Town of Erin
Urban Centre Wastewater Servicing
Class Environmental Assessment

Technical Memorandum
Two Treatment Plants Alternative
(One Hillsburgh and One Erin)

DRAFT

June 2017

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Two Treatment Plants Alternative
(One Hillsburgh and One Erin)

Project No. 115157

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The Town of Erin

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Executive Summary

Overview/Objectives

- This Technical Memorandum looks at the viability of a surface water discharge of treated effluent in Hillsburgh in support of a "Two-Plant Solution" for Hillsburgh and Erin.
- Based on the results of this review, the Technical Memorandum recommends whether to further study the two-plant solution or whether to proceed with the preferred alternative solution identified in the Servicing and Settlement Master Plan (SSMP)
- The review looks at available water quality data and river flow data to determine the viability of a surface water discharge in Hillsburgh and compares the cost of a two-plant solution with the single plant solution proposed in the SSMP

SSMP Approach to Establishing the Preferred Discharge Location

- The SSMP collected water quality data on the river from Hillsburgh through to south of Erin and based on this, recommended a preferred discharge south of Erin for the entire service area
- The preferred discharge location identified in the SSMP was supported by MOECC and CVC
- Subsequent to the SSMP, the current Class EA (UCWS EA) has established effluent limits and flows capable of supporting full build out of the urban areas at this location

Ability of the West Credit River to Assimilate Wastewater Effluent

- Based on this review, there is insufficient water quality data and insufficient river flow data available to support an assimilative capacity study to be able to define effluent limits and obtain MOECC/CVC approval for a discharge of treated effluent within the Hillsburgh area.
- No additional water quality or flow data has been collected for the West Credit River through Hillsburgh since the SSMP.
- Establishing whether river water quality can support a treated effluent discharge within Hillsburgh would require collection of additional data over several years
- Establishing a 7Q20 river flow, needed to determine whether the river through Hillsburgh could accept a discharge from the community, cannot be completed based on available data and would take several years of flow measurement to confirm viability and as much as 10 years to support an approval from MOECC/CVC. As such, it is not known whether the river can support full build out population for Hillsburgh or even the existing population.
- Collection of all required flow and quality data and completion of an assimilative capacity study for a surface water discharge in Hillsburgh would cost in excess of $500,000

Cost of Two Treatment Plants Compared to One Treatment Plant

- This Technical Memorandum also addresses the economic viability of using a two plant solution versus a one plant solution. Implementation plans were developed for both alternatives and the capital and operating costs were developed for each alternative on the basis of full build out of the communities and for each of the existing communities separately. The following has been established from this review:

- There is an industry focus on reduction of operational and compliance costs

- The Net Present Value of 50 year capital, operation and maintenance costs of the single plant solution is 32% cheaper for the full build-out scenario and 27% cheaper for the existing community scenario.

- The following represents the costs to full build out:

Inflation Adjusted Costs	One Plant	Two Plants
Capital Cost	$60,669,310	$98,348,076
Operation and Maintenance Costs	$75,113,136	$100,118,368
Total	$135,782,445	$198,466,444
Present Value Cost	**$70,497,472**	**$104,250,255**

- The following represents the costs to service just the existing community:

Inflation Adjusted Costs	One Plant	Two Plants
Capital Cost	$ 30,904,188	$42,910,949
Operation and Maintenance Costs	$31,707,382	$41,826,759
Total	$62,611,569	$84,737,708
Present Value Cost	**$36,810,320**	**$50,655,454**

- Even when the cost to convey the wastewater between Hillsburgh and the proposed WWTP site, is taken into account, the capital and operating costs of the two plant solution remains significantly more expensive than the single plant alternative.

- Subject to development of a cost sharing plan with developers, the full build out cost allocation to the existing community could substantially reduce the per capita cost to existing residents.

Conclusion and Recommendation

Based on the results of this review, it is recommended that the preferred alternative solution identified in the SSMP with a single treatment plant discharging to the West Credit River south of Erin Village, remain the preferred alternative.

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List of Abbreviations

ACS	-	Assimilative Capacity Study
CVC	-	Credit Valley Conservation
ECA	-	Environmental Compliance Approval
ECR	-	Existing Conditions Report
GTA	-	Greater Toronto Area
MOECC	-	Ministry of Environment and Climate Change
NPV	-	Net Present Value
PLC	-	Programmable Logic Controllers
PWQO	-	Provincial Water Quality Objectives
SCADA	-	Supervisory Control and Data Acquisition
SSMP	-	Servicing and Settlement Master Plan
UCWS EA	-	Urban Centre Wastewater Servicing Class EA
WSC	-	Water Survey of Canada
WWTP	-	Wastewater Treatment Plant

1.0 Introduction and Background

To date, the Erin Urban Centre Wastewater Servicing Class EA (UCWS EA) has proceeded with developing and evaluating alternative solutions for wastewater servicing of the urban areas of Erin Village and Hillsburgh based on a single treatment plant solution servicing both communities in keeping with the recommendations of the Servicing and Settlement Master Plan (SSMP) completed by BM. Ross in 2014 and the established terms of reference for the UCWS EA study. The preferred alternative solution established in the SSMP is to establish a municipal wastewater system for the study area; to collect all wastewater from the study area and to treat these flows and discharge treated effluent to the West Credit River. A review of available data on river water flows and quality established that the preferred discharge location for the treated effluent was between 10th Line and Winston Churchill Boulevard south of Erin Village. Having reviewed the discharge capabilities of the river throughout the study area based on available data and having established a preferred location for that discharge, a single treatment plant solution with a discharge at the preferred location, was identified as the preferred alternative solution.

An assimilative capacity study (ACS, BM Ross 2014) was completed for a discharge to the river within the preferred reach between 10th Line and Winston Churchill Boulevard and agreement was obtained for this solution from the Ministry of Environment and Climate Change (MOECC) and from Credit Valley Conservation (CVC). The terms of reference for the UCWS EA provided for a refinement of the ACS completed during the SSMP and this was completed during the initial phase of the UCWS EA and effluent criteria for the discharge are now accepted by MOECC and CVC. Although the ACS completed during the SSMP established effluent limits capable of treating wastewater flows from a population of 6,000 persons, the ACS completed during the UCWS EA, has established effluent limits capable of supporting a discharge from a population of 14,500 persons. This discharge would be capable of servicing all of the development lands identified in the present Town of Erin Official Plan.

In closing out Phase 2 activities, the UCWS EA has established servicing limits, system capacity and required effluent limits for the study area and the results are planned to be presented to the public in an upcoming Public Information Centre (PIC).

After the study team had developed the system capacity and effluent limits for a single surface water discharge, on March 2, 2017 Council requested the study team to address concerns expressed by members of the Public Liaison Committee that a solution based on decentralised treatment was being overlooked. To address this, the study team prepared a Technical Memorandum on the potential for Subsurface Disposal of treated effluent. This study was presented to Council on May 17, 2017 and concluded that the preferred solution established under the SSMP, was still valid. It is also noted that the Subsurface Disposal Technical Memorandum (Ainley May 2017) also looked at a two plant scenario for Hillsburgh and Erin (based on subsurface disposal) and concluded that it was more expensive than the single plant alternative.

At the May 2, 2017 Council Meeting, the following resolution was passed:

"Be it resolved that Council would like to determine why a two smaller sewage treatment plants option (one Hillsburgh and one Erin) has not been pursued; And that the Mayor direct our engineering consultants to put a short summary report on the potential feasibility of this option, requesting the MOECC (Ministry of Environment and Climate Change) and CVC (Credit Valley Conservation) to comment".

Based on this resolution, the intent of this Technical Memorandum is to review the alternative of a "two-plant solution" with separate surface water discharges and either, confirm selection of the preferred alternative solution established through the Servicing and Settlement Master Plan (SSMP) or to recommend further study of the two-plant approach with a surface water disposal alternative during Phase 3 of the UCWS EA."

1.1 Objectives of Technical Memorandum

The main objective of this technical memorandum is to review and establish the viability of collecting and treating wastewater in two separate systems for Hillsburgh and Erin Village with separate surface water discharges. As such, this technical memorandum:

- Provides an overview of the SSMP approach to identifying a discharge point for treated effluent to the West Credit River
- Summarises and re-presents the surface water quality and quantity information for the West Credit River through the study area gathered during the SSMP augmented with up to date available information on water quality and river flow.
- Outlines the activities required to conduct an Assimilative Capacity Study (ACS) for a discharge to the river in Hillsburgh.
- Identifies and compares conceptual level capital and operating costs for the single plant and two-plant solutions.

2.0 SSMP Approach to Establishing a Preferred Discharge Location

The SSMP provided a rationalisation for limiting surface water discharge to a location between 10th Line and Winston Churchill Boulevard in Erin Village. The surface water discharge limitation provided justification of the SSMP conclusions to establish a single wastewater treatment facility in Erin discharging to the West Credit River. The SSMP provides significant rationale for the single surface water discharge location and the decision was supported by the conclusions of the CVC "Environmental Component – Existing Conditions Report" which stated the following:

"The surface water quality in the upper portion of the study area [Hillsburgh] is fair in terms of impact to the health of aquatic biota. This lower ranking is the result of elevated levels of bacteria, total phosphorus, and nitrate-nitrogen. In addition, the West Credit River through Hillsburgh is a losing stream, thus reducing its assimilative capacity. In the mid-portions of the study area, the water quality ranking improves as downstream stations with significant groundwater discharge contribute to higher flows, which increase the streams ability to assimilate contaminant inputs. In the Villages of Hillsburgh and Erin, the influence of roads, septic systems and urban land use with higher population density is apparent because median concentration of total phosphorus, bacteria and nitrate are higher than in rural areas. Downstream of the Village of Erin, at 10th Line, the water quality improves once again as a result of significant groundwater discharge into the West Credit River. This indicates that

throughout this sub-watershed the quantity of groundwater discharges contribute significantly to improving the surface water quality."

The very clear conclusion of the SSMP was to establish a single plant with surface water discharge downstream of Erin Village and this was based on an evaluation of all available data on the river between Hillsburgh and Erin Village. In addition, work completed during this UCWS EA has established effluent limits for a surface water discharge between 10th Line and Winston Churchill that can support a population up to 14,500 from a single tertiary wastewater treatment plant. This single surface water discharge is a valid solution for both urban areas.

3.0 Surface Water discharge in Hillsburgh

3.1 Summary of Available Surface Water Quality Data

Surface water quality data was collected and presented in the "Phase 1 – Environmental Component – Existing Conditions Report" (ECR) completed in 2011, authored by the CVC, Aquafor Beech, and Blackport Hydrogeology. The data was gathered between 2007 and 2008 and covered a range of water quality indicators for chemical, microbiological and physical condition of the water and sediment in the West Credit River. Water quality information was collected from a series of locations along the West Credit River as well as from some tributaries. A map of the sampling locations is provided, see Figure 1.

Overall, water quality within the study area was determined to be fair-good based on the rankings of each station under the Water Quality Index scoring system. The primary parameters affecting the score of each station were total phosphorus, nitrate nitrogen and elevated bacterial levels. For the upper portions of the study area through Hillsburgh, water quality was fair in terms of the impact to the health of aquatic biota. A general trend of improving water quality exists through the mid-potions of the study area as significant groundwater discharge adds higher flows, increasing the streams ability to assimilate contaminants. The influence of urban land use is apparent; measurements at the sampling locations surrounding both of the urban areas show increases in total phosphorus, nitrate and bacterial concentrations.

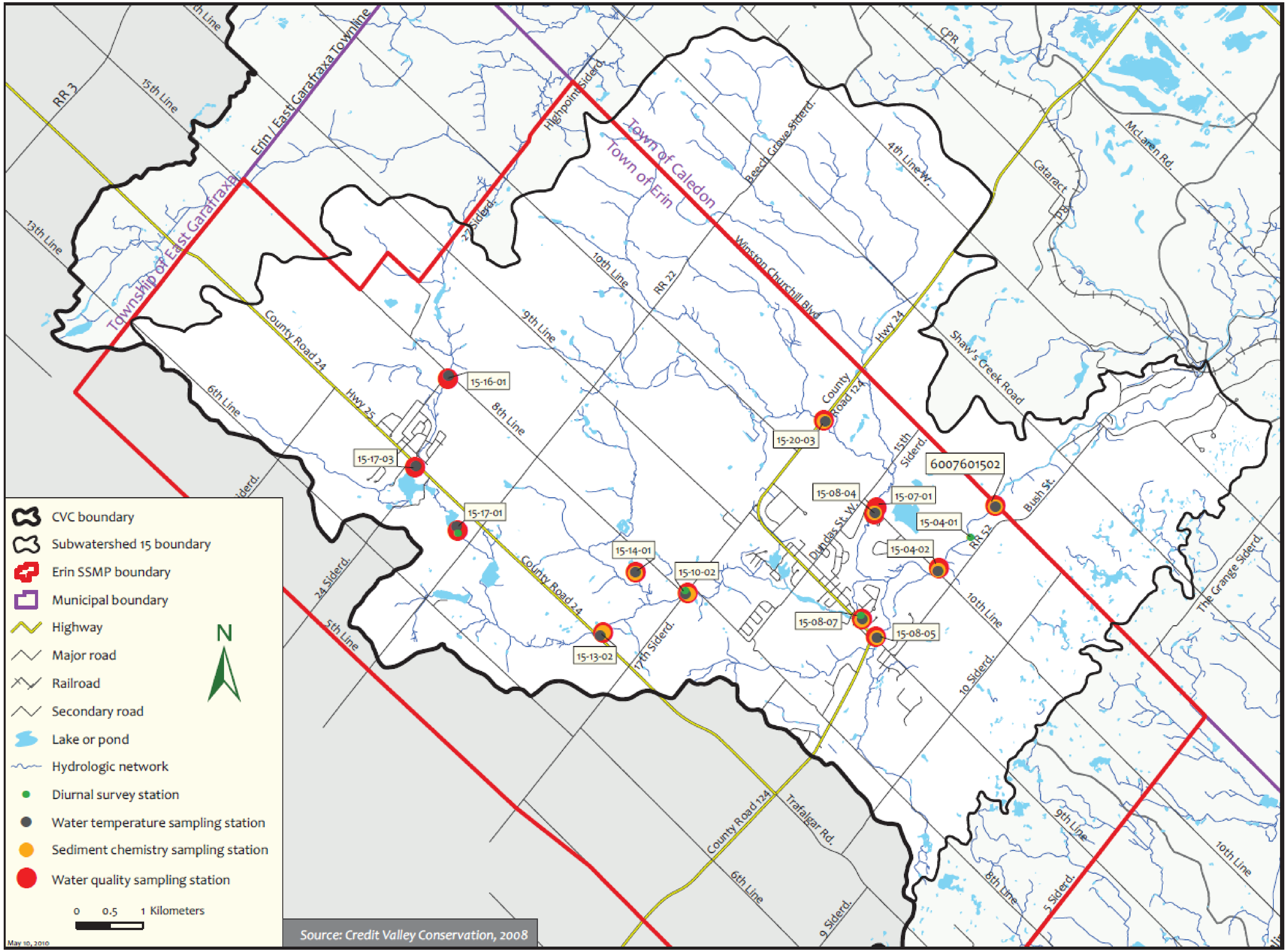

Figure 1 – Sampling Location Reference Map

The key parameters affecting the quality of treatment that will be required at the treatment facility and the volume of effluent that may be discharged to the receiver are, in this case, total phosphorus and nitrate-nitrogen. Discharge volumes are typically limited by available flow in the river (based on the 7Q20 flow statistic) and the capacity of the treatment facility to remove these nutrients from the wastewater before discharge to the river in order to keep the concentrations in the river below the provincial water quality objectives (PWQO). The PWQO limits are provided in Table 1.

Table 1 – PWQO Nutrient Limits of Concern

Nutrient Parameter	Limit (mg/L)
Total Phosphorus (MOECC 1994)	0.03
Nitrate-Nitrogen (CCME 2012)	3.0

A box-and-whisker plot of the total phosphorus data collected at each monitoring location is provided in Figure 2. For the purposes of comparison with the PWQO, the 75th percentile (upper quartile in Figure 3) value is used. Figure 3 is provided as a quick reference guide for understanding box-and-whisker plots.

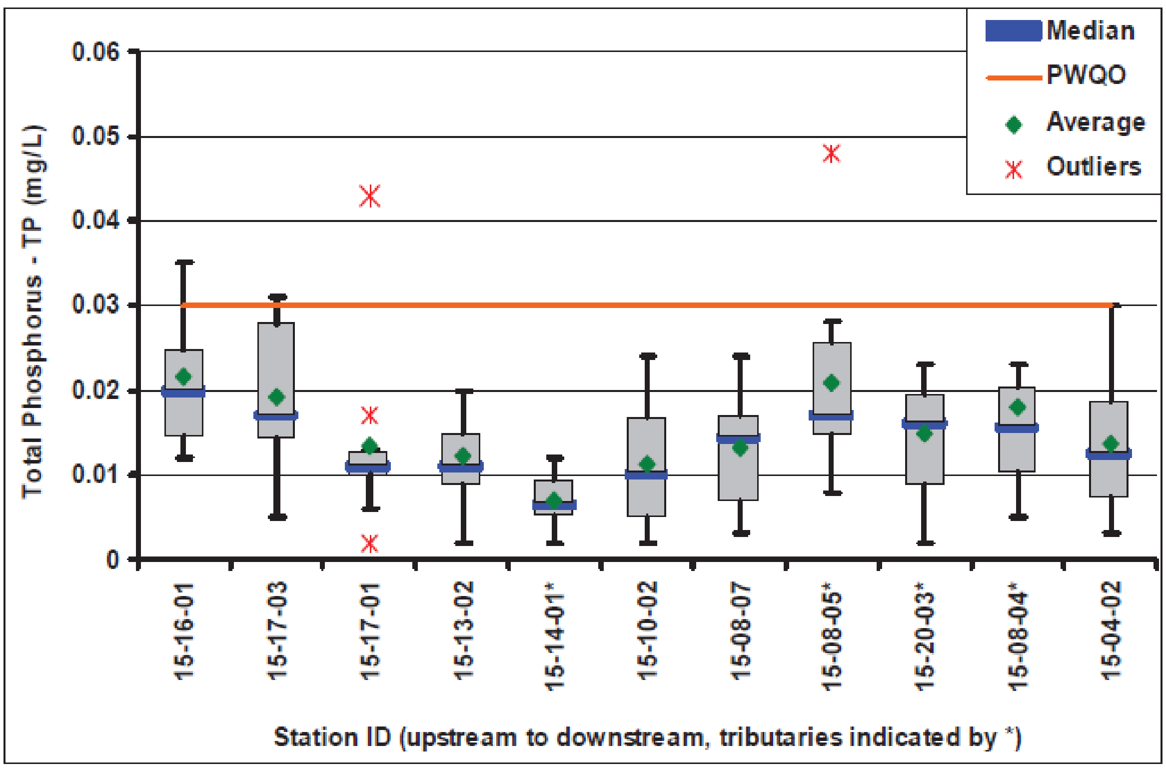

Figure 2 – Total Phosphorus Box-and-Whisker Plots (SSMP)

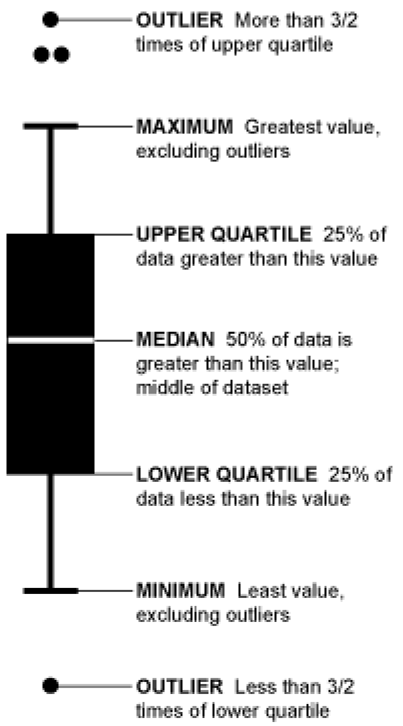

Figure 3 – Box-and-Whisker Plot Description

A box-and-whisker plot of the nitrate-nitrogen data collected at each monitoring location is provided in Figure 4.

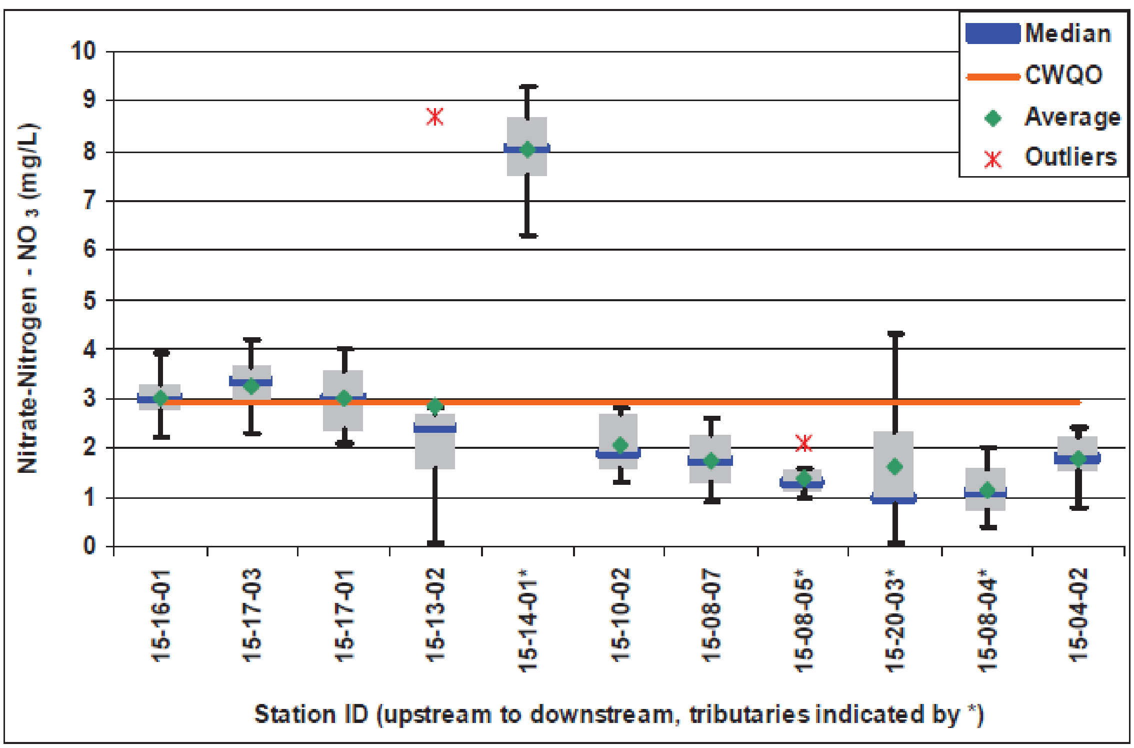

Figure 4 – Nitrate-Nitrogen Box-and-Whisker Plots (SSMP)

The station which is located closest to the planned discharge location in Erin Village is Station 15-04-02. This station is located at the intersection of the West Credit River and 10th Side Road and the following characteristics have been documented:

- 75th percentile total phosphorus concentration of 0.018 mg/L (ECR, 2007/08 data)
- Slight improvement of phosphorus levels over time, a 75th percentile phosphorus concentration of 0.016 mg/L (ACS Update, 2016 data)
- 75th percentile nitrate-nitrogen concentration of 2.3 mg/L (ECR, 2007/08 data)
- Slight improvement of nitrate-nitrogen levels over time, a 75th percentile nitrate-nitrogen concentration of 1.9 mg/L (ACS Update, 2016 data)
- 7Q20 flow rate of 225 L/s

Two monitoring locations exist at the south end of Hillsburgh. Based on the topography, the better discharge location would likely be between the two stations (15-17-03 and 15-17-01). The station closest to Hillsburgh is 15-17-03; this station has reduced water quality due to the proximity to the urban area, there is a general improvement of water quality downstream towards station 15-17-01. Based on the findings of the Existing Conditions Report (ECR):

- 75th percentile total phosphorus concentration of 0.028 mg/L at station 15-17-03.
- 75th percentile nitrate-nitrogen concentration of 3.6 mg/L at station 15-17-03.
- 75th percentile total phosphorus concentration of 0.013 mg/L at station 15-17-01.
- 75th percentile nitrate-nitrogen concentration of 3.5 mg/L at station 15-17-01.

While the total phosphorus concentrations measured show a significant improvement from station 15-17-03 to station 15-17-01, it should be noted that this is based on a limited dataset and there are significant outliers at the downstream station. Based on the tributary and impoundment network in the area it is not possible to reliably predict river water quality in the area. The nitrate-nitrogen concentrations remain relatively consistent from 15-17-03 to 15-17-01. The 75th percentile concentration of 3.5 mg/L exceeds the PWQO limits and would be a major limiting factor in obtaining approval for discharge at this location. The MOECC requires no further degradation of water quality in rivers and streams where water quality parameters have been exceeded.

There is insufficient site specific water quality data available to support an assimilative capacity study and to be able to define effluent limits and obtain MOECC approval for a discharge. Since completion of the SSMP, there is no additional water quality data available for the river through Hillsburgh. It is possible that the level of nitrates in the river would limit any approval for a discharge or require costly denitrification of the effluent to avoid any additional degradation of water quality.

3.2 River Flow Rate and 7Q20 Flow Data

A Water Survey of Canada (WSC) gauge located in the West Credit River at 8th Line provides a long-term (1983 - present) record of flow. Due to differences in geological conditions between the catchment area of this station and the WWTP study area (i.e., West Credit River between 10th Line and Winston Churchill Blvd.), flows from 8th Line could not be pro-rated for catchment size at 10th Line for the preliminary ACS (B.M.Ross 2014).

A flow gauging station was established at 10th Line in July 2013 by Credit Valley Conservation (CVC). Insufficient data had been collected from this station to determine a reliable 7Q20 low flow statistic; a minimum of 10 years of data is typically required. Flows measured at this gauge, however, were used by CVC to develop a flow transposition factor between the 8th Line and the 10th Line data. The preliminary ACS used 7Q20 flows for 10th Line as determined by CVC using a transposition factor based on stream flows collected from July to October 2013 at 10th Line. Additional flow data have been collected since the preliminary ACS to refine the transposition factor. In 2016, CVC recalculated the 7Q20 low flow statistic for 10th Line, using data from July 2013 to December 2015. The new 7Q20 flow statistic for 10th Line of 225 L/s includes a 10% reduction to account for potential effects of climate change.

Only minimal flow data is currently available for the span of river downstream of Hillsburgh. During the ECR a spot measurement of flow was taken in Hillsburgh at the same time as a measurement at 10th Line in Erin village. Based on the spot measurement, flow through Hillsburgh is approximately 26% of the flow at 10th Line, however, clearly there is insufficient data to be able to establish a 7Q20 flow that would be required to support approval for a discharge of treated wastewater effluent through Hillsburgh. It would take several years of flow data to support an assimilative capacity study for Hillsburgh and perhaps as much as 10 years before CVC and MOECC would be able to approve a discharge. CVC have indicated that they have no need or intent to establish a gauging station through Hillsburgh.

3.2.1 Conclusions on Discharge Potential to the West Credit River in Hillsburgh

There is insufficient water quality data and insufficient river flow data available to support an assimilative capacity study and to be able to define effluent limits and obtain MOECC/CVC approval for a discharge of treated effluent within the Hillsburgh area. It is possible that the level of nitrates in the river would limit any approval for a discharge.

No additional water quality or flow data has been collected for the West Credit River through Hillsburgh since the SSMP.

Establishing whether river water quality can support a treated effluent discharge within Hillsburgh would require collection of data over several years. Establishing a 7Q20 river flow that would be needed to determine whether the river could accept a discharge from the community, would take several years of flow measurement to even confirm viability and as much as 10 years to support an approval from MOECC/CVC. As such, it is not known whether the river can support full build out population for the community or even the existing population.

Since CVC have no plans to construct a gauging station to measure river flows in Hillsburgh, the cost of this station and the annual monitoring and analysis of all the flow and quality data over several years would become a cost to the ECWS Class EA. Once sufficient data had been collected, an assimilative capacity study could be undertaken. It is likely that the total cost of all data collection and the ACS will be in excess of $500,000.

4.0 Overview of Wastewater Collection and Treatment Planning

The planned wastewater system for the urban areas of Erin and Hillsburgh represents a small system and the overall area serviced will still be significantly smaller than the systems of many medium and large urban areas. The water and wastewater industry in Ontario is highly regulated to protect the health of its citizens and to protect the environment. In particular, effluent discharge limits are becoming stricter and the operational requirements for testing, monitoring and reporting to ensure compliance with MOECC Environmental Compliance Approvals (ECA) represent a significant operational cost for wastewater treatment plants. In many jurisdictions municipalities are looking to reduce the number of treatment plants in order to reduce operations cost. Decisions by municipalities over the last 20 years reflect the trend towards a lower number of larger treatment facilities in order to lower operational cost. The following are offered as a few examples:

- District of Muskoka is presently intending to eliminate one of its two Wastewater Treatment Plants in Huntsville, primarily to reduce operations cost.
- Clearview Township (Stayner) decided to pump its wastewater to Wasaga Beach rather than expand/upgrade its lagoon
- The Town of Tecumseth decided to pump its wastewater to Windsor rather than expand/upgrade their own plant
- York Region eliminated septic systems in King City and connected the wastewater system to the large York-Durham system rather than construct a smaller local treatment plant in King City
- The Town of Georgina decided to collect wastewater from all of the shoreline communities between Sutton and Keswick and pump all wastewater to the Keswick WWTP south of Keswick rather than build a more central treatment facility

Due to compliance issues and operational costs, the tendency is clearly towards elimination of smaller plants and to constructing larger systems which are less costly on a per capita basis.

5.0 Implementation Plan for Treatment Plant Alternatives

In order to compare the two-plant alternative with the single plant alternative, an implementation plan for each alternative was developed through to full build out of the growth areas identified in the system capacity technical memorandum. Cost scenarios for full build out and for each of the existing communities alone have been developed based on these implementation plans.

The final implementation plan will depend on many factors including:

- Revision and approval of the Town Official Plan to define growth;
- Limits for the urban areas; and
- Funding for the portion required to service the existing population.

The implementation plan used in this technical memorandum is purely for comparative analysis to illustrate cost differences between plant scenarios. Implementation phasing was developed with consideration of the following:

- The need to service the existing community in the first phase;
- The need to provide for a level of growth in the first phase; and
- Making best use of the scale effect where in larger capacity plants cost less on a per capita basis thus offsetting some cost for the existing communities.

For the purpose of evaluation, a two-phase approach was selected with allocation to growth in Phase 1 representing 33% of the overall treatment capacity. In addition to identifying full build out phasing, the analysis identifies the cost of a plant to service the existing community. The costing excludes the cost of treatment for septic wastes from rural communities in the town. It is assumed that this waste would be processed at only one plant.

It is noted that the implementation plan is significantly different from the scenario identified in the SSMP wherein the system was primarily aimed at servicing the existing community with a small growth allocation (up to a population of 6000). Based on work completed to date within this study, it is possible to service population greater than 14,500. In order to provide a meaningful comparison with the single plant solution developed as part of the UCWS EA, the implementation plans are for full build out to a service population of 14,500.

Within the discussion of alternatives it is assumed that all plants are designed to meet the effluent limits established under the assimilative capacity study undertaken as part of this project.

The alternatives considered are as follows:

- Alternative 1 – A single treatment facility for both communities with phased implementation
- Alternative 2 – Separate treatment facilities for each community with phased implementation

5.1 Alternative 1 – Single Plant Servicing Erin & Hillsburgh

Under Alternative 1, implementation is based on a two phase approach with a single plant designed for the population and flow capacities presented in Table 2.

Table 2 – Populations and Flows for Erin and Hillsburgh

Erin & Hillsburgh	Population	Capacity (m^3/d)
Existing Population	4,616	2,844
Growth	9,943	4,329
Total	14,559	7,173

The phasing plan is presented in Table 3. The table presents the plant size required to service the existing community in addition to a two-phase plant implementation plan with the capacity associated with each implementation phase.

Table 3 – Single Treatment Plant Phasing

Phase	Capacity (m^3/d)	Allocation to Existing	Allocation to Growth	Year Built
Existing Only	2,844	100%	Zero	2020-2022
Phase 1	4,300	66%	34%	2020-2022
Phase 2	2,873	Zero	100%	2028-2030

5.2 Alternative 2 – Two Plants Servicing Erin & Hillsburgh

Under Alternative 2, implementation is based on a two phase approach with separate treatment plants for Erin and Hillsburgh. Under this scenario, the population and flow capacities for Erin are presented in Table 4.

Table 4 – Populations and Flows for Erin

Erin	Population	Capacity (m^3/d)
Existing Population	3,225	2,244
Growth	5,340	2,523
Total	8,565	4,767

The phasing strategy is presented in Table 5. The table presents the plant size required to service the existing community in addition to a two-phase plant implementation plan with the capacity associated with each implementation phase.

Table 5 – Independent Treatment for Erin, Plant Phasing

Phase	Capacity (m^3/d)	Allocation to Existing	Allocation to Growth	Year Built
Existing Only	3,244	100%	Zero	2020-2022
Phase 1	3,400	66%	34%	2020-2022
Phase 2	1,367	Zero	100%	2028-2030

The population and flow capacities for Hillsburgh are presented in Table 6.

Table 6 - Populations and Flows for Hillsburgh

Hillsburgh	Population	Capacity (m^3/d)
Existing Population	1,391	599
Growth	4,603	1,806
Total	5,994	2,405

The phasing strategy is presented in Table 7. The table presents the plant size required to service the existing community in addition to a two-phase plant implementation plan with the capacity associated with each implementation phase.

Table 7 - Independent Treatment for Hillsburgh, Plant Phasing

Phase	Capacity (m^3/d)	Allocation to Existing	Allocation to Growth	Year Built
Existing Only	599	100%	Zero	2020-2022
Phase 1	900	66%	34%	2020-2022
Phase 2	1,505	Zero	100%	2028-2030

6.0 Cost Implications for a two Treatment Plant Solution

6.1 Capital Costs

The capital cost of the process components at each facility proposed was developed based on the cost estimation curve presented in Figure 5. Costing curves were originally developed for individual wastewater treatment processes as part of a Ministry of Infrastructure study (Water and Wastewater Asset Cost Study, Ministry of Public Infrastructure Renewal R J Burnside and Associates). The combined curve presented in Figure 5 was developed for full tertiary treatment process components and was supplemented with additional construction cost information for facilities constructed in Ontario over the past 10 years. Additional costs for individual facilities were included in the NPV calculation for land purchase, site works and operations buildings.

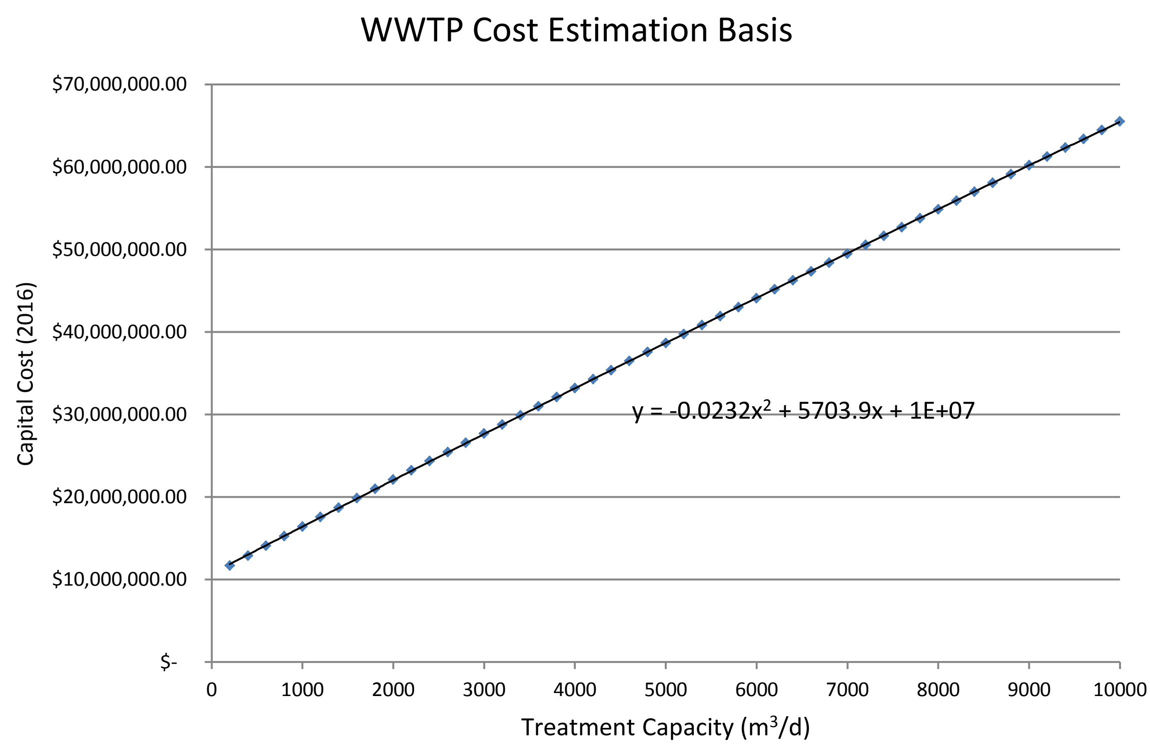

Figure 5 – Cost Basis for Process Aspects of Wastewater Treatment

6.2 Operation and Maintenance Costs

The cost of operating Municipal Wastewater Treatment Plants varies widely depending on the type of treatment, size and number of facilities operated by the particular municipality. Small communities with facultative lagoon type treatment represent low cost treatment and this approach has been used for many small communities throughout Ontario. However, as regulations change and these communities experience the need for growth, these lower cost systems are being replaced by more complex treatment plants needed to meet stricter discharge criteria. For example the Village of Havelock recently replaced their lagoon at a cost of $8.7 million resulting in a substantial increase in treatment cost.

Generally, the larger GTA Municipalities and Cities, such as City of Hamilton, City of Waterloo, City of Ottawa etc. have the lowest operating cost per cubic metre processed. Other larger municipalities with multiple facilities such as District of Muskoka, Township of Springwater and Kawartha Lakes for example, have operating costs of 1.7 to 1.8 times larger than Region/City plants. Smaller communities with advanced treatment plants have even higher operating costs.

In preparing this technical memorandum, we have reviewed the operations budgets of a number of municipalities. Based on this and discussion with operating authorities, we have compared operating cost components for both a single treatment plant and two treatment plants. Costs are expressed in terms of $/m^3 of installed plant capacity per day.

6.2.1 Personnel Costs

A comparison was conducted between the Phase 1 Single Plant and Phase 1 Two Plants. Discussions were held with operating authorities regarding personnel costs. For the single plant, three staff will be required on a part time basis for a total of 2,100 hours, while two plants would require around 3,700 hours of operation and maintenance per year. Typically more time is required for operation of the collection system than the treatment system and staff can be integrated to some degree, however, it is likely that two treatment plants would require a higher number of staff overall. Based on our assessment of the hours required to operate these plant alternatives, we anticipate that the personnel cost would be 70% more for two plants, versus one plant.

Translating this to the operating cost of similar plants gives a cost of $0.12/m^3 of installed capacity per day for a single plant versus $0.20/m^3 for two plants.

6.2.2 Power / Chemicals / Consumables

Two Plants would require duplication of building space for administration functions and larger overall building space for electrical, mechanical equipment and maintenance facilities. Power costs associated with lighting and heating for the larger space will be increased for two plants. Two plants will also require a higher number of process trains requiring a larger number of pumps, process equipment and control equipment and this will increase the overall power consumption. Chemicals used in wastewater are typically used in proportion to flow and so total chemical use for two plants should be similar to the one plant solution. Other consumables such as water, cleaning materials and transportation etc. will be significantly higher for the two plant scenario. Overall, our analysis indicates that two plants would cost some 20% more for power, chemicals and consumables.

Translating this to the operation cost of similar plants gives a cost of $0.25/m^3 of installed capacity per day for a single plant versus $0.30/m^3 of installed capacity for two plants.

Compliance with the MOECC ECA requires on-going monitoring of flows and water quality collected through instrumentation and automatic sampling devices. All of this work would be doubled for two plants versus one plant. Annual reporting and plant administration would also be doubled for two plants versus one plant.

6.2.3 Plant Maintenance

Although each of the two plants will have a smaller capacity than the larger single plant and therefore smaller pumps, motors and process equipment, the actual number of pieces of equipment will be double in the two plant scenario. Again, while parts for smaller equipment will cost less, it is likely that equipment maintenance costs will still be higher for the two plant alternative.

Modern wastewater treatment plants use advanced automation systems to control many plant functions. The entire automation (SCADA) and instrumentation system would be doubled for two plants versus one plant and maintenance costs associated with instruments, controllers (PLC), computers, and control software will be double with the two plant scenario. Likewise, a great deal of the electrical systems including the motor control centres would be doubled in two plants, versus one plant again leading to increased maintenance. Overall, it is considered that maintenance costs will be 20% more for the two plant scenarios.

Translating this to the operation cost of similar plants gives a cost of \$0.10/m^3 of installed capacity per day for a single plant versus \$0.12/m^2 for two plants.

6.2.4 Operations Cost Summary

Based on the above analysis, the daily Operations and Maintenance Costs are summarized in the Table 8.

Table 8 – Cost of Operations for Wastewater Treatment

	\$ / m^3 of Installed Capacity per day	
Category	Single Plant	Two Plants
Personnel	\$ 0.12	\$ 0.20
Power / Chemicals / Consumables	\$ 0.25	\$ 0.30
Maintenance Materials	\$ 0.10	\$ 0.20
Total	\$ 0.47	\$ 0.62

It is therefore anticipated that two plants will be some 32% more expensive to operate and maintain as compared to a single plant.

6.3 Net Present Value (NPV) Assessment

Four NPV calculations were completed evaluating the Alternatives discussed in Section 4.0. The scenarios evaluated include:

- A single treatment plant with phased implementation to service the full build-out population
- Separate treatment plants for Erin and Hillsburgh to service the full build-out population
- A single treatment plant to service the existing population
- Separate treatment plants for Erin and Hillsburgh to service the existing population

The net present value calculations assumed a 1% yearly inflation rate and a 4% interest rate. A reduction in the spread between inflation and interest rate will increase the NPV difference. All of the costs presented are calculated to 2016 as the base year. The results of the NPV calculations are summarised in Table 9 and Table 10. The calculation sheets for each scenario are provided in ***Appendix A.***

Table 9 – Full Buildout Servicing, Cost Comparison of Alternatives

Inflation Adjusted Costs	One Plant	Two Plants
Capital Cost	$60,669,310	$98,348,076
Operation and Maintenance Costs	$75,113,136	$100,118,368
Total	$135,782,445	$198,466,444
Present Value Cost	**$70,497,472**	**$104,250,255**

Table 10 – Existing Community Servicing, Cost Comparison of Alternatives

Inflation Adjusted Costs	One Plant	Two Plants
Capital Cost	$ 30,904,188	$42,910,949
Operation and Maintenance Costs	$31,707,382	$41,826,759
Total	$62,611,569	$84,737,708
Present Value Cost	**$36,810,320**	**$50,655,454**

Based on the NPV calculations providing servicing utilising a single plant is a better solution from a capital and operational cost basis. Over the 50-year life calculated the single plant solution is 32% cheaper for the full build-out scenario and 27% cheaper for the existing community scenario.

It should further be noted that whereas the existing residents would pay the full $ 30.9 million for a single plant with no growth, they would be liable to pay approximately one third of the $ 60.7 million cost of the full build out plant to a population of 14,500 or $ 20.2 million, provided an implementation plan can be devised that equally apportions costs. Likewise the operational burden on the existing residents would also be reduced for a full build out population of 14,500.

The calculations for NPV did not take into account the cost of constructing a forcemain between Hillsburgh and Erin or the required oversizing of gravity sewers through Erin to accommodate pumped waste from Hillsburgh. The associated costs for the additional collection system requirements to support the single plant solution have been estimated to be as follows:

- Forcemain/sewer from Hillsburgh to Erin (Elora Cataract Trail – 4.7 km) - $3.75 million
- Increase in trunk sewer diameter through Erin (approx. 1.4 km) – $200,000
- Increased forcemain diameter to plant (approx. 2.25 km) - $250,000
- Increased SPS capacity at 2 sites - $1.00 million

Considering that the additional collection system costs of over $5.0 million to convey wastes to a single treatment plant does not offset the additional capital cost of constructing two plants and considering that the operational costs associated with two treatment plants is higher, the single plant solution remains superior in terms of economic feasibility.

7.0 Conclusions and Recommendations

The approach taken in the SSMP was to evaluate water flows and water quality based on available data and additional water quality data collected for the river from Hillsburgh through to south of Erin in an effort to identify the best possible use of the West Credit River as a discharge for treated effluent. Based on this evaluation a recommended preferred discharge location was identified south of Erin Village for the entire service area.

Additional work within this UCWS EA study has confirmed that the preferred discharge location and effluent limits and flows are capable of supporting full build out of the urban areas and this has been accepted by MOECC and CVC as a valid solution.

Based on this review, it is apparent that there is insufficient water quality data and insufficient river flow data available to support an assimilative capacity study to be able to define effluent limits and obtain MOECC/CVC approval for a discharge of treated effluent within the Hillsburgh area.

No additional water quality or flow data has been collected for the West Credit River through Hillsburgh since completion of the SSMP.

In order to establish whether river water quality could support a treated effluent discharge within Hillsburgh it would require collection of data over several years.

In order to establish a 7Q20 river flow to determine whether the river could accept a discharge from the community, it would take several years of flow measurement to even confirm viability and as much as 10 years to support an approval from MOECC/CVC.

As such, it is not known whether the river can support a discharge from the existing population or even the full build out population for the community. Completing an assimilative capacity study for a surface water discharge in Hillsburgh could cost in excess of $500,000 and could take up to 10 years to complete.

This Technical Memorandum also addresses the economic viability of using a two plant solution versus a one plant solution. Implementation plans were developed for both alternatives and the capital and operating costs were developed for each alternative on the basis of full build out of the communities and for the existing communities alone. The following has been established from this review:

- The industry trend is towards less and larger treatment plants in order to reduce operational and compliance costs
- The Net Present Value of 50 year capital, operation and maintenance costs of the single plant solution is 32% cheaper for the full build-out scenario and 27% cheaper for the existing community scenario.
- The following represents the costs to full build out:

Inflation Adjusted Costs	One Plant	Two Plants
Capital Cost	$60,669,310	$98,348,076
Operation and Maintenance Costs	$75,113,136	$100,118,368
Total	$135,782,445	$198,466,444
Present Value Cost	**$70,497,472**	**$104,250,255**

- The following represents the costs to service just the existing community:

Inflation Adjusted Costs	One Plant	Two Plants
Capital Cost	$ 30,904,188	$42,910,949
Operation and Maintenance Costs	$31,707,382	$41,826,759
Total	$62,611,569	$84,737,708
Present Value Cost	**$36,810,320**	**$50,655,454**

- Even when the cost to convey the wastewater between Hillsburgh and the proposed WWTP site, is taken into account, the capital and operating costs of the two plant solution remains significantly more expensive than the single plant alternative.

- Subject to development of a cost sharing plan with developers, the full build out cost allocation to the existing community could substantially reduce the per capita cost to existing residents.

Based on the results of this review it is recommended that the preferred alternative solution identified in the SSMP with a single treatment plant discharging to the West Credit River south of Erin village, remain the preferred alternative.

Appendix - A

Net Present Value Calculations

Erin Urban Centre Wastewater Servicing Class EA
Single Plant - Full Build Out

Discount Rate: 4%
Inflation Rate 1%

Asset Description	Phase 1 - Annual Value in Constant Year 2016 Dollars	Phase 2 - Annual Value in Constant Year 2016 Dollars	NPV Total	2019	2020	2021	2022	2023	2028	2029	2030	2031	2068	2069
1) Capital Cost														
Treatment Process Components				$ 1,000,000	$ 15,000,000	$ 15,000,000	$ 6,600,000		$ 1,000,000	$ 11,000,000	$ 1,000,000			
Operations Building / Site Works					$ 4,500,000									
Land Cost				$ 150,000										
Engineering				$ 30,000	$ 450,000	$ 450,000	$ 198,000		$ 30,000	$ 330,000	$ 30,000			
Current Year Sub-total				$ 1,180,000	$ 19,950,000	$ 15,450,000	$ 6,798,000	$ -	$ 1,030,000	$ 11,330,000	$ 1,030,000	$ -	$ -	$ -
Inflation Adjusted				$ 1,215,755	$ 20,760,050	$ 16,238,105	$ 7,216,214	$ -	$ 1,160,630	$ 12,894,597	$ 1,183,958	$ -	$ -	$ -
NPV			$ 47,028,990	$ 1,080,802	$ 17,745,778	$ 13,346,539	$ 5,703,079	$ -	$ 724,926	$ 7,744,161	$ 683,706	$ -	$ -	$ -
2) O&M Costs														
Personnel	$ 188,340	$ 315,360						$ 188,340	$ 188,340	$ 188,340	$ 315,360	$ 315,360	$ 315,360	$ 315,360
Power/ Chemicals / Consumables	$ 392,375	$ 657,000						$ 392,375	$ 392,375	$ 392,375	$ 657,000	$ 657,000	$ 657,000	$ 657,000
Equipment Maintenance	$ 156,950	$ 262,800						$ 156,950	$ 156,950	$ 156,950	$ 262,800	$ 262,800	$ 262,800	$ 262,800
Current Year Sub-total								$ 737,665	$ 737,665	$ 737,665	$ 1,235,160	$ 1,235,160	$ 1,235,160	$ 1,235,160
Inflation Adjusted								$ 790,877	$ 831,219	$ 839,532	$ 1,419,785	$ 1,433,982	$ 2,072,214	$ 2,092,936
NPV			$ 23,468,482					$ 601,001	$ 519,177	$ 504,201	$ 819,890	$ 796,240	$ 269,588	$ 261,812
Total Costs (Infrastructure and O&M Costs)			$ 105,162,255	$ 1,180,000	$ 19,950,000	$ 15,450,000	$ 6,798,000	$ 737,665	$ 1,767,665	$ 12,067,665	$ 2,265,160	$ 1,235,160	$ 1,235,160	$ 1,235,160
Inflation Adjusted			$ 125,522,943	$ 1,215,755	$ 20,760,050	$ 16,238,105	$ 7,216,214	$ 790,877	$ 1,991,849	$ 13,734,128	$ 2,603,743	$ 1,433,982	$ 2,072,214	$ 2,092,936
PV Costs (Infrastructure and O&M Costs)			**$ 70,497,472**	$ 1,080,802	$ 17,745,778	$ 13,346,539	$ 5,703,079	$ 601,001	$ 1,244,103	$ 8,248,362	$ 1,503,597	$ 796,240	$ 269,588	$ 261,812

Erin Urban Centre Wastewater Servicing Class EA

Two Plants - Full Build Out

Discount Rate: 4%

Inflation Rate 1%

Asset Description	Phase 1 - Annual Value in Constant Year 2016 Dollars	Phase 2 - Annual Value in Constant Year 2016 Dollars	NPV Total	2019	2020	2021	2022	2028	2029	2030	2031	2068	2069
1) Capital Cost													
Treatment Process Components - Erin				$ 1,000,000	$ 20,000,000	$ 8,900,000		$ 1,000,000	$ 16,700,000	$ 1,000,000			
Treatment Process Components - Hillsburgh				$ 1,000,000	$ 13,850,000	$ 1,000,000		$ 1,000,000	$ 17,300,000	$ 1,000,000			
Operations Building / Site Works - Erin					$ 2,600,000								
Operations Building / Site Works - Hillsburgh					$ 1,480,000								
Land Cost - Erin				$ 150,000									
Land Cost - Hillsburgh				$ 150,000									
Engineering				$ 60,000	$ 1,137,900	$ 297,000	$ -	$ 60,000	$ 1,020,000	$ 60,000	$ -	$ -	$ -
Current Year Sub-total				$ 2,360,000	$ 39,067,900	$ 10,197,000	$ -	$ 2,060,000	$ 35,020,000	$ 2,060,000	$ -	$ -	$ -
Inflation Adjusted				$ 2,431,510	$ 40,654,213	$ 10,717,149	$ -	$ 2,321,260	$ 39,856,027	$ 2,367,917	$ -	$ -	$ -
NPV			$ 72,475,473	$ 2,161,604	$ 34,751,392	$ 8,808,716	$ -	$ 1,449,852	$ 23,936,497	$ 1,367,413	$ -	$ -	$ -
2) O&M Costs													
Personnel	$ 313,900	$ 525,600					$ 313,900	$ 313,900	$ 313,900	$ 525,600	$ 525,600	$ 525,600	$ 525,600
Power/ Chemicals / Consumables	$ 470,850	$ 788,400					$ 470,850	$ 470,850	$ 470,850	$ 788,400	$ 788,400	$ 788,400	$ 788,400
Equipment Maintenance	$ 188,340	$ 315,360					$ 188,340	$ 188,340	$ 188,340	$ 315,360	$ 315,360	$ 315,360	$ 315,360
Current Year Sub-total							$ 973,090	$ 973,090	$ 973,090	$ 1,629,360	$ 1,629,360	$ 1,629,360	$ 1,629,360
Inflation Adjusted							$ 1,032,955	$ 1,096,502	$ 1,107,467	$ 1,872,907	$ 1,891,636	$ 2,733,559	$ 2,760,895
NPV			$ 31,774,782				$ 816,359	$ 684,872	$ 665,116	$ 1,081,557	$ 1,050,359	$ 355,627	$ 345,369
Total Costs (Infrastructure and O&M Costs)			$ 155,577,220	$ 2,360,000	$ 39,067,900	$ 10,197,000	$ 973,090	$ 3,033,090	$ 35,993,090	$ 3,689,360	$ 1,629,360	$ 1,629,360	$ 1,629,360
Inflation Adjusted			$ 184,932,633	$ 2,431,510	$ 40,654,213	$ 10,717,149	$ 1,032,955	$ 3,417,762	$ 40,963,494	$ 4,240,824	$ 1,891,636	$ 2,733,559	$ 2,760,895
PV Costs (Infrastructure and O&M Costs)			**$ 104,250,255**	$ 2,161,604	$ 34,751,392	$ 8,808,716	$ 816,359	$ 2,134,724	$ 24,601,613	$ 2,448,970	$ 1,050,359	$ 355,627	$ 345,369

Erin Urban Centre Wastewater Servicing Class EA

Single Plant - Existing Community

Discount Rate: **4%**

Inflation Rate **1%**

Asset Description	**Phase 1 - Annual Value** in Constant Year 2016 Dollars	NPV Total	2019	2020	2021	2022	2023	2024	2025	2048	2049	2066	2067	2068	2069
1) Capital Cost															
Treatment Process Components			$ 1,000,000	$ 15,900,000	$ 10,000,000										
Operations Building / Site Works				$ 1,750,000											
Land Cost			$ 150,000												
Engineering			$ 30,000	$ 477,000	$ 300,000	$ -									
Current Year Sub-total			$ 1,180,000	$ 18,127,000	$ 10,300,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Inflation Adjusted			$ 1,215,755	$ 18,863,029	$ 10,825,404	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
NPV		$ 26,102,691	$ 1,080,802	$ 16,124,196	$ 8,897,693	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2) O&M Costs															
Personnel	$ 124,567					$ 124,567	$ 124,567	$ 124,567	$ 124,567	$ 124,567	$ 124,567	$ 124,567	$ 124,567	$ 124,567	$ 124,567
Power/ Chemicals / Consumables	$ 259,515					$ 259,515	$ 259,515	$ 259,515	$ 259,515	$ 259,515	$ 259,515	$ 259,515	$ 259,515	$ 259,515	$ 259,515
Equipment Maintenance	$ 103,806					$ 103,806	$ 103,806	$ 103,806	$ 103,806	$ 103,806	$ 103,806	$ 103,806	$ 103,806	$ 103,806	$ 103,806
Current Year Sub-total						$ 487,888	$ 487,888	$ 487,888	$ 487,888	$ 487,888	$ 487,888	$ 487,888	$ 487,888	$ 487,888	$ 487,888
Inflation Adjusted						$ 517,903	$ 523,082	$ 528,313	$ 533,596	$ 670,817	$ 677,526	$ 802,396	$ 810,420	$ 818,525	$ 826,710
NPV		$ 10,707,629				$ 409,306	$ 397,499	$ 386,033	$ 374,898	$ 191,222	$ 185,706	$ 112,907	$ 109,650	$ 106,487	$ 103,416
Total Costs (Infrastructure and O&M Costs)		$ 50,586,193	$ 1,180,000	$ 18,127,000	$ 10,300,000	$ 487,888	$ 487,888	$ 487,888	$ 487,888	$ 487,888	$ 487,888	$ 487,888	$ 487,888	$ 487,888	$ 487,888
Inflation Adjusted		$ 58,559,066	$ 1,215,755	$ 18,863,029	$ 10,825,404	$ 517,903	$ 523,082	$ 528,313	$ 533,596	$ 670,817	$ 677,526	$ 802,396	$ 810,420	$ 818,525	$ 826,710
PV Costs (Infrastructure and O&M Costs)		**$ 36,810,320**	$ 1,080,802	$ 16,124,196	$ 8,897,693	$ 409,306	$ 397,499	$ 386,033	$ 374,898	$ 191,222	$ 185,706	$ 112,907	$ 109,650	$ 106,487	$ 103,416

Erin Urban Centre Wastewater Servicing Class EA
Two Plants - Existing Community

Discount Rate: **4%**
Inflation Rate **1%**

Asset Description	**Phase 1 - Annual Value** in Constant Year 2016 Dollars	**Phase 2 - Annual Value** in Constant Year 2016 Dollars	NPV Total	2019	2020	2021	2022	2023	2026	2037	2041	2042	2043	2044	2068	2069
1) Capital Cost																
Treatment Process Components - Erin				$ 1,000,000	$ 17,000,000	$ 5,500,000										
Treatment Process Components - Hillsburgh				$ 1,000,000	$ 12,100,000	$ 1,000,000										
Operations Building / Site Works - Erin					$ 1,400,000											
Operations Building / Site Works - Hillsburgh					$ 750,000											
Land Cost - Erin				$ 150,000												
Land Cost - Hillsburgh				$ 100,000												
Engineering				$ 60,000	$ 937,500	$ 195,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Current Year Sub-total				$ 2,310,000	$ 32,187,500	$ 6,695,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Inflation Adjusted				$ 2,379,995	$ 33,494,442	$ 7,036,512	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
NPV			$ 36,530,496	$ 2,115,807	$ 28,631,189	$ 5,783,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2) O&M Costs																
Personnel	$ 207,612	$ 525,600					$ 207,612	$ 207,612	$ 207,612	$ 207,612	$ 207,612	$ 207,612	$ 207,612	$ 207,612	$ 207,612	$ 207,612
Power/ Chemicals / Consumables	$ 311,418	$ 788,400					$ 311,418	$ 311,418	$ 311,418	$ 311,418	$ 311,418	$ 311,418	$ 311,418	$ 311,418	$ 311,418	$ 311,418
Equipment Maintenance	$ 124,567	$ 315,360					$ 124,567	$ 124,567	$ 124,567	$ 124,567	$ 124,567	$ 124,567	$ 124,567	$ 124,567	$ 124,567	$ 124,567
Current Year Sub-total							$ 643,597	$ 643,597	$ 643,597	$ 643,597	$ 643,597	$ 643,597	$ 643,597	$ 643,597	$ 643,597	$ 643,597
Inflation Adjusted							$ 683,191	$ 690,023	$ 710,932	$ 793,164	$ 825,370	$ 833,623	$ 841,960	$ 850,379	$ 1,079,756	$ 1,090,553
NPV			$ 14,124,957				$ 539,936	$ 524,361	$ 480,280	$ 348,067	$ 309,610	$ 300,679	$ 292,006	$ 283,582	$ 140,473	$ 136,421
Total Costs (Infrastructure and O&M Costs)			$ 68,867,180	$ 2,310,000	$ 32,187,500	$ 6,695,000	$ 643,597	$ 643,597	$ 643,597	$ 643,597	$ 643,597	$ 643,597	$ 643,597	$ 643,597	$ 643,597	$ 643,597
Inflation Adjusted			$ 79,391,853	$ 2,379,995	$ 33,494,442	$ 7,036,512	$ 683,191	$ 690,023	$ 710,932	$ 793,164	$ 825,370	$ 833,623	$ 841,960	$ 850,379	$ 1,079,756	$ 1,090,553
PV Costs (Infrastructure and O&M Costs)			**$ 50,655,454**	$ 2,115,807	$ 28,631,189	$ 5,783,500	$ 539,936	$ 524,361	$ 480,280	$ 348,067	$ 309,610	$ 300,679	$ 292,006	$ 283,582	$ 140,473	$ 136,421