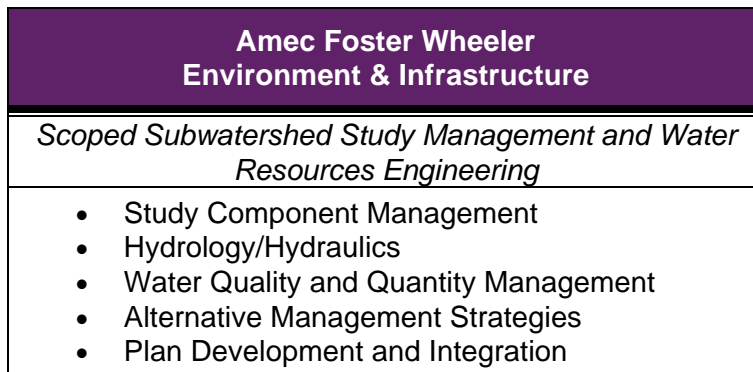


**Scoped Subwatershed Study
 Premiere Gateway, Phase 1B
 Employment Area – Integrated Planning Project
 Town of Halton Hills**



1. Team

Team Organization



Parish Aquatic Services	NRSI	Blackport and Associates
<i>Stream Morphology</i>	<i>Natural Heritage /Terrestrial Ecology /Fisheries</i>	<i>Groundwater /Geotechnical</i>
<ul style="list-style-type: none"> • Fluvial system assessment • Hazard Land Identification/Erosion • Input to plan and integration of NHS 	<ul style="list-style-type: none"> • Vegetation & Wildlife Assessment • Inventory & Habitat Assessment • Input to plan and integration of NHS • Fisheries Management Plan 	<ul style="list-style-type: none"> • Geologic Hydrogeologic Characterization • Groundwater Budget • Input to plan and integration of NHS

2. Important Study Area Characteristics

- *Several headwater drainage features in need of classification to establish appropriate management strategies*
- *Significant man-made infrastructure (Highway 401 corridor) including roadway culverts*
- *Extensive regulated flood plain*
- *Significant deposit of basal sand aquifer below the till*
- *Existing Hornby Towers golf course and Hornby Park*
- *Proximity of protected Greenbelt lands and associated woodlots*
- *Potential coldwater habitat within downstream reaches of the Sixteen Mile Creek Middle Branch*
- *Well-developed system of core habitat features within the Hornby Tributary through the study area as well as the adjacent Middle Branch and East Branch of the Sixteen Mile Creek*

3. Early Issues and Opportunities

- *Need for land use development plans to manage impacts (i.e. through conventional and Low Impact Development Best Management Practices)*
- *Watershed scale impact management related to water quality and quantity (overall East Sixteen Mile Creek)*
- *Protection of the quantity and quality of groundwater recharge in potentially sensitive areas*
- *Alternative approaches to development that lead to a more integrated and functional natural heritage system post-development including consideration of species at risk*
- *Strategies to integrate complementary land uses with existing natural features, to build on potential synergies between uses*

4. Goals and Objectives

From Terms of Reference:

Sufficient detail to support the designation of a sustainable Natural Heritage System, through refinement of the Regional Natural Heritage System, as well as recommendations for a Management Strategy to be followed by subsequent Secondary Plan and associated servicing studies. Future development and site specific environmental and servicing management plans will be required to adhere to and implement these recommendations.

5. Scoped Subwatershed Study Methodology

Phase 1: Characterization

Phase 2: Analyses and Impact Assessment

Technical Work Plan

1. Hydrology

- Task 1.1. Background Review and Field Work
- Task 1.2. Characterization Analysis
- Task 1.3. Interim Analysis/Impact Assessment
- Task 1.4. Monitoring

2. Hazard Land Identification

- Task 2.1. Background Review and Field Work
- Task 2.2. Flood Hazards
 - Subtask 2.2.1 Characterization Analysis*
 - Subtask 2.2.2 Interim Analysis/Impact Assessment*
- Task 2.3. Erosion Hazards
 - Subtask 2.3.1 Characterization*
 - Subtask 2.3.2 Analysis*

3. Geomorphologic Assessment

- Task 3.1. Characterization
- Task 3.2. Background Review and Field Work
 - Subtask 3.2.1 Background Review*
 - Subtask 3.2.2 Fieldwork*
- Task 3.3. Analysis

4. Hydrogeology

- Task 4.1. Background Review
- Task 4.2. Characterization and Constraints
- Task 4.3. Monitoring

5. Water Quality

- Task 5.1. Background Review
- Task 5.2. Analysis
- Task 5.3. Monitoring

6. Fisheries and Aquatic Habitat

- Task 6.1. Characterization and Background
- Task 6.2. Background Review and Field Work
 - Subtask 6.2.1 Fish Community Sampling*
 - Subtask 6.2.2 Benthic Invertebrates*
 - Subtask 6.2.3 Riparian Habitat*
- Task 6.3. Analysis

7. Terrestrial Ecology – Natural Heritage Features and Areas

- Task 7.1. Characterization and Background
- Task 7.2. Field Work
- Task 7.3. Analysis

8. Additional Background Review

- Task 8.1. Municipal and Land Use Planning
- Task 8.2. Subwatershed Synopsis

9. Reporting

- Task 9.1. Background Report
- Task 9.2. Characterization Report
- Task 9.3. Interim Report
- Task 9.4. Final Report

Consultation Work Plan

10. Meetings

- Task 10.1. Start-up Meeting with Subwatershed Technical Advisory Committee
- Task 10.2. Presentation of Work Plan
- Task 10.3. Presentation of Background Review/Walking Tour
- Task 10.4. Site Inspection with Agencies
- Task 10.5. Presentation of Characterization Report
- Task 10.6. Presentation of Interim Report
- Task 10.7. Presentation of Final Report to Halton Hills Council

11. Public Consultation

- Task 11.1. Notices
- Task 11.2. Public Information Centre #1 – Background/Goals/Objectives
- Task 11.3. Public Information Centre #2 – Constraints and Opportunities
- Task 11.4. Public Information Centre #3 – Review of Management Opportunities

6. Task 1: Hydrology

• Background Review

- Inventories and recommendations from previous Studies and Amec Foster Wheeler studies, notably:
 - o Sixteen Mile Creek Watershed Plan
 - o Sixteen Mile Creek Subwatershed Update Study
 - o 401 Corridor Integrated Planning Project
 - o Others – Subwatershed Impact Studies
- Current digital aerial and topographic base mapping
- Area-specific gauging for rainfall and streamflow
- Approved Permits to Take Water
- Current digital hydrologic and hydraulic models
- Soils and physiographic mapping
- Current land use mapping
- Culvert/roadway inventories

• Field Work

- one flow gauge
- one rain gauge (Golf Course?)
- based on field reconnaissance
- 2 to 3 staff gauges

• Hydrologic Modelling

- March 2013 Sixteen Mile Creek Subwatershed Update Study – HSP-F
- March 2000 401 Corridor Subwatershed Study – OTTHYMO89
- 1996 Watershed Plan – QUALHYMO
- need to determine preferred platform
 - o Terms of Reference – continuous
 - o HSP-F, QUALHYMO or Alternate?
- limit of modelling (downstream?)
- modelling will set targets for
 - o flooding
 - o water balance
 - o erosion

- **Impact Analysis**
 - proposed land use (future)
 - o without stormwater management
 - o with stormwater management (LID BMPs)
 - establish sizing criteria including LID BMPs
 - location and conceptual design for stormwater management
 - to complement erosion assessment (threshold conditions per Stream Morphology)
 - historical extreme storm analysis
 - o July 8, 2013 Toronto
 - o August 4, 2014 Burlington
- **Monitoring**
 - recommendations for future work to assess effectiveness of stormwater management

7. Task 2: Hazard Land Identification

- **Background Review**
 - review need for geotechnical assessment (detailed fieldwork) versus 3:1 stable slope plus 8 m toe erosion component
 - desktop Information
 - o Floodplain mapping studies
 - o Morphologic studies
 - o Detailed topographic survey/available mapping data for use in building a DEM
 - o Aerial Imagery (historical air photo coverage and current other imagery)
 - o Regulation mapping (from Conservation Halton)
 - o Geotechnical reports and logs
- **Flood Hazards**
 - review existing HEC-2 (2000?)
 - review current Conservation Halton floodplains
 - review structure inventory from:
 - o Town
 - o Region
 - o MTO
 - o Other? Private?
 - survey allowance
 - HEC-2 to HEC-RAS conversion
 - o floodplain hydraulics
 - o riparian storage assessment
 - quality of base map (contours?)
 - 50 ha Drainage area limit
 - o allowance for sub 50 ha drainage area
- **Impact Assessment**
 - Regional Storm (Regulatory)
 - No stormwater management per MNR 2002
- **Erosion Hazards**
 - per MNRF Technical Guide
 - Meander Belt delineation

Continued...
May 13, 2015

- Analysis of:
 - o Available detailed topographic information (0.5 m contours preferred)
 - o Current watercourse centreline,
 - o Reach break locations,
 - o Creek's central tendency (meander belt axis),
 - o Available historic watercourse centrelines;
 - o Calculated meander belt (preliminary meander belt),
 - o Analyzed 1:100 year erosion setback (100 year migration rate) and
 - o Regulated 15 m allowance.

8. Task 3: Geomorphological Assessment

(per Parish Aquatic Services)

9. Task 4: Hydrogeology

(per Blackport and Associates)

10. Task 5: Water Quality

- **Background Review**
 - PWQMN
 - Conservation Halton's LTEMP
 - Previous reporting including:
 - o Sixteen Mile Creek Watershed Plan
 - o North 16 District Scoped Subwatershed Study
- **Desktop Review of Parameters of Concern**
- **Establish Criteria Objectives**
 - New stormwater management / LID BMPs
 - Retrofits?
- **Monitoring**
 - future locations and scope
- **Optional Scoped Water Quality Monitoring**
 - Temperature
 - Chemistry
 - 2 wet weather (summer/fall)
 - 2 dry weather (summer/fall)
 - o Anions
 - o BOD
 - o Metals
 - o Ammonia
 - o Total Phosphorus
 - o Total Suspended Solids
 - o E.Coli
 - o TKN

11. Task 6: Fish and Aquatic Habitat

(per NRSI)

12. Task 7: Terrestrial Ecology

(per NRSI)

RBS/II

Minutes

Date: May 25, 2015
File #: TP115042 – 75
Meeting Date & Time: May 13, 2015 @ 9:30 a.m.
Meeting at: Hornby Glen Golf Course
Subject: Premier Gateway Phase 1B Employment Area Secondary Plan
 Technical Advisory Committee Meeting Number 1

Attendees:

Steve Burke, Town of Halton Hills	Richard Clark, Region of Halton
Steve Grace, Town of Halton Hills	Amanda Wong, Region of Halton
John Kwast, Town of Halton Hills	Karyn Poad, Region of Halton
Curtis Marshall, Town of Halton Hills	Ron Reinholt, Region of Halton
Wendy O'Donnell, Town of Halton Hills	Liz Howson, Macaulay, Shiomi Howson
Doug Penrice, Town of Halton Hills	Dave Stephenson, NRSI
Barb Veale, Conservation Halton	John Parish, Parish Geomorphic
Amy Mayes, Conservation Halton	Tatyana Hrytsak, Parish Geomorphic
Samantha Mason, Conservation Halton	Bill Blackport, Blackport & Associates
	Ron Scheckenberger, Amec Foster Wheeler

MATTERS DISCUSSED

ACTION BY:

1. Welcome and Introductions

Curtis Marshall introduced the meeting, outlining its purpose to inform the Technical Advisory Committee (TAC) of the study purpose, work plan and schedule to conduct a site walk.

Curtis indicated that he would be the principal contact for the Town of Halton Hills and Liz Howson would be the principal planning contact with respect to the Secondary Plan and Ron Scheckenberger would be principal engineering contact related to the Scoped Subwatershed Study.

2. Role of TAC in Project Charter

Steve Burke provided an outline of the Project Charter indicating that it defines the parameters and scope of the study's associated timelines for

PLEASE NOTE: If there is any comment or amendment to be made to these meeting notes, they should be brought to the notice of Amec Foster Wheeler within 24 hours of issue and confirmed in writing

Continued...

Meeting Date: May 13, 2015

MATTERS DISCUSSED

ACTION BY:

the Scoped Subwatershed Study and the Secondary Plan. He indicated that it was important that the Secondary Plan and the Scoped Subwatershed Study remain fully integrated. He requested that all parties review the draft Project Charter and provide comments within two (2) weeks to Curtis Marshall and once this is finalized, it would allow for sign off.

All

In terms of the composition of the TAC, it includes the Region of Halton and Conservation Halton; as well as other Agencies have been invited, including the MTO, MNRF, Hydro and others.

3. Secondary Plan Purpose, Work Plan and Schedule

Liz Howson provided an overall outline of the study intent to define a land use plan for the Premier Gateway Phase 1B Employment Area. She offered background to the study related to the freeze of employment lands associated with the GTA highway and the need for the Town to comprehensively plan for additional employment lands within this area. Liz indicated that the overall schedule is preliminary at this stage until the final Scoped Subwatershed Study elements are fully defined and vetted.

AFW/MSH

Curtis Marshall advised that the Town is maintaining a list of property ownership within the study area as well as access status.

4. Scoped Subwatershed Study Work Plan

Ron Scheckenberger and the balance of the Scoped Subwatershed Study Team provided an overview of the scope and provided various handouts (reference attached) related to the following:

- i) Study Team
- ii) Important Study Area Characteristics
- iii) Preliminary issues and opportunities
- iv) Goals & Objectives
- v) Scoped Subwatershed study methodology specific to:
 - Hydrology
 - Hazard land identification
 - Geomorphologic assessment
 - Hydrogeology
 - Water quality
 - Fisheries and aquatic habitat
 - Terrestrial ecology / Natural Heritage Features and areas
 - Public consultation

Various comments and questions arose including:

- i) Ron Scheckenberger requested that all technical agencies review their databases for any relevant information and for this accordingly.

All

Continued...

Meeting Date: May 13, 2015

MATTERS DISCUSSED

ACTION BY:

- ii) A request was made that Amec Foster Wheeler distribute the final Scoped Subwatershed Study work plan (reference attached). **AFW**
- iii) In terms of the optional water quality work plan, Conservation Halton is to provide a scoped list of parameters of concern and then Amec Foster Wheeler will review with the Town to decide on final scope and timing. **CH**
- iv) In terms of the Natural Heritage System, it was indicated that the areas outside of the study area are being reviewed using of desktop information. Conservation Halton is to provide input. **CH**
- v) Dave Stephenson outlined the Team's perspective with respect to the benthics investigation and the diminished utility of these data. Conservation Halton advised that it has done some analysis of benthic data and can potentially contribute to this, further discussion is required. **All**
- vi) Barb Veale indicated given that this is a Scoped Subwatershed Study and that further study will be required as part of the local Subwatershed Impact Studies, once additional definition of land use is provided, that perhaps the benthics and water quality investigations can be deferred and made part of the baseline work for the SIS. Ron Scheckenberger agreed noting that it is important to have baseline work as current as possible in order to measure change. In addition, in all likelihood there would be limited utility of benthics or water quality data to prescribe management conditions as part of the Scoped Subwatershed Study.
- vii) The matter of wetlands was raised and Dave Stephenson advised that there are two wetland sites in the study area, however they are relatively small. Barb Veale questioned whether or not they are provincially significant wetlands indicating the setback variance of 30 m if they are not and 120 m if they are. David Stephenson indicated that these are less than 2 ha however there is the question of the 750 m complexing threshold. Richard Clark added that the definition should not solely rely on provincial designation as there is also a Regional definition which relates to function.
- viii) Dave Stephenson questioned whether or not the ELC coding should adopt the 1998 or 2008 protocol, those present preferred the 1998.
- ix) Richard Clark advised that the Agreement 'Forest' terminology is being dropped in favour of the 'Halton Regional Forest Tract' (Coulsen).
- x) The question of the barrier provided by Highway 401 was raised and was noted to be a significant barrier for terrestrial wildlife movement, however, less of a barrier as related to aquatic species.

Continued...

Meeting Date: May 13, 2015

MATTERS DISCUSSED

ACTION BY:

xi) Richard Clark advised that the Region has the natural heritage system mapped and suggested that the study should refine the system as opposed to re-establish it. He advocated a system-based assessment and a strong focus on refinement. He also highlighted the need to consider linkages and enhancements to provide associated guidance including consideration of eco passages.

AFW Team

xii) Ron Scheckenberger noted the need to locate rain gauges and streamflow gauges, he suggested the rain gauge could potentially be sited at the Hornby Glen Golf Course and the streamflow gauges would need to be co-located with Conservation Halton. Amec Foster Wheeler will follow up with Amy Mayes accordingly.

AFW/CH

5. Next Steps

Curtis Marshall thanked all parties for attending and invited all those present to the site walk which followed shortly after noon. All parties are requested to collect associated data and related information and further dialogue is required to finalize the Scoped Subwatershed Study scope and finalize the associated schedule.

All

Meeting Minutes prepared by:

Amec Foster Wheeler Environment & Infrastructure
A division of Amec Foster Wheeler Americas Limited

Per:  Ron Scheckenberger, M.Eng., P.Eng.
Principal Consultant, Water Resources

RBS/cc/ll

/enclose.

Farrell, Aaron

----- Forwarded Message -----

Subject:RE: Halton Hills Background Request - RSD question (proj1624)

Date:Tue, 1 Mar 2016 18:55:59 +0000

From:McAllister, Aurora (MNRF) <Aurora.McAllister@ontario.ca>

To:Katharina Richter <krichter@nrsi.on.ca>

CC:Burkart, Jackie (MNRF) <Jackie.Burkart@ontario.ca>, Mott, Ken (MNRF) <ken.mott@ontario.ca>, ESA Aurora (MNRF) <ESA.Aurora@ontario.ca>

Hi Katharina,

I did not flag Redside Dace in the screening as there is no known habitat for this species within (or downstream) of your study area.

Regards,

Aurora

AURORA McALLISTER | MANAGEMENT BIOLOGIST | ONTARIO MINISTRY of NATURAL RESOURCES and FORESTRY |
AURORA DISTRICT OFFICE
50 Bloomington Road, Aurora, Ontario, L4G 0L8 | Email: aurora.mcallister@ontario.ca

From: Katharina Richter [<mailto:krichter@nrsi.on.ca>]

Sent: 23-Feb-16 9:13 AM

To: McAllister, Aurora (MNRF)

Cc: Burkart, Jackie (MNRF); Mott, Ken (MNRF); ESA Aurora (MNRF)

Subject: Re: Halton Hills Background Request - RSD question (proj1624)

Aurora,

Thank you for the information you provided in October.

A Technical Advisory Committee meeting took place yesterday on this Halton Hills Premier Gateway project, as we are about to submit the draft Scoped Subwatershed Study report. At the meeting, Samantha Mason from Conservation Halton stated that Redside Dace was confirmed by the MNRF from a watercourse not too far west of our study area. I've attached a map identifying our study area. Can you please let me know whether or not this Redside Dace observation has any implications on our study area? Has the Regulated Habitat for Redside Dace within the area been mapped?

Your guidance is appreciated.

Thank you!

-Katharina.



Katharina S. Richter, B.E.S.
Terrestrial & Wetland Biologist
Natural Resource Solutions Inc.
225 Labrador Drive, Unit 1
Waterloo, ON, N2K 4M8
(p) 519.725.2227
(f) 519.725.2575
(c) 519.635.6051
(e) krichter@nrsl.on.ca
www.nrsl.on.ca

Please note the change to my maiden name

On 23/10/2015 9:09 AM, McAllister, Aurora (MNRF) wrote:

Hi Katharina,

I did some searching in the ESA Inbox but was unfortunately unable to find your original request. I'm really sorry about that – it's possible that the ESA Inbox was full at the time your request was sent in and for that reason we never received it. I'm glad you followed up. Attached is the species at risk information you requested. Again, apologies for the delay in our response.

Regards,

Aurora

AURORA McALLISTER | MANAGEMENT BIOLOGIST | ONTARIO MINISTRY of NATURAL RESOURCES and FORESTRY | AURORA DISTRICT OFFICE
50 Bloomington Road, Aurora, Ontario, L4G 0L8 | Email: aurora.mcallister@ontario.ca

From: Katharina Walton [<mailto:kw Walton@nrsl.on.ca>]
Sent: 20-Oct-15 1:49 PM
To: McAllister, Aurora (MNRF)
Cc: Nyssa Clubine
Subject: Halton Hills Background Request (proj1624)

Hello Aurora,

Great to meet you this morning. I've attached the background request that was sent to the MNRF in March of this year. We did not receive any information. If you can provide information, esp. input re. SAR, we'd appreciate it! We are working on the Characterization Report now.

Regards,
Katharina.

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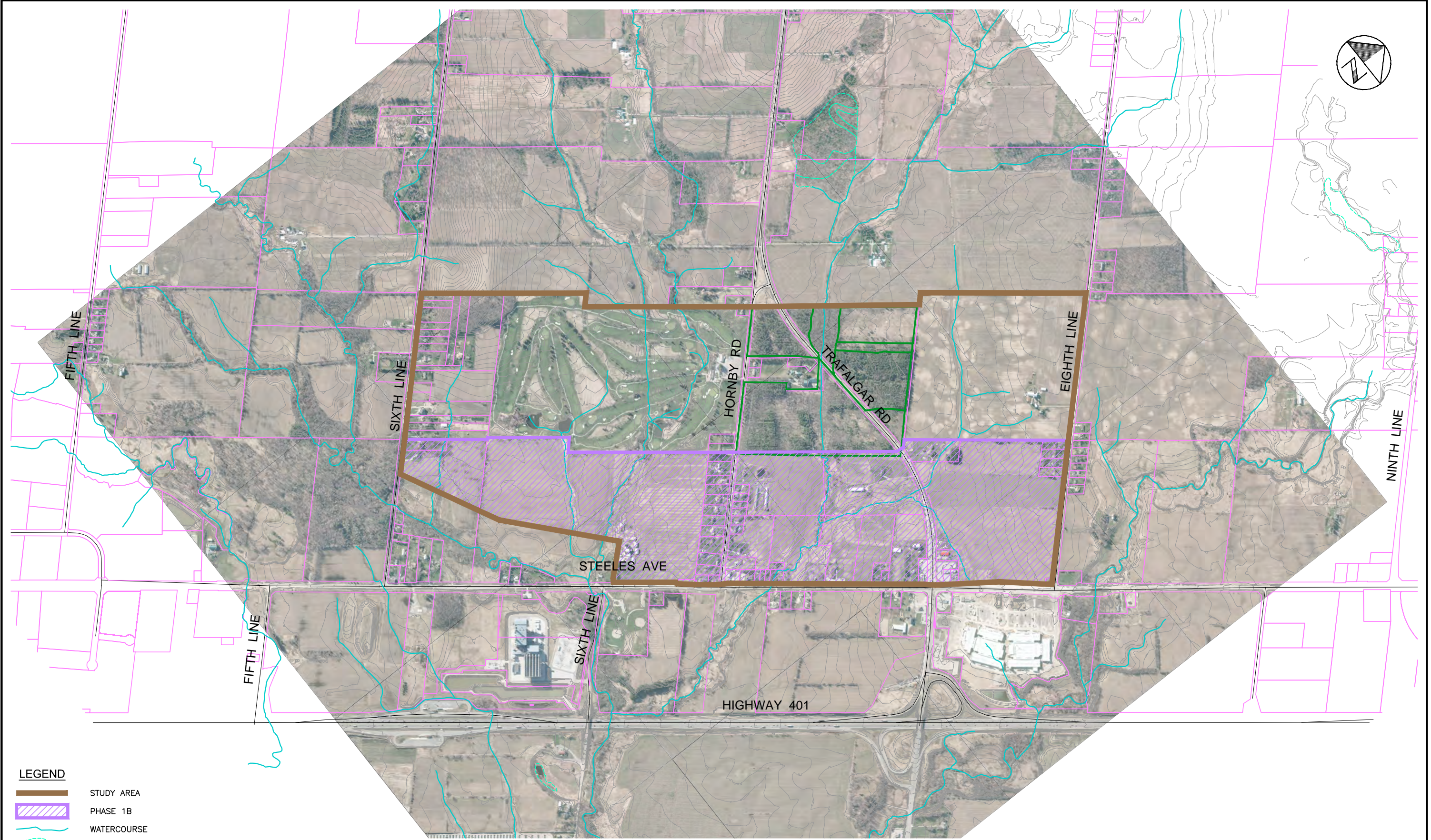
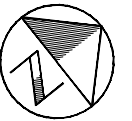


TOWN OF HALTON HILLS: HALTON HILLS PREMIER GATEWAY STORMWATER PLAN: INFORMATION TRANSFER TRACKING









DATA CATEGORY				DATA TRANSFER TRACKING			STATUS			COMMENTS
Item	Description	Type	Format	Data Owner	Data Provider	Contact	Details of Data Request	Status	Date Received	
	Local Hydrogeologic/Geotechnical Reports Related to Groundwater Quality/Quantity Complaints or Spills	Report		Town/Conservation Halton/Region				Pending		
Tier 1 Water Budget and Water Quantity Stress Assessment for Halton-Hamilton Source Protection Region		Report		Conservation Halton/MOECC				Pending		
Tier 2 Water Budget and Water Quantity Stress Assessment for the Upper West Branch of Sixteen Mile Creek and Middle Spencer Creek Watersheds		Report		Conservation Halton/MOECC				Pending		
Vulnerability Analysis for the Milton and Campbellville Wellfields, Regional Municipality of Halton Ontario (April, 2010).		Report		Conservation Halton/MOECC				Pending		
Assessment Report Halton Region Source Protection Area (January, 2012)		Report		Region				Pending		
3. Other										
Local Rainfall and Streamflow Data		Data	Digital (Excel)	Town/Conservation Halton				Pending		
Fish and Benthic Community Records		Data	Digital	Conservation Halton				Pending		
Rare Species List		Data	Digital	Conservation Halton/MNRF/Region				Pending		
Hydraulic Structure Inventory		Data	Any	Town/Region/MTO				Pending		
As-Built Information for Drainage Infrastructure (i.e. sewers, culverts, bridges, etc.)		Data	Any	Town/Region/MTO				Pending		
Hydrologic/Hydraulic Models		Data	Digital	Town/Conservation Halton				Pending		
PWQMN Data		Data	Digital	Conservation Halton/MOECC				Pending		
Conservation Halton's LTEMP		Data	Any	Conservation Halton				Pending		
Private Property Access Permission		Permission	Any	Town				Pending		
Approved PTTW's		Data	Any	MOECC				Pending		

Path: P:\Work\TP115042\water\dwg\BasePlan.dwg

Plotted By: josh.seraoj
Last Saved By: richard.bartolo
2015-05-25
2015-05-13



LEGEND

-  STUDY AREA
-  PHASE 1B
-  WATERCOURSE
-  WETLAND
-  CONTOUR (1m)
-  ROADWAY
-  PROPERTY LINE
-  AGREEMENT FOREST

**PREMIER GATEWAY
SCOPED SUBWATERSHED
STUDY
TOWN OF HALTON HILLS**

BASE PLAN



SCALE VALID ONLY FOR
24"x36" VERSION

Scale 1:7500
0 75 150 300

Consultant File No.
TP115042

Drawing No.

Fish and Aquatic Habitat

Characterization

Background data collection and review is ongoing

A preliminary review of background data was completed to inform this work plan. This included a number of the reports listed in the Terms of Reference and others

Sampling locations to be chosen where water flow is anticipated to occur in the months of April, May, and June and in conjunction with fluvial and other disciplines (i.e. based on defined channel segments (i.e. reaches)

Habitat assessment

Fish community sampling

The approach to surveys of benthic macroinvertebrates to be confirmed (based on presence of appropriate physical conditions and associated value/sensitivity of the data)

Assessment of the riparian area will be completed as part of the ELC vegetation inventory

Analysis

The identification of existing habitat features critical to the maintenance of the existing fishery and features that may presently be limiting aquatic species production

Sensitive features and functions within, and downstream of, the study area will be identified

Collaborative assessment of stream corridors

Recommend and develop enhancement opportunities

Development of monitoring plans

Terrestrial and Wetland Ecology

Characterization

Background data collection and review is ongoing (see above)

The methodological approach will be discussed and confirmed. Standard methodologies for each field survey are to be used

Comprehensive, multi-season field investigations

A field schedule with specific dates, times, and personnel is being developed and will be reviewed and approved by the Technical Steering Committee.

Wetlands found in the area will be mapped and described using both the OWES as well as ELC systems.

Vegetation communities found within the area will be mapped and described using the ELC system (including wetlands and riparian areas)

Cavity trees will be identified for potential bat habitat.

Multi-season floral inventories (spring, summer, fall) will be completed within the ELC polygons.

Surveys of breeding birds, Owl and raptor surveys

Targeted surveys for amphibians, snakes and turtles

All mammal observations during field surveys will be documented. During evening amphibian and bird surveys, bat activity will be recorded.

Targeted surveys for butterflies and odonates

Observations of all species of plants and wildlife observed throughout the study will be recorded. Location by ELC polygon, or finer as warranted, will be used. These observations will be integrated with results of the targeted wildlife surveys.

Analysis

The identification of existing habitat features critical to the maintenance of the existing upland and wetland features and functions

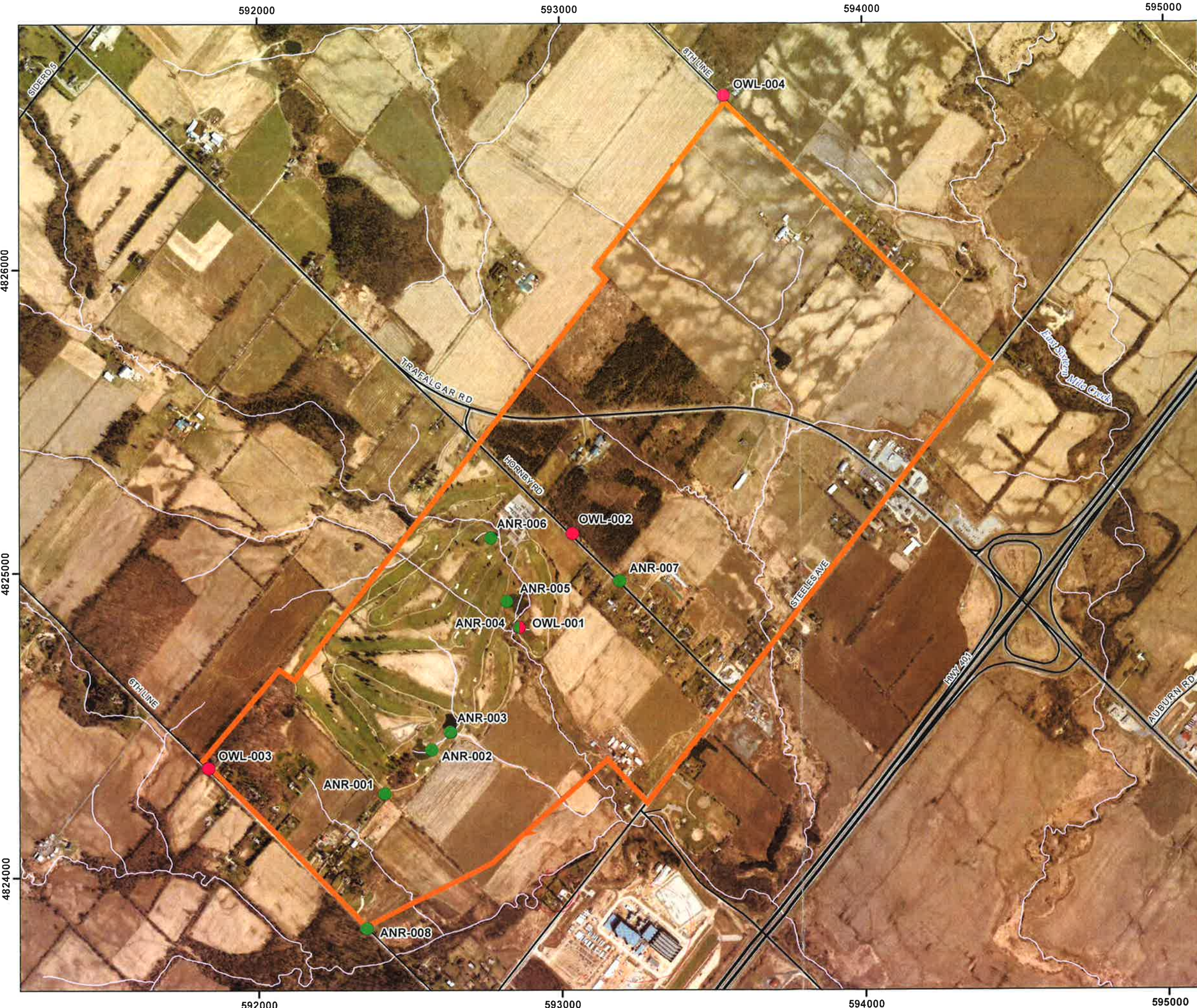
Sensitive features and functions within, and adjacent to, the study area will be identified

Development of a connected Natural Heritage System

Collaborative assessment of stream corridors, ecological linkages

Recommend and develop enhancement opportunities

Development of monitoring plans



Halton Hills Premier Gateway Secondary Plan Monitoring Stations

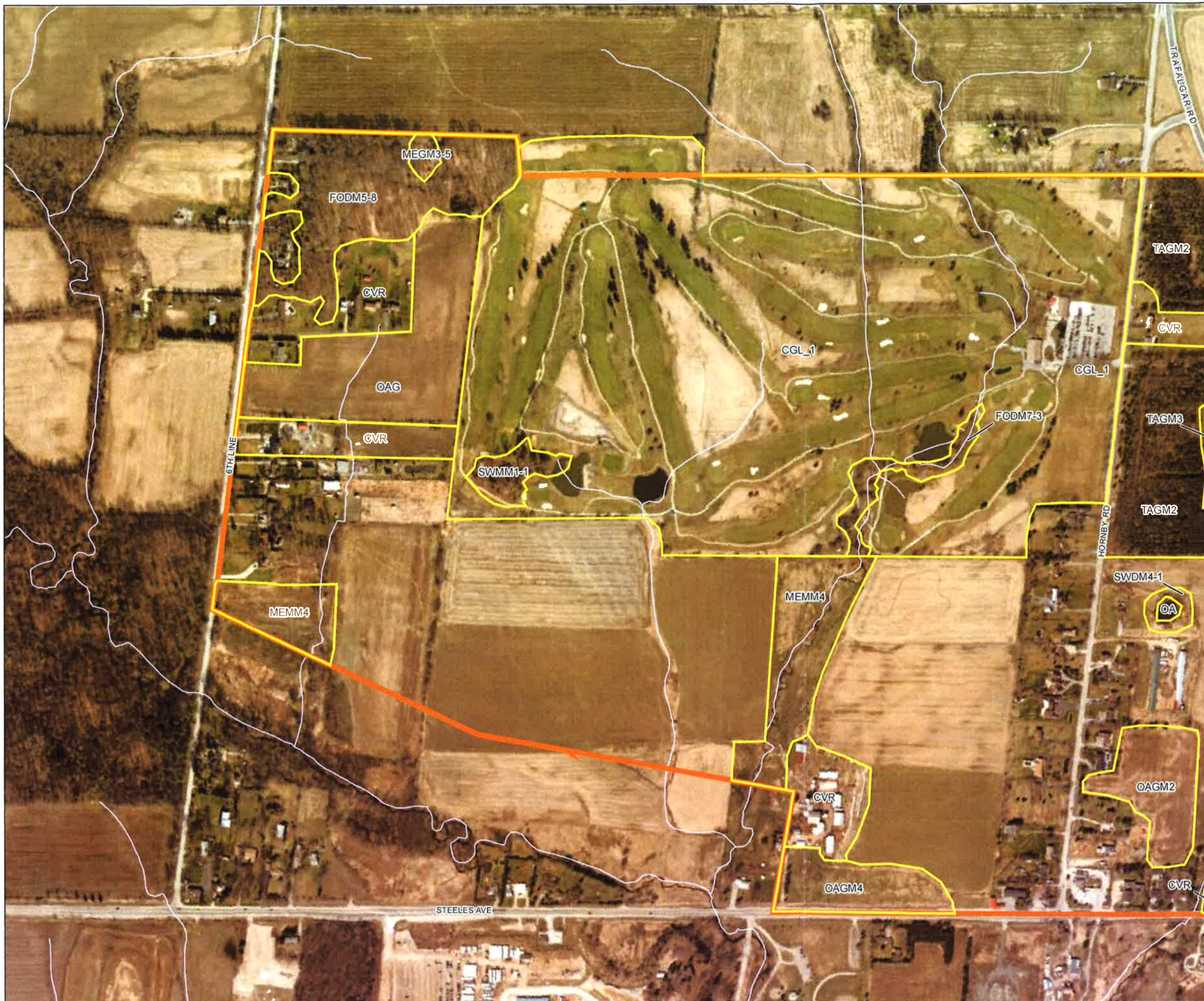
- Legend**
- ▭ Subject Area
 - Anuran Monitoring Station (ANR)
 - Owl Monitoring Station (OWL)
 - Highway
 - Primary Road
 - Secondary Road
 - ~ Watercourse

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 Aquatic, Terrestrial and Wetland Biologists

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Project 1624 Date: April 30, 2015	NAD83 - UTM Zone 17 Size: 11x17" 1:12,500

Halton Hills Premier Gateway Secondary Plan Vegetation Communities



Legend

- Subject Area
- Watercourse
- Ecological Land Classification (ELC)
- (CGL_1) Golf Course
- (CVR) Residential
- (FODM5-8) Dry-Fresh Sugar Maple-White Ash Deciduous Forest Type
- (FODM7-3) Fresh-Moist Willow Lowland Deciduous Forest Type
- (MEGM3-5) Smooth Brome Graminoid Meadow Type
- (MEMM4) Fresh-Moist Mixed Meadow Ecosite
- (OA) Open Water
- (OAG) Open Agriculture
- (OAGM2) Perennial Cover Crops
- (OAGM4) Open Pasture
- (SWDM4-1) Willow Mineral Deciduous Swamp Type
- (SWMM1-1) White Cedar-Hardwood Mineral Mixed Swamp Type
- (TAGM2) Mixed Plantation
- (TAGM3) Deciduous Plantation

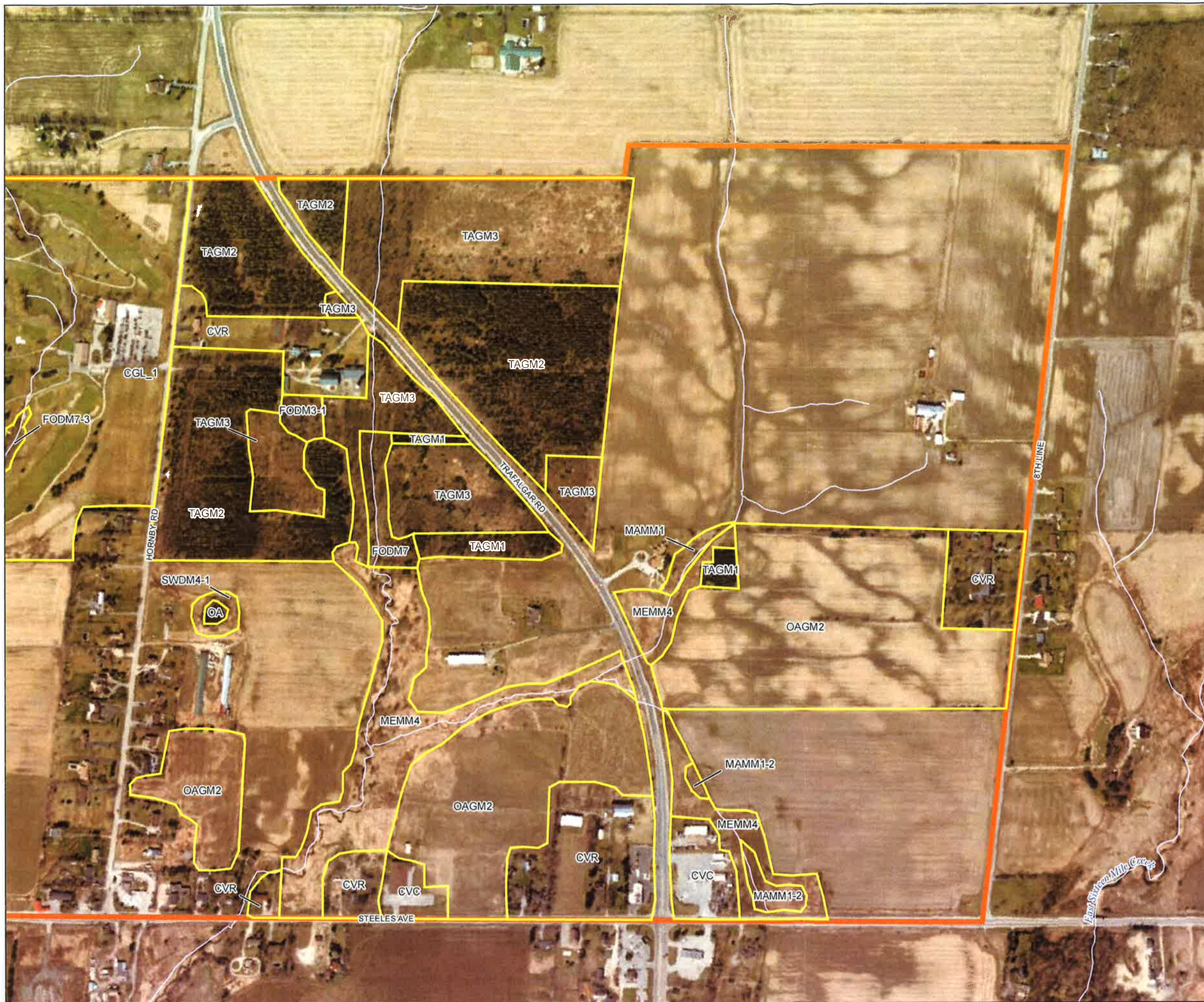
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Project: 1624 Date: May 11, 2015	NAD83 - UTM Zone 17 Size: 11x17" 1:6,000
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Halton Hills Premier Gateway Secondary Plan Vegetation Communities



Legend

- Subject Area
- Watercourse
- Ecological Land Classification (ELC)
- (CGL_1) Golf Course
- (CVC) Commercial and Institutional
- (CVR) Residential
- (FODM3-1) Dry-Fresh Poplar Deciduous Forest Type
- (FODM7) Fresh-Moist Lowland Deciduous Forest Ecosite
- (FODM7-3) Fresh-Moist Willow Lowland Deciduous Forest Type
- (MAMM1) Graminoid Mineral Meadow Marsh Ecosite
- (MAMM1-2) Cattail Graminoid Mineral Meadow Marsh Type
- (MEMM4) Fresh-Moist Mixed Meadow Ecosite
- (OA) Open Water
- (OAGM2) Perennial Cover Crops
- (SWDM4-1) Willow Mineral Deciduous Swamp Type
- (TAGM1) Coniferous Plantation
- (TAGM2) Mixed Plantation
- (TAGM3) Deciduous Plantation



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Aquatic, Terrestrial and Wetland Biologists

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14-May-15

Technical Work Plan

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- Task 1.2. Characterization Analysis
- Task 1.3. Interim Analysis/Impact Assessment
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10. Meetings

- Task 10.1. Start-up Meeting with Subwatershed Technical Advisory Committee
- Task 10.2. Presentation of Work Plan
- Task 10.3. Presentation of Background Review/Walking Tour
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11. Public Consultation

- Task 11.1. Notices
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- Task 11.4. Public Information Centre #3 – Review of Management Opportunities

The following sections provide a detailed description of the activities proposed under each Discipline:

Task 1. Hydrology

Task 1.1. Background Review and Field Work

Background Review

The Terms of Reference provide a detailed listing of available background information, as well as concurrent undertakings. In addition to this information, data available through the other initiatives completed in the interim will be reviewed along with data information from the Amec Foster Wheeler Team's internal resources including the January 2000 Sixteen Mile Creek Subwatershed Study and the March 2013 Sixteen Mile Creek Subwatershed Update Study, which included frequency flow analysis using continuous simulation for the Sixteen Mile Creek Watershed. It is anticipated that data sources will include Conservation Halton, Town of Halton Hills, Region of Halton, MNRF, DFO and other Stakeholders. The experience of the Amec Foster Wheeler Team, through conducting other similar subwatershed studies will prove beneficial in understanding the relevant background information which will assist in this task. A detailed summary of all

the background information will be prepared, along with details on data gaps, coordinated with the balance of the Amec Foster Wheeler Team members.

Specific information which will need to be documented as part of the Hydrology Background and Characterization will include:

- Inventories and recommendations from previous Studies and Amec Foster Wheeler studies, notably:
 - Sixteen Mile Creek Watershed Plan
 - Sixteen Mile Creek Subwatershed Update Study
 - 401 Corridor Integrated Planning Project
 - Others – Subwatershed Impact Studies
- Current digital aerial and topographic base mapping
- Area-specific gauging for rainfall and streamflow
- Approved Permits to Take Water
- Current digital hydrologic and hydraulic models
- Soils and physiographic mapping
- Current land use mapping
- Culvert/roadway inventories

Field Work

As noted in the study Terms of Reference, field reconnaissance would be conducted in order to identify the strategic location for installing one (1) flow gauge for the collection of stream flow data, as well as a rainfall gauge for the collection of local rainfall data. A preliminary screening of candidate locations for installing the gauges would be completed in consultation with Town staff, and field reconnaissance would be conducted with members of the SWTAC in order to finalize the locations for installation of the monitoring equipment. For the purpose of this proposal, it has been assumed that the monitoring program would be completed over the course of 2015 (i.e. April – November) to collect flow data corresponding to spring, summer, and autumn conditions.

To assist in model calibration, an area rain gauge will be installed on either a publically controlled building or a local residence in the area (participating land owner). The duration of monitoring will mirror the period for the stream flow gauge. It is also anticipated that rainfall data may be available from other area gauges from the SWTAC which would complement this effort.

A rating curve will need to be established for the streamflow monitoring location over the duration of the monitoring period to define the depth-flow relationship at the gauge location. Field measurements will also be validated based on a local hydraulic model supported by field survey.

The service included under this task includes:

- Field meeting with Town and Conservation Authority to site gauge
- Gauge installation (Note – fee estimate does not include costs for a weir nor approvals if a suitable natural section cannot be found)
- Bi-weekly monitoring downloads (8 months – 16 downloads)

- Opportunistic velocity-depth metering to establish rating curves (5 visits / year)
- Gauge tear down and storage (circa November 30 or freeze-up)
- Processing of streamflow and rainfall data

Amec Foster Wheeler has conducted similar data collection exercises in Conservation Halton's jurisdiction, hence, staff is familiar with the protocols and associated expectations.

Other field work which will complement the foregoing includes the installation of 2 or 3 staff gauges at strategic locations which would allow Amec Foster Wheeler staff to observe water levels during storms when velocity metering is being conducted. Also, in the event there are significant storms over the monitoring period, Amec Foster Wheeler staff could survey high water marks, however this service is not included as part of the estimated fee. The Groundwater Team as part of its scope will also gather spot flow measurements which can then be used to complement the overall streamflow dataset.

Task 1.2. Characterization Analysis

The hydrologic modelling for the study drainage area represents a key input to characterizing the area's stream systems, flood and erosion potential, water budget (linked to the groundwater component), and the ultimate management strategy for mitigation.

The Middle and East Branches of the Sixteen Mile Creek have been modelled previously as part of the March 2013 Subwatershed Update Study using the HSP-F methodology, the 2000 Scoped Subwatershed Study using the OTTHYMO89 methodology, and the 1996 Watershed Plan using the QUALHYMO methodology. The Terms of Reference for the study specify that a continuous simulation methodology is to be applied to establish stormwater management requirements to the 100 year control condition, as well as to establish requirements to provide erosion control for the receiving watercourses. The HSP-F methodology and the QUALHYMO methodology represent the previously applied modelling platforms, capable of completing continuous simulation, hence represent the two most appropriate platforms for completing the hydrologic analyses.

Amec Foster Wheeler developed the currently approved HSP-F model for the Sixteen Mile Creek Watershed prepared as part of the January 2000 Subwatershed Study, and has maintained and updated the model as part of various hydrologic analyses within the Town of Milton, including the March 2013 Subwatershed Update Study since that time. Notwithstanding, Amec Foster Wheeler is also fully proficient with the development and application of the QUALHYMO hydrologic model, and has applied that methodology for similar studies including the 2007 Waterdown North OPA 28 Master Drainage Plan in the City of Hamilton and the 2013 Subwatershed Studies for the Annexed Lands in Barrie. While the HSP-F methodology is considered preferable due to the recent application and legacy of that model within the Sixteen Mile Creek Watershed, the application of either the QUALHYMO or the HSP-F methodology (or some alternate platform) will be determined at the start-up meeting in consultation with the SWTAC and, in particular, Conservation Halton.

The limit of modelling will be reviewed with the Town of Halton Hills and Conservation Halton, to establish a consensus on the limit of modelling in order to appropriately assess off-site impacts and management.

The hydrologic model of existing land use conditions will be used to set targets for flooding, water balance and erosion based upon continuous simulation and frequency analysis, as well as Regional Storm response. The latter will be combined with the Stream Morphology component in order to develop an understanding of system erosion potential using field based thresholds (established by Parish Aquatic Services), as well as temporal (i.e. duration) and volumetric exceedence based upon continuous simulation response.

Task 1.3. Interim Analysis/Impact Assessment

The hydrologic model developed under Stage 1 will be revised in order to reflect the proposed future land use conditions within the study area. Hydrologic analyses would be conducted for the proposed land use condition without stormwater management, in order to determine the impacts of the proposed development with respect to peak flow rates and overall water balance, on a local and subwatershed scale. The results of this assessment would form the basis for the impact assessment, and would then be used to develop recommendations and sizing criteria for stormwater management within the study area. Conceptual designs of the stormwater management facilities would be developed based upon the sizing criteria and contributing land use to illustrate feasibility of implementation and provide guidance regarding the spatial requirements for the stormwater management facilities, with consideration for maintenance access requirements and potential grading requirements within the adjacent development.

Analyses would be completed to determine the erosion potential under future land use conditions with and without the recommended stormwater management, using the methodology applied for the erosion assessment of existing land use conditions. An impact assessment would be completed in order to determine the relative increase or decrease in erosion potential compared to existing land use conditions. The analyses would be completed at key locations within the study area as determined from the fluvial geomorphologic and erosion assessments.

The stormwater management plan would also provide general guidance for the implementation of Low Impact Development Best Management Practices (LID BMP's) within the study area. This would include identifying practices for further assessment as part of subsequent studies to address functional requirements to maintain groundwater recharge and/or water budget.

As noted in the Terms of Reference, other area historical extreme events will be transposed to this watershed to evaluate the impact of these extreme events in terms of flood risk. Amec Foster Wheeler has data from current and on-going assessments (based on radar imagery for several storms including July 8, 2013 Toronto and August 4, 2014 Burlington) hence can apply this in a spatially discrete manner to *stress-test* the area subwatershed under these extreme events as a value-added exercise. The results of these analyses would serve to inform adaptive management requirements and

considerations to address potential impacts of climate change related to increased flood potential.

Task 1.4. Monitoring

As noted in the Terms of Reference, recommendations would be provided for a future monitoring plan to demonstrate the functionality of the stormwater management system and sediment and erosion controls during and post-construction. The monitoring plan would provide recommendations on the parameters to be monitored, as well as general guidance on the selection of locations and duration of monitoring.

Task 2. Hazard Land Identification

Task 2.1. Background Review and Field Work

Data gathering and field work will need to be conducted for both the flooding and the erosion criteria associated with Hazard Land identification. As noted in the Terms of Reference, the long term stable top-of-slope may be determined either through geotechnical analysis, or else through the application of conservative estimations of geotechnical parameters (i.e. a stable slope inclination of 3:1 and a to erosion component of 8 m). Due to the uncertainty regarding the extent of a geotechnical field program required, it has been assumed that the latter approach would be applied, and would include consultation with Conservation Halton regarding the need, location and scope of geotechnical investigation as part of subsequent SIS studies. A unit cost for this component of the Work Plan has been incorporated into this fee estimate as per the requirements of Addendum #1.

Specific “desktop” information to be collected will include:

- Floodplain mapping studies
- Morphologic studies
- Detailed topographic survey/available mapping data for use in building a DEM
- Aerial Imagery (historical air photo coverage and current other imagery)
- Regulation mapping (from Conservation Halton)
- Geotechnical reports and logs

In terms of stream morphology field work to support the hazard land identification, it is proposed to generally conduct the program of field work as detailed in Primary Task 3. This would include:

- hazard delineation (meander belt width and 100-year erosion rate)
- a ‘desktop’ review of the background information, specifically the topographic mapping and aerial photography
- mapping to confirm the physical setting and channel reach boundaries
- ‘screen out’ areas of potential concern and hazard
- focus any necessary field work to fill identified data gaps
- Using the topographic mapping, channel reaches would be delineated and subjected to an initial classification and sensitivity score.

- Using the historical aerial imagery, areas of channel adjustment would be identified and measured to provide migration rates. Areas and timing of land use change would also be noted.
- hazard delineation (meander belt width and 100-year erosion rate)
- areas of potential concern and hazard would be mapped and assessed
- field work would include the completion of synoptic level surveys (Rapid Geomorphic Assessment, Rapid Stream Assessment Technique) to identify areas of active erosion or deposition. A walk of the stream reaches will also be coordinated with Conservation Halton staff and other members of the SWTAC.
- field work would include the completion of synoptic level surveys (Rapid Geomorphic Assessment, Rapid Stream Assessment Technique) to identify areas of active erosion or deposition.

Task 2.2. Flood Hazards

Subtask 2.2.1 Characterization Analysis

Current floodline mapping for Sixteen Mile Creek within the study area, as well as current hydraulic models (HEC-2) will be reviewed in order to characterize the existing hydraulic conditions within the study area. This exercise will also include a screening of the number of structures located within the currently approved floodplain and a review of the available data for updating and calibrating the hydraulic model. Based upon the initial screening of the available design and as-built information for the hydraulic structures, recommendations for additional field survey will be forwarded to the SWTAC. For the purpose of this proposal, an allowance has been made for one crew day to complete Total Station Survey and hydraulic structure inventory for the hydraulic structures at Trafalgar Road, Hornby Road, and Steeles Avenue within and bounding the study area. Subject to receipt of permission to enter, the crossings at the private roadways at the upstream limit of the study area would also be surveyed. Based upon a review of available mapping, it is estimated that survey information would be obtained at nine (9) hydraulic structures.

The hydraulic characterization will also include an assessment of the impacts on the subwatershed hydrology (i.e. peak flow reduction or attenuation due to impoundment behind existing hydraulic structures), and will thus be completed concurrently with the calibration of hydrologic modelling. Given the well-defined valley reaches for the Middle Branch of the Sixteen Mile Creek and the Hornby Tributary, it is anticipated that there will be substantial man-made and riparian storage in this system.

The existing HEC-2 hydraulic models would be imported into HEC-RAS for the hydraulic analyses in order to establish the existing floodplain through the study area. The hydraulic models would be refined within the limits of the study area based upon the base mapping provided for this study, as well as the as-built and design information for existing hydraulic structures and the Total Station Survey for additional structures. The limits of the model would be extended to include any watercourses within the study area with drainage areas greater than 50 ha which are not currently included within the current floodline mapping. An allowance (provisional) item has been included in the cost estimate to conduct sub-50 ha floodplain mapping as deemed necessary by the SWTAC.

The HEC-RAS hydraulic model would be updated to include the peak flows for the 2 year through Regional Storm events as determined by the hydrologic analyses, and floodline mapping would be prepared to depict the 100 year and Regional Storm Floodplains through the limits of the study area.

Subtask 2.2.2 Interim Analysis/Impact Assessment

The impact assessment for the initial preliminary land use would consist of an evaluation of the difference in flood plain characteristics (i.e. the change in water surface elevation, flood depth, storage and floodplain limits) under the future land use scenario compared to existing land use conditions (Regulatory event only). This would include determining the number of potentially affected residences (buildings) within the flood plain. This assessment would be conducted such that it is consistent with Ministry of Natural Resources Technical Guidelines (2002).

Task 2.3. Erosion Hazards

Subtask 2.3.1 Characterization

Regardless of whether the channel reach is confined or unconfined, an erosion hazard limit will be delineated. The hazard assessment will follow the MNR Technical Guide – River & Stream Systems: Erosion Hazard Limit (2002). Meander belt widths will be delineated for all unconfined channel reaches. The belt width delineation will follow standard procedures (TRCA, CVC, MNRF). This characterization will also provide an indication of the sensitivity of the area watercourses, as well as a measure of the local dynamics. This will be helpful when interpreting field conditions and developing appropriate management strategies. As noted in the Terms of Reference, this will include a field walk with Conservation Halton and other members of the Technical Advisory Committee.

Subtask 2.3.2 Analysis

The analyses will build upon the characterization and provide a further level of quantification on the erosion hazards. Using historical information (mapping, air photos, reports, channel crossings), channel migration rates will be determined. This will include both lateral and down-valley movement. The lateral values will be applied as a factor of safety and extrapolated to determine the 100-year erosion limit. These analyses will be applied to determine and map the ultimate corridor width following MNRF guidelines and Conservation Halton policy. This part of the assessment will be documented and presented in a drawing format. The drawing and mapping will include:

- Available detailed topographic information (0.5 m contours preferred)
- Current watercourse centreline,
- Reach break locations,
- Creek's central tendency (meander belt axis),
- Available historic watercourse centrelines;
- Calculated meander belt (preliminary meander belt),
- Analyzed 1:100 year erosion setback (100 year migration rate) and
- Regulated 15 m allowance.

Task 3. Geomorphological Assessment

Task 3.1. Characterization

The fluvial geomorphological component will focus on updating the understanding related to the condition and physical function of the channels in the study area. Given the setting of the study area, the primary objective is the characterization of channel erosion and sediment movement. For some of the headwater channels and upstream drainage area, the cumulative effect of these systems will also need to be assessed. This will include following the headwater drainage feature approach and a drainage density evaluation.

The purpose of this study component is to identify and characterize the physical processes which are responsible for the existing channel form. This will provide an understanding of the channel function and stability and the knowledge gained from this characterization can then be applied to managing the area creek system, in order to identify and determine the probable causes of erosion as well as sediment transport rates.

Task 3.2. Background Review and Field Work

Subtask 3.2.1 Background Review

Any pertinent background information would be collected and reviewed including:

- Available hydrologic and hydraulic models;
- Mapping (topographic, Regulatory, aerial);
- Reporting (Watershed, Subwatershed, Drainage Study, Stormwater Management Report);
- Policy and Criteria;
- As-built information for existing drainage infrastructure, including culverts, bridges and storm sewers; and
- Databases including storm sewers and Hydromet data (precipitation and stream flows).

The list of reference material from the Town of Halton Hills will be reviewed in addition to other relevant studies. It should be noted that Parish Aquatic Services completed the geomorphic component of the 401 Corridor Integrated Planning Project, Town of Halton Hills – Scoped Subwatershed Plan (Dillon Consulting March 2000), and currently has record of the streams south of Steeles Avenue, which will be reviewed and re-assessed to provide a more complete understanding of channel dynamics in this area.

Subtask 3.2.2 Field Work

The field work has three primary components: 1) reach characterization through a synoptic level survey; 2) detailed field work, specifically for erosion analyses; and 3) establishment of monitoring stations. From this field exercise, sufficient information would be collected to permit a variety of analyses.

The synoptic level survey would consist of ‘Rapid Geomorphic Assessments’ to evaluate and rank channel stability, health and function. While this synoptic level survey is intended to be completed for all of the identified channel reaches, it would be scoped and prioritized

based on any previously identified erosion/sedimentation sites. The rapid assessments would identify the reaches that would be most prone to erosion/sedimentation, based on overall channel stability and mode of adjustment. Included in this assessment is the relative stability of the bed and bank material. As requested by the Terms of Reference, the areas prone to sedimentation would be further evaluated. This would include a determination of volume of accumulated sediment (area and depth); particle size characterization and determination of sediment quality, through chemical analyses of samples. The results of the rapid assessment would be summarized and a copy of the field notes would be included in the initial report, as an appendix.

The rapid assessment is intended to identify those systems that warrant more investigation to better ascertain their role in delivering flow and sediment. This would be addressed by a 'scoped' field investigation where channel thresholds would be determined and the rate and mode of sediment delivery can be assessed and ideally quantified.

During the rapid assessments, any areas of active erosion would be mapped and linked with the slope stability work. In addition, areas of sediment accumulation (bars) would also be identified and mapped, which will provide an initial understanding of the effectiveness of the creek in moving its sediment load.

The detailed field work would be completed at all of the reaches that were deemed to be 'sensitive' to erosion/sedimentation. The field work would follow standard geomorphic field protocols and would include bankfull cross-sections, a profile survey, characterization of the bed and banks and documentation of any other features that may be affecting flow and sediment movement.

The data would be of sufficient detail to enable subsequent analyses of channel processes. At each of the detailed field sites, a monitoring station would be established, again following the standard protocols. The boundary material (bed and banks) would be characterized in the field to provide enough data to permit erosion analyses and interpretation. If warranted, bulk samples of the bed and bank material would be collected and subjected to laboratory grain size analyses; no allowance for this task is included with this proposal.

Task 3.3. Analysis

The results of the geomorphological assessment will be analyzed to determine active channel processes within the study area. Through the background review, initial field reconnaissance work and detailed field work, an integration of the results will be used to understand the erosion processes that are occurring. In addition, the data will also help to identify areas susceptible to erosion (sediment supply), and be used to determine critical channel thresholds at strategic points in the receiving channels.

All of the desktop and field data would be synthesized to provide a complete understanding of the overall role and performance of the various study area stream reaches. This would include reach stability, sensitivity and function, which will be presented in a series of thematic maps. The broader mapping will include insight on the headwater channels and low-order streams and their overall contribution to the function

of the main stem systems. Included in this assessment would be drainage density targets, which will be refined and applied to evaluate land use options.

Based on the detailed geomorphic assessment, erosion thresholds from the three (3) field work sites will be determined for the channel bed at sites determined to be the most sensitive or representative. Channel thresholds determine the magnitude of flows required to potentially erode and transport sediment. Therefore, these thresholds provide acceptable limits to prevent an increase in channel erosion and deposition beyond the natural rates. Based on this assessment, recommendations will be offered with respect to management decisions.

In addition to providing the traditional erosion threshold flows, analytical methods (critical shear and threshold velocity models) will be applied to the data to define threshold flows for the bed of the sensitive reaches. Additionally, various ecological instream flows would also be determined and provided for consideration. These flows incorporate a target for the flushing of fine sediments, as well as low flow thresholds. If incorporated into stormwater management systems, they would provide an opportunity for low flow enhancement. The modelled results will then be examined for convergence and compatibility with field observations to provide appropriate and meaningful erosion thresholds in terms of critical discharge. Selection of appropriate threshold values will, in part, be dictated by channel substrate, since certain models have been developed specifically for certain bed substrates. Erosion thresholds will also be based on the median grain size (D50), which is the general practice. These erosion thresholds will inform hydrologic modeling of stormwater management solutions to determine the controls required to prevent an increase in stream bank erosion under post development conditions.

Requirements for geomorphological monitoring both prior to, during and post-development will be identified as part of an integrated monitoring plan. Parish Aquatic Services has assumed that three (3) geomorphological monitoring sites will be established, and that one baseline and one monitoring survey will be completed. The number and location of these monitoring sites would be refined based on rapid assessment findings and discussions with other disciplines. Digital photography showing each of the 10 proposed cross sections will be prepared. The data will be analyzed and a structured summary of findings will be prepared for each of the three (3) sites.

Detailed field data will be collected at each of these sites, including:

- Measurements of bankfull cross-sections at 10 locations reporting riffle, pool and transitional sections of the reach;
- Bank characterization;
- Bed substrate characterization using a modified Wolman pebble count to evaluate substrate characteristics; and
- A long profile survey of channel bottom and bankfull elevations to determine local energy gradients, including top-of-riffle, bottom-of-riffle, maximum depth and any obstructions to flow.

Task 4. Hydrogeology

The primary objectives for the groundwater component of the subwatershed study include:

- Identify water quality and quantity constraints associated with surface water and groundwater features within and adjacent to and downstream of the Primary Study Area, including their interaction and associated ecological and hydrologic functions.
- Identify groundwater resources and constraints to development to ensure functions are maintained during and following development.

Task 4.1. Background Review

The Terms of Reference provide a detailed listing of available background information. Background data collection will be carefully coordinated and managed. A detailed summary of all the background information will be prepared, along with details on data gaps.

A background review of reports and datasets listed in the Terms of Reference will be conducted. Existing relevant groundwater characterization is currently presented in the following reports:

- Sixteen Mile Creek Watershed Plan.
- Ministry of the Environment and Climate Change (MOECC) Water Well Records
- 401 Corridor Integrated Planning Project, Town of Halton Hills – Scoped Subwatershed Plan (Dillon Consulting March 2000)
- Tier 1 Water Budget and Water Quantity Stress Assessment for Halton-Hamilton Source Protection Region and Tier 2 Water Budget and Water Quantity Stress Assessment for the Upper West Branch of Sixteen Mile Creek and Middle Spencer Creek Watersheds (Halton-Hamilton SPC 2010).
- Vulnerability Analysis for the Milton and Campbellville Wellfields, Regional Municipality of Halton, Ontario (Earthfx 2010).
- Assessment Report Halton Region Source Protection Area (Halton-Hamilton SPC 2012)

A detailed hydrogeologic study for the Hornby area was referenced in Dillon, 2000. This study may provide more site specific hydrogeologic information.

Task 4.2. Characterization and Constraints

The hydrogeological setting within the study area will be defined, both locally and within a more regional context. A delineation of the flow system(s) in this way will identify where groundwater originates, where it discharges and the most prominent paths it travels between these points (e.g. aquifer pathways or more permeable hydrostratigraphic units; Dillon 2000 indicates a localized basal sand aquifer within the study area). This will allow for the assessment of the relative sensitivity of the linkage from the groundwater system to the aquatic or terrestrial systems. The potential groundwater quantity and quality impacts of particular types and scales of land uses or land use changes on the groundwater flow system and other linked ecosystem components can then be defined.

A preliminary characterization of the hydrogeologic setting will be carried out based on the review of the existing reports and data described earlier and within the Terms of Reference. This preliminary characterization will also include relevant groundwater functional information coming out of the background reviews for the other disciplines. This preliminary characterization is intended to provide an initial assessment of the hydrogeologic sensitivity related to aquifer potential and groundwater/surface water interaction. This will confirm whether additional groundwater field work will be necessary to sufficiently characterize the hydrogeologic setting to meet the objectives or whether this more site specific work would need to be carried out during the Subwatershed Impact Study (SIS) stage. This additional work would likely include drilling/logging boreholes, monitoring well and drivepoint piezometer installation and groundwater quality sampling.

The groundwater component of this study includes a minor field component to carry out spot baseflow measurements at select sites on 2 occasions within the study area. Developing an understanding of the potential baseflow is considered a basic data need to assess potential groundwater contributions. This minor field program will also be integrated with the streamflow and groundwater discharge/seepage observations from the hydrology, geomorphological and aquatic field programs.

The relevant hydrogeologic discussion and mapping as presented in Section 6.0 of the Scoped Subwatershed Terms of Reference will be provided in the reporting task. In addition where sufficient information is available, select hydrogeologic cross-sections will also be provided.

The assessment and data from the other study components will be incorporated into the refined hydrogeologic characterization/conceptualization, particularly where it provides information on recharge and groundwater/surface water interaction. Within the Scoped Subwatershed Study Team's integrated characterization process, the results of the groundwater characterization will also be incorporated into the hydrological and ecosystem components.

Management strategies will be presented that will reflect the local and functional linkages of sensitive recharge and discharge areas and the potential groundwater quantity and quality impacts on groundwater supplies. The integration of the groundwater impact assessment with the stormwater management assessment, will focus on the protection of the groundwater recharge and appropriate maintenance of groundwater levels and groundwater quality at various applicable scales.

Task 4.3. Monitoring

As outlined in the Terms of Reference a groundwater quality and quantity monitoring plan, related to potential development impacts and mitigation measures, will be provided to address groundwater functions outlined in Subtask 4.2.

The groundwater monitoring (pre, during and post construction), will also take the following into consideration:

- Potential construction dewatering.
- Short circuiting of groundwater flowpaths through subsurface infrastructure.

- Impacts on groundwater supply users.
- Integrated groundwater functional ecosystem monitoring (must consider seasonal sensitivity).

The guidelines for more detailed site specific groundwater characterization and related field work for future planning stages (i.e. at SIS stage) will be provided.

Task 5. Water Quality

Task 5.1. Background Review

Information on surface water quality for the primary watercourse system through the study will be gathered from available information as outlined in the Terms of Reference which includes:

- PWQMN
- Conservation Halton's LTEMP
- Previous reporting including:
 - Sixteen Mile Creek Watershed Plan
 - North 16 District Scoped Subwatershed Study

In addition, the findings of the scoped water quality monitoring program which was recently completed by Amec Foster Wheeler for the Ninth Line Lands Scoped Subwatershed Study will be used to further inform the characterization of the surface water chemistry and water quality at the overall subwatershed scale.

The existing dataset will be reviewed to determine the spatial distribution of water quality monitoring, the methodologies applied (i.e. grab sampling versus continuous water quality monitoring), the parameters monitored and the frequency of monitoring (i.e. number of samples per year, wet weather versus dry weather, etc.). This information will be compiled into a tabular summary, in order to identify any gaps which exist in the current dataset related to characterizing the surface water quality within the study area and evaluating future stormwater management performance related to surface water quality control.

Task 5.2. Analysis

A synthesis of the desk-top information will be used to characterize the area's water quality, as related to key Parameters of Concern. To the extent possible, the data will be used to assess the spatial and temporal characterization in the study area and off-site to gain an understanding of trends related to water chemistry (as related to Provincial Water Quality Objectives) and temperature.

Existing contaminant sources will relate to the current and legacy uses in the area, with a strong preponderance to rural activities. It is expected that the sampling results would demonstrate a mix of rural and urban contaminants, largely from roadways. Future urban uses and associated loading are reasonably well understood and data are expected to be readily available from desktop sources.

Traditional stormwater management in combination with LID BMPs will be prescribed to address water quality and thermal impacts. It is noteworthy that residual impact management (i.e. after application of stormwater management and LID BMPs), may bring forth consideration for stormwater management retrofits, with the objective to offset the impacts which cannot be managed by stormwater management alone. Amec Foster Wheeler recently worked with the City of Brampton on this matter and also conducted a significant undertaking for Barrie to establish a 'zero-based' net impact management plan for phosphorus loading to Lake Simcoe. Amec Foster Wheeler's insight and background knowledge to this issue, and particularly managing Ministry of the Environment and Climate Change expectations, will be particularly beneficial to the Town of Halton Hills.

Task 5.3. Monitoring

Terms of Reference for future environmental studies and recommendations related to the water quality management strategy and associated monitoring would be developed as per the Scoped Subwatershed Study. These requirements would be established with consideration for the locations and objectives of current and future monitoring programs, as well as the specific requirements of the water quality monitoring program to inform adaptive management practices for the study area.

Subtask 5.3.1 Scoped Water Quality Monitoring

Although not required under the Terms of Reference for this study, it is recommended that consideration be given toward conducting a scoped water quality monitoring program for the study area. Amec Foster Wheeler's recent experience with the Ninth Line Lands Scoped Subwatershed Study in Mississauga has indicated that the collection of a limited set of local water quality data is an expectation on the part of Conservation Halton, and serves to inform the overall baseline characterization of surface water quality and aquatic habitat within the area. To this end, a provisional item has been included within the fee estimate for the completion of a scoped water quality monitoring program within the study area. The scoped water quality monitoring program would be comprised of the following.

Temperature

Continuous monitoring for instream water temperature is proposed to be completed as part of this program. Hobo continuous temperature loggers would be installed at two (2) locations in order to characterize the water temperature at the upstream and downstream limits of the study area. Recognizing that the critical period for monitoring water temperature is during the summer months, water temperature data collection is proposed to be conducted between the months of June and September 2015.

Chemistry

Surface water chemistry monitoring would be completed using grab sampling for two (2) wet weather and two (2) dry weather events. In order to capture seasonal variations in surface water chemistry, one (1) wet weather sample and one (1) dry weather sample would be obtained for the summer and fall of 2015. The grab samples would be analyzed by an accredited analytical laboratory for the following water quality parameters:

- Anions
- BOD
- Metals
- Ammonia
- Total Phosphorus
- Total Suspended Solids
- E.Coli
- TKN

Turbidity

At the time of grab sampling, spot measurements for turbidity would be obtained using the Lamotte 2020 unit. All grab samples and turbidity measurements would be obtained at the same locations for temperature monitoring.

Task 6. Fish and Aquatic Habitat

Task 6.1. Characterization and Background

A review of available background information on the study area was collected and reviewed to inform this work plan. This included a number of the reports listed in the Terms of Reference, legacy data, as well as the 401 Corridor Integrated Planning Project prepared by Dillon in 2000 that overlaps with the study area.

All available documents, reports, fish community records (current and historic) and benthic invertebrate records will be completed for the Study Area as well as the larger subwatershed, upstream and downstream of the Study Area.

The team will work closely with Conservation Halton (CH), Fisheries and Oceans Canada (DFO), the Ministry of Natural Resources and Forestry (OMNRF), and the Technical Steering Committee when gathering background records and data, and when obtaining permits required for detailed field investigations. Site selection for aquatic inventories and data collection will occur in collaboration with other disciplines (e.g. stream morphology, riparian habitat, groundwater data, water quality and quantity) so that data can be effectively and efficiently compared throughout the subwatershed study process.

Any Species at Risk (SAR) present within the study area will be identified through the Natural Heritage Information Center (NHIC) database. Additionally, OMNRF, DFO, and CH will be consulted for information regarding any historical records of SAR. A preliminary search of the DFO Species at Risk distribution mapping (2014) indicates that Redside Dace is known from Sixteen Mile Creek, but does not identify any Species at Risk within the study area.

Task 6.2. Background Review and Field Work

Background data collected for the Characterization and Background Review task will be utilized throughout the study in order to appropriately scope field tasks and address any data gaps. Baseline data will be collected in the field for fish community, fish habitat, and benthic invertebrates. The methodological approach will be discussed and confirmed with the Technical Steering Committee prior to conducting field surveys. Sampling locations will be chosen where water flow is anticipated to occur in the months of April, May, and June to ensure that each site location can include fish community assessments, benthic invertebrate collection, water temperatures and stream morphology. Additional site preferences include well-vegetated streambanks, and if possible near existing road crossings for easy access. During site selection, consideration will be given to post

development and long-term monitoring requirements. Monitoring stations will be set during initial fieldwork to ensure consistency from year to year.

Based on defined channel segments (i.e. reaches) a habitat assessment will be conducted in order to establish existing aquatic conditions and to identify and quantify key habitat areas within the Study Area. The habitat assessment will include an inventory of barriers to fish migration (using the Ontario Stream Assessment Protocol *Instream Crossing and Barrier Attribution* Module, Stanfield et al. April 2013), existing on-line ponds, sources of stream baseflow and groundwater discharge (e.g. seeps and springs), a water temperature survey, and aquatic vegetation. Standard methods will be used following the Ontario Stream Assessment Protocol. Existing areas of disturbance and the source of such disturbance and/or alteration will be identified during the habitat assessment.

Within the Study Area, an examination of seasonal watercourses (if any) will be undertaken in regards to potential indirect habitat (i.e. spawning, seasonal re-colonization, water quality and quantity, detritus and nutrients delivered to downstream habitat) for the existing fish community. In addition, watercourses (permanent, intermittent and ephemeral features) will be classified based on the priority of habitat type and will be assigned a cold, cold-cool, cool, cool-warm, or warmwater designation, based on temperature surveys and background information.

Subtask 6.2.1 Benthic Invertebrates Field Monitoring

As part of this study in support of understanding the ecology of the Study Area, surveys of benthic macroinvertebrates will be undertaken at approximately six (6) locations, based on the availability of sites with appropriate physical conditions. Paired sample sites will be located near the upstream and downstream ends of existing watercourses. The baseline data will enable the characterization of the benthic invertebrate community throughout the study area, and will be used during the impact assessment phase for identifying reaches that are potentially sensitive to proposed land use changes, as well as long-term monitoring.

The sampling methodology will follow the Before/After/Control/Impact (BACI) experimental design and the *Ontario Benthos Biomonitoring Network Protocol Manual* (OBBNPM).

Samples will be collected in the spring, as samples collected during the summer are indicative of limiting conditions when results will show impairment to a greater degree than will samples collected in either spring or fall. Methods outlined in the OBBN will be followed and where possible, methods described in previous studies within the subwatershed and the Study Area will be incorporated in order to provide effective comparison of data and results between several studies in the area. NRSI will identify the organisms from the samples in NRSI's in-house wet lab. Upon receiving the raw data, NRSI will calculate a variety of indices to describe the benthic community in the Study Area. The following is a list of the indices that will be calculated:

- % EPT
- Shannon Weaver Index
- Taxa richness (number of taxa)
- Hisenhoff Index
- % Oligochaeta
- % Chironomidae
- % Isopoda
- % Gastropoda
- % Dipteran
- % Insecta
- Dominant taxon
- Relative abundance of families
- Relative abundance of functional feeding groups

As per the Terms of Reference, the relative health of each site will be determined based on:

- EPT
- Taxa Richness
- % Oligochaeta
- % Chironomidae
- % Isopoda
- % Gastropoda
- % Diptera
- % Insecta
- HFI
- SDI

Physical stream measurements and field observations will be assembled from aquatic field assessments and the various disciplines, in order to allow for detailed analysis of benthic macroinvertebrate communities within the Study Area. These measurements and observations will include:

- pH,
- Conductivity,
- Flow velocity,
- Dissolved oxygen,
- Water temperature,
- Stream channel depth profile,
- Stream width (wetted and bankfull)
- Riparian vegetation composition and cover,
- Substrate composition and imperviousness, and
- Percent overhead and instream cover (from debris, fall and leaning trees, and other vegetation).

Subtask 6.2.2 Fish Community

Fish community sampling will be conducted in accordance with the Ontario Stream Assessment Protocol (OSAP). Quantitative sampling for fish species will be conducted in June at six (6) sampling locations. The sampling locations will be strategically located in the vicinity of the benthic stations and will cover the Study Area.

All habitats within each station will be sampled with an attempt to capture all fish observed. Collected fish will be identified and enumerated, and will be released alive back into the same watercourse outside the isolation block nets and sampling station. Fish community abundance will be analyzed with reference and comparisons made using data collected from other disciplines (e.g. stream morphology, riparian vegetation, hydrogeological data, surface water quantity and quality, and benthic invertebrates).

Subtask 6.2.3 Riparian Habitat

Riparian habitat will be assessed in terms of the function it provides to fish habitat. An assessment of the riparian area will be completed as part of the background review and vegetation inventory in the terrestrial ecology component and will include delineation of vegetation communities identified using the ELC protocol.

Task 6.3. Analysis

The identification of existing habitat features critical to the maintenance of the existing fishery and features that may presently be limiting fish production will be identified during the Impact Assessment. In coordination with the fluvial geomorphology component, recommendations will be provided for improvement of aquatic habitat and stream function, including, but not limited to, the instream, stream bank and floodplain habitat enhancement, removal of fish barriers and on-line ponds, and retrofitting any existing altered habitats. Sensitive areas within, and downstream of, the study area will be identified as part of an assessment of stream classification efforts. Constraint rankings, along with the identification and protection of appropriate buffers and/or setbacks will be developed and applied in assessing land use options for the Study Area. Impacts on the productive capacity of fish habitat and health within the Study Area and downstream will be assessed with particular emphasis on the most sensitive areas.

Categorization of aquatic habitats in terms of the relative importance and sensitivity of the habitat to development is helpful for guiding management decisions. Utilizing background information and data collected in the field, streams within the Study Area will be classified using a *green*, *blue*, and *red* characterization to denote low, medium, and high constraint rankings respectively. In collaboration with the various disciplines (e.g. geomorphology, hydrology, hydrogeology, etc.) an overall constraint ranking will be developed to identify locations of the channel that are sensitive to disturbance and future development. The constraint ranking and information will be used in collaboration with other related disciplines (i.e. hydrology, water quality, fluvial geomorphology, and terrestrial ecology) to recommend and develop enhancement opportunities for aquatic habitats.

Stream corridors will be identified in collaboration with stream morphology, water quality and quantity, terrestrial ecology and groundwater assessments. A management plan will be developed in association with reach-specific conditions.

A monitoring plan for benthic invertebrates, as well as fish habitat and communities will be developed in consultation with the Technical Steering Committee. An iterative decision making process will be applied to allow for adaptive management during and post construction. Data collected as part of the characterization component of the subwatershed study will be applied as a baseline of existing conditions and will be incorporated into the pre-construction monitoring phase. The same methodologies outlined in the Fieldwork and Analysis section will be followed. This will ensure that year to year comparisons can be made to the baseline data. Monitoring will occur both during and post construction to identify issues or problems occurring due to development and to allow for an adaptive management approach for mitigation. Continued monitoring of the riparian habitat will be assessed for 30 m from each side of the bankfull channel during and post construction as part of the terrestrial ecology component (ref. Task 7 for more information).

Task 7. Terrestrial Ecology – Natural Heritage Features and Areas

Task 7.1. Characterization and Background

A preliminary review of background data was completed to inform this work plan. This included a number of the reports listed in the Terms of Reference as well as the 401 Corridor Integrated Planning Project prepared by Dillon in 2000.

A full review of background information will be undertaken in order to appropriately scope the field component. Available records of the natural features and areas within the Study Area will be gathered, including existing and historic information. All features previously identified will be mapped and described based on background information that is collected and additional GIS data provided by the Technical Steering Committee, Conservation Halton, as well as the Town of Halton Hills and Region of Halton. Data sources will include, but may not be limited to, the list included in Appendix I of the Terms of Reference Aurora District MNRF office, as well as CH will be contacted for more detailed, site specific data and information if it is available. Any gaps in the data collected in previous studies and inventories will be identified and addressed as part of the field study plan.

The methodological approach will be discussed and confirmed with the Technical Steering Committee prior to conducting the field surveys. Standards set out in the Regional Natural Heritage System framework, as part of the Region Official Plan Amendment number 38, will be followed. Standard methodologies for each field survey are described in the Background Review and Fieldwork Section.

Task 7.2. Background Review and Field Work

Based on a review of background information and data as described in the Characterization and Background Review section, a plan for field surveys will be developed. Any necessary permits for sampling, for both aquatic and terrestrial studies, will be applied for immediately following the study award.

Comprehensive, multi-season field investigations of the Study Area will be conducted to allow for refinement of natural heritage feature and area boundaries. Field surveys will focus on assessing any identified Species at Risk (SAR). The following is a description

of the field surveys that will be conducted. These surveys are designed to identify and delineate the habitats for SAR, Species of Conservation Concern (SCC) and other significant species identified during the background review. Specific field methodologies will be prepared by the team, and reviewed and approved by the Technical Steering Committee and agencies prior to initiation.

A field schedule with specific dates, times, and personnel will be developed following award of the project and will be reviewed and approved by the Technical Steering Committee.

Wetlands

Wetlands found in the area will be mapped and described using both the OWES as well as ELC systems. This will provide the information necessary for the mapping and characterization components of any wetland evaluations. The wetlands will be evaluated and classified using the standard Ontario Wetland Evaluation System (OWES) Southern Manual (OMNR 2013).

Vegetation and ELC Surveys

Vegetation communities found within the area will be mapped and described using the ELC system. This will include wetlands (as noted above), as well as riparian areas as discussed under the aquatic work program discussion. Confirmation of the vegetation communities will be undertaken in conjunction with other field surveys. In addition, cavity trees will be identified for potential bat habitat. All natural features and functions will be identified based on the representativeness and rarity, using the ELC vegetation type, within the context of the Study Area, Town of Halton Hills, Conservation Halton, and the Province of Ontario. Where vegetation communities extend beyond the Study Area, the entire community will be assessed, including portions outside of the property boundary.

Multi-season floral inventories (spring, summer, fall) will be completed within the ELC polygons. This will allow for the calculation of floristic indices.

Wildlife Surveys

Extensive background information will be used to identify wildlife that are currently occupying the Study Area. Wildlife surveys will target any identified SAR and will follow standard protocols when available. Survey techniques will be reviewed and approved by the Technical Advisory Committee prior to implementation.

A review of potential Significant Wildlife Habitat (SWH) will be conducted based on available background information. The SWH Ecoregion 7E Criterion Schedule (OMNR 2012) will be applied where appropriate as it provides greater detail for the determination and identification of SWH. ELC communities identified during vegetation surveys will initially be compared to the ecoregion schedule and confirmed where possible based on available background data. NRSI will then identify locations to carry out targeted field investigations to determine SWH and identify “confirmed” or “candidate” SWH. All rare or uncommon species identified during SWH surveys will be documented.

Breeding Bird Surveys

Surveys of breeding birds will be conducted within the Study Area. Locations for targeted surveys will be chosen that represent the full diversity of habitat found within the Study Area. The field protocol will be followed based on the Ontario Breeding Bird Atlas protocol (OBBA 2001), the Forest Bird Monitoring Program (CWS 2002), or the Marsh Monitoring Program (BSC 2003). Each site will be surveyed twice: early June and late June at least 10 days apart.

Owl and raptor surveys will also be conducted in the winter as well as during migration.

Amphibian Surveys

Targeted surveys for amphibians will be conducted in April, May and June and will follow the Marsh Monitoring Protocol (BSC 2009).

Reptile Surveys

Targeted surveys for snakes and turtles will be conducted in conjunction with other scheduled field surveys. The protocols will be confirmed by the TAC, but are anticipated to consist of systematic area searches of potential habitats.

Mammal Surveys

Extensive background information will be used to identify mammals known within the Study Area. In addition, all mammal observations (e.g. individual sightings or signs such as tracks, scat, dens sites, etc.) during field surveys will be documented. In addition, during vegetation surveys, cavity trees will be identified for potential bat habitat, and during evening amphibian and bird surveys, bat activity will be recorded.

Butterfly and Odonate Surveys

A review of background information will be conducted to determine potential habitat for any Species of Conservation Concern (SCC) within the Study Area. Targeted surveys for butterflies and odonates will be conducted using survey protocols approved by the TAS.

Incidental Observations

Observations of all species of plants and wildlife observed throughout the study will be recorded. Location by ELC polygon, or finer as warranted, will be used. These observations will be integrated with results of the targeted wildlife surveys.

Task 7.3. Analysis

Based on all background information and data reviewed and field surveys completed as described above, the form and function of both ecological and hydrologic features will be identified. The ecological interactions between and among the natural heritage features and areas will be identified and described. A detailed review of Region of Halton, and Town of Halton Hills data will be conducted, along with other available background information regarding natural heritage features and linkages within the Study Area. A

connected Natural Heritage System will be developed in light of the regional system and watershed directions, which will include the following:

- Natural heritage features and areas (ecological and hydrologic);
- Appropriate setbacks and buffers, to be maintained during the development process;
- Restoration and enhancement areas to protect and improve the long-term natural function of the system;
- Functional corridors and linkages to define relationships between wildlife and natural areas within the Study Area, including stream corridors; and
- Opportunities to link isolated natural features to the Regional Natural Heritage System.

Recommendations will be provided for future data needs at the Subwatershed Impact Study stage, based on data and results obtained through the hydrology, natural hazards, geomorphology, hydrogeology, water quality, and aquatic and terrestrial biology assessments.

A monitoring plan will be developed in order to evaluate the effectiveness of recommendations in the implementation plan. An iterative decision making process will be applied to allow for adaptive management during and post construction. Data collected as part of the characterization component of the scoped subwatershed study will be applied as a baseline of existing conditions and will be incorporated into the pre-construction monitoring phase. Continued monitoring of natural features will include, but is not limited to:

- Riparian habitat
- Wetland function
- Vegetation community and woodland health
- Wildlife response (e.g. changes in abundance, distribution and behavior)
- Encroachment

A monitoring schedule will be developed in consultation with the Technical Steering Committee, and will include a schedule for during construction monitoring, and post-construction monitoring.

Task 8. Additional Background Review

Task 8.1. Municipal and Land Use Planning

A review of existing legislation, policies, by-laws related to municipal and land use planning for the Town of Halton Hills will be conducted in order to establish the legislative and policy framework. This information will also be used, to the extent possible, to identify the limits of existing and approved development and infrastructure, which will further inform the baseline characterization and the evaluation of opportunities as part of the overall Scoped Subwatershed Study process. Mapping will be developed to efficiently and effectively manage and communicate the information related to key existing resources and infrastructure in the study area. This summary will ultimately form a key component of the final document, clearly defining the basis for completing the Scoped Subwatershed Study and the required outcome in accordance with Provincial legislation and policy. The compiled mapping will serve to further inform the characterization and

impact assessment of the Scoped Subwatershed Study. A problem statement will be developed in consultation with the Town and the SWTAC to concisely articulate the requirements and objectives of the Scoped Subwatershed Study.

As noted in the Terms of Reference, a data gap analysis will be undertaken in order to identify any field monitoring to augment the existing datasets and to inform the overall Subwatershed Study process. This gap analysis will be informed by the background information review to be undertaken as part of the baseline assessment to inform future studies; no provision for additional monitoring, beyond that which is outlined in the preceding sections, has been included within this proposal scope.

Task 8.2. Subwatershed Synopsis

An integrated assessment of the findings of the baseline characterization for each study discipline will be completed to establish fully integrated constraints and opportunities for the future development of the study area. Maps will be prepared to provide a synopsis of the constraints and opportunities related to the terrestrial, aquatic, fluvial, groundwater, and surface water resources within the study area, as well as the hazard limits as defined by the characterization. A summary would also be prepared to document the key findings from the baseline characterization for inclusion in the characterization report.

Task 9. Reporting

As noted in the Terms of Reference, a digital plus three (3) copies of each report (one for each member of SWTAC) and three (3) copies of the Final Report will be prepared as part of the Reporting tasks; specifics are noted in the following:

Task 9.1. Background Report

As noted in the Terms of Reference, a background report will be prepared to document the information provided for the study. The information collected will be summarized in the form of an information tracking chart, to document the information received and any outstanding information requirements. To the extent possible, this document will also provide a summary of any identified gaps within the background information, in order to facilitate the transfer of any additional information from the SWTAC for use in this study.

Task 9.2. Characterization Report

The technical tasks under *Phase 1: Characterization*, will provide a sound scientific understanding of the physical environmental issues across Area 4 and 5 of the Sixteen Mile Creek subwatersheds. By combining both the physical and land use (from Land Use study) elements of subwatershed issues, a comprehensive understanding of the area's opportunities and constraints will be generated. It is proposed that this information be synthesized and summarized into a clear and understandable form as this will become the foundation to establishing the future subwatershed management strategies. The key interrelationships between water quantity, water quality, natural heritage, aquatic habitat and land use will be identified.

A fundamental component of the first phase of this scoped subwatershed study will be the establishment of a preliminary set of targets and objectives by discipline. It is

expected that these targets will take guidance from the senior policy and plans, and then transition to the more regional scale (i.e. Sixteen Mile Creek Watershed Plan).

Task 9.3. Interim Report

The Phase 2 Analyses and Impact Assessment will be documented into this Interim Report which will define the impacts of the preferred land use and associated mitigation/management requirements. The report will be comprehensive, including text, graphics, mapping and the associated digital version of the various models used in the impact assessment of the respective land use scenarios.

This report will also provide details on implementation matters used to transition to the SIS stage, including:

- Timing for the construction of any required facilities with respect to the future development.
- Recommended Natural Heritage System in accordance with Regional and Town Official Plan requirements, including the recommended approaches for buffers, linkages, restoration and management both during and following the development period.
- Recommendations for future studies.
- The operation and maintenance responsibilities for the recommended facilities.
- A general approach to the establishment of a monitoring program to ensure compliance with the Scoped Subwatershed Study, and a strategy for corrective actions which may be necessary based on results of the monitoring program.
- Time frame for the review/update of the Scoped Subwatershed Study, and
- Recommendations for a Natural Heritage System

Task 9.4. Final Report

This task will involve a compilation of reporting related to Phases 1 and 2, based on input from the SWTAC.

Task 10. Meetings

Clearly, meetings will be a major component of this study process. The resources proposed to be dedicated to consultation and communications needs to be carefully managed. As per the Terms of Reference, seven (7) meetings/presentations have been budgeted as part of this task.

Task 11. Public Consultation

Public consultation will be an integral component of this study. In order to achieve effective consultation, there is a need to ensure that all of those who are interested in these studies have the opportunity to participate. The public consultation program will consist of notices, and Public Information Centres (PICs).

Public Information Centres

As per the Terms of Reference, three (3) PIC's will be held to advise the community of the study and its findings, and to provide an opportunity for input to the study, as follows:

Public Information Centre #1 – Background/Goals/Objectives

Public Information Centre #2 – Constraints and Opportunities

Public Information Centre #3 – Review of Management Opportunities

The same format will be used for each PIC. A portion of the PIC will be an informal review of display boards and discussions with the Amec Foster Wheeler Scoped Subwatershed Study Team. A presentation would form the balance of the PIC. The presentations will provide an overview of key study information and allow an opportunity for questions and answers.

Summaries of each PIC will be prepared and will form part of the overall study documentation.