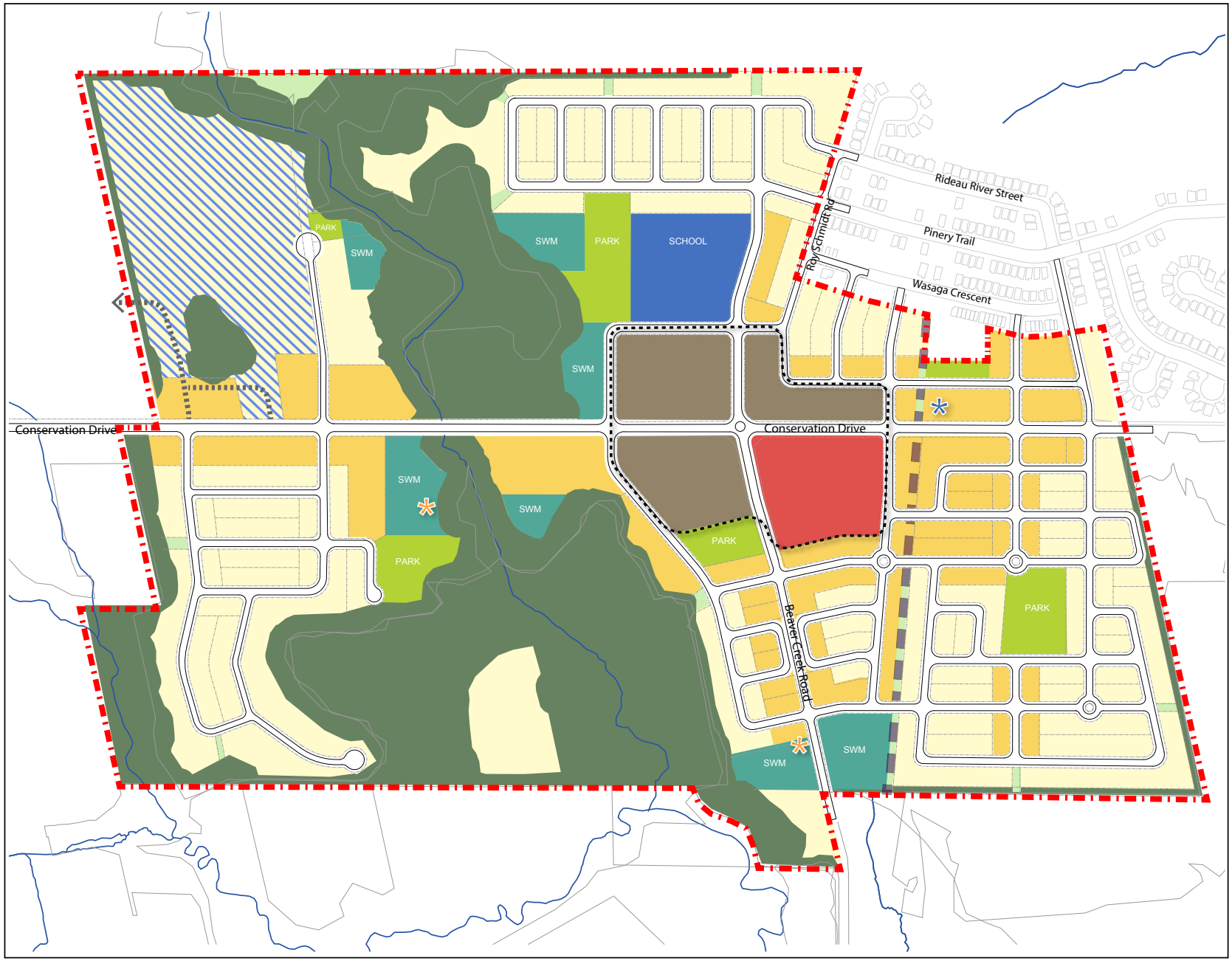
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BEAVER CREEK MEADOWS DISTRICT PLAN

MAP 3
LAND USES



LEGEND

- District Plan Boundary
- Mixed Use Node

Residential Designations

- Low Density Residential 1
- Low Density Residential 2
- Mixed Use Medium Density Residential

Commercial Designations

- Mixed-Use Neighbourhood Commercial

Open Space Designations

- Open Space Land Uses - Park
- Other Green Spaces
- Natural System (includes buffers)

Other Lands and Features

- SWM Stormwater Management Facility
- Temporary Stormwater Management Facility
- Spiritual Use
- Elementary School
- Potential New Road Connection
- Hydro Corridor
- Pumping Station

0 50 100 200 300 metres

Last Updated: January 6, 2016

APPENDIX I

Species at Risk and Species of Conservation Concern Habitat Screening Results

Species at Risk and Species of Conservation Concern Habitat Screening Results

Scientific Name	Common Name	SRANK[1]	COSEWIC[2]	COSSARO[3]	SARA Schedule[4]	Background Source	Habitat Preference[5,6,7,8]	Suitable Habitats within Subject Property (within 120m)	Potential to be Impacted by Project	Observed by NRSI
Vascular Plants & Mosses										
Arisaema dracontium	Green Dragon	S3	SC	SC	Schedule 3	MNRF 2014	Wet bottomlands along rivers and creeks.	Yes. Bottomlands along creeks exist within the subject properties.	Yes	No
Castanea dentata	American Chestnut	S2	E	END	Schedule 1	MNRF 2014	Moist to well drained forests on sand, occasionally heavy soils.	Yes. Suitable forest habitat exists within the subject properties.	Yes	No
Cornus florida	Eastern Flowering Dogwood	S2?	E	END	Schedule 1	MNRF 2014	Dry (usually oak) to rich deciduous forests, especially on hillsides and river banks.	No. The native range for this species is restricted to Ecoregion 7E.	No	No
Fissidens exilis	Pygmy Pocket Moss	S1	SC	SC	-	MNRF 2014	Moist, barren soil, typicaly clay, often asscoiated with forests.	No. Subject properties located within the Waterloo Sand Hills physiographic region, dominated by sandy loams.	No	No
Gymnocladus dioicus	Kentucky Coffee-tree	S2	T	THR	Schedule 1	MNRF 2014	Floodplains, edges of marshes and shallow soil over limestone.	No. The native range for this species is restricted to Ecoregion 7E.	No	No
Juglans cinerea	Butternut	S3?	E	END	Schedule 1	MNRF 2014	Rich woods of river terraces and valleys, also dry rocky slopes.	Yes. Suitable habitat for this species exists within the subject properties.	Yes	Yes
Panax quinquefolius	American Ginseng	S3	E	END	Schedule 1	MNRF 2014	Deep leaf litter in rich, moist deciduous woods, especially on rocky, shaded cool slopes in sweet soil.	Yes. Rich, moist deciduous woods exists within the subject proeprties.	Yes	No
Birds										
Ammodramus henslowii	Henslow's Sparrow	SHB	E	END	Schedule 1	MNRF 2014	Large, fallow, grassy area with ground mat of dead vegetation, dense herbaceous vegetation, ground litter and some song perches; neglected weedy fields; wet meadows; cultivated uplands; a moderate amount of moisture needed; requires a minimum tract of grassland of 40 ha, but usually in areas >100 ha.	No. Suitable grassland habitat does not exist within the subject properties.	No	No
Ammodramus savannarum	Grasshopper Sparrow	S4B	SC	--	--	MNRF 2014	Well-drained grassland or prairie with low cover of grasses, taller weeds on sandy soil; hayfields or weedy fallow fields; uplands with ground vegetation of various densities; perches for singing; requires tracts of grassland > 10 ha.	No. Suitable grassland habitat does not exist within the subject properties.	No	No
Asio flammeus	Short-eared Owl	S2N, S4B	SC	SC	Schedule 3	MNRF 2014	Grasslands, open areas or meadows that are grassy or bushy; marshes, bogs or tundra; both diurnal and nocturnal habits; ground nester; destruction of wetlands by drainage for agriculture is an important factor in the decline of this species; home range 25 -125 ha; requires 75-100 ha of contiguous open habitat.	No. Suitable grassland habitat does not exist within the subject properties.	No	No
Caprimlugus vociferus	Eastern Whip-poor-will	S4B	T	THR	Schedule 1	MNRF 2014	Dry, open, deciduous woodlands of small to medium trees; oak or beech with lots of clearings and shaded leaflitter; wooded edges, forest clearings with little herbaceous growth; pine plantations; associated with >100 ha forests; may require 500 to 1000 ha to maintain population.	No. Habitats within the subject properties do not meet the size requirements for this species.	No	No
Cardellina canadensis	Canada Warbler	S4B	T	SC	Schedule 1	MNRF 2014	An interior forest species; dense, mixed coniferous, deciduous forests with closed canopy, wet bottomlands of cedar or alder; shrubby undergrowth in cool moist mature woodlands; riparian habitat; usually requires at least 30 ha.	No. Forested habitat within the subject properties is not large enough to support this species.	No	No
Chaetura pelagica	Chimney Swift	S4B, S4N	T	THR	Schedule 1	MNRF 2014	Commonly found in urban areas near buildings; nests in hollow trees, crevices of rock cliffs, chimneys; highly gregarious; feeds over open water.	Yes. Buildings, hollow trees, and chimneys within the subject properties may provide habitat for this species.	Yes	No

Scientific Name	Common Name	SRANK[1]	COSEWIC[2]	COSSARO[3]	SARA Schedule[4]	Background Source	Habitat Preference[5,6,7,8]	Suitable Habitats within Subject Property (within 120m)	Potential to be Impacted by Project	Observed by NRSI
Childonias niger	Black Tern	S3B	NAR	SC	--	MNRF 2014	Wetlands, coastal or inland marshes; large cattail marshes, marshy edges of rivers, lakes or ponds, wet open fens, wet meadows; returns to same area to nest each year in loose colonies; must have shallow (0.5 to 1m deep) water and areas of open water near nests; requires marshes >20 ha in size; feeds over adjacent grasslands for insects; also feeds on fish, crayfish and frogs.	No. Wetlands within the subject properties are not large enough to support this species.	No	No
Chordeiles minor	Common Nighthawk	S4B	T	SC	Schedule 1	MNRF 2014	Generally prefer open, vegetation-free habitats, including dunes, beaches, recently harvested forests, burnt-over areas, logged areas, rocky outcrops, rocky barrens, grasslands, pastures, peat bogs, marshes, lakeshores, and river banks. This species also inhabits mixed and coniferous forests. Can also be found in urban areas (nest on flat roof-tops).	Yes. Clearings and ploughed fields exist within the subject properties.	Yes	Yes
Colinus virginianus	Northern Bobwhite	S1	E	END	Schedule 1	MNRF 2014	Generally inhabits a variety of edge and grassland type habitats including non-intensively farmed agricultural lands.	No. Suitable grassland habitat does not exist within the subject properties.	No	No
Contopus virens	Eastern Wood-Pewee	S4B	SC	SC	-	MNRF 2014; NWSSS (Ecoplans et al. 2013)	Open, deciduous, mixed or coniferous forest; predominated by oak with little understory; forest clearings, edges; farm woodlots, parks.	Yes. Forested habitat, forest clearings and edges exist within the subject properties.	Yes	Yes
Dolichonyx oryzivorus	Bobolink	S4B	T	THR	-	MNRF 2014	Large, open expansive grasslands with dense ground cover; hayfields, meadows or fallow fields; marshes; requires tracts of grassland >50 ha.	No. Suitable habitat not present within the subject properties.	No	No
Empidonax virescens	Acadian Flycatcher	S2S3B	E	END	Schedule 1	MNRF 2014	Mature, shady, deciduous forests; heavily wooded ravines; creek bottoms or river swamps; availability of good quality habitat is limiting factor; needs at least 30 ha of forest.	No. Forested habitat within the subject properties is not large enough to support this species.	No	No
Falco peregrinus	Peregrine Falcon	S3B	SC	SC	Schedule 1	MNRF 2014	Rock cliffs, crags, especially situated near water; tall buildings in urban centres.	No. Suitable topographic and anthropogenic features not present within the subject properties.	No	No
Haliaeetus leucocephalus	Bald Eagle	S2N, S4B	NAR	SC	-	MNRF 2014	Require large continuous area of deciduous or mixed woods around large lakes, rivers; require area of 255 ha for nesting, shelter, feeding, roosting; prefer open woods with 30 to 50% canopy cover; nest in tall trees 50 to 200 m from shore; require tall, dead, partially dead trees within 400 m of nest for perching.	No. Suitable aquatic features are not present within the subject properties.	No	No
Hirundo rustica	Barn Swallow	S4B	T	THR	-	MNRF 2014; NWSSS (Ecoplans et al. 2013)	Farmlands or rural areas; cliffs, caves, rock niches; buildings or other man-made structures for nesting; open country near body of water.	Yes. Creek and open fields, and man-made structures are within the subject properties.	Yes	Yes
Hylocichla mustelina	Wood Thrush	S4B	T	SC	-	MNRF 2014; NWSSS (Ecoplans et al. 2013)	Carolinian and Great Lakes-St. Lawrence forest zones; undisturbed moist mature deciduous or mixed forest with deciduous sapling growth; near pond or swamp; hardwood forest edges; must have some trees higher than 12 m.	Yes. Forested habitat exists within the subject properties.	Yes	Yes
Icteria virens	Yellow-breasted Chat	S2B	E	END	Schedule 1	MNRF 2014	Generally prefer dense thickets around wood edges, riparian areas, and in overgrown clearings.	Yes. Suitable thicket habitat exists within the subject properties.	Yes	No
Ixobrychus exilis	Least Bittern	S4B	T	THR	-	MNRF 2014	Deep marshes, swamps, bogs; marshy borders of lakes, ponds, streams, ditches; dense emergent vegetation of cattail, bulrush, sedge; nests in cattails; intolerant of loss of habitat and human disturbance.	No. Subject properties are too fragmented and encroached upon to provide suitable habitat for this species.	No	No
Melanerpes erythrocephalus	Red-headed Woodpecker	S4B	T	SC	Schedule 1	MNRF 2014	Open, deciduous forest with little understory; fields or pasture lands with scattered large trees; wooded swamps; orchards, small woodlots or forest edges; groves of dead or dying trees; feeds on insects and stores nuts or acorns for winter; loss of habitat is limiting factor; requires cavity trees with at least 40 cm dbh; require about 4 ha for a territory.	Yes. Deciduous forest and swamp habitats within the subject properties may provide habitat for this species.	Yes	No

Scientific Name	Common Name	SRANK[1]	COSEWIC[2]	COSSARO[3]	SARA Schedule[4]	Background Source	Habitat Preference[5,6,7,8]	Suitable Habitats within Subject Property (within 120m)	Potential to be Impacted by Project	Observed by NRSI
Parkesia motacilla	Louisiana Waterthrush	S3B	SC	SC	Schedule 1	MNRF 2014	Generally inhabits mature forests along steeply sloped ravines adjacent to running water. It prefers clear, cold streams and densely wooded swamps.	Yes. Swamp and creek habitats exist within the subject properties.	Yes	No
Riparia riparia	Bank Swallow	S4B	T	THR	-	MNRF 2014; NWSSS (Ecoplans et al. 2013)	Sand, clay or gravel river banks or steep riverbank cliffs; lakeshore bluffs of easily crumbled sand or gravel; gravel pits, road-cuts, grassland or cultivated fields that are close to water; nesting sites are limiting factor for species presence.	No. Suitable nesting habitat does not exist within the subject properties.	No	No
Setophaga cerulea	Cerulean Warbler	S3B	E	THR	Schedule 1	MNRF 2014	Mature deciduous woodland of Great Lakes- St. Lawrence and Carolinian forests, sometimes coniferous; swamps or bottomlands with large trees; area sensitive species needing extensive areas of forest (>100 ha).	No. Forested habitat within the subject properties is not large enough to support this species.	No	No
Sturnella magna	Eastern Meadowlark	S4B	T	THR	-	MNRF 2014	Open, grassy meadows, farmland, pastures, hayfields or grasslands with elevated singing perches; cultivated land and weedy areas with trees; old orchards with adjacent, open grassy areas >10 ha in size.	No. Suitable grassland habitat does not exist within the subject properties.	No	No
Vermivora chrysoptera	Golden-winged Warbler	S4B	T	SC	Schedule 1	MNRF 2014	Generally prefer areas of early successional vegetation, found primarily on field edges, hydro or utility right-of-ways, or recently logged areas.	No. Suitable thicket habitat does not exist within the subject properties.	No	No
Herpetofauna										
Ambystoma jeffersonianum	Jefferson Salamander	S2	E	END	Schedule 1	MNRF 2014; NWSSS (Ecoplans et al. 2013)	Inhabit deciduous and mixed deciduous forests with suitable breeding areas which generally consist of ephemeral (temporary) bodies of water that are fed by spring runoff, groundwater, or springs.	No. There is no suitable breeding habitat (i.e. vernal pools) within the subject properties. Ambystomid salamander habitat suitability assessments conducted in the NWSSS. No suitable breeding ponds identified within the NWSSS primary study area. No additional surveys undertaken, in consultation with MNRF (Ecoplans et al. 2013).	No	No
Chelydra serpentina serpentina	Snapping Turtle	S3	SC	SC	Schedule 1	MNRF 2014; NWSSS (Ecoplans et al. 2013)	Permanent or semi-permanent fresh water; marshes, swamps or bogs; rivers and streams with soft muddybanks or bottoms. The species often uses soft soil or clean dry sand on south-facing slopes for nest sites and may nest at some distance from water.	Yes. Swamp, and stream habitat identified within the subject properties. As well, suitable basking and/or nesting habitat may exist within the subject properties. Targeted turtle nesting surveys conducted by NRSI in 2015 confirmed no evidence of turtle nesting.	Yes	No
Emydoidea blandingii	Blanding's Turtle (*Great Lakes/St Lawrence population*)	S3	T	THR	Schedule 1	MNRF 2014; NWSSS (Ecoplans et al. 2013)	Shallow water marshes, bogs, ponds or swamps, or coves in larger lakes with soft muddy bottoms and aquatic vegetation; basks on logs, stumps, or banks; surrounding natural habitat is important in summer as they frequently move from aquatic habitat to terrestrial habitats; hibernates in bogs; not readily observed.	Yes. Wetland habitat identified, and suitable basking and/or nesting habitat may exist within the subject properties. Targeted turtle nesting surveys conducted by NRSI in 2015 confirmed no evidence of turtle nesting.	Yes	No
Glyptemys insculpta	Wood Turtle	S2	T	END	Schedule 1	MNRF 2014	Slow-moving streams with sandy bottoms and woody edges; ponds, marshes, swamps; woodlands in floodplains; lives within 150 m of stream shores; home range may be 5 to 25 ha, sometimes as much as 115 ha; riparian corridors important since this species is quite terrestrial.	No. This species no longer occurs within Waterloo Region.	No	No

Scientific Name	Common Name	SRANK[1]	COSEWIC[2]	COSSARO[3]	SARA Schedule[4]	Background Source	Habitat Preference[5,6,7,8]	Suitable Habitats within Subject Property (within 120m)	Potential to be Impacted by Project	Observed by NRSI
Graptemys geographica	Northern Map Turtle	S3	SC	SC	Schedule 1	MNRF 2014; NWSSS (Ecoplans et al. 2013)	Large bodies of water with soft bottoms, and aquatic vegetation; basks on logs or rocks or on beaches and grassy edges, will bask in groups; uses soft soil or clean dry sand for nest sites; may nest at some distance from water; home range size is larger for females (about 70 ha) than males (about 30 ha) and includes hibernation, basking, nesting and feeding areas; aquatic corridors (e.g. stream) are required for movement; not readily observed.	No. Large bodies of water not present within subject properties. No suitable habitat observed within the NWSSS primary study area (Ecoplans et al. 2013).	No	No
Pseudacris triseriata	Western Chorus Frog	S3	T	NAR	Schedule 1	NWSSS (Ecoplans et al. 2013)	Roadside ditches or temporary ponds in fields; swamps or wet meadows; woodland or open country with cover and moisture; small ponds and temporary pools.	Yes. Swamps and suitable wet habitats exist within the subject area.	Yes	No
Regina septemvittata	Queensnake	S2	E	END	Schedule 1	MNRF 2014; NWSSS (Ecoplans et al. 2013)	Margins of streams with slow currents and gravel bottoms; shorelines with rocks and debris; old quarries; canals; aquatic habitat with overhanging trees, particularly willows.	No. Watercourse features within the subject properties not suitable habitat for this species (Ecoplans et al. 2013).	No	No
Thamnophis sauritus septentrionalis	Northern Ribbonsnake	S3	SC	SC	Schedule 1	MNRF 2014; NWSSS (Ecoplans et al. 2013)	Sunny grassy areas with low dense vegetation near bodies of shallow permanent quiet water; wet meadows, grassy marshes or sphagnum bogs; borders of ponds, lakes or streams; hibernates in groups.	Yes. Wet meadows, grassy marshes, and stream edges exist within the subject properties.	No. Considered to be absent.	No
Mammals										
Myotis leibii	Eastern Small-footed Bat	S2S3	-	END	-	MNRF 2014	Overwintering habitat: Caves and mines that remain above 0. Maternal Roosts: primarily under loose rocks on exposed rock outcrops, crevices and cliffs, and occasionally in buildings, under bridges and highway overpasses and under tree bark.	No. Bat habitat assessment conducted by NRSI in 2014 confirmed no use by bats within buildings that are to be demolished.	No	No
Myotis lucifugus	Little Brown Myotis	S4	E	END	-	MNRF 2014	Uses caves, quarries, tunnels, hollow trees or buildings for roosting; winters in humid caves; maternity sites in dark warm areas such as attics and barns; feeds primarily in wetlands, forest edges.	No. Bat habitat assessment conducted by NRSI in 2014 confirmed no use by bats within buildings that are to be demolished. No tree removal proposed.	No	No
Myotis septentrionalis	Northern Myotis	S3	E	END	-	MNRF 2014	Hibernates in mines or caves; during summer males roost alone and females form maternity colonies of up to 60 adults; roosts in houses, man-made structures but prefers hollow trees or under loose bark; hunts within forests, below canopy.	No. Bat habitat assessment conducted by NRSI in 2014 confirmed no use by bats within buildings that are to be demolished. No tree removal proposed.	No	No
Perimyotis subflavus	Tri-colored Bat	S3?	E	--	Schedule 1	MNRF 2014	Open woods near water; roosts in trees, cliff crevices, buildings or caves; hibernates in damp, draft-free, warm caves, mines or rock crevices.	No. Bat habitat assessment conducted by NRSI in 2014 confirmed no use by bats within buildings that are to be demolished. No tree removal proposed.	No	No
Taxidea taxus jacksoni	American Badger	S2	E	END	Schedule 1	MNRF 2014; NWSSS (Ecoplans et al. 2013)	Generally prefer open habitats, whether natural (grasslands) or man-made (road right-of-ways, golf courses). Potential habitat also includes agricultural fields consisting of cereal crops, hay, and pasture and along the edges of corn and soybean fields.	Yes. Open habitats exist within the subject properties. Targetted surveys conducted in 2010 and 2011 within potential suitable habitats, in consultation with MNR. Field studies concluded no evidence of American Badger use within the NWSSS primary study area (Ecoplans et al. 2013). Targeted habitat assessment conducted by NRSI in 2015 confirmed the habitat conditions are unchanged; no candidate badger dens were observed.	No	No

Scientific Name	Common Name	SRANK[1]	COSEWIC[2]	COSSARO[3]	SARA Schedule[4]	Background Source	Habitat Preference[5,6,7,8]	Suitable Habitats within Subject Property (within 120m)	Potential to be Impacted by Project	Observed by NRSI
Insects										
Bombus affinis	Rusty-patched Bumble Bee	S1	E	END	-	MNRF 2014	Generally inhabits a range of diverse habitats including mixed farmland, sand dunes, marshes, urban and wooded areas. It usually nests underground in abandoned rodent burrows. Currently, the only known population occurs in a managed oak savanna remnant.	No. Known species range is within Lambton County, Ontario.	No	No
Danaus plexippus	Monarch	S2N, S4B	SC	SC	Schedule 1	MNRF 2014; NWSSS (Ecoplans et al. 2013)	Open areas with milkweed species (*Asclepias* spp.).	Yes. Milkweed is present within the subject properties.	Yes	Yes
Epiaeschna heros	Swamp Darner	S2S3	-	-	-	NWSSS (Ecoplans et al. 2013)	Shallow, shaded woodland ponds, including those that are sometimes temporary; also some swamps and slow streams.	Yes. Woodlands along Beaver Creek.	Yes	No
Pieris virginiensis	West Virginia White	S3	SC	-	-	MNRF 2014	Generally prefer moist, deciduous woodlands. The larvae feed only on the leaves of the two-leaved toothwort (*Cardamine diphylla*), which is a small, spring-blooming plant of the forest floor.	Yes. Suitable deciduous woodland habitat exists within the subject properties. Host plant observed in primary study area during NWSSS (Ecoplans et al. 2013).	Yes	No

[1,3]MNRF 2015a, [2,4]Government of Canada 2015, [5]MNRF 2000, [6]Layberry et al. 1998, [7]MNRF 2014, [8]Reznicek et al. 2011

Legend	COSEWIC/COSSARO
S1 Critically Imperiled	E/END Endangered
S2 Imperiled	T/THR Threatened
S3 Vulnerable	SC Special Concern
S4 Apparently Secure	NAR Not at Risk
B Breeding	
N Non-breeding	

APPENDIX II

Vegetation Species Observed by Monitoring Plot (2014 – 2016)

Vegetation Species Observed by Monitoring Plot (2014-2016)

Scientific Name	Common Name	CC	CW	Weed	SRANK[1]	Waterloo Region[2]	NHIC Data[3]	NRSI Observed				
								VEG-003	VEG-004	VEG-005	VEG-006	VEG-007
Pteridophytes	**Ferns & Allies**											
Dryopteridaceae	**Wood Fern Family**											
Athyrium filix-femina var. angustum	Northern Lady Fern	4	0		S5				X	X	X	X
Cystopteris bulbifera	Bulblet Fern	5	-2		S5			X	X			X
Dryopteris carthusiana	Spinulose Wood Fern	5	-2		S5				X	X	X	X
Dryopteris cristata	Crested Wood Fern	7	-5		S5				X			X
Dryopteris intermedia	Evergreen Wood Fern	5	0		S5			X	X	X	X	
Dryopteris marginalis	Marginal Wood Fern	5	3		S5				X			X
Onoclea sensibilis	Sensitive Fern	4	-3		S5			X	X		X	X
Polystichum braunii	Braun's Holly Fern	9	5		S3	R	X					
Equisetaceae	**Horsetail Family**											
Equisetum arvense	Field Horsetail	0	0		S5			X	X			X
Thelypteridaceae	**Beech Fern Family**											
Thelypteris palustris var. pubescens	Marsh Fern	5	-4		S5				X			
Gymnosperms	**Conifers**											
Cupressaceae	**Cypress Family**											
Thuja occidentalis	White Cedar	4	-3		S5			X	X		X	X
Pinaceae	**Pine Family**											
Pinus strobus	Eastern White Pine	4	3		S5			X				
Tsuga canadensis	Eastern Hemlock	7	3		S5				X	X	X	X
Dicotyledons	**Dicots**											
Aceraceae	**Maple Family**											
Acer negundo	Manitoba Maple	0	-2		S5			X				
Acer platanoides	Norway Maple		5	-3	SE5			X				
Acer rubrum	Red Maple	4	0		S5				X			
Acer saccharum ssp. saccharum	Sugar Maple	4	3		S5				X	X	X	X
Apiaceae	**Carrot or Parsley Family**											
Cicuta maculata	Spotted Water-hemlock	6	-5		S5			X				X
Daucus carota	Wild Carrot		5	-2	SE5			X				
Hydrocotyle americana	American Marsh-pennywort	7	-5		S5							X
Araliaceae	**Ginseng Family**											
Aralia nudicaulis	Wild Sarsaparilla	4	3		S5				X			
Asclepiadaceae	**Milkweed Family**											
Asclepias incarnata ssp. incarnata	Swamp Milkweed	6	-5		S5			X				
Asclepias syriaca	Common Milkweed	0	5		S5			X				
Asteraceae	**Composite or Aster Family**											
Ambrosia artemisiifolia	Common Ragweed	0	3		S5			X				
Arctium minus ssp. minus	Common Burdock		5	-2	SE5			X				
Bidens frondosa	Devil's Beggar-ticks	3	-3		S5			X	X			X
Cirsium arvense	Canada Thistle		3	-1	SE5			X				

Scientific Name	Common Name	CC	CW	Weed	SRANK[1]	Waterloo Region[2]	NHIC Data[3]	NRSI Observed				
								VEG-003	VEG-004	VEG-005	VEG-006	VEG-007
Cirsium vulgare	Bull Thistle		4	-1	SE5			X				
Erigeron annuus	Daisy Fleabane	0	1		S5			X				
Eupatorium perfoliatum	Perfoliate Thoroughwort	2	-4		S5			X				
Eupatorium maculatum ssp. maculatum	Spotted Joe-pye-weed	3	-5		S5			X	X			
Euthamia graminifolia	Flat-topped Bushy Goldenrod	2	-2		S5			X				
Solidago altissima var. altissima	Tall Goldenrod	1	3		S5			X				
Solidago canadensis	Canada Goldenrod	1	3		S5			X	X			
Solidago patula	Rough-leaved Goldenrod	8	-5		S5			X				
Solidago rugosa ssp. rugosa	Rough Goldenrod	4	-1		S5			X	X			
Symphyotrichum lanceolatum var. lanceolatum	Tall White Aster	3	-3		S5			X				
Symphyotrichum lateriflorum var. lateriflorum	Calico Aster	3	-2		S5			X		X		X
Symphyotrichum novae-angliae	New England Aster	2	-3		S5			X				
Symphyotrichum puniceum var. puniceum	Purple-stemmed Aster				S5			X	X			
Taraxacum officinale	Common Dandelion		3	-2	SE5			X	X			X
Tussilago farfara	Coltsfoot		3	-2	SE5			X	X			X
Balsaminaceae	**Touch-me-not Family**											
Impatiens capensis	Spotted Touch-me-not	4	-3		S5			X	X			X
Berberidaceae	**Barberry Family**											
Caulophyllum giganteum	Blue Cohosh				S5			X		X		
Betulaceae	**Birch Family**											
Betula alleghaniensis	Yellow Birch	6	0		S5			X	X	X	X	X
Ostrya virginiana	Hop Hornbeam	4	4		S5					X	X	
Boraginaceae	**Borage Family**											
Lithospermum latifolium	American Gromwell	9	5		S3	R	X					
Myosotis laxa	Smaller Forget-me-not	6	-5		S5				X			
Brassicaceae	**Mustard Family**											
Cardamine diphylla	Two-leaved Toothwort	7	5		S5				X			X
Campanulaceae	**Bellflower Family**											
Lobelia siphilitica	Great Lobelia	6	-4		S5			X				X
Caprifoliaceae	**Honeysuckle Family**											
Sambucus canadensis	Common Elderberry	5	-2		S5			X	X			X
Sambucus racemosa ssp. pubens	Red-berried Elderberry	5	2		S5					X		
Viburnum lentago	Nannyberry	4	-1		S5			X				
Viburnum opulus	Guelder Rose		0	-1	SE4			X		X	X	X
Viburnum trilobum	High Bush Cranberry	5	-3		S5			X				
Cornaceae	**Dogwood Family**											
Cornus alternifolia	Alternate-leaved Dogwood	6	5		S5			X	X	X	X	
Cornus amomum ssp. obliqua	Silky Dogwood	5	-4		S5			X				
Cornus stolonifera	Red-osier Dogwood	2	-3		S5			X	X			
Fabaceae	**Pea Family**											
Trifolium pratense	Red Clover		2	-2	SE5			X				
Vicia caroliniana	Carolina Vetch	10	5		S2	R	X					

Scientific Name	Common Name	CC	CW	Weed	SRANK[1]	Waterloo Region[2]	NHIC Data[3]	NRSI Observed				
								VEG-003	VEG-004	VEG-005	VEG-006	VEG-007
Fagaceae	**Beech Family**											
Fagus grandifolia	American Beech	6	3		S5					X		
Quercus macrocarpa	Bur Oak	5	1		S5			X				
Geraniaceae	**Geranium Family**											
Geranium maculatum	Spotted Crane's-bill	6	3		S5			X				
Geranium robertianum	Herb Robert		5	-2	SE5				X	X	X	X
Grossulariaceae	**Currant Family**											
Ribes americanum	Wild Black Currant	4	-3		S5				X			
Ribes cynosbati	Prickly Gooseberry	4	5		S5				X	X		
Juglandaceae	**Walnut Family**											
Carya cordiformis	Bitternut hickory	6	0		S5					X	X	
Juglans nigra	Black Walnut	5	3		S4	R+*		X		X		
Lamiaceae	**Mint Family**											
Lycopus americanus	Cut-leaved Water-horehound	4	-5		S5			X	X			
Lycopus uniflorus	Northern Water-horehound	5	-5		S5			X				
Mentha arvensis ssp. borealis	American Wild Mint	3	-3		S5			X				
Monarda didyma	Oswego-tea	8	3		S3	R+	X					
Prunella vulgaris ssp. lanceolata	Heal-all	5	5		S5			X			X	X
Scutellaria lateriflora	Mad-dog Skullcap	5	-5		S5			X				X
Oleaceae	**Olive Family**											
Fraxinus americana	White Ash	4	3		S5					X	X	
Fraxinus nigra	Black Ash	7	-4		S5				X			X
Fraxinus pennsylvanica	Green Ash	3	-3		S5			X	X			X
Onagraceae	**Evening-primrose Family**											
Circaea alpina	Smaller Enchanter's Nightshade	6	-3		S5				X			
Circaea lutetiana ssp. canadensis	Yellowish Enchanter's Nightshade	3	3		S5			X	X	X	X	X
Epilobium coloratum	Purple-veined Willow-herb	3	-5		S5				X			
Epilobium parviflorum	Sparse-flowered Willow-herb		3	-1	SE4			X				
Oenothera biennis	Common Evening-primrose	0	3		S5			X				
Oxalidaceae	**Wood Sorrel Family**											
Oxalis stricta	Upright Yellow Wood-sorrel	0	3		S5							X
Papaveraceae	**Poppy Family**											
Sanguinaria canadensis	Bloodroot	5	4		S5					X		
Plantaginaceae	**Plantain Family**											
Plantago major	Common Plantain		-1	-1	SE5			X				
Polemoniaceae	**Phlox Family**											
Phlox subulata ssp. subulata	Moss Phlox		5	-1	S1?		X					
Primulaceae	**Primrose Family**											
Lysimachia ciliata	Fringed Loosestrife	4	-3		S5			X				X

Scientific Name	Common Name	CC	CW	Weed	SRANK[1]	Waterloo Region[2]	NHIC Data[3]	NRSI Observed				
								VEG-003	VEG-004	VEG-005	VEG-006	VEG-007
Ranunculaceae	**Buttercup Family**											
Actaea rubra	Red Baneberry	5	5		S5				X			
Anemone canadensis	Canada Anemone	3	-3		S5			X				
Caltha palustris	Marsh-marigold	5	-5		S5				X			
Ranunculus abortivus	Kidney-leaf Buttercup	2	-2		S5				X			
Ranunculus acris	Tall Buttercup		-2	-2	SE5			X				X
Ranunculus hispidus var. caricetorum	Swamp Buttercup	5	-5		S5				X			
Rhamnaceae	**Buckthorn Family**											
Rhamnus cathartica	Common Buckthorn		3	-3	SE5			X	X		X	
Frangula alnus	Glossy Buckthorn		-1	-3	SE5			X				
Rosaceae	**Rose Family**											
Agrimonia gryposepala	Tall Hairy Agrimony	2	2		S5			X	X			
Fragaria vesca ssp. americana	Woodland Strawberry	4	4		S5				X			X
Fragaria virginiana ssp. virginiana	Scarlet Strawberry	2	1		SU			X	X		X	X
Geum aleppicum	Yellow Avens	2	-1		S5				X			
Geum canadense	White Avens	3	0		S5				X	X	X	
Malus domestica	Apple							X				
Prunus pensylvanica	Pin Cherry	3	4		S5			X				
Prunus serotina	Black Cherry	3	3		S5			X	X	X	X	X
Prunus virginiana ssp. virginiana	Choke Cherry	2	1		S5			X	X	X		
Rubus allegheniensis	Alleghany Blackberry	2	2		S5				X	X	X	
Rubus idaeus ssp. melanolasius	Wild Red Raspberry	0	-2		S5			X		X		
Rubus pubescens	Dwarf Raspberry	4	-4		S5				X			X
Sorbus aucuparia	European Mountain-ash		5	-2	SE4						X	
Rubiaceae	**Madder Family**											
Galium aparine	Cleavers	4	3		S5				X			
Galium asprellum	Rough Bedstraw	6	-5		S5				X			
Galium triflorum	Sweet-scented Bedstraw	4	2		S5				X			
Salicaceae	**Willow Family**											
Populus balsamifera ssp. balsamifera	Balsam Poplar	4	-3		S5			X				
Populus tremuloides	Trembling Aspen	2	0		S5			X				X
Salix bebbiana	Long-beaked Willow	4	-4		S5			X				
Salix purpurea	Basket Willow		-3	-1	SE4			X				
Saxifragaceae	**Saxifrage Family**											
Mitella nuda	Naked Mitrewort	6	-3		S5				X			
Tiarella cordifolia	False Mitrewort	6	1		S5				X			
Scrophulariaceae	**Figwort Family**											
Chelone glabra	Turtlehead	7	-5		S5			X	X			X
Veronica americana	American Speedwell	6	-5		S5							X
Veronica officinalis	Common Speedwell		5	-2	SE5			X			X	
Solanaceae	**Nightshade Family**											
Solanum dulcamara	Bitter Nightshade		0	-2	SE5			X	X	X	X	X

Scientific Name	Common Name	CC	CW	Weed	SRANK[1]	Waterloo Region[2]	NHIC Data[3]	NRSI Observed				
								VEG-003	VEG-004	VEG-005	VEG-006	VEG-007
Tiliaceae	**Linden Family**											
Tilia americana	American Basswood	4	3		S5			X	X	X	X	
Ulmaceae	**Elm Family**											
Ulmus americana	White Elm	3	-2		S5							X
Urticaceae	**Nettle Family**											
Boehmeria cylindrica	False Nettle	4	-5		S5				X			
Laportea canadensis	Wood Nettle	6	-3		S5				X			
Pilea pumila	Dwarf Clearweed	5	-3		S5				X			X
Urtica dioica ssp. gracilis	American Stinging Nettle	2	-1		S5				X			
Verbenaceae	**Vervain Family**											
Verbena urticifolia	White Vervain	4	-1		S5			X				
Vitaceae	**Grape Family**											
Parthenocissus vitacea	Woodbine	3	3		S5			X	X	X	X	X
Vitis riparia	Riverbank Grape	0	-2		S5			X	X		X	X
Monocotyledons	**Monocots**											
Araceae	**Arum Family**											
Arisaema triphyllum	Jack-in-the-pulpit	5	-2		S5			X	X	X	X	X
Cyperaceae	**Sedge Family**											
Carex albicans var. albicans	Closely-covered Sedge	9	5		S3	R#	X					
Carex albursina	White Bear Sedge	7	5		S5			X				
Carex arctata	Drooping Wood Sedge	5	5		S5						X	
Carex bebbii	Bebb's Sedge	3	-5		S5			X				
Carex comosa	Bristly Sedge	5	-5		S5			X				
Carex flava	Yellow Sedge	5	-5		S5			X				
Carex gracillima	Graceful Sedge	4	3		S5			X		X	X	X
Carex granularis	Meadow Sedge	3	-4		S5			X				
Carex hitchcockiana	Hitchcock's Sedge	6	5		S5					X	X	
Carex hystericina	Porcupine Sedge	5	-5		S5			X				
Carex lacustris	Lake-bank Sedge	5	-5		S5				X			
Carex pedunculata	Long-stalked Sedge	5	5		S5			X	X	X	X	
Carex radiata	Radiate Sedge	4	5		S5			X	X			
Carex retrorsa	Retrorse Sedge	5	-5		S5			X				
Carex scabrata	Rough Sedge	8	-5		S5	R			X			
Carex stipata	Awl-fruited Sedge	3	-5		S5				X			X
Carex vulpinoidea	Fox Sedge	3	-5		S5			X				
Eleocharis erythropoda	Red-footed Spike-rush	4	-5		S5			X				
Scirpus atrovirens	Dark-green Bulrush	3	-5		S5			X				
Iridaceae	**Iris Family**											
Sisyrinchium montanum	Montane Blue-eyed-grass		-1		S5			X				
Juncaceae	**Rush Family**											
Juncus effusus var. solutus	Soft Rush	4	-5		S5			X				
Juncus tenuis	Path Rush	0	0		S5			X				

Scientific Name	Common Name	CC	CW	Weed	SRANK[1]	Waterloo Region[2]	NHIC Data[3]	NRSI Observed				
								VEG-003	VEG-004	VEG-005	VEG-006	VEG-007
Liliaceae	**Lily Family**											
Allium tricoccum	Wild Leek	7	2		S5					X		
Maianthemum canadense	Wild Lily-of-the-valley	5	0		S5				X	X	X	
Maianthemum racemosum ssp. racemosum	False Solomon's Seal	4	3		S5			X		X		
Maianthemum stellatum	Star-flowered Solomon's Seal	6	1		S5			X		X		
Orchidaceae	**Orchid Family**											
Epipactis helleborine	Common Helleborine		5	-2	SE5			X	X	X	X	X
Poaceae	**Grass Family**											
Dactylis glomerata	Orchard Grass		3	-1	SE5			X				
Elymus virginicus var. virginicus	Virginia Wild Rye	5	-2		S5				X			
Glyceria striata	Fowl Meadow Grass	3	-5		S5			X	X	X		X
Leersia oryzoides	Rice Cut Grass	3	-5		S5			X				X
Leersia virginica	White Cut Grass	6	-3		S4			X				
Muhlenbergia mexicana var. mexicana	Mexican Satin Grass	1	-3		S5			X				
Poa palustris	Fowl Meadow Grass	5	-4		S5			X	X			
Typhaceae	**Cattail Family**											
Typha latifolia	Broad-leaved Cattail	3	-5		S5			X				
							Total	**105**	**76**	**38**	**34**	**48**

[1]MNRF 2016a, [2]Richardson & Martin 1999, [3]MNRF 2015b

LEGEND
SRANK
S1 Critically Imperiled
S2 Imperiled
S3 Vulnerable
S4 Apparently Secure
S5 Secure
SU Unrankable
S#? Rank Uncertain
Region of Waterloo
R Native, Present, Rare
+ Significant only if demonstrably indigenous
* Significant, but additional research may prove otherwise

APPENDIX III

Avifauna Observed within the Subject Property (2014 – 2016)

Avifauna Observed within Subject Property (2014-2016)

Scientific Name	Common Name	SRANK[1]	COSSARO[2]	COSEWIC[3]	SARA Schedule[4]	Region of Waterloo Status[5]	Kartway Property		Northgate Property											
							WSU-11		WSU-9		WSU-10		WSU-12		WSU-13		WSU-14		WSU-15	
Anatidae	**Ducks, Geese & Swans**						Br.Ev.	#	Br.Ev.	#	Br.Ev.	#	Br.Ev.	#	Br.Ev.	#	Br.Ev.	#	Br.Ev.	#
Branta canadensis	Canada Goose	S5					X	3	X	1			X	2	X	1			X	19
Anas platyrhynchos	Mallard	S5					H	11							X	1	X	2	P	3
Phasianidae	**Partridges, Grouse & Turkeys**																			
Meleagris gallopavo	Wild Turkey	S5					H	6	H	2			H	3	H	16	H	2	H	10
Ardeidae	**Herons & Bitterns**																			
Ardea herodias	Great Blue Heron	S4B				√	X	1									X	1		
Butorides virescens	Green Heron	S4B				√	S	1												
Cathartidae	**Vultures**																			
Cathartes aura	Turkey Vulture	S5B				√	X	1	X	1			X	1	X	1			X	1
Accipitridae	**Hawks, Kites, Eagles & Allies**																			
Buteo jamaicensis	Red-tailed Hawk	S5	NAR	NAR					X	1										
Charadriidae	**Plovers**																			
Charadrius vociferus	Killdeer	S5B, S5N													H	1	X	1	H	3
Scolopacidae	**Sandpipers, Phalaropes & Allies**																			
Tringa solitaria	Solitary Sandpiper	S4B																	X	1
Scolopax minor	American Woodcock	S4B											S	1						
Laridae	**Gulls, Terns & Skimmers**																			
Larus delawarensis	Ring-billed Gull	S5B, S4N					X	1												
Columbidae	**Pigeons & Doves**																			
Zenaida macroura	Mourning Dove	S5					X	1									S	1	S	1
Strigidae	**Typical Owls**																			
Bubo virgianus	Great Horned Owl	S4													FY	1				
Caprimulgidae	**Goatsuckers**																			
Chordeiles minor	Common Nighthawk	S4B	SC	T	Schedule 1	√*			T	1			T	5						
Trochilidae	**Hummingbirds**																			
Archilochus colubris	Ruby-throated Hummingbird	S5B				√	X	1												
Picidae	**Woodpeckers**																			
Melanerpes carolinus	Red-bellied Woodpecker	S4				√	T	1							H	2			S	3
Picoides pubescens	Downy Woodpecker	S5													P	4	H	1	S	2
Picoides villosus	Hairy Woodpecker	S5									X	1			T	2				
Colaptes auratus	Northern Flicker	S4B					P	2			X	1			X	1	H	1	T	2
Dryocopus pileatus	Pileated Woodpecker	S5				√									X	1				
Tyrannidae	**Tyrant Flycathers**																			
Contopus virens	Eastern Wood-Pewee	S4B	SC	SC			S	2							T	6	S	1	T	11
Empidonax minimus	Least Flycatcher	S4B				√	S	1												
Myiarchus crinitus	Great Crested Flycatcher	S4B					T	3			X	1	X	2	S	2	T	1	T	7
Tyrannus tyrannus	Eastern Kingbird	S4B															S	1		
Vireonidae	**Vireos**																			
Vireo gilvis	Warbling Vireo	S5B															S	1		
Vireo olivaceus	Red-eyed Vireo	S5B													T	7			T	10
Corvidae	**Crows & Jays**																			
Cyanocitta cristata	Blue Jay	S5					S	2	X	3					A	8			A	7
Corvus brachyrhynchos	American Crow	S5B					S	5							T	8	H	4	P	11

Scientific Name	Common Name	SRANK[1]	COSSARO[2]	COSEWIC[3]	SARA Schedule[4]	Region of Waterloo Status[5]	Kartway Property		Northgate Property											
							WSU-11		WSU-9		WSU-10		WSU-12		WSU-13		WSU-14		WSU-15	
Alaudidae	**Larks**																			
Eremophila alpestris	Horned Lark	S5B							S	2					T	2	S	2		
Hirundinidae	**Swallows**																			
Tachycineta bicolor	Tree Swallow	S4B					H	1												
Hirundo rustica	Barn Swallow	S4B	THR	T			P	2			X	2	X	2						
Paridae	**Chickadees & Titmice**																			
Poecile atricapillus	Black-capped Chickadee	S5					H	2							T	10	P	3	T	7
Sittidae	**Nuthatches**																			
Sitta carolinensis	White-breasted Nuthatch	S5					S	1							S	2			X	1
Certhiidae	**Creepers**																			
Certhia americana	Brown Creeper	S5B				√									S	1			S	1
Troglodytidae	**Wrens**																			
Troglodytes aedon	House Wren	S5B					A	7							T	6	T	6	NY	7
Turdidae	**Thrushes**																			
Catharus fuscescens	Veery	S4B				√													S	1
Catharus ustulatus	Swainson's Thrush	S4B				√									X	1				
Hylocichla mustelina	Wood Thrush	S4B	SC	T											X	1				
Turdus migratorius	American Robin	S5B					CF	7	X	1	X	2	X	1	N	17	FY	9	T	7
Mimidae	**Mockingbirds, Thrashers & Allies**																			
Dumetella carolinensis	Gray Catbird	S4B					T	2							S	2	S	2		
Toxostoma rufum	Brown Thrasher	S4B				√	H	1							P	2				
Sturnidae	**Starlings**																			
Sturnus vulgaris	European Starling	SNA					AE	27					X	1	X	1	X	1	X	1
Bombycillidae	**Waxwings**																			
Bombycilla cedrorum	Cedar Waxwing	S5B					S	2							T	8	H	1	X	1
Parulidae	**Wood Warblers**																			
Geothylpis trichas	Common Yellowthroat	S5B					T	2							X	1	T	4	S	
Setophaga ruticilla	American Redstart	S5B				√													S	1
Setophaga petechia	Yellow Warbler	S5B					T	5											S	1
Setophaga pensylvanica	Chestnut-sided Warbler	S5B				√	S	1											S	1
Setophaga striata	Blackpoll Warbler	S4B					X	1							X	1				
Setophaga pinus	Pine Warbler	S5B				√	S	2							S	2			S	2
Emberizidae	**New World Sparrows & Allies**																			
Spizella passerina	Chipping Sparrow	S5B					T	1	X	1					T	3	S	4	S	2
Melospiza melodia	Song Sparrow	S5B					T	6	S	1					T	4	T	4	T	5
Melospiza georgiana	Swamp Sparrow	S5B					T	3												
Cardinalidae	**Cardinals, Grosbeaks & Allies**																			
Cardinalis cardinalis	Northern Cardinal	S5					T	4			X	1			T	3	S	2	T	7
Pheucticus ludovicianus	Rose-breasted Grosbeak	S4B					T	2							T	2	T	4	T	3
Passerina cyanea	Indigo Bunting	S4B					S	3	X	1	X	2			S	5	T	6	T	7
Icteridae	**Blackbirds**																			
Agelaius phoeniceus	Red-winged Blackbird	S4					T	6					X	1	X	1	T	7	P	8
Quiscalus quiscula	Common Grackle	S5B					CF	8	X	1					T	6	X	2		
Molothrus ater	Brown-headed Cowbird	S4B					T	6	X	1					H	3	T	2	T	4
Icterus galbula	Baltimore Oriole	S4B					P	2											S	1

Scientific Name	Common Name	SRANK[1]	COSSARO[2]	COSEWIC[3]	SARA Schedule[4]	Region of Waterloo Status[5]	Kartway Property		Northgate Property									
							WSU-11		WSU-9		WSU-10		WSU-12		WSU-13		WSU-14		WSU-15	
Fringillidae	**Finches & Allies**																			
Carpodacus mexicanus	House Finch	SNA													X	1				
Spinus tristis	American Goldfinch	S5B					H	2	H	1	X	1	X	1	T	7	T	2	H	3
						Total	42		14		8		11		41		29		37	

[1,4]MNRF 2016a; [3,4]Government of Canada 2016; [5]Martin 1996

LEGEND
SRANK
S4 Apparently Secure
S5 Secure
SNA Unranked
COSSARO/COSEWIC
NAR Not at Risk
SC Special Concern
THR/T Threatened
SARA Schedule
Schedule 1 Officially protected under SARA
Region of Waterloo
√ Regionally Significant
√* Significant when nesting in natural circumstances

APPENDIX IV

Anuran Monitoring Data from within the Subject Property (2014 – 2016)

Anuran Monitoring Data from within the Subject Property (2014 - 2016)

Station ANR-004 (Northgate Property)		2014			2015			2016		
Common Name	**Scientific Name**	April 21	May 12	June 10	April 16	May 25	June 16	April 18	May 17	June 21
American Toad	*Bufo americanus*									
Northern Spring Peeper	*Pseudarcris crucifer crucifer*				3			1(1)		
Tetraploid Gray Treefrog	*Hyla versicolor*					2 (3)				
Western Chorus Frog	*Pseudacris triseriata*									
Northern Leopard Frog	*Rana pipiens*									
Pickerel Frog	*Rana palustris*									
Green Frog	*Rana clamitans melanota*									
Mink Frog	*Rana septentrionalis*									
Bullfrog	*Rana catesbeiana*									
Wood Frog	*Rana sylvatica*									
	Beaufort Wind Scale	1	2	2	3	3	1	1	1	0
	%Cloud Cover	100	100	50	100	30	0	0	10	40
	Air temp. (°C)	17	16.5-18	21.6-23	9	14	16	13	13	16
	Water temp. (°C)	N/A	N/A	N/A	N/A	17.4	16.6	N/A	11.3	N/A
	Water pH	N/A	N/A	N/A	N/A	8.8	7.8	N/A	6.8	N/A
	Precipitation?	None	Drizzle	Drizzle	None	Light rain	None	None	None	None

Nothing Heard

Notes:
2014
Spring Peepers heard call code 3 in the distance to the west and southwest (April 21), Gray Tree Frog heard in distance (June 10)
2015
- No standing water, background noise = 1 (April 16)
- Northern Leopard Frog observed, no Common Nighthawk observed, Gray Treefrog (calling code 2) heard beyond 100m radius (June 16)
2016
- Not enough standing water to collect pH reading (April 18)

Station ANR-005 (Northgate Property)		2014			2015			2016		
Common Name	**Scientific Name**	April 21	May 12	June 10	April 16	May 25	June 16	April 18	May 17	June 21
American Toad	*Bufo americanus*									
Northern Spring Peeper	*Pseudarcris crucifer crucifer*				3	3		1 (2)		
Tetraploid Gray Treefrog	*Hyla versicolor*					1 (1)				
Western Chorus Frog	*Pseudacris triseriata*									
Northern Leopard Frog	*Rana pipiens*									
Pickerel Frog	*Rana palustris*									
Green Frog	*Rana clamitans melanota*									1 (1)
Mink Frog	*Rana septentrionalis*									
Bullfrog	*Rana catesbeiana*									
Wood Frog	*Rana sylvatica*									
	Beaufort Wind Scale	1	2	2	1	3	1	1	1	0
	%Cloud Cover	100	100	50	100	20	0	0	10	40
	Air temp. (°C)	17	16.5-18	21.6-23	9	14	16	13	12	16
	Water temp. (°C)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Water pH	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Precipitation?	None	Drizzle	Drizzle	Light rain	None	None	None	None	None

Nothing Heard

Notes:
2014
-heard Spring Peepers (call code 3) to the south beyond subject property (April 21), Not enough pooling water in May to support breeding amphibians, Gray Tree Frog heard in the distance offsite (June 10)
2015
- No standing water, background noise = 1 (April 16)
- No Common Nighthawk observed, Gray Treefrog (calling code 1) and American Toad (calling code 1) heard beyond 100m radius (June 16)
2016
- None

Station ANR-006 (Northgate Property)		2014			2015			2016		
Common Name	**Scientific Name**	April 21	May 12	June 10	April 16	May 25	June 16	April 18	May 17	June 21
American Toad	*Bufo americanus*	Nothing Heard	Nothing Heard	Nothing Heard				1 (1)		Nothing Heard
Northern Spring Peeper	*Pseudarcris crucifer crucifer*				3	1 (1)		2 (5)	1 (2)	
Tetraploid Gray Treefrog	*Hyla versicolor*						1 (2)			
Western Chorus Frog	*Pseudacris triseriata*									
Northern Leopard Frog	*Rana pipiens*									
Pickerel Frog	*Rana palustris*									
Green Frog	*Rana clamitans melanota*									
Mink Frog	*Rana septentrionalis*									
Bullfrog	*Rana catesbeiana*									
Wood Frog	*Rana sylvatica*				1 (1)			1 (2)		
	Beaufort Wind Scale	1	2	2	3	3	1	1	1	0
	%Cloud Cover	100	100	50	100	30	0	0	10	40
	Air temp. (°C)	17	16.5-18	21.6-23	8	14	16	13	12	18
	Water temp. (°C)	N/A	N/A	N/A	N/A	N/A	19.5	N/A	N/A	16.4
	Water pH	N/A	N/A	N/A	N/A	N/A	7.9	N/A	N/A	7.7
	Precipitation?	None	Drizzle	Drizzle	Light rain	Light rain	None	None	None	None

Notes:
2014
-Spring Peeper and 3 American Toads heard off property (May 12)
2015
- No standing water, background noise = 1 (April 16)
- No Common Nighthawk observed (June 16)
2016
- No standing water (May 17)

Station ANR-007 (Northgate Property)		2014			2015			2016		
Common Name	**Scientific Name**	April 21	May 12	June 10	April 16	May 25	June 16	April 18	May 17	June 21
American Toad	*Bufo americanus*	Station Not Surveyed	Station Not Surveyed	Station Not Surveyed	Nothing Heard	Nothing Heard		1 (1)	Nothing Heard	Nothing Heard
Northern Spring Peeper	*Pseudarcris crucifer crucifer*							3		
Tetraploid Gray Treefrog	*Hyla versicolor*						1 (2)			
Western Chorus Frog	*Pseudacris triseriata*									
Northern Leopard Frog	*Rana pipiens*									
Pickerel Frog	*Rana palustris*									
Green Frog	*Rana clamitans melanota*									
Mink Frog	*Rana septentrionalis*									
Bullfrog	*Rana catesbeiana*									
Wood Frog	*Rana sylvatica*							1 (2)		
	Beaufort Wind Scale	1	2	2	3	3	1	1-2	1	0
	%Cloud Cover	100	100	50	100	30	0	0	10	40
	Air temp. (°C)	17	16.5-18	21.6-23	8	14	16	13	13	16
	Water temp. (°C)	N/A	N/A	N/A	N/A	N/A	14.7	13.3	11.4	N/A
	Water pH	N/A	N/A	N/A	N/A	N/A	7.8	8.2	6.9	N/A
	Precipitation?	None	Drizzle	Drizzle	Light rain	Light rain	None	None	None	None

Notes:
2014
N/A
2015
- No standing water, background noise = 1 (April 16)
- Northern Leopard Frog observed 30m from survey point, not vocalizing (May 25)
- No Common Nighthawk observed (June 16)
2016
- Limited standing water (May 17)

Station ANR-008 (Kartway Property)		2014			2015			2016		
Common Name	**Scientific Name**	April 21	May 12	June 10	April 16	May 25	June 16	April 18	May 17	June 21
American Toad	*Bufo americanus*	Station Not Surveyed	Station Not Surveyed	Station Not Surveyed		Nothing Heard				Nothing Heard
Northern Spring Peeper	*Pseudarcris crucifer crucifer*				3			3	1 (2)	
Tetraploid Gray Treefrog	*Hyla versicolor*						1 (2)			
Western Chorus Frog	*Pseudacris triseriata*									
Northern Leopard Frog	*Rana pipiens*									
Pickerel Frog	*Rana palustris*									
Green Frog	*Rana clamitans melanota*									
Mink Frog	*Rana septentrionalis*									
Bullfrog	*Rana catesbeiana*									
Wood Frog	*Rana sylvatica*									
	Beaufort Wind Scale	1	2	2	3	3	1	1	1	0
	%Cloud Cover	100	100	50	100	20	0	0	10	40
	Air temp. (°C)	17	16.5-18	21.6-23	8	14	18	13	12	18
	Water temp. (°C)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Water pH	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Precipitation?	None	Drizzle	Drizzle	None	None	None	None	None	None

Notes:
2014
N/A
2015
- No standing water, background noise = 1 (April 16)
- Gray Treefrog (calling code 3) heard beyond 100m radius (May 25)
- No Common Nighthawk observed, Gray Treefrog (calling code 1) and American Toad (calling code 1) heard beyond 100m radius (June 16)

2016
- No standing water (May 17)

APPENDIX V

Fish Species Known from the Study Area

Fish Species Reported from the Study Area

Scientific Name	Common Name	SRANK[1]	COSSARO[2]	COSEWIC[3]	Thermal Regime	Spawn Time	Beaver Creek (Ecoplans et al. 2013)	Laurel Creek (Ecoplans et al. 2013)
Cyprinidae	**Carps and Minnows**							
Campostoma anomalum	Central Stoneroller	S4		NAR (April 1998)	warm	may-july		X
Chrosomus eos	Northern Redbelly Dace	S5			cool	may-july	X	X
Luxilus cornutus	Common Shiner	S5			cool	may-june	X	X
Nocomis biguttatus	Hornyhead Chub	S4	NAR	NAR (April 1988)	cool	may-july	X	
Notropis heterodon	Blackchin Shiner	S4	NAR	NAR (April 1994)	cool	jun-aug	X	
Pimephales promelas	Fathead Minnow	S5			warm	may-aug	X	X
Rhinichthys cataractae	Longnose Dace	S5			cool	may-june	X	X
Rihinchthys obtusus	Western Blacknose Dace	S5			cool	may-june	X	X
Semotilus atromaculatus	Creek Chub	S5			cool	may-june	X	X
Catostomidae	**Suckers**							
Catostomus commersonii	White Sucker	S5			cool	apr-june	X	X
Gasterosteidae	**Sticklebacks**							
Culaea inconstans	Brook Stickleback	S5			cool	may-july	X	
Centrarchidae	**Sunfishes and Basses**							
Lepomis gibbosus	Pumpkinseed	S5			warm	may-aug	X	
Lepomis macrochirus	Bluegill	S5			warm	jun-aug	X	
Percidae	**Perches and Darters**							
Etheostoma caeruleum	Rainbow Darter	S4			cool	apr-june	X	X
Etheostoma nigrum	Johnny Darter	S5			cool	may-june	X	X
						Total	**14**	**10**

[1,2]MNRF 2016a; [3]Government of Canada 2016

Legend
SRANK
S4 Apparently Secure
S5 Secure
COSSARO/COSEWIC
NAR Not at Risk

APPENDIX VI

Mammal Species Observed within the Subject Property (2014 – 2016)

Mammal Species Observed within the Subject Property (2014-2016)

Scientific Name	Common Name	SRANK[1]	COSSARO[2]	COSEWIC[3]	SARA Schedule[4]	Region of Waterloo Status[5]	Ontario Mammal Atlas[6]	NRSI Observed
Didelphimorphia	**Opossums**							
Didelphis virginiana	Virginia Opossum	S4				R	X	X
Insectivora	**Shrews and Moles**							
Blarina brevicauda	Northern Short-tailed Shrew	S5					X	
Condylura cristata	Star-nosed Mole	S5					X	
Parascalops breweri	Hairy-tailed Mole	S4				R	X	
Sorex cinereus	Masked Shrew	S5				G	X	
Sorex fumeus	Smoky Shrew	S5				R	X	
Sorex palustris	Water Shrew	S5				R	X	
Chiroptera	**Bats**							
Eptesicus fuscus	Big Brown Bat	S5					X	
Lasionycteris noctivagans	Silver-haired Bat	S4					X	
Lasiurus borealis	Red Bat	S4					X	
Lasiurus cinereus	Hoary Bat	S4					X	
Myotis lucifugus	Little Brown Myotis	S4	END	E	Schedule 1		X	
Myotis septentrionalis	Northern Myotis	S3	END	E	Schedule 1		X	
Perimyotis subflavus	Tri-colored Bat	S3?		E	Schedule 1		X	
Lagomorpha	**Rabbits and Hares**							
Lepus americanus	Snowshoe Hare	S5				S	X	
Lepus europaeus	European Hare	SNA					X	
Sylvilagus floridanus	Eastern Cottontail	S5					X	X
Rodentia	**Rodents**							
Castor canadensis	Beaver	S5				S	X	
Erethizon dorsatum	Porcupine	S5				S	X	
Glaucomys sabrinus	Northern Flying Squirrel	S5				R	X	
Marmota monax	Woodchuck	S5					X	
Microtus pennsylvanicus	Meadow Vole	S5					X	X
Mus musculus	House Mouse	SNA					X	
Napaeozapus insignis	Woodland Jumping Mouse	S5					X	
Ondatra zibethicus	Muskrat	S5					X	

Scientific Name	Common Name	SRANK[1]	COSSARO[2]	COSEWIC[3]	SARA Schedule[4]	Region of Waterloo Status[5]	Ontario Mammal Atlas[6]	NRSI Observed
Peromyscus leucopus	White-footed Mouse	S5					X	
Peromyscus maniculatus	Deer Mouse	S5					X	
Rattus norvegicus	Norway Rat	SNA					X	
Sciurus carolinensis	Eastern Gray Squirrel	S5					X	X
Tamiasciurus hudsonicus	Red Squirrel	S5					X	X
Tamias striatus	Eastern Chipmunk	S5					X	X
Zapus hudsonius	Meadow Jumping Mouse	S5					X	
Carnivora	**Carnivores**							
Canis latrans	Coyote	S5				S	X	X
Mephitis mephitis	Striped Skunk	S5					X	
Mustela erminea	Ermine	S5					X	
Mustela frenata	Long-tailed Weasel	S4				S	X	
Mustela vison	American Mink	S4				S	X	
Procyon lotor	Northern Raccoon	S5					X	X
Vulpes vulpes	Red Fox	S5					X	
Artiodactyla	**Deer and Bison**							
Odocoileus virginianus	White-tailed Deer	S5					X	X
						Total	40	9

[1,2]MNRF 2016a, [3,4]Government of Canada 2016, [5]Regional Municipality of Waterloo 1985, [6]Dobbyn 1994

LEGEND
SRANK
S3 Vulnerable
S4 Apparently Secure
S5 Secure
SNA Unranked
COSSARO/COSEWIC
END/E Endangered
SARA Schedule
Schedule 1 Officially protected under SARA
Region of Waterloo
G General
R Rare
S Scarce