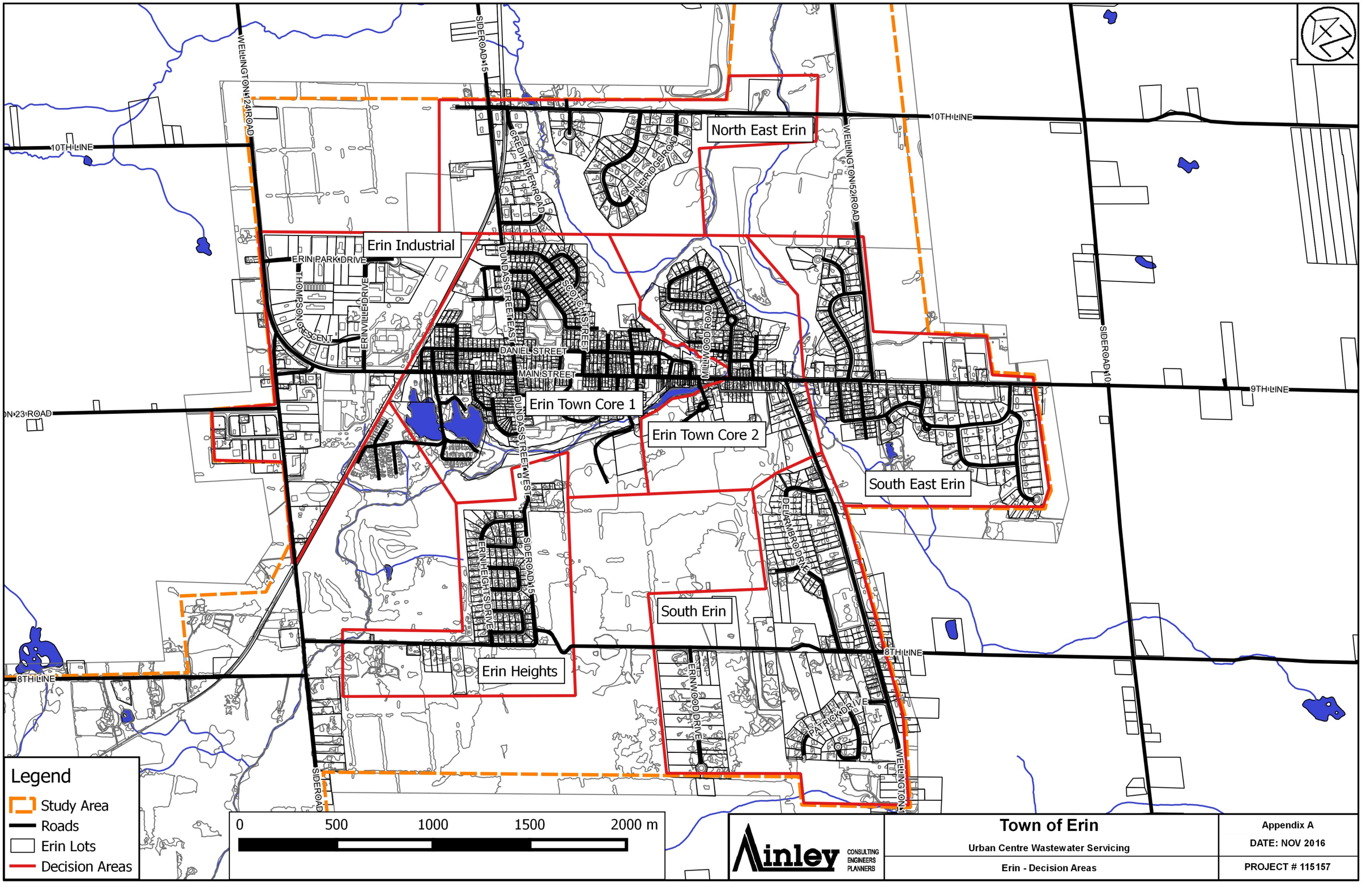
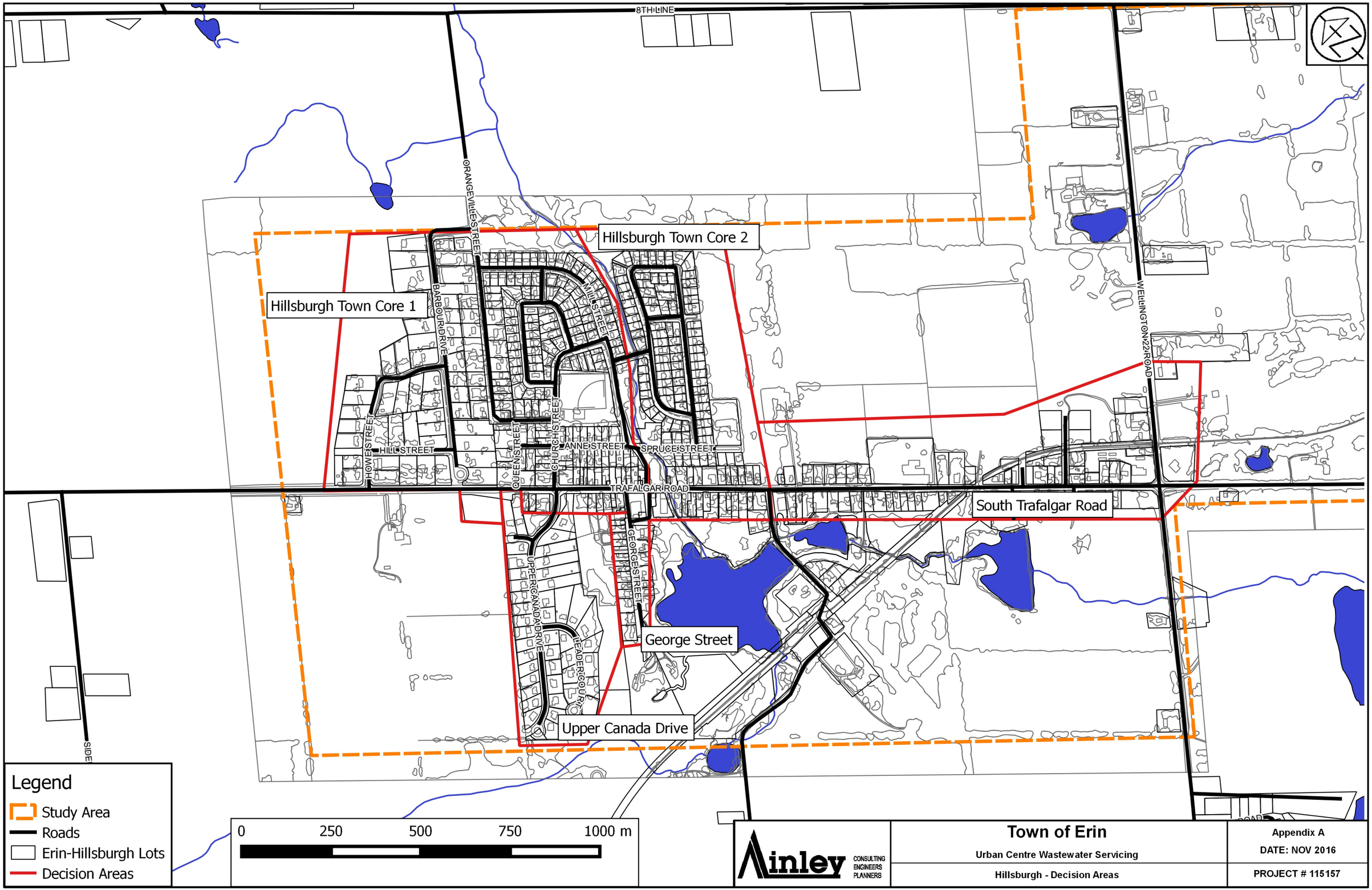
Appendix - A

Decision Areas


North East Erin
Erin Industrial
Erin Town Core 1
Erin Town Core 2
South East Erin
South Erin
Erin Heights
10TH LINE
WELLINGTON 124 ROAD
SIDEROAD 15
CREDIT RIVER ROAD
PINERIDGE ROAD
WELLINGTON 52 ROAD
SIDEROAD 10
9TH LINE
ON 23 ROAD
ERIN PARK DRIVE
THOMPSON CRESCENT
ERINVILLE DRIVE
DUNDAS STREET EAST
SCOTT STREET
DANIEL STREET
MAIN STREET
MILLWOOD ROAD
DUNDAS STREET WEST
ERIN HEIGHTS DRIVE
DEARBORN DRIVE
ERINWOOD DRIVE
PATRICK DRIVE
8TH LINE
SIDEROAD
Legend
Study Area
Roads
Erin Lots
Decision Areas
0
500
1000
1500
2000 m
Ainley
CONSULTING ENGINEERS PLANNERS
Town of Erin
Urban Centre Wastewater Servicing
Erin - Decision Areas
Appendix A
DATE: NOV 2016
PROJECT # 115157


8TH LINE
ORANGEVILLE STREET
Hillsburgh Town Core 2
Hillsburgh Town Core 1
BARBOUR DRIVE
MILL STREET
HOWE STREET
HILL STREET
QUEEN STREET
CHURCH STREET
ANNE STREET
SPRUCE STREET
TRAFALGAR ROAD
South Trafalgar Road
WELLINGTON 22 ROAD
GEORGE STREET
George Street
UPPER CANADA DRIVE
LEADER COURT
Upper Canada Drive
SIDE
Legend
Study Area
Roads
Erin-Hillsburgh Lots
Decision Areas
0
250
500
750
1000 m
Ainley
CONSULTING ENGINEERS PLANNERS
Town of Erin
Urban Centre Wastewater Servicing
Hillsburgh - Decision Areas
Appendix A
DATE: NOV 2016
PROJECT # 115157

Appendix - B

Hutchinson Environmental

Water Quality Memo

Memorandum

Date: **October 20, 2016**

To: **Gary Scott, Ainley Group**

From: **Deborah Sinclair, Neil Hutchinson and Tara Roumeliotis**

Re: **J160005 – Recommended Downstream TP Target for West Credit River at Winston Churchill Blvd.**

The Town of Erin (Town) is currently completing a Schedule C Class EA for a proposed Waste Water Treatment Plant (WWTP) to service the existing population and proposed new growth in Erin and Hillsburgh. The proposed phasing of the plant will eventually accommodate Full Build Out of the Town's official plan with additional capacity for growth. Ainley Group (consultants for the Town) requested that Hutchinson Environmental Sciences Ltd (HESL) recommend a downstream water quality target for Total Phosphorus (TP) for the West Credit River at Winston Churchill Blvd. as input to determining the effluent flow and treatment limits for the proposed WWTP.

The Ontario Ministry of the Environment and Climate Change (MOECC) provides guidance on the management of surface water and groundwater quality and quantity for the Province of Ontario. They have established a Provincial Water Quality Objective (PWQO) of 0.03 mg/L for Ontario rivers and Policy 1 for management of surface water quality which states *"In areas which have water quality better than the PWQO, water quality shall be maintained at or above the objectives. Although some lowering of water quality is permissible in these areas, degradation below the Provincial Water Quality Objectives will not be allowed …"*.

This memo provides information and a rationale to support a permissible lowering of water quality in the West Credit River from discharge of treated municipal waste water from the proposed Erin WWTP.

TP Concentrations in West Credit River at 10th Line and Winston Churchill Blvd.

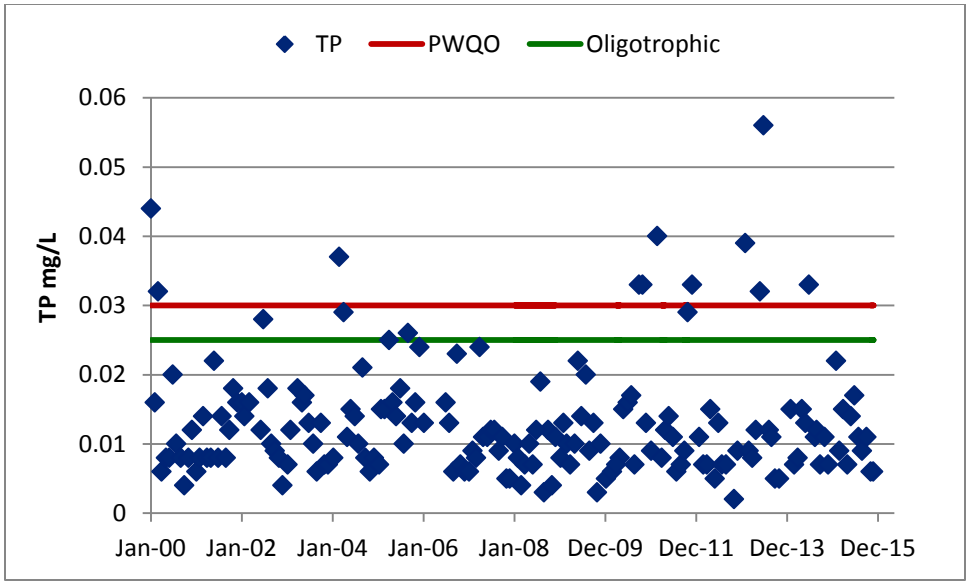
Total phosphorus (TP) concentrations in the West Credit River have been monitored as part of the Ministry of the Environment and Climate Change's (MOECC) Provincial Water Quality Monitoring Network (PWQMN) at Winston Churchill Boulevard since 1975 (station 6007601502). The median (2005 - 2015) and 75th percentile TP concentrations (0.011 mg/L and 0.015 mg/L) are well below the Provincial Water

Quality Objective[1] (PWQO) of 0.03 mg/L. Concentrations are stable; with no apparent increasing or decreasing trend over time (Figure 1).

TP measurements were also collected from the West Credit River upstream of Winston Churchill at 10th Line by Credit Valley Conservation (CVC) in 2007 and 2008 (CVC 2011) and by HESL in 2016 (unpublished data). The median and 75th percentile TP concentrations at 10th Line were also well below the PWQO at 0.014 mg/L and 0.016 mg/L, respectively (based on 15 measurements). The lower TP concentrations, and hence better water quality, at Winston Churchill is due to groundwater discharge to the river between the two stations (CVC 2011).

In 2016, HESL collected chlorophyll "*a*" samples from 10th Line on five occasions. Concentrations ranged from 0.598 µg/L to 3.91 µg/L, with a median of 2.63 µg/L.

Figure 1 Total Phosphorus concentrations measured (2000-2015) in the West Credit River at Winston Churchill Blvd. (PWQMN station 6007601502)



Trophic Status of West Credit River and Implications

Total phosphorus is the key limiting nutrient in plant and algal growth in freshwater systems. Increases in total phosphorus concentrations often results in increased algal biomass (e.g. Dodds et al., 1997). Phosphorus concentrations are therefore commonly used to classify lakes and rivers according to their nutrient ("trophic") status[2] (e.g. oligotrophic, mesotrophic, and eutrophic). Generally oligotrophic systems have low nutrients, low algal biomass, high water clarity, and can support a cold-water fishery. Eutrophic

[1] *The PWQO are numerical and narrative criteria that serve as chemical and physical indicators representing a satisfactory level for surface waters (i.e. lakes and rivers) and where it discharges to the surface, the groundwater of the province of Ontario. The PWQO are set at a level of water quality, which is protective of all forms of aquatic life and all aspects of the aquatic life cycles during indefinite exposure to the water (MOEC 1994a).*

[2] *Trophic status – the availability of growth limiting nutrients (Smith et al. 1999) such as total phosphorus or nitrogen.*

systems are nutrient enriched (high nutrient concentrations), have high algal biomass, can have frequent algal blooms, and wide swings in dissolved oxygen (with potential for conditions of no oxygen (anoxia)). Mesotrophic systems have intermediate characteristics (Dodds et al., 1998).

The trophic status classification of the West Credit River between the 10th Line and Winston Churchill Blvd. is oligotrophic using the spot TP data from 10th Line, the long-term PWQMN data and the recent chlorophyll "*a*" data from 10th Line. The oligotrophic classification is based on a trophic status system developed for temperate streams by Dodds et al. (1998; Table 1).

Table 1 Trophic classification boundaries for streams (based on Dodds et al., 1998)

Trophic Level	TP (mg/L)	Suspended Chlorophyll *a* (µg/L)
Oligotrophic	<0.025	<10
Mesotrophic	0.025-0.075	10-30
Eutrophic	>0.075	>30

The West Credit River discharges to the Credit River downstream of Belfountain. The median and 75th percentile (2005-2014) TP concentrations of the Credit River downstream of Belfountain, at Highway 10 (PWQMN station 06007605202) are 0.031 mg/L and 0.052 mg/L respectively; above the PWQO of 0.03 mg/L.

The MOECC provides guidance on the management of surface water and groundwater quality and quantity for the Province of Ontario. In their document: *Policies, Guidelines and Provincial Water Quality Objectives of the Ministry of Environment and Energy (MOE 1994a)* two policies relate to the protection of water quality:

> Policy 1 – *In areas which have water quality better than the PWQO, water quality shall be maintained at or above the objectives. Although some lowering of water quality is permissible in these areas, degradation below the Provincial Water Quality Objectives will not be allowed …"*
>
> Policy 2 - Water quality which presently does not meet the PWQO shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the objectives.

The West Credit River at Erin is therefore managed under MOECC Policy 1 which allows some degradation of water quality, but flows into the main trunk of the river downstream of Belfountain which is managed under Policy 2 such that no additional degradation is allowed and remediation measures are encouraged. The discharge of effluent from the proposed Erin WWTP must not, therefore, contribute to any additional degradation of the main Credit River downstream.

For the purposes of the Schedule C Class EA, the MOECC stated (Paul Odom, October 3, 2016 Core Management Team Meeting) that the MOECC Policies are guidance statements, and that the Town of Erin may not increase the TP concentration in the West Credit River beyond the PWQO of 0.03 mg/L.

They did note, however, that if the Town of Erin discharge were to increase total phosphorus concentrations in the river to 0.03 mg/L that there would be no remaining assimilation capacity to accommodate other dischargers on this reach of the river or downstream, such as industrial dischargers or other municipalities, or to accommodate stormwater runoff. We note that the MOECC guidance does not encourage dischargers to discharge up to the PWQO, but states "… *some lowering of water quality is permissible in these areas…".* Therefore, MOECC suggested that the study team recommend a downstream objective and rationale for total phosphorus for consideration by MOECC. The downstream objective, because it differs from the MOECC generic PWQO of 0.03 mg/L, would be considered a Site Specific Water Quality Objective (CCME 2003).

The PWQO of 0.03 mg/L represents a two-fold increase over the current 75th percentile TP (0.015 mg/L) concentration and a change in trophic status from oligotrophic to mesotrophic in the West Credit River between 10th Line and Winston Churchill Boulevard. CVC has designated the West Credit River downstream of 10th Line as a cold-water aquatic community due to the presence of brook trout. The most productive brook trout spawning reaches and the best brook trout populations in the West Credit River are located downstream of Erin Village (CVC 2011) and the longest contiguous brook trout habitat in the Credit River watershed is the West Credit River between Erin and Belfountain. The effect of doubling the TP concentration, thus changing the trophic status of the river, on brook trout and other aquatic life in the West Credit River is not well understood but detrimental changes would include increased growth of algae attached to bottom substrate (periphyton) which impairs habitat for fish spawning and benthic invertebrates and increased dissolved oxygen concentrations during the day and decreased concentrations at night in response to increased algal respiration which would stress aquatic life. A cautionary approach to establishing a target downstream TP concentration for the purposes of defining the flow and treatment limits is therefore recommended to protect aquatic life.

The following sections review available guidance to develop a downstream phosphorus objective for the West Credit River that will protect the cold water fishery. We then recommend an effluent TP limit that will meet the objective in the river at the projected effluent flows.

Environment Canada Framework for Managing Phosphorus

Environment Canada (2004) has developed a guidance framework for managing phosphorus concentrations in fresh water systems that is consistent with Canada Council of Ministers of the Environment (CCME) guideline development principles, but permits site-specific management of phosphorus. It was published as part of their *Ecosystem Health: Science-based Solutions* series which is dedicated to the dissemination of information and tools for monitoring, assessing and reporting on ecosystem health to support Canadians in making sound decisions (Environment Canada 2004). The guidance recommends a trigger approach to setting and establishing thresholds for TP concentrations. The framework steps include:

- Set ecosystem goals and objectives (enhance, protect, or restore)
- Define reference/baseline conditions
- Select trigger ranges
- Determine current TP concentrations
- Compare current concentrations and concentrations predicted from an undertaking to the trigger range

- Compare current concentrations and concentrations predicted from an undertaking to the baseline

In this case, the goal is to protect the sensitive brook trout population and maintain a healthy diverse aquatic system, while servicing existing development in Erin Village and Hillsburgh and allowing for new growth in the Town. The reference/baseline conditions in the river are well understood, and in this case represent the current concentrations of total phosphorus, which have not shown any increasing/decreasing trend in the last 15 years.

The Canadian Council of Ministers of the Environment (CCME 2003, p.15) provides the following guidance on setting Site Specific Water Quality Objectives (SSWQOs):

> *Two distinct strategies are commonly used to establish WQOs in Canada, including the antidegradation strategy and the use protection strategy. For water bodies with aquatic resources of national or regional significance, the WQOs are established to avoid degradation of existing water quality. For other water bodies, the WQOs are established to protect the designated uses of the aquatic ecosystem. As long as the designated water uses are protected, some degradation of existing water quality may be acceptable in these water bodies, provided that all reasonable and preventative measures are taken to protect water quality conditions.*

The brook trout population in the West Credit River is of regional significance and the West Credit River is the only portion of the Credit River sustaining Policy 1 oligotrophic waters. Therefore the Site Specific Water Quality Objective should be focused on "antidegradation" to maintain the oligotrophic status of the river.

CCME (2003) identifies four methods for developing a SSWQO; the background concentration procedure, recalculation procedure, water effect ratio procedure, and the resident species procedure. The "background concentration procedure" is appropriate for the West Credit River. *"In the background concentration procedure, the natural background concentrations of a contaminant in water …are determined and these levels are used to define acceptable water quality conditions at the site under consideration. Its use is based on the premise that surface water systems with superior water quality (i.e., relative to the Canadian WQGs) should not be degraded. This approach has been used most commonly to define WQOs for relatively pristine water bodies, including several river systems in Canada (e.g., Dunn 1989; MacDonald and Smith 1990). It has also been used in somewhat contaminated water bodies, such as Burrard Inlet (Nijman and Swain 1989)."* (CCME 2003, p. 19). We used three approaches to define the background concentration and resultant SSWQO for the West Credit River.

Although the natural background concentrations of total phosphorus in the West Credit River are not known, current concentrations are low and exceptional for Southern Ontario and are a reasonable approximation of natural background levels. The background concentration procedure uses the upper limit of the natural background concentration of a contaminant to define acceptable water quality conditions (CCME 2003). In this case the "natural" background concentration is the current stable TP concentration of the receiver, prior to the input from the WWTP. The two examples provided to determine the upper limit are the mean concentration plus two standard deviations and the 90th percentile concentration. For the West Credit River at Winston Churchill Blvd. these values are 0.030 mg/L (mean = 0.012 mg/L, standard deviation = 0.009 mg/L) and 0.024 mg/L respectively. Since the data are highly variable (2 x standard deviation is greater than the mean) this approach is not protective of water quality.

Using the 90th percentile approach to establish the upper limit of the background concentration of 0.024 mg/L is recommended, and recognizes the oligotrophic nature of the receiver.

Therefore, use of the background concentration procedure for derivation of the SSWQO will define the natural background concentration of the West Credit River as the 75th percentile total phosphorus concentration (=0.016 mg/L) with the upper limit defined by the 90th percentile concentration of 0.024 mg/L.

A trigger range is defined as a "desired concentration range for phosphorus; if the upper limit of the range is exceeded, that indicates ***a potential*** environmental problem, and therefore **"triggers" further investigation**. The internationally-accepted Organization for Economic Co-operation and Development (OECD) trophic status values are the recommended trigger ranges (Table 2) for Canadian lakes and rivers (CCME 2004). These trophic values were originally established for lakes and reservoirs (Environment Canada 2004), which is why they differ slightly than those presented in Table 1. Rivers can, however, sustain higher loads of TP than lakes before any observable changes in community composition and biomass (Smith et al. 1999): TP is flushed through the system before it can be taken up and utilized by aquatic plants. Therefore, the United States Environmental Protection Agency (USEPA) has adopted trophic classification for rivers based on the Dodds et al. values (Table 1), which are higher than the OECD values.

Table 2 Recommended trigger ranges for Canadian Lakes and Rivers (CCME 2004)

Trophic Status	TP concentration (µg/L)
Ultra-oligotrophic	< 4
Oligotrophic	4-10
Mesotrophic	10-20
Meso-eutrophic	20-35
Eutrophic	35-100
Hyper-eutrophic	>100

We recommend using the Dodds et al (1998) trigger ranges as they have specifically been established for rivers in temperate sites. The oligotrophic trophic range is <0.025 mg/L TP (Table 1); therefore a downstream concentration over 0.024 mg/L TP would indicate a potential shift to mesotrophic classification and trigger further investigation.

In addition to the trigger ranges, the Environment Canada guidance also recommends comparing predicted concentrations to baseline conditions, and notes that *"up to a 50% increase in phosphorus concentrations above the baseline level is deemed acceptable"…"If a 50% increase from baseline is not observed, then there is considered a low risk of adverse effects….if the increase is greater than 50%, the risk of observable effects is considered to be high and further assessment is recommended*" (Environment Canada 2004). We established a natural background 75th percentile concentration of 0.016 mg/L in the West Credit River at Erin. A 50% increase above this results in a trigger concentration of 0.024 mg/L.

Use of the Environment Canada guidance of a 50% increase above background supports a total phosphorus concentration of 0.024 mg/L as an upper range to protect the oligotrophic waters of the West Credit River.

We therefore recommend a value of 0.024 mg/L as the SSWQO for total phosphorus in the West Credit River.

Conclusions and Recommendations

We therefore recommend that a downstream SSWQO of 0.024 mg/L TP be adopted to protect the cold water habitat and water quality in the West Credit River, consistent with Environment Canada and CCME guidance. This will maintain the current trophic status of the river. A higher water quality objective is not recommended as the effect of changing the trophic status of the river on brook trout and other aquatic life in the West Credit River is not well understood at this time.

Water quality objectives are developed as guidelines and not as enforced regulatory standards. They are conservative, in that the best scientific information concludes that aquatic life will be protected at concentrations below the objective but this does not mean that the ecosystem will necessarily be impaired if concentrations increase above the objective. Therefore, Environment Canada (2004) states that, if total phosphorus concentrations increase to the SSWQO, the management response is investigation to determine if the changes have been harmful or if further increases can be sustained. This provides the opportunity for adaptive management of discharge from the proposed WWTP at Erin.

During Phase 1 of the WWTP, we recommend that the Town implement a receiver monitoring program for the West Credit River to determine the resultant phosphorus concentration in the river and assess any effects of increased TP loadings on water quality and aquatic communities (e.g. algal, benthos and fish). Effluent monitoring is also required to confirm that the lower effluent limits and objectives required to accommodate future growth can be met. The findings from these monitoring studies can:

a) inform a future application to rerate the Erin WWTP to accommodate a higher wastewater flow at a lower effluent TP concentration if monitoring shows that the plant can be operated at a lower effluent limit,

b) inform a decision to maintain the downstream West Credit River TP objective at 0.024 mg/L at Full Build Out or if it can be relaxed to 0.027 mg/L with no threat to aquatic life to accomodate either a higher population or a higher effluent limit.

Phosphorus Control for New Development

Wastewater discharge will not be the only source of total phosphorus to the West Credit River as the Town of Erin is serviced and grows. New development, infill and intensification of development will increase impervious services in Erin and Hillsburgh, leading to increased runoff of stormwater which will contain phosphorus and other pollutants. Growing recognition of non-point source pollution by urban runoff has lead to increased demands for management of stormwater quality, as well as quantity. New development in the Lake Simcoe and Nottawasaga River watersheds and in the City of Oakville, for

example, must set a target of “net zero” increase in phosphorus loading, such that the cumulative phosphorus loading from municipal wastewater effluent and stormwater runoff must not increase between the pre-development and post-development condition. Jennifer Dougherty, of Credit Valley Conservation stated that this was typically required for cases where the receiving waters were Policy 2 but that this would not be required for Erin[3]. Nevertheless, the sensitivity of the West Credit River at Erin may stimulate requests for phosphorus abatement from stormwater as Erin and Hillsburgh are built out.

Decommissioning of septic systems upon completion of the Erin WWTP will reduce one source of phosphorus (and nitrate) loading to the watershed. Development and redevelopment can reduce phosphorus loading in storm water through implementation of improved stormwater management (Best Management Practices) for older areas and Low Impact Development Techniques, particularly infiltration of runoff for new development. Infiltration techniques reduce surface runoff volume, remove particulates and suspended solids from runoff (including particulate phosphorus), encourage adsorption of phosphorus onto mineral surfaces in soils and cool the runoff, all of which will protect the cold water habitat in the West Credit River and help offset the discharge form the new WWTP.

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