Town of Erin
Urban Centre Wastewater Servicing
Class Environmental Assessment

Technical Memorandum
Subsurface Disposal Alternative
Final

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Urban Centre Wastewater Servicing Class Environmental Assessment

Technical Memorandum
Subsurface Disposal Alternative

Project No. 115157

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The Town of Erin

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Executive Summary

This technical memorandum examines subsurface disposal of treated effluent as an alternative to the preferred alternative established in the SSMP involving a surface water discharge to the West Credit River downstream of Erin Village. Whereas the SSMP identified a more detailed process to examine subsurface disposal, as a means to increase the serviced population, it did not consider subsurface disposal as a general alternative solution for the existing communities. This technical memorandum examines the alternative of subsurface disposal as a general alternative solution in order to confirm whether or not it represents a valid alternative for the communities of Erin and Hillsburgh.

Subsurface disposal of treated effluent from the existing and full build out of the communities would require design according to Ministry of Environment and Climate Change (MOECC) requirements for Large Subsurface Sewage Disposal Systems (LSSDS). This technical memorandum provides an overview of the MOECC design requirements for subsurface disposal. Based on these MOECC requirements, extensive field investigations would be required to confirm viability and design parameters. The scope of this technical memorandum is to determine whether there is merit in proceeding with these detailed field investigations.

LSSDS systems are used throughout Ontario and an overview is provided of similar subsurface disposal systems in order to provide a comparative analysis of system requirements. It is noted that most LSSDS systems developed in Ontario are associated with communities or facilities where the developer controls the lands needed for the disposal system.

This technical memorandum provides an overview of the likely effluent standards that a LSSDS would have to meet and also identifies the likely treatment systems that would need to be put in place to meet these standards. It is anticipated that the treatment facility required prior to subsurface discharge would involve a plant similar to a traditional secondary sewage treatment plant discharging to surface water. The facility design would be required to demonstrate that the suite of contaminants in the raw sewage and contaminant loadings would be treated to meet MOECC requirements. Effluent limits for nitrates would be anticipated to be no greater than 2.5 mg/L at the property boundary of the disposal field. Due to the volumes of wastewater proposed, it is expected that the dilution volumes would be greatly exceeded by the effluent thereby minimizing the natural attenuation potential. Further, it is expected that the sorption capacity of the tile bed would be expended over time allowing for contaminant breakthrough. As this is the case, it is believed that the plant would require the establishment of a denitrification system.

While LSSDS's are a common effluent management practice throughout rural Ontario, they are typically used for small single developments such as nursing homes, hotels, subdivisions, recreational parks and centres, industrial and commercial parks. Such applications typically have an Average Day Flow (ADF) in the range of 10-80 m^3/d, much less than the ADF anticipated for the communities of Erin or Hillsburgh. These systems are known to be sensitive to plugging from intermittent periods of high flow causing solids to enter the disposal beds resulting in potential effluent breakout at the surface. Design of treatment systems for LSSDS's need to be robust in order to protect against disposal field failure.

Based on a broad generalisation of groundwater quality within the study area, and an understanding of the existing "Reasonable Use" guidelines for effluent criteria, the key effluent quality requirements anticipated are listed in Table ES1:

Table ES1 - Potential Effluent Requirements Subsurface Disposal

Parameter	Concentration (mg/L)
BOD_5	10
TSS	10
NO_3-N	2.5

It is noted that the effluent requirements for surface water discharge are much more stringent for phosphorus concentration and somewhat less stringent for nitrate concentration. In effect, a plant discharging to the surface water will require advanced tertiary treatment for the removal of both phosphorus and nitrate. A plant discharging to the subsurface will require tertiary treatment to achieve the lower nitrate requirement while phosphorus limits can likely be achieved using secondary treatment processes.

Subsequent to the SSMP, this Class EA study (Assimilative Capacity Study) has confirmed that the preferred surface water discharge alternative identified in the SSMP can support full buildout of the existing community Official Plan. This is a significant finding of the study and is still subject to public comment. However, it is reasonable to assume that alternatives to the surface water discharge would also be evaluated on the same basis. For this reason the subsurface disposal approach to effluent management discussed in this Technical Memorandum, for both of the communities of Erin and Hillsburgh considers the full build out flows as noted in Table ES2.

Table ES2 - Projected Sewage Flow Rates

	Erin	Hillsburgh	Total
Existing Community	2,244.1 m^3/d	599.4 m^3/d	2,843.5 m^3/d
Growth Areas	2,523.0 m^3/d	1,805.7 m^3/d	4,328.7 m^3/d
Total	4,767.1 m^3/d	2,405.1 m^3/d	7,172.2 m^3/d

While overall alternative solutions should address the full build out flows, components of the solution could be based on subsurface disposal. In order to evaluate the range of potential solutions for subsurface disposal, three (3) alternative treatment and disposal strategies were considered:

- Alternative 1: Decentralised treatment and disposal systems servicing sewer decision areas established in the Septic System Survey technical memorandum.
- Alternative 2: Centralised treatment system with a series of disposal fields distributed to areas suitable for subsurface disposal based on the hydrogeological overview of the study area

- Alternative 3: Centralised treatment system for either Erin Village or Hillsburgh with a single disposal field suitable for subsurface disposal based on the hydrogeological overview of the study area

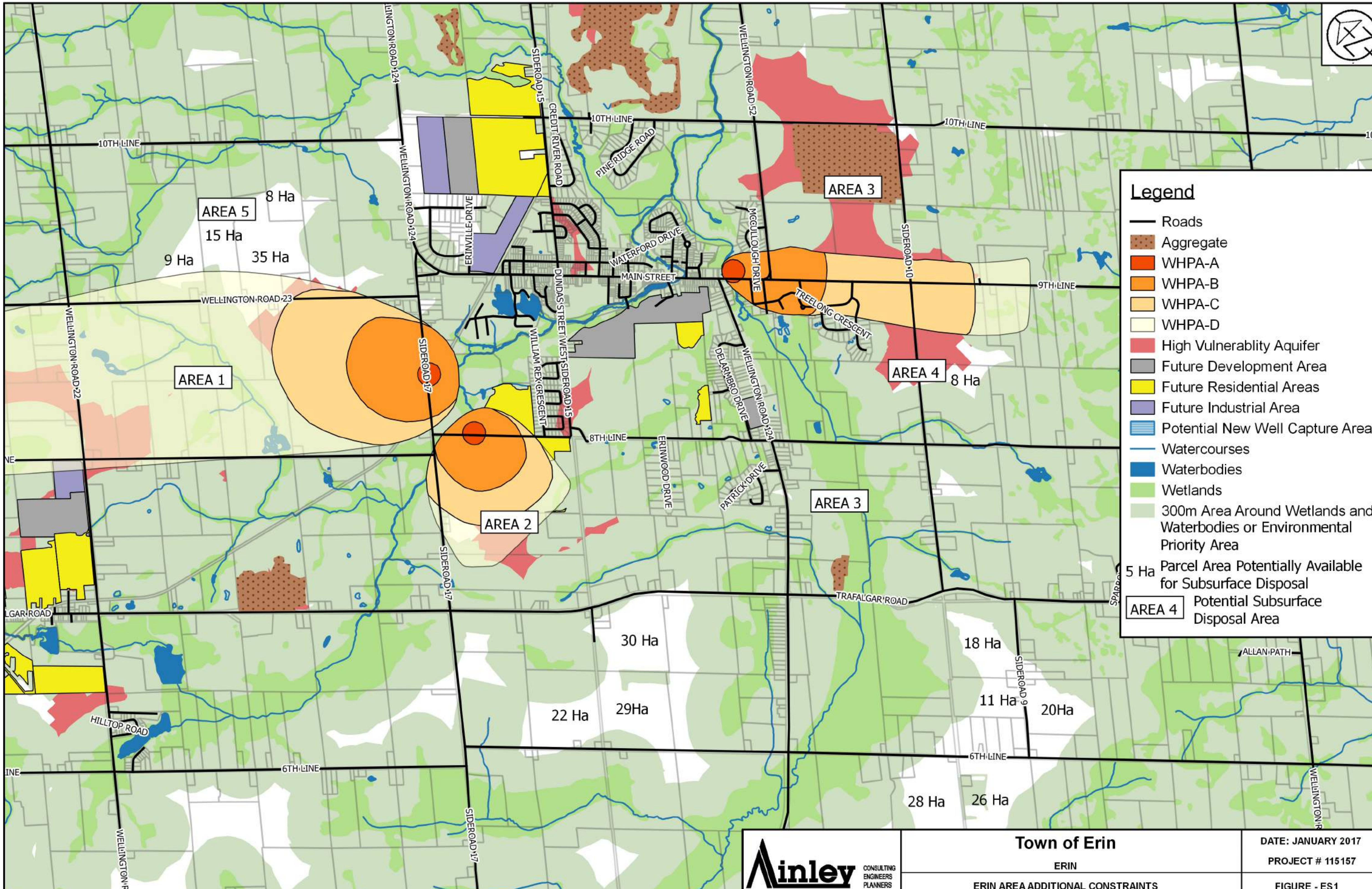
This technical memorandum provides an overview of the existing environmental constraints, within the Erin and Hillsburgh study areas with respect to developing LSSDS's for the communities. Based on these restraints, which require set-backs from existing surface waters and avoidance of sensitive aquifer conditions as well as interference with existing and potential future municipal wells, remaining areas potentially suitable for LSSDS's are identified. These are shown in Figure ES1 and Figure ES2. It is clear from this overview, that potential locations for subsurface disposal within the Erin and Hillsburgh areas is severely limited mostly due to the extensive pattern of surface water drainage and topography but also due to the potential impact on drinking water supplies. Well Head Protection Areas, areas with Highly Vulnerable Aquifers, and the required 300m buffer from surface water features have all been considered in establishing potential areas for subsurface disposal. Potential areas are identified and discussed in the technical memorandum.

While the exact requirements to obtain an ECA for a treatment system and LSSDS will depend on the local conditions of potential disposal sites, there are a number of requirements which will be imposed regardless of the site selected. The following treatment plant components are anticipated to be required regardless of the location selected for the LSSDS:

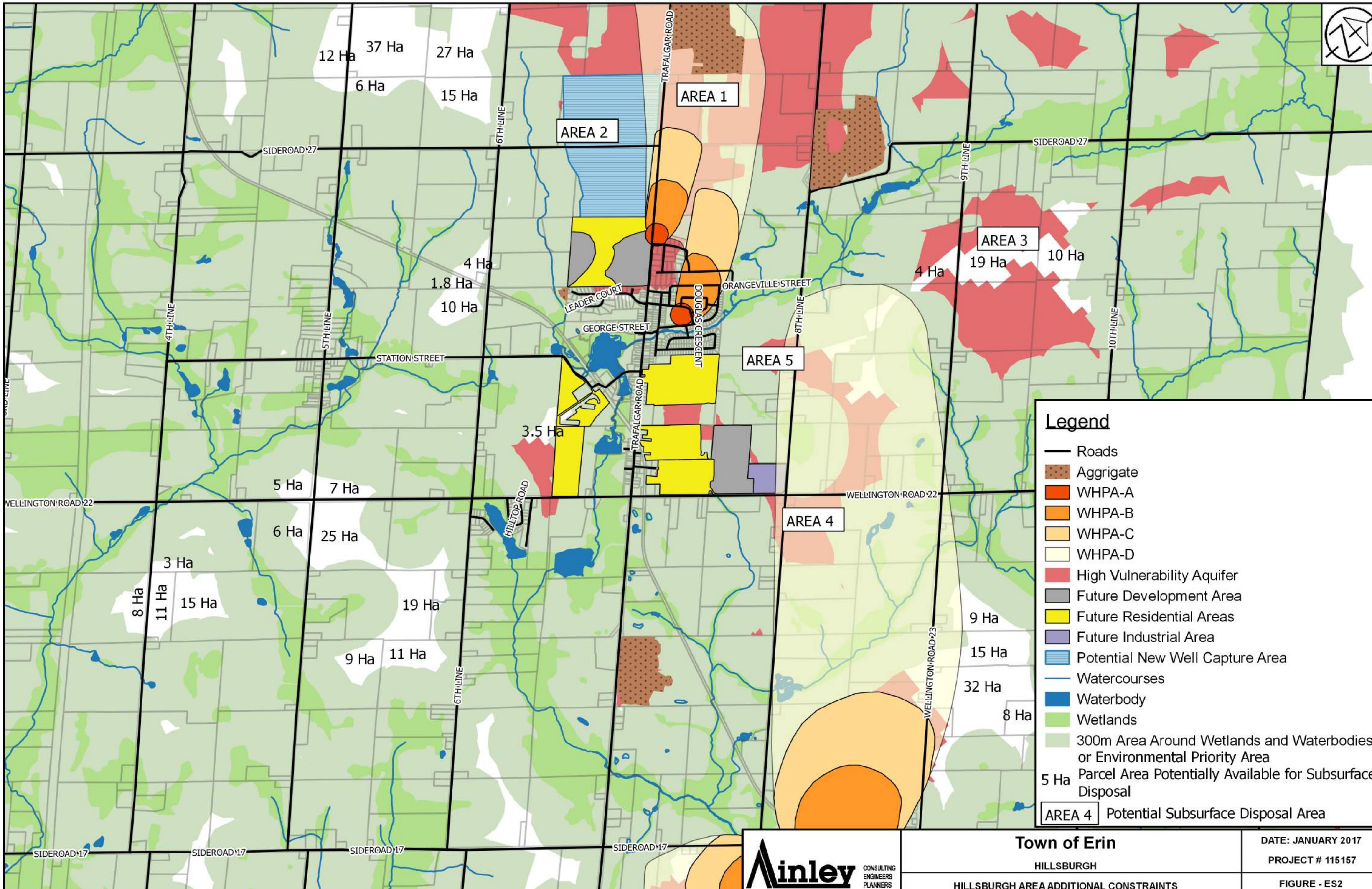
1. Preliminary Treatment (screening and grit removal)
2. Primary Treatment (sedimentation)
3. Secondary Treatment/Clarification
4. Denitrification
5. Biosolids Storage/ Management
6. Subsurface Disposal Field
7. Plant common facilities including standby power

Based on the potentially available disposal areas and review of alternatives for Erin Village, it is concluded that there is little opportunity around the village to support a multiple plant/multiple disposal bed solution. While there is likely the required 38.6 Ha available to support the single treatment plant and either multiple disposal fields or a single disposal field from lands further outside Erin, there is also little cost advantage in either of these alternatives and added risk associated with disposal bed failure. It is also considered that land purchase for the purpose of wastewater disposal could prove problematic based on present land use. A commitment to meet compliance limits downstream of the disposal fields before the effluent reaches surface water also represents a considerable risk for the Town. It is further noted that the vulnerability of the aquifers in the potential disposal areas around Erin represents further risk moving ahead with more detailed studies as potential disposal areas may ultimately prove to be non-viable. It is therefore concluded that subsurface disposal alternatives do not provide a viable alternative to surface water discharge for Erin Village.

Based on the potentially available disposal areas and review of alternatives for the community of Hillsburgh, it is concluded that there may be opportunity around the community to support a subsurface disposal solution. A review of the potential environmental restraints indicates that the required 19.5 Ha may be available to support disposal from either multiple disposal fields or a single disposal field. Based on this, a more detailed assessment was undertaken of the alternatives for Hillsburgh and the potential solutions were costed and compared to the preferred surface water alternative established in the SSMP.



Legend
Roads
Aggregate
WHPA-A
WHPA-B
WHPA-C
WHPA-D
High Vulnerablity Aquifer
Future Development Area
Future Residential Areas
Future Industrial Area
Potential New Well Capture Area
Watercourses
Waterbodies
Wetlands
300m Area Around Wetlands and Waterbodies or Environmental Priority Area
5 Ha Parcel Area Potentially Available for Subsurface Disposal
AREA 4 Potential Subsurface Disposal Area
AREA 1
AREA 2
AREA 3
AREA 4
AREA 5
8 Ha
15 Ha
9 Ha
35 Ha
30 Ha
22 Ha
29Ha
18 Ha
11 Ha
20Ha
28 Ha
26 Ha
10TH LINE
9TH LINE
8TH LINE
6TH LINE
MAIN STREET
WELLINGTON ROAD 23
WELLINGTON ROAD 22
WELLINGTON ROAD 124
WELLINGTON ROAD 52
SIDEROAD 17
SIDEROAD 15
SIDEROAD 10
SIDEROAD 9
TRAFALGAR ROAD
HILLTOP ROAD
ALLAN PATH
CREDIT RIVER ROAD
PINE RIDGE ROAD
WATERFORD DRIVE
ERINVILLE DRIVE
DUNDAS STREET WEST
WILLIAM REX CRESCENT
MCCULLOUGH DRIVE
TREELONG CRESCENT
DELARMBRO DRIVE
ERINWOOD DRIVE
PATRICK DRIVE
Ainley CONSULTING ENGINEERS PLANNERS
Town of Erin
ERIN
ERIN AREA ADDITIONAL CONSTRAINTS
DATE: JANUARY 2017
PROJECT # 115157
FIGURE - ES1


AREA 1
AREA 2
AREA 3
AREA 4
AREA 5
TRAFALGAR ROAD
SIDEROAD 27
SIDEROAD 17
6TH LINE
4TH LINE
5TH LINE
8TH LINE
9TH LINE
10TH LINE
STATION STREET
GEORGE STREET
LEADER COURT
ORANGEVILLE STREET
DOUGLAS CRESCENT
HILLTOP ROAD
WELLINGTON ROAD 22
WELLINGTON ROAD 23
12 Ha
37 Ha
27 Ha
6 Ha
15 Ha
4 Ha
1.8 Ha
10 Ha
3.5 Ha
5 Ha
7 Ha
6 Ha
25 Ha
3 Ha
8 Ha
11 Ha
15 Ha
19 Ha
9 Ha
11 Ha
4 Ha
19 Ha
10 Ha
9 Ha
15 Ha
32 Ha
8 Ha
Legend
Roads
Aggrigate
WHPA-A
WHPA-B
WHPA-C
WHPA-D
High Vulnerability Aquifer
Future Development Area
Future Residential Areas
Future Industrial Area
Potential New Well Capture Area
Watercourses
Waterbody
Wetlands
300m Area Around Wetlands and Waterbodies or Environmental Priority Area
5 Ha Parcel Area Potentially Available for Subsurface Disposal
AREA 4 Potential Subsurface Disposal Area
Ainley CONSULTING ENGINEERS PLANNERS
Town of Erin
HILLSBURGH
HILLSBURGH AREA ADDITIONAL CONSTRAINTS
DATE: JANUARY 2017
PROJECT # 115157
FIGURE - ES2

Based on the review of the costs to establish an LSSDS for Hillsburgh, it is concluded that it is likely to cost between 10-20% more in capital costs to service both communities to official plan build out based on a subsurface disposal alternative for Hillsburgh and a surface water alternative for Erin. In addition, the operation and maintenance of two treatment plants would add significantly to the lifecycle cost of this alternative.

Based on the findings of this technical memorandum the following is concluded:

1) Treatment and Disposal Regulations

- The requirements for both treatment and disposal for subsurface disposal systems in Ontario will require the Town to meet reasonable use guidelines at the property line and to demonstrate that the treatment process meets all MOECC design guidelines to ensure a robust and reliable system that meets all effluent requirements.
- While treatment processes for subsurface disposal are less stringent than for surface water, the treatment processes for subsurface disposal still require a high level of treatment
- Servicing Hillsburgh using subsurface disposal would represent one of the largest subsurface disposal systems in Ontario and this would require an extensive hydrogeological study to ensure that effluent limits can be maintained at the property limits
- MOECC will likely require the Town to secure sufficient lands for replacement of the disposal beds in event that they fail.
- Environmental approvals will also require an extensive monitoring program to verify ongoing compliance

2) Land Availability

- Available lands without environmental restraints likely do not exist to support a subsurface disposal alternative for Erin Village
- For Hillsburgh, the study has identified availability of lands with potentially no restraints in terms of subsurface disposal, however, confirmation of this is clearly subject to extensive additional study
- LSSDS systems are usually designed within developments wherein the developer/site owner actually owns the lands required for the LSSDS. Purchase of lands specifically for this purpose from a limited number of land owners, may prove to be problematic
- This overview study does not consider existing land use or the willingness of land owners to sell their lands.
- Purchase of necessary lands would be subject to agreement between the owners and the Town
- Developers may not be willing to purchase additional lands for wastewater disposal when a suitable and more cost effective alternative exists

3) Topography around Erin and Hillsburgh

- The extensive pattern of surface water drainage around the existing communities severely limits the availability of lands for subsurface disposal without impact to these surface waters
- The topography around Erin and Hillsburgh limits the availability of lands for subsurface disposal

4) Cost

- Based on the results of this technical memorandum it is unlikely that there is any cost advantage in developing a subsurface alternative for Hillsburgh

Based on this review, it is suggested that subsurface disposal of treated wastewater effluent for Erin Village is not viable. Also based on this review, it is suggested that subsurface disposal of treated wastewater effluent for the community of Hillsburgh offers no advantage over the preferred surface water discharge alternative established during the SSMP.

It is recommended that the results of this technical memorandum be incorporated into the public review process for Phase 2 of the Class EA with the recommendation that the Town moves forward with Phase 3 of the Class EA based on a single treatment plant discharging to the West Credit River downstream of Erin Village.

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1.0 Introduction

The purpose of this report is to examine the viability of a subsurface disposal alternative solution for the Erin Urban Centre Wastewater Servicing Class EA (UCWS EA) either servicing the entire study area using a single treatment plant or as multiple systems servicing components of the study area. The intent of the report is to either confirm selection of the preferred alternative solution established through the Servicing and Settlement Master Plan (SSMP) or to recommend further study of the subsurface disposal alternative during Phase 3 of the UCWS EA. The request to consider this alternative was made by members of the Public Liaison Committee (PLC) and by members of the community group Transition Erin who were concerned that the viability of treating wastewater at multiple smaller facilities was being overlooked.

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 conclusions of the SSMP to establish a single plant with surface water discharge downstream of Erin are supported by the findings of the CVC. 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 and if confirmed as the preferred alternative solution. Treatment alternatives will be established and evaluated during Phase 3 of the UCWS EA.

The viability of establishing subsurface disposal systems for the management of effluent will be further investigated in this technical memorandum as a Phase 2 activity of the Class EA process.

1.1 Subsurface Disposal Alternative

The SSMP did not review the viability of subsurface disposal as an alternative solution. However, due to the growth restrictions (population of 6,000) that were identified in the SSMP, resulting from the original West Credit River assimilative capacity assessment; subsurface disposal was identified as a possible means to increase the amount of growth possible for the two urban areas. The SSMP review of subsurface disposal is provided below:

"In order to provide a comprehensive review of all wastewater servicing options for the Town to consider, preliminary consideration was given to the possibility of a system that would discharge to the subsurface. It is generally agreed, by the various approval agencies, that a review of the feasibility of a subsurface discharge is site specific and will require detailed assessments at specific locations and cannot be completed in the broad based technical review of the SSMP. As such, this SSMP provides a description of the studies that would need to be completed to sufficiently review the feasibility of a subsurface discharge

Just as you would complete a preliminary Assimilative Capacity Study of a surface water body in order to demonstrate the feasibility of discharge of treated effluent to a surface water, it is necessary to demonstrate, in at least a preliminary manner, that the site has the proper characteristics to support the hydraulic loading of effluent and to identify whether there are any constraints to the operation of a subsurface system such as restrictive soil horizons, groundwater sensitive habitat or existing groundwater users whose wells cannot be jeopardized. This would include, but not be limited to, a detailed hydrogeological investigation including:

- *Assessment of soil permeability and infiltration rates in the receiving geologic unit, including whether there are any potential impedances to infiltration (e.g. low permeability layers).*
- *Determination of depth to the water table to ensure there is sufficient unsaturated zone to allow for water table mounding and dissipation of the infiltrating effluent.*
- *Assessment of the ability of the soils to treat (i.e. attenuate) contaminants of concern such as nitrate, phosphorous and BOD.*
- *Determination of the probable migration path of the sewage impacted aquifer systems.*
- *Identification of potential environmental receptors such as wetlands or cold water fisheries.*

After having demonstrated the viability of a particular site(s) due to suitable soils and lack of other constraints, it would also be necessary to undertake an assessment of impact on the water resources (both ground and surface) prepared following the guidance in section 22.5 of the Design Guidelines for Sewage Works, 2008, MOE and following the guidance in ministry Guideline B-7 which is more commonly referred to as the Reasonable Use Guideline. This particular assessment would include, but not be limited to the following:

- *A water resources impact assessment of to all sensitive users including drinking water and environmental receptors (e.g. the West Credit River and its tributaries) using applicable water quality guidelines.*
- *Determination of critical contaminants such as nitrate in groundwater and phosphorous and ammonia potentially discharging to surface water.*
- *Setting water quality limits in accordance with the Reasonable Use Guideline, which would include assessing existing and background water quality, and prediction of contaminant attenuation and dilution at the property boundary.*

- *Assessment of sewage effluent volumes.*
- *Assessment of effluent quality.*

The above assessment is better suited as part of a Schedule "C" Class EA in order to fully demonstrate feasibility and enable the subsequent consideration of different technologies. A long term environmental monitoring program might also be required to assess the effectiveness of the proposed groundwater aquifer contamination control measures."

Should subsurface disposal be established as a viable alternative solution, then the above-noted activities would need to be carried out during Phase 3 of the UCWS EA.

1.2 Objectives

The main objective of this technical memorandum is to review and establish the viability of treating wastewater and discharging treated effluent to subsurface disposal fields within the study area. The Ministry of Environment and Climate Change (MOECC) guidelines refer to these systems as "Large Subsurface Sewage Disposal Systems (LSSDS)". As such, this technical memorandum:

- Documents regulations and likely effluent standards for treatment and subsurface disposal
- Performs a hydrogeological/geotechnical overview of the study area based on existing knowledge, studies, etc. (no field work) to determine water table conditions, general flow direction, vulnerability of the underlying aquifers etc.
- Reviews available background water quality of local shallow groundwater to aid in determining potential treatment requirements
- Identifies opportunities for treatment and subsurface disposal for existing Erin and Hillsburgh communities and for growth areas
- Identifies potential service areas, treatment requirements and size of disposal fields for each decentralized system
- Identifies land requirements and environmental constraints (wetlands, surface waters, source water protection areas, areas of high aquifer vulnerability, etc.)
- Identifies conceptual level capital and operating costs for potentially viable subsurface disposal alternatives
- Determines whether any treatment/subsurface disposal opportunities represent viable and cost effective alternatives to surface water discharge
- Identifies scope, cost and time implications to include treatment/subsurface disposal alternatives in Phase 3 and 4 of the UCWS EA for any viable alternatives

2.0 Review of Legislation and Guidelines for Subsurface Disposal

An overview of practices for the design of Large Subsurface Sewage Disposal Systems (LSSDS) is presented in Chapter 22 of the Design Guidelines for Sewage Works published by the MOECC. The guidelines are applicable to systems exceeding 10 m^3/d. Systems with lower flow rates are under the jurisdiction of the *Building Code Act*. Most existing private sewage systems in the urban areas of Erin Village and Hillsburgh fall under the building code.

As outlined in the design guidelines, there is a significant amount of site investigation required for the establishment of a LSSDS. In order to obtain MOECC approval for a LSSDS the following investigations would be required to fully understand the site characteristics and ensure proper operation of the system:

1. Full hydrogeological, hydrological / surface water assessment
2. Reasonable Use Guideline assessment (MOECC Guideline B-7)
3. Groundwater / water well, surface water / aquatic life and microbiological risk assessments;
4. Water well survey within 2 to 5 km of site (radius may vary depending on specific geologic conditions etc.);
5. Integrated groundwater - surface water flow modelling;
6. Anticipated area of land required for beds (and therefore not available for other use);
7. Influent, effluent, groundwater and surface water monitoring plans, and performance criteria that would need to be met (MOECC Guideline B-7-1);
8. Contingency plans to address system failure;

It is anticipated that the treatment facility required prior to subsurface discharge would involve a plant similar to a traditional secondary sewage treatment plant discharging to surface water. The facility design would be required to demonstrate that the suite of contaminants in the raw sewage and contaminant loadings would be treated to meet MOECC requirements and to safely percolate the effluent into the disposal field. Engineering design would likely need to demonstrate effluent discharge requirements to the bed for nitrate, anticipated to be no greater than 2.5 mg/L to accommodate the size of the beds required, and meet reasonable use guidelines at the property boundary.

It should be noted that previous feedback from the MOECC and CVC has indicated that surface water discharge through Hillsburgh and Erin village was not a preferred option due to the high background phosphorus levels in the West Credit River in the area and the fact that, for this reach, the West Credit is a losing stream. Any subsurface disposal systems must therefore demonstrate that there will be no impact on the River or any surface waters through this area. The design guidelines state that, in most cases, a 300m separation is sufficient to ensure that there are no appreciable impacts on the surface water. However, due to the rolling topography of the study area, it is likely that the separation would need to be at least 300m. A key aspect of this technical memorandum will, therefore, be the establishment of available land for the LSSDS systems. Wastewater will need to be pumped from the collection systems to a suitable location for treatment and subsurface disposal.

Treated effluent requirements similar to those established for the surface water discharge proposed at 10th Line will be triggered unless it can be established that a proposed LSSDS does not influence surface water. CVC have also indicated that they would not support a discharge through Hillsburgh and Erin Village where there is influence on the West Credit River.

3.0 Review of Similar Systems in Ontario

Large subsurface disposal systems are a common effluent management practice throughout rural Ontario. Typically LSSDS are used for small single developments such as nursing homes, hotels, subdivisions, recreational parks and centres, industrial and commercial parks. Such applications are typically designed in concert with the individual development and the environmental reviews are completed by the developer/owner. Implementation of a proposed LSSDS system by the developer/owner typically means that the land required is already in the hands of the developer/owner. LSSDS are typically designed for an average day flow (ADF) of 10-80 m^3/d. Greater than 80 m^3/d would generally represent a large system for this approach to wastewater management.

Based on operational experience with LSSDS systems, one of the important design considerations is avoidance of "plugging" of the disposal beds wherein excessive solids build up in the bed eventually stops effective percolation resulting in effluent breakout at the surface. Subsurface disposal systems have been documented to plug even at average total suspended solids (TSS) values less than 10 mg/L. It is likely that plugging results from short term spikes in TSS values which deposit in the system over time and eventually cause failure. The design of an LSSDS therefore needs to account for plugging as an eventuality and provide a contingency measure for this type of failure. The simplest and most likely contingency measure would be the establishment of additional / reserve disposal beds. In addition, treatment systems must be robust and achieve effluent TSS levels less than 10 mg/L which is equivalent to a reasonably high level of secondary treatment.

As noted, within Ontario, an ADF of 80 m^3/d would represent a large system for a LSSDS. In comparing this scale to the UCWS EA study area, it is noted that the volume of effluent anticipated from just the existing Erin Village would need to accommodate an ADF of 2,244 m^3/d, while the existing community of Hillsburgh would need to accommodate an ADF of 599 m^3/d (assuming gravity sewers). At the typical size for a LSSDS, servicing the existing communities would likely require some 30 to 40 separate systems each with their own treatment systems and disposal fields and each requiring their own effluent limits and MOECC approval and ongoing operation, maintenance, monitoring and reporting.

3.1 Centre 2000 Review

In Erin Village, the Erin District High School and Erin Community Centre (Centre 2000) are currently serviced by a secondary sewage treatment system discharging to an LSSDS with a design ADF of 40 m^3/d. The system at Centre 2000 was upgraded in 2011 to a series of three Waterloo BioFilter units (trickling filter, denitrification trickling filter, polishing trickling filter). The effluent criteria for the system is outlined in the plant Environmental Compliance Approval (ECA # 5808-95HSF5) as described in Table 1. The effluent criteria must be met by the system prior to discharging to the tile beds.

Table 1 – Effluent Requirements for Centre 2000

Parameter	Concentration (mg/L)
$CBOD_5$	15
Suspended Solids	15
(Ammonia + Ammonium) Nitrogen	2 (summer), 3 (winter)
Nitrate Nitrogen	3.6
TKN	3 (summer), 4 (winter)

The effluent results from 2012-2015 at the Centre 2000 plant are provided in Table 2. As shown, the plant is able to maintain adequate effluent concentrations for most parameters, however, the average Nitrate concentration in the effluent is in exceedance of the ECA. The Nitrate levels in the effluent vary greatly with some samples measuring very high for Nitrate and other samples measured as low as 0.06 mg/L. Overall, over the 2012-2015 period, 49 of 104 samples measured in exceedance of the ECA for Nitrate. Based on the effluent data, the treatment efficacy for Nitrate with the existing system appears to correlate with sewage flow rates.

Table 2 – Effluent Characteristics 2012-2015

Year	ADF (m^3/d)	CBOD (mg/L)	TSS (mg/L)	TAN (mg/L)	NO3-N (mg/L)	TKN (mg/L)
2012	10.0	3	3	0.3	7.78	1.9
2013	8.9	10	4	0.4	6.08	1.6
2014	10.9	12	6	1.3	8.21	2.3
2015	9.9	10	4	0.5	3.75	1.1

The failure of the Centre 2000 to adequately treat Nitrate does not necessarily mean that all treatment processes will have difficulty meeting effluent requirements. However, for larger systems sized appropriately for multiple areas of the Erin-Hillsburgh service area, it would be imperative to ensure consistent compliance with effluent requirements and clearly a more robust and reliable treatment system would be required. Failure to meet effluent requirements would likely result in orders from the MOECC to enhance the treatment provided.

3.2 Island Lake Subdivision

The Island Lake subdivision is a 71 Hectare development in the Town of Mono, with 335 detached residential lots and may be considered a very large application for an LSSDS. To service the 335 lots, a treatment system discharging to an LSSDS was proposed. In 2014 an ECA was obtained for a 365 m^3/d system consisting of primary, secondary and, tertiary wastewater treatment. The system is also equipped with a 140 m^3 equalization tank to manage peak flows.

The treatment at the plant consists of a primary clarifier, a rotating biological contactor (RBC) for secondary treatment discharging to a final clarifier, and upflow continuous backwash sand filters for tertiary treatment. In order to meet the effluent limits, tertiary filters are used to reduce nitrate and phosphorus levels. Effluent limits for the system are described in Table 3.

Table 3 – Effluent Requirements for Island Lake Estates

Parameter	Concentration (mg/L)
$CBOD_5$	10
Suspended Solids	10
(Ammonia + Ammonium) Nitrogen	2.0
Nitrate Nitrogen	3.0
Total Phosphorus	0.25

The total length of distribution pipe required was calculated based using Equation 1 as provided in Section 8.7.3.1 of the Ontario Building Code (OBC):

Equation 1 – Length of Distribution Piping for LSSDS

$$L = \frac{Q * T}{300}$$

Where:
L = Total length of pipe required
Q = Design flow (L/d)
T = Percolation rate (min/cm)

Based on an extensive geotechnical investigation at the site which included a total of 51 test pits and 47 bore holes, it was concluded that the native soils at the site had percolation times (T-Times) which were too high for a functional tile bed. A series of boreholes within the tile bed area and down gradient from the tile bed were established as monitoring wells to allow for groundwater quality monitoring to ensure adequate attenuation is maintained. As a result of the percolation rates, a partially raised tile bed was selected and sand fill was specified for the site to achieve a percolation rate of 6min/cm. For a design flow rate of 335 m^3/d and a percolation rate of 6 min/cm, the total length of distribution pipe was calculated to be 6.7 km. To accommodate the proper spacing for the distribution chambers, spacing for piping to each leaching bed cell, a clay berm around the tile bed, and a mantle in the direction of shallow groundwater flow, the total area needed for the site was over 2.8 Ha.

It is believed that the all-in system cost, including investigations, engineering, treatment and the disposal bed, was $7 million to implement (excluding collection system sewers). This represents around $21,000 per lot for wastewater treatment and disposal alone. It should also be noted that this is a new development wherein the developer owned and controlled sufficient land area to complete the development and construct the disposal field.

4.0 Establishing Effluent Standards

The effluent requirements for LSSDSs' are determined through a review of the land where the system is proposed. The land is reviewed under the MOECC Guideline B-7 for Reasonable Use which provides a standard approach for the determination of "reasonable use" for the groundwater/soil in the vicinity of the site. The determination of reasonable use at a site is a Ministry decision and is based largely on three major considerations: the present use of groundwater in the vicinity, the potential use of groundwater in the vicinity, and the existing quality and quantity of the groundwater in the vicinity.

The reasonable use of the groundwater at a site is most often associated with the current use, however if no current use is established it is typically assumed that groundwater will be used for drinking water. The reasonable use determined for a site dictates the effluent requirements. In general, a LSSDS will be restricted to polluting the groundwater up to a limit of 25% of the health-related water quality objectives or up to 50% of non-health-related water quality objectives. Nitrates, for example, are a health-related water quality objective with a limit of 10 mg/L to ensure safe drinking water; in following the guidelines the maximum discharge concentration would be limited to 2.5 mg/L. Based on broad generalisation of groundwater quality within the Town, the key effluent quality requirements anticipated are listed in Table 4.

Table 4 – Potential Effluent Requirements Subsurface Disposal

Parameter	Concentration (mg/L)
BOD_5	10
TSS	10
NO_3-N	2.5

In contrast to the effluent requirements expected for the LSSDS, the effluent requirements for surface water disposal previously identified through the UCWS EA are listed in Table 5.

Table 5 – Potential Effluent Requirements Surface Disposal

Parameter	Concentration (mg/L)
BOD_5	7.5
TSS (mg/L)	10
Total Phosphorus (mg/L)	0.046
Total Ammonia (mg/L)	2.0
NO_3-N	6
TKN (mg/L)	3

Both discharge scenarios will require a form of tertiary treatment. The effluent requirements for surface water discharge are much more stringent for phosphorus concentration and somewhat less stringent for nitrate concentration. In effect, this will require a plant discharging to the surface water to have advanced tertiary treatment for the removal of both phosphorus and nitrate. A plant discharging to the subsurface will require tertiary treatment to achieve the lower nitrate requirement while phosphorus limits can likely be achieved using secondary treatment processes.

5.0 System Capacity Requirements

Should the Town proceed with an LSSDS for effluent management, the system capacity required for the existing communities of Erin and Hillsburgh are listed in Table 6. Also listed in the table are the projected flow rates for the growth areas in the Urban Areas which would also have to be managed.

Table 6 – Projected Sewage Flow Rates

	Erin	Hillsburgh	Total
Existing Community	2,244.1 m^3/d	599.4 m^3/d	2,843.5 m^3/d
Growth Areas	2,523.0 m^3/d	1,805.7 m^3/d	4,328.7 m^3/d
Total	4,767.1 m^3/d	2,405.1 m^3/d	7,172.2 m^3/d

The flow rates presented in Table 6 are the total projected average day flows for the study area as established in the recently completed system capacity assessment based on gravity collection systems.

Whereas the alternative solution for surface water discharge is based on a single treatment facility for the existing communities and all growth areas, the alternative for subsurface disposal can be based on a range of alternatives involving multiple treatment plants and disposal fields. In order to confirm viability of subsurface disposal, the following alternatives are considered for each of Erin Village and Hillsburgh:

- Alternative 1: Discrete treatment systems servicing sewer decision areas established in the Septic System Survey technical memorandum.
- Alternative 2A: centralised treatment system with a series of disposal fields distributed to areas suitable for subsurface disposal based on the hydrogeological overview of the study area
- Alternative 3A: centralised system with a single disposal field suitable for subsurface disposal based on the hydrogeological overview of the study area

Consideration for each approach will be explored in detail in Section 8.

6.0 Study Area Suitability for Subsurface Disposal

6.1 Overview

The approach taken to determine areas potentially suitable for subsurface disposal was to identify constraint areas for LSSDS wastewater disposal and remove these areas from further assessment. This was preformed through a "desktop" assessment, using information from existing studies and reports. Additional considerations were then factored for any remaining areas to determine if any sites would be potentially suitable (i.e. not determined to be unsuitable), which would require further assessment through site specific investigations, in particular geotechnical investigations. It is recognized that any potential site would likely be comprised of a number of privately owned parcels of land and no contact or agreements have been made with any property owners. Whether potentially suitable lands would be available for use has not been determined.

The determination of the suitability of an area for subsurface wastewater disposal was divided into three components:

- existing and future urban areas as per the current Official Plan
- natural environment constraint areas including topography, and
- hydrogeological constraint areas.

Existing and future urban development areas within the Hillsburgh and Erin urban boundaries were not assessed but were included as a constraint, given that is where development and growth will occur. Growth areas are shown in the constraints figures for Erin Village and Hillsburgh.

6.2 Environmental Constraint Areas

Environmental constraints are primarily related to natural heritage features with the majority of the information obtained from the data base at Credit Valley Conservation (CVC) and mapping provided by CVC. Areas determined to be unsuitable for large-scale subsurface wastewater disposal due to environmental constraints included the following:

- any wetland areas and surface water features
- a 300 metre buffer from wetland and surface water features, as previously discussed in Section 2, and
- any forested areas

Figure 1, provided in foldout, shows the wetlands, rivers and streams in Erin and the surrounding area as provided by the CVC. Figure 2, also in foldout, shows the 300m buffer zone from wetlands and watercourses in Erin Village.

Figure 3, provided in foldout, shows the wetlands, rivers and streams in Hillsburgh and the surrounding area as provided by the CVC. Figure 4, also in foldout, shows the 300m buffer zone from wetlands and watercourses in Hillsburgh.

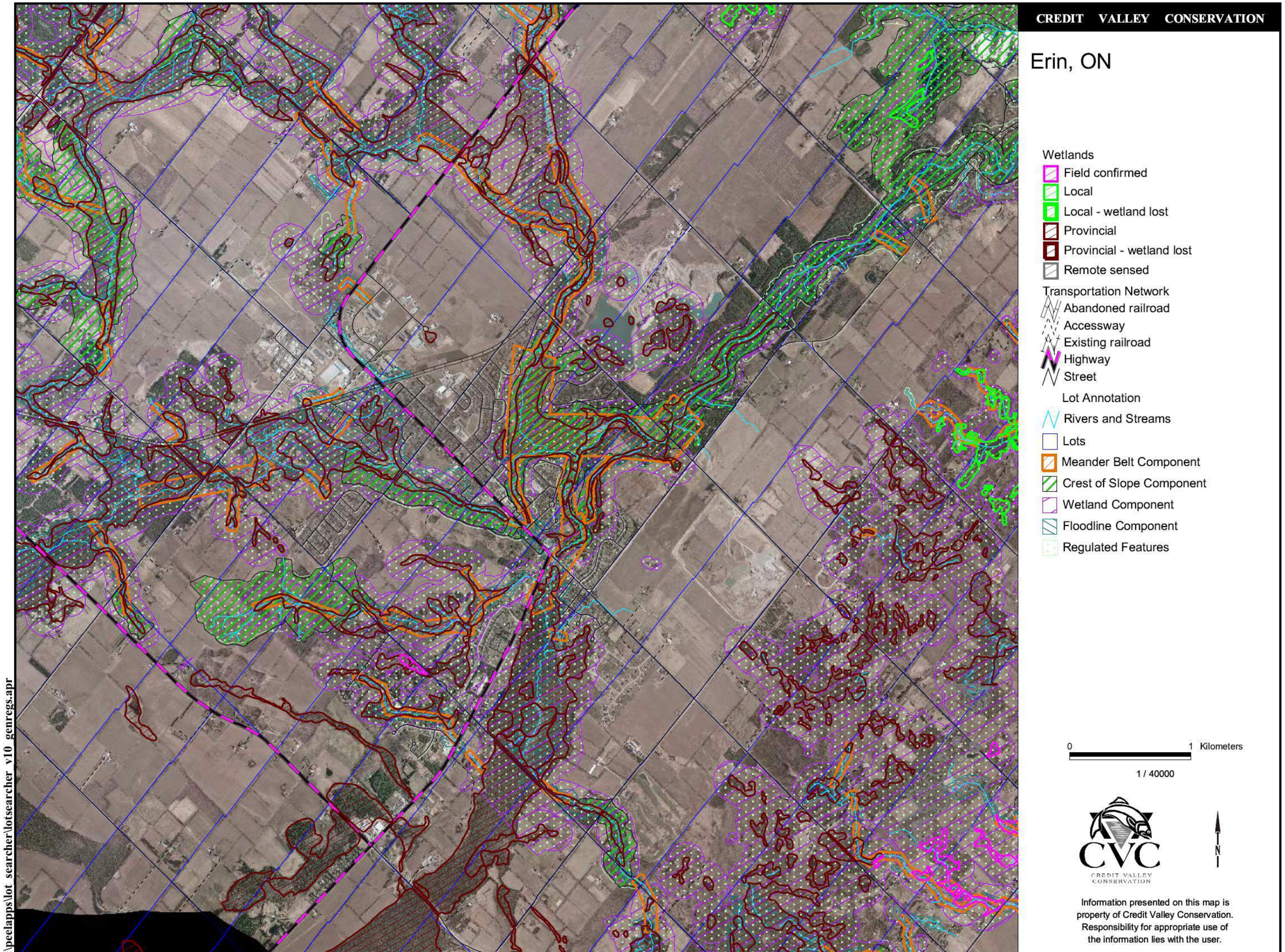

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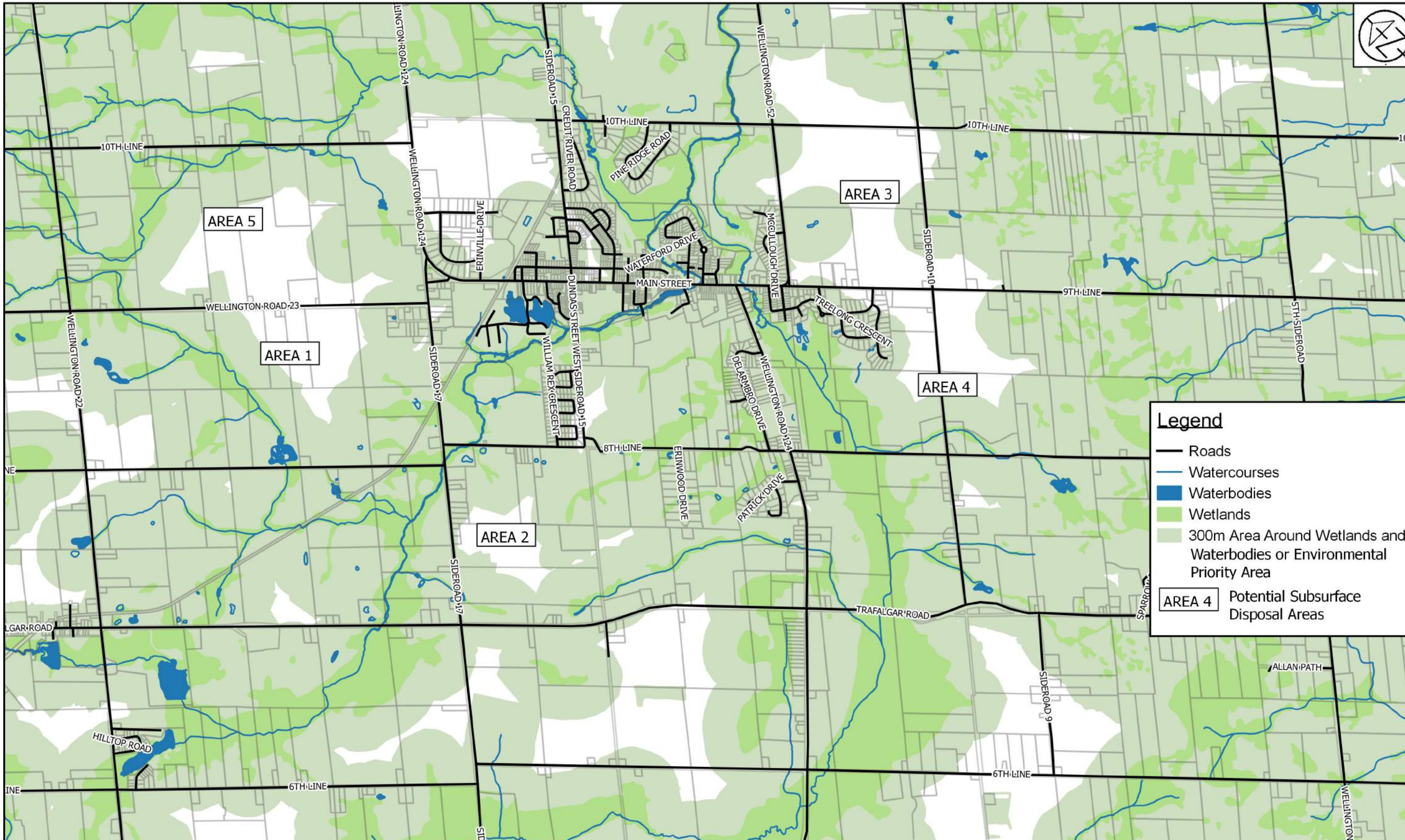
Figure 1 – CVC Wetlands and Watercourses Erin



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Town of Erin

ERIN

300m BUFFER AREA AROUND WETLANDS - ERIN

DATE: JANUARY 2017

PROJECT #115157

FIGURE - 2

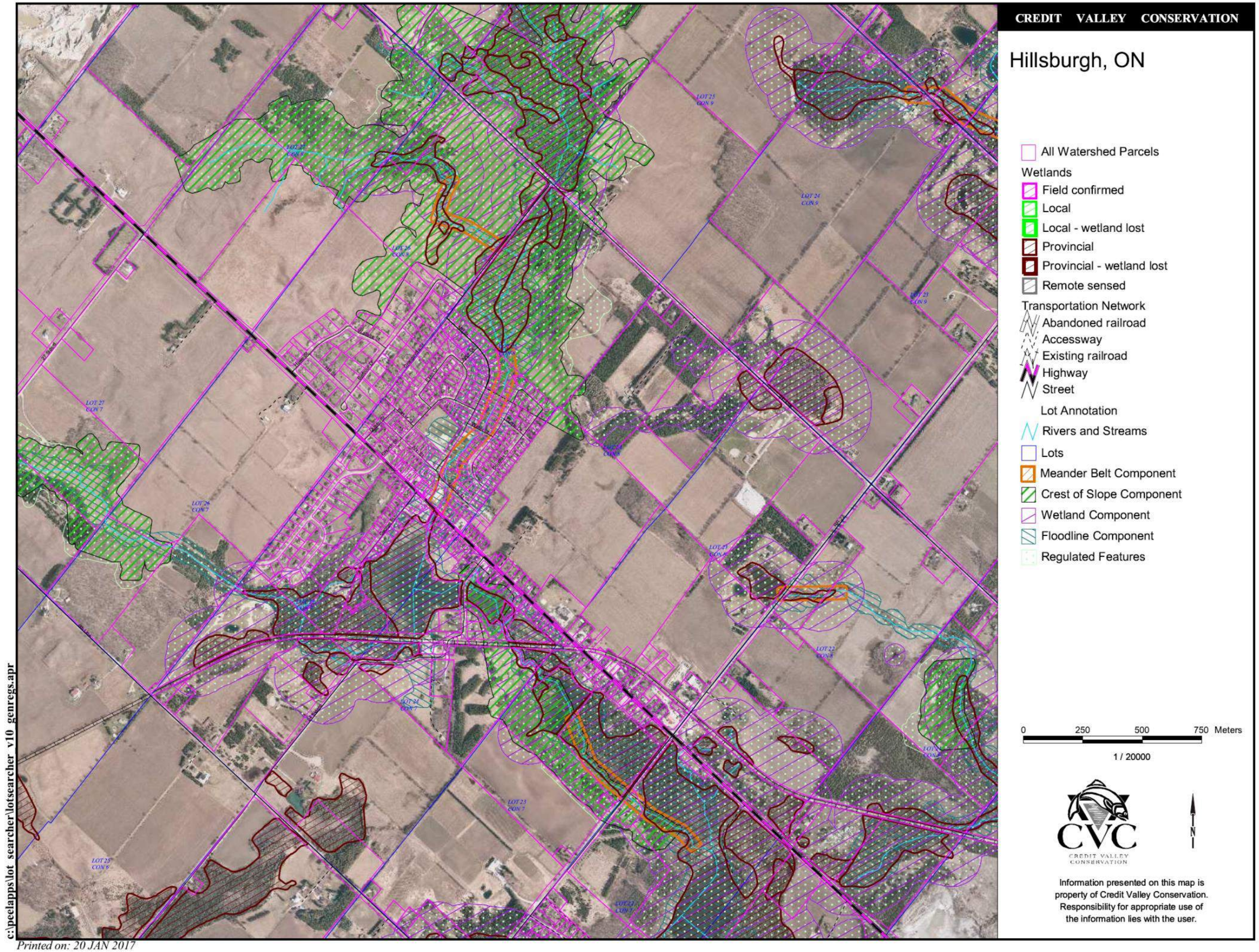
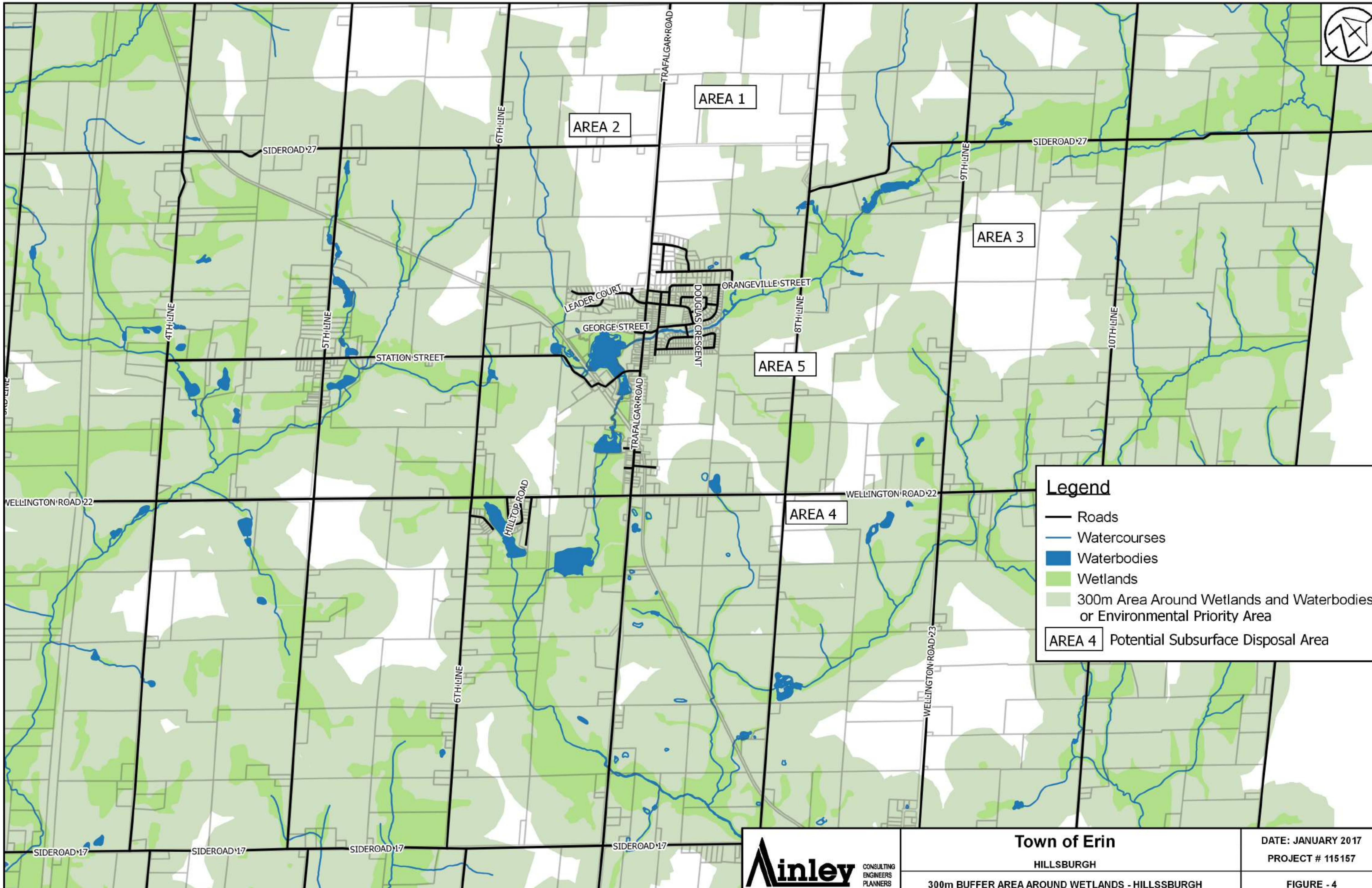


Figure 3 – CVC Wetlands and Watercourses Hillsburgh


AREA 1
AREA 2
AREA 3
AREA 4
AREA 5
SIDEROAD 27
SIDEROAD 17
TRAFALGAR ROAD
6TH LINE
4TH LINE
5TH LINE
8TH LINE
9TH LINE
10TH LINE
LEADER COURT
GEORGE STREET
STATION STREET
ORANGEVILLE STREET
DOUGLAS CRESCENT
HILLTOP ROAD
WELLINGTON ROAD 22
WELLINGTON ROAD 23
Legend
Roads
Watercourses
Waterbodies
Wetlands
300m Area Around Wetlands and Waterbodies or Environmental Priority Area
AREA 4 Potential Subsurface Disposal Area
Ainley CONSULTING ENGINEERS PLANNERS
Town of Erin
HILLSBURGH
300m BUFFER AREA AROUND WETLANDS - HILLSSBURGH
DATE: JANUARY 2017
PROJECT # 115157
FIGURE - 4

6.3 Hydrogeological Constraint Areas

Hydrogeological constraints are primarily related to protection of municipal water supplies, and to a lesser extent, private water wells, and include the following:

- Well Head Protection Areas (WHPAs) for the current municipal wells, and
- source water protection areas that have been designated as having Highly Vulnerable Aquifers (HVAs), which is typically a shallow aquifer with limited natural protection from surface source of contamination.

Well Head Protection Areas (WHPAs) were developed through the Clean Water Act (2006) and Source Protection studies and are documented in the Updated Approved Assessment Report – Credit Valley Source Protection Area, dated July 2015. WHPAs are created for several zones, primarily based on the time of travel from the surface to the well head. There are four main zones: WHPA – 100 m radius around a municipal well; WHPA-B – pathogen management zone (0-2 Year Time of Travel); WHPA-C – DNAPL contaminant protection zone (2-5 Year Time of Travel); and, WHPA-D – secondary protection zone (5-25 years). Within these zones, the vulnerability of the aquifer from surface sources of contamination was also assessed (low, medium, and high) to determine the risk to the water supply for various types of contaminant threats. As part of the assessment a groundwater vulnerability analysis was conducted to determine highly vulnerable aquifers (HVAs) and significant recharge areas (SRAs). HVAs were designated through the development and use of geological and numerical models to produce a vulnerability score based on level of protection and travel time of a potential surface contaminant to the underlying aquifer.

As well as vulnerability scores, various types of drinking water threats were determined and were prescribed a range of levels of threat. As outlined in the Approved Source Protection Plan for the CTC Source Protection Region (July 2015), sewage is a prescribed drinking water threat. Sewage is defined as "*The establishment, operation or maintenance of a system that collects stores transmits, treats or disposes of sewage*". There are numerous sub-categories ranging from septic systems to sanitary sewers to sewage treatment plant effluent discharges. Although, as previously discussed in Section 2, there are design guidelines for LSSDS's exceeding 10 m^3/day, the volume of discharge of septic effluent to the subsurface from the large subsurface wastewater disposal system proposed for Hillsburgh or Erin Village will be much greater than any sub-category addressed in the prescribed drinking water threats. An understanding of the potential types and concentration of contaminants from any large-scale subsurface disposal system may be necessary, to assign the potential risk associated with the scale of subsurface wastewater discharge that would be required.

6.4 Other Considerations

Other considerations need to be factored in to determine the potential suitability for large-scale subsurface wastewater disposal. These include, but are not limited to:

- the location of private water wells and the level of protection of these wells
- the ability of the surficial geologic material to accept large volumes of wastewater
- depth to the local water table and the ability of the site to accept the large volume of wastewater without mounding of the water table to ground surface, and
- the topographic slope of the site

These considerations require site-specific geotechnical investigations. As well, aggregate extraction areas and certain agricultural areas would be excluded from consideration. An additional factor to consider will be potential future municipal well sites and the associated Well Head Protection Areas. The potential future population growth will require a number of additional municipal water supply wells and any siting of a large subsurface disposal bed may exclude a considerable geographic area in the vicinity of Hillsburgh or Erin Village for consideration as a future well site. The following discussion is presented, summarizing the findings for the Hillsburgh and Erin Village areas.

6.5 Erin Village

6.5.1 Environmental

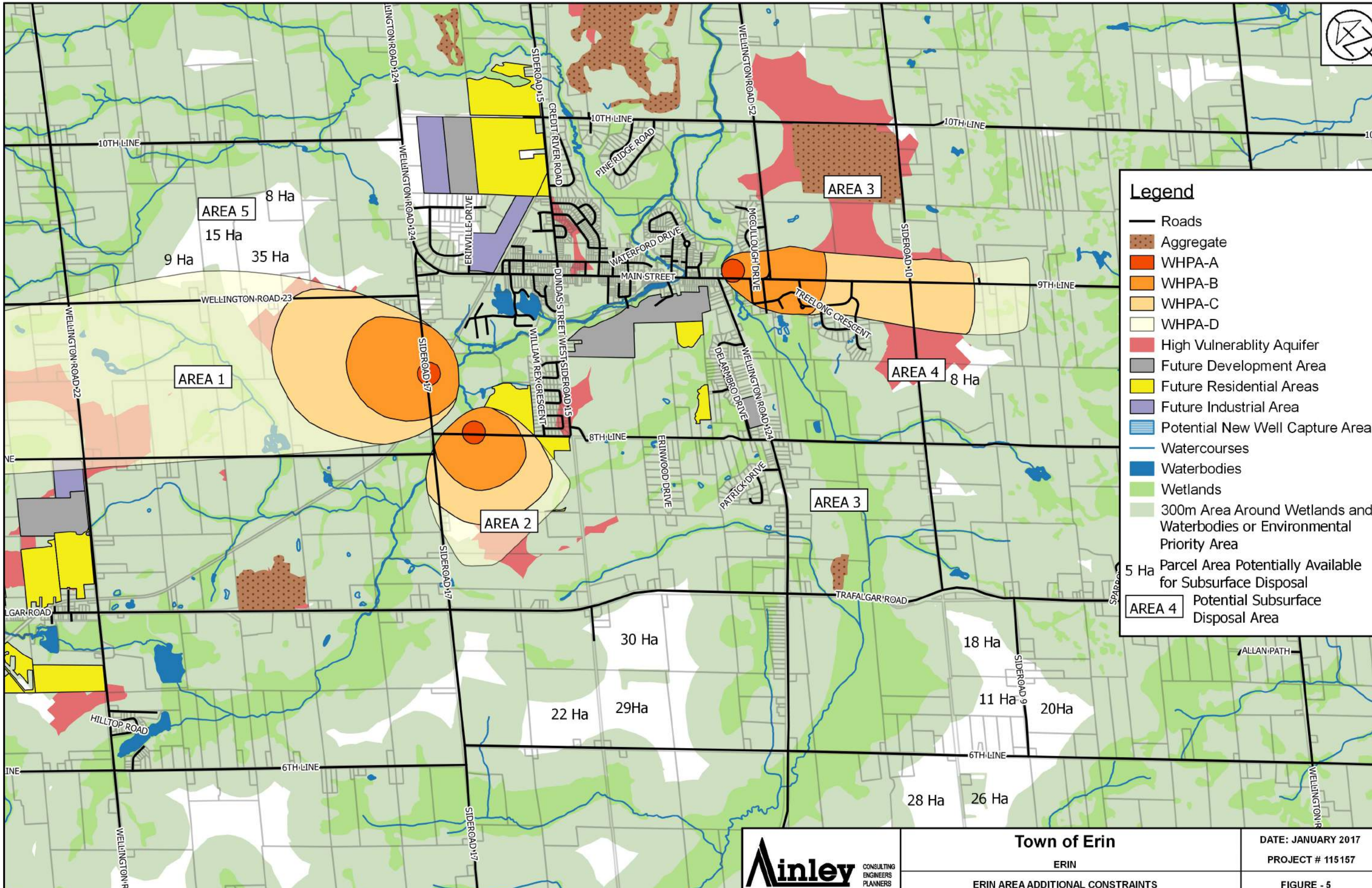
The environmental constraints in the vicinity of the Erin Village Urban Area are shown in Figure 1. Many of the constraint areas are located, as expected, along the West Credit River, primarily west and east of Erin. There are numerous small tributaries and wetlands. When factoring in a 300 m setback from these features, a considerable portion of the area surrounding Erin is excluded from consideration, as shown in Figure 2. There are no areas within the existing developed area of Erin village that would be suitable for subsurface disposal and treated wastewater would likely need to be pumped some distance from the community for disposal. Areas outside the developed village area with potentially less environmental constraints were the focus of a more detailed assessment of hydrogeological constraints.

6.5.2 Hydrogeological

The assessment of hydrogeological constraints in the vicinity of Erin Village focussed on the designated source protection areas and the sensitivity of these areas to surface sources of contamination, in particular in the geographic areas where there were potentially no environmental or land use constraints. Figures 2 identifies five (5) areas in the vicinity of Erin with this potential. Figure 5 also shows the current WHPAs for the Erin municipal wells and the Bel-Erin municipal wells. Figure 5 also shows the areas designated as having a Highly Vulnerable Aquifer (HVA). As previously indicated, this aquifer may not be the municipal aquifer, and is typically the shallowest aquifer capable of producing sufficient water for domestic water wells. Much of the area within and surrounding Erin Village is highly vulnerable to surface contamination, with the exception of the area to the northwest of Erin.

Areas 1-5 labeled on Figures 2 and 5 represent five (5) areas near Erin Village where there are potentially less land use or environmental constraints. The following is noted for each area, with respect to the hydrogeological conditions and the potential for subsurface wastewater disposal in these areas:

Area 1 – This area contains the WHPA for Erin Municipal well E7. Much of the WHPA area is designated as having a High Vulnerability Aquifer, although the vulnerable aquifer is not the municipal aquifer. Much of the area where there are no environmental constraints is within the WHPA-C protection zone. Given the potential volume of subsurface wastewater discharge, it is likely that the potential discharge would be considered a drinking water threat. Considerable site specific investigation would be required to assess Area 1 as a potential site. It is noted that this area was previously the subject of a private proposal for a subsurface waste disposal facility and substantial concerns were raised with respect to the potential long-term impact on recharge to the municipal aquifer system.


Legend
Roads
Aggregate
WHPA-A
WHPA-B
WHPA-C
WHPA-D
High Vulnerablity Aquifer
Future Development Area
Future Residential Areas
Future Industrial Area
Potential New Well Capture Area
Watercourses
Waterbodies
Wetlands
300m Area Around Wetlands and Waterbodies or Environmental Priority Area
5 Ha Parcel Area Potentially Available for Subsurface Disposal
AREA 4 Potential Subsurface Disposal Area
AREA 1
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WELLINGTON ROAD 23
WELLINGTON ROAD 22
WELLINGTON ROAD 124
WELLINGTON ROAD 52
SIDEROAD 17
SIDEROAD 15
SIDEROAD 10
SIDEROAD 9
CREDIT RIVER ROAD
PINE RIDGE ROAD
WATERFORD DRIVE
MCCULLOUGH DRIVE
TREELONG CRESCENT
ERINVILLE DRIVE
DUNDAS STREET WEST
WILLIAM REX CRESCENT
ERINWOOD DRIVE
DELARMBRO DRIVE
PATRICK DRIVE
HILLTOP ROAD
ALLAN PATH
Ainley CONSULTING ENGINEERS PLANNERS
Town of Erin
ERIN
ERIN AREA ADDITIONAL CONSTRAINTS
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FIGURE - 5

Area 2 – This area contains the WHPA for Erin Municipal well E8. All of the WHPA area is designated as having a High Vulnerability Aquifer, although the vulnerable aquifer is not the municipal aquifer. Much of the area where there are no environmental constraints, to the west of the well, is within the WHPA-C and WHPA-D protection zone. Given the potential volume of subsurface wastewater discharge, it is likely that the potential discharge would be considered a drinking water threat. Considerable site specific investigation would be required to assess Area 2 as a potential site.

Area 3 – This area is one of the largest areas where there are few environmental constraints. Most of the area is designated as aggregate extraction and much of the area is currently an active extraction area. The area is also designated as having a Highly Vulnerable Aquifer and is part of a major recharge area. Based on this information the area is not considered suitable for large volume subsurface wastewater disposal. This is the area proposed for a Wastewater Treatment Plant for the Surface Water Disposal Alternative.

Area 4 – This is one of the few areas near Erin Village which contains a reasonable size area of land with no environmental constraints; however, the area is also designated as having a Highly Vulnerable Aquifer and part of a major recharge area.

Area 5 – This area, north of Erin Village, contains a large zone with no environmental constraints and is within an area designated as having a low vulnerability to aquifer contamination. Based on the known environmental and hydrogeological constraints, the potential exists for subsurface disposal in this area; however, the area is mapped as having a lower permeability till unit at ground surface and would have to be further investigated to determine the capability of the surficial geologic material to infiltrate a large volume of subsurface discharge of wastewater.

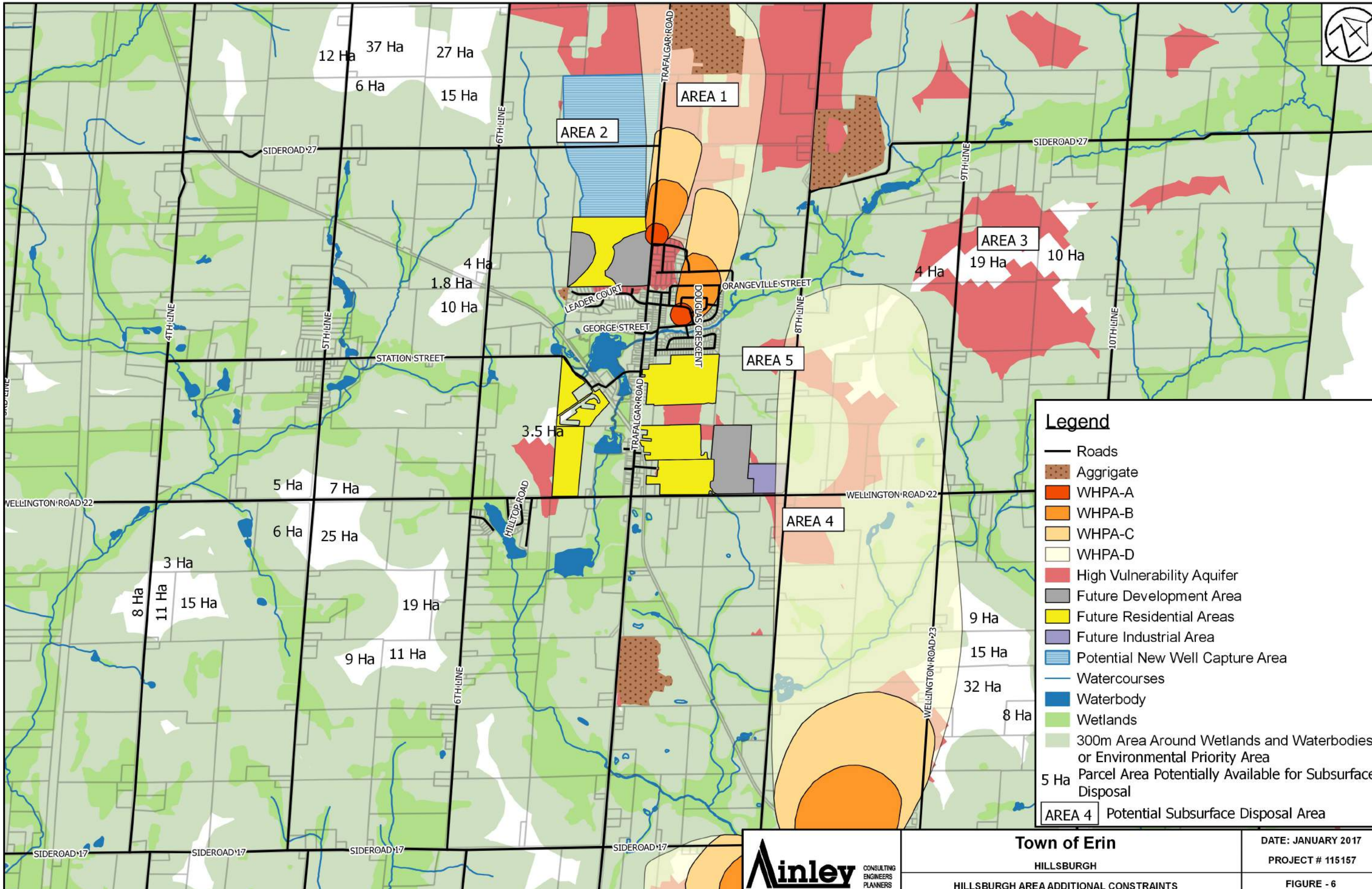
6.6 Hillsburgh

6.6.1 Environmental Constraints

The environmental constraints in the vicinity of the Hillsburgh Urban Area are shown in Figure 3. Many of the constraint areas are located, as expected, along the West Credit River, primarily north and south of Hillsburgh. There are numerous small tributaries and wetlands. When factoring in a 300 m setback from these features, a considerable portion of the area surrounding Hillsburgh is excluded from consideration, as shown in Figure 4. Several larger areas, located to the northwest and east of Hillsburgh have potentially less environmental constraints and were the focus of a more detailed assessment of hydrogeological constraints. These are labelled as Areas 1 to 5 on Figure 6.

6.6.2 Hydrogeological Constraints

The assessment of hydrogeological constraints focussed on the designated source protection areas and the sensitivity of these areas to surface sources of contamination, in particular in the geographic areas where there were no environmental or land use constraints. Figure 6 shows the current WHPAs for Hillsburgh, from the Approved Source Protection Plan: CTC Source Protection Region, July, 2015. Figure 6 also shows the areas designated as having a Highly Vulnerable Aquifer (HVA), as indicated in the Approved Assessment Report: Credit Valley Source Protection Area, February 2015. As previously indicated, this aquifer may not be the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DOUGLAS CRESCENT
HILLTOP ROAD
Legend
Roads
Aggrigate
WHPA-A
WHPA-B
WHPA-C
WHPA-D
High Vulnerability Aquifer
Future Development Area
Future Residential Areas
Future Industrial Area
Potential New Well Capture Area
Watercourses
Waterbody
Wetlands
300m Area Around Wetlands and Waterbodies or Environmental Priority Area
5 Ha Parcel Area Potentially Available for Subsurface Disposal
AREA 4 Potential Subsurface Disposal Area
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Town of Erin
HILLSBURGH
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FIGURE - 6

municipal aquifer, and is typically the shallowest aquifer capable of producing sufficient water for domestic water wells. Much of the area within and surrounding Hillsburgh is highly vulnerable to surface contamination.

Areas 1-5 labeled on Figures 4 and 6 represent five (5) areas near Hillsburgh where there are potentially less land use or environmental constraints. The following is noted for each area, with respect to the hydrogeological conditions and the potential for subsurface wastewater disposal in these areas:

Area 1 – This area contains the WHPAs for both of the current Hillsburgh municipal wells. Although much of the WHPA does not have a high aquifer vulnerability, much of the WHPA is a secondary protection zone. Given the potential volume of subsurface wastewater discharge, it is likely that the potential discharge would be considered a drinking water threat. Considerable site specific investigation would be required to assess Area 1 as a potential site.

Area 2 – Although not a WHPA, the area is being assessed as a potential new source of municipal water under the Water Component of the Class Environmental Assessment and is interpreted as having the same hydrogeological constraints as Area 1.

Area 3 – This area is one of the largest areas where there are potentially few land use and/or environmental constraints. The area is designated as having a Highly Vulnerable Aquifer and is part of a major recharge area. Based on this information, the area is not considered suitable for large volume subsurface wastewater disposal.

Area 4 – This is one of the few areas near Hillsburgh which contains an area of land with potentially no environmental constraints; however the area is also designated as having a Highly Vulnerable Aquifer and part of a major recharge area. WHPA-D for Well E7.

Area 5 – This area contains a zone with potentially no environmental constraints and is within an area designated as having a Low Vulnerability Aquifer. Based on the known environmental and hydrogeological constraints, the potential exists for subsurface disposal in this area; however, the area is mapped as a having a lower permeability till unit at ground surface and would have to be further investigated.

7.0 Subsurface Disposal Bed Requirements

7.1 Sizing and Cost

As discussed in Section 5, this technical memorandum will include consideration of a range of alternatives. To support development of these alternatives, the sizing and costs of a range of LSSDS systems have been examined as follows:

- A LSSDS servicing a single drainage area/subdivision.
- A LSSDS servicing the existing Hillsburgh community
- A LSSDS servicing full build out of Hillsburgh
- A LSSDS servicing full build out of Erin Village

Size requirements for LSSDSs' are determined on the basis of local geological/ hydrogeological conditions. Important factors in the design include the soil infiltration rates, soil attenuation capacity, and local groundwater levels. Generally, based on MOECC Sewage Works Guidelines, if the soils at any proposed LSSDS site are not well suited for the disposal bed application, soils would need to be brought to the site. When designing the disposal bed, a minimum of 900mm depth should be maintained from the bottom of the disposal bed trenches to the groundwater level/bedrock/ impervious soil layer. If this separation is not available naturally then additional soils must be imported to build up the disposal field.

Infiltration rates are typically measured as “T-Time”; For example, Hillsburgh, T -Times have been documented along with the septic bed records for a number of properties throughout the community. On average, the T-Time for the soils in Hillsburgh is 12. Soil conditions vary throughout the communities and include some areas with higher T-Times. The MOECC Guidelines provide information on system sizing based on general soil types. The guidelines provide areas which align closely with the standard method for calculating required disposal pipe lengths under the Building Code shown in Equation 1 in section 3 of this technical memorandum.

Assuming a LSSDS site in Hillsburgh would have average soil characteristics (T-Time = 12) for the area, the trench length needed for the existing population of Hillsburgh would be 24 km. For the ultimate buildout population of Hillsburgh, the total trench length would be 96 km. In order to approximate how much land area would be required for the leaching bed, the size of the Island Lake Subdivision LSSDS (illustrated above) is prorated based on the total length of trench required. A pro-rated cost of the disposal bed, based on bed area, is also provided for reference.

Table 7 illustrates the disposal system sizing and estimated cost for a range of systems. Native Soil (NS) notation in Table 6 denotes the construction of the subsurface disposal system in the native soils with an assumed T-Time of 12. Imported Fill (IF) notation denotes the construction of the subsurface disposal system using imported fill with an assumed T-Time of 6. Approximately 40% of the tile bed cost calculated for Island Lakes LSSDS was associated with the imported sand fill. Costing for the construction of the LSSDS in native soils has therefore been calculated pro rata with a 40% cost reduction; it should be noted however, that the cost of tile bed construction does not take into account the cost of purchasing the land so a land cost has been calculated assuming $25,000/Ha. The reference values are highlighted in orange.

Table 7 – Subsurface Disposal System Sizing and Cost

System Capacity (m^3/d)	**100**	**365**	**600**	**2,400**	**4,750**
	Subdivision	**Island Lake**	**Existing Hillsburgh**	**Full Hillsburgh**	**Full Erin**
Trench Length (m) – IF	2,000	6,700	12,000	48,000	95,000
Tile Bed Area (m^2) – IF	8,120	27,200	48,700	194,865	385,670
Tile Bed Cost (million $) – IF	0.7	2.33	4.2	16.7	33.0
Land Cost (million $) - IF	0.02	0.07	0.12	0.49	0.97
Total Disposal Field Cost (million $) – IF	**0.72**	**2.40**	**4.32**	**17.19**	**33.97**

System Capacity (m^3/d)	100	365	600	2,400	4,750
	Subdivision	**Island Lake**	**Existing Hillsburgh**	**Full Hillsburgh**	**Full Erin**
Trench Length (m) – NS	4,000		23,975	96,200	190,000
Tile Bed Area (m^2) – NS	16,240		97,330	390,540	771,350
Tile Bed Cost (million $) – NS	1.4		8.3	33.5	66.1
Land Cost (million $) – NS	0.04		0.24	0.97	1.93
Total Disposal Field Cost (million $) – NS	**1.44**		**8.54**	**34.47**	**68.03**
Treatment Plant Cost (million $) (IF & NS)	**1.5**	**3.5**	**5.2**	**17.5**	**33.0**
Total System Cost (million $) (IF)	**2.22**	**5.9**	**9.52**	**34.69**	**66.97**
Total System Cost (million $) (NS)	**2.94**		**13.74**	**51.97**	**101.03**

It should be noted that the full build out costs reflect costs to the existing residents and for all growth. Since the soil properties of the potential sites are not known in detail the thickness of the imported fill required was assumed to be approximately 2.1m, the hydraulic properties of the native overburden were not taken into account in this assumption.

As shown in Table 7 the reduction in trench length and land area for establishing an LSSDS with imported fill reduces cost overall when compared to a system designed for the native soils with an assumed T-Time of 12.

It should be noted that the areas and capital costs prorated from the Island Lake example may not be directly applicable to the larger scale systems that are required to service Erin and Hillsburgh. The area provided for the Island Lake design was sufficient for the distribution piping and near-ideal layout which was possible for this particular disposal system. In effect, the tile bed area needed for larger Erin Village and Hillsburgh systems may need to be disproportionately larger to adequately disperse the higher flow. In addition, the Island Lake system did not include additional disposal beds to manage the risk of disposal bed failure. For Erin Village and Hillsburgh, extra disposal beds would likely be a mandatory contingency requirement and therefore the areas presented below would need to be increased substantially to accommodate this spare bed area.

7.2 LSSDS Design

Figure 7 provides an example layout for an LSSDS field. Individual distribution pipes are generally arranged into cells with a maximum length of 30 m and each pipe must be separated by 1.6m. In the Island Lake example, the field was surrounded with an impermeable clay berm to control the direction of shallow groundwater flow. Separation is provided between the cells to provide space for distribution piping and monitoring locations. Monitoring will generally be required throughout the tile field and at locations downgradient in the direction of shallow groundwater flow. A shallow grade should be maintained from the tile field towards the attenuation mantle to encourage the direction of the shallow groundwater flow.

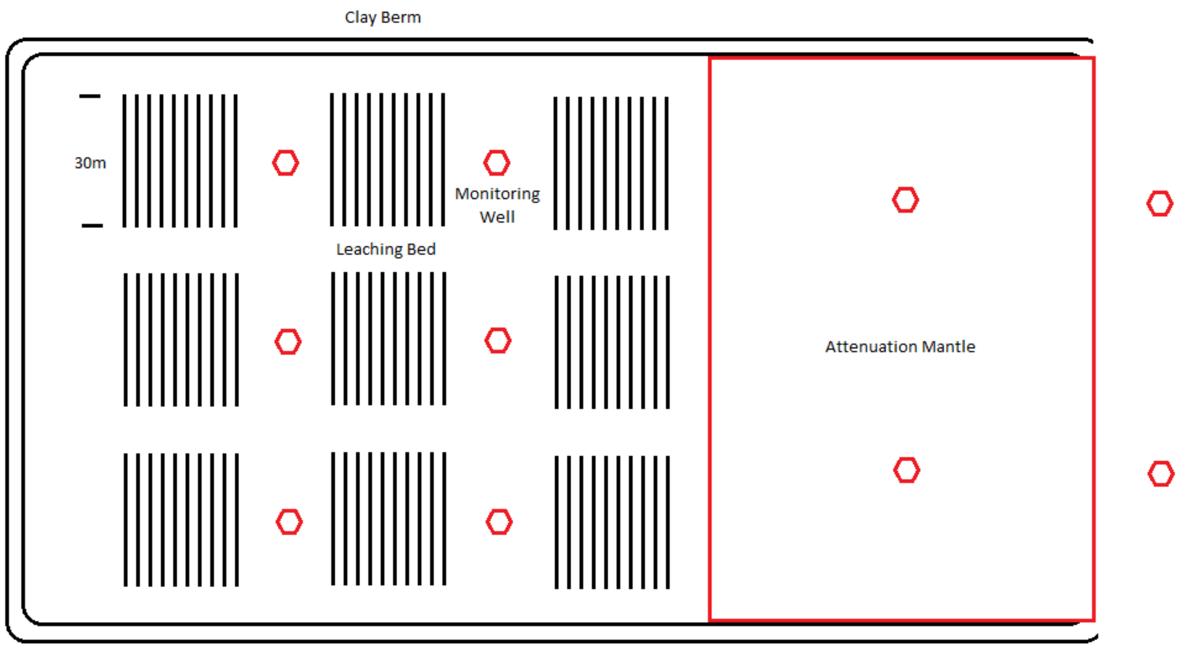


Figure 7 - Example LSSDS Design

8.0 Subsurface Disposal Alternatives

In order to confirm the viability of subsurface disposal systems within the UCWS EA study area, there are a range of alternatives which may be considered as discussed in section 5 above. For each of Erin Village and Hillsburgh these include:

- Alternative 1 -- Discrete treatment systems servicing sewer decision areas established in the Septic System Survey technical memorandum.
- Alternative 2 -- A centralised treatment system with a series of disposal fields distributed to areas suitable for subsurface disposal based on the hydrogeological overview of the study area
- Alternative 3 -- A centralised system with a single disposal field suitable for subsurface disposal based on the hydrogeological overview of the study area

8.1 General Requirements for Alternatives

All of the alternatives defined above will be required to conform to the regulations and guidelines outlined in Section 3.0. The main factor which will determine the level of treatment required under any alternative will be the characteristics of the disposal sites. In general, it is expected that any alternative selected will require, at a minimum, primary and secondary wastewater treatment with tertiary treatment for nitrate reduction, before discharging effluent to the subsurface. Biosolids management will also be required. While it is anticipated that specific processes applicable to surface water discharge criteria may be eliminated, where strict nutrient levels do not have to be met, treatment plants for subsurface disposal sites will still have to meet MOECC strict requirements for design of wastewater facilities in Ontario including secure utilities with reliable control systems and standby power. All of the required treatment plant facilities will be defined in the plant ECA and plant operations would be monitored against that.

Each subsurface disposal field will also need to be designed in accordance with the MOECC guidelines to ensure adequate attenuation of contaminants downgradient of the discharge area. Regular monitoring of groundwater quality will be required to ensure that the system remains in compliance with the ECA. The regular monitoring will require the establishment of monitoring wells within the LSSDS and at multiple points downgradient, in the direction of shallow groundwater flow. The Town will need to either own the downgradient land or obtain an access agreement to the downgradient land to ensure that monitoring can be conducted.

8.2 Treatment Plant Requirements for Alternatives

While the exact requirements to obtain an ECA for a treatment system and LSSDS will depend on the local conditions of a site, there are a number of requirements which will be imposed regardless of the site selected. In order to meet the anticipated effluent requirements a treatment process with primary and secondary treatment will be needed as a minimum. To manage the expected nitrate limits, a denitrification system will likely be required. There are a range of approaches to provide denitrification, this process can be integrated into secondary treatment by establishing an anoxic zone for denitrifying bacteria or it can be integrated into a tertiary treatment process such as a deep bed upflow sand reactor. Regardless of the system selected, there is considerable management requirement for denitrification processes due to the sensitivity of denitrifying bacteria to environmental conditions.

Further investigation would be required to determine whether phosphorus removal would also be required for the system. Due to the low dilution volumes in comparison to the effluent discharge, it is likely that the overall dilution is insignificant. While the sorption capacity of the soil may provide sufficient attenuation of phosphorus in the near-term, the sorption capacity of the soils is finite, and phosphorus breakthrough would occur over time.

The management of biosolids will also need to be considered under each alternative. To meet the MOECC guidelines for biosolids storage, a minimum of 240 days of storage volume must be available. The total volume of storage does not necessarily need to be at the treatment plant site, however, for the sake of comparing alternatives it will be assumed that each treatment facility will have adequate storage for its own needs in order to minimise trucking of biosolids around the community to a central storage system.

As discussed above, a treatment facility discharging to an LSSDS will require the following components:

1. Preliminary Treatment (screening and grit removal)
2. Primary Treatment (sedimentation)
3. Secondary Treatment/Clarification
4. Denitrification
5. Biosolids Storage/ Management
6. Subsurface Disposal Field
7. Plant common facilities including standby power

8.3 Erin Village Subsurface Disposal Alternatives

8.3.1 Erin Village Alternative 1 - Multiple Plants and Disposal Fields

As previously described, Alternative 1 is the option for the Town to establish multiple treatment plants throughout the communities each with an independent treatment plant and disposal field. In order to evaluate the viability of this alternative, it is assumed that the pumping station catchments for gravity sewers, described in the Collection System Alternatives Memorandum, will delineate the catchments for the separate treatment systems. The gravity sewer catchments are selected because they are based on the pre-existing topography of the Town and represent natural drainage areas, minimizing the need for pumping stations. Figure 5 shows the areas which are suitable for subsurface discharge in Erin Village. The pumping station catchments proposed for Erin Village are outlined on Figure 8 in foldout.

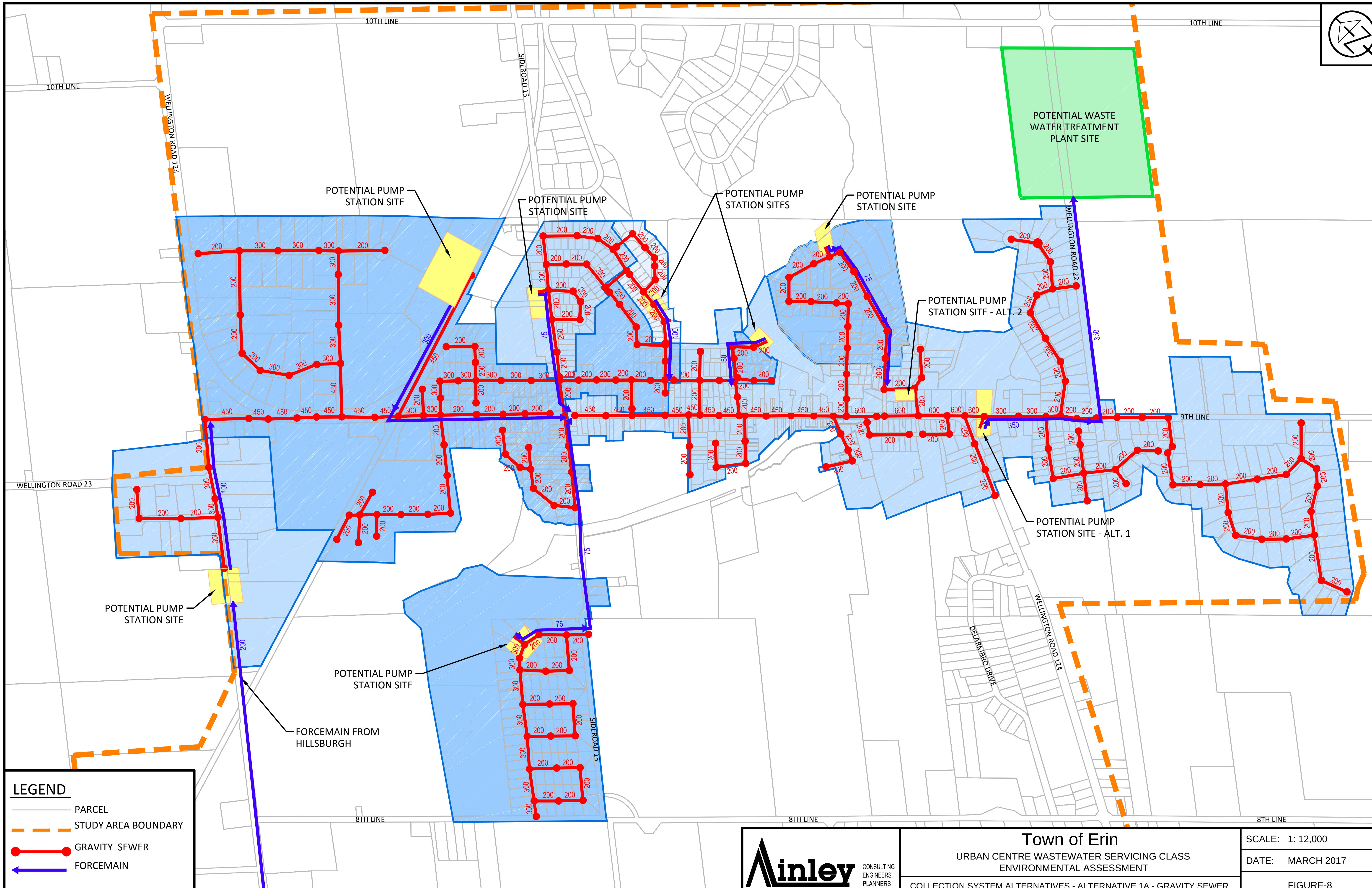
As noted in section 6 above, there is very little land available for subsurface disposal around Erin Village and there is no solution for Erin wherein multiple treatment plants and disposal fields can service each sewer catchment area. Erin Heights subdivision consists of 114 residential lots, which combine for a projected ADF of 112.6 m^3/d and would likely be a suitable size for a LSSDS. In addition, it is remote from Erin Village on the west side of the river making it more expensive to connect to a communal system. However there is no land around the subdivision suitable for a subsurface disposal system. The lands are either unsuitable due to proximity to surface water, within WHPA’s or with highly vulnerable aquifers. In addition most of the adjacent lands have substantial slopes. The closest available lands are 3.8 km away which makes it more expensive to pump to a LSSDS than the proposed Erin Village collection system.

For all of the catchments in the village there are no suitable disposal locations within the immediate area or even within a 2 km radius. As such, Alternative 1 is not a viable solution for Erin Village. The slightly less costly treatment alternative in this case would be largely offset by the additional cost for land purchase and disposal bed construction leaving very little capital cost benefit over the surface water discharge alternative. Considering the added cost to operate and maintain multiple plants and the disposal fields, this alternative for Erin Village is considered non-competitive. This is further reinforced by the added risk of failure of the disposal field.

8.3.2 Erin Village Alternative 2 - One Plant and Multiple Disposal Fields

As previously described, Alternative 2 is the option for the Town to establish a single treatment plant in Erin Village with a series of disposal fields throughout the village to manage the effluent. For Erin Village, the full build-out of the village is expected to generate an ADF of 4,770 m^3/d, which will require a total of 38.6 Ha of land for subsurface disposal.

Figure 5 shows the areas which are suitable for subsurface discharge in Erin and it can be seen from the figure that there are a limited number of locations which are suitable for discharge. Once the various restrictions on discharge are considered there is only “Area 5” on Figure 5 which provides a viable discharge location for a system of this size. “Area 5” is situated along 10 Sideroad between 8th Line and 9th Line and is also aligned along the zone of influence for one of the Town’s water supply wells. As there is only the single suitable location for the disposal field, Alternative 2 is non-viable.



Ainley CONSULTING ENGINEERS PLANNERS

Town of Erin

URBAN CENTRE WASTEWATER SERVICING CLASS ENVIRONMENTAL ASSESSMENT

COLLECTION SYSTEM ALTERNATIVES - ALTERNATIVE 1A - GRAVITY SEWER

SCALE: 1: 12,000

DATE: MARCH 2017

FIGURE-8

8.3.3 Erin Village Alternative 3 - One Plant and One Disposal Field

As previously described, Alternative 3 is the option for the Town to establish a single treatment plant in Erin Village with a single disposal field to manage the effluent. For Erin Village, the full build-out of the village is expected to generate an ADF of 4,770 m^3/d, which will require a total of 38.6 Ha of land for subsurface disposal.

As discussed in Section 8.3.2 there is only a single viable treatment and discharge location, namely “Area 5” on Figure 5. “Area 5” is located to the north of Erin and is located approximately 4.2 km from the ideal primary pumping station location for the village which is twice as far as the proposed location of the treatment plant for the surface water discharge alternative. It is possible that Alternative 3 may provide a viable solution for Erin Village, however, as with Alternative 2, there is no cost saving in terms of collection and pumping and the added cost of land purchase and the disposal beds as well as the pumping costs to the disposal area likely do not offset the less costly treatment cost. There is little cost advantage over the surface water discharge alternative. Considering the added cost to operate and maintain the disposal fields, this alternative for Erin Village is considered non-competitive. This is further reinforced by the added risk of failure of the disposal bed.

8.4 Hillsburgh Subsurface Disposal Alternatives

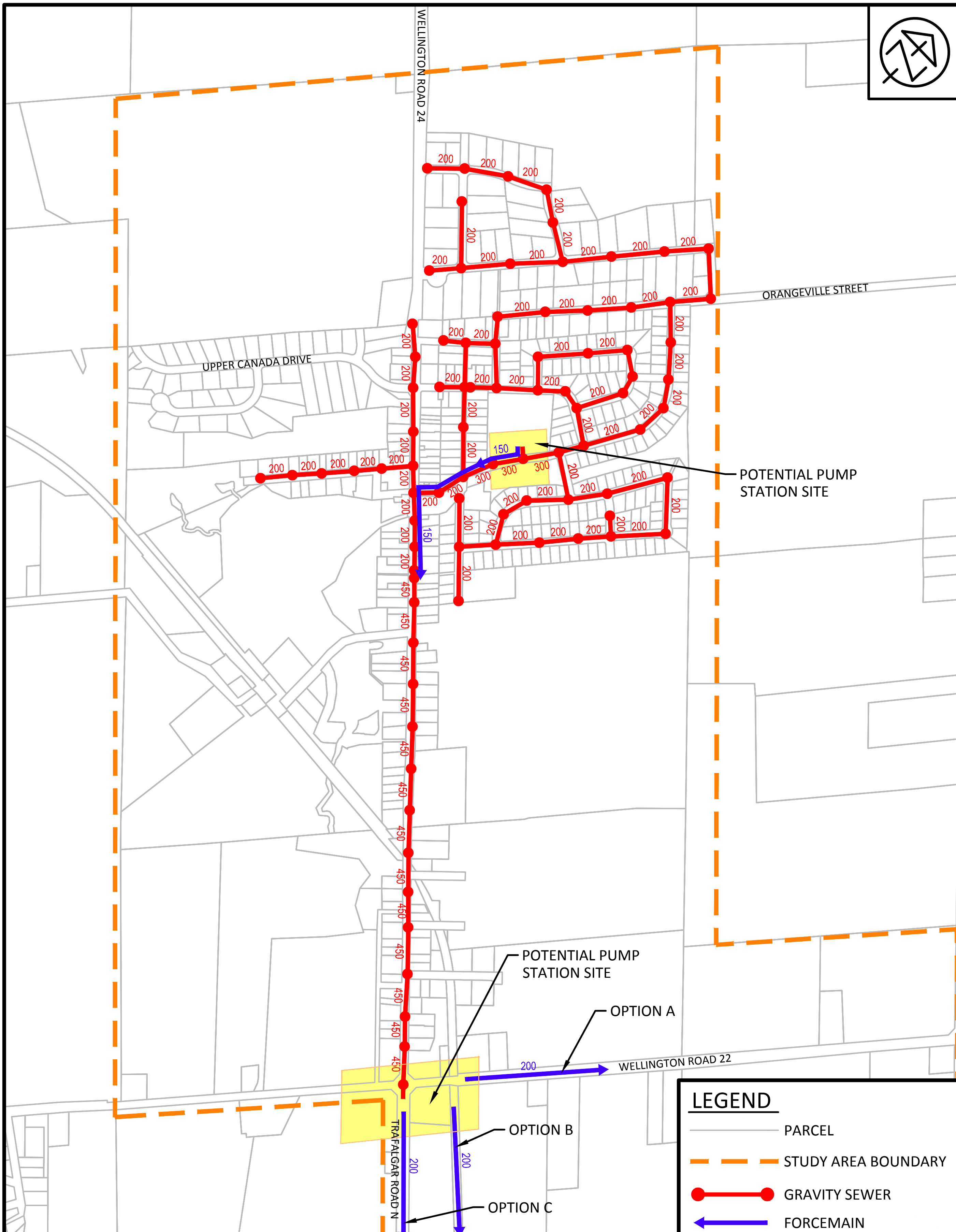
8.4.1 Hillsburgh Alternative 1 - Multiple Plants and Disposal Fields

This analysis uses the full build out population and projected sewage flows established for the surface water discharge alternative. While an alternative exists to service the existing community only using a subsurface disposal alternative, there is over 100 Ha designated for development within the community and a solution for wastewater servicing is also required for these lands. Including full build out population also incorporates the advantage of not having to pump wastewater to Erin.

As previously described, Alternative 1 is the option for the Town to establish multiple treatment plants throughout Hillsburgh each with an independent disposal field. In order to evaluate the viability of this alternative, it is assumed that the pumping station catchments for gravity sewers, described in the Collection System Alternatives Memorandum, will delineate the catchments for the separate treatment systems. The gravity sewer catchments are selected because they are based on the pre-existing topography of the Town and represent natural drainage areas, minimizing the need for pumping stations. The pumping station catchments proposed for Hillsburgh are outlined on Figure 9. Figure 6 shows the areas which are suitable for subsurface discharge in Hillsburgh. In total, the full build-out of Hillsburgh, is expected to generate an ADF of 2,400 m^3/d, which will require a total of 19.5 Ha of land for subsurface disposal.

The disposal areas identified in Figure 4 are heavily dominated by various environmental constraints. “Area 3” is the only area which has land available which is unaffected by one or more constraint. Some additional pockets of land are available to the south/ west of the village but do not serve the spirit of Alternative 1 which seeks to treat and dispose of waste as close to the point of production as possible.

The closest location, west of the village between Sideroad 27 and Station Street, lies along three separate properties for a total area of 15.8 Ha. This location is approximately 2.5 km from



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Town of Erin

URBAN CENTRE WASTEWATER SERVICING CLASS ENVIRONMENTAL ASSESSMENT

COLLECTION SYSTEM ALTERNATIVES - ALTERNATIVE 1 - GRAVITY

SCALE: 1: 12,500

DATE: MARCH 2017

FIGURE-9

the proposed pumping station site for the main residential area of Hillsburgh assuming that a forcemain could be constructed along Station Street.

Two additional locations which could be considered are “Area 3” as shown on Figure 6 and the pocket of viable land to the west of the village along Wellington Road 22. These locations are both at a similar distance from the village.

The locations described provide sufficient space for the construction of the necessary disposal beds and treatment. Based on potential availability of disposal lands, this alternative will be evaluated in more detail and compared to the surface water discharge alternative which involves pumping all of Hillsburgh’s wastewater to Erin Village for treatment and surface water disposal.

8.4.2 Hillsburgh Alternative 2- One Plant and Multiple Disposal Fields

As previously described, Alternative 2 is the option for the Town to establish a single treatment plant in Hillsburgh with a series of disposal fields throughout the village to manage the effluent. For Hillsburgh, the full build-out of the community is expected to generate an ADF of 2,400 m^3/d, which will require a total of 19.5 Ha of land for subsurface disposal.

Figure 6 shows the areas which are suitable for subsurface discharge, as described above the locations available for discharge are heavily limited by the existing environmental constraints. The areas identified in Section 8.4.1 would also be considered for Alternative 2. Ultimately, due to the limitations which exist, the only significant difference between Alternative 1 and Alternative 2 is the establishment of two treatment plants compared to the establishment of a single treatment plant.

Based on potential availability of disposal lands, this alternative will also be evaluated in more detail and compared to the surface water discharge alternative which involves pumping all of Hillsburgh’s wastewater to Erin Village for treatment and surface water disposal.

8.4.3 Hillsburgh Alternative 3- One Plant and One Disposal Field

As previously described, Alternative 3 is the option for the Town to establish a single treatment plant in Hillsburgh with a single disposal field to manage the effluent. For Hillsburgh, the full build-out of the village is expected to generate an ADF of 2,400 m^3/d, which will require a total of 19.5 Ha of land for subsurface disposal.

Figure 6 shows the areas which are suitable for subsurface discharge. As described above, the locations available for discharge are heavily limited by the existing environmental constraints. Two locations exist which provide land viable for discharge and sufficient space for the establishment of the necessary disposal field. The two locations are “Area 3” as indicated on Figure 6 and the land surrounding the intersection of 5th Line and Wellington Road 22. For the purpose of evaluating this option it will be assumed that the later area will be selected.

Based on potential availability of disposal lands, this alternative will also be evaluated in more detail and compared to the surface water discharge alternative which involves pumping all of Hillsburgh’s wastewater to Erin Village for treatment and surface water disposal.

8.5 Conclusions

8.5.1 Alternatives for Erin Village

Based on the above, it is concluded that there is little opportunity around Erin Village to support a multiple plant/multiple disposal bed solution. While there is likely the required 38.6 Ha available to support the single treatment plant and either multiple disposal fields or a single disposal field from lands further outside Erin, there is also little cost advantage in either of these Alternatives and added risk associated with disposal bed failure. It is also considered that land purchase for the purpose of wastewater disposal could prove problematic. A commitment to meet compliance limits downstream of the disposal fields before the effluent reaches surface water, also represents a considerable risk for the Town. It is further noted that the vulnerability of the aquifers in the potential disposal areas represents further risk moving ahead with more detailed studies as potential disposal areas may ultimately prove to be non-viable. It is therefore concluded that subsurface disposal Alternatives do not provide a viable option to surface water discharge for Erin Village.

8.5.2 Alternatives for Hillsburgh

Based on the above, it is concluded that there is opportunity around Hillsburgh to support a multiple plant/multiple disposal bed solution. The required 19.5 Ha is also likely available to support the single treatment plant and either multiple disposal fields or a single disposal field from lands around Hillsburgh. For this reason these alternatives are considered in more detail in Section 9.0 to identify whether there is sufficient cost advantage to outweigh the added risk associated with subsurface disposal.

9.0 Conceptual Cost Estimate

Section 8 concludes that there is likely little cost advantage in the subsurface disposal alternatives for Erin village but that there may be a cost advantage for Hillsburgh. This section provides a more detailed cost assessment of subsurface alternatives for Hillsburgh. Cost estimates for each of the alternatives proposed in Section 8.4 are presented herein.

The cost estimate for Alternative 1, which assumes the establishment of two independent treatment systems in Hillsburgh each with an independent LSSDS, is provided in Table 8.

Table 8 - Hillsburgh Alternative 1 Cost Summary

System Component	Description	Estimated Capital Cost
Forcemain (1)	2,500m, 150 mm dia.	$ 1,000,000
Forcemain (2)	850m, 150 mm dia.	$ 340,000
Treatment Facilities	2 x 1,200 m^3/d ADF	$ 18,800,000
Land Cost	28 Ha	$ 700,000
Tile Beds	2 x 9.8 Ha beds	$ 18,000,000
Total		$ 38,840,000

The cost estimate for Alternative 2, which assumes the establishment of one treatment system in Hillsburgh discharging to two separate LSSDS, is provided in Table 9.

Table 9 - Hillsburgh Alternative 2 Cost Summary

System Component	Description	Estimated Capital Cost
Forcemain (1)	850m, 250 mm φ	$ 425,000
Forcemain (2)	1,900m, 150 mm φ	$ 760,000
Treatment Facility	2,400 m^3/d ADF	$ 17,500,000
Land Cost	28 Ha	$ 700,000
Tile Beds	2 x 9.8 Ha beds	$ 18,000,000
Total		$ 37,385,000

The cost estimate for Alternative 3, which assumes the establishment of one treatment system for Hillsburgh with a single LSSDS, is provided in Table 10.

Table 10 - Hillsburgh Alternative 3 Cost Summary

System Component	Description	Estimated Capital Cost
Forcemain	1,550m, 250 mm φ	$ 775,000
Treatment Facility	2,400 m^3/d ADF	$ 17,500,000
Land Cost	28 Ha	$ 700,000
Tile Beds	19.5 Ha bed	$ 18,000,000
Total		$ 36,975,000

From the above cost estimates, it is likely that the cost of a single plant and single disposal field is less than the cost of the alternatives involving multiple plants and/or multiple disposal fields. In addition, alternatives involving multiple facilities require a higher operating cost. It is therefore apparent that Alternative 3 with one plant and one disposal field represents the best alternative for a subsurface disposal alternative for Hillsburgh. The cost for full build out of Hillsburgh for Alternative 3 represents approximately $18,500 per lot as compared to the Island Lake example previously illustrated which cost approximately $21,000 per lot for a smaller system. The cost to service just the existing community would likely be closer to the Island Lake example.

For the purposes of estimating costs, the total land area assumed for each alternative is based on the required tile bed area with additional land assumed for the establishment of additional tile beds if necessary to manage failures and space for the treatment plant. It should be noted that it is unlikely that an exact area of land suitable for establishing these systems can be purchased. It is likely that larger areas of land would need to be purchased as it may be inconvenient for a land owner to sell only a portion of their property. Once all suitable lands are identified, it would be necessary to identify land owners willing to sell property and to conduct all of the necessary studies. The final disposal field solution may include multiple fields throughout the community with the costs being closer to those identified for Alternative 2.

Forcemain costs were estimated on the same basis as provided in the Collection System Alternatives memorandum. The cost tables are available in that report. Treatment plant costs were interpolated from the known construction costs of treatment plants within southern Ontario. The costs were interpolated on the basis of treatment capacity. The cost of the tile beds was calculated on a pro rata basis from the construction cost of the Island Lake system in Mono.

10.0 Comparison of Subsurface Disposal and Surface Water Discharge

Section 9 above identifies the potential cost for a subsurface solution for Hillsburgh. This cost has to be set against the total cost of a wastewater solution for both communities and compared to the surface water discharge solution which was identified as the preferred alternative in the SSMP.

Table 11 below provides a cost comparison of alternatives for treatment and disposal excluding the cost of collection. Costs are for full build out and not all of these costs are applicable to the existing community.

"Hillsburgh Alternative 3" assumes that there will be two separate systems for Erin Village and Hillsburgh with the Hillsburgh system discharging effluent to an LSSDS and the Erin Village system discharging to the West Credit River.

"Erin Surface Water Discharge" assumes all wastewater from both communities is pumped to Erin Village for treatment and surface water disposal as outlined in the SSMP. The preferred collection system is anticipated to be predominantly the same and is therefore not included in the cost summary.

Table 11 – Cost Comparison of Treatment and Disposal Alternatives

	Hillsburgh Alternative 3		Erin Surface Water Discharge
System Component	**Hillsburgh (2,400 m³/d)**	**Erin (4,700 m³/d)**	**(7,170 m³/d)**
Hillsburgh to Erin Forcemain	N/A	N/A	$ 3,750,000
Hillsburgh Forcemain to Treatment Site	$ 775,000	N/A	N/A
Preliminary Treatment	$ 1,200,000	$ 2,200,000	$ 3,725,000
Primary Treatment	$ 1,750,000	$ 3,400,000	$ 5,730,000
Secondary Treatment	$ 3,500,000	$ 6,700,000	$ 11,460,00
Clarification	$ 2,100,000	$ 3,950,000	$ 6,700,000
Denitrification	$ 2,675,000	N/A	N/A
Tertiary Treatment	N/A	$ 4,800,000	$ 8,600,000
Disinfection	$ 465,000	$ 960,000	$ 1,400,000
Biosolids Storage/ Management	$ 4,100,000	$ 7,910,000	$ 14,300,000
Effluent Pumping	$ 230,000	$ 480,000	$ 720,000
Subsurface Disposal Field	$ 18,700,000	N/A	N/A
Outfall	N/A	$ 600,000	$ 800,000
Plant Common Facilities/ Site works	$ 1,480,000	$ 2,600,000	$ 4,500,000
Additional Site Investigation	$ 500,000	N/A	N/A
Subtotal	$ 37,475,000	$ 33,600,000	N/A
Total	**$ 71,075,000**		**$ 61,685,000**

It should be noted that the cost estimates provided in Table 11 are preliminary for the purpose of this comparative evaluation.

Based on the above analysis, in terms of capital cost, there is no advantage for the Hillsburgh subsurface alternative and it is likely to cost between 10 – 20% more to construct this alternative. In addition, the costs to operate two plants instead of one would likely be approximately 10% more in ongoing operation and maintenance cost. While the surface water alternative involves the cost of pumping wastewater from Hillsburgh to Erin, the subsurface alternative likely involves a similar cost in pumping to the disposal fields. Further, there are several additional costs for subsurface disposal that were not included in the overall costing; extensive long-term monitoring of ground water quality, additional disposal beds to manage potential failures and effluent holding tanks for high groundwater level conditions may also be required to have a successful groundwater disposal system.

The above cost analysis includes an additional cost of $500,000 for the technical studies required to establish whether lands are suitable for subsurface disposal. It is likely that this alternative would also incur considerable realty and legal costs in order to support the purchase of the disposal field lands.

As listed in Section 2.0 the following assessments would need to be conducted to obtain approval for the site(s) of a subsurface disposal field(s).

1. Full hydrogeological, hydrological / surface water and Reasonable Use Guideline assessment (exceeding that in Ch.22 of the Design Guideline for Sewage Works, 2008);
2. Groundwater / water well, surface water / aquatic life and microbiological risk assessments;
3. Water well survey within 2 to 5 km of site (radius may vary depending on specific geologic conditions etc.);
4. Integrated groundwater - surface water flow modelling;
5. Engineering design with comparable effluent treatment and disinfection, prior to discharge, to a traditional sewage treatment plant required to demonstrate that the suite of contaminants in sewage effluent and contaminant loadings would be addressed;
6. Engineering design would also need to demonstrate effluent discharge requirement to the bed for nitrate, anticipated to be no greater than 2.5 mg / L to accommodate the size of the beds required, and meet reasonable use at the property boundary;
7. Anticipated area of land required for beds (and therefore not available for other use);
8. Influent, effluent, groundwater and surface water monitoring plans, and performance criteria that would need to be met;
9. Contingency plans to address system failure;

In addition to the above subsurface disposal studies, it will be necessary to integrate this work with the Water Supply Class EA to ensure that future supply wells are not impacted.

It is likely that further investigation of the subsurface disposal alternative would delay the Class EA by up to one year.

11.0 Conclusions and Recommendations

The purpose of this report is to examine the viability of a subsurface disposal alternative solution for the Erin Urban Centre Wastewater Servicing Class EA (UCWS EA) either servicing the entire study area using a single treatment plant or as multiple systems servicing components of the study area. The intent of the report is to either confirm selection of the preferred alternative solution established through the Servicing and Settlement Master Plan (SSMP) or to recommend further study of the subsurface disposal alternative during Phase 3 of the UCWS EA. The request to consider this alternative was made by members of the Public Liaison Committee (PLC) and by members of the community group Transition Erin who were concerned that the viability of treating wastewater at multiple smaller facilities was being overlooked.

- The 2014 SSMP provided a brief review of subsurface disposal and a rationale for the disposal of waste effluent to the West Credit River below Erin Village, however, an in-depth review of subsurface disposal viability was not completed.
- The rationale for disposing of effluent in the West Credit River was originally based on the characteristics of the West Credit River through Hillsburgh in comparison to Erin Village.
- The decision to treat wastewater at a single treatment plant and discharge to the West Credit River below Erin Village was supported by feedback from the CVC.
- Design standards for large subsurface disposal systems (LSSDS) are outlined in the existing MOECC Design Guidelines for Sewage Works.
- An ECA application acceptance requires extensive site investigations to ensure the system is properly designed for the site and that the Reasonable Use Guidelines are met. These additional investigations are estimated to cost $500,000.
- LSSDSs are a common effluent management practice in Ontario, however, the scale of the system needed for managing waste from an entire village the size of Erin Village or Hillsburgh is well beyond any system currently operating in Ontario.
- At the typical size for an LSSDS, servicing the existing communities would likely require some 30 to 40 separate systems each with their own treatment systems and disposal fields and each requiring their own effluent limits and MOECC approval and ongoing operation, maintenance, monitoring and reporting.
- Based on broad generalisation of groundwater quality within the Town, the approved effluent standards of similar systems and an understanding of the Reasonable Use Guidelines, the key effluent quality requirements anticipated are listed in Table 12.

Table 12 – Potential Effluent Requirements Subsurface Disposal

Parameter	Concentration (mg/L)
BOD_5	10
TSS	10
NO_3-N	2.5

- Should the Town proceed with an LSSDS for effluent management, the system capacity required for the existing communities of Erin Village and Hillsburgh are listed in Table 13. The equivalent disposal bed area required is also provided for reference.

Table 13 – Projected Sewage Flow Rates and Disposal Area

	Erin		Hillsburgh		Total	
	Flow (m^3/d)	Disposal Area (Ha)	Flow (m^3/d)	Disposal Area (Ha)	Flow (m^3/d)	Disposal Area (Ha)
Existing Community	2,244.1	18.17	599.4	4.87	2,843.5	23.03
Growth Areas	2,523.0	20.44	1,805.7	14.62	4,328.7	35.07
Total	4,767.1	38.61	2,405.1	19.48	7,172.2	58.09

- The alternative for subsurface disposal can be based on a range of alternatives involving multiple treatment plants and disposal fields. In order to confirm viability of subsurface disposal, the following alternatives are considered for each of Erin and Hillsburgh:
    - Alternative 1: Decentralised treatment systems servicing sewer decision areas established in the Septic System Survey technical memorandum.
    - Alternative 2A: centralised treatment system with a series of disposal fields distributed to areas suitable for subsurface disposal based on the hydrogeological overview of the study area
    - Alternative 3A: centralised system with a single disposal field suitable for subsurface disposal based on the hydrogeological overview of the study area
- All of the alternatives defined above will be required to conform to the regulations and guidelines as described in the MOECC guidelines.
- The selection of any alternative presented is restricted heavily by existing environmental conditions in the area surrounding Erin Village and Hillsburgh.
- Prior to the selection of a location for a disposal bed, the existing environmental and hydrogeological constraints must be considered as well as the location of existing wells and the geology of the area.
- The known environmental constraints are shown graphically in Figure 5 and Figure 6 and include the existing Well Head Protection Areas (WHPAs), Highly Vulnerable Aquifers (HVAs), woodland areas, wetlands, watercourses, and a 300m buffer from surface water features.
- The level of treatment required at any LSSDS site can only be established when all the characteristics of the disposal site are known.
- It is anticipated that any subsurface alternative selected will require, at a minimum, the following treatment components:
    - Preliminary Treatment (screening and grit removal)
    - Primary Treatment (sedimentation)
    - Secondary Treatment/Clarification
    - Denitrification
    - Biosolids Storage/ Management
    - Subsurface Disposal Field
    - Plant common facilities including standby power
- Alternative 1, Alternative 2 and Alternative 3 were all determined to be non-viable solutions for Erin Village.
    - There is likely not enough viable land within Erin Village to support Alternative 1.
    - There is little cost advantage in either Alternative 2 or Alternative 3 and added risk associated with disposal bed failure, the cost of land purchase, the commitment to meet compliance limits downstream of the disposal fields, and the added cost of further study make these alternatives non-competitive with the surface water disposal alternative.
- Alternative 1, Alternative 2 and Alternative 3 were all determined to be potentially viable solutions for the community of Hillsburgh.
- As these alternatives are considered potentially viable they were evaluated economically to identify whether there is sufficient cost advantage to outweigh the added risk associated with subsurface disposal.
- Including treatment cost, tile bed construction and land acquisition the estimated costs associated with each subsurface disposal alternative for full build out of Hillsburgh are summarised in Table 14. These costs include both the existing community costs and new growth costs.

Table 14 – Estimated Costs for Subsurface Alternatives in Hillsburgh

	Estimated Capital Cost
Alternative 1	$ 38,840,000
Alternative 2	$ 37,385,000
Alternative 3	$ 36,975,000

- Since Alternative 3 was the least costly alternative for subsurface disposal in Hillsburgh, a cost comparison with the single plant, surface water discharge solution for Erin Village and Hillsburgh was completed.
- The total full build out treatment and disposal cost, for Alternative 3, including the construction of an independent treatment and disposal system for the community of Hillsburgh and a separate treatment and disposal system for Erin is $71,075,000, exclusive of collection system costs.
- Comparatively, the full build out treatment and disposal costs for the single treatment plant located downstream of Erin Village (original SSMP solution) with surface water disposal, including the cost of a forcemain connection from Hillsburgh to Erin Village, is estimated to be $ 61,685,000.
- Based on the above, it is clear that the single plant with surface water discharge provides the most economical solution in terms of capital cost. In addition, the operation and maintenance costs associated with two plants would be greater than for the single plant.
- The risks associated with developing a subsurface disposal alternative, in purchasing the necessary lands and obtaining approvals for the system, combined with the added costs means that there is no advantage in further development of subsurface disposal alternatives for either community.
- Based on the findings herein, the recommendation of this report is that the Town of Erin proceed with the SSMP recommendation to establish a single treatment plant in Erin Village with surface water discharge to the West Credit River to provide wastewater servicing to both Hillsburgh and Erin Village.

Appendix - A

Review Agency Comments

CVC | CREDIT VALLEY CONSERVATION

May 2, 2017

Town of Erin
5684 Trafalgar Road
RR2 Hillsburgh, ON
N0B 1Z0

Attention: Dina Lundy, Clerk

Re: Town of Erin
Urban Centre Wastewater Servicing Class Environmental Assessment
Technical Memorandum Subsurface Disposal Alternative
Final for Agency Comment

Staff of Credit Valley Conservation (CVC) have reviewed Town of Erin Town of Erin Urban Centre Wastewater Servicing Class EA – Technical Memorandum – Subsurface Disposal Alternatives Final for Agency Review. March 2017 and provide the following comments for your consideration.

It is our understanding that the goal of this study was to be a high level screening report to determine the feasibility of Subsurface Disposal in the Town of Erin (specifically in the Hillsburgh area). Recognizing the high level nature of the report, CVC is satisfied with the conclusion outlined in section 11of the report. There are significant risks and uncertainties in determining the long term effects of subsurface disposal in the Hillsburgh study area.

In addition, CVC is concerned with the ability of Subsurface Disposal systems to consistently meet the low nitrogen levels required (<2.5 mg/L) to ensure protection of aquatic resources. Effluent monitoring results from existing LSDDS systems at Centre 2000 and St. John Brebeuf elementary school have shown a high exceedance rates for nitrate. This is particularly concerning for surface water features downgradient of large tile beds which support habitats sensitive to nitrate in groundwater discharge.

If the Town is considering moving forward with subsurface disposal due to the highly vulnerable nature of the aquifer in the Hillsburgh region, more specific studies will be needed. These include the assessment of the hydraulic connection between the surficial sand and gravel aquifer and the wetlands and surface water receptors. The evaluation of the potential impacts to localized wetland water balance, from continuous hydrologic loading in areas downgradient of large tile fields will be needed. CVC is specifically concerned due to the specific vulnerability of the shallow subsurface environment, as there may be limited protection to surficial aquifer systems (ie. silts, clays, aquitards) and a relatively short travel time for contaminants to move vertically through the soils. Given this, there is a danger of potential impacts to both local private wells and significant natural heritage features.

In conclusion while a large subsurface system may be feasible, there is a significant risk to the Town that they will not be able to confirm the viability of this mode of servicing. In addition, there is also concern with respect to the long-term effects that could result to the natural environment. Therefore, CVC would recommend that the Town continue with determining the viability of the surface water discharge.

Please do not hesitate to contact me, if you have any additional questions.

Yours truly,

Liam Marray
Senior Manager Planning Ecology

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Memorandum

Date: April 10, 2017

To: Barbara Slattery
EA/Planning Coordinator, Technical Support Section (TSS)

From: Salah Sharif
Hydrogeologist, Technical Support Section (TSS)

Re: Technical Review of the Subsurface Disposal Alternatives for the Communities of Erin Village and Hillsburgh, Town of Erin, Ontario (IDS Ref. No. 6881-AKVP6R)

As requested, I have reviewed the following report:

Town of Erin Urban Centre Wastewater Servicing - Class Environmental Assessment: Technical Memorandum - Subsurface Disposal Alternative - Final Draft, prepared by Ainley Group Consulting Engineers & Planners, and dated March 2017.

The above mentioned technical memorandum (hereafter referred to as memorandum) examines the option for subsurface disposal of treated effluent from the existing and full build-out communities of Erin Village and Hillsburgh in the Town of Erin as an alternative of the preferred option for surface water disposal to the West Credit River downstream of Erin Village.

This memorandum provides a screening level overview of the technical feasibility and applicability of the MOECC's design requirements for subsurface disposal for Large Subsurface Sewage Disposal Systems (LSSDS) with respect to the option for subsurface disposal of treated effluent from the existing and full build-out communities of Erin Village and Hillsburgh. No detailed hydrogeologic investigation was conducted to evaluate the feasibility of LSSDS and the assessment was based on desktop study using existing information gathered as part of the Servicing and Settlement Master Plan (SSMP), Erin Urban Centre Wastewater Servicing Class EA (UCWS EA) and associated Class EA studies.

The major objectives of the above mentioned memorandum are as follows:

- To determine whether subsurface disposal of treated effluent is a feasible option for the communities of Erin Village and Hillsburgh as an alternative of the preferred option established in the SSMP involving surface water discharge to the West Credit River downstream of Erin Village;

- The above assessment/feasibility was based on screening level desktop studies using available information and no site-specific detailed geotechnical and hydrogeological investigation and risk assessments were conducted;
    - To identify whether there is any merit in proceeding with detailed field investigations (i.e., hydrogeologic investigations, modeling, and risk assessments) to be required for detailed feasibility assessment for LSSDS.

<u>MOECC's Comments</u>

1. The "*Executive Summary*" of the memorandum reported that "*It is anticipated that the treatment facility required prior to subsurface discharge would involve a plant similar to a traditional secondary sewage treatment plant discharging to surface water. The facility design would be required to demonstrate that the suite of contaminants in the raw sewage and contaminant loadings would be treated to meet MOECC requirements. Effluent limit for nitrates would be anticipated to be no greater than 2.5 mg/L to accommodate the size of the beds required, and meet MOECC "Reasonable Use" policies at the property boundary. Required effluent limits would require the establishment of a denitrification system".*

   The above statement is highly confusing as the alternative under consideration is subsurface disposal of treated sewage effluent; therefore, the criteria of effluent quality are achieved before disposal to subsurface. There is no requirement to ensure MOECC's "Reasonable Use" criteria before subsurface disposal of treated effluent. The MOECC's "Reasonable Use" criteria are applicable at property boundary (i.e., down-gradient of the leaching bed and area of natural attenuation), which are expected to be much lower than pre-disposal treated effluent due to natural attenuation processes.

2. Based on MOECC's "Reasonable Use" criteria the key effluent quality requirements for subsurface disposal at property boundary (i.e., down-gradient of the leaching bed and area of natural attenuation) are anticipated as BOD, TSS, and NO_3-N with concentrations of 10 mg/L, 10 mg/L, and 2.5 mg/L, respectively. The effluent quality requirement for surface water disposal were identified through the UCWS EA (i.e., BOD; 7.5 mg/L; TSS: 10 mg/L; total phosphorus: 0.046 mg/L; total ammonia: 2 mg/L; NO_3-N: 6 mg/L, and TKN: 3 mg/L). The requirement for additional treatment of the treated sewage effluent for any of the above parameters should be based on predictive calculation provided in the Section 22.5.8 of the 2008 MOECC's Design Guideline for Sewage. The calculation provides contaminants concentration at down-gradient property boundary using annual dilution volume, dilution area, total volume of water, annual sewage volume, actual concentration in the sewage, and annual dilution precipitation rate.

Therefore, the requirement for additional treatment of the treated sewage effluent for the subsurface disposal should be evaluated based on Section 22.5.8 of the 2008 MOE Design Guideline for Sewage and system design parameters for site-specific LSSDS. Subsurface disposal effluent quality at discharge point can be assessed based on the effluent discharge quality after secondary treatment and effluent quality requirements for subsurface disposal at property boundary (i.e., down-gradient of the leaching bed). This assessment will evaluate the need for tertiary treatment, specifically for NO3-N and TSS.

3. Environmental and hydrogeological constraints due to large-scale subsurface disposal of sewage effluent for Both Erin Village and Hillsburgh were evaluated. The evaluation did not consider possible changes in the groundwater flow systems, hydraulic connection between shallow and deep aquifers (i.e., municipal aquifer), and surface water-groundwater interaction (i.e., losing-gaining relationship of the Credit River with respect to shallow aquifer due to large-scale subsurface infiltration of effluent into the shallow aquifer). Any mounding effect with locally high hydraulic gradient due to large-scale infiltration and low permeability in the soil below the infiltration bed may significantly increase the groundwater flow velocity, as well as decrease travel time, which may affect the designated WHPA-B, WHPA-C, and WHPA-D.

4. The capacity of the surficial geologic material to accept large volumes of wastewater was not evaluated. It is understood that extensive site-specific geotechnical, lithologic, and hydrogeologic investigation together with qualitative and quantitative risk assessment and groundwater modeling (i.e., integrated surface water – groundwater interaction and water budget) are required to understand the environmental and hydrogeological constraints due to large-scale subsurface disposal system in the area.

5. Section "*6.3 Hydrogeological Constraint Areas"* reported that "*An understanding of the potential types and concentration of contaminants from any large-scale sub-surface disposal system may be necessary, to assign the potential risk associated with the scale of subsurface wastewater discharge that would be required."*

   The estimated effluent volume for subsurface disposal from combined or either Erin Village or Hillsburgh is so high that there is no comparable existing or proposed subsurface disposal system is available. Therefore, even the screening level evaluation for the feasibility of the large-scale subsurface disposal from Erin Village and Hillsburgh is a unique case study and uncertainties exist at every level of prediction. A cumbersome and costly measure/investigation is required to reduce the inherent uncertainty in the prediction of technical feasibility and costing perspective. Therefore, it is critical to adequately evaluate for merit, if any, in proceeding with detailed and expensive field investigations to be required for LSSDS.

6. Subsurface disposal bed requirements and associated costings for Erin Village and Hillsburgh were estimated based on Island Lake Subdivision in the Town of Mono with an approved ECA for subsurface sewage volume of 365 m^3/day. It is considered reasonable to utilize Island Lake data to estimate disposal bed requirements and system costings for Erin Village and Hillsburgh; however, it is not clear whether the reasonable thickness of the disposal bed (i.e., imported fill) was considered based on hydraulic properties of native overburden for the calculation of the volume of imported fill.

7. Section *"8.2 Treatment Plant Requirements for Alternatives"* reported several components including denitrification for a treatment facility discharging to an LSSDS. It is not clear whether the leaching bed has capacity to attenuate total phosphorus below the MOECC's "Reasonable Use" criteria at property boundary (i.e., down-gradient of the leaching bed). Due to low dilution volume compared to total sewage discharge volume, it is likely that dilution is insignificant as a natural attenuation for phosphorus. The sorption capacity of soil may be sufficient to attenuate the phosphorus concentrations below the MOECC's "Reasonable Use" criteria at property boundary (i.e., down-gradient of the leaching bed); however, breakthrough of phosphorus due to exceedance of sorption capacity of soil with time cannot be ignored.

8. The conclusion that the subsurface disposal alternatives do not provide a viable alternative to surface water discharge for Erin Village is not based on detailed site-specific investigations, which is considered very extensive in nature, as well as expensive; however, the assumptions, design criteria, reference examples, environmental and hydrogeological constraints, associated risks, and level of uncertainties in the subsurface disposal option for Erin Village used to conclude to this conclusion are considered reasonable in terms of screening level evaluation.

9. Area 5 in the Hillsburgh (i.e., Figure 6) is considered to have potential for subsurface disposal based on the fact that there exists potentially no environmental constraints and the area is designated as having Low Vulnerability Aquifer as indicated in the Approved Assessment Report: Credit Valley Source Protection Area, February 2015. The shallow aquifer in Area 5 and other areas in Hillsburgh is not the municipal aquifer, and is typically the shallowest aquifer capable of producing sufficient water for domestic water wells and is highly vulnerable to surface contamination. No information is provided between the interaction (i.e., hydraulic connectivity) of this shallow aquifer and municipal aquifer. It is also reported that the Area 5 is mapped as having low permeability till at ground surface; therefore, Area 5 was not evaluated for suitability of leaching bed, possibility of mounding in case of raised bed consisting of imported fill, and changing hydrodynamic condition due to infiltration of large-scale sewage effluent, changing shallow groundwater and surface water interaction, and possible water quality impacts in municipal aquifer.

10. It is concluded that there may be opportunity around the Hillsburgh community to support a subsurface disposal option, specifically having potential areas for subsurface disposal consisting of either multiple disposal beds or a single disposal field. This conclusion was based on physical, environmental and hydrogeological constraints (i.e., distribution of surface drainage, topography, woodlands, wetlands, potential impact on drinking water supplies, wellhead protection areas, highly vulnerable aquifers, 300 m setback distance between leaching bed and surface water bodies, interference with existing and potential future municipal wells, and future development in the communities) in the Hillsburgh. Although the screening level evaluation presented in the memorandum supports a subsurface disposal option for Hillsburgh, the long-term cumulative effect of the subsurface disposal system on the surface water and groundwater system in the quality and quantity perspective was not evaluated, this is considered very extensive, as well as expensive and may bring more constraints to support the above conclusion.

11. It was concluded that in terms of capital cost, there is no advantage for the Hillsburgh subsurface alternative with Erin Village having surface water disposal option and it is likely to cost 10-20% more to construct this alternative compared to surface water discharge option at Erin Village with a single treatment system for pumped sewage disposal from both Erin Village and Hillsburgh. It is not clear whether the cost for extensive monitoring and contingency plans (i.e., replaceable disposal beds, reservoir/holding tanks to accommodate high groundwater level condition/floods) to address subsurface disposal system failure was included in cost summary for Hillsburgh, which will further increase the capital cost for subsurface disposal system at Hillsburgh.

Conclusions and Recommendations:

Based on the review and evaluation of the findings of the subject memorandum, it is my opinion that there is no significant benefits in terms of capital cost for the inclusion of a subsurface disposal option for Hillsburgh; however, a detailed feasibility investigation will involve significant time, cost and uncertainties, which may further negate the option of subsurface disposal for Hillsburgh.

Further investigation (i.e., geotechnical, hydrogeological, modeling, and risk assessments) to support a subsurface disposal option for Hillsburgh is not recommended while there is a feasible option for subsurface disposal with known constraints and risks exists.

Instead, the interactive surface water-groundwater modeling can be further developed to understand the long-term cumulative effect in terms of risks and quality and quantity of water resources (i.e., surface and groundwater) perspective for this preferred surface water disposal system for the Erin Village and Hillsburgh communities.

I trust that the above comments will be of benefit. If you have any questions, I can be reached at 905-521-7705 or salah.sharif@ontario.ca

Statement of Limitations:

The purpose of the preceding review is to provide advice to the Ministry of the Environment regarding subsurface conditions based on a review of the information provided in the above referenced document. The conclusions, opinions and recommendations of the reviewer are based on information provided by others. The Ministry cannot guarantee that the information that has been provided by others is accurate or complete. A lack of specific comment by the reviewer is not to be construed as endorsing the content or views expressed in the reviewed material.

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Hydrogeologist