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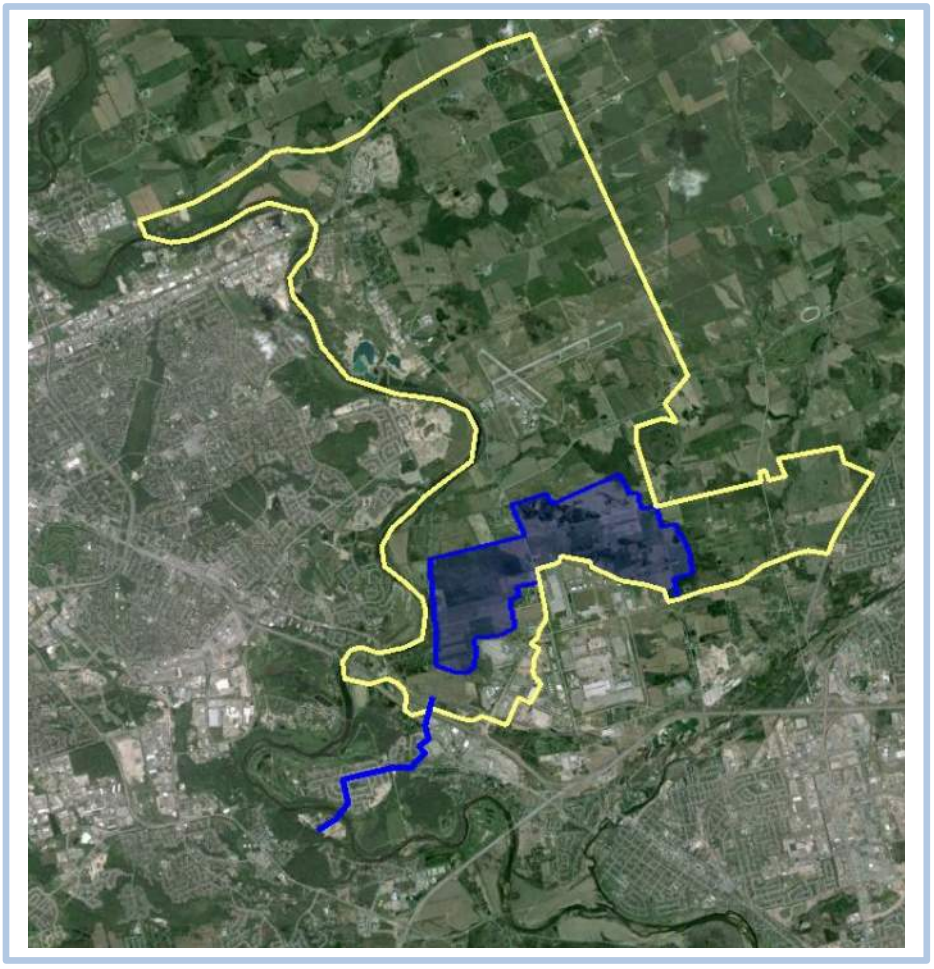
Region of Waterloo

REPORT

Region of Waterloo
East Side Lands Sanitary Servicing

Class Environmental Assessment
Environmental Study Report



Final Version - November 2018

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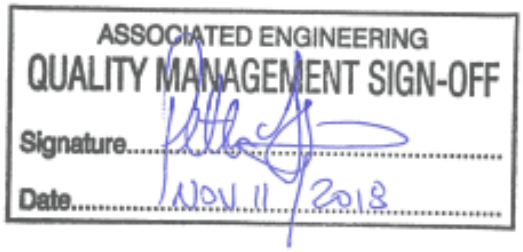
AE Document Distribution & Submission Control Table

Version	Date Issued	Recipient	Comments
0	Nov 30, 2015	D. Arsenault	Initial version – for review & comment
1	July 12, 2016	N. Ritchie	Revised per 2015 Workshop
2	July 22, 2016	Steering Committee	Submitted for review & comment
3	Dec 23, 2016	N. Sapeta	Final 'Draft' Report for approval
4	May 19, 2017	N. Sapeta	Revised 'Draft' per Cultural Heritage comments and AODA formatting
5	Oct 26, 2017	N. Sapeta	Updated w/ CHRA and MTCS Comments
6	Nov 11, 2018	N. Sapeta	Updated per Part II Order & Final Stakeholder Comments



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Executive Summary

Introduction

In 2013, The Regional Municipality of Waterloo (Region) retained Associated Engineering to initiate a Schedule 'B' Class Environmental Assessment (Class EA) to investigate a preferred sanitary solution for the East Side Lands. The boundaries of the Study Area are coarsely defined by Highway #7 to the North, the Grand River to the West, Shantz Station Road / Speedsville Road to the East and Highway #8 / Highway #401 to the South. Located within the municipal boundaries of the Township of Woolwich, the City of Cambridge and the City of Kitchener, these Lands comprise of approximately 4,000 hectares (ha) that are favourably positioned for future development due to the proximity to the Region of Waterloo International Airport, Highway 401 and the Canadian Pacific (CP) Rail corridor.

The fundamental purpose of this Study is to develop a long-term sanitary servicing strategy to allow sanitary flows generated by future development within the East Side Lands to be conveyed to the Kitchener Wastewater Treatment Plant (WWTP). The Class EA will identify opportunities and constraints as they relate to the natural, social and physical environments. The Study will investigate several servicing pipeline alignments and alternative conveyance methodologies (i.e. gravity sewers versus a pumping station and forcemain). The evaluation of the alternatives confirms a preferred solution for the long-term servicing strategy.

This project is considered to be a Schedule 'B' Class EA assessment as it involves the extension of a sanitary pipeline to an existing treatment facility. Typically, Schedule 'B' projects require a Project File report, whereas Schedule 'C' projects require a comprehensive Environmental Study Report (ESR). Due to the technical complexity and level of stakeholder engagement involved in this Class EA, it was deemed appropriate to present the Study findings through a formal ESR.

Background

This Class EA Study stems from recommendations in the Region's Wastewater Treatment Master Plan (WWTMP) as well as the East Side Lands – Stage 1 - Master Environmental Servicing Plan (MESP), both of which identified the need to construct infrastructure to convey wastewater from the proposed East Side Lands development areas to the Kitchener WWTP.

Scope and Rationale

Pursuant to the Master Plan recommendations, the Region initiated the current Class EA Study to identify the preferred solution to provide sanitary servicing for the East Side Lands using a staged development approach to ensure that adequate infrastructure is in place to accommodate the proposed development staging for the East Side Lands.

Supporting Investigations

Geotechnical

The geotechnical report, produced by Englobe, investigated the sub surface soil and groundwater conditions along the potential route alignments. Their findings investigate the geotechnical implications of the preferred alignment considering the two viable river crossing locations. The investigation revealed that the native soil conditions did not pose significant construction risks and groundwater conditions are suitable, provided dewatering techniques are used.

Environmental Impact Study

As part of the Class EA Study consultant team, Natural Resource Solutions Inc. (NRSI) was commissioned to complete the natural heritage inventory and Environmental Impact Study (EIS) for the Study Area. This report summarizes background information on natural heritage features, as well as the methods and results of a comprehensive field program including Ecological Land Classification, a multi-season vascular flora inventory, aquatic habitat characterization, and targeted surveys for birds, reptiles, and amphibians within the Study Area.

The detailed characterization of existing natural features was used to inform an analysis of the significance and sensitivity of natural features within the Study Area with consideration for applicable municipal and provincial policies and legislation. This information was then used to evaluate several alternative routes/locations for the pipeline, and conveyance methodology (i.e. gravity versus pumping) from a natural heritage perspective.

A preliminary qualitative analysis considered direct impacts to woodlands and wetlands, potential indirect impacts to tree root zones and/or wetlands, and watercourse crossings. It is anticipated that minor or temporary impacts to wildlife and wildlife habitats can be mitigated through carefully planned construction timing windows and construction practices.

Archaeology and Cultural Heritage

Some lands within the focussed Study Area identified as possible sanitary infrastructure sites exhibit potential for the existence of Aboriginal and Euro-Canadian archaeological sites or artifacts. Furthermore, the background research has determined that a historic cemetery, namely the Doon Pioneer Tower Cemetery, is located within the Study Area.

In addition to the Stage 1 Archaeological Investigation, ASI also completed a scoped cultural heritage inventory for the Study Area. The results of background historical research and a review of secondary source material revealed a Study Area with a rural land use history dating back to the late-eighteenth century. The field review confirmed that this area retains nineteenth and twentieth-century cultural heritage resources. A total of eight cultural heritage resources were identified within or adjacent to the East Side Lands Sanitary Servicing Study Area including the Grand River and Pioneer Tower. Of particular concern are the potential impacts to the vistas of the historic Pioneer Tower and the Grand River.

Development of Alternatives & Evaluation Process

For this Class EA Study, a comprehensive evaluation process was developed to assess the sanitary servicing alternative solutions. An important consideration is the ability of the evaluation process to properly inform the public, review agencies, and affected stakeholders. To that end, the evaluation process was designed to be transparent and defendable.

An underlying principle of this project's evaluation process is that the best alternative is considered the one with the *least overall impact*. The evaluation of impacts is based on a numeric scoring for each criterion, which are then compiled for an overall impact score for each alternative. An important convention to observe is that the process based on an approach where the lowest overall score indicates the preferred solution.

Based on the complexity of the Study scope, the development of alternatives and their respective evaluation has been broken into two parts, as follows:

Part 1 – Alternative Pipeline Routes

The Kitchener WWTP is approximately 4 km away from the southern limit of the East Side Lands. A sanitary servicing pipeline connection is necessary, and there are many alternative alignments that could be considered.

Part 1 of the alternative evaluation process considers the spatial aspects of the sanitary pipeline alternatives, assessing the impacts that each alignment's linear construction footprint would have within Study Area. It focuses on qualitative criteria categorized as impacts to the natural, social and technical environments.

Quantitative criteria such as cost were not explicitly assessed in Part 1, however, the length of alignment has a direct correlation to all impacts, including cost.

The result of Part 1 is the identification of the *preferred sanitary servicing pipeline route*, which is then used as the underlying framework for the conveyance methodologies to be assessed in Part 2.

Part 2 – Alternative Conveyance Methodologies
Once a preferred sanitary pipeline route was identified, a preferred methodology for imparting energy to the sanitary sewage flow is needed to ensure efficient conveyance to the WWTP. Specifically, the alternative solutions being considered include pumping station / forcemain configurations, gravity sewers, and combinations of the two.

Part 2 of the evaluation process considers operational aspects of the conveyance methodology alternatives, assessing the impacts of the long-term operations of the infrastructure over an assumed life cycle of 50 years. A specific focus in Part 2 are the methodologies and related impacts associated with the necessary crossing the Grand River.

Part 2 applies both qualitative and quantitative criteria. Similar to Part 1, the qualitative criteria are categorized as impacts to the natural, social and technical environments. Part 2 also includes a quantitative assessment for financial impacts.

The result of the Part 2 evaluation process is the selection of the preferred overall sanitary servicing solution for the East Side Lands.

Preferred Solution

Based on the thorough two-part analysis, considering the physical footprint of the alignment route and the method of conveyance, Route 'B' with Alternative Methodology #3 was identified as the preferred sanitary solution. The preferred solution (Alternative #3) consists of the following components:

- Approximately 3.6 km of 975 mm diameter Gravity Sewer extending from the pipeline origin point (north of Freeport Creek) to River Crossing Location #2 at the south end of Lookout Lane, including:
    - Approximately 1,060 m of trenchless construction of the sewer pipes across the CP Rail / Hwy #8 / King Street corridors, and along Grand Hill Drive to Deer Ridge Drive, assuming micro-tunnelling techniques are utilized. Approximate depth ranges from 8 m to 20 m.

  - Approximately 400 m of trenchless construction of the sewer pipes through the deeper section of the community trail / hydro corridor along the former Pioneer Tower Road alignment, assuming micro-tunnelling techniques. Approximate depth ranges from 6 m to 8 m.
  - Open cut excavation and construction of the sewer pipe along the remainder of the pipeline route, at a nominal depth ranging between 2 m to 6 m of cover.
- A new service bridge crossing the Grand River, approximately 120 m, that will span the entire width of the Grand River without intermediate support. The wastewater pipe will be supported by a series of rollers spaced evenly along a concrete deck to allow for differential thermal expansion.

  It is noted that the proposed bridge crossing presents potential slope stability challenges along the steep embankment of the Grand River near the existing Pioneer Tower. A detailed slope stability analysis and appropriate engineering measures will be required during detailed design to ensure the long-term stability of both the slope and the service bridge.
- After crossing the Grand River, an additional 350 m span will be required for the service bridge to cross the WWTP property and connect to the elevated influent channel. This additional structure would use shorter spans (approximately 30 m) with intermediate supports.
- The gravity sewer would require a new connection into the Kitchener WWTP's elevated influent channel, combining sewage flows from the East Side Lands with flows from Kitchener.

Project Cost

The estimated construction cost of the preferred solution is $29.5 million.

Approval Requirements

Through the future detailed design and prior to construction, approvals will be required from the Grand River Conservation Authority (GRCA), Ministry of the Environment and Climate Change (MOECC), Ministry of Natural Resources and Fisheries (MNRF), Ministry of Tourism, Culture, and Sport (MTCS), Ministry of Transportation Ontario (MTO), and local municipalities.

Anticipated Project Timing & Staging

Based on the scope of work, it is estimated that the detailed design and approvals for the proposed works will take approximately two to three years, including additional investigations, engineering design, property acquisitions and utility relocations.

Construction is anticipated to be completed using a multi-stage approach and could potentially be completed within a 2-year time frame. This results in a design and construction timing window of approximately five years.

Subject to monitoring of actual wastewater flows and development plans in the East Side Lands area, for budgeting and long-term planning purposes, it is suggested that implementation of the preferred solution be considered to be in the ten to twenty-year time frame.

Stakeholder Consultation

Consultation has been a key element to this Class EA. The development of the preferred solution included extensive consultation with the project team and stakeholders.

Public consultation included notices to the residents and identified stakeholders (initially derived from the MESP) and culminated with a Public Consultation Centre, held on November 8th, 2016, where the preferred alternative was presented. Later in 2017, there was additional, extensive consultation with the City of Kitchener, MTCS and Parks Canada regarding the potential impacts to the Pioneer Tower.

Filing of Environmental Study Report

The Environmental Study Report was placed on public record for the required minimum 30-day review period, from January 19th to February 28th, 2018. During this time, stakeholders were able to review any outstanding issues with the Project Team.

On February 28th, 2018 a request for a Part II Order was filed with the MOECC. The issues were addressed by the Region and reviewed by the Ministry. The Part II Order was formally resolved on October 13, 2018. Refer to **Appendix K** for details.

On February 28th, 2018 a request for a Part II Order was filed with the MOECC. The Region provided responses to the comments received in the request, which were then reviewed by the Ministry. Notification was provided by the Ministry on October 13, 2018 that the Part II Order request was not granted. The decision was based on careful consideration of the project documentation, the provisions of the Municipal Class Environmental Assessment, the comments received in the request, and relevant matters under the Environmental Assessment Act.

During the review, it was noted that further work is to be completed in the next stages of the project, prior to construction, to fully address comments received. This includes the preparation of both a construction management plan and risk management plan prior to construction. Details regarding these conditions are provided in Appendix K. The Project Team reviewed the conditions and considered them to be reasonable and in good alignment with best management practises.

Conclusions

A preferred solution has been identified as a gravity sewer with a service bridge across the Grand River and the Kitchener WWTP site. This solution is deemed to have the least overall impact to the natural and social environments, be the best technical solution from a design, operations and maintenance perspective, and have the lowest overall cost.

Recommendations

In consideration of all the foregoing, it is recommended that:

1. A comprehensive detailed design assignment be undertaken by the Region for the proposed gravity sewer and service bridge.

2. A detailed slope stability analysis by a qualified geotechnical engineer be completed prior to and in concert with the detailed design for the proposed service bridge. The analysis should include a comprehensive field investigation and appropriate remedial actions to accommodate the bridge foundation elements and associated construction activities, to ensure the long-term stability of the slope and adjacent lands.

3. Future site visit(s) with GRCA staff be undertaken during detailed design to confirm and document the presence/boundary of existing wetland and/or other natural features in the vicinity of the proposed works and the associated construction footprint.

   More specifically, a GRCA permit pursuant to Ontario Regulation 150/06 is required for implementation of the preferred alternative and a more detailed (i.e. quantitative) assessment of impacts is required by the GRCA. The required permit application should include the following documentation:

   a. Scoped Environmental Impact Study (EIS) that addresses GRCA regulatory policies and incorporates and interprets the findings of related studies where required. A detailed Terms of Reference should be submitted to the GRCA for review and comment prior to commencement of fieldwork.

   b. A geotechnical investigation that addresses slope stability issues along the Grand River corridor, including a construction site plan that will determine what type(s) of temporary and permanent slope stabilization measures are required (i.e. as recommended in Section 6.2 in **Appendix E** of the ESR). 0.

c. Detailed construction drawings, including: access, staging/sequencing, grading, erosion and sediment control, dewatering, contingency, and emergency response plans.

Furthermore, a self-assessment is recommended to address Federal Fisheries Act and Species At Risk Act requirements. For further details, please consult with Department of Fisheries and Oceans (DFO) directly. Refer to the February 28, 2018 letter from the GRCA (located in **Appendix K**) regarding further requirements and recommendations.

4. Future consultation with MNRF staff be undertaken during detailed design to confirm and further document the presence/boundary of existing natural features in the vicinity of the proposed works and the associated construction footprint. Specifically:

    a. The MNRF notes that a Crown Easement under the Public Lands Act (PLA) will likely be required to support the proposed bridge crossing of the Grand River. Please be advised that the review process for an easement application can take some time to complete.

    b. The stretch of the Grand River near the proposed bridge crossing is known habitat for aquatic species at risk (e.g. Wavy-Rayed Lampmussel) that are protected under the Endangered Species Act (ESA). If no in-water works will be required to support the bridge construction and appropriate mitigation is implemented (e.g. sedimentation and erosion control), there may be an opportunity to avoid impacts to aquatic species at risk and their habitats. It is recommended that during detailed design an Information Gathering Form (IGF) be completed to address the proposed bridge crossing. The purpose of the IGF is to provide the MNRF with the necessary information to inform whether or not the proposed activity will likely contravene the ESA, and whether an authorization under the Act may be required.

    c. If the servicing will be installed within 50 m of the identified Butternut tree, it is recommended that a Butternut Health Assessment (BHA) be completed during detailed design to inform the potential implications of the ESA.

    a. If tree removal in the study area is required when bats are potentially residing in the area, it is recommended that the MNRF be consulted for further advice under the ESA during detailed design.

    It is recommended that a Crown Easement application be submitted to the MNRF for review as early as possible in the detailed design phase of the project. To help inform the potential implications of the ESA, it is also

recommended that an IGF for aquatic species at risk and a BHA be submitted to the MNRF for review during detailed design. Refer to the March 1, 2018 letter from the MNRF (located in **Appendix K**) for further details.

5. Where trenchless pipe installation is to be employed, it should be conducted by a contractor who specializes in Trenchless Technology. The subsurface stratigraphy should be further analyzed and considered by the design engineer and bidding contractors when assessing production rates and project costs. It is recommended that the trenchless installation system be left to the contractor's discretion, but the contractor must be required to submit a detailed summary of the procedures for review and approval.

6. Lands within the Study Area that are considered to possess archaeological potential should be subject to Stage 2 Archaeological Assessment by test-pit survey prior to any proposed impacts by the projects.

7. The lands associated with the Doon Pioneer Tower and Cemetery should be subject to Protection and Avoidance from any proposed impacts by the project. Lands within ten metres of the documented extent of the cemetery require Cemetery Investigation, in accordance with the regulations under the Funeral, Burial and Cremation Services Act and the Ontario Heritage Act. The potential exists for Aboriginal human remains within and beyond the cemetery. The Cemetery Investigation should involve engagement with Aboriginal communities to ensure that there are no unaddressed Aboriginal archaeological interests with the cemetery.

8. A cultural Heritage Impact Assessment (HIA) should be carried out for BHR 1, CHL 1, CHL 2, CHL 3, and CHL 7 at the earliest stage possible of detail design. The HIA will, at a minimum address the various recommendations identified in the CHRA prepared for this EA Study (refer to Section 4.6).

   Summarizing, the HIA will confirm the cultural heritage value and cultural heritage attributes of the resources, include evaluation of significant views and vistas, and develop appropriate mitigation measures, including setbacks, vibration analyses and post construction maintenance. As these resources are linked and generally encompassed within the limits of the Pioneer Tower West Cultural Heritage Landscape (CHL 7), all resources should be addressed in one HIA report. The HIA should follow the Region of Waterloo Implementation Guidelines for Cultural Heritage Landscape Conservation (October 2013). The Ministry of Tourism and Culture and Parks Canada should be consulted to help form appropriate mitigation measures in order to minimize impacts to the resources.

9. Any proposed service bridge across the Grand River should be suitably designed to be sympathetic to the historical setting and context of the area. Additionally, the Standards and Guidelines for the Conservation of Historic Places in Canada (2010) recommend general design guidelines in relation to new additions in CHLs, particularly in relation to areas with significant visual relationships, ecological features, or built features. The results of the HIA should help guide the design of any proposed service bridge across the Grand River.

10. In addition to mitigating impacts to important vistas the proposed bridge design should also address public access and safety concerns regarding possible pedestrian use of the structure. Furthermore, considering the proximity of the proposed service bridge to the existing power lines crossing the Grand River, consideration should be given during detailed design to attach or enclose the power lines within the proposed structure.

11. Hydro One has high voltage transmission facilities within the study area that may be affected by the proposed works. Further consultation is required with Hydro One and any design developments should not reduce line clearances or limit access to Hydro One facilities at any time. Any construction activities must maintain the electrical clearance from the transmission line conductors as specified in the Ontario Health and Safety Act for the respective line voltage.

    The integrity of the structure foundations must be maintained at all times, with no disturbance of the earth around the poles, guy wires and tower footings. There must not be any grading, excavating, filling or other civil work close to the structures. Once it is confirmed whether the proposed works will affect Hydro One facilities including the rights of way, submit detailed plans to Hydro One Real Estate Management, 185 Clegg Road, Markham L6G 1B7. Please refer to the February 28, 2018 letter from Liping (Philip) Wu, P.Eng. of Hydro-One (located in Appendix K) for details.

12. A hydrogeological investigation is required to confirm and/or address impacts to the groundwater system and to accurately assess dewatering rates required for construction. Perched groundwater conditions in the saturated sands and gravels above the relatively impermeable glacial till will require dewatering where excavations extend into these deposits. It is envisaged that Category 2 or 3 Permits to Take Water will be needed for sections of the work. In particular, impacts to the private wells within the Grand Hill Drive subdivision must be considered where construction activity and related dewatering may be of impact.

13. A trunk sanitary sewer system Study should be undertaken to identify and confirm the future alignments and depths of the sewers that will connect to and convey flow into the preferred solution of this Study.

14. In response to the requested Part II Order for this project, the Ministry of Environment, Parks & Conservation imposes the following conditions:
    a. Prior to construction, the Region shall prepare a risk management plan to ensure the sewage is not released into the Grand River. This plan shall include information on technical design components, spill response and maintenance.
    b. Prior to construction, the Region shall prepare a construction management plan.
        i. The plan shall include mitigation measures that consider but are not limited to: noise, traffic, and other construction impacts.
        ii. The Region shall hold one public meeting on the plan prior to finalization.
        iii. The plan shall be posted on the Region's website for a minimum of 60 days
    c. Once conditions a. and b. have been satisfied, the Region shall notify in writing the Director of the Environmental Assessment and Permissions Branch.

Glossary of Terms

Abbreviation	Term
ADF	Average Daily Flow
AE	Associated Engineering (Ont.) Ltd.
ANSI	Area of Natural Scientific Interest
ASI	Archaeological Services Inc.
BHR	Built Heritage Resource
CBSA	Cross Boarder Servicing Agreement
CHL	Cultural Heritage Landscape
CIP	Cast-In-Place / Cured in Place
Class EA	Class Environmental Assessment
CPR	Canadian Pacific Railway
CWA	Clean Water Act
DFO	Department of Fisheries and Oceans
DGSSMS	Design Guidelines and Supplemental Specifications for Municipal Services
EA	Environmental Assessment
EAA	Environmental Assessment Act
EIS	Environmental Impact Study
ELC	Environmental Land Classification
ESA	Environmentally Sensitive Areas
ESPA	Environmentally Sensitive Policy Area
ESR	Environmental Study Report

Abbreviation	Term
GRCA	Grand River Conservation Authority
HADD	Harmful Alteration, Disruption or Destruction (of Fish Habitat)
HDD	Horizontal Directional Drilling
HIA	Heritage Impact Assessment
I&I	Inflow and Infiltration
ICI	Industrial / Commercial / Institutional
MEA	Municipal Engineers Association
MESP	Master Environmental Servicing Plan
MNRF	Ministry of Natural Resources and Forestry
MOECC	Ministry of the Environment and Climate Change
MPAC	Municipal Property Assessment Corporation
MTBM	Micro-Tunnel Boring Machine
MTCS	Ministry of Tourism, Culture & Sport
MTO	Ministry of Transportation Ontario
NPV	Net Present Value
NPWA	Navigable Waters Protection Act
NRSI	Natural Resource Solutions Inc.
O&M	Operations and Maintenance
OCWA	Ontario Clean Water Agency
OPA	Official Plan Amendment
OPSD	Ontario Provincial Standard Drawing
OPSS	Ontario Provincial Standard Specification
PISR	Prime Industrial Strategic Reserve

Abbreviation	Term
ppha	Persons per hectare
PPS	Provincial Policy Statement
PS	Pumping Station
PSW	Provincially Significant Wetland
PTMP	Pilot Tube Micro-Tunneling
ROW	Right-of-Way
Region	The Regional Municipality of Waterloo
RGMS	Regional Growth Management Strategy
ROP	Regional Official Plan
ROW	Region of Waterloo
SAR	Species at Risk
WHPA's	Well Head Protection Areas
WWTMP	Wastewater Treatment Master Plan
WWTP	Wastewater Treatment Plant

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1 Introduction

1.1 PROJECT OVERVIEW / STUDY HISTORY

In 2013 the Regional Municipality of Waterloo (the Region), through their consultants, Associated Engineering Limited (AE), initiated the East Side Lands Sanitary Servicing Class Environmental Assessment (Class EA) Study. **Figure 1-1** presents the boundary of the lands considered under the current Class EA Study.

The purpose of this Study was to identify the preferred sanitary servicing strategy and conveyance alignment to allow sanitary flows generated by future development within the East Side Lands to be conveyed to the Kitchener Wastewater Treatment Plant (WWTP) for treatment and discharge to the Grand River.

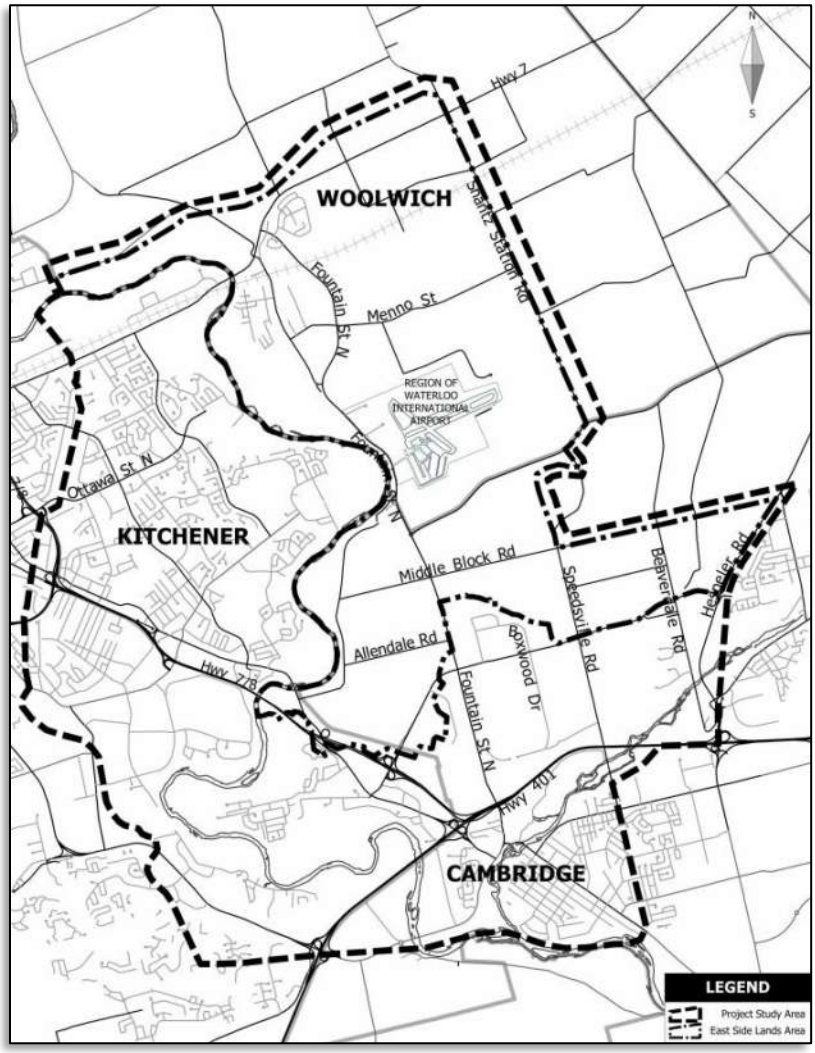

Figure 1-1
Study Area – Key Map

As this Class EA involves the extension and enlargement of a sewage collection system with connection to an existing sewage treatment facility and the location of the sewage collection system is not within an existing road allowance or utility corridor, the proposed undertaking is considered to be a Schedule 'B' Environmental Assessment, pursuant to the Municipal Class Environmental Assessment document (Municipal Engineers Association (MEA) 2000, as amended 2007, 2011, and 2015) and the Environmental Assessment Act (2010). The East Side Lands consist of an agglomeration of land parcels comprising approximately 4,000 ha located within the municipal boundaries of the Township of

Woolwich, The City of Kitchener and the City of Cambridge. The boundary of these lands is coarsely defined by Highway #7 to the North, the Grand River to the West, Shantz Station Road / Speedsville Road to the East and Highway #8 / Highway #401 to the South.

A portion of the East Side Lands included within the Study Area of this Class EA was previously identified in the 2003 Regional Growth Management Strategy as targeted lands for future Greenfields development. The intention was for these lands to be developed for employment uses within Waterloo Region. The 2006 Provincial Growth Plan for the Greater Golden Horseshoe identified the Region as a significant growth area; it was projected that the population of Waterloo Region would grow to 729,000 by the year 2031, based on an initial population estimate of 456,000 in 2001. As part of this estimate, it was forecasted that the employment population would also increase significantly; from 236,000 reported in 2001 to 366,000 by 2031. As of 2014, the Region estimated that the population within Waterloo Region has grown to 568,500.

The 2009 Regional Official Plan (ROP) also included approximately 300 ha of the East Side Lands as part of the Urban Lands within Waterloo Region and designated these lands to be Prime Industrial/ Strategic Reserve. The ROP indicates that these lands are intended to accommodate large lot employment developments. In order to accommodate the employment growth proposed by the Provincial Growth Plan, the Region has designated the East Side Lands as a key area for both employment lands and residential development.

The Provincial Policy Statement (2014) provides province-wide land use planning and development guidance to ensure that growth is accomplished in a sustainable manner while protecting resources of provincial interest, public health and safety, and the quality of the natural and built environment. To ensure that development within the East Side Lands proceeds in a manner consistent with all provincial and municipal planning policies, The Region initiated a Master Environmental Servicing Plan (MESP) for Stage 1 of the East Side Lands, being a smaller component of the broader East Side Lands Area. In 2014, the Region completed its East Side Lands MESP study[1].

The Stage 1 MESP provided recommendations for addressing issues and identifying opportunities related to municipal services for transportation, sanitary (wastewater), potable water and storm water management. The MESP was carried out in accordance with the master planning process for the Municipal Engineers Association Class EA document (2000 as amended in 2007, 2011, and 2015), and included public and agency consultation throughout the planning process. The MESP identified a listing of strategically phased water and wastewater projects to meet servicing needs and to

[1] Dillon Consulting Limited, *Region of Waterloo Master Environmental Servicing Plan*, 2014.

provide necessary infrastructure while minimizing environmental impacts. Specific to this Study, the MESP identified the following projects:

- Trunk sanitary sewer collections mains for the broader East Side Lands;
- A proposed Regional pumping station to service the broader East Side Lands; and
- A sanitary forcemain from the proposed pumping station to the Kitchener WWTP.

Pursuant to the MESP recommendations, the Region initiated the current Class EA Study to identify the preferred solution to provide sanitary servicing for the East Side Lands using a staged development approach to ensure that adequate infrastructure is in place to accommodate the contemplated development staging for the East Side Lands.

Completion of the Class EA requires an evaluation of the sanitary servicing strategies for the East Side Lands and must consider the appropriate staging of development as identified in the MESP. While the pumping station and forcemain solution identified in the MESP is included, the scope of this Class EA Study must also consider other suitable infrastructure alternatives for the collection and the conveyance of sanitary flows from the subject lands to the Kitchener Wastewater Treatment Plant (WWTP) as per the recommendations of the Region's 2007 Wastewater Treatment Master Plan (WWTMP).

1.2 FORMAT OF REPORT

The proposed undertaking is a Schedule 'B' project under the Class EA process. Typically, Schedule 'B' projects are required to complete a Project File, which is documentation of the planning process conducted during Phase 1 and 2 of the Class EA process. The Project File is made available to the public for review and comment after Phase 2 has been completed and after the proponent has issued a Notice of Completion.

Due to the technical complexity associated with the alternative solutions contemplated, as well as the level of stakeholder engagement and consultation undertaken throughout this Class EA, a more substantial summary report was warranted. In order to ensure that the project summary documentation is presented in a structured and intuitive fashion, the Environmental Study Report (ESR) format has been utilized in place of the Project File for this Class EA. An ESR is typically prepared for Schedule 'C' projects only.
This report was prepared to meet the requirements of the MEA Municipal Class EA planning process. The report combines all phases of the planning process completed for the East Side Lands Sanitary Servicing EA under one cover and incorporates steps considered essential for compliance with the requirements of the Environmental Assessment Act. The ESR is comprised of the following sections:

- Section 2 – Provides the historical context for this Study and describes the findings of the 2014 Master Environmental Servicing Plan, the 2009 East Side Servicing

Review Technical Memorandum, and the 2007 Waste Water Treatment Master Plan (WWTMP).

- Section 3 – Provides an overview of the Class EA planning process and background information leading to the initiation of this Study. This section also identifies the specific problem statement to be addressed in this Class EA Study.
- Section 4 – Provides an inventory of the project study area, including location, existing land uses and natural environmental features.
- Section 5 – Describes the wastewater servicing requirements for the broader East Side Lands and establishes design flow rates.
- Section 6 – Describes the alternative evaluation process, which is broken into two distinct parts for this Study.
- Section 7 – Describes the alternatives related to Part 1 of the evaluation process, focussing on the pipeline alignments between the East Side Lands and the Kitchener WWTP
- Section 8 – Presents the evaluation of Part 1 and the alternative pipeline alignments, and identifies the preferred pipeline route.
- Section 9 – Describes the alternatives related to Part 2 of the evaluation process, focussing on the conveyance methodology to be used along the preferred pipeline alignment, including both 1) pumping station and forcemain and 2) gravity sewer options.
- Section 10 – Applies screening criteria to generate a short list of alternative solutions for evaluation.
- Section 11 – Presents the evaluation of Part 2 and the conveyance methodologies, and identifies the preferred methodology.
- Section 12 – Summarizes the preferred solution, and describes mitigation measures recommended to ensure that adverse impacts of the proposed works are managed appropriately.
- Section 13 – Discusses additional study and approval requirements for future work
- Section 14 – Discusses the anticipated project implementation duration and staging of construction.
- Section 15 - Describes public and stakeholder consultation activities undertaken as part of this Class EA.
- Section 16 – Presents the final Study conclusions and recommendations and summarizes the results of the Class EA planning process.

Additionally, various studies and supplemental information can be found in the various Appendices associated with this ESR.

This document was prepared with the intention of presenting all information relevant to the project under one cover for ease of reference. However, if you feel that any information relevant to the proposed undertaking or the Class EA process conducted is absent, please contact the proponent’s designate below.

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2 Planning Context

The Region identified the need for planning and directing growth to ensure that development within Waterloo Region would proceed in an environmentally sustainable and socially responsible manner. The 2003 Regional Growth Management Strategy (RGMS) was prepared to direct and inform future development. The RGMS identified lands within the Class EA Study Area for future greenfield development with a focus on increasing employment opportunities within the Region. Similarly, the Places to Grow Act (2005) designated the Region as a future growth area, with the population within Waterloo Region projected to increase to 729,000 by the year 2031. The employment population within Waterloo Region was also anticipated to increase from a reported 236,000 in 2001 to an anticipated 366,000 by 2031; a net increase of 130,000 jobs. In order to facilitate this level of growth, the East Side Lands were selected as a targeted area for industrial/commercial and institutional development. To foster the level of development proposed, appropriate municipal servicing was also required. As a result, several planning studies have been completed in order to ensure that required municipal infrastructure has been planned for. The following sections describe planning studies which provided input on sanitary servicing for the East Side Lands.

2.1 WASTEWATER TREATMENT MASTER PLAN (2007)

An update to the Region's Wastewater Treatment Master Plan (WWTMP) was completed in 2007. The purpose of the WWTMP was to develop a strategy to ensure there was sufficient sanitary sewage collection and treatment capacity within the Region for future growth to a design horizon of 2041. The WWTMP assessed different technologies and servicing strategies to meet the sanitary servicing needs associated with projected growth across the entire Region. Conceptual wastewater servicing alternatives were reviewed for land areas that were classified as being potentially suitable to support current and contemplated future large industrial developments across the Region. The WWTMP also specifically identified short-term, mid-term and long-term servicing alternatives for what was then defined as the East Side Study Area. The Master Plan projected that the East Side Study Area would consist of 4121 hectare (ha) of developed lands requiring servicing by 2041.

Per the 2007 WWTMP, lands located within the East Side Lands (the Study Area for this Class EA) which could be developed in the short-term included a 164 ha area east of the Village of Breslau as well as 200-300 ha within proximity to Maple Grove Road and Fountain Street in the City of Cambridge. These areas were identified as developable in the short-term because they have the capability to outlet to existing serviced areas. The WWTMP identified that the area east of Breslau could utilize the existing Victoria Street Pumping Station while the lands located within the City of Cambridge boundary could be directed to the Preston WWTP for short-term servicing needs. The WWTMP concluded

that the most appropriate outlet for the whole of the East Side Lands in the mid-term and long-term was the Kitchener WWTP. The WWTMP identified that sanitary servicing of the East Side Lands would consist of a Regional pump station and forcemain for conveyance to the Kitchener WWTP.

2.2 EAST SIDE LANDS SERVICING REPORT (2009)

In 2009, the Region supplemented the 2007 WWTMP with an East Side Lands Servicing Report (completed by AECOM). The intent of the East Side Lands Servicing Report was to provide the Region with a long-term strategy for a large scale, Regional pumping station to service the entire East Side Lands with conveyance to the Kitchener WWTP. The East Side Lands Servicing Report also re-examined potential short-term servicing options with focus on the Stage 1 Lands. These lands are loosely defined as those areas near Maple Grove Road and Fountain Street.

The report provides a summary of work that was completed as part of the 2007 WWTMP and evaluated the existing capacities of four Regional WWTPs (the Galt, Hespeler, Preston and Kitchener WWTPs). The report also examined each WWTP's existing conveyance infrastructure, as well as infrastructure that could be built to service portions of the East Side Lands in the short-term as proposed in the 2007 WWTMP. Two potential alternative pumping station scenarios were outlined in the report, as well as possible sanitary sewer mains and related infrastructure to address the sanitary servicing needs projected under both the short and long-term development scenarios for the East Side Lands. The report concluded with the following key recommendations:

- Complete a MESP for the East Side Lands;
- Identify staging of development for the City of Cambridge;
- Upgrade the Speed River and Highway #401 sanitary sewer crossings;
- Assess / confirm capacities of the Region's WWTPs; and
- Identify the location for an area-wide pumping station for East Side Lands (this project).

2.3 EAST SIDE LANDS - STAGE 1 - MASTER ENVIRONMENTAL SERVICING PLAN (2014)

Based on the recommendation of the East Side Lands Servicing Report, a MESP was jointly undertaken by the City of Cambridge, the Grand River Conservation Authority (GRCA) and the Region to facilitate the coordination of efforts between the municipalities and various other Stakeholders. Completed in early 2014, the MESP covers a variety of technical topics including:

- Community Planning;
- Municipal Water Servicing;

- Municipal Sanitary Servicing;
- Transportation Systems;
- Drainage and Sub-Watershed Issues; and
- Utilities.

In the context of sanitary servicing, the intent of the MESP was to evaluate the various servicing scenarios including alignments, sizes and depths of the major / trunk sanitary sewers as well as the location, size and depth of a Regional pumping station.

The primary focus of the MESP was on what is defined as the Stage 1 Study Area, (see Figure 4-1). This area was identified in previous studies as a priority for short-term development. An area known as the Quick Start Lands is located within the Stage 1 Lands between Middle Block Road and Allendale Road. They contain the Prime Industrial Strategic Reserve (PISR) blocks, which are blocks of land conducive to immediate development based on their proximity to existing sanitary services. The proposed Creekside development lands (which are within the East Side Lands boundary) are also identified as a key part of the Stage 1 development.

Similar to the East Side Lands Servicing Report (2009), the MESP recommends that sanitary flows generated from these Quick Start Lands be initially conveyed to the Preston WWTP in the short-term. This would require the construction of some interim infrastructure by the City of Cambridge, including municipal sewers and potentially private pumping station(s) and forcemain(s), to convey sanitary flows to the existing trunk sewer on Fountain Street that crosses Highway #401 and outlets to the Preston WWTP.

In the long-term (ultimate) scenario, the MESP made the overall conclusion that sanitary flows from all of the broader East Side Lands (including Stage 1) are to be conveyed to the Kitchener WWTP. It concluded that sewers can be aligned to convey sanitary flows from north to south via gravity flow and that a Regional pumping station should be constructed in the vicinity of the southwest corner of the East Side Lands boundary. This pumping station would then convey sanitary flows from the East Side Lands via a forcemain to the Kitchener WWTP. The MESP identified that design of the pumping station and forcemain would be subject to a separate Class EA (i.e. this project). Depending on how and when the full extent of the Stage 1 lands develops, some temporary works and associated extra costs related to potential re-routing of sanitary infrastructure may be necessary to convey the ultimate flows to the Regional pumping station.

In addition to the areas defined as being within the broader East Side Lands and/or the Stage 1 boundaries, there are also some additional City of Cambridge lands that are considered in the MESP; namely the Hunt Club and the Boxwood subdivisions. Furthermore, the City of Cambridge has indicated, in recent discussions regarding the areas defined in the MESP, a desire to have flows from the existing industrial areas on

Fountain Street and Maple Grove Road (i.e. Toyota) be redirected from the Preston WWTP to the Kitchener WWTP via the new Regional pumping station in the long-term (i.e. build out conditions). It is understood that the Region intends to consider this long-term servicing proposal during the next update to the WWTMP.

In addition to the lands that are discussed, the MESP document also identifies various flow rates and design parameters. These include land areas, population densities, land uses and peaking factors that are used to define design flow rates for the Study Area. In some cases, the values stated in the MESP differ from typical design guidelines such as the Ministry of Environment and Climate Change (MOECC) Design Guidelines for Sewage Works (MOECC, 2008) or the Region's Design Guidelines and Supplemental Specifications for Municipal Services (DGSSMS). It is understood that the MESP is the culmination of extensive stakeholder consultation, which included discussion regarding the very conservative nature of the typical design guidelines versus what is actually being observed with existing developments. Therefore, the design flowrates included in the MESP are considered to reflect past sanitary sewer servicing experience within Waterloo Region.

Considering all of the prior work completed to date, this project (i.e. the East Side Lands Sanitary Servicing Class EA) is intended to build on the data and findings of the MESP and the WWTMP as it relates to sanitary servicing. As such, it will make reference to the MESP where appropriate, and where changes or deviations from what is prescribed in the parent documents occur, these will be qualified and explained with supporting rationale.

An important consideration of the MESP's recommendation for the proposed Regional pumping station and forcemain to service the East Side Lands is the notion of timing or staging of flows for both the Stage 1 area, as well as the broader East Side Lands. It suggests that the pumping station be designed and constructed for the ultimate servicing of the broader East Side Lands area; however, it must accommodate a range of interim flow rates that are to be expected as the development for the East Side Lands proceeds.

2.4 WASTEWATER TREATMENT MASTER PLAN (2016 UPDATE)

Concurrent with the completion of this Class EA Study, the Region has initiated an update to the 2007 Wastewater Treatment Master Plan, scheduled to be completed by mid 2017.

The 2007 WWTMP indicated that all of the broader East Side Lands is intended to be serviced by the Kitchener WWTP. However, based on recent internal technical assessments completed by Region staff, there is indication that servicing of the Stage 1 areas of the East Side Lands can be provided by the Preston WWTP in the interim and for the foreseeable future. A formal assessment of this is being included in the WWTMP update.

As such, the scope of this Class EA Study will focus on the ultimate servicing strategy for the broader East Side Lands, with the assumption that interim servicing for the Stage 1 areas will be provided via other means.

3 Class Environmental Assessment - Overview

The East Side Lands Sanitary Servicing Class EA is considered to be a Schedule 'B' undertaking pursuant to the Municipal Class Environmental Assessment document (MEA, 2000 as amended in 2007, 2011, and 2015). The Class EA process is a process used for the planning of municipal infrastructure projects (roads, water and wastewater, and transit) to ensure that project planning and predesign proceeds in accordance with the Environmental Assessment Act. A Schedule 'B' project includes public and review agency consultation, an evaluation of alternatives, an assessment of the impacts of the preferred solution, and identification of measures to mitigate any adverse impacts.

Typically, in Class EA studies, one of the alternatives considered is to do nothing. As noted in the 2007 WWTMP:

> "The do nothing alternative must be reviewed as part of a Class Environmental Assessment. This alternative is not a viable option in this case. This alternative would require a stagnation of growth and the further use of septic systems within the East Side. This scenario does not meet the Region's mandate to prepare for growth as noted in the Regional Growth Management Strategy."

Table 3-1 is an excerpt from the municipal Class EA guideline document illustrates the process followed in the typical planning and design of projects covered by a Class EA. A further description of the Class EA process is provided in subsequent sections.

Table 3-1
Municipal Class EA Process

	PHASE 1	PHASE 2	PHASE 3	PHASE 4	PHASE 5
BASIC PROCESS (See Exhibit A.2 for detailed flow chart)	PROBLEM OR OPPORTUNITY	ALTERNATIVE SOLUTIONS	ALTERNATIVE DESIGN CONCEPTS FOR PREFERRED SOLUTION	ENVIRONMENTAL STUDY REPORT	IMPLEMENTATION
Consultation Requirements	Optional	Mandatory	Mandatory	Mandatory	Optional
SCHEDULE A/A+ PROJECTS[1]	✓ (3)				✓
SCHEDULE B PROJECTS[1]	✓	✓			✓
SCHEDULE C PROJECTS[1]	✓	✓	✓	✓	✓
MASTER PLANS[1] (See Section A.2.7)	✓	✓ (As a minimum Master Plans address Phases 1 and 2)	✓ (2)	✓ (2)	✓ (2)

NOTES:
✓ Actions required during relevant phase

3.1 CLASS ENVIRONMENTAL ASSESSMENT PLANNING PROCESS

Every municipality in Ontario is subject to the provisions of the Environmental Assessment Act (EAA) and its requirements to conduct an Environmental Assessment for most public works projects. The MEA Class EA document provides municipalities with a five-phase planning procedure approved under the EAA which provides direction on how to plan and undertake all municipal projects that recur frequently, are usually limited in scale and have a predictable range of environmental impacts. Projects considered by the Class EA process include municipal roads, wastewater, storm water management, water and transit. The MEA Class EA document also requires that the decision-making process followed by the municipalities in the planning and implementation of infrastructure is transparent and provides opportunity for public and stakeholder involvement.

Table 3-1 illustrates the steps followed in the planning and design of projects covered under the Class EA process. This figure incorporates steps considered essential for compliance with the requirements of the EAA. With increasing complexity and higher likelihood for adverse environmental impacts, projects are required to complete additional planning steps, termed 'Phases' by the Class EA document, prior to obtaining approval to proceed with a proposed project. The Municipal Class EA document (MEA, 2000 as amended in 2007, 2011, and 2015) provides the following description of the five phases potentially requiring completion before Class EA projects can be approved:

Phase 1 Identify the problem (deficiency) or opportunity.

Phase 2 Identify alternative solutions to address the problem or opportunity by taking into consideration the existing environment, and establish the preferred solution taking into account public and review agency input.

Phase 3 Examine alternative methods of implementing the preferred solution, based upon the existing environment, public and review agency input, anticipated environmental effects and methods of minimizing negative effects and maximizing positive effects.

Phase 4 Document, in an Environmental Study Report a summary of the rationale, and the planning, design and consultation process of the project as established through the above phases, and make such documentation available for scrutiny by review agencies and the public.

Phase 5 Complete contract drawings and documents, and proceed to construction and operation; monitor construction for adherence to environmental provisions and commitments. Where special conditions dictate, also monitor the operation of the completed facilities.

Based on the MEA Class EA document, projects are classified as either Schedule 'A', 'A+', 'B' or 'C' projects. Each of these classifications requires a different level of review to complete the requirements of the Class EA, and thus comply with the EAA, as noted below.

Schedule '**A**' projects are limited in scale, have minimal adverse effects and include the majority of municipal sewage, storm water management and water operations and maintenance activities. These projects are pre-approved and may be implemented without following the Class EA process. Schedule 'A' projects typically include normal or emergency operational maintenance activities where the environmental effects of those activities are usually minimal. Examples of Schedule 'A' projects include the installation of new service connections, catch basins and appurtenances for existing sewers.

Schedule '**B**' projects have the potential for some adverse environmental effects. The proponent (i.e. The Region in the case of this Class EA) is required to undertake a screening process involving mandatory contact with directly affected public, First Nations groups and relevant government agencies to ensure that they are aware of the project and that their concerns are addressed. A Schedule 'B' activity requires the proponent to conduct two mandatory points of public contact during Phase 2. Additionally, the proponent may elect to undertake a discretionary public consultation at the end of Phase 1 to present the problem or opportunity identified.

Phases 1 and 2 of the Class EA process must be followed and a Project File report must be prepared and submitted for review by the public. A notice of completion must be submitted to review agencies and the public and a period of 30 calendar days are provided for comment and input on the Project File report.

As long as there are no outstanding concerns raise by the public and/or relevant government agencies, the proponent may proceed to project implementation. However, should a person or party have a concern or objection, they are expected to consult with the proponent to try to resolve the concern. Alternatively, if concerns cannot be resolved, the person or party with the objection may request a Part II Order from the Minister of the Environment and Climate Change. Further Details on the process of requesting a Part II Order can be found in Section 3.2.

Projects that involve improvements and expansions to existing facilities where there is the potential for some adverse environmental impacts generally fall under the Schedule 'B' Class EA procedure. An example might include establishing, extending or enlarging a sewage collection system and all works necessary to connect the system to an existing sewage outlet where such facilities are not in an existing road allowance or an existing utility corridor.

Schedule '**C**' projects are those that have the potential for significant adverse environmental impact, and must proceed under the full planning and documentation procedures (Phases 1 to 5) specified in the MEA Class EA document. A Schedule 'C' project is required to complete an Environmental Study Report (as opposed to a Project File for Schedule 'B').

The proponent is required to undertake consultation during multiple phases during the Class EA involving mandatory contact with directly affected public, First Nations groups and relevant government agencies to ensure that they are aware of the project and that their concerns are addressed. Schedule 'C' projects involve 4 points of mandatory public contact: twice during Phase 2, once during Phase 3 and again during Phase 4 after the ESR document is placed on public record. Schedule 'C' projects require that an Environmental Study Report be prepared and submitted for review by the public. If concerns are raised that cannot be resolved, then a Part II order can be invoked.

Schedule 'C' projects generally include the siting-construction of new facilities and major expansions to existing facilities. An example would be constructing a new road through a wetland or forest area, where environmental impact could be significant.

3.2 PART II ORDER

Public, review agency and First Nations consultation is a key part of the Class EA process. In a Schedule 'B' project, such as the sanitary servicing solutions for the East Side Lands considered under this Class EA Study, the proponent is required to provide opportunity for the public to be consulted about the proposed project. Consultation is intended to inform the public and other stakeholders about the proposed project, the various alternative solutions considered and their anticipated environmental impacts, as well as the preliminary preferred solution. It is also intended that the public be given opportunity to provide input or raise concerns prior to completion of the Class EA process. It is intended that issues be identified early into the project by means of public involvement and that resolutions between the proponent and the person or party with the objection be achieved through consultation.

It is incumbent on the public that concerns about the environmental effects of a proposed project or the planning process being followed are brought to the attention of the proponent early in the planning process, when the proponent has greater flexibility to accommodate changes in the project development and the process.

If the consultation process raises a concern that cannot be resolved between the proponent and the person or party raising the objection, then a Part II order can be invoked. However, prior to a Part II Order being requested, the person or party with the objection may request the proponent to voluntarily elevate a Schedule 'B' project to a Schedule 'C' project, or to elevate a Schedule 'B' or 'C' project to an individual environmental assessment. If the proponent declines this request, the person or party raising the objection may write to the Minister of the Environment and Climate Change or delegate to request a Part II Order. A request for a Part II Order must be copied by the requester to the proponent at the same time that it is submitted to the Minister or delegate.

For Schedule 'B' projects, a written Part II order must be submitted to the Minister or delegate within 30 calendar days of the proponent issuing the Notice of Completion.

Should you wish to request a Part II Order for the East Side Lands Sanitary Servicing Class EA, please provide a written request to the Minister of the Environment and Climate Change or delegate at the contact details provided below. You must also provide a copy of the written request to the MOECC Director, Environmental Approvals Branch and the Proponent.

Minister, Ministry of the Environment and Climate Change
Floor 11
77 Wellesley St W
Toronto ON M7A 2T5
Fax: 416-314-8452

Director, Environmental Approvals Branch
Ministry of the Environment and Climate Change
135 St. Clair Ave West, 1st Floor
Toronto ON M4V 1P5

Nicole Sapeta, P.Eng.
Project Engineer, Water Services Division
Region of Waterloo
150 Frederick Street,
Kitchener, ON, N2G 4J3

You should include the following information, but are not limited to:

- Your name and address;
- Project name;
- Proponent name;
- Details about the project;
- Clear statement that you are requesting a Part II Order;
- Specific reasons why the request is being made - concerns and issues;
- Why a higher level of environmental assessment would address your concerns;
- Information about efforts to date to discuss and resolve concerns with the proponent; and
- Other matters relevant to the request.

Unless you state otherwise in your request, any personal information you provide will become part of the public record and will be released, if requested, to any person.

In your request, you must:

- focus on potential environmental effects of the project or the Class EA process;
- not focus on decisions outside the Class EA process (e.g., land-use planning decisions made under the Planning Act or issues related to municipal decision-making about the process);
- not raise issues unrelated to the project

3.3 STUDY ORGANIZATION & PROJECT TEAM

A Steering Committee was formed for this project, comprised of representatives from the Region of Waterloo, City of Cambridge, City of Kitchener, Township of Woolwich, Grand River Conservation Authority, and members of the consultant team, as follows:

Region of Waterloo Representatives:

Nicole Sapeta	Project Engineer (Region Project Manager)
Jorge Cavalcante	Manager of Engineering & Planning – Water Services
Nancy Corbett	Senior Project Manager, Design and Construction
Nancy Kodousek	Director, Water Services
Trevor Brown	Manager of Operations & Maintenance, Kitchener WWTP
Brenna MacKinnon	Manager, Development Planning
Kevin Dolishny	Senior Project Engineer, Water Services
Tim Van Hinte	Principal Planner (Environmental)

City of Kitchener:

Steve Allen	Manager, Engineering

City of Cambridge

Sarah Austin	Manager of Development Engineering

Township of Woolwich

John Scarfone	Senior Planner
Randy Miller	Project Engineer

Grand River Conservation Authority

Beth Brown	Senior Resource Planner
Kaitlyn Smith	Resource Planner

Council Members:

Donna Reid	City of Cambridge
Murray Martin	Township of Woolwich
John Gazzola	City of Kitchener

Consultant Team Representatives:

Duane Lindner	Associated Engineering (Consultant Project Manager)
Alannah Connell	Associated Engineering (Environmental Technician)
Jessica Linton	Natural Resource Solutions Inc. (Environmental Consultant)
Karen Thrams	Englobe Inc. (Geotechnical Consultant)
Paul Ritchie	Archaeological Services Inc. (Archaeology Consultant)
Annie Villieux	Archaeological Services Inc. (Cultural Heritage Consultant)
Dave Hardy	Hardy Stevenson & Associates (Communications Consultant)

3.4 DESCRIPTION OF THE STUDY AREA

The following describes the project Study Area, including its location, existing land uses and natural environmental features. This information was considered when reviewing potential effects of alternative sanitary servicing solutions.

As defined in the MESP, the East Side Lands Study Area refers to an area of land east of the Grand River within the east side of Waterloo Region. The East Side Lands consist of the northern portion of the City of Cambridge, the southern portion of the Township of Woolwich and the southeast portion of the City of Kitchener.

The East Side Lands contain a total of approximately 4,000 ha of land, of which the MESP defines 855 ha in the northern part of the City of Cambridge to be the Stage 1 Lands. The broader East Side Lands are defined as the remaining area of the East Side Lands, not including the Stage 1 Lands. The MESP further defined the East Side Lands to include an area referred to as Quick Start Lands that comprised of 171 ha area adjacent to Fountain Street and north of Allendale Road. Quick Start Lands were identified based on land that could be developed with a minimal amount of infrastructure.

3.5 OBJECTIVE OF THE STUDY & PROBLEM STATEMENT

Phase 1 of the Class EA planning process requires the proponent (i.e. the Region) of an undertaking to first document factors leading to the conclusion that the improvement is needed, and ultimately, develop a clear statement of the identified problem or opportunity to be investigated.

As such, the problem statement is the principle starting point in the undertaking of a Class EA and becomes the central theme and integrating element of the project. It also assists in setting the scope of the project.

Problem Statement

> *The Region of Waterloo's East Side Lands Master Environmental Servicing Plan (MESP) assessed the wastewater servicing options necessary to meet future growth in accordance with the Region's Official Plan (to a planning horizon of 2020). The MESP provides a listing of strategically phased projects to meet servicing needs and to provide the necessary services in an environmentally sustainable manner.*
>
> *The East Side Lands are targeted for greenfield development related to growing employment within the Region. The MESP has identified the need for capacity expansion within the East Side Lands wastewater servicing, including a new pumping station and forcemain alignment to the Kitchener Wastewater Treatment Plant. However, consistent with the recommendations of the Municipal Class EA document (MEA, 2000 as amended 2007,2011, and 2015), all reasonable and feasible alternative solutions for sanitary servicing of the East Side Lands must be considered.*

The Region initiated this Class EA planning process in 2013, which identifies and evaluates alternative solutions to address the above problem statement. This Class EA ESR has been prepared to determine how the proposed East Side Lands sanitary servicing can be best sited, designed, constructed and operated.

3.6 CONSULTATION PROCESS

As part of the planning process, several steps have been completed to inform government agencies, affected landowners and the local community/general public of the nature and scope of the project and to solicit any comments.

Throughout the Study, public, stakeholder, First Nations and agency notification included:

- Notice of Study Commencement	November 2013
- Interim Notice to Deer Ridge Residents	September 2014
- Updated Notice of Project	August 2015
- Stakeholder Alternative Evaluation Workshop	November 2015
- Public Consultation Centre Notice	October 2016
- Public Consultation Centre (PCC)	November 8, 2016
- Additional Consultation (Re. Cultural Heritage)	January – October 2017
- Notice of Completion (Regional Council)	January 2018
- Environmental Study Report 30 Day Review Period	February 2018
- Part II Order Requested	February 28, 2018
- Part II Order Resolved	October 2018
- Final ESR Issued & Filed	November 2018

Further consultation process details are provided within Section 14 of this report.

4 Inventory of Existing Conditions

As part of Phase 2 of the Class EA process, a data collection and inventory exercise must be conducted for the various environments existing within the Study Area. The natural, social and technical environments, as well as relevant planning considerations affecting the project were considered and together form the existing conditions of the Study Area. The Municipal Class EA document (MEA, 2000, as amended in 2007, 2011, and 2015) defines an environment as:

> “ a) air, land or water;
> b) plant and animal life, including human life;
> c) the social, economic and cultural conditions that influence the life of humans, or a community;
> d) any building, structure, machine or other device or thing made by humans,
> e) any solid, liquid, gas, odour, head, sound, vibration or radiation resulting directly or indirectly from human activities; or
> f) any part or combination of the foregoing and the interrelationships between any two or more of them;
>
> in or of Ontario.”

In order to adequately consider the environment and characterize the potential impacts the proposed project may have on it, the Class EA document states that the proponent should consider the following (**Table 4-1**):

Table 4-1:
Key Considerations identified in the Municipal Class EA document

Key Consideration	Definition
1. Land-Use Planning Objectives	Refer to the plans and policies as identified in provincial plans and municipal official plans and secondary plans. At a provincial level, key policies/plans include the Provincial Policy Statement (PPS), the Places to Grow Act (2005) and associated Growth Plan(s).
2. Natural Heritage Features	• Landforms (including valleylands); • Groundwater; • Surface water and fisheries; • Terrestrial vegetation and wetlands; • Wildlife and habitat; and • Connections provided by or between these resources.
3. Social Environment	Includes existing communities, residential areas and recreational areas.
4. Cultural Environment	Refers to cultural heritage and archaeological resources in the environment
5. First Nations/Aboriginal Peoples	This may include, but not be limited to: • First Nations lands • Aboriginal Peoples' Treaty Rights or use of land and resources for traditional purposes • Aboriginal Peoples' industry • Pre-historic and historic Aboriginal Peoples' archaeological sites • Aboriginal Peoples' rights claims
6. Economic Environment	Commercial and industrial land uses and activities. It also includes the financial costs associated with the alternatives, including construction, operation, maintenance and property costs.
7. Property	Property impacts should be avoided where possible. Property impacts include direct impacts on: access, parking, and buildings, and indirect impacts where by as a result of relocating property lines the property owner is placed out of compliance with local standards (i.e. building setback requirements, etc.)

As a method to ensure that these key considerations were adequately addressed through this Study, the documents presented in **Table 4-2** were reviewed.

Table 4-2:
Reference Documentation Providing Context to the Current Class EA Study

Provincial Policy Statement, 2014
Provincial Growth Plan for the Greater Golden Horseshoe, Province of Ontario, 2006
2003 Regional Growth Management Strategy
Regional Official Plan, Region of Waterloo, as approved in 2015
Regional Aerial Imagery, GIS and Topography data
Grand River Conservation Authority Mapping
East Side Lands Master Environmental Servicing Plan (MESP), 2013
Wastewater Treatment Master Plan (WWTMP), Region of Waterloo, 2007
East Side Servicing Review Technical Memorandum, AECOM, 2009
Kitchener WWTP Upgrades – Partial Site Plan 1 – 6, 2012
Creekside Development Concept Plan, MTE Consultants, 2013
Environmental Impact Study – Creekside Phase 1 Lands, MMM Group, 2014
MOECC Design Guidelines for Sewage Works
Region of Waterloo Design Standards

During the evolution of this Study and to supplement these background reports, additional investigations and studies were commissioned to address data gaps for specific areas of relevance. These are listed below and discussed in greater detail later in this report.

East Side Lands Sanitary Servicing Class EA - Environmental Impact Study (EIS), - Natural Resource Solutions Inc., 2015
East Side Lands Sanitary Servicing Class EA - Stage 1 Archaeological Assessment, - Archaeological Services Inc., 2015
East Side Lands Sanitary Servicing Class EA - Cultural Heritage Resource Assessment, - Archaeological Services Inc., 2015
East Side Lands Sanitary Servicing Class EA - Geotechnical Investigation Report - Englobe Inc., 2015

The following sections provide a characterization of existing conditions within and proximal to the Study Area as they related to the key considerations outlined by the Class EA document.

4.1 STUDY AREA

In order to properly identify and provide conceptual design details related to sanitary servicing alternative solutions for the East Side Lands, a clear definition of the Class EA Study Area and its associated land uses is required. Furthermore, existing land designations and their uses within the Study Area which require sanitary servicing must be identified to aid in defining the design flow rates and allow for the appropriate sizing and location of the sanitary servicing infrastructure.

The Study Area includes what is generally referred to as the broader East Side Lands, and can be coarsely defined as lands constrained by Highway #7 to the North, the Grand River to the West, Shantz Station Road / Speedsville Road to the East and Highway #8 / Highway #401 to the South.

While the 2014 MESP considered the broader East Side Lands, it focused primarily on the area identified as Stage 1, being south of the current City of Cambridge urban boundary and west of Speedsville Road.

Since the sanitary sewage from the broader East Side Lands will ultimately be conveyed to the Kitchener WWTP, the Study Area for this Class EA must also include lands that will contain the pipeline route traversing the area between the East Side Lands and the Kitchener WWTP.

Similar to the 2014 MESP, while the broader East Side Lands are considered in this Study, in particular with regard to contributing sanitary drainage areas, the primary focus area of this Study relates to the lands where new infrastructure would be required to implement the alternative solutions that are being considered. Essentially, this includes the lands generally bounded by the City of Cambridge Urban boundary to the north, the Grand River to the west and south, Highway #401 to the south and the broader East Side Lands boundary to the east.

Considering all this, the Study Area for this East Side Lands Sanitary Servicing Class EA is depicted in **Figure 4-1**.

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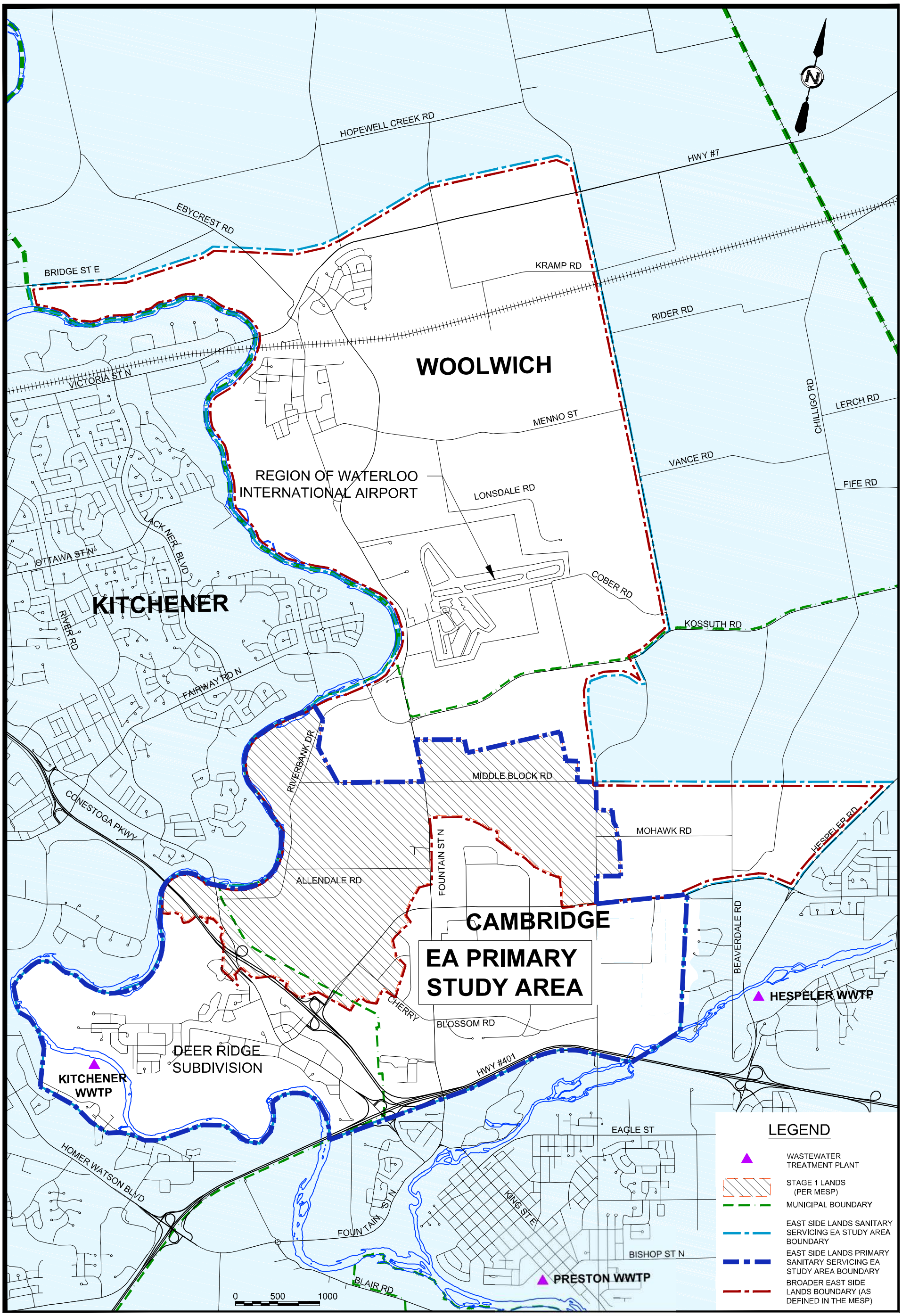

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REGION OF WATERLOO

EAST SIDE LANDS SANITARY SERVICING EA

STUDY AREA

4.2 STUDY AREA TOPOGRAPHY

As the East Side Lands will be servicing a large area, and since gravity sewer flow will be a key factor in the development of alternative solutions, it is important to understand the topographical nature of the land within the Study Area.

In general, the topography of the broader East Side Lands slopes naturally from the north in the Township of Woolwich toward the south-southwest boundary of the Grand River with numerous localized low points and high points throughout. The highest points are located east of the Village of Breslau while the lowest points are located near the Kitchener-Cambridge municipal border. **Figure 4-2** provides a graphical representation of the elevation differences throughout the Study Area.

According to the 2014 MESP (Section 4.6), in the long-term it is possible to service the majority of the broader East Side Lands via gravity collection sewers. Based on the topography, trunk sewers can be designed to convey flows from north to south along a route generally consistent with the Fountain Street road alignment. To minimize depths of the trunk sewers, local pumping stations may be utilized. Depending on the bulk area grading schemes for developments in some low lying areas, local pumps stations may be required to convey flows into the trunk sewer. The trunk sewer and/or ancillary pump stations would all be considered municipal infrastructure (i.e. owned and operated by the City of Cambridge and / or Township of Woolwich).

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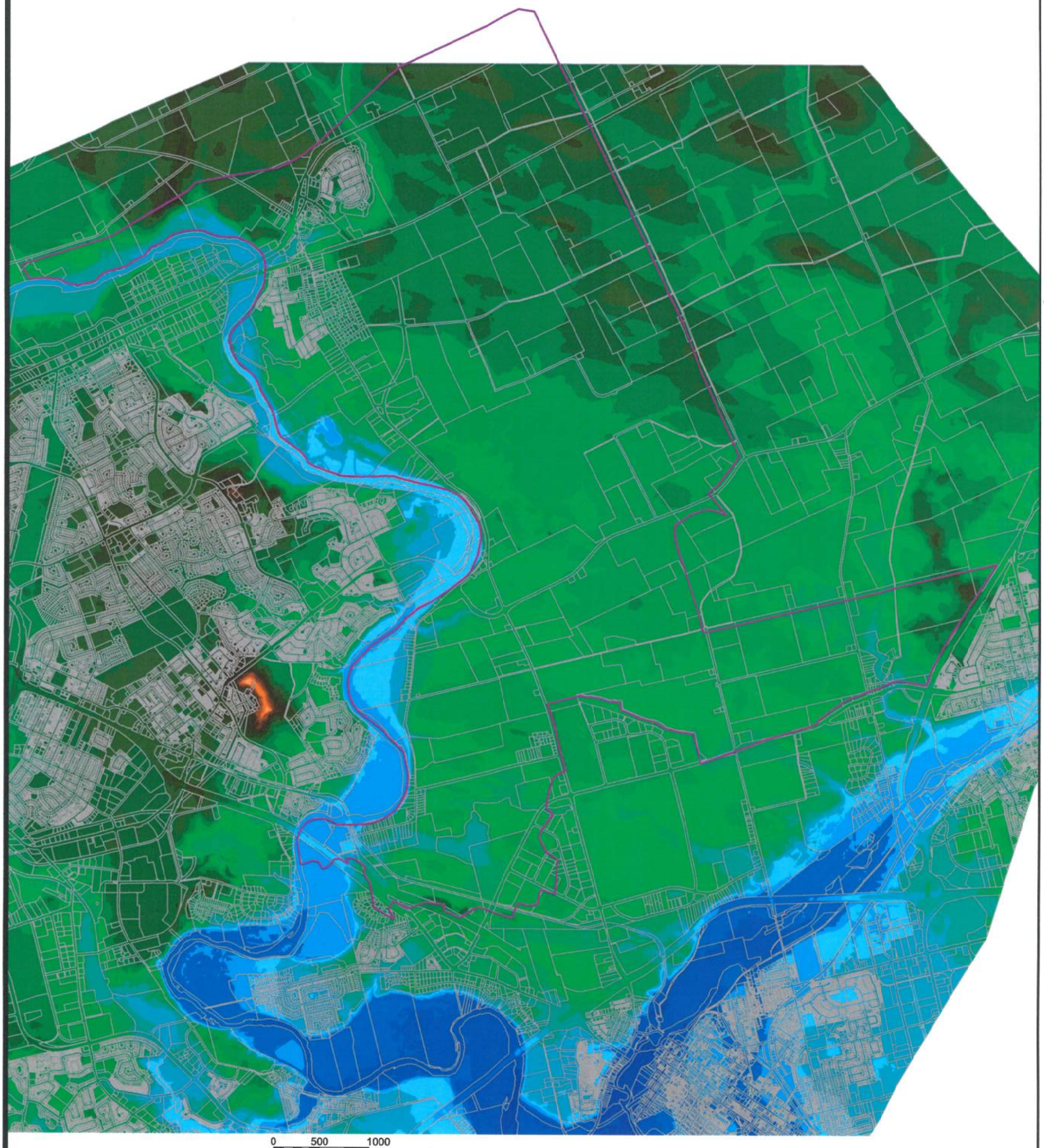
Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	266.50	271.50	
2	271.50	276.50	
3	276.50	281.50	
4	281.50	286.50	
5	286.50	291.50	
6	291.50	296.50	
7	296.50	301.50	
8	301.50	306.50	
9	306.50	311.50	
10	311.50	316.50	
11	316.50	321.50	
12	321.50	326.50	
13	326.50	331.50	
14	331.50	336.50	
15	336.50	341.50	
16	341.50	346.50	
17	346.50	351.50	
18	351.50	356.50	
19	356.50	361.50	
20	361.50	366.50	
21	366.50	371.50	
22	371.50	376.50	
23	376.50	381.50	
24	381.50	386.50	
25	386.50	391.50	
26	391.50	398.50	



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REGION OF WATERLOO

EAST SIDE LANDS PUMPING STATION & FORCEMAIN CLASS EA

LAND TOPOGRAPHY

4.3 GEOLOGY & HYDROGEOLOGY

As part of the Class EA Study consultant team, Englobe Inc. was commissioned to complete the geotechnical and hydrogeological inventory for the Study Area.

4.3.1 Preliminary Desktop Information

The general soil geology within lands adjacent to the Grand River is sandy to sandy/silt and till moraines. This is consistent with the conditions shown in the Region of Waterloo Quaternary mapping illustrated on **Figure 4-3**.

Since a significant component of the Region's water supply comes from groundwater sources, it is important to consider the existing groundwater conditions within the Study Area. Based on available mapping, it is understood that the Study Area includes groundwater resource features identified as Clean Water Act (CWA) Vulnerability Areas as well as Regional Well Head Protection Areas (WHPA's), as referenced in the Grand River Source Protection Area – Approved Assessment Report.

Figure 4-4 presents a high-level overview of the existing groundwater conditions as well as areas of sensitivity. It is noted that the groundwater contours shown are based on the limited information that was available within the 2014 MESP.

4.3.2 2015 Geotechnical Investigation

Through the evolution of this Class EA Study, and specifically the development of its alternative solutions, it was concluded that more detailed geotechnical and hydrogeological information would be required to properly assess and evaluate the various alternatives. To address these data gaps a scoped geotechnical investigation was commissioned by the project team.

At the time of report preparation, a preferred pipeline alignment (Route 'B') had been identified, including two alternate river crossings that were being considered; one located south of the Pioneer Tower and the other located south of the pumping station at the west end of Pioneer Tower Road.

In July 2015, Englobe issued a desktop study report for the proposed Study Area. Additionally, geotechnical field work (i.e. new boreholes) has been completed along sections of Route 'B'.

The proposed corridor is underlain by about 20 to 40 m of Quaternary overburden deposits of the 'Late Wisconsinan Age' over dolostone of the Salina Formation. Surficial materials on the north side of Highway 8 generally comprise sand overlying silt till material (Port Stanley Till) which is interbedded with sand seams. An esker ridge of sand

and gravel occurs between Highway 8 and the Canadian Pacific Railway (CPR) tracks. To the southwest of Highway 8 and King Street East, the soil conditions generally comprise a complex succession of outwash gravel, sand, silt, and glacial tills (Port Stanley Till). The soil conditions encountered in the vicinity of the Grand River comprise recent alluvial deposits of sand, gravel, and silt overlying glacial till at depth.

Measured perched groundwater levels range from approximately Elevation 300 to 310 m north of Highway 8, and from 290 to 305 m south of Highway 8. The groundwater level near the Grand River is close to the river water level of approximately Elevation 277 m.

It is understood that a new pipeline will be installed using both open cut and trenchless technologies. Trenchless methods are being considered for the installation beneath the CPR tracks, Highway 8, and depending on the final design through sections of the Deer Ridge Subdivision.

Perched groundwater conditions in the saturated sands and gravels above the relatively impermeable glacial till will require dewatering where excavations extend into these deposits. It is envisaged that Category 2 or 3 Permits to Take Water will be needed for sections of the work. Detailed construction design drawings and excavation methods are required in order to accurately assess the dewatering rates.

Conventional open-cut sewer construction is expected to be relatively straight forward in the competent soils encountered to date along the planned routes.

For trenchless methods, it is recommended to install the sewer in the glacial till horizon if possible; however, occasional to numerous cobbles and boulders should be expected and might result in construction difficulties or delays. The risk of loss of drilling fluid or release of drilling fluid to the environment should be considered for trenchless technologies.

Three slopes are located in the vicinity of the two possible river crossing locations. All the slopes were inspected and rated using the Ministry of Natural Resources slope stability rating charts. Preliminary slope stability analyses were completed for the west slope at the Pioneer Tower and the south slope at the pumping station using interpolated slope profiles. The south slope at the Pioneer Tower was excluded as no topographic information was available. The preliminary results indicate that the south slope at the pumping station is stable at a factor of safety of greater than 1.5. The west slope at the Pioneer Tower is marginally stable with a factor of safety near 1.0 and a preliminary stable slope allowance of 22 m from the current top of slope for a factor of 1.5 needs to be considered. Additionally, a minimum toe erosion of 5 to 8 m and an access allowance of 6 m needs to considered for the slopes. A detailed slope analysis using data from a detailed topographic slope survey will be required as part of detailed design.

For preliminary excess soil management, the MOECC Table 2 Standards were used as an indication of contamination at the site and the MOECC Table 1/Table 8 Standards were used for off-site excess soil re-use purposes.

The analytical results showed that several samples exceed the MOECC Table 1 Standards for Sodium Adsorption Ratio (SAR) and/or Electrical Conductivity (EC); however, they are not considered as contaminants of concern in accordance with Ontario Regulation 153/04, as amended (O.Reg.153/04). An elevated concentration of chromium exceeding the MOECC Table 1 Standard was detected at Borehole BH-07-15, within the fill materials. The excess soils must be re-used within appropriate areas of the site (considering the elevated concentration of chromium above the MOECC Table 1 Standard at Borehole BH-07-15 and the presence of the GRCA wetland, Grand River, creek crossing, and Area of Natural Scientific Interest (ANSI)) or re-used or disposed of off-site at appropriate sites considering the concentrations of contaminants in the excess material.

Please refer to **Appendix A** for the full Geotechnical Investigation Report.

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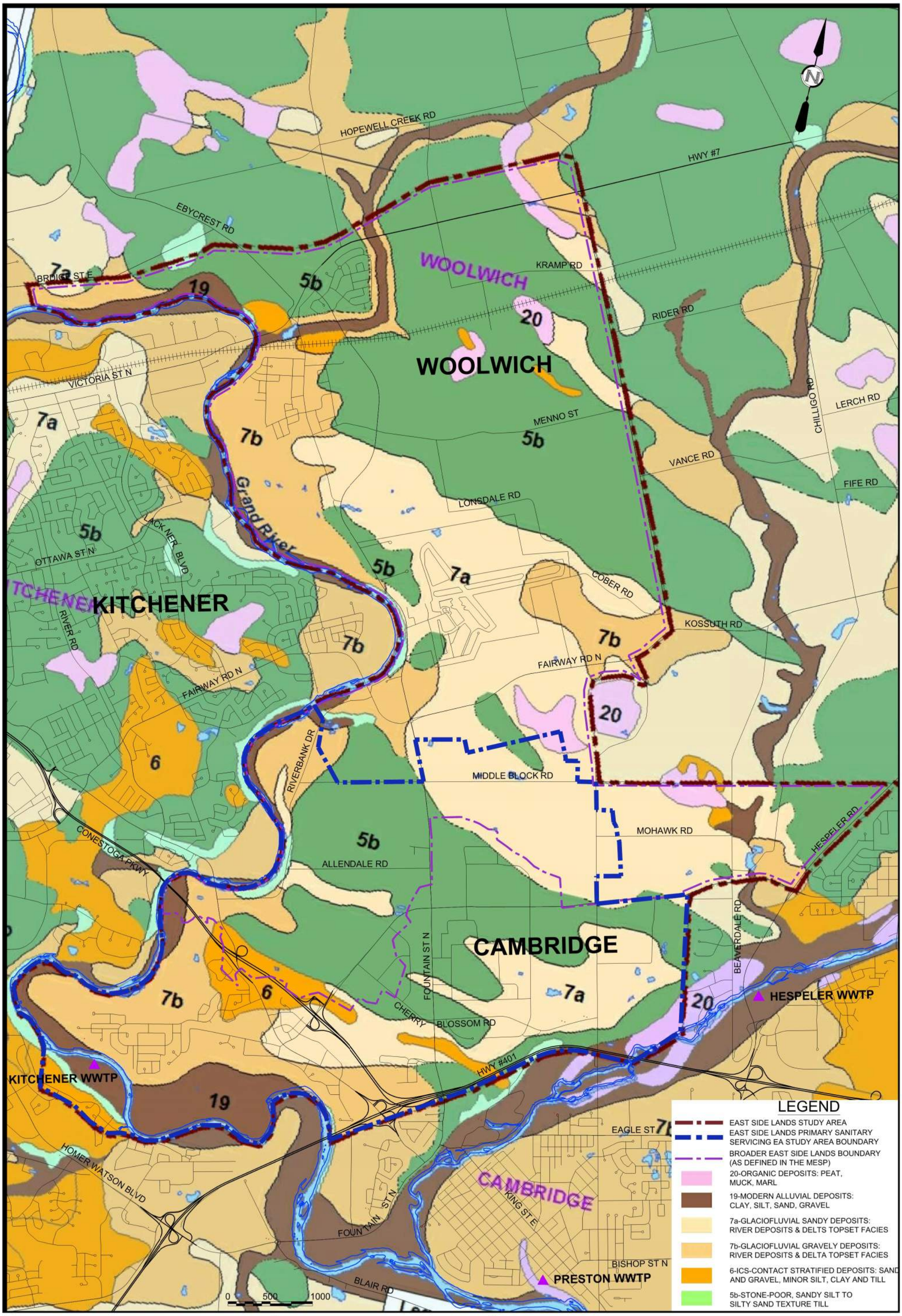

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EAST SIDE LANDS PUMPING STATION & FORCEMAIN CLASS EA

QUATERNARY SOIL MAPPING

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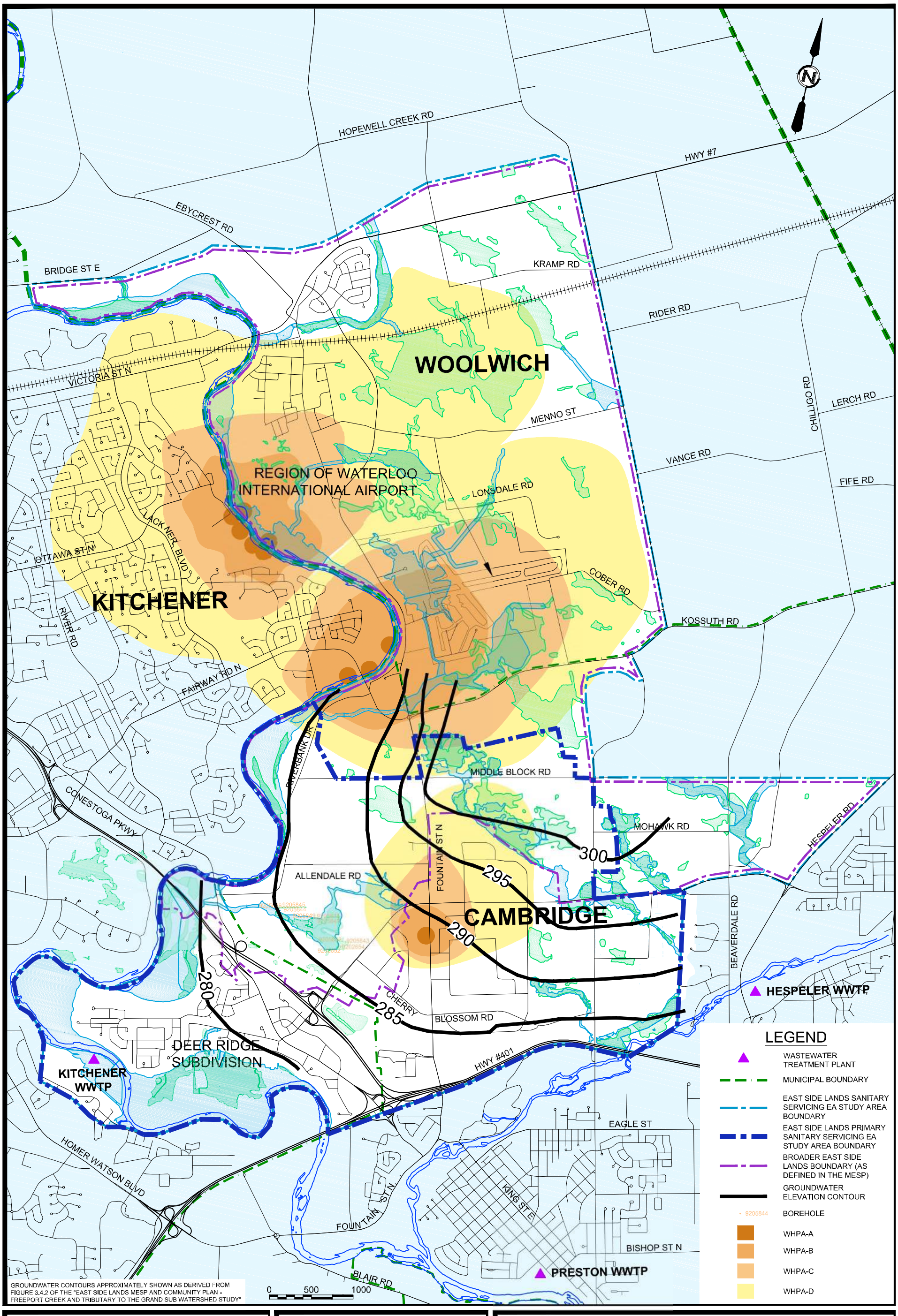

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REGION OF WATERLOO

EAST SIDE LANDS SANITARY SERVCING CLASS EA

GROUNDWATER MAPPING

4.4 NATURAL ENVIRONMENT

As part of the Class EA Study consultant team, Natural Resource Solutions Inc. (NRSI) was commissioned to complete the natural heritage inventory and Environmental Impact Study (EIS) for the Study Area (please refer to **Appendix B** for full report).

This report summarizes background information on natural heritage features, as well as the methods and results of a comprehensive field program including Ecological Land Classification, a multi-season vascular flora inventory, aquatic habitat characterization, and targeted surveys for birds, reptiles, and amphibians within the Study Area.

The detailed characterization of existing natural features was used to inform an analysis of the significance and sensitivity of natural features within the study area. This analysis, in consideration with applicable municipal and provincial policies and legislation, was used to evaluate several alternative routes/locations for the pipeline, and conveyance methodologies, from a natural heritage perspective.

The following significant natural features have been confirmed within the Study Area and require consideration:

Aquatic Habitat Features

- Grand River
- Freeport Creek
- Unnamed Tributaries
- Floodplain

Wetlands Features

- Upper Freeport Creek Provincially Significant Wetland (PSW) Complex
- Lower Freeport Creek Wetland Complex
- Grandview PSW Complex
- Locally Significant Wetlands

Geological Features

- Freeport Esker Earth Science ANSI
- Regionally Significant Valleyland
- Steep Slopes

Significant Wildlife Habitat

- Deer Winter Congregation Area
- Waterfowl Overwintering Area
- Turtle Wintering and Nesting Area
- Rare Vegetation Community
- Bald Eagle and Osprey Nesting, Foraging and Perching Habitat

- Groundwater Seeps and Springs
- Amphibian Breeding Habitat
- Marsh Bird Breeding Habitat
- Habitat for Species of Conservation Concern (American Gromwell, Eastern Wood-Pewee, Bald Eagle, Snapping Turtle, Milksnake, Western Chorus Frog, Common Sootywing, Mucket Mussel, and Elktoe Mussel)

Habitat for Threatened and Endangered Species

- Butternut
- Barn Swallow
- Bobolink
- Eastern Meadowlark
- Rainbow Mussel
- Wavy-rayed Lampmussel
- Silver Shiner
- Black Redhorse

Other Significant Natural Features/Area Designations

- Regional Core Environmental Features (Significant Woodlands, Grandview Woods Environmentally Sensitive Policy Area (ESPA) Homer Watson Park ESPA and Proposed Freeport Marsh ESPA)
- Habitat for Regionally rare vascular plants, birds, and amphibians

A preliminary qualitative analysis which considered obvious direct impacts to woodlands and wetlands, potential indirect impacts to tree root zones and/or wetlands, and watercourse crossings. Generally, it is anticipated that minor or temporary impacts to wildlife and wildlife habitats can be mitigated through carefully planned construction timing windows and construction practices.

Figure 4-5 illustrates Vegetation Communities within the Study Area. (Sheets 1-5)
Figure 4-6 illustrates the Significant Wildlife Habitat within the Study Area.
Figure 4-7 illustrates the Species at Risk Habitat within the Study Area.

SHEET 1 of 5

East Side Lands Sanitary Servicing Class EA

FIGURE 4-5
VEGETATION COMMUNITIES

HOFSTETTER AVE
STONEGATE DR
HIDDEN VALLEY RD
KINGSTON BYPASS HIGHWAY 8
KINGSTON
RIVERBANK DR
GRAND HILL DR
Grand River
Trib 1
Trib 2
Grandview PSW Complex
FODM5-8 34
FODM7 67
MEMM4 27
SWDM4-1 68
MEMM4 27
MASO1-1 26
FOD
SWDM4-1 23A
THDM2-6 25B
MEMM4 27
SWDM4-1 23A
TAGM1 25
MAMM2 25A
MAMM1-3 35
MEMM3 23
TAGM1 25
MAMM1-2 23C
SWDM4-1 43B
SWTM5 24
FODM5 1A
FOCM4-1 95
OA
CGL_4
FODM5 1A
FODM5 12
CGL_1 49
Grandview PSW Complex
TAGM1 25
SWTM5 24
FODM7-2 43A
MEFM1-1 21B
FODM5 12
FOMM3-2 36A
SWDM2-1 43
FODM5-2 36
TAGM1 33A
FOCM6-3 33
MEMM4 28A
OAG
HR-D
Berm
MEMM3 28
MAMM1-2 28B
MAMM1-2 28B
HR-D
OAG
Berm
TAGM1 29A
FODM4-9 29
TAGM1 29A
FODM5-11 30
SWTM2-1 31A
FODM5-11 30
FODM3-1 31
FODM5-11 30
THDM4-1 30A
HR-D
MEMM4
MAMM1
MASM1-1
Berm
SAS_1
HR-S
Berm
THDM2
MAMM1-3
MEMM4

Legend

- Study Area
- Primary Road
- Secondary Road
- Permanent Watercourse
- Provincially Significant Wetland (PSW)
- Other Wetland

Pipeline Route Options

- Option A
- Option B
- Option C
- Option D
- Option E
- NRSI Ecological Land Classification (ELC)

(CGL_1) Golf Course
(CGL_4) Recreational
(FOCM4-1) Fresh-Moist White Cedar Coniferous Forest Type
(FOCM6-3) Dry-Fresh Scotch Pine Naturalized Coniferous Plantation Type
(FODM3-1) Dry-Fresh Poplar Deciduous Forest Type
(FODM4-9) Dry-Fresh Basswood Deciduous Forest Type
(FODM5) Dry-Fresh Sugar Maple Deciduous Forest Ecosite
(FODM5-11) Dry-Fresh Sugar Maple-Ironwood Deciduous Forest Type
(FODM5-2) Dry-Fresh Sugar Maple-Beech Deciduous Forest Type
(FODM5-8) Dry-Fresh Sugar Maple-White Ash Deciduous Forest Type
(FODM7-2) Fresh-Moist Green Ash-Hardwood Lowland Deciduous Forest Type
(FOMM3-2) Dry-Fresh Sugar Maple-Hemlock Mixed Forest Type
(MAMM1-2) Cattail Graminoid Mineral Meadow Marsh Type
(MAMM1-3) Reed-canary Grass Graminoid Mineral Meadow Marsh Type
(MAMM2) Forb Mineral Meadow Marsh Ecosite
(MASO1-1) Cattail Organic Shallow Marsh Tpe
(MEFM1-1) Goldenrod Forb Meadow Type
(MEMM3) Dry-Fresh Mixed Meadow Ecosite
(MEMM4) Fresh-Moist Mixed Meadow Ecosite
(OA) Open Water
(SWDM2-1) Black Ash Mineral Deciduous Swamp Type
(SWDM4-1) Willow Mineral Deciduous Swamp Type
(SWTM2-1) Red-osier Dogwood Mineral Deciduous Thicket Swamp Type
(SWTM5) Mineral Deciduous Thicket Swamp Ecosite
(TAGM1) Coniferous Plantation
(THDM2-6) Buckthorn Deciduous Shrub Thicket Type
(THDM4-1) Native Deciduous Regeneration Thicket Type

- ELC Revisions (NRSI 2016)

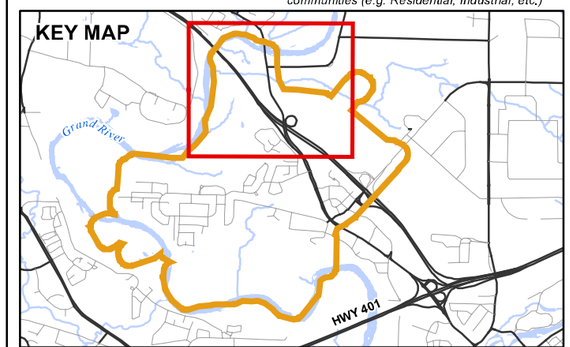
(MAMM1-3/MAM2-2) Reed-canary Grass Graminoid Mineral Meadow Marsh Type
(MASM1-1/MAS2-1) Cattail Mineral Shallow Marsh Type
(SAS_1/SAS-1) Submerged Shallow Aquatic Ecosite
(THDM2/CUT1) Dry-Fresh Deciduous Shrub Thicket Ecosite

- MESP Ecological Land Classification (Aquafor Beech Ltd. 2013)

(FOD) Deciduous Forest
(HR-D) Deciduous Hedgerow
(HR-S) Shrub Hedgerow
(MAMM1/MAM2) Graminoid Mineral Meadow Marsh Ecosite
(MEMM4/CUM1-1)Fresh-Moist Mixed Meadow Ecosite
(OAG/Ag) Open Agriculture

** Lands not designated with an ELC code within the Study Area consist of developed lands that do not support natural plant communities (e.g. Residential, Industrial, etc.)*

KEY MAP



NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists

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Project: 1380
Date: December 8, 2016

NAD83 - UTM Zone 17
Size: 11x17"
1:6,000

0 100 200 300 Metres

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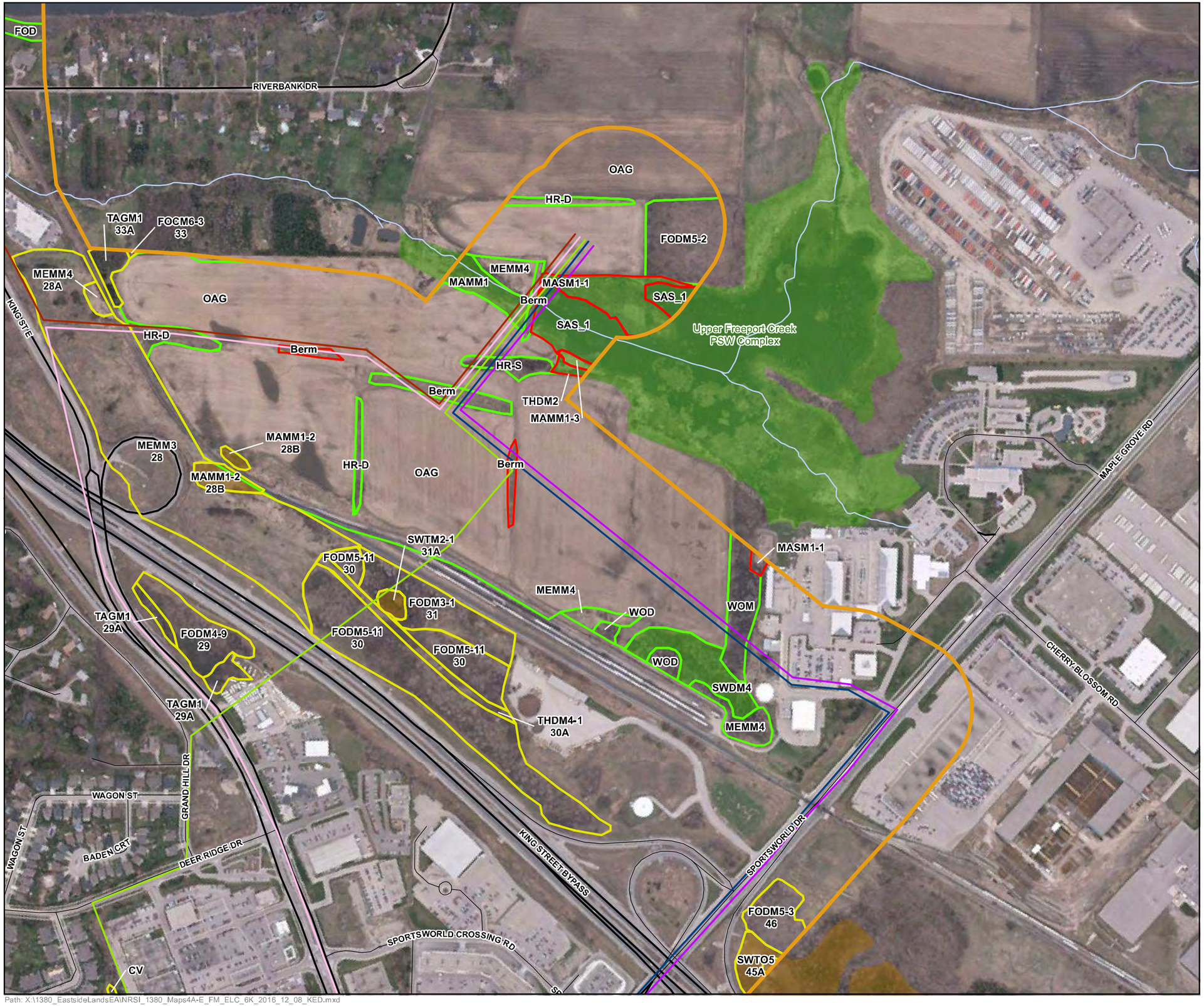
East Side Lands Sanitary Servicing Class EA

FIGURE 4-5
VEGETATION COMMUNITIES



Legend

- Study Area
- Primary Road
- Secondary Road
- Permanent Watercourse
- Provincially Significant Wetland (PSW)
- Other Wetland

Pipeline Route Options

- Option A
- Option B
- Option C
- Option D
- Option E
- NRSI Ecological Land Classification (ELC)

(CV) Stormwater Management Pond

(FOCM6-3) Dry-Fresh Scotch Pine Naturalized Coniferous Plantation Type

(FODM3-1) Dry-Fresh Poplar Deciduous Forest Type

(FODM4-9) Dry-Fresh Basswood Deciduous Forest Type

(FODM5-11) Dry-Fresh Sugar Maple-Ironwood Deciduous Forest Type

(FODM5-3) Dry-Fresh Sugar Maple-Oak Deciduous Forest Type

(MAMM1-2) Cattail Graminoid Mineral Meadow Marsh Type

(MEMM3) Dry-Fresh Mixed Meadow Ecosite

(MEMM4) Fresh-Moist Mixed Meadow Ecosite

(SWDO2-1) Red Maple Organic Deciduous Swamp Type

(SWTM2-1) Red-osier Dogwood Mineral Deciduous Thicket Swamp Type

(SWTO5) Organic Deciduous Thicket Swamp

(TAGM1) Coniferous Plantation

(THDM4-1) Native Deciduous Regeneration Thicket Type

ELC Revisions (NRSI 2016)

(MAMM1-3/MAM2-2) Reed-canary Grass Graminoid Mineral Meadow Marsh Type

(MASM1-1/MAS2-1) Cattail Mineral Shallow Marsh Type

(SAS_1/SAS-1) Submerged Shallow Aquatic Ecosite

(THDM2/CUT1) Dry-Fresh Deciduous Shrub Thicket Ecosite

- MESP Ecological Land Classification (Aquafor Beech Ltd. 2013)

(FOD) Deciduous Forest

(FODM5-2/FOD5-2) Dry-Fresh Sugar Maple-Beech Deciduous Forest Type

(HR-D) Deciduous Hedgerow

(HR-S) Shrub Hedgerow

(MAMM1/MAM2) Graminoid Mineral Meadow Marsh Ecosite

(MEMM4/CUM1-1)Fresh-Moist Mixed Meadow Ecosite

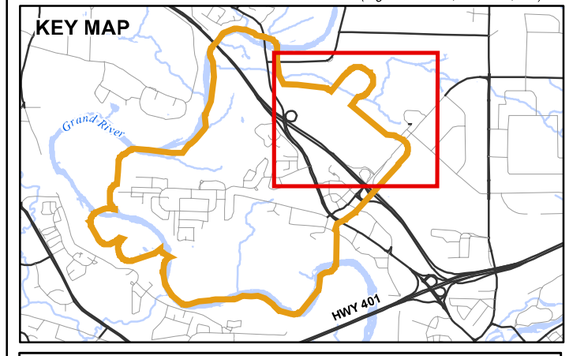
(OAG/Ag) Open Agriculture

(SWDM4/SWD4) Mineral Deciduous Swamp Ecosite

(WOD/CUW1) Deciduous Woodland

(WOM/CUW1) Mixed Woodland

** Lands not designated with an ELC code within the Study Area consist of developed lands that do not support natural plant communities (e.g. Residential, Industrial, etc.)*



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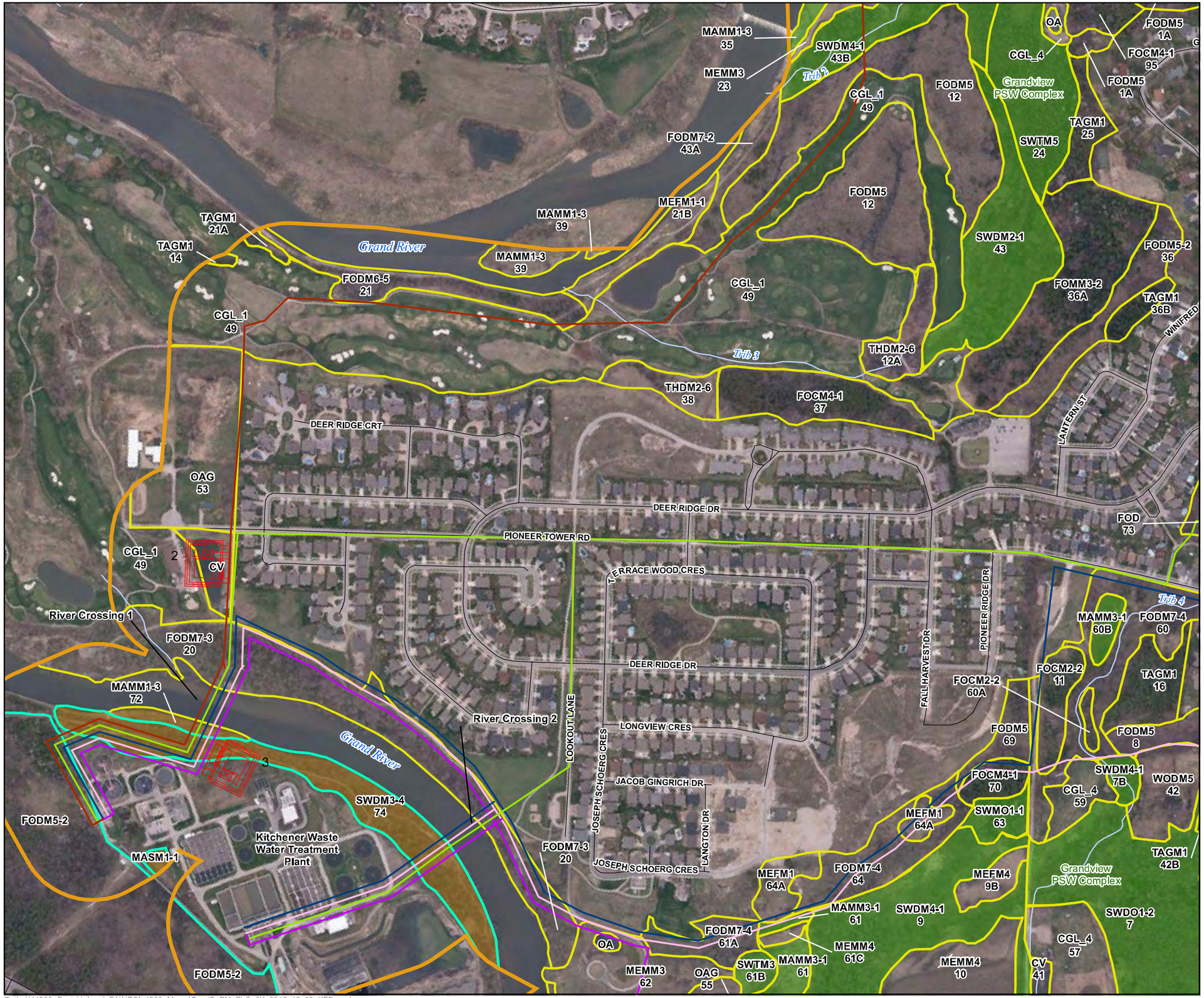
SHEET 3 of 5

East Side Lands Sanitary Servicing Class EA

FIGURE 4-5
VEGETATION COMMUNITIES



Legend

- Study Area
- Proposed Pumping Station Locations
- Primary Road
- Secondary Road
- Permanent Watercourse
- Provincially Significant Wetland (PSW)
- Other Wetland

Pipeline Route Options

- Option A
- Option B
- Option C
- Option D
- Option E
- NRSI Ecological Land Classification (ELC)

(CGL_1) Golf Course

(CGL_4) Recreational

(CV) Stormwater Management Pond

(FOCM2-2) Dry-Fresh White Cedar Coniferous Forest Type

(FOCM4-1) Fresh-Moist White Cedar Coniferous Forest Type

(FOD) Deciduous Forest

(FODM5) Dry-Fresh Sugar Maple Deciduous Forest Ecosite

(FODM5-2) Dry-Fresh Sugar Maple-Beech Deciduous Forest Type

(FODM6-5) Fresh-Moist Sugar Maple-Hardwood Deciduous Forest Type

(FODM7-2) Fresh-Moist Green Ash-Hardwood Lowland Deciduous Forest Type

(FODM7-3) Fresh-Moist Willow Lowland Deciduous Forest

(FODM7-4) Fresh-Moist Black Walnut Lowland Deciduous Forest Type

(FOMM3-2) Dry-Fresh Sugar Maple-Hemlock Mixed Forest Type

(MAMM1-3) Reed-canary Grass Graminoid Mineral Meadow Marsh Type

(MAMM3-1) Mixed Mineral Meadow Marsh Type

(MEFM1) Dry-Fresh Forb Meadow Ecosite

(MEFM1-1) Goldenrod Forb Meadow Type

(MEFM4) Fresh-Moist Forb Meadow Ecosite

(MEMM3) Dry-Fresh Mixed Meadow Ecosite

(MEMM4) Fresh-Moist Mixed Meadow Ecosite

(OA) Open Water

(OAG) Open Agriculture

(SWDM2-1) Black Ash Mineral Deciduous Swamp Type

(SWDM3-4) Manitoba Maple Mineral Deciduous Swamp Type

(SWDM4-1) Willow Mineral Deciduous Swamp Type

(SWDO1-2) Green Ash Organic Deciduous Swamp Type

(SWMO1-1) White Cedar-Hardwood Organic Mixed Swamp Type

(SWTM3) Willow Mineral Deciduous Thicket Swamp Ecosite

(SWTM5) Mineral Deciduous Thicket Swamp Ecosite

(TAGM1) Coniferous Plantation

(THDM2-6) Buckthorn Deciduous Shrub Thicket Type

(WODM5) Fresh-Moist Deciduous Woodland Ecosite

- Kitchener WWTP Upgrades Ecological Land Classification (AECOM 2014)

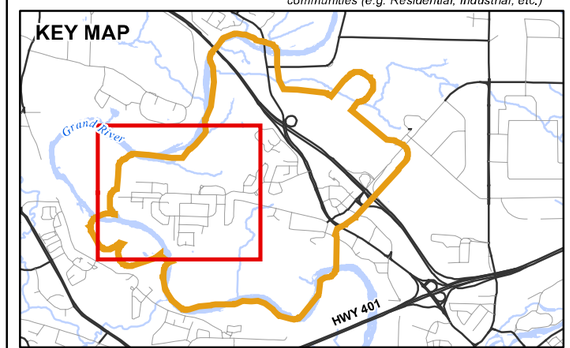
(FODM5-2/FOD5-2) Dry-Fresh Sugar Maple-Beech Deciduous Forest Type

(MASM1-1/MAS2-1) Cattail Mineral Shallow Marsh Type

(SWDM3-4/SWD3-4) Manitoba Maple Mineral Deciduous Swamp Type

**Proposed pumping station locations 1, 4, and 5 were associated with conveyance methodologies that were deemed not technically feasible and have been removed from the evaluation of impacts and all mapping as a result. Please refer to Section 9 in the main Environmental Study Report for further details.*

** Lands not designated with an ELC code within the Study Area consist of developed lands that do not support natural plant communities (e.g. Residential, Industrial, etc.)*



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0 100 200 300 Metres

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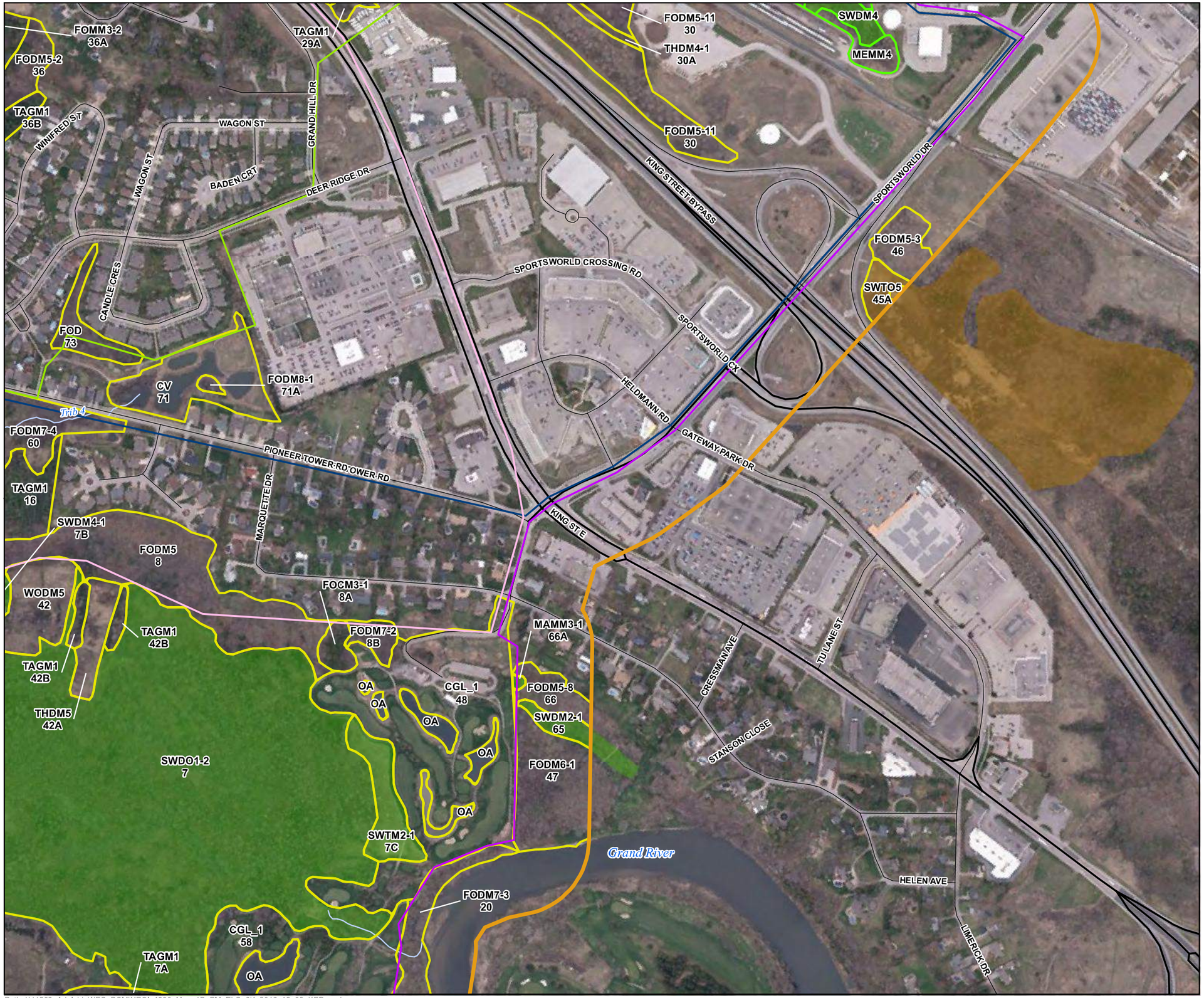
SHEET 4 of 5

East Side Lands Sanitary Servicing Class EA

FIGURE 4-5
VEGETATION COMMUNITIES



Legend

- Study Area
- Primary Road
- Secondary Road
- Permanent Watercourse
- Provincially Significant Wetland (PSW)
- Other Wetland

Pipeline Route Options

- Option A
- Option B
- Option C
- Option D
- Option E
- NRSI Ecological Land Classification (ELC)

(CGL_1) Golf Course

(CV) Stormwater Management Pond

(FOCM3-1) Fresh-Moist Hemlock Coniferous Forest Type

(FOD) Deciduous Forest

(FODM4-9) Dry-Fresh Basswood Deciduous Forest Type

(FODM5) Dry-Fresh Sugar Maple Deciduous Forest Ecosite

(FODM5-11) Dry-Fresh Sugar Maple-Ironwood Deciduous Forest Type

(FODM5-2) Dry-Fresh Sugar Maple-Beech Deciduous Forest Type

(FODM5-3) Dry-Fresh Sugar Maple-Oak Deciduous Forest Type

(FODM5-8) Dry-Fresh Sugar Maple-White Ash Deciduous Forest Type

(FODM6-1) Fresh-Moist Sugar Maple-Lowland Ash Deciduous Forest Type

(FODM7-2) Fresh-Moist Green Ash-Hardwood Lowland Deciduous Forest Type

(FODM7-3) Fresh-Moist Willow Lowland Deciduous Forest

(FODM7-4) Fresh-Moist Black Walnut Lowland Deciduous Forest Type

(FODM8-1) Fresh-Moist Poplar Deciduous Forest Type

(FOMM3-2) Dry-Fresh Sugar Maple-Hemlock Mixed Forest Type

(MAMM3-1) Mixed Mineral Meadow Marsh Type

(OA) Open Water

(SWDM2-1) Black Ash Mineral Deciduous Swamp Type

(SWDM4-1) Willow Mineral Deciduous Swamp Type

(SWDO1-2) Green Ash Organic Deciduous Swamp Type

(SWDO2-1) Red Maple Organic Deciduous Swamp Type

(SWTM2-1) Red-osier Dogwood Mineral Deciduous Thicket Swamp Type

(SWTO5) Organic Deciduous Thicket Swamp

(TAGM1) Coniferous Plantation

(THDM4-1) Native Deciduous Regeneration Thicket Type

(THDM5) Fresh-Moist Deciduous Thicket Ecosite

(WODM5) Fresh-Moist Deciduous Woodland Ecosite

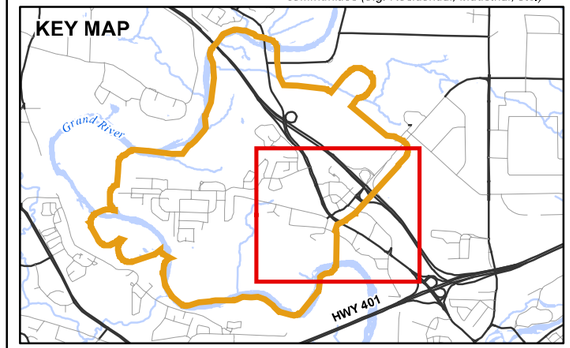
- MESP Ecological Land Classification (Aquafor Beech Ltd. 2013)

(MEMM4/CUM1-1)Fresh-Moist Mixed Meadow Ecosite

(SWDM4/SWD4) Mineral Deciduous Swamp Ecosite

** Lands not designated with an ELC code within the Study Area consist of developed lands that do not support natural plant communities (e.g. Residential, Industrial, etc.)*

KEY MAP



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SHEET 5 of 5

East Side Lands Sanitary Servicing Class EA

FIGURE 4-5
VEGETATION COMMUNITIES

Legend

- Study Area
- Primary Road
- Secondary Road
- Permanent Watercourse
- Provincially Significant Wetland (PSW)
- Other Wetland

Pipeline Route Options

- Option A
- Option B
- Option C
- Option D
- Option E
- NRSI Ecological Land Classification (ELC)
- Kitchener WWTP Upgrades Ecological Land Classification (AECOM 2014)

(CGL_1) Golf Course

(CGL_4) Recreational

(CV) Stormwater Management Pond

(FOCM2-2) Dry-Fresh White Cedar Coniferous Forest Type

(FOCM3-1) Fresh-Moist Hemlock Coniferous Forest Type

(FOCM4-1) Fresh-Moist White Cedar Coniferous Forest Type

(FODM5) Dry-Fresh Sugar Maple Deciduous Forest Ecosite

(FODM6-1) Fresh-Moist Sugar Maple-Lowland Ash Deciduous Forest Type

(FODM7-2) Fresh-Moist Green Ash-Hardwood Lowland Deciduous Forest Type

(FODM7-3) Fresh-Moist Willow Lowland Deciduous Forest

(FODM7-4) Fresh-Moist Black Walnut Lowland Deciduous Forest Type

(MAMM3-1) Mixed Mineral Meadow Marsh Type

(MEFM1) Dry-Fresh Forb Meadow Ecosite

(MEFM4) Fresh-Moist Forb Meadow Ecosite

(MEMM3) Dry-Fresh Mixed Meadow Ecosite

(MEMM4) Fresh-Moist Mixed Meadow Ecosite

(OA) Open Water

(OAG) Open Agriculture

(SWDM3-4) Manitoba Maple Mineral Deciduous Swamp Type

(SWDM4-1) Willow Mineral Deciduous Swamp Type

(SWDO1-2) Green Ash Organic Deciduous Swamp Type

(SWMO1-1) White Cedar-Hardwood Organic Mixed Swamp Type

(SWTM2-1) Red-osier Dogwood Mineral Deciduous Thicket Swamp Type

(SWTM3) Willow Mineral Deciduous Thicket Swamp Ecosite

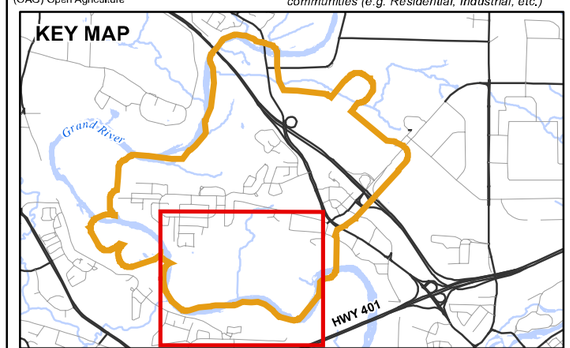
(TAGM1) Coniferous Plantation

(THDM5) Fresh-Moist Deciduous Thicket Ecosite

(WODM5) Fresh-Moist Deciduous Woodland Ecosite

SWDM3-4/SWD3-4) Manitoba Maple Mineral Deciduous Swamp Type

** Lands not designated with an ELC code within the Study Area consist of developed lands that do not support natural plant communities (e.g. Residential, Industrial, etc.)*



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Project: 1380 Date: December 8, 2016	NAD83 - UTM Zone 17 Size: 11x17" **1:6,000**

0 100 200 300 Metres

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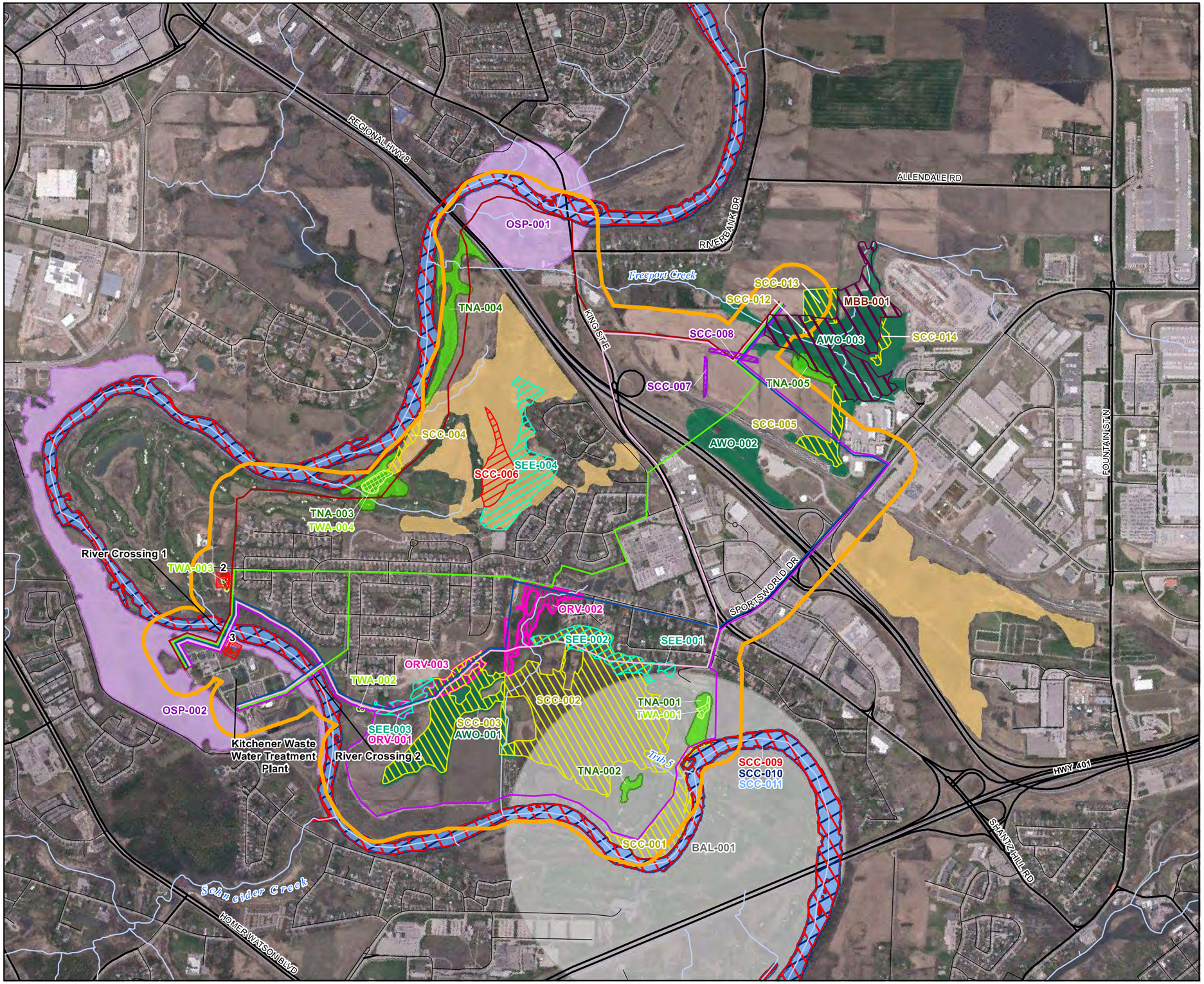
Path: X:\1380_EastsideLandsEA\NRSI_1380_Maps4AandE_FM_ELC_6K_2016_12_08_KED.mxd

East Side Lands Sanitary Servicing Class EA

FIGURE 4-6
SIGNIFICANT WILDLIFE HABITAT



Legend

- Study Area
- Proposed Pumping Station Locations*
- Marsh Breeding Bird Habitat (MBB)
- Amphibian Breeding Habitat (AWO)
- Turtle Nesting Area (TNA)
- Turtle Wintering Area (TWA)
- Bald Eagle Nesting, Foraging and Perching Habitat (BAL)
- Osprey Nesting, Foraging and Perching Habitat (OSP)
- Deer Winter Congregation Habitat
- Rare Vegetation Community (ORV)
- Seeps and Springs (SEE)

Species of Conservation Concern (SCC)

- Eastern Wood-Pewee (SCC-001, 002, 003, 004, 005, 012, 013, 014)
- American Gromwell (SCC-006)
- Common Sootywing (SCC-007, 008)
- Greater Redhorse (SCC-009)
- Elktoe Mussel (SCC-010)
- Mucket Mussel (SCC-011)
- Primary Road
- Secondary Road
- Permanent Watercourse

Pipeline Route Options

- Option A
- Option B
- Option C
- Option D
- Option E

**Proposed pumping station locations 1, 4, and 5 were associated with conveyance methodologies that were deemed not technically feasible and have been removed from the evaluation of impacts and all mapping as a result. Please refer to Section 9 in the main Environmental Study Report for further details.*

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Project: 1380 Date: December 6, 2016	NAD83 - UTM Zone 17 Size: 11x17" **1:18,000**

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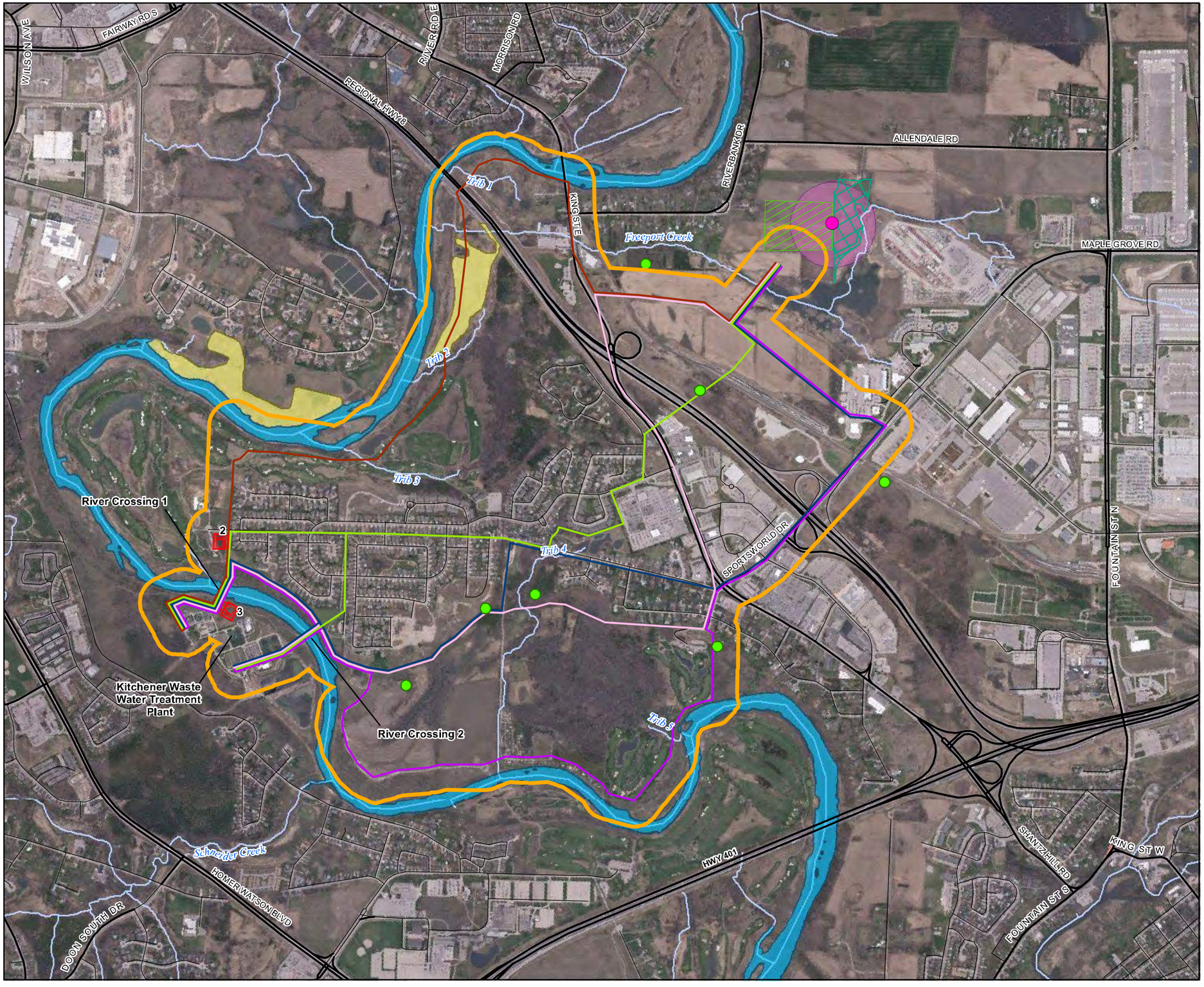
East Side Lands Sanitary Servicing Class EA

FIGURE 4-7
SPECIES AT RISK HABITAT



Legend

- Study Area
- Proposed Pumping Station Locations
- Barn Swallow Habitat (Dillon Consulting 2012)
- Butternut Habitat
- Bobolink Habitat
- Bobolink Habitat (Historical) (Dillon Consulting 2012)
- Eastern Meadowlark Habitat
- Wavy-rayed Lampmussel, Rainbow Mussel, Black Redhorse and Silver Shiner Habitat
- Barn Swallow Habitat
- Primary Road
- Secondary Road
- Permanent Watercourse

Pipeline Route Options

- Option A
- Option B
- Option C
- Option D
- Option E

**Proposed pumping station locations 1, 4, and 5 were associated with conveyance methodologies that were deemed not technically feasible and have been removed from the evaluation of impacts and all mapping as a result. Please refer to Section 9 in the main Environmental Study Report for further details.*

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Project: 1380 Date: December 6, 2016	NAD83 - UTM Zone 17 Size: 11x17" **1:18,000**

0 500 1,000 Metres

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4.5 ARCHAEOLOGY

As part of the Class EA Study consultant team, Archaeological Services Inc. (ASI) was commissioned to complete the archaeological inventory for the Study Area.

4.5.1 Preliminary Desktop Information

Initially, a desktop review of the available background information was undertaken, focusing on the southwestern quadrant of the Study Area (i.e. the primary Study Area). The intent of the review was to identify areas that based on historical documentation, exhibit potential for archaeological potential. ASI provided a preliminary memo summarizing their findings, dated May 31, 2013, which can be found in **Appendix C**.

Within the focus area of the East Side Lands, the following features of archaeological potential are present:

- Previously identified archaeological sites (e.g. Jacob Furtney Homestead AiHc-83)
- Water source: primary, secondary or past water source (i.e. Grand River)
- Early historical transportation routes (e.g. King Street E.)
- Property designated as a federal historic site (i.e. Waterloo Pioneer Memorial Tower)
- Areas of early Euro-Canadian settlement (e.g. Freeport; Doon Pioneer Tower Cemetery)
- Areas identified with historical occupation (e.g. Haldimand Tract)

Some lands within the focussed Study Area identified as possible sanitary infrastructure sites exhibit potential for the existence of Aboriginal and Euro-Canadian archaeological sites or artifacts. Furthermore, the background research has determined that a historic cemetery is located within the Study Area: namely the Doon Pioneer Tower Cemetery. Should the proposed work impact this feature, a Cemetery Investigation may be required in accordance with the Cemeteries Act. It should be noted that the modern boundaries of a cemetery are not entirely reliable indicators of its actual extent, and there is considerable potential for the presence of unmarked graves beyond the modern limits.

4.5.2 2015 Stage 1 Archaeological Investigation

Through the evolution of this Class EA Study, and specifically the development of its alternative solutions, it was concluded that more detailed archaeological information would be required to properly assess and evaluate the various alternatives. To that end, a scoped Stage 1 Archaeological Investigation was commissioned by the project team. The Stage 1 Archaeological Assessment determined that 10 previously registered archaeological sites are located within one kilometre of the Study Area. A review of the historical and archaeological contexts of the Study Area suggests that it has potential for the identification of Aboriginal and Euro-Canadian archaeological resources.

The property inspection determined that some lands within the Study Area possess archaeological potential. These lands require Stage 2 Archaeological Assessment by test-pit survey at five metre intervals. Other lands are determined to possess potential for deeply buried deposits. This potential exists despite some lands being documented to possess conditions which preclude further assessment. These include steeply sloping conditions and previous disturbance.

In light of these results, the following recommendations are made:

1. The Study Area includes the Doon Pioneer Tower Cemetery. These lands should be subject to Protection and Avoidance from any proposed impacts by the project. Lands beyond the documented extent of the cemetery require Cemetery Investigation, in accordance with Provincial regulations. It is recommended that the property boundary be demonstrated by erecting a temporary barrier and "no go" instructions be issued for all on-site crews as a precautionary measure. The potential exists for Aboriginal human remains within and beyond the cemetery. The Cemetery Investigation should involve engagement with Aboriginal communities to ensure that there are no unaddressed Aboriginal archaeological interests with the cemetery;
2. The Study Area includes lands which are considered to possess archaeological potential. These lands should be subject to Stage 2 archaeological assessment by test-pit survey prior to any proposed impacts by the projects;
3. The Study Area includes lands that are considered to possess potential for deeply buried deposits. The following assessment strategy is recommended:
    a. Mechanical excavation of trenches should be conducted at 10 m intervals using a smooth-edged bucket to remove sterile 'B' horizon overburden. Trenches should be aligned perpendicular to the axis of the Grand River channel and the existing fluvial terraces. Excavation should be periodically halted to permit cleaning of the exposed horizon and trench profiles by shovel and trowel and to explore any apparent subsurface cultural features or buried paleosols;
    b. If buried paleosols are documented, mechanical excavation should halt and the exposed paleosol subjected to test-pit survey at five metre intervals;
    c. Upon confirmation that any paleosols are void of cultural remains, mechanical excavation should resume under the above protocol. Such investigation should proceed until sterile 'C' horizon is exposed;
    d. This process should be monitored by a licensed archaeologist and a geomorphologist/geo-archaeologist; and,
    e. Investigation of deep deposits should be conducted only after all near-surface assessment by test-pit survey at five metre intervals has been completed.
4. Parts of the Study Area have been previously subjected to archaeological assessment. These lands do not require any further archaeological assessment;
5. The remainder of the Study Area has been documented to not retain archaeological potential on account of deep and extensive land disturbance or

steeply sloping conditions. These lands do not require further archaeological assessment except where indicated to possess potential for deeply buried deposits; and,

6. Should the proposed work extend beyond the current Study Area then further Stage 1 Archaeological Assessment should be conducted to determine the archaeological potential of the surrounding lands.

Figure 4-8 illustrates the areas of archaeological potential within the Study Area.

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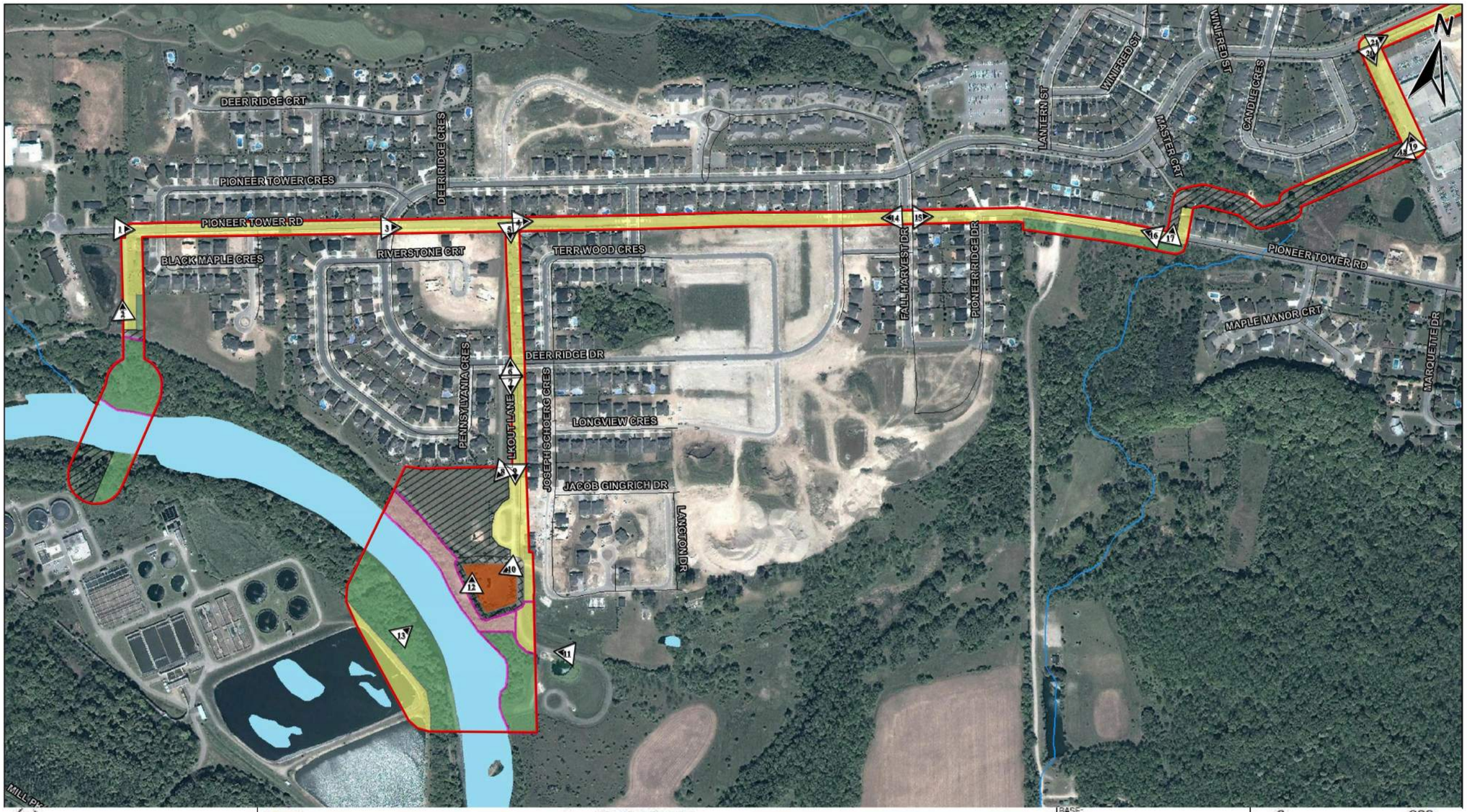

PROJECT No.	2013-5592
DATE:	MAY, 2017
APPROVED:	D. LINDNER
SCALE:	N.T.S.
DWG. No.	FIGURE 4-8

Associated Engineering

Region of Waterloo

REGION OF WATERLOO

EAST SIDE LANDS SANITARY SERVICING CLASS EA

ARCHAEOLOGICAL FEATURES (SHEET 1 OF 2)

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No Representations Of Any Kind Are Made To Other Parties

Archaeological & Cultural Heritage Services
520 Bathurst Street Toronto, ONTARIO M5S 2P9
416 966 1069 | 416 966 9723 | asiheritage.ca

Study Area
Photo Plate
Previously Assessed (ASI 1989; 1997; MHC 1993)
Cemetery: Requires Protection and Avoidance
Requires Cemetery Investigation
No Potential (Disturbed)
No Potential (Steeply Sloping)
Requires Investigation of Deep Deposits
Potential (Test Pit Survey Required)
Road
Water

BASE
Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

0 200
Metres

ASI PROJECT NO: 17PA-097
DATE: 11 Aug 2015
DRAWN BY: MB
FILE: 12EA282_Fig7_S1

PROJECT No.	2013-5592
DATE:	MAY, 2017
APPROVED:	D. LINDNER
SCALE:	N.T.S.
DWG. No.	FIGURE 4-8

Associated Engineering

Region of Waterloo

REGION OF WATERLOO

EAST SIDE LANDS SANITARY SERVICING CLASS EA

ARCHAEOLOGICAL FEATURES (SHEET 2 OF 2)

4.6 CULTURAL HERITAGE

In addition, and supplementary to the Stage 1 Archaeological Investigation, ASI was also commissioned to complete a scoped Cultural Heritage Resource Assessment for the Study Area.

The results of background historical research and a review of secondary source material revealed a Study Area with a rural land use history dating back to the late-eighteenth century. The field review confirmed that this area retains nineteenth and twentieth-century cultural heritage resources. A total of eight cultural heritage resources were identified within or adjacent to the East Side Lands Sanitary Servicing Study Area, specifically focussing on the preferred pipeline route that was identified through the evolution of this EA study. These include one Built Heritage Resource (BHR 1) and seven Cultural Heritage Landscapes (CHL 1 to 7), as follows:

- Pioneer Tower (BHR 1);
- Grand River (CHL 1);
- Doon Pioneer Cemetery (CHL 2);
- Betzner Farmstead (CHL 3);
- Pioneer Tower Road and Lookout Lane (CHL 4);
- Pioneer Sportsmen Club (CHL 5);
- Canadian Pacific Rail Line (CHL 6); and
- Pioneer Tower West Park (CHL 7).

Based on the results of background data collection and field review, and through additional consultation with the City of Kitchener (Planning Division), the Ministry of Tourism and Culture, and Parks Canada the following recommendations were developed for the East Side Lands Sanitary Servicing Class Environmental Assessment:

1. Construction activities and staging should be suitably planned and undertaken to minimize impacts to identified cultural heritage resources.

2. A cultural heritage impact assessment (HIA) should be carried out for BHR 1, CHL 1, CHL 2, and CHL 7. As the timing of construction is estimated to be greater than 10 years away, it is recommended that the HIA be conducted at the earliest possible stage of detailed design and prior to construction activities in order to allow most current information and conditions, as well as potential technological advancements, to be considered when confirming the appropriate mitigation measures to minimize potential impacts to the resources during and after construction activities.

These cultural heritage resources are linked and generally encompassed within the limits of the Pioneer Tower West Cultural Heritage Landscape (CHL 7), therefore, it is recommended that all resources should be addressed in one HIA report. The HIA should

follow the Region of Waterloo Implementation Guidelines for Cultural Heritage Landscape Conservation (October 2013). The HIA should also be developed based on the heritage provisions contained in the 2014 Provincial Policy Statement, the Ontario Heritage Act (2005), the Standards and Guidelines for the Conservation of Historic Places in Canada (2010), and the Ministry of Tourism, Culture and Sport's Ontario Heritage Toolkit (2006).

The HIA should include consultation with Parks Canada, MTCS, the Region of Waterloo, and the City of Kitchener to help form appropriate mitigation measures in order to minimize impacts to the resources.

At a minimum, the HIA should consider the following:

- Additional archival research regarding the Waterloo Pioneer Memorial Tower in order to better understand methods and materials used in the construction of the tower to inform any necessary conditions assessment/vibration studies. The Kitchener Public Library has two collections associated with the Waterloo Pioneers Memorial Tower: MC.55 includes newspapers, correspondence, plans, and drawings; MC.113 includes correspondence, bills, tablet information, sketches and blueprints, and other miscellaneous items. Research at other repositories should be conducted as needed.

- Adequate setbacks of the alignment to minimize vibrations given the sensitive nature of the tower construction. Setback distances will need to be confirmed in consultation with the geotechnical engineers.

- Pre-construction conditions assessment or vibration analysis of the Waterloo Pioneer Memorial Tower, as well as vibration monitoring during construction, and post-construction conditions assessment (if needed).

- Post-construction maintenance and restoration activities related to dust and/or dirt impacts from construction activities on the Waterloo Pioneer Memorial Tower, as well as post-construction rehabilitation activities to reflect the pre-construction conditions of the surrounding landscape.

- The maintenance of continued access to the site during and after construction for both the public and staff to allow for maintenance activities.

- If technically feasible, alignment of the proposed bridge to be parallel to and in line with the existing hydro lines in order to concentrate all modern physical and visual elements crossing the river in one area.

- The design and material of the proposed service bridge across the Grand River should be suitably designed to minimize visual impacts as much as possible and to

be sympathetic to the historical setting and context of the area. For example, Standard 11 of the Standards and Guidelines for the Conservation of Historic Places in Canada (2010) state:

- Conserve the heritage value and character-defining elements when creating any new additions to an historic place or any related new construction.
- Make the new work physically and visually compatible with, subordinate to, and distinguishable from the historic place.

Additionally, the Standards and Guidelines recommend the following general design guidelines in relation to new additions in CHLs, particularly in relation to areas with significant visual relationships, ecological features, or built features:

- Designing a new feature when required by a new use that respects the historic visual relationships in the cultural landscape.
- Introducing a new element, when required by a new use, that does not have a negative impact on the heritage value and condition of the ecological feature.
- Designing a new built feature, when required by a new use, to be compatible with the heritage value of the cultural landscape. For example, erecting a new [structure] using traditional forms and materials, or installing signs and lighting compatible with the cultural landscape.

The results of the HIA should help guide the design of any proposed service bridge across the Grand River.

3. Where technically feasible, make further adjustments to the profile, cross-section, and grading limits of the proposed trenches to reduce encroachment and avoid removal of mature trees along CHL 4 and CHL 5. Post-construction rehabilitation should reflect the pre-construction conditions of the resource and include plantings sympathetic to the historical context of the resource.

4. Should future work require an expansion of the East Side Lands Sanitary Servicing Class EA study area then a qualified heritage consultant should be contacted in order to confirm the impacts of the proposed work on potential cultural heritage resources.

Figure 4-9 illustrates the cultural heritage resources within the Study Area.

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CHL-4- PIONEER TOWER ROAD & LOOKOUTLANE

CHL-5- PIONEER SPORTSMEN CLUB

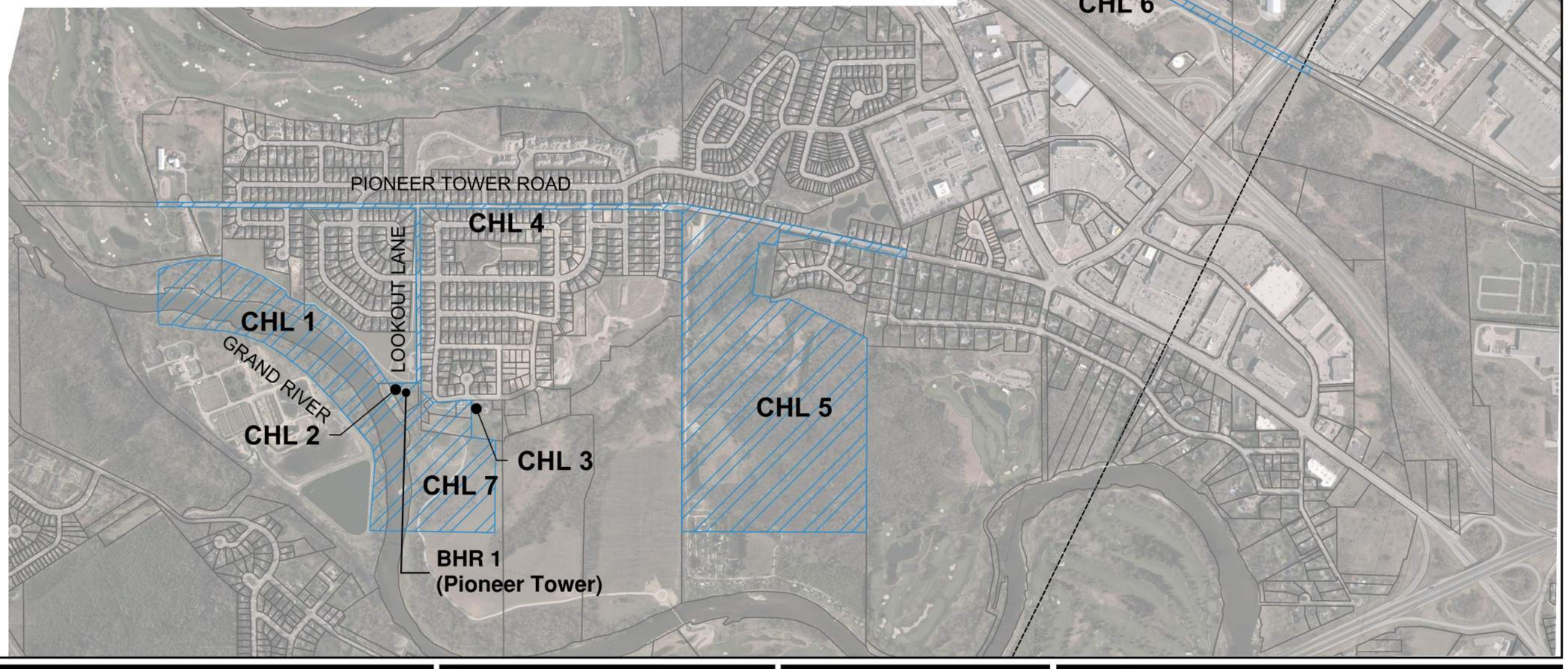
CHL-6- CPR RAILWAY

CHL-7- PIONEER TOWER WEST PARK

CHL-3- SAMUEL BETZNER FARMSTEAD

CHL-2- CEMETERY

CHL-1- GRAND RIVER



LEGEND

CULTURAL HERITAGE LANDSCAPE

INFORMATION TAKEN FROM: "CULTURAL HERITAGE RESOURCE ASSESSMENT REPORT" BY ARCHAEOLOGICAL SERVICES INC (ASI)-2017

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REGION OF WATERLOO

EAST SIDE LANDS SANITARY SERVICING CLASS EA

CULTURAL HERITAGE FEATURES

4.7 TRANSPORTATION NETWORK

The transportation network is important to identify as the road corridors that will likely be the setting for most of the new sanitary servicing infrastructure (i.e. trunk sewers, pumping stations and/or forcemains) connecting the East Side Lands to the Kitchener WWTP. The identification and classification of roads and any potential constraints is important for the determination of logistical issues for the servicing infrastructure locations. Understanding the road network is also important to assess the feasibility and timing of construction as well as access for any future maintenance or improvements to related infrastructure.

The following is a list of the main Regional arterial roads and major highways within the project limits.

Highways

- Highway #401
- Highway #8 (King Street)
- Highway #7 (Victoria Street)
- Highway #24 (Hespeler Road)

Regional Arterial Roads

- Maple Grove Road
- Fountain Street
- Kossuth Road / Fairway Road
- Shantz Station Road
- Speedsville Road
- Beaverdale Road
- Middle Block Road
- Ebycrest Road

The MESP (Section 3.3), forecasts future transportation conditions and provides a breakdown of constraining factors which may impact the decision to align sanitary sewers and/or forcemains along these various corridors. Of specific importance to this project, future development of two key roadways should be noted:

1. Fountain Street is proposed to be upgraded in 2018. The Region has recently completed a Class EA Study and detailed design is underway for the proposed upgrades from Kossuth Road to Cherry Blossom Road. That project includes the construction of a local sanitary sewer to service lands south of Kossuth Road and also includes a new forcemain from the Airport to the new gravity sewer.
2. The MESP identifies a new four lane roadway, referred to as the North-South Collector, connecting Middle Block Road to King Street, approximately 1 km west of Fountain Street and Maple Grove Road. This new roadway would provide access to the proposed Creekside development lands and could also be a potential alignment for a trunk sanitary sewer that would service the broader East Side Lands.

5 Wastewater Servicing Requirements

An important consideration for the development of alternative solutions to provide sanitary servicing to the East Side Lands is the size of the necessary infrastructure. To properly address this, it is necessary to define the sanitary flow rate that will be generated from the contributing sanitary drainage area. This section provides a summary of the various existing constraints and boundary conditions, as well as projected conditions that will influence the wastewater servicing requirements for the Study Area.

5.1 EXISTING SANITARY SERVICING INFRASTRUCTURE

The location and proximity of existing sanitary servicing infrastructure in the broader East Side Lands is important to understand so it is not overlooked when developing the long-term servicing strategy. An overview of the relevant sanitary infrastructure within and adjacent to the East Side Lands is provided in **Figure 5-1**

The Region, City of Kitchener and the City of Cambridge operate and maintain a number of sanitary pump stations within proximity to the East Side Lands. **Table 5-1** summarizes the current capacities of some of the key pump stations that may be important for the assessment of alternative design solutions for the East Side Lands.

Table 5-1
Existing Sewage Pumping Stations

Pump Station	Wet Well Volume (m^3)	Station Firm Capacity (L/s)
Bridgeport	18	135
Victoria St	7.26	387
Zeller Dr	16.03	173
Otterbein (Forwell)	14.16	126
Freeport	194	290
Pioneer Tower	137.3	125
Boxwood	+/-190	75
ATS	N/A	Decommissioned
Dover	209	190

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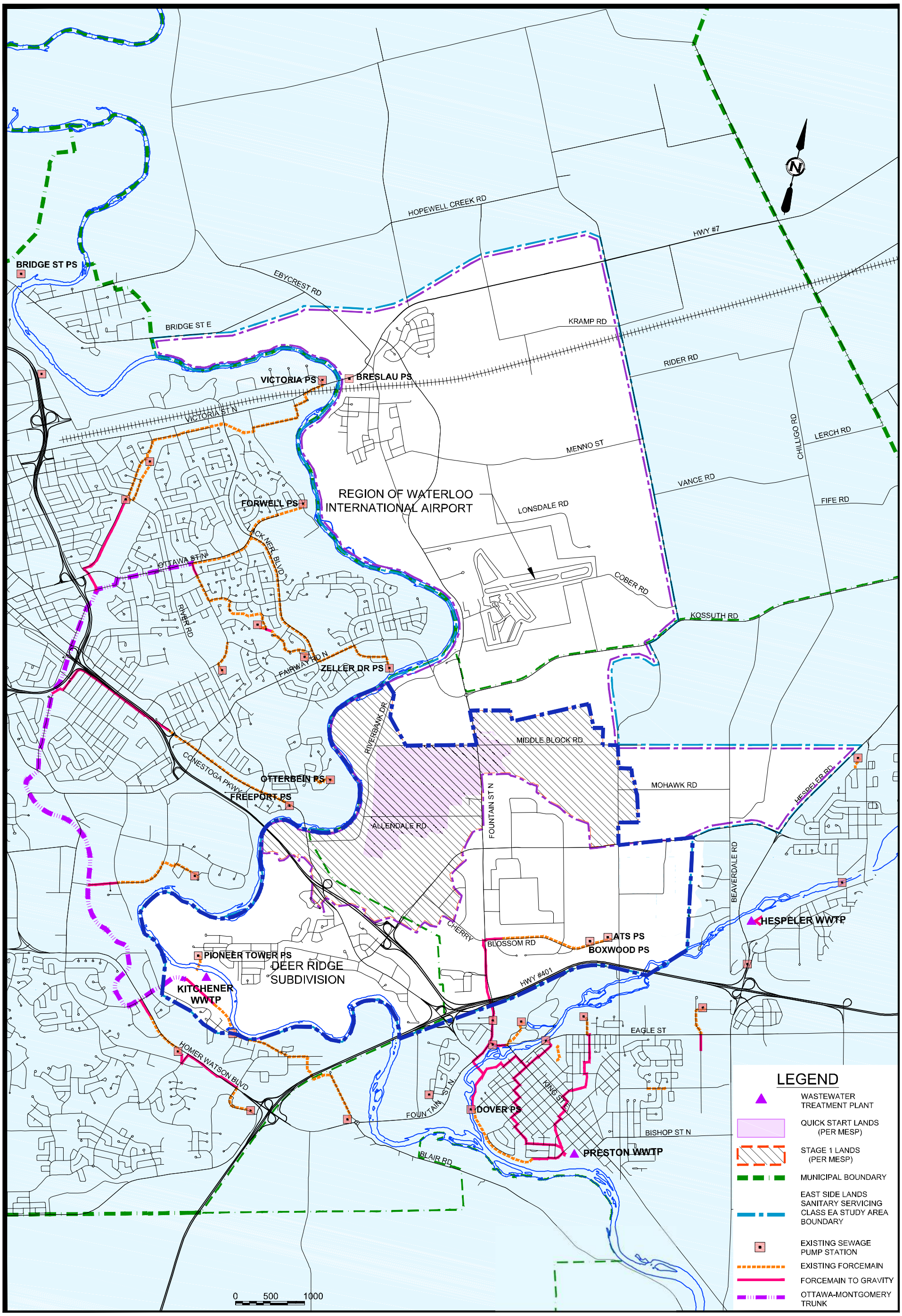

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REGION OF WATERLOO

EAST SIDE LANDS SANITARY SERVICING CLASS EA

EXISTING SANITARY INFRASTRUCTURE

The Ottawa-Montgomery trunk sewer drains a large portion of the City of Kitchener and at its largest, is 2.4m in diameter at the Kitchener WWTP. The trunk sewer starts along Ottawa Street just east of Old Chicopee Drive and eventually heads south, winding its way through various streets and easements to the Kitchener WWTP.

Municipal sanitary servicing infrastructure within the Township of Woolwich portion of the East Side Lands exists mainly within the Village of Breslau. According to the Breslau Cross Border Sanitary Flow Allocation Review (Stantec, 2013) the Village of Breslau currently directs sanitary flows to the City of Kitchener via the Victoria St Pumping Station (Victoria PS). A Cross Border Servicing Agreement (CBSA) was formed in 2003 between the City of Kitchener and the Township of Woolwich to service 1,250 residential units as well as 3 ha of commercial/industrial development within the Village of Breslau. In summary, the Township has been allocated 25% of the flow capacity of Victoria PS.

As of 2012, the allocated sanitary peak flows from Breslau are 94 L/s. The Breslau flows are pumped to the Breslau Pumping Station (Breslau PS) which in turn pumps to the Victoria PS and into the Manchester-Montgomery Trunk, eventually to the Ottawa-Montgomery Trunk and then to the Kitchener WWTP. The overall capacity of the Victoria PS is 387 L/s while the Breslau PS is 96L/s. The current wet well of the Breslau PS could allow for a peak flow of 143 L/s, however; the CBSA only allows for 25% of the Victoria PS capacity (96.7 L/s) therefore, an EA and an another amendment to the CBSA may be required if there is a demand for additional capacity. Further details regarding the allocated flows can be obtained in the Breslau Cross Border Sanitary Flow Allocation Review (Stantec, 2013).

There may be opportunity to relieve the Victoria PS of the Breslau flows as part of the East Side Lands Sanitary Servicing project. However, recent discussions with the City of Kitchener confirmed that the long-term (indefinite) intentions of the City are to maintain the flows (96 L/s) from Breslau to the Victoria Street PS.

Another key land area that has the capacity to produce significant flows is the Region of Waterloo International Airport. Currently, sanitary infrastructure only exists on the Airport site in the form of underground holding tanks which are pumped by tanker trucks and disposed of off-site. An Airport Servicing Analysis Memo was completed in April 2013 (Dillon) and outlines the current wastewater generation from yearly flow monitoring data. Based on the 2011 flow data, the current sanitary flow (based on a maximum flow which occurred in May 2011) is equivalent to an average daily flow (ADF) of 33 m^3/day or 1.23 L/s. The projected future peak flow rate, which includes an assumed 500 employees and day-to-day travellers, was approximated to be 6.3 L/s. The need for sanitary infrastructure will be based on the staging of development of the surrounding lands. For this project, it is assumed that sanitary flows from the airport lands are included in the East Side Lands Sanitary Servicing design flows.

5.2 EXISTING WWTPs AND RESIDUAL CAPACITY

There are a number of WWTPs which surround the East Side Lands development area. The 2014 MESP reviewed the existing available capacities of the Preston, Galt, Hespeler and Kitchener WWTPs. These available WWTP capacities will impact the short and long-term decisions for the alternative servicing solutions for the East Side Lands.

The Kitchener WWTP was identified as the long-term servicing solution for the East Side Lands due to its proximity to the East Side Lands and its size as compared to the other WWTPs. The Kitchener WWTP currently services the City of Kitchener and the Village of Breslau via the Ottawa – Montgomery Trunk sewer. As per the 2007 WWTMP, a portion of the remaining capacity of the Kitchener WWTP has been reserved for flows from the East Side Lands. Furthermore, the Kitchener WWTP is currently undergoing significant upgrades which will improve its operation and performance.

Consistent with the Region's WWTMP (2007), the 2014 MESP recommends that sanitary flow from the Quick Start Lands could be conveyed to the Preston WWTP as a short-term solution, recognizing that the long-term solution is to convey all of the Stage 1 lands (including the Quick Start Lands) and the broader East Side Lands sanitary flows to the Kitchener WWTP.

Table 5-2 summarizes the current and future capacities of the Kitchener and Preston WWTPs according to the 2016 Water and Wastewater Monitoring Report.

Table 5-2
Existing WWTPs for East Side Lands Use

Facility	Existing Capacity (m^3/d)	Avg. Measured Capacity (m^3/d)	Committed Flows (m^3/d)	Residual Capacity (m^3/d)	Future Capacity (m^3/d)	Future Residual Capacity (m^3/d)
Preston	16,820	8,970	2,700	5,150	16,820	5,150
Kitchener	122,700	70,970	11,560	40,160	122,700	40,160

The Preston WWTP currently receives flows from the 675 mm diameter Fountain St Trunk sewer located at the Maple Grove Road and Fountain St intersection and has a slope of 0.10%. The current theoretical capacity of the Trunk sewer is 277 L/s with a residual capacity of 160 L/s. The Fountain St Trunk sewer crosses Hwy 401 where it reduces to 600 mm diameter pipe with a 0.29% slope. The theoretical capacity of Hwy 401 crossing is 350 L/s with a residual capacity of 230 L/s. There is a plan to upgrade this stretch of pipe to a 750mm diameter pipe which will allow for an increased theoretical flow of 367 L/s. The Fountain St Trunk eventually crosses the Speed River via a siphon to the

Dover Street PS. The siphon capacity is 655 L/s and is comprised of 300, 450 and 500 mm diameter pipes.

The capacities of the Fountain Street Trunk and the Speed River siphon are important as they will directly affect the short-term scenario and the rate at which the Stage 1 Lands can be developed before the Regional Pumping Station is operational.

Per the 2007 WWTMP, the Preston WWTP currently services the community of Preston as well as the Cambridge industrial area along Maple Grove Road, Cherry Blossom Road and Fountain Street. As these areas develop to full capacity, it is anticipated that the available capacity at the Preston WWTP will be committed, triggering a change from the short term servicing solution for Stage 1 of the East Side Lands to the ultimate solution at the Kitchener WWTP.

However, in 2012, the Region completed a transfer of flows from the Industrial Road Service Area (IRSA) to the Galt WWTP. This transfer, along with other water conservation measures and treatment plant upgrades, resulted in an increased residual capacity at the Preston WWTP. As such, it is believed that the interim servicing of the full build out of the Stage 1 lands may be able to be accommodated by the Preston WWTPs defined capacity. This is dependent on the amount and nature of actual development that occurs. As part of the Region's current WWTMP update (to be completed in 2017), a review of the servicing strategy for the East Side Lands will be conducted, and the capacity and timing constraints for directing flow to the Preston WWTP will be confirmed.

Therefore, for the purposes of this Class EA Study, the alternative solutions will focus on the ultimate build-out conditions for the broader East Side Lands area. The following sections outline how the design flow rate for the Study Area has been determined.

5.3 EXISTING LAND USES & NET DEVELOPABLE AREA

Currently, the East Side Lands Study Area contains a large portion of prime agricultural and open space lands with a mix of residential, commercial and institutional land uses as well as industrial areas to the north and south. Current zoning and land use information was compiled for the Study Area from the Regional Official Plan and Municipal Property Assessment Corporation (MPAC) data, overlain on the Terranet parcel fabric as provided by the Region.

Within the broader East Side Lands boundary there are approximately 1600 unique properties. Of these properties many have multiple zoning / land use designations and several span the borders between the City of Cambridge, the City of Kitchener and the Township of Woolwich. Furthermore, some of the parcels are partly or completely comprised of wetlands, creeks and watercourses, woodlots or other environmentally sensitive lands which would be considered undevelopable and therefore will not contribute sanitary flows.

Using GRCA mapping as well as other constraint boundaries documented in the 2014 MESP, the floodplains, significant valley slopes and wetland boundaries within the Study Area were quantified as areas that are considered undevelopable. This is illustrated in **Figure 5-2.** It should be noted that, to be conservative, the undevelopable floodplain and wetland areas did not include the set-back or buffer areas. Subtracting these undevelopable areas from the Study Area yields a Net-Developable area of approximately 2906 ha.

The remaining Net-Developable area was further sub-divided into the respective land uses based on the available Official Plan and/or MPAC designations. While the available land use / planning information included a vast number of zoning and land use classifications, to simplify the analysis these were summarized into the following broader categories:

- Agricultural
- Open Space
- Business Park
- Commercial
- Core (Employment)
- Industrial
- Institutional
- Residential

Figure 5-3 illustrates the Net-Developable Land Areas.

It should be noted that the analysis of developable land depicted herein is based on available data and mapping. The definition of developable lands in this Class EA Study should not be construed as being an approval of development (in any way). Rather, the definitions of developable area are presented solely for the purposes of calculating a design sanitary flow rate for the East Side Lands Study Area.

Note: The limits of natural features depicted herein are defined solely for the purposes of identifying potential contributing drainage areas from the East Side Lands. These are not intended to serve as approved limits of development. Any future development plans are subject to permit application and approval processes, where formal development limits will be officially established.

HWY 7

TOWNSHIP OF WOOLWICH

SHANTZ STATION RD

REGION OF WATERLOO INTERNATIONAL AIRPORT

KITCHENER

KOSSUTH RD

MIDDLE BLOCK RD

RIVERBANK DR

KING ST E

ALLENDALE RD

CAMBRIDGE

MAPLE GROVE RD

FOUNTAIN ST

SPEEDSVILLE RD

CHERRY BLOSSOM RD

HWY 8

DEER RIDGE SUBDIVISION

HWY 401

Hespeler WWTP

Kitchener WWTP

Preston WWTP

TOWNSHIP OF NORTH DUMFRIES

0 0.5 1 2 Km

Legend

- Wastewater Treatment Plant
- Floodplain
- Wetland
- River Slopes and Erosion Allowances
- East Side Lands Sanitary Servicing EA Study Area Boundary
- Municipal Boundary

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DATE:	MAY, 2017
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EAST SIDE LANDS SANITARY SERVICING CLASS EA

UNDEVELOPABLE LANDS

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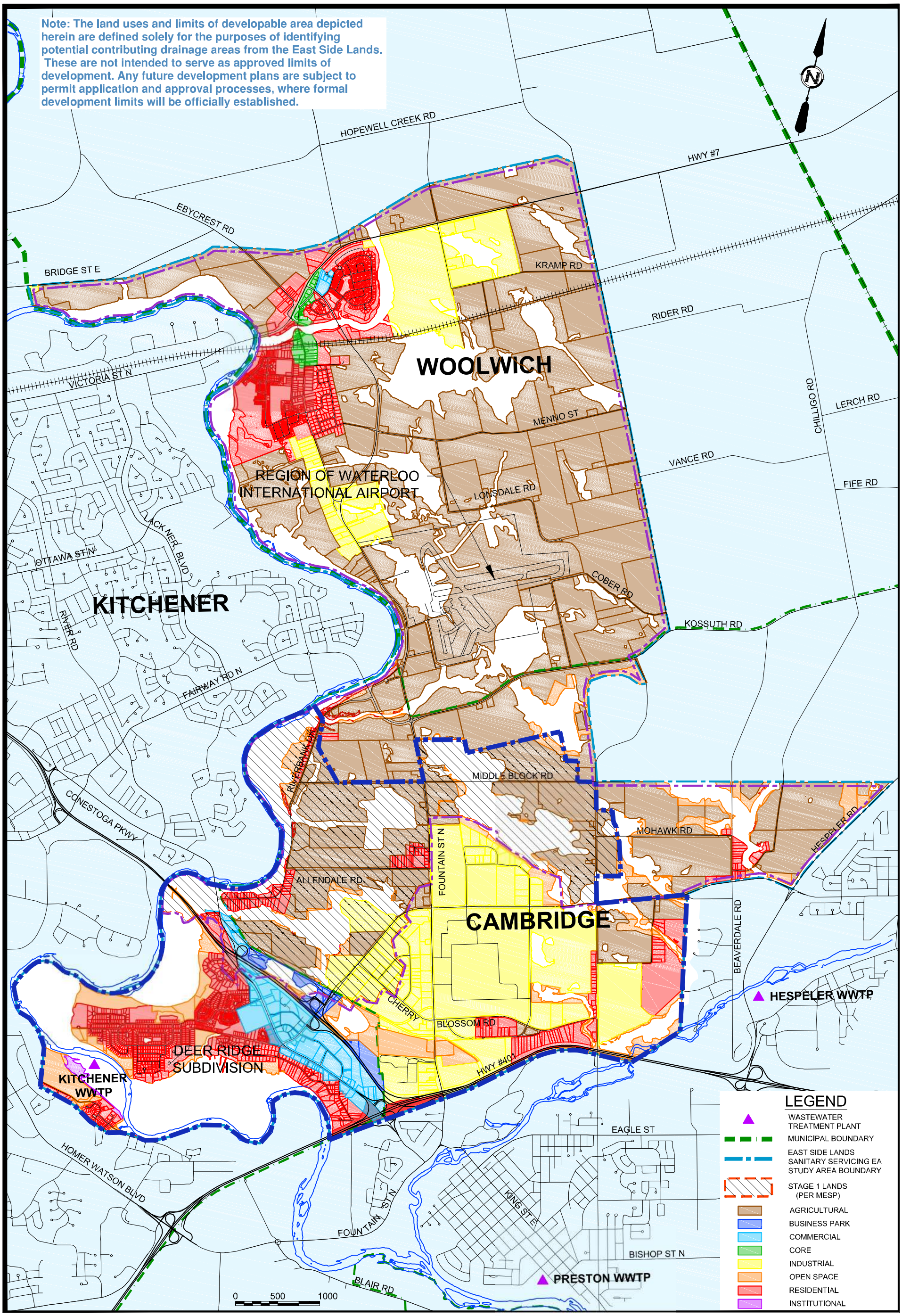
Note: The land uses and limits of developable area depicted herein are defined solely for the purposes of identifying potential contributing drainage areas from the East Side Lands. These are not intended to serve as approved limits of development. Any future development plans are subject to permit application and approval processes, where formal development limits will be officially established.



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DATE:	MAY, 2017
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REGION OF WATERLOO

EAST SIDE LANDS PUMPING STATION & FORCEMAIN CLASS EA

NET-DEVELOPABLE LANDS & LAND USE

5.4 CONTRIBUTING SANITARY DRAINAGE AREAS

Based on the analysis of the net-developable areas of the broader East Side Lands (Figure 5-2), there is a total land area of 4,057 ha, of which 1151 ha is deemed un-developable, leaving 2906 ha as being potentially developable.

In order to efficiently and concisely define and identify the contributing sanitary drainage areas, the Study Area has been further sub-divided into ***Key Sub-Areas*** that relate to existing settlements, developments, and/or other key features identified in the 2014 MESP, the WWTMP, other planning documents or through discussions with Regional or other municipal staff.

Table 5-3 provides a brief verbal description of the Key Sub-Areas and their significance to the East Side Lands Sanitary Servicing Class EA. **Figure 5-4** illustrates the geographical relationship for each Key Sub-Area.

It should be noted that these areas include some additional areas (in Cambridge) that are outside the broader East Side Lands boundary. Rationale for including these areas for consideration is based on the need to fully understand the sanitary flow contributors to the WWTPs to complete the flow rate analysis. The addition of these extra lands results in an increase of the net developable land area to 3,589 ha. This is considered to be the ultimate (maximum) contributing flow area for determining the theoretical sanitary flow rate that will be generated from the broader East Side Lands and conveyed to the Kitchener WWTP.

Using GIS analytical techniques, an analysis was performed to determine the finite land areas (in hectares) for the various land uses within each Key Sub-Area. **Table 5-4** provides a detailed breakdown of the total land areas for the various land uses within each Key Sub-Area.

Table 5-3
Description of East Side Lands Key Sub-Areas

KEY LAND AREA	AREA (ha)	DESCRIPTION
Woolwich 1 (W-1)	91.8	The Township of Woolwich lands, south of Bridge Street, north of the Grand River, and west of the high point on Bridge Street (near Ebycrest Road). This area is well suited to be serviced via gravity sewers draining to the Bridgeport Pumping station.
Woolwich 2.1 (W-2.1)	396.0	The existing Village of Breslau and areas to the northwest of Hwy #7 (Victoria Street). This section generally matches the ***developed*** portions of the Breslau Secondary Plan. This area contains a large residential portion and a mix of commercial and institutional land.
Woolwich 2.2 (W-2.2)	76.8	The existing Village of Breslau and areas to the northwest of Hwy #7 (Victoria Street). This section generally matches the ***developed*** portions of the Breslau Secondary Plan. This area contains a large portion of industrial land at the south end of the village. This area is not designated to drain to the City of Kitchener's Victoria Street Pumping Station.
Woolwich 3 (W-3)	217.9	The remaining generally ***un-developed*** portion of the Breslau Secondary Plan, currently consisting of mainly prime agriculture and/or open space land-use.
Woolwich 4 (W-4)	626.2	The remainder of Woolwich lands outside of the Breslau Secondary Plan and north of Menno Street. This area currently contains prime agricultural and open space lands. Future development is expected to assume a mixed-use of residential, commercial and industrial.
Woolwich 5 (W-5)	605.2	The remainder of Woolwich lands outside of the Breslau Secondary Plan, south of Menno Street, east of Fountain Street and north of Kossuth Road, excluding the Airport. This area currently contains prime agricultural and open space lands. Future development will assume a mixed-use of residential, commercial and industrial. Currently, the main business and sanitary flow generator in this area is Conestoga Meats.
Woolwich 6A (W-6A)	79.0	The remainder of Woolwich lands outside of the Breslau Secondary Plan, south of Menno Street, west of Fountain Street and north of Kossuth Road, excluding the Airport. This area currently contains prime agricultural and open space lands. Future development is likely to be connected to a Quick Start Lands servicing scenario.
Woolwich 6B (W-6B)	146.8	The remainder of Woolwich lands outside of the Breslau Secondary Plan, south of Menno Street, west of Fountain Street and north of Kossuth Road, excluding the Airport. This area currently contains prime agricultural and open space lands. Future development is expected to assume a mixed-use of residential, commercial and industrial and is ***not likely*** to be connected to Quick Start Lands servicing scenarios.
Airport	302.1	Lands currently designated as part of the Region of Waterloo International Airport. These lands are currently subject to an ongoing Airport Master Plan. Land uses are expected to be a mix of industrial and commercial in support of airport operations.
Cambridge 1.1 (C-1.1) ***(MESP Stage 1)***	212.1	Part of the lands defined as ***Stage 1*** in the MESP and specifically, the lands south of Middle Block Road and west of Fountain Street, designated as Prime Industrial Strategic Reserve (PISR) lands and defined in the MESP as the ***Quick Start Lands***.
Cambridge 1.2 (C-1.2) ***(MESP Stage 1)***	250.1	Part of the lands defined as ***Stage 1*** in the MESP and specifically, the lands straddling Middle Block Road and east of Fountain Street, also designated as PISR lands.
Cambridge 1.3 (C-1.3) ***(MESP Stage 1)***	41.1	Part of the lands defined as ***Stage 1*** in the MESP and specifically, the proposed ***Creekside*** Development.
Cambridge 1.4 (C-1.4) ***(MESP Stage 1)***	282.8	The remainder of the lands defined as ***Stage 1*** in the MESP.
Cambridge 2A (C-2A)	146.6	Lands north of the Stage 1 Lands and south of the City of Cambridge Boundary. Future development is likely to be connected to a Quick Start Lands servicing scenario.
Cambridge 2b (C-2B)	138.2	Lands north of the Stage 1 Lands and south of the City of Cambridge Boundary. Future development is expected to assume a mixed-use of residential, commercial and industrial and is ***not likely*** to be connected to Quick Start Lands servicing scenarios.
Cambridge 3.1 (C-3.1)	178.6	Lands east of the Stage 1 Lands and within but west of the East Side Lands boundary as defined in the MESP. This area is not included in the Hespeler WWTP catchment area.
Cambridge 3.2 (C-3.2)	198.0	Lands east of the Stage 1 Lands and within (but just west of) the East Side Lands boundary as defined in the MESP. This area is currently included in the Hespeler WWTP catchment area.
***Cambridge 4 (C-4)**	124.5	Lands defined as the **Hunt Club** Development *(outside the East Side Lands boundary as defined in the MESP).*
***Cambridge 5 (C-5)**	90.8	Lands defined as the **Boxwood** Development (outside the East Side Lands boundary as defined in the MESP).
***Cambridge 6 (C-6)**	99.5	Lands south of the Hunt Club and Boxwood developments, east of Speedsville Road, north of Highway #401, *(outside the East Side Lands boundary as defined in the MESP).*
***Cambridge 7 (C-7)**	505.4	Lands south and east of Stage 1, west of Boxwood, north of Highway #401, consisting of existing industrial land use (eg Toyota, Loblaws). *(outside the East Side Lands boundary as defined in the MESP).*
Kitchener 1 (K-1)	67.8	City of Kitchener lands south of the Cambridge boundary and within the East Side Lands boundary as defined in the MESP.
Kitchener 2 (K-2)	N/A	City of Kitchener lands south of the East Side Lands boundary, west and north of the Grand River. K-2 contains the Deer Ridge Golf course to the west as well as the Deer Ridge estates development and Pioneer Tower community. This area was included for Environmental Assessment purposes in relation to the potential forcemain alignments from the proposed Regional Pumping Station to the Kitchener WWTP. It is not under consideration for servicing by the proposed Pumping Station.

**Note: Areas C-4, C-5, C-6 and C-7 are outside the East Side Lands boundary as defined in the MESP. The MESP identifies these lands as draining to the Preston WWTP in the immediate / interim timeframe. The City of Cambridge has proposed that sanitary flows could ultimately be diverted to the Kitchener WWTP via the new Regional sanitary servicing infrastructure.*

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W-1
W-2.1
W-2.2
W-3
W-4
W-5
W-6A
W-6B
C-1.1
C-1.2
C-1.3
C-1.4
C-2A
C-2B
C-3.1
C-3.2
C-4
C-5
C-6
C-7
K-1
K-2
HOPEWELL CREEK RD
HWY #7
EBYCREST RD
BRIDGE ST E
KRAMP RD
RIDER RD
VICTORIA ST N
MENNO ST
LERCH RD
CHILLIGO RD
VANCE RD
FIFE RD
LONSDALE RD
COBER RD
KOSSUTH RD
RIVERBANK DR
MIDDLE BLOCK RD
MOHAWK RD
HESPELER RD
FOUNTAIN ST N
ALLENDALE RD
CHERRY BLOSSOM RD
BRAEMAR DR
HWY #401
EAGLE ST
BISHOP ST N
BLAIR RD
FOUNTAIN
HOMER WATSON BLVD
CONESTOGA PKWY
0 500 1000

LEGEND

- QUICK START LANDS (PER MESP)
- STAGE 1 LANDS (PER MESP)
- SECTION BOUNDARY
- MUNICIPAL BOUNDARY
- EAST SIDE LANDS SANITARY SERVICING CLASS EA STUDY AREA BOUNDARY

PROJECT No.	2013-5592
DATE:	MAT, 2017
APPROVED:	D. LINDNER
SCALE:	N.T.S.
DWG. No.	FIGURE 5-4

Associated Engineering

Region of Waterloo

REGION OF WATERLOO

EAST SIDE LANDS SANITARY SERVICING CLASS EA

STUDY AREA - KEY SUB-AREAS

Table 5-4 - Key Sub-Areas: Detailed Breakdown of Land Uses

ID	Total Area	Agricultural	Business Park	Commercial	Core	Industrial	Institutional	Open Space	Residential	Roads	Environmental Constraints	Total Undevelopable	Net Developable
Areas within the East Side Lands Boundary (as defined in the MESP)													
W-1	91.8	55.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.8	35.1	35.9	55.9
W-2.1	396.0	73.3	0.0	3.2	14.7	1.4	0.0	0.0	195.3	47.7	60.4	108.1	287.9
W-2.2	76.8	0.2	0.0	0.0	0.0	59.0	0.0	0.0	5.0	7.0	5.7	12.6	64.2
W-3	217.9	24.9	0.0	0.0	0.0	134.8	0.0	0.0	0.0	6.9	51.4	58.2	159.7
W-4	626.2	469.9	0.0	0.0	0.7	0.0	0.0	0.0	7.4	11.7	136.6	148.3	478.0
W-5	605.2	505.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.6	79.3	99.9	505.3
W6-A	79.0	53.6	0.0	0.0	0.0	0.0	0.0	0.1	0.0	2.7	22.6	25.3	53.7
W6-B	146.8	89.1	0.0	0.0	0.0	0.2	0.0	0.0	0.6	6.2	50.8	57.0	89.8
Airport	302.1	217.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	83.9	84.3	217.9
C-1.1	212.1	161.0	0.0	0.0	0.0	0.0	0.0	5.6	0.1	7.2	38.2	45.4	166.7
C-1.2	250.1	121.9	0.0	0.0	0.0	0.0	0.0	7.1	0.0	3.9	117.2	121.1	129.0
C-1.3 (Creekside)	41.1	37.5	1.0	0.3	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	41.1
C-1.4	282.8	35.9	0.1	0.1	0.0	60.2	0.0	16.1	30.9	15.6	124.0	139.6	143.2
C-2A	146.6	108.1	0.0	0.0	0.0	0.0	0.0	6.6	2.8	12.9	16.3	29.2	117.5
C-2B	138.2	79.1	0.0	0.0	0.0	0.0	0.0	16.8	0.0	6.3	35.9	42.3	95.9
C-3.1	76.0	28.2	0.0	0.0	0.0	0.0	0.0	10.5	6.1	5.1	26.0	31.1	44.9
C-3.2	300.5	194.1	0.0	0.0	0.0	0.0	0.0	33.5	12.4	14.1	46.3	60.4	240.1
K-1	67.8	0.0	7.3	5.0	0.0	0.1	0.0	1.2	2.4	15.9	36.0	51.9	16.0
Total	4057.1	2254.8	8.4	8.5	15.3	256.6	0.0	99.7	262.9	184.9	965.6	1150.6	2906.6
Additional City of Cambridge Areas for Consideration of Ultimate Sanitary Flow (Outside the MESP East Side Lands Boundary)													
C-4 (Hunt Club)	124.5	31.6	0.0	0.0	0.0	21.5	0.0	15.8	43.7	3.3	8.6	11.9	112.6
C-5 (Boxwood)	90.8	0.0	0.0	0.0	0.0	67.4	0.0	3.3		2.9	17.3	20.2	70.6
C-6	99.5	0.6	0.0	0.0	0.0	31.4	0.0	13.8	18.3	13.0	22.4	35.4	64.1
C-7	505.4	10.6	0.4	0.1	0.0	370.0	0.0	39.3	15.1	60.7	9.3	70.0	435.4
Total	820.2	42.8	0.4	0.1	0.0	490.3	0.0	72.2	77.0	79.8	57.6	137.4	682.8
Total Potential Contributing Area to Proposed Pumping Station													
Total	4877.3	2297.6	8.8	8.6	15.3	746.9	0.0	171.9	340.0	264.7	1023.2	1288.0	3589.4
Additional City of Kitchener Area - Future Forcemain Alignments (Outside the MESP East Side Lands Boundary)													
K-2	734.1	0.0	14.0	83.0	0.0	0.2	4.6	90.2	156.1	74.4	311.6	386.0	348.1

Note: All areas reported in hectares.

5.5 ZONING & POPULATION DENSITIES

For each of the major subdivided sections shown in Figure 5-4, (i.e. W-1, W-2, W-3, C-1.1….etc.), the associated zoning and/or land uses for each of the individual property parcels were tabulated, as defined by either the ROP or MPAC data. While there are a large number of specific zoning / land-use designations, for simplicity the land uses were summarized into the gross categories listed in **Table 5-5.** The associated population densities (as provided by the Region's Planning Department and consistent with the planning assumptions stated in the 2014 MESP) are also provided.

Table 5-5
Population Densities for Various Land Uses

ZONING	POPULATION (person/ha)
AGRICULTURE	40 / 55
GREEN SPACE	40 / 55
OPEN SPACE	40 / 55
RESIDENTIAL	55
COMMERCIAL	40
INDUSTRIAL	40
INSTITUTIONAL	40
EMPLOYMENT (Stage 1)	25

For much of the broader East Side Lands, the current zoning (i.e. as shown in the ROP) is currently identified as Agricultural, Green Space or Open Space. As the East Side Lands develop, it is expected that the zoning for most (if not all) of these areas will change to suit the proposed land uses. As recommended by the Region's Planning Department, the assumption was made that these future development lands would be split into 40% residential land use and 60% employment lands.

Consistent with the ROP, anything classified residential has a projected population density of 55 persons per hectare (ppha) while typical employment lands (including commercial, industrial, business park, institutional and core areas) have a density of 40 ppha. As recommended by the Region's Planning Department, the population density for the Stage 1 Employment Lands (as identified in the MESP) was assumed to be 25 ppha. This is consistent with what is presented in the 2014 MESP.

5.6 CALCULATION OF DESIGN PEAK SANITARY FLOW RATES

In the 2014 MESP, projected average daily flow rates from the East Side Lands were calculated in reference to the Kitchener and Preston WWTP treatment capacities, measured in m^3/day. While these are important in the context of the treatment plants, they are not the appropriate basis for sizing and design of sanitary servicing infrastructure such as gravity sewers, pumping stations or forcemains.

Typically, the design of a sanitary collection / conveyance system is determined by the peak (instantaneous) flow of the sanitary sewer collection system. This theoretical peak flow is calculated based on the contributing drainage area(s) and the anticipated average daily flow (ADF). For residential lands, the area is multiplied by the population density and then multiplied by a per capita flow rate (in L/s per person). For Industrial / Commercial / Institutional (ICI) lands, the area is multiplied by an appropriate area flow rate (in L/s per hectare). According to both the MOECC "Design Guidelines for Sewage Works" and the Region of Waterloo and Area Municipalities "Design Guidelines and Supplemental Specifications for Municipal Services" (DGSSMS), an ADF of 350L/day/cap for residential lands is typically assigned. For Commercial / Industrial / Institutional lands, the recommended flow rates vary between 0.6 L/s/ha to 1.16 L/s/ha.

Once the ADF is determined, a peak flow is calculated by applying an appropriate peaking factor. For residential land uses, the peaking factor is typically calculated using the Harmon formula. This approach typically yields a peaking factor between 2.0 and 4.5 and is intended to be representative of the typical diurnal pattern peak of water use by municipal patrons. It should be noted that the Harmon formula has an inverse relationship to population (and hence land area). Therefore, the larger the population (or area), the smaller the peaking factor, and vice versa.

For ICI lands, a peaking factor is typically selected that is representative of the specific land uses based on historic or actual flow data from the wastewater generators. In the absence of such data, the guidelines suggest peaking factor of 2.5.

Finally, once the peak generated flow is determined an additional allowance is made to account for extraneous flows such as inflow and infiltration (I&I). This is typically due to rain or groundwater flow migrating into the sewer pipe system. Design guidelines recommend an I&I allowance of 0.15 L/s/ha to be added to the peak flow calculation.

Table 5-6 summarizes the application of the typical design approach and calculates the peak flows for each Key Sub-Area and sums them for the entire potential contributing sanitary drainage area.

Table 5-6 - Theoretical Design Flow Rates - Typical Calculation Approach

Population Densities	
Residential	55
Stage 1 Employment	25
I/C/I	40

Average Daily Flows		
Residential	350	L/pers/day
Employment	0.60	L/s/ha
Business Park	1.16	L/s/ha
Commercial	0.60	L/s/ha
Core	1.16	L/s/ha
Industrial	0.50	L/s/ha
Institutional	1.00	L/s/ha

Peaking Factor		
Residential	varies	Harmon: 1+(14/(4+(Population/1000)^0.5))
Employment	2.5	Per DGSSMS
I/C/I	2.5	Per DGSSMS

Extraneous Flows		
L/s/Ha	0.15	Per DGSSMS

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				DOMESTIC (Residential)									EMPLOYMENT LANDS			COMMERCIAL / INDUSTRIAL / INSTITUTIONAL (ICI)									I&I FLOWS		
Key Sub-Area	Total Area (Ha)	Un-Developable Area (ha)	Net Development Area (Ha)	Residential (Zoned) (Ha)	Agricultural (Ha)	Open Space (Ha)	Assumed Residential (F + G x 40%) (Ha)	Total Residential Land (Ha)	Residential Population (pers)	Avg Daily Flow Residential (L/s)	Peaking Factor (MESP)	Peak Flow Residential (L/s)	Total Employment Land (F + G x 60%) (Ha)	Peaking Factor (DGSSMS)	Peak Flow Employment (L/s)	Bus. Park (Ha)	Comm. (Ha)	Core (Ha)	Indust. (Ha)	Inst. (Ha)	Total I/C/I Area (Ha)	Avg Daily Flow I/C/I (L/s)	Peaking Factor (DGSSMS)	Peak Flow I/C/I (L/s)	Ext. Flow Factor (D x Y) (L/Ha/s)	Exraneous Flow (L/s)	Total Peak Flow (L/s)
A	B	C	D	E	F	G	H	I	J	K	L	M	N	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
Areas within the East Side Lands Boundary (as defined in the MESP)																											
W-1	91.8	35.9	55.9	0.0	55.0	0.0	22.0	22.0	**1,210**	4.9	3.75	18.4	33.0	2.5	49.5	0.0	0.0	0.0	0.9	0.0	0.9	**0.4**	2.5	1.1	0.15	8.4	62.7
W-2.1	396.0	108.1	287.9	195.3	73.3	0.0	29.3	224.6	**12,355**	50.0	2.86	143.3	44.0	2.5	66.0	0.0	3.2	14.7	1.4	0.0	19.3	**19.6**	2.5	49.1	0.15	43.2	161.1
W-2.2	76.8	12.6	64.2	5.0	0.2	0.0	0.1	5.0	**277**	1.1	4.09	4.6	0.1	2.5	0.2	0.0	0.0	0.0	59.0	0.0	59.0	**29.5**	2.5	73.7	0.15	9.6	87.6
W-3	217.9	58.2	159.7	0.0	24.9	0.0	10.0	10.0	**549**	2.2	3.95	8.8	15.0	2.5	22.4	0.0	0.0	0.0	134.8	0.0	134.8	**67.4**	2.5	168.5	0.15	24.0	218.8
W-4	626.2	148.3	478.0	7.4	469.9	0.0	188.0	195.3	**10,742**	43.5	2.92	127.2	281.9	2.5	422.9	0.0	0.0	0.7	0.0	0.0	0.7	**0.8**	2.5	2.0	0.15	71.7	499.5
W-5	605.2	99.9	505.3	0.0	505.3	0.0	202.1	202.1	**11,117**	45.0	2.91	131.0	303.2	2.5	454.8	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	2.5	0.0	0.15	75.8	533.5
W6-A	79.0	25.3	53.7	0.0	53.6	0.1	21.5	21.5	**1,181**	4.8	3.75	17.9	32.2	2.5	48.3	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	2.5	0.0	0.15	8.1	60.1
W-6B	146.8	57.0	89.8	0.6	89.1	0.0	35.6	36.2	**1,993**	8.1	3.59	29.0	53.4	2.5	80.1	0.0	0.0	0.0	0.2	0.0	0.2	**0.1**	2.5	0.2	0.15	13.5	97.4
Airport	302.1	84.3	302.1	0.0	0.0	0.0	0.0	0.0	**0**	0.0	0.00	0.0	302.1	2.5	453.2	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	2.5	0.0	0.15	45.3	498.5
C-1.1	212.1	45.4	166.7	0.1	161.0	5.6	66.6	66.8	**3,672**	14.9	3.37	50.1	99.9	2.5	149.9	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	2.5	0.0	0.15	25.0	178.3
C-1.2	250.1	121.1	129.0	0.0	121.9	7.1	51.6	51.6	**2,838**	11.5	3.46	39.8	77.4	2.5	116.1	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	2.5	0.0	0.15	19.3	138.9
C-1.3 (Creekside)	41.1	0.0	41.1	0.0	37.5	2.3	15.9	15.9	**875**	3.5	3.84	13.6	23.9	2.5	35.8	1.0	0.3	0.0	0.0	0.0	1.3	**1.3**	2.5	3.3	0.15	6.2	49.1
C-1.4	282.8	139.6	143.2	30.9	35.9	16.1	20.8	51.7	**2,843**	11.5	3.46	39.9	31.2	2.5	46.7	0.1	0.1	0.0	60.2	0.0	60.3	**30.2**	2.5	75.6	0.15	21.5	147.2
C-2A	146.6	29.2	117.5	2.8	108.1	6.6	45.9	48.7	**2,676**	10.8	3.48	37.8	68.8	2.5	103.2	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	2.5	0.0	0.15	17.6	124.3
C-2B	138.2	42.3	95.9	0.0	79.1	16.8	38.4	38.4	**2,110**	8.5	3.57	30.5	57.6	2.5	86.3	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	2.5	0.0	0.15	14.4	104.3
C-3.1	76.0	31.1	44.9	6.1	28.2	10.5	15.5	21.6	**1,187**	4.8	3.75	18.0	23.2	2.5	34.8	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	2.5	0.0	0.15	6.7	45.3
C-3.2	300.5	60.4	240.1	12.4	194.1	33.5	91.0	103.4	**5,689**	23.0	3.19	73.6	136.6	2.5	204.8	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	2.5	0.0	0.15	36.0	244.0
K-1	67.8	51.9	16.0	2.4	0.0	1.2	0.5	2.8	**156**	0.6	4.19	2.6	0.7	2.5	1.1	7.3	5.0	0.0	0.1	0.0	12.4	**11.5**	2.5	28.8	0.15	2.4	36.5
Total	**4057.1**	**1150.6**	**2990.8**	**262.9**	**2037.0**	**99.7**	**854.7**	**1117.6**	**61,470**	**249.0**		**786.0**	**1584.2**		**2376.2**	**8.4**	**8.5**	**15.3**	**256.6**	**0.0**	**288.9**	**160.9**		**402.3**		**448.6**	**3287.3**
Additional City of Cambridge Areas for Consideration of Ultimate Sanitary Flow (Outside the MESP East Side Lands Boundary)																											
C-4 (Hunt Club)	124.5	11.9	112.6	43.7	31.6	15.8	19.0	62.7	**3,446**	14.0	3.39	47.3	28.5	2.5	42.7	0.0	0.0	0.0	21.5	0.0	21.5	**10.7**	2.5	26.9	0.15	16.9	89.8
C-5 (Boxwood)	90.8	20.2	70.6	0.0	0.0	3.3	1.3	1.3	**72**	0.3	4.28	1.2	2.0	2.5	2.9	0.0	0.0	0.0	67.4	0.0	67.4	**33.7**	2.5	84.2	0.15	10.6	102.0
C-6	99.5	35.4	64.1	18.3	0.6	13.8	5.8	24.1	**1,324**	5.4	3.72	19.9	8.7	2.5	13.0	0.0	0.0	0.0	31.4	0.0	31.4	**15.7**	2.5	39.3	0.15	9.6	65.6
C-7	505.4	70.0	435.4	15.1	10.6	39.3	19.9	35.0	**1,924**	7.8	3.60	28.1	29.9	2.5	44.9	0.4	0.1	0.0	370.0	0.0	370.5	**185.5**	2.5	463.8	0.15	65.3	577.5
Total	**820.2**	**137.4**	**682.8**	**77.0**	**42.8**	**72.2**	**46.0**	**123.0**	**6,766**	**27.4**		**96.6**	**69.0**		**103.5**	**0.4**	**0.1**	**0.0**	**490.3**	**0.0**	**490.8**	**245.7**		**614.1**		**102.4**	**835.0**
Total	**4877.3**	**1288.0**	**3673.6**	**340.0**	**2079.8**	**171.9**	**900.7**	**1240.7**	**68,236**	**276.4**		**882.6**	**1653.1**		**2479.7**	**8.8**	**8.6**	**15.3**	**746.9**	**0.0**	**779.6**	**406.6**		**1016.4**		**551.0**	**4122.3**

Applying this typical approach to calculating the peak flow yields a very high peak design flow rate for this project; much higher than what is suggested in the 2014 MESP. Since this Class EA Study is intended to build on the recommendations of the MESP, it is prudent to consider the approach and parameters used in that document. The following bullet points summarize the 2014 MESP's approach:

- Using an equivalent population approach for all lands – i.e. converting ICI lands to similar residential loading by equating estimated employment densities, (as presented in Table 5-5 above) to population densities;
- Using a stipulated population of 500 persons for the Airport lands;
- Use of a stipulated population density of 25 persons/hectare for the Stage 1 Employment Lands;
- Use of an ADF for residential lands of 240 L/d/pers;
- Use of an ADF for ICI lands of 300 L/d/pers;
- Application of a standard peaking factor of 2.05 for all lands;
- Addition of extraneous (I&I) flows equal to 20% of the calculated peak flow;

Using this approach, the peak flows for each Key Sub-Area are calculated to be significantly less, as outlined in **Table 5-7.**

While the theoretical flow rates in **Table 5-6** are perhaps excessively conservative, future trunk sewer design calculations servicing the broader East Side Lands will likely use a similar conservative approach. The fact that the approach taken in the 2014 MESP is different from the typical method may be subject to future scrutiny. As such, it is worthwhile to provide supporting rationale for the approach and parameters used, and qualify why they should apply to this project and the calculation of the design flow rate.

Through discussion with Regional staff, it is deemed appropriate to follow the same approach as the MESP for the following reasons:

1. The parameter values and resultant design flow rates calculated in the MESP are consistent with recent observed values in the Region of Waterloo and other similar large municipalities in Ontario. It is believed that the typical design guidelines are overly conservative and result in excessively high design flow rates. Furthermore, recent efforts and successful water conservation programs paired with I&I reduction programs have reduced actual sanitary flow rates being observed.
2. The 2014 MESP is a governing document for the future planning and development of the East Side Lands (Stage 1), and has been subject to extensive review and discussion by Regional and Municipal Staff. As such, Region staff have confirmed that the information provided therein should be used as the basis for future design.

Therefore, the ultimate design flow rate for the East Side Lands sanitary servicing infrastructure will be determined using the approach outlined in **Table 5-7**.

Table 5-7 - Theoretical Design Flow Rates - MESP Calculation Approach

Population Densities	
Residential	55
Stage 1 Employment	25
I/C/I	40

Average Daily Flows		
Residential	240	L/pers/day
Employment	300	L/pers/day
Business Park	300	L/pers/day
Commercial	300	L/pers/day
Core	300	L/pers/day
Industrial	300	L/pers/day
Institutional	300	L/pers/day

Peaking Factor		
Residential	2.05	(MESP)
Employment	2.05	(MESP)
I/C/I	2.05	(MESP)

Extraneous Flows		
As % of Peak	20%	(MESP)

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				DOMESTIC (Residential)									EMPLOYMENT LANDS		COMMERCIAL / INDUSTRIAL / INSTITUTIONAL (ICI)										I&I FLOWS		
Key Sub-Area	Total Area (Ha)	Un-Developable Area (ha)	Net Development Area (Ha)	Residential (Zoned) (Ha)	Agricultural (Ha)	Open Space (Ha)	Assumed Residential (F + G x 40%) (Ha)	Total Residential Land (Ha)	Residential Population (pers)	Avg Daily Flow Residential (L/s)	Peaking Factor (MESP)	Peak Flow Residential (L/s)	Total Employment Land (F + G x 60%) (Ha)	Equivalent Population (pers)	Bus. Park (Ha)	Comm. (Ha)	Core (Ha)	Indust. (Ha)	Inst. (Ha)	Total I/C/I Land (Ha)	Equivalent Population (pers)	Total Equivalent Population Emp. + I/C/I	Avg Daily Flow Emp. + I/C/I (L/s)	Peaking Factor (DGSSMS)	Peak Flow Emp. + I/C/I (L/s)	Ext. Flow: % of Peak (L/s)	Exraneous Flow (L/s)	Total Flow (L/s)
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
[1] Airport Population prescribed as 500 employees per MESP																												
Areas within the East Side Lands Boundary (as defined in the MESP)																												
W-1	91.8	35.9	55.9	0.0	55.0	0.0	22.0	22.0	**1,210**	3.4	2.05	6.9	33.0	**825**	0.0	0.0	0.0	0.9	0.0	0.9	**36**	**861**	3.0	2.05	6.1	20%	2.6	15.6
W-2.1	396.0	108.1	287.9	195.3	73.3	0.0	29.3	224.6	**12,355**	34.3	2.05	70.4	44.0	**1,100**	0.0	3.2	14.7	1.4	0.0	19.3	**772**	**1,871**	6.5	2.05	13.3	20%	16.7	100.4
W-2.2	76.8	12.6	64.2	5.0	0.2	0.0	0.1	5.0	**277**	0.8	2.05	1.6	0.1	**3**	0.0	0.0	0.0	59.0	0.0	59.0	**2,360**	**2,362**	8.2	2.05	16.8	20%	3.7	22.1
W-3	217.9	58.2	159.7	0.0	24.9	0.0	10.0	10.0	**549**	1.5	2.05	3.1	15.0	**374**	0.0	0.0	0.0	134.8	0.0	134.8	**5,390**	**5,765**	20.0	2.05	41.0	20%	8.8	53.0
W-4	626.2	148.3	478.0	7.4	469.9	0.0	188.0	195.3	**10,742**	29.8	2.05	61.2	281.9	**7,049**	0.0	0.0	0.7	0.0	0.0	0.7	**28**	**7,077**	24.6	2.05	50.4	20%	22.3	133.9
W-5	605.2	99.9	505.3	0.0	505.3	0.0	202.1	202.1	**11,117**	30.9	2.05	63.3	303.2	**7,580**	0.0	0.0	0.0	0.0	0.0	0.0	**0**	**7,580**	26.3	2.05	54.0	20%	23.5	140.7
W6-A	79.0	25.3	53.7	0.0	53.6	0.1	21.5	21.5	**1,181**	3.3	2.05	6.7	32.2	**805**	0.0	0.0	0.0	0.0	0.0	0.0	**0**	**805**	2.8	2.05	5.7	20%	2.5	14.9
W6-B	146.8	57.0	89.8	0.6	89.1	0.0	35.6	36.2	**1,993**	5.5	2.05	11.3	53.4	**1,336**	0.0	0.0	0.0	0.2	0.0	0.2	**6**	**1,342**	4.7	2.05	9.6	20%	4.2	25.1
Airport	302.1	84.3	302.1	0.0	0.0	0.0	0.0	0.0	**0**	0.0	2.05	0.0	302.1	**500 [1]**	0.0	0.0	0.0	0.0	0.0	0.0	**0**	**500**	1.7	2.05	3.6	20%	0.7	4.3
C-1.1	212.1	45.4	166.7	0.1	161.0	5.6	66.6	66.8	**3,672**	10.2	2.05	20.9	99.9	**2,498**	0.0	0.0	0.0	0.0	0.0	0.0	**0**	**2,498**	8.7	2.05	17.8	20%	7.7	46.4
C-1.2	250.1	121.1	129.0	0.0	121.9	7.1	51.6	51.6	**2,838**	7.9	2.05	16.2	77.4	**1,935**	0.0	0.0	0.0	0.0	0.0	0.0	**0**	**1,935**	6.7	2.05	13.8	20%	6.0	35.9
C-1.3 (Creekside)	41.1	0.0	41.1	0.0	37.5	2.3	15.9	15.9	**875**	2.4	2.05	5.0	23.9	**597**	1.0	0.3	0.0	0.0	0.0	1.3	**52**	**648**	2.3	2.05	4.6	20%	1.9	11.5
C-1.4	282.8	139.6	143.2	30.9	35.9	16.1	20.8	51.7	**2,843**	7.9	2.05	16.2	31.2	**779**	0.1	0.1	0.0	60.2	0.0	60.3	**2,413**	**3,192**	11.1	2.05	22.7	20%	7.8	46.7
C-2A	146.6	29.2	117.5	2.8	108.1	6.6	45.9	48.7	**2,676**	7.4	2.05	15.2	68.8	**1,720**	0.0	0.0	0.0	0.0	0.0	0.0	**0**	**1,720**	6.0	2.05	12.2	20%	5.5	33.0
C-2B	138.2	42.3	95.9	0.0	79.1	16.8	38.4	38.4	**2,110**	5.9	2.05	12.0	57.6	**1,439**	0.0	0.0	0.0	0.0	0.0	0.0	**0**	**1,439**	5.0	2.05	10.2	20%	4.5	26.7
C-3.1	76.0	31.1	44.9	6.1	28.2	10.5	15.5	21.6	**1,187**	3.3	2.05	6.8	23.2	**581**	0.0	0.0	0.0	0.0	0.0	0.0	**0**	**581**	2.0	2.05	4.1	20%	2.2	13.1
C-3.2	300.5	60.4	240.1	12.4	194.1	33.5	91.0	103.4	**5,689**	15.8	2.05	32.4	136.6	**3,414**	0.0	0.0	0.0	0.0	0.0	0.0	**0**	**3,414**	11.9	2.05	24.3	20%	11.3	68.0
K-1	67.8	51.9	16.0	2.4	0.0	1.2	0.5	2.8	**156**	0.4	2.05	0.9	0.7	**18**	7.3	5.0	0.0	0.1	0.0	12.4	**496**	**514**	1.8	2.05	3.7	20%	0.9	5.5
Total	**4057.1**	**1150.6**	**2990.8**	**262.9**	**2037.0**	**99.7**	**854.7**	**1117.6**	**61,470**	**170.7**		**350.0**	**1584.2**	**32,551**	**8.4**	**8.5**	**15.3**	**256.6**	**0.0**	**288.9**	**11,552**		**153.1**		**313.9**		**132.8**	**796.8**
Additional City of Cambridge Areas for Consideration of Ultimate Sanitary Flow (Outside the MESP East Side Lands Boundary)																												
C-4 (Hunt Club)	124.5	11.9	112.6	43.7	31.6	15.8	19.0	62.7	**3,446**	9.6	2.05	19.6	28.5	**712**	0.0	0.0	0.0	21.5	0.0	21.5	**860**	**1,571**	5.5	2.05	11.2	20%	6.2	37.0
C-5 (Boxwood)	90.8	20.2	70.6	0.0	0.0	3.3	1.3	1.3	**72**	0.2	2.05	0.4	2.0	**49**	0.0	0.0	0.0	67.4	0.0	67.4	**2,696**	**2,744**	9.5	2.05	19.5	20%	4.0	23.9
C-6	99.5	35.4	64.1	18.3	0.6	13.8	5.8	24.1	**1,324**	3.7	2.05	7.5	8.7	**216**	0.0	0.0	0.0	31.4	0.0	31.4	**1,256**	**1,473**	5.1	2.05	10.5	20%	3.6	21.6
C-7	505.4	70.0	435.4	15.1	10.6	39.3	19.9	35.0	**1,924**	5.3	2.05	11.0	29.9	**748**	0.4	0.1	0.0	370.0	0.0	370.5	**14,820**	**15,567**	54.1	2.05	110.8	20%	24.4	146.1
Total	**820.2**	**137.4**	**682.8**	**77.0**	**42.8**	**72.2**	**46.0**	**123.0**	**6,766**	**18.8**		**38.5**	**69.0**		**0.4**	**0.1**	**0.0**	**490.3**	**0.0**	**490.8**	**19,631**	**21,355**	**74.2**		**152.0**		**38.1**	**228.6**
Total	**4877.3**	**1288.0**	**3673.6**	**340.0**	**2079.8**	**171.9**	**900.7**	**1240.7**	**68,236**	**189.5**		**388.6**	**1653.1**	**44,757**	**8.8**	**8.6**	**15.3**	**746.9**	**0.0**	**779.6**	**31,184**	**21,355**	**227.3**		**465.9**		**170.9**	**1025.4**

It is of note that, when including all of the Key Sub-Areas that could potentially contribute to the sanitary flows of the broader East Side Lands (i.e. excluding area K-2), the equivalent population is 133,123. This is significantly higher than the estimated population of 113,389 that is stated in the MESP. As such, there are two important additional factors to consider:

1. It is generally understood that population projections are difficult to accurately estimate as they are subject to the ever changing influence of actual residential and employment market conditions; and
2. The calculations presented in **Table 5-7** include equivalent population contributions from Key Sub-Areas C-4 (Hunt Club), C5 Boxwood, C-6 and C-7. These are not explicitly and / or equivalently included in the 2014 MESP population calculations.

The latter of these considerations is discussed further in the following section.

5.7 PROPOSED DEVELOPMENTS & STAGING OF FLOWS – ULTIMATE CONDITIONS

As indicated in the MESP, the ultimate build-out of the East Side Lands is subject to development and market conditions and is expected to take at least 35 years (or longer). The design of the proposed sanitary servicing infrastructure that will convey sewage to the Kitchener WWTP must be sized to meet ultimate build out conditions; however, it must also consider the initial start-up conditions.

The design of sanitary servicing infrastructure must be adaptable to the evolution of the East Side Lands and be adaptable to a large range of design flows. It is logically anticipated that the initial conditions will have a design flow rate that is significantly less than the ultimate flow rate. The difficult question is “what flow rates shall be used for design?”

The sizing of the sanitary servicing infrastructure could be considered as a relatively simple matter, and its design could be based on a conservatively calculated peak flow rate that includes all of the Key Sub-Areas (except for K-2). Per **Table 5-7** this would result in an ultimate design flow rate of 1,025 L/s.

However, this approach is likely overly conservative, and depending on how the various lands actually develop, it is very possible that this ultimate flow rate is never actually achieved. Understanding some specific nuances and possible development scenarios, there are a number of areas that should be considered for exclusion from the contributing sanitary drainage area, specifically:

Woolwich 1 (W-1): based on existing topography, this area is likely better serviced via gravity sewer to the Bridge Street Pumping Station with conveyance to the Waterloo WWTP.

Woolwich 2.1 (W-2.1): based on the recently updated Cross Border Agreement with the City of Kitchener, this area is assigned to be conveyed to the Victoria Street Pumping Station in perpetuity.

Cambridge 3.2 (C-3.2): per the Speed River Assimilative Capacity Study, and depending on future capacity upgrades, it is more appropriate to drain this area to the Hespeler WWTP.

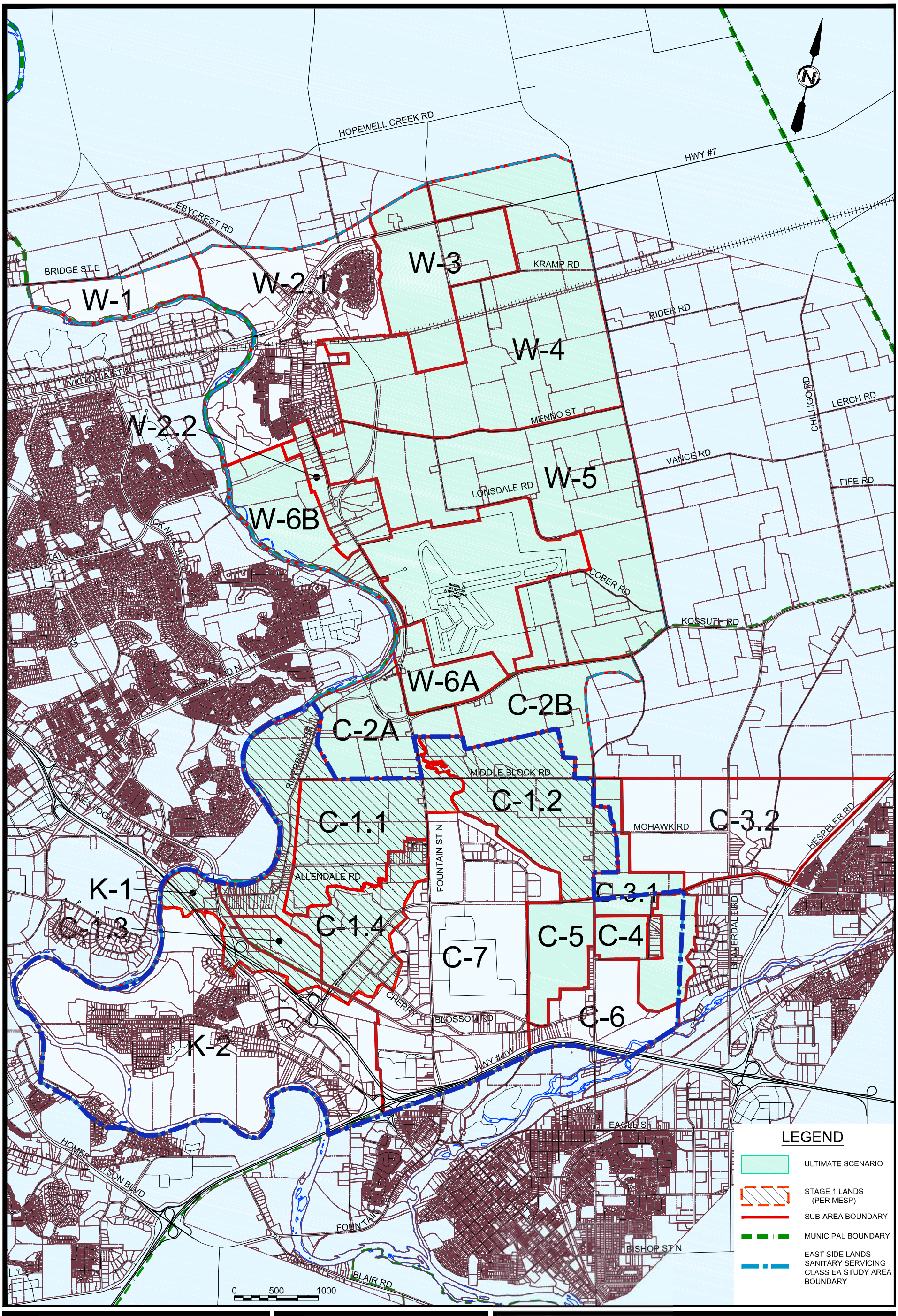
Cambridge 6 (C-6) and Cambridge 7 (C-7): The existing developed areas (eg. Toyota, Loblaws, etc.) are currently serviced by the Preston WWTP and can remain as such in the long-term.

Based on the above rationale, it is recommended that the future maximum "ultimate" flow scenario for the pumping station and forcemain be based on the areas noted above being excluded from the flow rate calculation. **Figure 5-5** presents the ultimate sanitary servicing infrastructure design catchment area. **Table 5-8** presents the scenario where all of the areas identified above are excluded from the ultimate flow rate calculation. **Therefore, the theoretical, ultimate design flow rate for the East Side Lands Sanitary Servicing infrastructure is projected to be 627 L/s.**

It is of note that Kitchener 1 (K-1) is a small area and is at the lowest elevation of all the contributing Key Sub-Areas, but has very limited development potential. To service this area via gravity sewer is likely significantly more costly than servicing via private or communal wastewater systems.

Also, it should be noted that the theoretical ultimate flow rate will only be achieved at a point in the distant future. This theoretical design flow rate has been utilized as a preliminary design parameter for establishing the general sizing requirements for the sanitary servicing infrastructure.

This Drawing Is For The Use Of The Client And Project Indicated
No Representations Of Any Kind Are Made To Other Parties



PROJECT No.	2013-5592
DATE:	MAY, 2017
APPROVED:	D. LINDNER
SCALE:	N.T.S.
DWG. No.	FIGURE 5-5

Associated Engineering

Region of Waterloo

REGION OF WATERLOO

EAST SIDE LANDS SANITARY SERVICING CLASS EA

ULTIMATE SCENARIO - SANITARY CATCHMENT AREAS

Table 5-8 - Theoretical Design Flow Rates - Ultimate "Exclusion" Scenario

(Based on MESP Calculation Approach)

Population Densities	
Residential	55
Stage 1 Employment	25
I/C/I	25

Average Daily Flows		
Residential	240	L/pers/day
Employment	300	L/pers/day
Business Park	300	L/pers/day
Commercial	300	L/pers/day
Core	300	L/pers/day
Industrial	300	L/pers/day
Institutional	300	L/pers/day

Peaking Factor		
Residential	2.05	(MESP)
Employment	2.05	(MESP)
I/C/I	2.05	(MESP)

Extraneous Flows		
As % of Peak	20%	(MESP)

Region of Waterloo

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				DOMESTIC (Residential)								EMPLOYMENT LANDS		COMMERCIAL / INDUSTRIAL / INSTITUTIONAL (ICI)										I&I FLOWS		
Key Sub-Area	Total Area (Ha)	Un-Developable Area (ha)	Net Development Area (Ha)	Residential (Zoned) (Ha)	Agricultural (Ha)	Open Space (Ha)	Assumed Residential (F + G x 40%) (Ha)	Total Residential Land (Ha)	Residential Population (pers)	Avg Daily Flow Residential (L/s)	Peaking Factor (MESP)	Peak Flow Residential (L/s)	Total Employment Land (F + G x 60%) (Ha)	Equivalent Population (pers)	Bus. Park (Ha)	Comm. (Ha)	Core (Ha)	Indust. (Ha)	Inst. (Ha)	Total I/C/I Land (Ha)	Equivalent Population (pers)	Total Equivalent Population Emp. + I/C/I	Avg Daily Flow Emp. + I/C/I (L/s)	Peaking Factor (DGSSMS)	Peak Flow Emp. + I/C/I (L/s)	Ext. Flow: % of Peak (L/s)	Exraneous Flow (L/s)	Total Flow (L/s)
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
Notes:																												
Areas within the East Side Lands Boundary (as defined in the MESP)																												
W-1							0.0	0.0	0	0.0	2.05	0.0	0.0	0						0.0	0	0	0.0	2.05	0.0	20%	0.0	0.0
W-2.1							0.0	0.0	0	0.0	2.05	0.0	0.0	0						0.0	0	0	0.0	2.05	0.0	20%	0.0	0.0
W-2.2	76.8	12.6	64.2	5.0	0.2	0.0	0.1	5.0	277	0.8	2.05	1.6	0.1	3	0.0	0.0	0.0	59.0	0.0	59.0	1,475	1,477	5.1	2.05	10.5	20%	2.4	14.5
W-3	217.9	58.2	159.7	0.0	24.9	0.0	10.0	10.0	549	1.5	2.05	3.1	15.0	374	0.0	0.0	0.0	134.8	0.0	134.8	3,369	3,743	13.0	2.05	26.6	20%	6.0	35.7
W-4	626.2	148.3	478.0	7.4	469.9	0.0	188.0	195.3	10,742	29.8	2.05	61.2	281.9	7,049	0.0	0.0	0.7	0.0	0.0	0.7	18	7,066	24.5	2.05	50.3	20%	22.3	133.8
W-5	605.2	99.9	505.3	0.0	505.3	0.0	202.1	202.1	11,117	30.9	2.05	63.3	303.2	7,580	0.0	0.0	0.0	0.0	0.0	0.0	0	7,580	26.3	2.05	54.0	20%	23.5	140.7
W6-A	79.0	25.3	53.7	0.0	53.6	0.1	21.5	21.5	1,181	3.3	2.05	6.7	32.2	805	0.0	0.0	0.0	0.0	0.0	0.0	0	805	2.8	2.05	5.7	20%	2.5	14.9
W6-B	146.8	57.0	89.8	0.6	89.1	0.0	35.6	36.2	1,993	5.5	2.05	11.3	53.4	1,336	0.0	0.0	0.0	0.2	0.0	0.2	4	1,340	4.7	2.05	9.5	20%	4.2	25.1
Airport	302.1	84.3	302.1	0.0	0.0	0.0	0.0	0.0	0	0.0	2.05	0.0	302.1	500 [1]	0.0	0.0	0.0	0.0	0.0	0.0	0	500	1.7	2.05	3.6	20%	0.7	4.3
C-1.1	212.1	45.4	166.7	0.1	161.0	5.6	66.6	66.8	3,672	10.2	2.05	20.9	99.9	2,498	0.0	0.0	0.0	0.0	0.0	0.0	0	2,498	8.7	2.05	17.8	20%	7.7	46.4
C-1.2	250.1	121.1	129.0	0.0	121.9	7.1	51.6	51.6	2,838	7.9	2.05	16.2	77.4	1,935	0.0	0.0	0.0	0.0	0.0	0.0	0	1,935	6.7	2.05	13.8	20%	6.0	35.9
C-1.3 (Creekside)	41.1	0.0	41.1	0.0	37.5	2.3	15.9	15.9	875	2.4	2.05	5.0	23.9	597	1.0	0.3	0.0	0.0	0.0	1.3	32	629	2.2	2.05	4.5	20%	1.9	11.4
C-1.4	282.8	139.6	143.2	30.9	35.9	16.1	20.8	51.7	2,843	7.9	2.05	16.2	31.2	779	0.1	0.1	0.0	60.2	0.0	60.3	1,508	2,287	7.9	2.05	16.3	20%	6.5	39.0
C-2A	146.6	29.2	117.5	2.8	108.1	6.6	45.9	48.7	2,676	7.4	2.05	15.2	68.8	1,720	0.0	0.0	0.0	0.0	0.0	0.0	0	1,720	6.0	2.05	12.2	20%	5.5	33.0
C-2B	138.2	42.3	95.9	0.0	79.1	16.8	38.4	38.4	2,110	5.9	2.05	12.0	57.6	1,439	0.0	0.0	0.0	0.0	0.0	0.0	0	1,439	5.0	2.05	10.2	20%	4.5	26.7
C-3.1	76.0	31.1	44.9	6.1	28.2	10.5	15.5	21.6	1,187	3.3	2.05	6.8	23.2	581	0.0	0.0	0.0	0.0	0.0	0.0	0	581	2.0	2.05	4.1	20%	2.2	13.1
C-3.2							0.0	0.0	0	0.0	2.05	0.0	0.0	0						0.0	0	0	0.0	2.05	0.0	20%	0.0	0.0
K-1	67.8	51.9	16.0	2.4	0.0	1.2	0.5	2.8	156	0.4	2.05	0.9	0.7	18	7.3	5.0	0.0	0.1	0.0	12.4	310	328	1.1	2.05	2.3	20%	0.6	3.9
Total	**3268.8**	**946.1**	**2406.9**	**55.2**	**1714.6**	**66.2**	**712.3**	**767.6**	**42,216**	**117.3**		**240.4**	**1370.6**	**27,212**	**8.4**	**5.3**	**0.7**	**254.3**	**0.0**	**268.7**	**6,716**	**33,928**	**117.8**		**241.5**		**96.4**	**578.3**
Additional City of Cambridge Areas for Consideration of Ultimate Sanitary Flow (Outside the MESP East Side Lands Boundary)																												
C-4 (Hunt Club)	124.5	11.9	112.6	43.7	31.6	15.8	19.0	62.7	3,446	9.6	2.05	19.6	28.5	712	0.0	0.0	0.0	21.5	0.0	21.5	537	1,249	4.3	2.05	8.9	20%	5.7	34.2
C-5 (Boxwood)	90.8	20.2	70.6	0.0	0.0	3.3	1.3	1.3	72	0.2	2.05	0.4	2.0	49	0.0	0.0	0.0	67.4	0.0	67.4	1,685	1,734	6.0	2.05	12.3	20%	2.5	15.3
C-6							0.0	0.0	0	0.0	2.05	0.0	0.0	0						0.0	0	0	0.0	2.05	0.0	20%	0.0	0.0
C-7							0.0	0.0	0	0.0	2.05	0.0	0.0	0						0.0	0	0	0.0	2.05	0.0	20%	0.0	0.0
Total	**215.3**	**32.1**	**183.3**	**43.7**	**31.6**	**19.1**	**20.3**	**64.0**	**3,518**	**9.8**		**20.0**	**30.4**		**0.0**	**0.0**	**0.0**	**88.9**	**0.0**	**88.9**	**2,222**	**2,982**	**10.4**		**21.2**		**8.3**	**49.5**
Total	**3484.1**	**978.2**	**2590.2**	**98.9**	**1746.2**	**85.3**	**732.6**	**831.5**	**45,733**	**127.0**		**260.4**	**1401.0**	**35,041**	**8.4**	**5.3**	**0.7**	**343.2**	**0.0**	**357.6**	**8,938**	**36,911**	**128.2**		**262.7**		**104.6**	**627.8**

5.8 EAST SIDE LANDS TRUNK GRAVITY SEWER

The 2014 MESP and other related studies indicate that a future trunk sanitary sewer is required to service the broader East Side Lands (i.e. from Highway #7 to the southwestern corner of the Study Area). To date, the design of such a trunk sewer has only been illustrated in a very coarse, very preliminary sense. Since the depth of the trunk sewer will directly influence the design and depth of the necessary sanitary servicing infrastructure that will connect to the Kitchener WWTP (i.e. pumping station or further extension of the trunk sewer), it was deemed important to look closer at the future trunk sewer design.

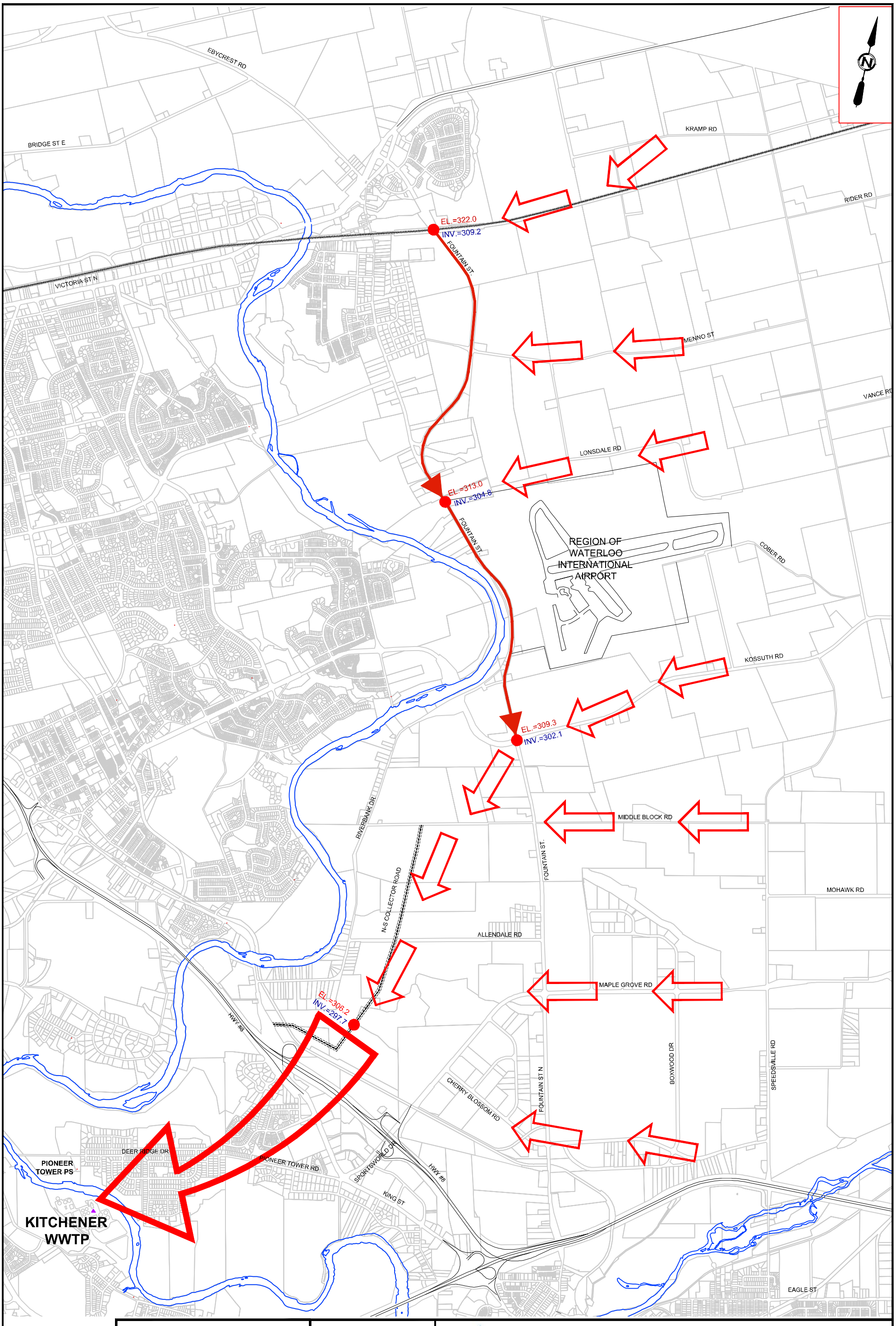
For the purposes of this Class EA Study, a preliminary assessment of the likely sewer routes and depths throughout the broader East Side Lands was completed. This assessment was conservatively based on a cursory, high-level review of likely sewer alignments and depths of its tributary branches. It was also assumed that, upstream of Middle Block Road the primary alignment for the trunk sewer would more-or-less follow the Fountain Street right-of-way (R.O.W.) and tributary branches would follow along existing road alignments. As the trunk sewer extends south of Middle Block Road, different alignments are possible.

The depth of the sewer is based on existing surface topography as well as an assumed (conservative) sewer slope of approximately 0.5% and the size of sewer is estimated to range from 300mm diameter at the upstream limit to approximately 975mm diameter at the downstream limit of the broader East Side Lands.

For the purposes of this Study, the terminus of the East Side Lands trunk sewer is defined as the location just north of where the future City of Cambridge North-South Collector road crosses over Freeport Creek. Sanitary sewage conveyance infrastructure downstream (south) of this point is the primary focus of this Study. The Region will be responsible for the ownership and maintenance of the trunk between the terminus point (just north of Freeport Creek) and the Kitchener WWTP.

Additional studies will be required for infrastructure upstream of the terminus of the East Side Lands Trunk Sewer (just north of Freeport Creek). An important consideration in determining the approach for the infrastructure upstream of the East Side Lands trunk sewer will be how development progresses.

Figure 5-6 provides a high level overview of the general alignment and depth of the assumed trunk sanitary sewer for the broader East Side Lands.



LEGEND

GRAVITY SEWER
EL.=###.# EXISTING GROUND ELEVATION
INV.=###.# ESTIMATED SEWER INVERT ELEVATION

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FIGURE 5-6 - TRUNK SANITARY SEWER OVERVIEW

6 Evaluation Methodology Overview

As part of the Class EA process, alternative solutions are developed and then evaluated against project specific criteria. The evaluation process must consider the impacts on various aspects that together comprise the broad definition of the "environment" as described in the EAA. Based on the results of the evaluation, a preferred solution is identified and presented for approval.

For this Class EA Study, a comprehensive evaluation process has been developed to assess the sanitary servicing alternative solutions. An important point of consideration is the ability of the evaluation process to properly inform the public, review agencies, and affected stakeholders. To that end, the evaluation process has been designed to be transparent and defendable.

The evaluation process has been broken into two parts, as follows:

- **Part 1 – Evaluation of Alternative Pipeline Routes**
  The Kitchener WWTP is approximately 4 km away from the southern limit of the East Side Lands. A sanitary servicing pipeline connection is necessary, and there are many alternative alignments that could be considered.

  Part 1 of the evaluation process considers the spatial aspects of the sanitary pipeline alternatives, assessing the impacts that each alignment's linear construction footprint would have within the Study Area. It focuses on qualitative criteria categorized as impacts to the natural, social and technical environments.

  Quantitative criteria such as cost are not explicitly assessed in Part 1, however the linear nature of the alternative pipeline alignments (i.e. length of pipeline), has a direct correlation to all impacts, including cost.

  The result of Part 1 is the identification of the ***preferred sanitary servicing pipeline route***, which is then used as the underlying framework for the conveyance methodologies to be assessed in Part 2.

- **Part 2 – Evaluation of Alternative Conveyance Methodologies**
  Once a preferred sanitary pipeline route has been identified, a preferred methodology for imparting energy to the sanitary sewage flow is needed to ensure efficient conveyance to the WWTP. Specifically, the alternative solutions being considered include pumping station / forcemain configurations, gravity sewers, and combinations of the two.

Part 2 of the evaluation process considers operational aspects of the conveyance methodology alternatives, assessing the impacts of the long-term operations of the infrastructure over an assumed life cycle of 50 years. An important component of Part 2 is the methodology and related impacts associated with the necessary crossing of the Grand River.

Part 2 applies both qualitative and quantitative criteria. Similar to Part 1, the qualitative criteria are categorized as impacts to the natural, social and technical environments. Part 2 also includes a quantitative assessment focusing on financial impacts.

The result of the Part 2 evaluation process is the selection of the preferred overall sanitary servicing solution for the East Side Lands.

An underlying principle of this project's evaluation process is that the best alternative will be considered as the one with the *least overall impact*. The assessment of impacts under each criterion will vary for each alternative. As such, the evaluation process includes a numeric scoring system that compiles an aggregate of scores for all criteria.

Therefore, an important convention to observe is that the evaluation process is based on an approach where the lowest overall score indicates the preferred solution.

The two parts of the evaluation process are explained in greater detail in the following sections. The subsequent sections then outline the alternatives and the evaluation process and results. Specifically:

- Section 7 – presents the alternative pipeline alignments.
- Section 8 – presents the evaluation of the pipeline alignments (i.e. Part 1)
- Section 9 – presents the alternative conveyance methodologies and key technical considerations leading to a short-list of alternative solutions.
- Section10 – presents the details of the short-listed alternative solutions.
- Section 11 – presents the evaluation of the short-listed alternatives (i.e. Part 2)
- Section 12 – presents a summary of the preferred solution.

7 Part 1 - Alternative Pipeline Routes

7.1 PIPELINE ROUTES – ASSUMPTIONS AND COMMON ELEMENTS

The development of alternative pipeline routes considers that there are different conveyance methodologies possible for servicing the Study Area. Specifically, these would be via a pumping station and forcemain configuration, a gravity sewer system, or a combination of the two.

While the detailed assessment of the alternative conveyance methodologies is handled in Part 2 of the evaluation process, an understanding of the typical pipeline conditions for the different methodologies is necessary. Based on a coarse preliminary engineering assessment, two pipeline configurations have been assumed.

For pumping station and forcemain configurations, it is assumed that, to accommodate a range of flows over time and to provide sufficient forcemain redundancy, three pipes will be required. These would be constructed in a common trench, with a nominal depth of cover typically ranging between two metres (minimum) and four metres (maximum).

For gravity sewer configurations, it is assumed that a single 975 mm reinforced concrete pipe would be required. This pipe would be located within a confined trench and would have an approximate outside diameter of 1.2 m. The depth of the pipe would be based on the necessary invert elevations required to maintain gravity flow at a minimum slope of 0.1%.

While details of the physical pipeline may vary based on a particular conveyance methodology (i.e. pipe diameter, pipe depth, associated appurtenances, etc.), for the purposes of evaluation the implementation and resultant linear ‘footprint’ of the physical pipeline is considered to be similar and common to all alternatives.

7.2 PIPELINE ROUTES – ORIGIN & DESTINATION

For the purposes of this evaluation, a common origin point for all alternative alignments has been selected. This pipeline origin location is assumed to be within the right-of-way of the City of Cambridge's future North-South Collector road, immediately north of where the future road will cross Freeport Creek.

In addition to the common origin point, all alignments also have a common ending point, namely a connection to the influent channel of the Kitchener WWTP. This is an elevated concrete box channel that runs along the southwest boundary of the WWTP and discharges into the headworks building.

Figure 7-1 illustrates the Sanitary Pipeline Origin & Destination locations.

It is of note that the existing WWTP is currently undergoing significant upgrades that are proposed to be completed by 2019. The existing headworks building will be demolished in favour of a new headworks building offset to the south as well as an adjusted influent channel. It will be important for the future detailed design of the sanitary servicing solution to consider the ongoing WWTP upgrades. However, for the purposes of this assessment and based on discussions with WWTP staff, the proposed connections to the current influent channel are understood to be feasible.

In order to make the connection to the WWTP, the pipeline route must cross the Grand River. Based on a preliminary engineering assessment and the alternative pipeline routes being considered, two potential locations have been identified as being suitable for the crossing. These are based on the shortest route to the WWTP as well as known conditions in the surrounding area. Specifically, these are:

- River Crossing Location #1 – near the existing City of Kitchener's Pioneer Tower Pumping Station
- River Crossing Location #2 – at the end of Lookout Lane near the historic Pioneer Tower

Figure 7-2 illustrates the locations of where the alternative sewage pipeline alignment options could cross the river.

The following section describes how the alternative pipeline routes were selected and defined in the context of how each will be evaluated.

Pipeline Origin Point:
North of Freeport Creek

FREEPORT
PS

ALLENDALE RD

Future City of Cambridge
N-S Collector Road

MAPLE GROVE RD

FUTURE CREEKSIDE
ACCESS ROAD

HWY #8

FOUNTAIN ST N

CAMBRIDGE

CHERRY
BLOSSOM RD

SPORTSWORLD DR

PIONEER TOWER RD

DEER RIDGE DR

PIONEER
TOWER PS

River Crossing #1

KITCHENER
WWTP

River Crossing #2

Pipeline Destination:
Kitchener WWTP

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FIGURE 7-1 - SANITARY PIPELINE ORIGIN & DESTINATION

ALLENDALE RD

MAPLE GROVE RD

HWY #8

DEER RIDGE DR

PIONEER TOWER

GRAND RIVER

KITCHENER

CAMBRIDGE

River Crossing #1

KITCHENER WWTP

River Crossing #2

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FIGURE 7-2 - GRAND RIVER CROSSING LOCATIONS

7.3 PIPELINE ROUTE SELECTION CONSIDERATIONS

With such a large Study Area, there are a number of possible alternatives for the proposed sanitary pipeline to follow. To hone the development of alternatives, the following guidelines were considered:

- Avoid / minimize impacts on urban areas and existing infrastructure;
- Avoid / minimize impacts on sensitive natural features;
- Optimize topographic conditions to minimizing depth and avoid high / low points;
- Utilize existing utility corridors and publicly owned right-of-ways, where possible;
- Avoid / minimize impacts to heavily travelled streets and intersections;
- Capitalize on undeveloped lands that may be more easily available for purchase;
- Allow flexibility in construction techniques to minimize construction costs;
- Avoid / minimize pipeline bends to optimize hydraulic conditions.
- Avoid operational impacts (i.e. noise / odour) to adjacent land uses; and
- Optimize proximity to existing and/or proposed future forcemain and trunk sanitary sewers (i.e. per the Quick Start Lands servicing strategy shown in the 2014 MESP).

Based on these guidelines, 5 viable pipeline routes were identified. Each route has been assigned a unique letter designation (i.e. Alignment A, B, C, D and E). Each alignment has been broken into several segments (referred to as pipeline legs), which are identified by a unique number. The pipeline legs represent either logical geographical breaks along the alignment (i.e. at key intersections or locations) and/or different construction conditions that would result in different impacts and/or costs. There are a total of 39 individual pipeline legs identified which comprise the five alignments.

Dividing the alternative routes into the various pipeline legs allows for an evaluation of discrete parts along an alignment, clarifying key areas of impact along its length. For example, a leg crossing the Grand River will have different conditions and impacts than a stretch of pipeline along a residential street.

The five pipeline routes crossing the Grand River at River Crossing Location #1, are defined by adding the number ‘1’ immediately following the routes’ letter identifiers (e.g. A1, B1, etc.). Pipeline routes crossing at River Crossing Location #2 are defined by adding the number ‘2’ (e.g. A2, B2, etc.).

Figure 7-3 illustrates the general alignments of the five alternative pipeline routes, including consideration of both river crossing locations.

Table 7-1 describes each of the 39 pipeline legs and their respective lengths, as well as which alignment(s) each leg is associated with.

The following sections describe each of the five alignments and identify their key features.

FREEPORT PS

FUTURE CREEKSIDE ACCESS ROAD

ALLENDALE RD

FUTURE N-S COLLECTOR

KITCHENER

MAPLE GROVE RD

PS #1

FUTURE CREEKSIDE ACCESS ROAD

HWY #8

FOUNTAIN ST N

CAMBRIDGE

CHERRY BLOSSOM RD

SPORTSWORLD DR

RIVER CROSSING #1

PS #2

PIONEER TOWER PS

DEER RIDGE DR

PIONEER TOWER RD

HWY #8

PS #4

PS #3

PS #5

KING ST

KITCHENER WWTP

RIVER CROSSING #2

LEGEND

- WASTEWATER TREATMENT PLANT
- STAGE 1 LANDS (PER MESP)
- MUNICIPAL BOUNDARY
- EAST SIDE LANDS PS & FM CLASS EA STUDY AREA BOUNDARY
- EXISTING PUMP STATION
- FLOODPLAIN
- WETLAND
- CONSTRAINTS
- POSSIBLE PUMPING STATION SITE LOCATIONS
- PROPOSED N-S COLLECTOR ROAD
- PIPELINE ALIGNMENT "A"
- PIPELINE ALIGNMENT "B"
- PIPELINE ALIGNMENT "C"
- PIPELINE ALIGNMENT "D"
- PIPELINE ALIGNMENT "E"
- ## PIPELINE LEG NUMBER

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FIGURE 7-5 - ALTERNATIVE PIPELINE ALIGNMENTS

Table 7-1
Description of Pipeline Legs

FM LEG	ALTERNATIVE ALIGNMENT	LENGTH (km)	DESCRIPTION / KEY FEATURES
1	A1, B1, C1, D1, E1	0.35	From the Kitchener WWTP to the Grand River Crossing.
2	A1, B1, C1, D1, E1	0.14	Grand River Crossing (assumed to be via trenchless methods).
3	A1, B1, C1, D1, E1	0.10	Grand River crossing to the Pioneer Tower Pumping Station / Walter Bean Trail.
4	A1, A2, B1	0.14	From Pioneer Tower PS to Pioneer Tower Road.
5	A1, A2	0.48	From Pioneer Tower Road to Deer Ridge Golf Course.
6	A1, A2	1.12	Through the Deer Ridge Golf Course (centred on fairways)
7	A1, A2	0.82	From Deer Ridge Golf Course to Hwy #8 Crossing (parallel to Walter Bean Trail)
8	A1, A2	0.05	Under Hwy #8 bridge along Walter Bean Trail.
9	A1, A2	0.54	Past Hwy #8 crossing, NE along Walter Bean Trail to King Street
10	A1, A2	0.55	South along King Street East to PS #7 location (incl. crossing of Freeport Creek)
11	A1, A2	0.21	From PS #7, SE along King Street East to proposed North-South arterial road
12	A1, A2, D1, D2	0.47	Along North-South arterial from King Street East to PS #6, (incl. crossing of railway tracks)
13	A1, A2, D1, D2	0.14	From PS #6 along North-South arterial SE to PS #5
14	A1, A2, B1, B2, C1, C2, D1, D2, E1, E2	0.17	Along North-South arterial from PS #5 location to PS #4 location (south of Freeport Creek).
15	A1, A2, B1, B2, C1, C2, D1, D2, E1, E2	0.18	From PS #4 along North-South arterial, across Freeport Creek to PS #3
16	A2, B2, C2, D2, E2	0.27	From proposed influent channel to northeast edge of Kitchener WWTP property line
17	A2, B2, C2, D2, E2	0.08	From northeast edge of Kitchener WWTP property line to West bank of Grand River
18	A2, B2, C2, D2, E2	0.10	Grand River Crossing
19	B2	0.14	From West Bank of Grand River to Lookout Lane Paved Trail
20	B2	0.37	Along Lookout Lane Paved Trail to hydro corridor behind Deer Ridge Dr. homes
21	B1, B2	0.77	Along trail / hydro corridor behind Deer Ridge Dr. homes to Pioneer Sportsmen Club
22	B1, B2, C1, C2	0.18	Along Pioneer Tower Road to existing City trail / park entrance.
23	B1, B2	0.44	From Pioneer Tower Road through park / green space to Deer Ridge Drive.
24	B1, B2	0.32	East along Deer Ridge Drive to Grand Hill Drive.
25	B1, B2	0.21	Grand Hill Drive from Deer Ridge Drive to crossing of King St. & Hwy #8
26	B1, B2	0.71	Crossing under King Street, Hwy #8 and the railway tracks (trenchless)
27	B1	0.54	East Along Pioneer Tower Rd and along trail to Lookout Lane
28	A2, C1, D1, E1	0.51	From the Pioneer Tower PS, east along trail to Green Space adjacent to Pioneer Tower
29	C1, C2, D1, D2, E1, E2	0.13	Along trail following the Grand River, South of Pioneer Tower, towards Lookout Ln
30	C1, C2, D1, D2	0.89	From lookout lane to south of Pioneer Sportsman Club entrance.
31	C1, C2	0.32	North along Pioneer Sportsman Club entrance to Pioneer Tower Road.
32	C1, C2	0.81	Along Pioneer Tower Road from park entrance to Sportsworld Drive.
33	C1, C2, E1, E2	0.90	Sportsworld Drive from Pioneer Tower Road to proposed PS #8
34	C1, C2, E1, E2	0.96	Northeast along RR tracks from Maple Grove Road (near PS #8) to PS #5.
35	D1, D2	0.98	From Pioneer Sportsman Club gravel road to River's Edge Golf Course entrance.
36	D1, D2, E1, E2	0.20	From the River's Edge Golf Course Entrance to Pioneer Tower Road.
37	D1, D2, E1, E2	1.51	Along King Street from North-South arterial road to Pioneer Tower Road
38	E1, E2	2.74	Along Walter Bean Trail, along the private road, along edge of River's Edge Golf Course
39	E1, E2	0.36	Through the woodlot and up the steep slope east of River's Edge Golf Course.

7.4 ALTERNATIVE PIPELINE ROUTE 'A'

Pipeline Route A-1 is composed of 15 legs and Pipeline Route A-2 is composed of 16 legs. A-1 and A-2 have a total pipeline length of 5.1 and 5.4 km, respectively (refer to Figure 7-5).

Pipeline Route A is generally aligned to the following path:

- South along future North-South Collector Road alignment from north of Freeport Creek;
- West along the future Creekside Access Road, crossing the CP Rail tracks;
- Northerly along King Street East, including a second crossing of Freeport Creek;
- West and south along or parallel to the Walter Bean Trail (crossing under Hwy #8 and along the Grand River and through a portion of the Deer Ridge Golf Course);
- South crossing Pioneer Tower Road and the Grand River to the Kitchener WWTP.

Table 7-2 summarizes the pipeline legs associated with both Route A-1 and A-2, including the lengths of each leg and a brief description.

Table 7-2
Pipeline Route 'A'

Pipe Leg	Length (km)	Description / Key Features	Alignment A1	Alignment A2
1	0.35	From the elevated Influent Channel of the WWTP to the Grand River Crossing.	✓	
2	0.14	Grand River Crossing - Location #1	✓	
3	0.10	Grand River Crossing #1 to the Pioneer Tower Pumping Station / Walter Bean Trail.	✓	
4	0.14	From Pioneer Tower PS to Pioneer Tower Road.	✓	✓
5	0.48	From Pioneer Tower Road to Deer Ridge Golf Course.	✓	✓
6	1.12	Through the Deer Ridge Golf Course (centred on fairways)	✓	✓
7	0.82	From Deer Ridge Golf Course to Hwy #8 Crossing (parallel to Walter Bean Trail)	✓	✓
8	0.05	Under Hwy #8 bridge along Walter Bean Trail.	✓	✓
9	0.54	Past Hwy #8 crossing, NE along Walter Bean Trail to King Street	✓	✓
10	0.55	South along King Street East from Grand River to N-S Collector (incl.crossing of Freeport Creek)	✓	✓
11	0.21	Along Creekside Access Road from King Street East to north of the RR crossing (incl. the RR Xing).	✓	✓
12	0.47	Along Creekside Access Road from north of the RR Crossing to the N-S Collector Road	✓	✓
13	0.14	Along Creekside Entrance Road from Align B Easement to N-S Collector Road		
14	0.17	Along N-S Collector from Creekside Access Road to south of the Freeport Creek.	✓	✓
15	0.18	Along N-S Collector Crossing Freeport Creek to Study Limit	✓	✓
16	0.27	From the elevated Influent Channel of the WWTP to NE Edge of Kitchener WWTP property line		✓
17	0.08	From NE Edge of Kitchener WWTP property line to West bank of Grand River		✓
18	0.10	Grand River Crossing - Location #2		✓
28	0.51	From the Pioneer Tower PS, east along trail / top of bank to Green Space adjacent to Pioneer Tower		✓

Implementation of the pipeline along this route could include:

- Coordination with the construction of the future North-South Collector Road and Creekside Access Road;
- Potentially two (2) crossings of Freeport Creek;

- Crossing of the existing railway tracks (via trenchless methods);
- Significant traffic controls and restoration of disturbed portions of King Street;
- Construction beneath the existing Ministry of Transportation Ontario (MTO) Hwy #8 bridge over the Grand River;
- Construction and restoration along a significant length of the Walter Bean Trail;
- Potential slope stability issues in areas where the trail is along a steep river embankment;
- Potential concerns relating to seasonal ice flows that could impact the Grand River valley slope and pipeline location (where forcemain is close to the slope);
- Likely flood protection issues relating to construction and long-term operations of the pipeline and related air / vacuum relief chambers within the floodplain (for forcemain options);
- Odour controls for air/vacuum relief chambers nearby to sensitive receivers / residents (for forcemain options);
- Potential construction impacts to existing natural habitat areas;
- Construction impacts and restoration to the Deer Ridge Golf Course and other private properties;
- Crossing of the Grand River;
- Construction of pipeline through the Kitchener WWTP.

7.5 ALTERNATIVE PIPELINE ROUTE 'B'

Pipeline Route B-1 is composed of 14 legs and Pipeline Route B-2 is composed of 14 legs. B-1 and B-2 have a total pipeline length of 4.39km and 4.08km, respectively. (Refer to Figure 7-5)

Pipeline Route 'B' is generally aligned to the following path:

- South along future North-South Collector Road alignment from north of Freeport Creek;
- Southwest across Creekside lands, CP Railway tracks, Hwy #8 and King Street (via trenchless methods);
- South along Grand Hill Drive;
- Southwest on Deer Ridge Drive;
- South and back-lot between Deer Ridge Drive and Candle Crescent;
- West along Pioneer Tower Road;
- West along back-lot trail/hydro easement;
- West along Pioneer Tower Road;
- South crossing the Grand River to the Kitchener WWTP.

Table 7-3 summarizes the pipeline legs associated with both Routes B-1 and B-2, including the lengths of each leg and a brief description.

Table 7-3
Pipeline Route 'B'

Pipe Leg	Length (km)	Description / Key Features	Alignment B1	Alignment B2
1	0.35	From the elevated Influent Channel of the WWTP to the Grand River Crossing.	✓	
2	0.14	Grand River Crossing - Location #1	✓	
3	0.10	Grand River Crossing #1 to the Pioneer Tower Pumping Station / Walter Bean Trail.	✓	
4	0.14	From Pioneer Tower PS to Pioneer Tower Road.	✓	
13	0.14	Along Creekside Entrance Road from Align B Easement to N-S Collector Road	✓	✓
14	0.17	Along N-S Collector from Creekside Access Road to south of the Freeport Creek.	✓	✓
15	0.18	Along N-S Collector Crossing Freeport Creek to Study Limit	✓	✓
16	0.27	From the elevated Influent Channel of the WWTP to NE Edge of Kitchener WWTP property line		✓
17	0.08	From NE Edge of Kitchener WWTP property line to West bank of Grand River		✓
18	0.10	Grand River Crossing - Location #2		✓
19	0.14	From East Bank of Grand River to Lookout Lane Paved Trail		✓
20	0.37	Along Lookout Lane Paved Trail to hydro corridor behind Deer Ridge Dr. homes		✓
21	0.77	Along trail / hydro corridor behind Deer Ridge Dr. homes to Pioneer Sportsmen Club	✓	✓
22	0.18	Along Pioneer Tower Road to existing City trail / park entrance.	✓	✓
23	0.44	From Pioneer Tower Road through park / green space to Commercial Plaza	✓	✓
24	0.32	Along Commercial Plaza Parking lot and East along Deer Ridge Drive to Grand Hill Drive.	✓	✓
25	0.21	Along Grand Hill Drive from Deer Ridge Drive to crossing of King St. & Hwy #8	✓	✓
26	0.71	Crossing under King Street, Hwy #8 and the railway tracks (trenchless)	✓	✓
27	0.54	East Along Pioneer Tower Rd and along trail to Lookout Lane	✓	

Implementation of the pipeline along this alignment could include:

- Coordination with the construction of the future North-South Collector Road and Creekside Access Road;
- One crossing of Freeport Creek;
- Trenchless crossing of the existing railway tracks, Hwy #8 and King Street;
- Restoration of disturbed portions of Grand Hill Drive;
- Traffic controls and restoration of disturbed portions of Deer Ridge Drive;
- Dust controls and consultation with affected Deer Ridge residents;
- Odour controls for air/vacuum relief chambers nearby to sensitive receivers / residents;
- Trenchless construction through the existing green space / park land;
- Traffic controls and restoration of disturbed portions of Pioneer Tower Road;
- Restoration of the existing trail behind the houses on Deer Ridge Drive;
- Crossing of the Grand River;
- Construction of pipeline through the Kitchener WWTP.

7.6 ALTERNATIVE PIPELINE ROUTE 'C'

Pipeline Route C-1 is composed of 14 legs and Pipeline Route C-2 is composed of 13 legs. C-1 and C-2 have a total pipeline length of 5.78km and 5.13km, respectively. (Refer to Figure 7-5)

Pipeline Route 'C' is generally aligned to the following path:

- South along future North-South Collector Road alignment from north of Freeport Creek;
- Southeast along the Creekside Access Road alignment;
- Southwest along Maple Grove Road and Sportsworld Drive, crossing under the CP Rail tracks and Hwy #8 at the existing bridges;
- West along Pioneer Tower Road;
- South along a private lane (Pioneer Sportsman Club & Camping);
- West along back-lots of Deer Ridge homes / edge of floodplain;
- West along Walter-Bean Trail;
- South crossing the Grand River to the Kitchener WWTP.

Table 7-4 summarizes the pipeline legs associated with both Routes C-1 and C-2, including the lengths of each leg and a brief description.

Table 7-4
Pipeline Route 'C'

Pipe Leg	Length (km)	Description / Key Features	Alignment C1	Alignment C2
1	0.35	From the elevated Influent Channel of the WWTP to the Grand River Crossing.	✓	
2	0.14	Grand River Crossing - Location #1	✓	
3	0.10	Grand River Crossing #1 to the Pioneer Tower Pumping Station / Walter Bean Trail.	✓	
13	0.14	Along Creekside Entrance Road from Align B Easement to N-S Collector Road	✓	✓
14	0.17	Along N-S Collector from Creekside Access Road to south of the Freeport Creek.	✓	✓
15	0.18	Along N-S Collector Crossing Freeport Creek to Study Limit	✓	✓
16	0.27	From the elevated Influent Channel of the WWTP to NE Edge of Kitchener WWTP property line		✓
17	0.08	From NE Edge of Kitchener WWTP property line to West bank of Grand River		✓
18	0.10	Grand River Crossing - Location #2		✓
22	0.18	Along Pioneer Tower Road to existing City trail / park entrance.	✓	✓
28	0.51	From the Pioneer Tower PS, east along trail / top of bank to Green Space adjacent to Pioneer Tower	✓	
29	0.13	Along trail following the Grand River, South of Pioneer Tower, towards Lookout Ln	✓	✓
30	0.89	From lookout lane to south of Pioneer Sprortsman Club entrance.	✓	✓
31	0.32	North along Pioneer Sportsman Club entrance to Pioneer Tower Road.	✓	✓
32	0.81	Along Pioneer Tower Road from park entrance to Sportsworld Drive.	✓	✓
33	0.90	Sportsworld Drive from Pioneer Tower Road to proposed PS #8	✓	✓
34	0.96	Northeast along RR tracks from Maple Grove Road (near PS #8) to PS #5.	✓	✓

Implementation of the pipeline along this alignment could include:

- Coordination with the construction of the future North-South Collector Road and Creekside Access Road;
- One crossing of Freeport Creek;
- Traffic controls and restoration of disturbed portions of Maple Grove Road / Sportsworld Drive;
- Traffic controls and restoration of disturbed portions of Pioneer Tower Road;
- Impacts and restoration to the existing private lane (Pioneer Sportsman Club);
- Construction down and alongside steep embankments of the Grand River valley slope;
- Potential slope stability issues in areas where the alignment is along a steep embankment;
- Likely flood protection issues relating to construction and long-term operations of the forcemain and related air / vacuum relief chambers within the floodplain;
- Potential construction impacts to existing natural habitat areas;
- Construction and restoration along a significant length of the Walter Bean Trail;
- Dust controls and consultation with affected Deer Ridge residents;
- Odour controls for air/vacuum relief chambers nearby to sensitive receivers / residents;
- Crossing of the Grand River;
- Construction of pipeline through the Kitchener WWTP.

7.7 ALTERNATIVE PIPELINE ROUTE 'D'

Pipeline Route D-1 is composed of 13 legs and Pipeline Route D-2 is composed of 12 legs. D-1 and D-2 have a total pipeline length of 5.84km and 5.19km, respectively. (Refer to Figure 7-5)

Pipeline Route 'D' is generally aligned to the following path:

- South along future North-South Collector Road alignment from north of Freeport Creek;
- West along the future Creekside Access Road, crossing the CP Rail tracks;
- Southeasterly on King Street East;
- South on Baxter Place;
- West along rear lots of Edgehill Drive and along the slope / edge of woodlot;
- West along back-lots of Deer Ridge homes / edge of floodplain;
- West along Walter-Bean Trail;
- South crossing the Grand River to the Kitchener WWTP.

Table 7-5 summarizes the pipeline legs associated with both Routes D-1 and D-2, including the lengths of each leg and a brief description.

Table 7-5
Pipeline Route 'D'

Pipe Leg	Length (km)	Description / Key Features	Alignment D1	Alignment D2
1	0.35	From the elevated Influent Channel of the WWTP to the Grand River Crossing.	✓	
2	0.14	Grand River Crossing - Location #1	✓	
3	0.10	Grand River Crossing #1 to the Pioneer Tower Pumping Station / Walter Bean Trail.	✓	
11	0.21	Along Creekside Access Road from King Street East to north of the RR crossing (incl. the RR Xing).	✓	✓
12	0.47	Along Creekside Access Road from north of the RR Crossing to the N-S Collector Road	✓	✓
13	0.14	Along Creekside Entrance Road from Align B Easement to N-S Collector Road		
14	0.17	Along N-S Collector from Creekside Access Road to south of the Freeport Creek.	✓	✓
15	0.18	Along N-S Collector Crossing Freeport Creek to Study Limit	✓	✓
16	0.27	From the elevated Influent Channel of the WWTP to NE Edge of Kitchener WWTP property line		✓
17	0.08	From NE Edge of Kitchener WWTP property line to West bank of Grand River		✓
18	0.10	Grand River Crossing - Location #2		✓
28	0.51	From the Pioneer Tower PS, east along trail / top of bank to Green Space adjacent to Pioneer Tower	✓	
29	0.13	Along trail following the Grand River, South of Pioneer Tower, towards Lookout Ln	✓	✓
30	0.89	From lookout lane to south of Pioneer Sprortsman Club entrance.	✓	✓
35	0.98	From Pioneer Sportsman Club gravel road to River's Edge Golf Course entrance.	✓	✓
36	0.20	From the River's Edge Golf Course Entrance to Pioneer Tower Road.	✓	✓
37	1.51	Along King Street from N-S arterial road to Pioneer Tower Road	✓	✓

Implementation of the pipeline along this alignment could include:

- Coordination with the construction of the future North-South Collector Road and Creekside Access Road;
- One crossing of Freeport Creek;
- Crossing of the existing railway tracks;
- Significant traffic controls and restoration of disturbed portions of King Street;
- Construction beneath the existing MTO Hwy #8 interchange at King Street;
- Restoration of disturbed portions Baxter Place / Edgehill Drive;
- Traffic controls and coordination to avoid impacts to the River's Edge Golf Course;
- Potential slope stability issues in areas where the trail is along a steep river embankment;
- Odour controls for air/vacuum relief chambers nearby to sensitive receivers / residents;
- Dust controls and consultation with affected Deer Ridge residents;
- Potential construction impacts to existing natural habitat areas;
- Likely flood protection issues relating to construction and long-term operations of the forcemain and related air / vacuum relief chambers within the floodplain;
- Construction and restoration along a significant length of the Walter Bean Trail;
- Crossing of the Grand River;
- Construction of forcemain around the north side of the Kitchener WWTP.

7.8 ALTERNATIVE PIPELINE ROUTE 'E'

Pipeline Route E-1 is composed of 13 legs and Pipeline Route E-2 is composed of 12 legs. E-1 and E-2 have a total pipeline length of 6.88km and 6.23km, respectively. (Refer to Figure 7-5)

Pipeline Route 'E' is generally aligned to the following path:

- South along future North-South Collector Road alignment from north of Freeport Creek;
- Southeast along the Creekside Access Road;
- Southwest along Maple Grove Road and Sportsworld Drive, crossing under the CP Rail tracks and Hwy #8 at the existing bridges;
- South on Baxter Place;
- South and westerly along the limits of River's Edge golf course;
- Westerly along private lane (Pioneer Sportsman Club & Camping);
- Westerly along Walter-Bean trail;
- South crossing the Grand River to the Kitchener WWTP.

Table 7-6 summarizes the pipeline legs associated with both Routes E-1 and E-2, including the lengths of each leg and a brief description.

Table 7-6
Pipeline Route 'E'

Pipe Leg	Length (km)	Description / Key Features	Alignment E1	Alignment E2
1	0.35	From the elevated Influent Channel of the WWTP to the Grand River Crossing.	✓	
2	0.14	Grand River Crossing - Location #1	✓	
3	0.10	Grand River Crossing #1 to the Pioneer Tower Pumping Station / Walter Bean Trail.	✓	
13	0.14	Along Creekside Entrance Road from Align B Easement to N-S Collector Road	✓	✓
14	0.17	Along N-S Collector from Creekside Access Road to south of the Freeport Creek.	✓	✓
15	0.18	Along N-S Collector Crossing Freeport Creek to Study Limit	✓	✓
16	0.27	From the elevated Influent Channel of the WWTP to NE Edge of Kitchener WWTP property line		✓
17	0.08	From NE Edge of Kitchener WWTP property line to West bank of Grand River		✓
18	0.10	Grand River Crossing - Location #2		✓
28	0.51	From the Pioneer Tower PS, east along trail / top of bank to Green Space adjacent to Pioneer Tower	✓	
29	0.13	Along trail following the Grand River, South of Pioneer Tower, towards Lookout Ln	✓	✓
33	0.90	Sportsworld Drive from Pioneer Tower Road to proposed PS #8	✓	✓
34	0.96	Northeast along RR tracks from Maple Grove Road (near PS #8) to PS #5.	✓	✓
36	0.20	From the River's Edge Golf Course Entrance to Pioneer Tower Road.	✓	✓
38	2.74	Along Walter Bean Trail, along the private road, along edge of River's Edge Golf Course	✓	✓
39	0.36	Through the woodlot and up the steep slope east of River's Edge Golf Course.	✓	✓

Implementation of the pipeline along this alignment could include:

- Coordination with the construction of the future North-South Collector Road and Creekside Access Road;
- One crossing of Freeport Creek;
- Traffic controls and restoration of disturbed portions of Maple Grove Road / Sportsworld Drive;
- Restoration of disturbed portions of the natural area adjacent to River's Edge Golf Course;
- Impacts and restoration to the existing private lane (Pioneer Sportsman Club);
- Mitigation of impacts on residents / patrons of the Pioneer Sportsman Club;
- Potential construction impacts to existing natural habitat areas;
- Construction down and alongside steep embankments of the Grand River valley slope;
- Potential slope stability issues in areas where the alignment is along a steep embankment;
- Likely flood protection issues relating to construction and long-term operations of the forcemain and related air / vacuum relief chambers within the floodplain;
- Construction and restoration along a significant length of the Walter Bean Trail;
- Dust controls and consultation with affected Deer Ridge residents;
- Odour controls for air/vacuum relief chambers nearby to sensitive receivers / residents;
- Crossing of the Grand River;
- Construction of forcemain around the north side of the Kitchener WWTP.

8 Evaluation of Alternative Pipeline Routes

8.1 PART 1 - EVALUATION CRITERIA

In order to select one of the alternative pipeline routes as the preferred route, each must first be evaluated by considering their potential qualitative impacts.

As noted previously, the evaluation in Part 1 focusses on the spatial aspects of the alternatives, assessing the impacts that each alignments' linear construction footprint would have within the Study Area. Each alternative is evaluated against qualitative criteria; specifically, three criterion each under the categories of natural environment impacts, social environment impacts and technical considerations.

Part 1 of the evaluation process does not explicitly include assessment of financial impacts, which is considered a quantitative criterion. However, the evaluation does consider the length of the alignments which is directly related to cost.

The following sections outline the evaluation criteria selected for each of the three qualitative categories.

Natural Environment

The natural environment includes all items related to existing watercourses, wetlands, vegetated areas, wildlife habitats and also considers soil and groundwater systems. The evaluation of impacts to the natural environment requires the review of an extensive amount of data which, for this project, can be broken into two major areas:

Area 1 - Lands associated with the downstream / low lying areas within the southwest corner of the broader East Side Lands. This area is generally contained within the Stage 1 boundary limits, as defined in the MESP, solely within the City of Cambridge and north of Hwy #8.

The primary natural environmental feature identified within Area 1 is Freeport Creek and its associated wetland complexes. There are also various wooded areas present. Most of these natural features have been delineated and assessed in the Freeport Creek and Tributary to the Grand Subwatershed Study, completed by Aquafor Beech as part of the MESP.

Area 2 - Lands associated with pipeline alignment alternatives. These are generally south of the MESP Stage 1 boundary and include lands bordered by the Grand River, Highway 8 and Pioneer Tower Road within the City of Kitchener and the City of Cambridge. In particular, Area 2 includes the Deer Ridge subdivision and the crossing of the Grand River to the Kitchener WWTP.

The primary natural environment feature identified within the Study Area is the Grand River and its adjacent floodplain and associated wetlands. The Grand River valley is a Significant Valleyland as defined within the ROP (2015).

Initially, as part of this Class EA Study, an inventory of environmental features for Area 2 was compiled via a desktop study of the available (but limited) data. Through further consultation with the GRCA, MNRF and DFO and their preliminary review of the alternative solutions being considered for this project, an expanded scope of environmental field investigation work was identified and completed to support the evaluation process (refer to Section 4.4).

The field work included survey, delineation and documentation of aquatic and terrestrial habitats and wetlands; Environmental Land Classification (ELC) mapping; and targeted surveys for Species at Risk (SAR) that have been identified as potentially being present within the Study Area. This work was completed during the spring, summer and fall of 2014. Refer to **Appendix B** for a copy of the detailed Environmental Impact Study (EIS) that was developed for this work.

The results of the EIS were used as background information during the pipeline route selection process as well as in the scoring of the impacts for the individual pipeline legs. The underlying principle considers that the alternative pipeline routes considered should minimize or avoid impacts to the natural environment features identified in the EIS. The qualitative evaluation considers potential impacts based on the following three criteria:

- Potential impacts on terrestrial and aquatic features/habitat (including wetlands);
- Potential effects to local groundwater/soil systems; and
- Potential presence of SAR.

Examples of potential impacts to these criteria arising from the construction of the pipeline are presented in **Table 8-1**.

Table 8-1
Natural Environment Criteria and Example Impacts

EVALUATION CRITERIA	EXAMPLES OF POTENTIAL IMPACTS
1. Potential Impacts on Terrestrial and Aquatic Features / Habitat and/or Wetlands / ESPA's	• Disturbance to wetlands, ESPA's, or watercourses • Disturbances to fisheries and/or spawning areas • Disturbances to woodlands, open meadows or other terrestrial habitats • Open cut crossings of watercourses • Disturbances to valley slopes, floodplains, meander belts, • Sedimentation from upstream construction • Disturbance, loss, or destruction of vegetation or tree cover • Removal / pruning of tree limbs
2. Potential Impacts Relating to Local Groundwater and/or Soil Systems	• Interruption of groundwater regimes through excavation • Interruption of groundwater regimes through dewatering • Impacts to groundwater protection areas • Contamination due to spills / leaks
3. Potential for Presence of SAR	• Disturbance to and/or loss of habitat transportation networks • Ability to mitigate the impacts to SAR and associated habitat

Assessment of the impacts will be based on the actual field conditions documented in previous and current work, as well as consideration for applicable regulations.

Social Environment

The social environment consists of the features that define the interactions of humans in the physical world. It includes elements such as the culture, ownership, function and history of a particular area. For this project, the pipeline routes contemplated involve construction within a primarily residential community and has the potential to impact associated recreational areas and pathways.

The lands under consideration are in close proximity to cultural heritage sites. Due to the historic nature of the area, archaeological concerns must also be considered. Initially, as part of this Class EA Study, an inventory of cultural heritage and archaeological potential was compiled via a desktop study of the available data. These studies were used as background information during the pipeline route selection process as well as in the scoring of the impacts for the individual pipeline legs, with the aim of avoiding impacts to identified cultural heritage and/or potential archaeological resources.

Social Environment Criteria included:

- Impacts on adjacent residents / businesses / traffic
- Land-related impacts
- Impacts on archaeological / cultural heritage features

Examples of potential impacts to these criteria arising from pipeline construction activities are provided in **Table 8-2**.

Table 8-2
Social Environment - Criteria and Example Impacts

EVALUATION CRITERIA	EXAMPLES OF POTENTIAL IMPACTS
1. Impacts on Adjacent Residents, Businesses, or Traffic	• Short term construction related impacts • Noise, vibrations, dust, traffic delays / detours
2. Land Related Impacts	• Availability of land – privately vs. publicly owned, vacant vs. not • Impact of acquisition on current / future land uses (i.e. segmentation of parcels) • Compliance with ROP, zoning, current occupied land uses • Ability to coordinate with future / proposed developments
3. Impacts on Archaeological / Cultural Heritage Features	• Potential for loss or disruption to known archaeological and/or built heritage features (e.g. cemeteries, farmsteads etc.) • Ability to mitigate impacts on known features

While difficult to quantify, impacts to the social environment are often subjective in nature, and can present significant obstacles for the selection of a preferred solution. Specifically, adverse impacts to key stakeholders – whether temporary, permanent or only perceived – can significantly affect the acceptance of one alternative versus another through the public consultation process.

It is of note that, subsequent to the PCC held on November 8th, 2016, concerns were expressed regarding impacts to the localized cultural heritage features, specifically the Pioneer Tower and the Grand River. To address this concern, the original (2015) Cultural Heritage Investigation was revisited in 2017 with a greater emphasis on the impacts to these features. As a result, the original scoring for criterion #3 was adjusted (increased) to “4” for legs 18 and 19 which are proximal to the River and Pioneer Tower.

Technical Environment

The technical environment includes factors relating to the relative complexity of the alternative and/or risks that may present themselves during construction of the proposed works. These include impacts to public infrastructure, private property and natural heritage systems. The location of physical constraints related to transportation and servicing corridors as well as natural features must be considered.

For Part 1 of the evaluation process, the nature of impacts is considered to be specifically related to construction (i.e. temporary). Therefore, the technical assessment of the solutions will be high level in nature, based on best practices and engineering judgement, and informed by the available record drawings, background studies, and GIS information associated with the physical areas.

Technical environment criteria included:

- Potential for impacts to existing/future infrastructure
- Significant construction risks
- Constructability issues

Examples of potential impacts to these criteria arising from pipeline construction activities are provided in **Table 8-3**.

Table 8-3
Technical Environment – Criteria and Example Impacts

EVALUATION CRITERIA	EXAMPLES OF POTENTIAL IMPACTS
1. Potential for Impacts to Existing / Future Infrastructure	• Crossing and/or proximity conflicts with existing underground pipes / structures or above ground utilities • Impacts associated with excavations adjacent to infrastructure • Impacts to existing travelled roadways and traffic
2. Significant Construction Risks	• Crossings of major features – highways, roads, watercourses etc. • Ability to mitigate the impacts / risks of critical crossings
3. Constructability Issues	• Physical site constraints (topography, adjacent features) • Geotechnical and/or groundwater conditions • Slope stability issues • Site access, marshalling and working room • Construction timing windows (i.e. fisheries windows, community events)

The viability of various construction methodologies along with the severity and/or duration of these impacts can affect the outcome of the evaluation process.

8.2 PART 1 – EVALUATION SCORING METHODOLOGY

To allow for a detailed analysis of the alternatives, an evaluation model has been designed that manages the complexity of comparing the myriad of solutions and their representative parts (i.e. pipeline legs). The result is a large amount of data to assess. A preliminary scoring of each component was completed based on compiled knowledge of the Study Area and an assessment of conditions throughout. The scoring of each component was discussed and further refined by the project team and key stakeholders.

The application of the evaluation model follows a step-wise process, comprised of scoring each alternative solution against the qualitative evaluation criteria of the social, natural and technical environments, as follows:

1. The first step is to score the impacts of each alternative's individual components (legs). Scoring is based on a numeric impact ranking system, based on the rationale outlined in **Table 8-4**. Scores were assigned to each leg for each of the nine qualitative evaluation criteria.

Table 8-4
Part 1 - Impact Ranking Scale

Score	Impact Ranking Scale
0 ○	Beneficial Impact / Ideal Conditions
1 ◔	No Adverse Impacts for this Criterion
2 ◑	Low Impact / Neutral After Mitigation
3 ◕	Temporary Negative Impact (During Construction)
4 ●	Permanent Negative Impact

Using the approach above, it should be noted that a lower impact score is considered to be a more attractive option; the lower the score the less severe the impacts for each leg are anticipated to be.

2. The second step is the summing of the impact scores for each component in each qualitative criteria category (natural / social / technical);

3. Next, the category impact scores are pro-rated for length by multiplying each leg's category score by its respective length in kilometers. This results in a length-weighted impact score to account for the concept that the scoring of pipeline legs of similar conditions should be differentiated by their length. For example, two pipeline legs under similar conditions and the same length should have the same impact score; but if one of these legs were twice as long as the other, the impact score of the longer leg should be double.

4. The fourth step is to sum the total "length-weighted impact scores" for each pipeline leg.

5. The final step is to sum the total length weighted impact scores for each alternative pipeline route under each evaluation category.

Initially, each of the three categories and their associated criteria were equally weighted. A sensitivity analysis that presents differential weighting is discussed in Section 8.3.

Table 8-5 presents the comprehensive evaluation model for Part 1 – Evaluation of Alternative Pipeline Alignments.

Table 8-5 Part 1 - Evaluation of Alternative Pipeline Alignments
East Side Lands Sanitary Servicing Class EA

May 2017

Region of Waterloo — Associated Engineering — GLOBAL PERSPECTIVE. LOCAL FOCUS.

Score	Part 1 - Impact Ranking Scale
0 ○	Beneficial Impact / Ideal Conditions
1 ◔	No Adverse Impacts for this Criterion
2 ◑	Low Impact / Neutral After Mitigation
3 ◕	Temporary Negative Impact (During Construction)
4 ●	Permanent Negative Impact

Lowest Impact ↓ Highest Impact

			1.0 Natural Environment (Category Weighting Factor = 1.0)					2.0 Social Environment (Category Weighting Factor = 1.0)					3.0 Technical Environment (Category Weighting Factor = 1.0)											
			1.0	1.0	1.0			1.0	1.0	1.0			1.0	1.0	1.0									
Pipe Leg	Length (km)	Description / Key Features	1.1 Potential Impacts on Terrestrial and Aquatic Features / Habitat (Incl. Wetlands & SWH)	1.2 Potential Impacts Related to Local Groundwater/Soil Systems	1.3 Potential for Impacts to Species at Risk (SAR)	Total Environmental Impact Points	Length Weighted Impact Score	2.1 Impacts on adjacent Residents / Businesses / Traffic	2.2 Land-Related Impacts	2.3 Impacts on Archaeological / Cultural Heritage Features	Total Social Impact Points	Length Weighted Impact Score	3.1 Proximity / Impacts to Infrastructure	3.2 Significant Construction Risks	3.3 Constructability Issues	Total Technical Impact Points	Length Weighted Impact Score	Sum of Impact Scores	Total Length Weighted Impact Score	Alignment A1	Alignment A2	Alignment B1	Alignment B2	Alignment C1	Alignment C2	Alignment D1	Alignment D2	Alignment E1	Alignment E2
1	0.35	From the elevated Influent Channel of the WWTP to the Grand River Crossing.	3	4	2	9	3.2	1	1	1	3	1.1	2	2	3	7	2.5	19	6.7	✓		✓		✓		✓		✓	
2	0.14	Grand River Crossing - Location #1	3	4	3	10	1.4	1	1	1	3	0.4	2	4	3	9	1.3	22	3.1	✓		✓		✓		✓		✓	
3	0.10	Grand River Crossing #1 to the Pioneer Tower Pumping Station / Walter Bean Trail.	3	1	2	6	0.6	1	1	1	3	0.3	2	2	3	7	0.7	16	1.6	✓		✓		✓		✓		✓	
4	0.14	From Pioneer Tower PS to Pioneer Tower Road.	3	1	2	6	0.8	2	1	1	4	0.6	2	1	2	5	0.7	15	2.1	✓	✓	✓							
5	0.48	From Pioneer Tower Road to Deer Ridge Golf Course.	3	1	1	5	2.4	3	4	1	8	3.8	0	1	3	4	1.9	17	8.2	✓	✓								
6	1.12	Through the Deer Ridge Golf Course (centred on fairways)	2	2	2	6	6.7	4	4	2	10	11.2	1	3	3	7	7.8	23	25.8	✓	✓								
7	0.82	From Deer Ridge Golf Course to Hwy #8 Crossing (parallel to Walter Bean Trail)	3	2	2	7	5.7	3	4	2	9	7.4	1	2	3	6	4.9	22	18.0	✓	✓								
8	0.05	Under Hwy #8 bridge along Walter Bean Trail.	1	2	2	5	0.3	1	1	1	3	0.2	3	4	3	10	0.5	18	0.9	✓	✓								
9	0.54	Past Hwy #8 crossing, NE along Walter Bean Trail to King Street	3	4	2	9	4.9	2	4	2	8	4.3	2	2	4	8	4.3	25	13.5	✓	✓								
10	0.55	South along King Street East from Grand River to N-S Collector (incl.crossing of Freeport Creek)	2	1	2	5	2.8	3	1	2	6	3.3	4	3	3	10	5.5	21	11.6	✓	✓								
11	0.21	Along Creekside Access Road from King Street East to north of the RR crossing (incl. the RR Xing).	1	1	1	3	0.6	1	2	2	5	1.1	1	3	1	5	1.1	13	2.7	✓	✓					✓	✓		
12	0.47	Along Creekside Access Road from north of the RR Crossing to the N-S Collector Road	2	1	1	4	1.9	1	2	2	5	2.4	1	1	1	3	1.4	12	5.6		✓					✓	✓		
13	0.14	Along Creekside Entrance Road from Align B Easement to N-S Collector Road	2	3	3	8	1.1	1	2	2	5	0.7	2	2	1	5	0.7	18	2.5			✓	✓	✓	✓			✓	✓
14	0.17	Along N-S Collector from Creekside Access Road to south of the Freeport Creek.	3	4	4	11	1.9	1	2	2	5	0.9	1	1	1	3	0.5	19	3.2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
15	0.18	Along N-S Collector Crossing Freeport Creek to Study Limit	4	4	4	12	2.2	1	2	2	5	0.9	1	3	1	5	0.9	22	4.0	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
16	0.27	From the elevated Influent Channel of the WWTP to NE Edge of Kitchener WWTP property line	1	1	1	3	0.8	1	1	1	3	0.8	2	2	2	6	1.6	12	3.2		✓		✓		✓		✓		✓
17	0.08	From NE Edge of Kitchener WWTP property line to West bank of Grand River	3	2	2	7	0.6	1	1	2	4	0.3	2	2	2	6	0.5	17	1.4		✓		✓		✓		✓		✓
18	0.10	Grand River Crossing - Location #2	3	4	3	10	1.0	1	1	4	6	0.6	1	4	3	8	0.8	24	2.4		✓		✓		✓		✓		✓
19	0.14	From East Bank of Grand River to Lookout Lane Paved Trail	3	2	2	7	1.0	2	1	4	7	1.0	2	2	3	7	1.0	21	2.9				✓						
20	0.37	Along Lookout Lane Paved Trail to hydro corridor behind Deer Ridge Dr. homes	1	1	1	3	1.1	2	2	2	6	2.2	3	2	2	7	2.6	16	5.9				✓						
21	0.77	Along trail / hydro corridor behind Deer Ridge Dr. homes to Pioneer Sportsmen Club	1	1	1	3	2.3	3	1	1	5	3.9	3	2	3	8	6.2	16	12.3			✓	✓						
22	0.18	Along Pioneer Tower Road to existing City trail / park entrance.	3	2	3	8	1.4	2	2	2	6	1.1	3	1	2	6	1.1	20	3.6			✓	✓	✓	✓				
23	0.44	From Pioneer Tower Road through park / green space to Commercial Plaza	3	1	1	5	2.2	2	2	2	6	2.6	2	1	3	6	2.6	17	7.5			✓	✓						
24	0.32	Along Commercial Plaza Parking lot and East along Deer Ridge Drive to Grand Hill Drive.	2	1	1	4	1.3	3	1	1	5	1.6	3	1	1	5	1.6	14	4.5			✓	✓						
25	0.21	Along Grand Hill Drive from Deer Ridge Drive to crossing of King St. & Hwy #8	1	1	1	3	0.6	3	4	2	9	1.9	3	1	1	5	1.1	17	3.6			✓	✓						
26	0.71	Crossing under King Street, Hwy #8 and the railway tracks	3	1	3	7	5.0	1	4	2	7	5.0	3	4	4	11	7.8	25	17.8			✓	✓						
27	0.54	East Along Pioneer Tower Rd and along trail to Lookout Lane	1	1	1	3	1.6	3	1	1	5	2.7	3	1	2	6	3.2	14	7.6			✓							
28	0.51	From the Pioneer Tower PS, east along trail / top of bank to Green Space adjacent to Pioneer Tower	3	1	2	6	3.1	2	3	3	8	4.1	1	4	4	9	4.6	23	11.7		✓			✓		✓		✓	
29	0.13	Along trail following the Grand River, South of Pioneer Tower, towards Lookout Lane	3	1	2	6	0.8	2	1	2	5	0.7	1	4	4	9	1.2	20	2.6					✓	✓	✓	✓	✓	✓
30	0.89	From lookout lane to south of Pioneer Sportsman Club entrance.	4	4	4	12	10.7	1	4	2	7	6.2	1	4	4	9	8.0	28	24.9					✓	✓	✓	✓		
31	0.32	North along Pioneer Sportsman Club entrance to Pioneer Tower Road.	2	2	2	6	1.9	3	4	2	9	2.9	2	1	2	5	1.6	20	6.4					✓	✓				
32	0.81	Along Pioneer Tower Road from park entrance to Sportsworld Drive.	3	1	2	6	4.9	3	2	2	7	5.7	2	1	2	5	4.1	18	14.6					✓	✓				
33	0.90	Sportsworld Drive from Pioneer Tower Road to CPR tracks	1	1	1	3	2.7	3	1	1	5	4.5	4	3	2	9	8.1	17	15.3					✓	✓			✓	✓
34	0.96	Northeast along future Boychuk Drive from Maple Grove Road to Future N-S Collector.	2	3	3	8	7.7	1	2	2	5	4.8	2	2	1	5	4.8	18	17.3					✓	✓			✓	✓
35	0.98	From Pioneer Sportsman Club gravel road to River's Edge Golf Course entrance.	4	4	4	12	11.8	3	4	2	9	8.8	1	1	4	6	5.9	27	26.5							✓	✓		
36	0.20	From the River's Edge Golf Course Entrance to Pioneer Tower Road.	2	1	1	4	0.8	2	2	2	6	1.2	2	2	2	6	1.2	16	3.2							✓	✓	✓	✓
37	1.51	Along King Street from N-S arterial road to Pioneer Tower Road	1	1	1	3	4.5	3	1	1	5	7.6	4	3	2	9	13.6	17	25.7							✓	✓		
38	2.74	Along Walter Bean Trail, along the private road, along edge of River's Edge Golf Course	4	2	2	8	21.9	3	2	2	7	19.2	1	3	3	7	19.2	22	60.3									✓	✓
39	0.36	Through the woodlot and up the steep slope east of River's Edge Golf Course.	4	4	3	11	4.0	1	4	2	7	2.5	1	1	3	5	1.8	23	8.3									✓	✓

Alignment	A1	A2	B1	B2	C1	C2	D1	D2	E1	E2
Total Length (km)	5.32	5.69	4.39	4.08	5.78	5.13	5.84	5.19	6.88	6.23
Leg Count	14	15	14	14	14	13	13	12	13	12
Total Natural Impact Score (Pro-Rated for Length)	35.3	35.5	25.6	22.4	43.4	37.6	43.3	37.5	51.2	45.4
Total Social Impact Score (Pro-Rated for Length)	37.7	41.7	23.5	23.4	34.1	30.0	35.5	31.3	41.2	37.0
Technical Impact Score (Pro-Rated for Length)	34.0	37.1	30.8	28.9	39.9	33.8	42.7	36.6	47.4	41.3
Total Impact Score (Pro-Rated for Length)	106.9	114.3	79.9	74.8	117.5	101.4	121.5	105.4	139.7	123.7

Table 8-6 presents a summary of the qualitative scoring results for each alternative pipeline route.

Table 8-6
Part 1 Evaluation Results

Alternative Solutions	Length (km)	Natural Impacts	Social Impacts	Technical Impacts	Total Length Weighted Impact Score
A1	5.32	35.3	37.7	34.0	106.9
A2	5.69	35.5	41.7	37.1	114.3
B1	4.39	25.6	23.5	30.8	79.9
B2	**4.08**	**22.4**	**23.4**	**28.9**	**74.8**
C1	5.78	43.4	34.1	39.9	117.5
C2	5.13	37.6	30.0	33.8	101.4
D1	5.84	43.3	35.5	42.7	121.5
D2	5.19	37.5	31.3	36.6	105.4
E1	6.88	51.2	41.2	47.4	139.7
E2	6.23	45.4	37.0	41.3	123.7

Based on the qualitative scoring results, Alternative Pipeline Route B2, namely through the urban area of the Deer Ridge Subdivision with the crossing of the Grand River at River Crossing Location #2, has the lowest overall score. It is also the alternative with the shortest length.

However, it is of note that alternative pipeline Route B1 is a close second, and also scored very well (i.e. low) in comparison to the other alternatives, with the main difference being the location of the Grand River Crossing.

Based on these results, Route 'B' is identified as the preferred alignment. Both Route B1 and Route B2 were used to develop the conveyance methodology alternatives considered in Part 2 of the evaluation process.

In support of the development of the conveyance methodology alternatives, further site specific investigations were conducted along the Route 'B' alignment. These included a scoped geotechnical investigation, a Stage 1 Archaeological Investigation, Cultural Heritage Assessment; and an update to the scoped EIS. The information for these scoped assessments is reported as part of the Study Area inventory in Section 4.

8.3 SENSITIVITY ANALYSIS

The final step of the Part 1 evaluation model was to perform a sensitivity analysis. This was performed by applying two methods:

1. Weighting of evaluation criteria which affects all solutions; and/or
2. Application of a critical impact factor which affects only specific parts of some solutions.

These are explained further below.

8.3.1 Weighting of Evaluation Criteria

Upon stakeholder review, a single criteria or category may be determined to be of greater importance, warranting a higher weighting in the evaluation process. The evaluation model includes a weighting mechanism whereby the relative importance of a criteria or category over another can be tested. Applying such a weighting to any one criteria or category would affect the scoring of all alternative solutions.

For the initial evaluation, each criteria and category is given an equal weight of 1.0. Adjustment of the weighting factor up (or down) from the initial value of 1.0 will increase (or decrease) the relative importance of each criteria category. Applying a weighting factor of 0.0 eliminates the category from the evaluation process and can be used to assess the impacts of each category in isolation.

Through testing of the various weighting factors and discussion with the project team and stakeholders, it was confirmed that adjusting the weighting of any criteria or category does not fundamentally change the result of the evaluation. Regardless of different weighting scenarios, Alternative B2 is consistently the best (lowest scoring) solution.

Therefore, it is concluded that maintaining consistent and equal weighting for all criteria is appropriate.

8.3.2 Critical Impact Factors

Through the process of developing the evaluation criteria and process for this project, critical impacts were identified by the project team and external stakeholders. These critical impacts relate to specific components of the various solutions (i.e. features related to specific pipeline legs).

Specifically, the following critical impacts have been identified:

I. **Arterial Roads** – Arterial roadways within the Study Area, specifically King Street and Maple Grove Road, are important traffic arteries for the Region and are key connections to Hwy #8 and Hwy #401. Construction of the pipeline along these major arterial roads would have excessive impacts to traffic, businesses and/or existing infrastructure, and should be avoided.

II. **Highway Interchanges** - Per comments from the Ministry of Transportation (MTO), it is strongly discouraged to plan for new utility crossings within the footprint of an existing interchange, unless there is no other choice.

III. **Grand River Valley Slopes** – Pipeline alignments along and parallel to significant valley slopes (i.e. where slope stability could be a concern) should be avoided, unless there is no other choice. Engineered stabilization of natural flood plain slopes to support utilities is typically not permitted by the GRCA. As such, if part of an alignment is contained along a significant valley slope or within a slope's related zone of influence, then the route should be avoided.

Note: All alignments must cross the Grand River. The crossings will generally be perpendicular to the associated river valley slope. As part of detailed design, the Grand River crossing will require a detailed slope stability assessment and, where necessary, remedial measures. This condition is the same for all alternatives, and as such, the river crossings are not considered to be uniquely critical for the purpose of this evaluation.

A number of pipeline legs have been identified that exhibit these three types of critical impacts. Specifically:

Alignment A	Leg 6 – Grand River Valley Slope
	Leg 10 – King Street
	Leg 28 - Grand River Valley Slope
Alignment C	Leg 28 – Grand River Valley Slope
	Leg 29 – Grand River Valley Slope
	Leg 30 – Grand River Valley Slope
	Leg 3 – Maple Grove Road / Hwy #8 Interchange
Alignment D	Leg 28 – Grand River Valley Slope
	Leg 29 – Grand River Valley Slope
	Leg 30 – Grand River Valley Slope
	Leg 35 – Grand River Valley Slope
	Leg 37 – King Street and Hwy #8 Interchange
Alignment E	Leg 27 – Hwy #8 Interchange at Sportsworld Drive
	Leg 29 – Maple Grove Road
	Leg 30 – Fountain Street

To address these critical impacts, the evaluation model includes a mechanism to apply a critical impact factor, whereby the total length-weighted impact scores for each component of the various alternative solutions can be amplified. This is achieved by multiplying the length-weighted impact scores for specific pipeline legs by a factor as defined in **Table 8-7**.

Table 8-7
Critical Impact Factor - Ranking Scale

Factor	Description
1.0	**No Critical Impact**
2.0	**Significant Critical Impact** (Requires extensive stakeholder consultation and/or mitigation measures)
3.0	**Excessive Critical Impact** (Requires special consideration by Council / Stakeholder senior staff, extraordinary mitigation measures and/or potential additional compensation efforts)
4.0	**Un-Acceptable Critical Impact** (Considered to be a fatal flaw)

Applying the critical impact factor only affects those solutions that contain the critical impact component(s) and therefore significantly increases that solution's qualitative score. Considering the lowest impact approach of the evaluation model, alternative pipeline routes that contain one or more critically impacted components are at risk of being eliminated from further consideration (i.e. due to a comparatively higher score).

Through testing of the various critical impact factors and discussion with the project team and stakeholders, it was confirmed that the application of a critical impact factor does not change the resultant preferred alternative. Rather, applying such a factor only reinforces the conclusion of Route 'B' as the preferred alternative. This occurs because pipeline Route 'B' does not include any of the identified critical impacts.

9 Part 1 – Alternative Conveyance Methodologies

9.1 CONVEYANCE METHODOLOGY SELECTION

Based on the selection of Route 'B' as the preferred alignment, the next step in determining the preferred solution for providing sanitary servicing to the East Side Lands is to consider different conveyance methodologies for how the flow will obtain the hydraulic energy needed to reach the Kitchener WWTP.

In general terms, there are two primary methods that are deemed viable for conveyance of sewage via sanitary servicing pipelines:

- Forcemain conveyance, with flow energy provided by a pumping station; and
- Gravity sewer conveyance, with flow energy provided by the longitudinal slope of the sewer pipe.

The design parameters, construction methods, operating and maintenance (O&M) requirements and costs will differ significantly between gravity and forcemain conveyance alternatives. The alternative solutions being considered in this Class EA Study are made up of one or combinations of both of these two methodologies, and include common elements associated with pipeline Route 'B', as follows:

1. The pipeline origin point is the terminus of the future trunk sanitary sewer servicing the broader East Side Lands, assumed to be located north of the Freeport Creek Crossing (refer to Figure 7-3). Depending on the timing for implementation, this crossing may be constructed in conjunction with the future construction of the City of Cambridge's North-South Collector Road that was identified in the MESP.
2. The pipeline follows Route 'B', as defined in Part 1, through the urban area of the Deer Ridge Subdivision to one of the two river crossing locations.
3. The pipeline will need to cross under the existing CP Rail corridor, Highway #8 corridor and King Street Corridor via trenchless methods (i.e. open cut construction will not be permitted for these crossings). Due to existing soil conditions, it is anticipated that Horizontal Directional Drilling (HDD) will not be suitable. Based on a preliminary engineering assessment, micro-tunnelling has been identified as the appropriate trenchless technology to be applied.
4. The pipeline must cross the Grand River at one of the two identified river crossing locations (refer to Figure 7-4).

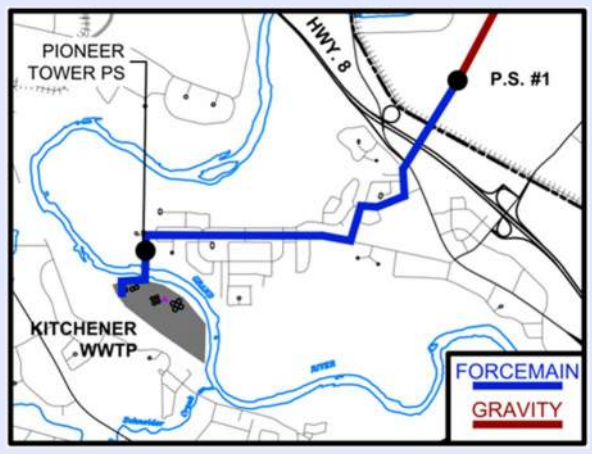
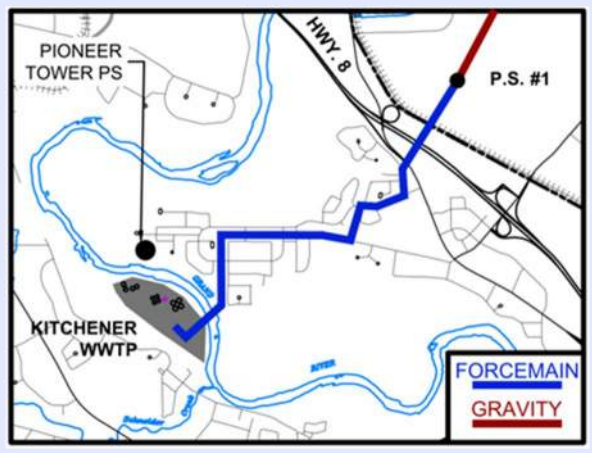
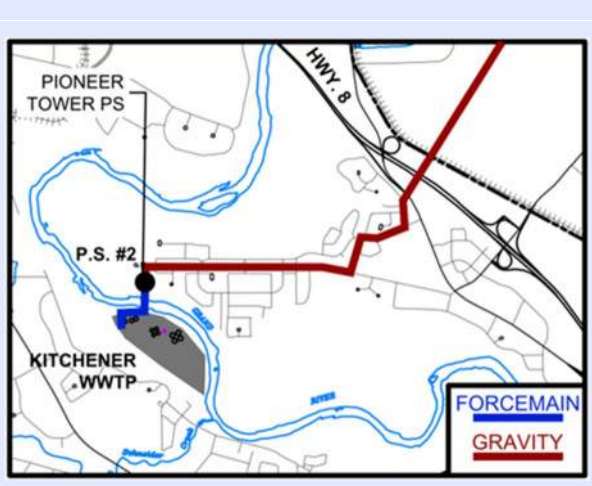
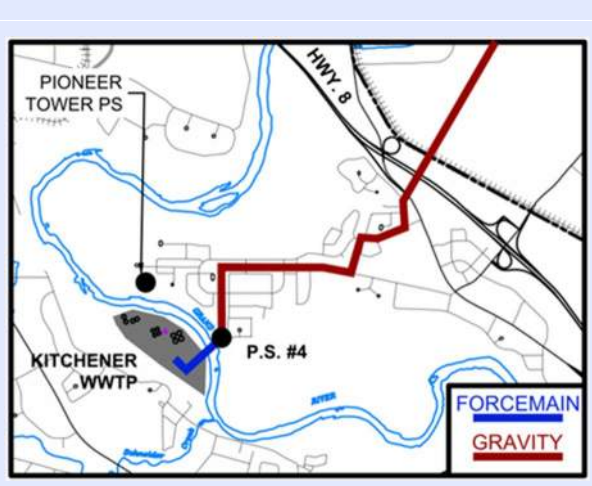
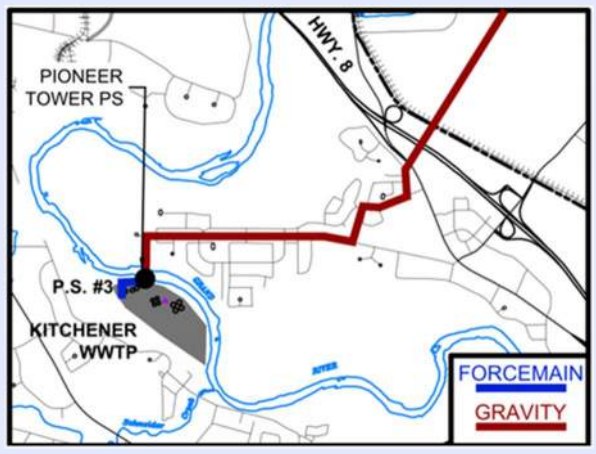
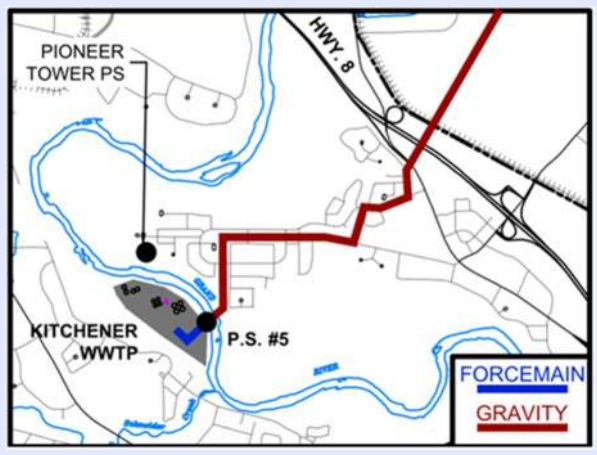
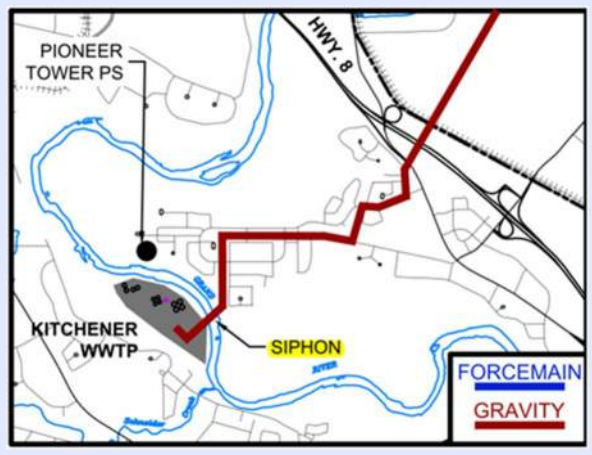
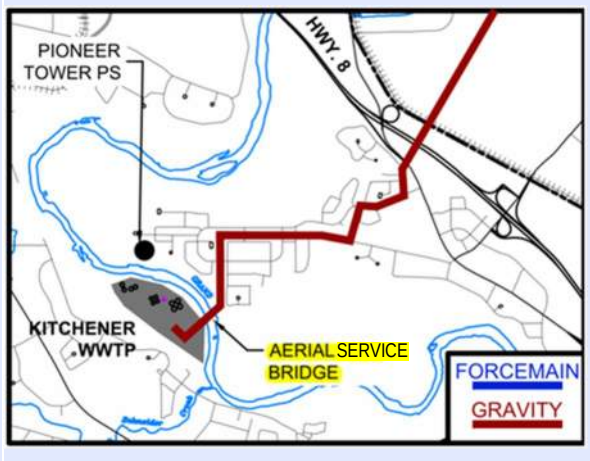
For the development of alternatives using the two primary conveyance methodologies (i.e. pumping or gravity), there are a number of underlying technical parameters that must be considered, including:

1. If the pipeline is to cross under the river, open cut construction is viable, however, this method could have significant adverse impacts to the watercourse and aquatic habitat. Furthermore, similar to the crossings of the major transportation corridors, soil conditions do not support the use of HDD, and micro-tunnelling techniques should be considered.
2. Alternatively, the pipeline could also cross over the river by means of a service bridge over the Grand River. To minimize impact to the river's natural habitat and its hydraulic features, a service bridge should span the entire width of the watercourse excluding any in-water structures / piers.
3. If the alternative includes a pumping station and forcemain, their design will need to accommodate flows ranging from approximately 200L/s initially to the ultimate design flow rate of 627 L/s (as defined in Section 5). The pumping station footprint should be sized based on ultimate flow rate. The forcemain would require a three or more pipe configuration that would be contained within a common trench, or when installed using trenchless methods within a common sleeve or casing.
4. If the alternative includes a gravity sewer, the design should be based on conveying the ultimate peak flow of 627 L/s and the sewer conservatively sized as a 975mm diameter pipe at minimum slope of 0.1%, in accordance with MOECC sewer design guidelines.

Based on these common elements and underlying technical parameters, five alternative conveyance methodologies have been identified for evaluation. Considering the two viable river crossing locations, this results in a long list of potential alternative solutions. These alternatives are described in **Table 9-1**.

It is of note that due to topographical constraints, two of the potential alternative methodologies are not viable at River Crossing Location #1.

Figure 9-1
Long List of Alterative Conveyance Methodologies

Description of Alternative Methodologies	River Crossing Location #1	River Crossing Location #2
1. A new **pumping station (PS#1)** located at the pipeline origin point (north of Freeport Creek) plus a long (4 km) Regional **forcemain** through the Deer Ridge Subdivision crossing under the Grand River, discharging into the WWTP influent channel.		
2. A Regional **gravity sewer** extending from the pipeline origin point (north of Freeport Creek) through the Deer Ridge Subdivision to a new Regional **pumping station (PS #2 or #4)** north of the Grand River, plus a shorter (approximately 600m) Regional **forcemain** crossing under the Grand River, discharging into the WWTP influent channel.		
3. A Regional **gravity sewer** extending from the pipeline origin point (north of Freeport Creek) through the Deer Ridge Subdivision, crossing under the Grand River to a new **pumping station (PS #3 or #5)** south of the Grand River on the WWTP lands, plus a shorter (approximately 350 m) Regional **forcemain** discharging into the WWTP influent channel.		
4. A Regional **gravity sewer** extending from the pipeline origin point (north of Freeport Creek) through the Deer Ridge Subdivision to a **siphon** crossing the Grand River discharging into the WWTP influent channel.	THIS OPTION IS NOT VIABLE AT RIVER CROSSING #1	
5. A Regional **gravity sewer** extending from the pipeline origin point (north of Freeport Creek) through the Deer Ridge Subdivision to a **service bridge** crossing over the Grand River discharging into the WWTP influent channel.	THIS OPTION IS NOT VIABLE AT RIVER CROSSING #1	

9.2 ALTERNATIVE METHODOLOGIES - TECHNICAL ISSUES

For the long list of alternative conveyance methodologies, there are a number of technical aspects that require consideration. A brief description of these aspects is provided below.

9.2.1 Conceptual Pumping Station Location(s) & Configuration

To develop the alternative solutions, viable pumping station site locations were identified. To select the location alternatives, first an appropriate pumping station footprint was developed using two key factors:

- the design flow rate and resultant pumping station size; and
- whether emergency overflow storage (in addition to standby power) is required.

Per the MOECC Design Guidelines for Sewage Works 2008, Chpt 7 Pumping Stations:

> "A controlled, high-level wet well overflow to supplement alarm systems and emergency power generation should be provided for use during possible periods of extensive power outages mandatory power reductions, or uncontrollable emergency conditions. Where a high level overflow is utilized, consideration should also be given to the installation of storage/detention tanks, or basins, which should be made to drain to the pumping station wet well. Where such overflows may affect public water supplies or other critical water uses, the ministry should be contacted for the necessary treatment or storage requirements"

Per discussions with Regional and City staff, it has been decided to follow the City of Kitchener's standard approach of including overflow storage (i.e. underground tank) for one hour of peak flow. Emergency standby power will also be included.

Pumping Station Sizing

For purpose of preliminary, conservative sizing of a suitable pumping station site and the required overflow storage tank, a design flow rate of 700 L/s has been used. Notably, this is greater than the identified ultimate design flow rate of 627 L/s, providing a more conservative approach towards sizing the pumping station site. The preliminary pumping station site design (i.e. wet well, drywell, control building and standby power) is based on a typical design for a similar installation in Ontario, plus the overflow storage tank.

The overflow storage tank is based on one hour of peak flow storage, and equates to a storage volume of approximately 2,520 m^3. To be conservative, a nominal storage depth of 3 m was assumed, which results in a tank footprint of 840 m^2.

The preliminary pumping station site design also assumes minimum setback requirements per the typical City Zoning By-Laws for Institutional Use Class Zones (Section 3.2). A 7.5 m side / rear yard setback and 6 m front yard setback was used. An

additional 15 m was added to the front for vehicle access and parking. This yielded a total PS site footprint of approximately 3,600 m^2.

In addition to the plan footprint of the pumping station and storage tank, the site design is also influenced by the excavation footprint required for the construction of the underground structure which is directly affected by the proposed depth of the station.

For the purpose of this Study and defining the preliminary pumping station footprint, it was conservatively assumed that standard excavation techniques would be applied, assuming a 1:1 excavation side slope. However, actual construction of the pumping station would likely employ complex shoring and dewatering techniques to minimize the excavation footprint which will vary for the different locations, based on the depth of the station. It can also be noted that the depth of the pumping station will be based on its local topography and the associated trunk sewer invert elevation. To provide a conservative estimate of footprint for this Study, a nominal wet well storage depth of approximately 3 m was assumed, plus one additional metre for foundation and bedding material.

Figure 9-2 presents a preliminary site plan layout for a potential pumping station.

Pumping Station Site Selection – Guidelines and Considerations

Based on the proposed alternatives discussed above, five potential pumping station locations were determined that could reasonably be implemented. The following criteria were used to develop the preliminary list of alternative pumping station locations.

1. Proximity to the proposed pipeline alignment (Route 'B');
2. Minimize impact on urban areas and avoid conflicts with existing infrastructure;
3. Minimize impacts on sensitive natural features;
4. Optimize topographic conditions re: gravity sewer & depth of pumping station;
5. Avoid impacts to heavily travelled streets and intersections as much as possible;
6. Minimize operational impacts (i.e. noise / odour) to adjacent land uses; and
7. Capitalize on municipally owned and/or undeveloped lands that are more easily available for purchase.

Figure 9-3 presents an overview of the five alternative pumping station locations being considered.

It is of note that, since the future North-South Collector Road has no formal status (i.e. has not been through an approved planning process and is only shown conceptually in the MESP), the actual location of PS #1 is subject to change. The intent would be to situate the pumping station adjacent to or in close proximity to the ultimate road alignment.

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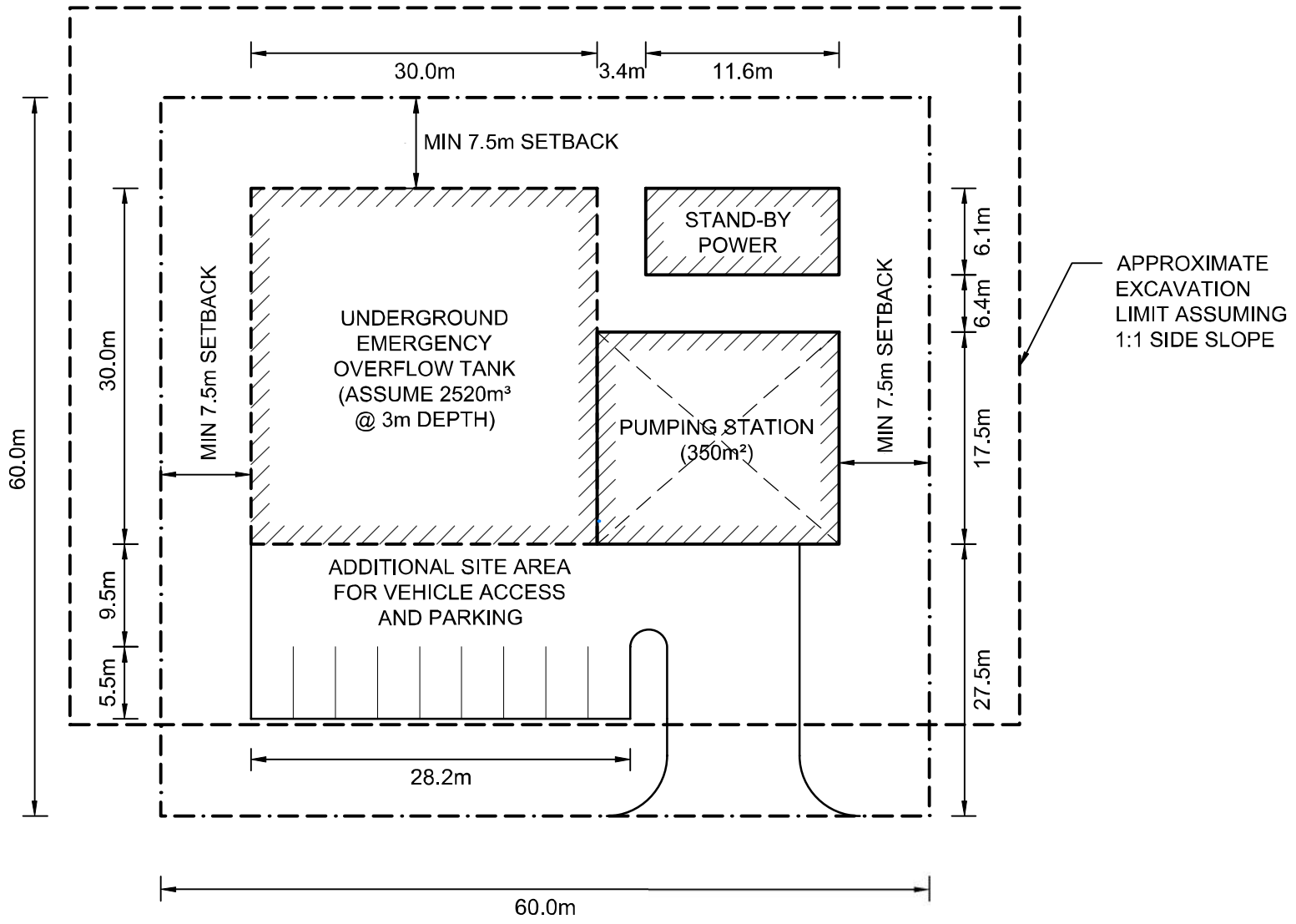

PROJECT No.	2013-5592
DATE:	MAY, 2017
APPROVED:	D. LINDNER
SCALE:	N.T.S.
DWG. No.	**FIGURE 9-2**

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Region of Waterloo

REGION OF WATERLOO

EAST SIDE LANDS
SANITARY SERVICING EA

PRELIMINARY PUMPING STATION SITE LAYOUT

This Drawing Is For The Use Of The Client And Project Indicated
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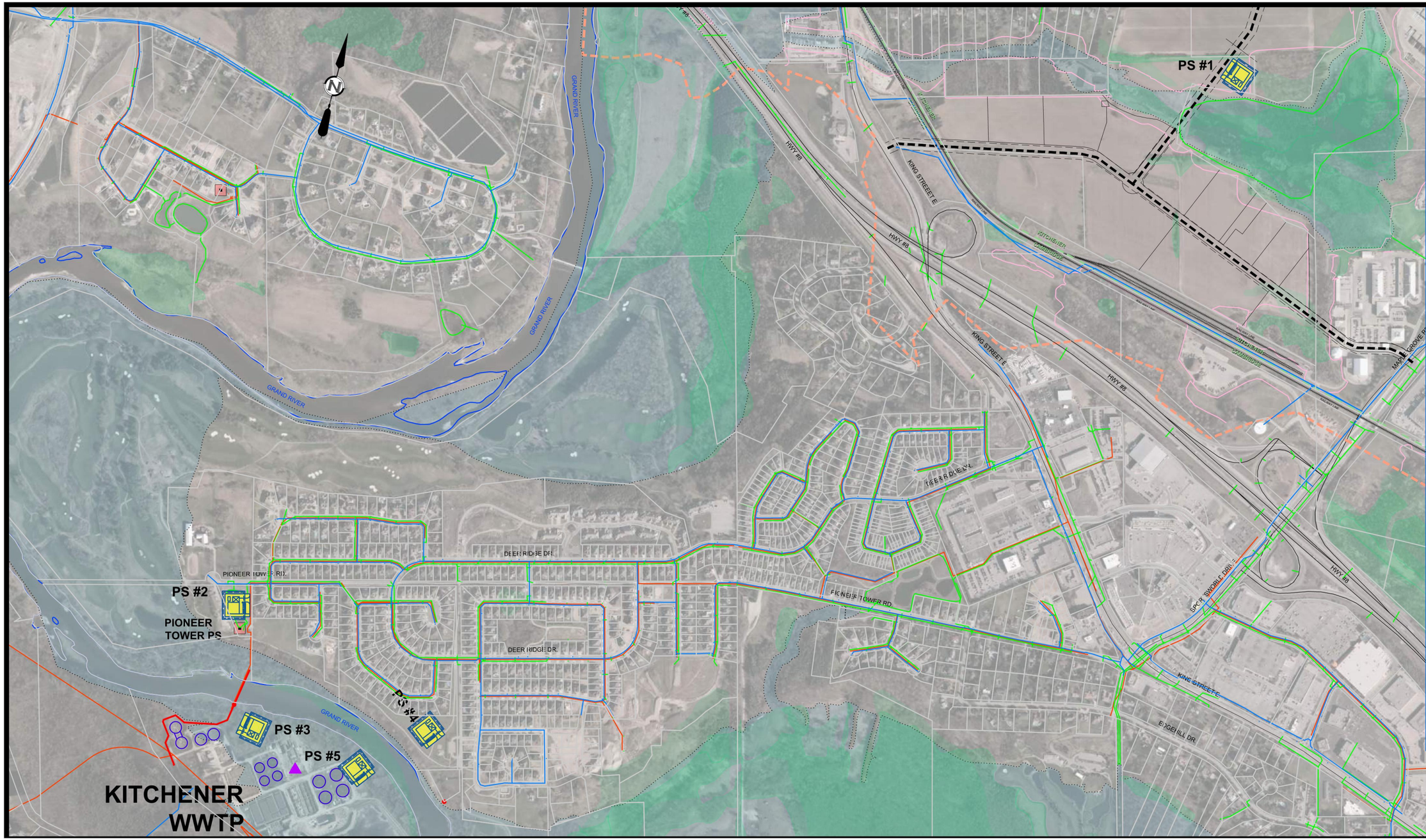


PUMPING STATION No.1	
Existing Ground Elevation	301.5m
Approx. Sewer Invert Elevation	297.1m
Approx. Depth	7.4m
Current Land Use/Zoning	Agricultural
Approximate Groundwater Elevation	
Estimated Bedrock Elevation	

PUMPING STATION No.2	
Existing Ground Elevation	286.3m
Approx. Sewer Invert Elevation	278.9m
Approx. Depth	10.4m
Current Land Use/Zoning	
Approximate Groundwater Elevation	
Estimated Bedrock Elevation	

PUMPING STATION No.3	
Existing Ground Elevation	281.0m
Approx. Sewer Invert Elevation	267.3m
Approx. Depth	16.7m
Current Land Use/Zoning	
Approximate Groundwater Elevation	
Estimated Bedrock Elevation	

PUMPING STATION No.4	
Existing Ground Elevation	293.7m
Approx. Sewer Invert Elevation	290.6m
Approx. Depth	6.1m
Current Land Use/Zoning	
Approximate Groundwater Elevation	
Estimated Bedrock Elevation	

PUMPING STATION No.5	
Existing Ground Elevation	278.2m
Approx. Sewer Invert Elevation	267.2 m
Approx. Depth	14.0 m
Current Land Use/Zoning	
Approximate Groundwater Elevation	
Estimated Bedrock Elevation	

LEGEND

- EXISTING PUMP STATION
- STAGE 1 LANDS (PER MESP)
- MUNICIPAL BOUNDARY
- FLOODPLAIN
- WETLAND
- PRIME INDUSTRIAL STRATEGIC RESERVE (PISR)
- ENVIRONMENTAL CONSTRAINT BOUNDARY
- EXISTING WATER SERVICES
- EXISTING SANITARY SERVICES
- EXISTING STORM SERVICES
- POSSIBLE PUMPING STATION SITE LOCATIONS (INCL. EXCAVATION LIMITS)
- PROPOSED N-S COLLECTOR

PROJECT No. 2013-5592
DATE: MAY 2017
APPROVED:
SCALE: 1:10000

Associated Engineering

Region of Waterloo

REGION OF WATERLOO
EAST SIDE LANDS PUMPING STATION & FORCEMAIN CLASS EA

FIGURE 9-3 - ALTERNATIVE PUMPING STATION LOCATIONS OVERVIEW

9.2.2 Pumping Station and Forcemain Complexity

As outlined in Section 5 of this ESR, the ultimate design sanitary flow rate for the East Side Lands has been estimated to be 627 L/s. As lands in the East Side Lands are generally undeveloped at this time, flow rates will increase from very low levels in the beginning towards maturity as development in the area progresses. Managing of the range of flows will present a significant technical challenge as the hydraulics of the complete system (i.e. pumping station and forcemain) are directly influenced by the flow rate(s). Multiple system curves would be required to represent the many different flow rate scenarios that will present themselves over the lifetime of the pumping station.

Considering the wide range of flows over the lifetime of the system (estimated to range from approximately 200 L/s to 627 L/s), and the minimum and maximum allowable flow rates within a forcemain pipe (i.e. to avoid solids settling in the pipe and to prevent cavitation), a single pipe solution will not be feasible. A preliminary design assessment indicates that multiple forcemain pipes will be required, likely with varying pipe diameters (i.e. approximately 250mm, 350mm and 450mm). These pipes would likely be installed at the same time within a common trench to avoid future environmental and social impacts along the preferred pipeline route.

In addition to the multiple pipes, there are also complex hydraulic conditions to consider. In particular, for alternatives that include a pumping station near the Freeport Creek crossing (PS #1 – see Figure 9-3), the forcemain length is significant (i.e greater than 4 km). Also, the profile of the pipeline alignment is generally downhill until the pipe(s) need to cross under the Grand River. This results in complicated pumping conditions, where the forcemain pipe will naturally self-drain during pump shut down (i.e. due to gravity), and check valves would be needed to provide backflow prevention and avoid draining of the forcemain pipes.

Due to its long length, and in consideration of un-avoidable localized high points along the pipeline, air/vacuum relief valve chambers would be needed, spaced at approximately 500m. Since there would be multiple forcemain pipes, each of these valves would need to be housed in large underground chambers (estimated at 5m long by 5m wide and 3m deep). These would require cast-in-place concrete construction; would present confined space access issues, and would also require odour control systems to prevent un-controlled venting of sewage gasses to the surrounding neighbourhood.

9.2.3 Application of Trenchless Construction Methods

The assessment and evaluation of conveyance methodologies along Route 'B' includes sections of the pipeline that cross through particularly sensitive areas where typical open cut construction may not be suitable and/or may not be permitted. In these sensitive areas, trenchless methods will need to be employed.

Trenchless construction methods provide a means of reducing the impact of utility construction within public right of ways. These methods attempt to minimize the amount of excavation required to perform utility construction. While open trench methods generally utilize a continuous trench along the length of the utility being installed, many of the trenchless methods only require excavations for small access pits, or may utilize existing manholes for rehabilitation and replacement projects.

Compared to conventional open cut utility construction methods, the utilization of trenchless methods can result in a significant reduction of social impacts; minimizes damage to existing infrastructure; has a reduced environmental impact; and can improve safety conditions for workers and the travelling public. Trenchless construction methods have been utilized extensively in North America for decades, and are proven construction techniques for the installation and replacement of buried pipe and conduits, as well as the rehabilitation of existing pipes.

The success of a trenchless installation depends significantly on proper investigation of the site. Detailed topographical surveys and sub-surface investigations are essential to identify significant problems and constraints that may impede a project. Insufficient site investigations increase construction costs, potentially lead to construction accidents, and increase the likelihood of claims by the contractor. Mitigation measures can be put in place to facilitate the project and protect the public if the risks are identified prior to the commencement of the project.

Some common issues that should be investigated during the planning and conceptual design stages of a project are listed below:

- Space requirements and site access
- Surface features (to be protected)
- Existing utilities and infrastructure
- Geotechnical conditions (soil and groundwater)

For this project, where the alternative being considered includes a forcemain (i.e. three pipes in a common trench), the pipeline profile will be relatively shallow, generally following surface topology as it does not need to maintain a constant downward gradient.

However, gravity sewers must meet the pipe slope requirements, and as such, can result in pipe depths that are deeper than what is typically feasible for open cut construction.

For this project, there are three site specific areas of concern (refer to **Figure 9-4**):

1. **From the Creekside Lands to the Deer Ridge Subdivision** (crossing under the CPR tracks, Highway #8 and King Street). This section includes approximately 500 m of pipeline. Both the CPR tracks and Highway #8 are considered as areas that are not to be disturbed. Open cut construction across the highway is strictly forbidden by the MTO. As King Street is a busy Regional arterial road, open cut construction is strongly opposed by Regional Transportation staff.

   The above conditions apply for both forcemain and gravity sewer configurations. However, it is noted that the gravity sewer option would be significantly deeper (approximately 8 m to 18 m) than the forcemain option (approximately 5 m to 12 m), and as a result, the length of trenchless construction would likely be greater for a gravity sewer.

2. **Along a section of the Deer Ridge rear yard trail** (a.k.a. the former Pioneer Tower Road alignment). Construction of the deeper gravity sewer alternatives along the 12 m wide trail corridor will require trenchless construction to avoid impacts to the adjacent private residential properties, and to avoid adverse impacts to existing sewer and watermain pipes along the same alignment.

   For forcemain alternatives, open cut construction in this area will be feasible.

3. **Crossing under the Grand River.** Traditional construction (i.e. open cut) is viable at River Crossing Location # 1. However, per discussions with staff at the Grand River Conservation Authority, an open cut crossing of the river is not a preferred method of construction and is strongly discouraged to avoid impacts to the aquatic habitat.

   At River Crossing Location #2, open cut construction is not feasible due to the extremely high and steep slope at this location, and the resultant slope failure risk that would accompany such an approach.

   Further details regarding crossing under the Grand River are discussed in Section 9.2.4.

FREEPORT PS

KITCHENER

ALLENDALE RD

MAPLE GROVE RD

HWY #8

Area #1 - From the Creekside Lands to the Deer Ridge Subdivision

FOUNTAIN ST N

CAMBRIDGE

CHERRY BLOSSOM RD

PIONEER TOWER RD

SPORTSWORLD DR

KING ST

KITCHENER WWTP

Area #2 - Along the Deer Ridge Rear Yard Trail (former Pioneer Tower Road Alignment)

Area #3 - Crossing Under the Grand River (at Crossing Location #1 or #2)

Associated Engineering

Region of Waterloo

REGION OF WATERLOO

EAST SIDE LANDS SANITARY SERVICING CLASS EA

FIGURE 7-4 - ALTERNATIVE PIPELINE ALIGNMENTS OVERVIEW

The preliminary alignments and profiles were reviewed and geotechnical information was collected to identify and address the technical challenges of trenchless construction, and to select the appropriate trenchless method.

Being new installation, guided trenchless installation will be required. Guided trenchless installation methods can install pipe accurately along a predefined alignment, and allow for steering corrections or changes in alignment during the installation process. This allows for installations to be curved in both the horizontal and vertical planes, and minimize the risks associated with navigating congested underground spaces. Guided methods include horizontal directional drilling and micro-tunneling methods such as slurry, earth pressure balance, pilot tube, and vacuum excavation.

Based on available background information and the 2015 geotechnical borehole investigation (refer to Section 4.3), soil conditions along the alignment include a mix of silt tills and coarse gravels including cobbles and larger boulders. These soil conditions are problematic for HDD techniques, and therefore micro-tunneling is deemed to be the appropriate method of trenchless construction for this project.

Micro-tunneling is a term used to describe horizontal earth boring pipe installation methods that do not require personnel to enter the pipe during its installation, is guided and steerable, and capable of installing pipes with tight tolerances on line and grade. Traditional micro-tunneling methods include slurry micro-tunneling and earth pressure balance micro-tunneling. More recent advances in methods and technology including pilot tube micro-tunneling, and vacuum micro-tunneling. Each of these methods are common in that they install pipes between excavated shafts, and are steerable by an operator who would be located outside of the shaft above grade.

Traditional methods utilize a micro-tunnel boring machine (MTBM) consisting of a leading cutting head unit and trailing unit. The cutting head unit houses a rotating cutter head and power plant to rotate the head. Between the two units are several hydraulic rams that are used to position the cutting head for steering and to adjust the pressure of the cutting head against the excavation face. The trailing unit houses the spoil handling equipment, and provides the reaction force necessary for the hydraulic rams. The MTBM is advanced through the ground as the product pipe is jacked from the launch pit. A jacking frame is set on the proposed line and grade of the installation, and used to first launch the micro-tunneling machine into the ground, and then continue to advance it by pushing pieces of sectional product pipe behind the trailing unit (refer to **Figure 9-5**). The product pipe is specifically designed and manufactured to withstand the high jacking forces developed during the installation process.

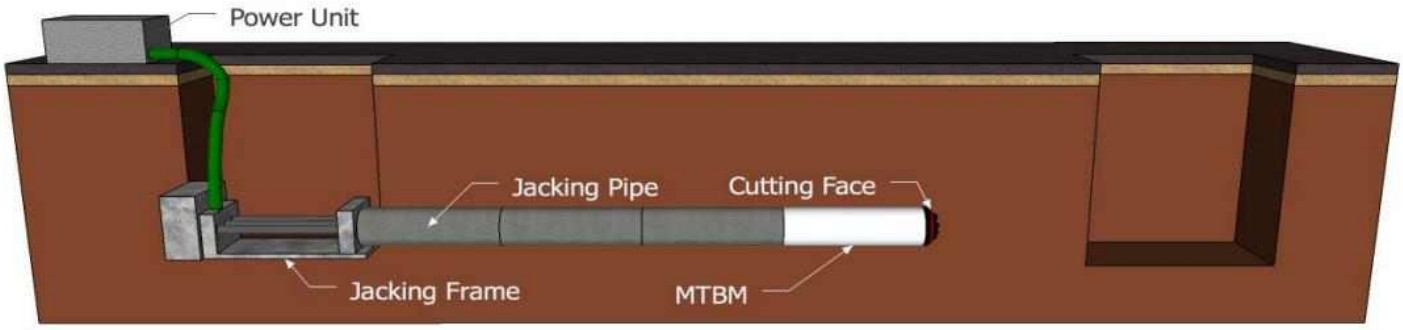


Figure 9-5
General Configuration of Traditional Micro-tunneling Installation

The trajectory of the micro-tunneling machine is monitored by observing the position of a laser projected from the launch pit onto a target located within the cutting head unit. The laser emitter is set to the proposed line and grade of the installation and positioned behind the jacking frame to allow the beam to travel down the inside of the product pipe string. The operator can observe the position of the laser on the target by closed circuit television, and adjust the alignment by positioning the cutting head with the hydraulic rams. Curved installations are also possible; however, additional survey is required within the pipe when the laser beam no longer can be observed on the target area.

The two main variants of traditional micro-tunneling methodologies that are slurry and earth pressure balance. These methodologies are differentiated by the means in which the cutting face is supported and controlled during the installation, and requirements for such can differ depending on soil and groundwater conditions.

Slurry micro-tunneling utilizes a self-contained circulating slurry system (typically a mixture of water and bentonite) to remove excavated spoil from the cutting face and provide support to the cutting face to prevent soil subsidence and control ground water.

Earth pressure balance machines utilize the excavated soil and pressure supplied by the hydraulic rams located between the cutting and trailing units as the means for supporting the cutting face during the installation.

There are many issues unique to trenchless construction methods that must be considered during design and construction. Understanding the impacts of these issues and having proper mitigation measures in place will greatly minimize the impact and occurrence of these issues and concerns.

9.2.4 Application of an Inverted Siphon

Sewer designers often encounter obstructions to typical gravity flow (such as rivers), and to pass these obstructions, a common method is to design the sewer pipe to drop sharply upstream of the obstruction, then run horizontal under the obstruction, and finally rise to the desired downstream outlet elevation. The piping going under the obstruction is traditionally called an inverted siphon.

In general terms, the design of an inverted siphon must consider:

- The size and slope of the upstream main sewer pipe;
- The estimated design flow rate(s) of the sewer;
- The elevation difference between the upstream and downstream pipe inverts;
- The head losses due to friction along the siphon pipe, based on the total length of the siphon as well as bends and appurtenances that may be required.

Unlike the main sewer pipe, the siphon pipe(s) flow under pressure. Special care must be taken in inverted siphon design since head losses due to friction are greater for pressurized flow. In order to maintain proper operations of the sewer pipe, the velocity in the siphon pipe must be at least 1.0 m/s, which is considered to be the minimum scour velocity for an inverted syphon. To ensure this condition, even if there is only one main sewer pipe, several siphon pipes are typically required, depending on the range of design flow rates that are being considered. Multiple pipes for the siphon crossing are also desirable to provide a measure of redundant capacity and protect against the risk of failure (i.e. clogging).

When considering the design flow rate(s), it is important to understand the typically diurnal nature of sanitary peak flows which relate to residential sewage. Under typical weekday scenarios, there are both morning and evening peak flows that coincide with people getting ready for the day (eg. showering), and coming home to finish their day (eg. cooking, laundry, etc.). These can be off-set from commercial flows which may peak for an extended time during the average work day. Also, specialised commercial / industrial users such as breweries may have higher flows that peak and/or could be sustained at any time during the day.

All of these factors together can make it challenging to determine an appropriate siphon design flow rate, and typically a range of flows is needed. Also, the selection of the siphon design flow rate(s) should conservatively not be chosen as the theoretical peak sewer design flows. Such flows (as presented in Section 5.0) are based on theoretical calculations using conservative flow assumptions, and the actual sewer peak flows only occur during wet weather conditions when inflow and infiltration (I&I) contributions are highest. For siphons, ideally the design flow rates are selected such that the minimum scour velocities for the siphon pipes are achieved on a daily basis, to prevent clogging.

To accommodate the transition from a larger, single sewer pipe to multiple siphon pipes, an inlet splitter chamber is typically used. The chamber design includes the setting of outlet pipe diameters and internal weir heights and/or control valves to manage influent flows via open channel hydraulics, orifice constraints and weir or valve flow controls. **Figure 9-6** provides an illustration of a typical siphon inlet chamber.

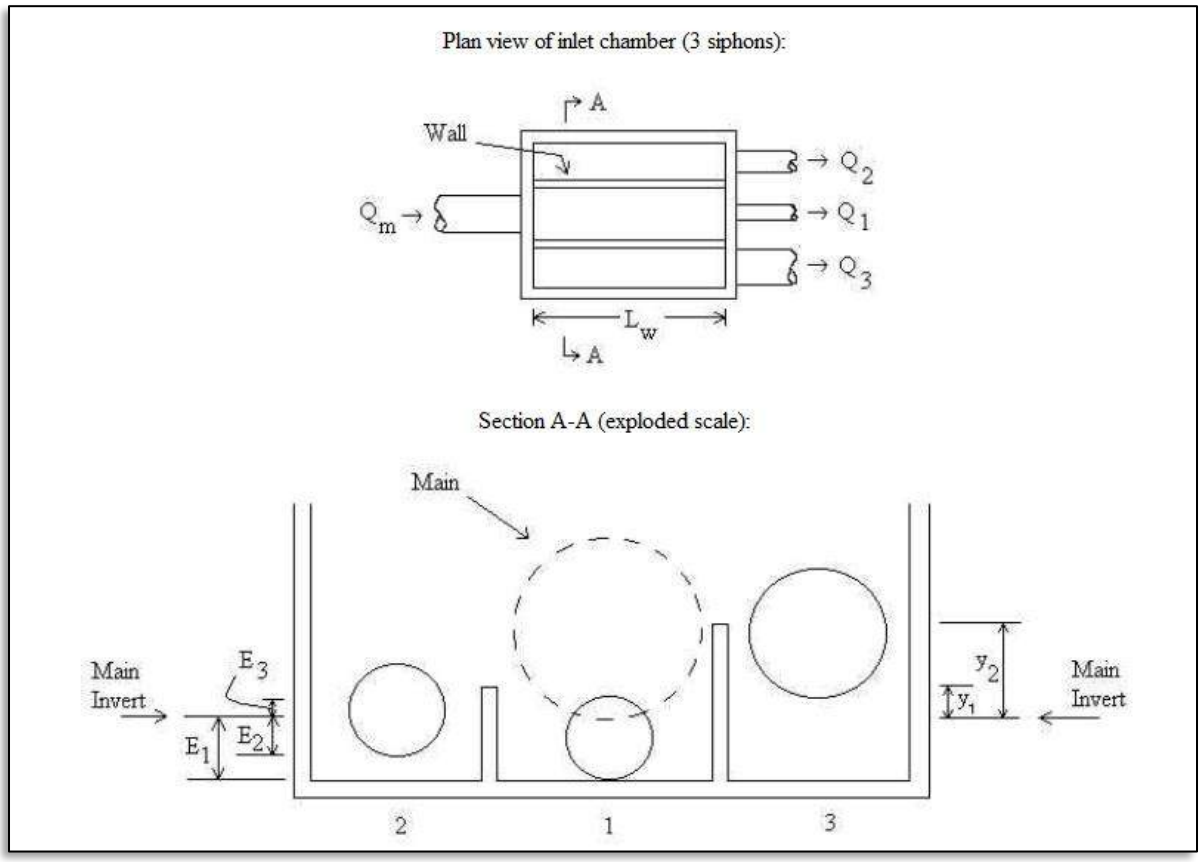


Figure 9-6
Typical Siphon Inlet Chamber Configuration

With any siphon, there are usually routine maintenance requirements that include flushing and/or swabbing of the pipes to ensure they are flowing properly. Operational issues can include access issues as they are often built close to obstructions (eg. rivers) and some of them do not have direct access for maintenance. A lack of routine and appropriate maintenance can result in pipes becoming partially plugged. Maintenance activities should include crews to complete bi-weekly inspections of the inlet chamber and the inlet and outlet flows, and also regular flushing of the pipes (i.e. monthly).

Based on the geometry of the proposed sanitary pipeline at River Crossing Location #2, it may be theoretically feasible that the conveyance of sewage flow crossing under the Grand River could be achieved through the application of an inverted siphon. There is an elevation difference of approximately 3 m from the upstream sewer invert elevation (290.6m) to the downstream outlet location at the WWTP raised influent channel (287.6m). The total length of the low pressure siphon pipe would be approximately 490m.

Based on this configuration and assuming the ultimate build-out conditions for the East Side Lands where the peak flow rate is approximately 627L/s, a preliminary siphon hydraulic analysis indicates that the design could work, but the available head differential is only marginally sufficient, and may not be enough to overcome friction losses or partial obstructions in the pipe. If implemented, the siphon would likely include at least three pipes, similar to the forcemain configuration; approximately 250 mm, 350 mm and 450 mm in diameter.

It should be noted that, while (marginally) theoretically feasible, the application of a siphon for the river crossing component of the East Side Lands sanitary servicing solution would likely be problematic, based on the following rationale:

1. The design flow rate will be variable for a significant period (approximately 30 to 50 years), until such time as the East Side Lands has achieved full build-out. As such, the design must consider not only a range of daily flows under the ultimate conditions, but also multiple ranges of flows to address the evolving flow conditions over time. The design and operation of the siphon will require an extensive analysis of varying flow conditions and regular monitoring of flows to ensure appropriate operations.

2. Typically siphon designs include steep sections of pipe to drop down below the obstruction and raise back up to the outlet elevation. Considering the geometry of the proposed East Side Lands sanitary sewer under the Grand River, and the proposed trenchless pipe crossing, these steep sections will actually be vertical. These vertical drops and 90-degree bends result in significant head losses, and may significantly impact the viability of the siphon design.

3. Depending on the influent sewage conditions, and the siphon's ability to achieve the minimum velocities on a daily basis, there is potential for the system to become septic within the pipe. This could result in odour issues at the upstream inlet chamber and or sewer manholes.

It is of note that there is an existing, similar condition for the crossing of the Grand River of the sanitary sewer pipe that services the existing industrial area south of the Stage 1 Lands. The 750 mm diameter Fountain Street Trunk sewer crosses the Speed River just

south of Shantz Hill Drive, via an inverted siphon and ultimately discharges to the Dover Street Pumping Station.

The siphon's design capacity is 655 L/s and is comprised of 300 mm, 450 mm and 500 mm diameter pipes and flows into a downstream pumping station. This siphon pipe is believed to be of significantly shorter length (estimated at approximately 100 m, and localized to just the river crossing) than what is proposed in Alternative Methodology #4.

9.3 POTENTIAL IMPACTS TO THE GRAND RIVER

Crossing of the Grand River is required for all alternatives. Avoiding a crossing of the river is not an option. The following sections discuss details of the alternative solutions that specifically impact the Grand River system.

9.3.1 Pipeline Crossing Under the River

Construction of a pipeline (either smaller forcemain pipes within a common casing pipe, or a larger gravity sewer pipe) under the Grand River via open cut construction is a viable approach at River Crossing Location #1. However, there are a number of site specific technical challenges to consider, including:

- It could impact the watercourse and its related aquatic and terrestrial habitats, including known SAR (Wavyrayed Lampmussel).

- There are a number of potential construction risks in relation to washout of the active construction area due to fluctuating river levels during the estimated 8-12 weeks needed to complete the river crossing (i.e. including the construction of temporary coffer dams and dewatering).

- The existing steep valley slopes on either side of the river would make access to the active construction zones for open-cut river crossings difficult.

At River Crossing Location #2 (Pioneer Tower), the extremely high, steep slope would essentially prohibit an open cut crossing.

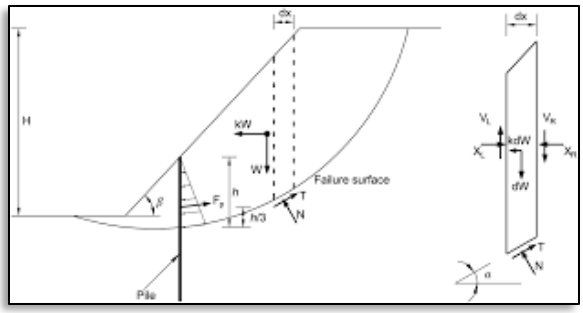
The application of trenchless technology (i.e. micro-tunnelling) for a pipeline crossing under the Grand River would require:

- Deep sending and receiving shafts on either side of the river, including significant dewatering and structural stabilization (shoring);

- Shafts on the WWTP side of the river that would be located within the floodplain, requiring temporary coffer dams around the shaft(s) / work area to minimize the risk of washout during a flood event within the construction window;

- Micro-Tunnelling equipment and an emergency response plan to address frac-out conditions and/or for retrieval of the equipment if an immovable obstacle is encountered (eg. large boulders).

- A slope stability analysis and associated mitigation measures to avoid adverse impacts from the deep shafts and construction activity on the north (Deer Ridge) side of the river and the steep river valley slopes;



9.3.2 Service Bridge Crossing Over the River

Considering the invert elevation of the proposed gravity sewer pipe upstream of the Grand River near the Pioneer Tower, and the outlet elevation at the WWTP, it is possible to convey flows from the East Side Lands all the way to the influent channel of the Kitchener WWTP by gravity sewer (i.e. not requiring a pumping station). To achieve this however, the sewer pipe would be required to traverse ***over*** the Grand River. Specifically, a service bridge for the pipe would span over pipeline legs #16, #17 and #18, as defined under the Part 1 evaluation, for a total length of approximately 450 m.

As part of this Class EA Study and specifically in support of Alternative Methodology #5 that includes an aerial pipe crossing over the Grand River, a conceptual design report was prepared that explores structural options that are reasonably available, with a focus on the critical span that crosses the watercourse and the non-critical spans that traverse across the WWTP to the raised influent channel (refer to **Appendix E).**

The conceptual bridge assessment used the Canadian Highway Bridge Design Code (CAN/CSA-S6-06), and assumed a design life of 75 years. It includes seismic, temperature, geotechnical and hydraulic conditions with live and dead loading as applicable for this project.

While many options exist for types of bridge structure, for the purposes of this assessment, the scope was limited to two structure types: Cast-In-Place (CIP) Deck on I Girder; and CIP Deck Through Pratt Truss.

Using these bridge types, two river spanning options were selected that include:

1. A longer (approximately 80 m) clear span crossing of the river's main channel without any in-water structures / piers, allowing for construction to be completed 'in the dry', and
2. A shorter (approximately 50 m) span structure with intermediate, in-water support piers, requiring construction activity within the river's main channel.

While it is expected that Option 2 will significantly decrease the required sizing of the bridge's structural members and the associated cost and difficulty of construction, it would require significant additional environmental permitting relating to in water works. Furthermore, the presence of additional piers within the river's main channel could have potential adverse impacts to the flow hydraulics and floodplain characteristics.

Construction of piers (likely on either spread footings or driven piles) adjacent to the valley slope and/or within the floodplain area of the Kitchener WWTP would require a hydraulic analysis to assess and mitigate impacts to the floodplain. Impacts and mitigation of ice-flows on the piers should also be considered.

It is noted that the preliminary configuration of the proposed service bridge presented herein is conceptual only and is for the sole purpose of evaluation of alternative solutions. The actual details, including any required mitigation of cultural heritage impacts relating to the Pioneer Tower, are to be determined through the future detailed design.

9.3.3 Pumping Station Located within the River's Floodplain

For alternatives that include a new pumping station on the WWTP side of the River Crossing, it is noted that its location would be within the floodplain boundary (as is the

majority of the WWTP). Any new above ground structure would require an appropriate hydraulic / floodplain analysis, consideration of ice flows, and appropriate waterproofing to avoid flooding of the structure and related consequences.

9.4 PRELIMINARY SCREENING OF ALTERNATIVES

The long list of alternatives (shown in Figure 9-1) were screened to develop a short-list for a more detailed and comprehensive evaluation. Considering the specific technical challenges identified and discussed in Section 9.2, some of the potential alternative methodologies were eliminated based on the following factors:

- Alternative Methodology #1 includes un-desirable hydraulic conditions relating to PS #1 and the long forcemain (approximately 4.0km) that has a generally downhill profile. It would require significant energy input for pumping, as well as complex pump and valve configurations to maintain efficient operations. Furthermore, large air / vacuum relief structures would be required along the alignment presenting odour control issues within the sensitive Deer Ridge Subdivision. Based on these factors, Alternative Methodology #1 (at both crossing locations) has been rejected and eliminated from further evaluation.

- Alternative Methodology #2 includes the construction of a new, large pumping station (PS #2 or #4) within the Deer Ridge Subdivision, in close proximity to existing residences. The design would require features for noise and odour abatement to avoid un-desirable social impacts to the surrounding community. At River Crossing Location #1, the City of Kitchener's Pioneer Tower Pumping Station already exists, and there is potential to retrofit the existing station and combine it with the new PS #2 to service both the Deer Ridge subdivision and the East Side Lands, (subject to future discussion and necessary agreements between the Region and the City of Kitchener). Since pumping station related issues already exist, and considering the potential to combine with the Pioneer Tower PS, Alternative Methodology #2 at River Crossing Location #1 will be considered for further evaluation.

  At River Crossing Location #2, a new pumping station would be required within the existing parkland. This station would include a very deep (approximately 26m) wet well and trenchless launching shaft. Noise and odour abatement would be required to minimize impacts to the park amenities and nearby residents. A new pumping station is considered to be more invasive at this location. Based on these factors, Alternative Methodology #2 at River Crossing Location #2 has been rejected and eliminated from further evaluation.

- Alternative Methodology #3 includes the construction of a new, large pumping station (PS #3 or #5) within the WWTP property, on the opposite side of the Grand River from the Deer Ridge subdivision. Either pumping station would be within the floodplain of the Grand River, however, this is a similar condition to the entire WWTP. For PS #3 (River Crossing Location #1), there is a location just north of the secondary clarifiers that could accommodate the new station, with an efficient

forcemain alignment around the northwest side of the WWTP, discharging into the existing influent chamber. Based on these factors, Alternative Methodology #3 at River Crossing Location #1 will be considered for further evaluation.

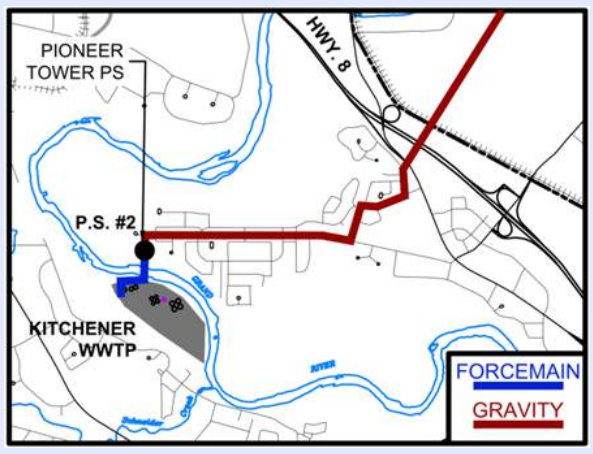
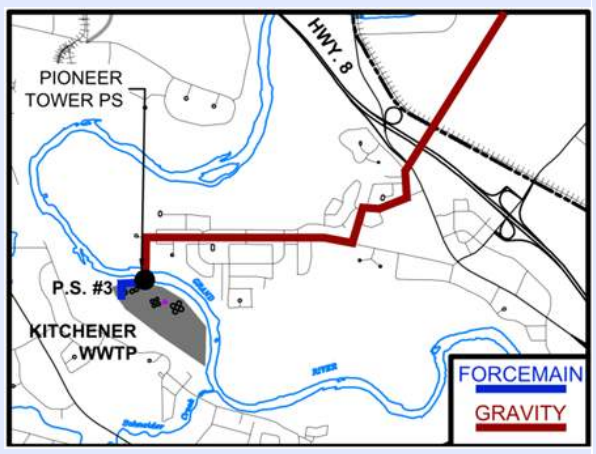
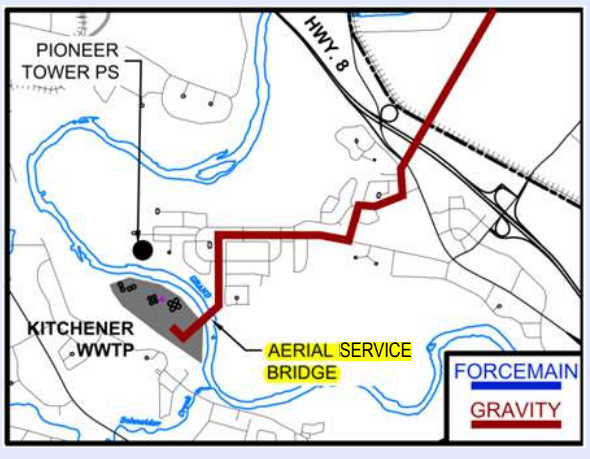
For PS #5 (River Crossing Location #2), a suitable site is not as readily available, especially considering the ongoing upgrades to the Kitchener WWTP. Also, the forcemain alignment would have to be either longer to connect to the existing influent chamber, or would be along (beneath) the existing WWTP service road which is heavily congested with existing utilities, and require a new connection to the elevated influent channel. Furthermore, crossing under the Grand River at River Crossing Location #2 would require a very deep (approximately 26m) launching shaft to accommodate the necessary trenchless approach. Based on these factors, Alternative Methodology #3 at River Crossing Location #2 has been rejected and eliminated from further evaluation.

- Alternative Methodology #4 includes the construction of an inverted siphon which has been assessed to be only marginally feasible (theoretically). Considering the need to accommodate a wide range of flows over time this option would require significant regular O&M effort. It would also require a maintenance building within the existing park lands to provide maintenance access to the necessary splitter structure and siphon inlet chamber. Mitigation of odour control issues at the siphon inlet chamber would be required. Due to the marginally effective hydraulic conditions, there is a high risk and consequence of failure of the siphon. Based on these factors, Alternative Methodology #4 has been rejected and eliminated from further evaluation.

- Alternative Methodology #5 includes the construction of a service bridge that crosses over the Grand River and eliminates the need for a pumping station. Due to existing topography, this alternative is only viable at River Crossing #2. Alternative Methodology #5 at River Crossing Location #2 will be considered for further evaluation.

Figure 9-7 summarizes the alternatives that were short-listed for further review to determine a preferred option.

Figure 9-7
Short List of Alterative Conveyance Methodologies

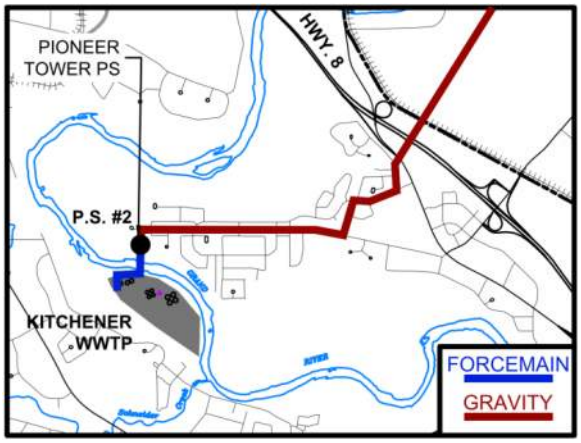
Screening Rationale	River Crossing Location #1	River Crossing Location #2
Alternative Methodology #1 • Un-desirable hydraulic conditions relating to **PS #1** and downhill forcemain profile. • Significant energy requirements input for pumping. • Complex pump and valve configurations. • Multiple large air / vacuum relief structures with potential odour issues within the Deer Ridge Subdivision.		
Alternative Methodology #2 • Invasive large pumping station (PS #4) within the Deer Ridge Subdivision park area, close to existing residences and park amenities. • Requires deep (approximately 26m) trenchless launching shaft. • Requires noise and odour abatement. • Potential social impacts.		
Alternative Methodology #3 • Constrained PS #5 site conditions within proposed upgrade area of WWTP. • Longer / congested forcemain alignment. • Requires deep (approximately 26m) trenchless launching shaft.		
Alternative Methodology #4 • Marginally effective / challenging hydraulics. • Complex O&M due to wide range of flows over time. • Requires a maintenance building within the existing park lands. • Siphon inlet chamber presents potential odour issues. • High risk and consequence of failure.	THIS OPTION IS NOT VIABLE AT RIVER CROSSING #1	
<u>Alternative Methodology #5</u> • Bridge at River Crossing Location #2 to be included in more detailed and comprehensive evaluation.	THIS OPTION IS NOT VIABLE AT RIVER CROSSING #1	

10 Short List of Alternative Solutions

The following sections outline the details of the alternative solutions to be evaluated for providing sanitary servicing to the East Side Lands. These alternative solutions are based on the preferred pipeline Route 'B' and the short-listed conveyance methodologies discussed in Section 9. Refer to **Appendix F** for plan and profile schematics.

10.1 ALTERNATIVE SOLUTION #1

Alternative Solution #1 consists of the following components:



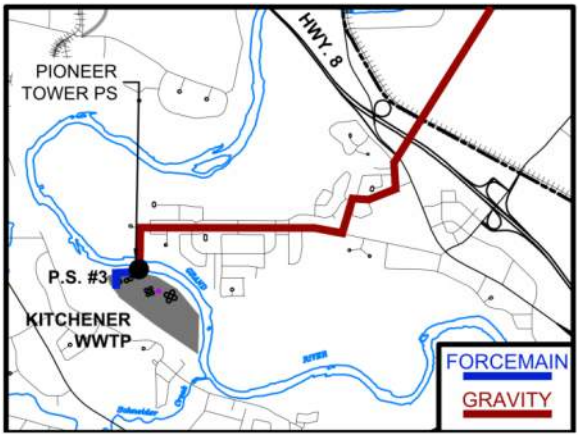
- Approximately 4 km of 975 mm diameter **Gravity Sewer** extending from the pipeline origin point (north of Freeport Creek) to the west end of Pioneer Tower Road, including:
  - Approximately 1,060 m of trenchless construction of the sewer pipes across the CP Rail / Hwy #8 / King Street corridors, and along Grand Hill Drive to Deer Ridge Drive, assuming micro-tunnelling techniques are utilized. Approximate depth ranges from 8 m to 20 m.
  - Approximately 400 m of trenchless construction of the sewer pipes through the deeper section of the community trail / hydro corridor along the former Pioneer Tower Road alignment, assuming micro-tunnelling techniques. Approximate depth ranges from approximately 6 m to 8 m.
  - Open cut excavation and construction of the sewer pipe along the remainder of the pipeline route, at a nominal depth ranging between 2-6m of cover.
- A new **pumping station (PS #2)** located near / adjacent to the existing City of Kitchener Pioneer Tower Pumping Station at the west end of Pioneer Tower Road.
- Approximately 100 m of **forcemain** (3 pipes – 250 mm, 350 mm and 450 mm diameter in a common trench) from the pumping station through the Deer Ridge Subdivision to River Crossing Location #1.
- A crossing of the Grand River. This crossing includes either:
  - A deep (greater than 8 m) trenchless crossing including: a large (approximately 7 m) diameter launching shaft, approximately 13 m deep on the north side of the river; a large (approximately 7 m) diameter receiving shaft, approximately 8 m deep on the south side of the river; and approximately 140 m of 1500 mm diameter steel carrier / casing pipe to house the three forcemain pipes under the river.

  - Or a shallower (approximately 3-4m) an open cut crossing including: coffer dams and a staged approach (i.e. half the river at a time), dewatering (including an MOECC Permit to Take Water as appropriate), physical relocation of SAR (Wavyrayed Lampmussel), downstream silt curtains and restoration of disturbed river valley slope and associated vegetation.

- Approximately 350 m of additional forcemain (3 pipes – 250 mm, 350 mm and 450 mm diameter in a common trench and/or steel carrier pipe casing) extending from the receiving shaft around the north end of the Kitchener WWTP and discharging into the WWTP influent channel.

10.2 ALTERNATIVE SOLUTION #2

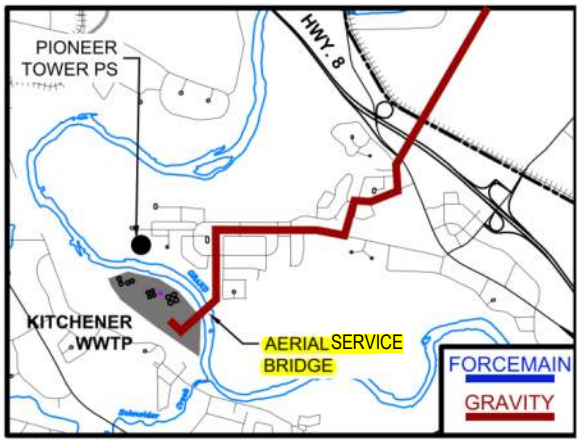
Alternative Solution #2 consists of the following components:



- Approximately 4.2 km of 975 mm diameter **gravity sewer** extending from the pipeline origin point (north of Freeport Creek) to the west end of Pioneer Tower Road, and southerly along the access road to River Crossing Location #1, including:
  - Approximately 1,060 m of trenchless construction of the sewer pipes across the CP Rail / Hwy #8 / King Street corridors, and along Grand Hill Drive to Deer Ridge Drive, assuming micro-tunnelling techniques are utilized. Approximate depth ranges from 8 m to 20 m.
  - Approximately 400 m of trenchless construction of the sewer pipes through the deeper section of the community trail / hydro corridor along the former Pioneer Tower Road alignment, assuming micro-tunnelling techniques. Approximate depth ranges from 6 m to 8 m.
  - Open cut excavation and construction of the sewer pipe along the remainder of the pipeline route, at a nominal depth ranging between 2-6m of cover.
- A crossing of the Grand River. This crossing includes either:
  - A deep (greater than 8 m) trenchless crossing including: a large (approximately 7 m) diameter launching shaft, approximately 13 m deep on the north side of the river; a large (approximately 7 m) diameter receiving shaft, approximately 8 m deep on the south side of the river; and approximately 140 m of 1500 mm diameter steel carrier / casing pipe to house the three forcemain pipes under the river.
  - Or a shallower (approximately 3-4 m) open cut crossing including: coffer dams with a staged approach (i.e. half the river at a time), dewatering (including an MOECC Permit to Take Water as appropriate), physical relocation of SAR (Wavyrayed Lampmussel), downstream silt curtains and restoration of disturbed river valley slope and associated vegetation.
  - Approximately 140 m of 1500 mm diameter steel carrier / casing pipe to house the 975 mm sewer pipe under the Grand River.
- A new **pumping station (PS #3)** located within the Kitchener WWTP property.

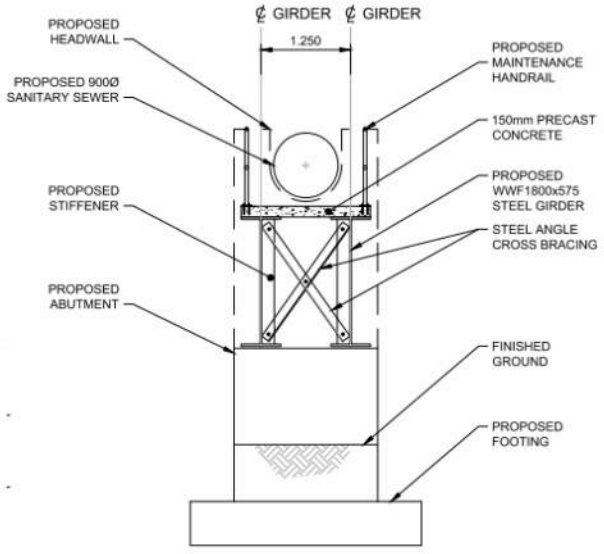
- Approximately 350 m of additional forcemain (3 pipes – 250 mm, 350 mm and 450 mm diameter in a common trench) extending from the receiving shaft around the north end of the Kitchener WWTP and discharging into the WWTP influent channel.

10.3 ALTERNATIVE SOLUTION #3 – SERVICE BRIDGE



Alternative Solution #3 consists of the following components:

- Approximately 3.6 km of 975 mm diameter **gravity sewer** extending from the pipeline origin point (north of Freeport Creek) to River Crossing Location #2 at the south end of Lookout Lane, including:
    - Approximately 1,060 m of trenchless construction of the sewer pipes across the CP Rail / Hwy #8 / King Street corridors, and along Grand Hill Drive to Deer Ridge Drive, assuming micro-tunnelling techniques are utilized. Approximate depth ranges from 8 m to 20 m.
    - Approximately 400 m of trenchless construction of the sewer pipes through the deeper section of the community trail / hydro corridor along the former Pioneer Tower Road alignment, assuming micro-tunnelling techniques. Approximate depth ranges from 6 m to 8 m.
    - Open cut excavation and construction of the sewer pipe along the remainder of the pipeline route, at a nominal depth ranging between 2 m to 6 m of cover.



- A new **service bridge crossing the Grand River,** approximately 120 m in length (assumed to be Cast in Place (CIP) concrete deck on "I" Girder – (1800 mm Depth – Single Span WWF 1800 x 575 Steel Girders for the purposes of this Study) that will span the entire width of the Grand River without intermediate support. The wastewater pipe will be supported by a series of rollers spaced evenly along a concrete deck to allow for differential thermal expansion.
- After crossing the Grand River, the service bridge would span an additional 350 m to cross the WWTP property and connect to the elevated influent channel. This additional structure would use shorter spans (approximately 30 m) with intermediate

supports. Similar to above, the structure for this span was assumed to be Cast in Place (CIP) concrete deck on “I” Girder – (1100 mm Depth – Single Span WWF 1800 x 575 Steel Girders) for the purposes of this Study.

It is noted that the preliminary configuration of the proposed service bridge presented herein is conceptual only and is for the sole purpose of evaluation of alternative solutions. The actual details, including any required mitigation of cultural heritage impacts relating to the Pioneer Tower, are to be determined through the future detailed design.

11 Part 2 – Evaluation of Conveyance Methodologies

11.1 PART 2 - EVALUATION CRITERIA

As described in Section 8, the evaluation process in Part 1 focussed on the spatial aspects of the alternative pipeline routes, assessing the impacts that each alignments' linear construction footprint would have within the Study Area.

The evaluation in Part 2 focusses on the engineering and operational nature of each of the short-listed alternative solutions, including the significant issues related to the options for crossing the Grand River. Similar to Part 1, qualitative evaluation criteria have been identified; specifically, two (2) criterion each under the categories of natural environment impacts, social environment impacts and technical impacts.

In addition to these three qualitative criteria, the alternatives are also assessed against a quantitative category, cost.

Natural Environment

The primary qualitative concerns regarding the natural environment relate to energy requirements required to operate and maintain the infrastructure, and the impacts to the Grand River system.

Examples of potential impacts to the natural environment relating to the alternative solutions are presented in **Table 11-1**.

Table 11-1
Natural Environment - Criteria & Example Impacts

EVALUATION CRITERIA	EXAMPLES OF POTENTIAL IMPACTS
1.1 Energy Requirements and Carbon Footprint	• Electricity required to operate pumping station • Fuel / emissions from standby power generation • Fuel / emissions resulting from transportation to and from infrastructure component sites (eg. pumping stations, air / vacuum valve chambers, sewer flushing)
1.2 Impacts to Grand River System (Watercourse & Floodplain)	• Presence of permanent structures within floodplain. • Hydraulic impacts of permanent structures on river flow (main channel and/or floodplain) • Impedance of above ground infrastructure on ice flows.

Social Environment

The primary qualitative concerns regarding the social environment are noise and/or odour issues relating to the long-term O&M of the infrastructure. Also, the aesthetic impact to the surrounding neighbourhood and adjacent lands must be considered.

Examples of potential impacts to social environment relating to the alternative solutions are presented in **Table 11-2**.

Table 11-2
Social Environment - Criteria & Example Impacts

EVALUATION CRITERIA	EXAMPLES OF POTENTIAL IMPACTS
2.1 Noise/Odour at Pump Stations	• Sewage / septic odours from pump station venting and or air/vacuum relieve chambers. • Noise from pumping station operations and/or standby power generation. • Noise / traffic associated with routine access to infrastructure for O&M purposes
2.2 Aesthetics / Public Appeal	• Visibility of infrastructure / Impedance of desirable vistas

Technical Environment

The primary qualitative concerns regarding the technical environment relate to the complexity of physically operating and maintaining the infrastructure for the duration of its design life. Furthermore, the risk and consequence of failure related to the operational complexity must also be considered.

Examples of potential technical impacts relating to the various alternative solutions are presented in **Table 11-3**.

Table 11-3
Technical Environment - Criteria & Example Impacts

EVALUATION CRITERIA	EXAMPLES OF POTENTIAL IMPACTS
3.1 Operational Complexity / Risk and Consequence of Failure	• Pumping station controls, instrumentation and communication systems with other Regional facilities. • Future upgrade requirements to accommodate changes in peak flow rates. • Specialized valving, pump controls and backup systems. • Management of wet-weather flow conditions. • Prevention and management of septic flow conditions and H_2S gas emissions. • Relative risk of system failure (eg. power failure, mechanical failure of pumps, clogging of pipes) • Likely severity of failure consequences (eg. sewer backups, overflow discharge to receiving watercourses / sensitive natural areas).
3.2 Maintenance Requirements	• Weekly / monthly / annual equipment maintenance • Accessibility to infrastructure for O&M. • Coordination of operations with OCWA / City / Region staff for ongoing maintenance. • Periodic system upgrade requirements (eg. pump replacements, impeller changes, additional pumps, station retrofits.) • Periodic testing of emergency systems

11.2 PART 2 - QUALITATIVE EVALUATION

Similar to Part 1, an evaluation model was designed to compare the various solutions and their representative parts. A preliminary scoring of each alternative was completed and then reviewed by the project team and key stakeholders. The application of the evaluation model follows a step-wise process, comprised of scoring the alternative solutions against the qualitative evaluation criteria for the social, natural and technical environments, as follows:

1. The first step is to score the impacts of each short listed alternative under the six qualitative criteria. As per Part 1, the scoring utilizes a numeric impact ranking system, based on the rationale outlined in **Table 11-4**. Again, using the approach

that a lower score is preferred, it should be noted that a higher score is considered to be a less attractive option as it has more adverse impacts.

Table 11-4
Part 2 - Impact Ranking Scale

Score	Impact Ranking Scale
0 ○	Beneficial Impact / Ideal Conditions
1 ◔	No Adverse Impacts for this Criterion
2 ◑	Low Impact / Neutral After Mitigation
3 ◕	Medium Impact
4 ●	High Impact

2. The second step is the summing of the impact scores for each component in each qualitative criteria category (natural / social / technical), and determining an overall, qualitative impact score;

Table 11-5 (next page) presents the comprehensive qualitative evaluation model for the Alternative Solutions.

Of particular note, the Impacts to the Grand River System (Watercourse & Floodplain) are considered to be similar impact for all three alternative solutions. The river crossing component of each option presents its own unique challenges and potential impacts. As the Grand River is a sensitive natural feature, any construction activity would inherently pose a significant, but temporary impact, therefore, a score of three (3) was allocated for each option.

Subsequent to the PCC held on November 8th, 2016, concerns were expressed regarding Alternative #3 due to impacts to the localized cultural heritage features, specifically the Pioneer Tower and the Grand River. To address this concern, the original Cultural Heritage Investigation was revisited with a greater emphasis on the impacts to these features. As a result, the scoring was adjusted in Part 2 for the Visual Aesthetics / Public Appeal criterion. It is important to note that the scoring was only adjusted from '2' to '3' in the evaluation model, comparable to Alternative #1 which would present a new pumping station structure nearby to the tower. Furthermore, the visual impacts of the service bridge could be mitigated by ensuring the design is sympathetic to the historical setting and context of the area.

Based on the results of the qualitative evaluation, the best (lowest scoring) solution is Alternative #3. Subject to consideration of quantitative (i.e. financial) impacts, Alternative Solution #3 is suggested as the preferred solution.

Table 11-5
Part 2 – Qualitative Evaluation of Alternative Solutions
East Side Lands Sanitary Servicing Class EA

May 2017

Score	Impact Ranking Scale
0 ○	Beneficial Impact / Ideal Conditions
1 ◔	No Adverse Impacts for this Criterion
2 ◑	Low Impact / Neutral After Mitigation
3 ◕	Medium Impact
4 ●	High Impact

		2.1 Natural Environment (Category Weighting Factor = 1.0)			2.2 Social Environment (Category Weighting Factor = 1.0)			2.3 Technical Environment (Category Weighting Factor = 1.0)			SUM
		1.0	1.0		1.0	1.0		1.0	1.0		
		2.1.1 Energy Requirements and Carbon Footprint	2.1.2 Impacts to Grand River System (Watercourse & Floodplain)	Total Environmental Impact Points	2.2.1 Noise/Odour at Pump Stations and Air Relief Valves	2.2.2 Visual Aesthetics / Public Appeal	Total Social Impact Points	2.3.1 Operational Complexity / Risk & Consequence of Failure	2.3.2 Maintenance Requirements	Total Technical Impact Points	Sum of Qualitative Impact Scores
Route B1 - At River Crossing #1 - Pioneer Tower Pumping Station											
Alternative #1	Gravity Sewer + PS#2 within Deer Ridge / beside ex. Pioneer Tower PS + Short Forcemain Crossing Grand River to WWTP Influent Channel	Electrical Energy Requirements for Pumping Station Operation. Standby Diesel Generator. Potential to reduce net energy req'mt if combined with Ex. Pioneer Tower PS. ◕ 3	Pumping Station adjacent to steep river valley slope. Deep (12m) Trenchless shafts + permanent access structure within floodplain on WWTP side - OR - Open Cut crossing of River. ◕ 3	6	Pump station located in residential area, however shorter forcemain negates need for air relief valves ◕ 3	Pump station located adjacent to prime residential area. Adjacent to historic Pioneer Tower site. ◕ 3	6	Typical Pump Station operations. Need to upgrade with flow rate increases. Need to maintain pressure and manage self-draining pipes. Risk of sewage spillage to Grand River & Deer Ridge Neighbourhood if PS failure occurs. ● 4	Regular / frequent maintenance required on pump station. ◕ 3	7	19
Alternative #2	Gravity Sewer Crossing Grand River + PS#3 at WWTP + Short Forcemain to WWTP Influent Channel	Electrical Energy Requirements for Pumping Station Operation. Standby Diesel Generator. ● 4	Pumping Station within Grand River Floodplain (in WWTP). Deep (12m) Trenchless shafts + permanent access structure within floodplain on WWTP side - OR - Open Cut crossing of River. ◕ 3	7	Pump station located on wooded lands adjacent to WWTP, shorter forcemain negates need for air relief valves. Odour is less important as it is next to WWTP. ◔ 1	Pump station located on WWTP property and screened from residential areas by tree cover. ◔ 1	2	Typical Pump Station operations. Need to upgrade with flow rate increases. Risk of sewage spillage to the Grand River if PS failure occurs. ◕ 3	Regular / frequent maintenance required on pump station (coordinate with adjacent WWTP operations). ◑ 2	5	14
Route B2 - At River Crossing #2 - Pioneer Tower / Lookout Lane											
Alternative #3	Gravity Sewer + Service Bridge Crossing Grand River to WWTP Influent Channel	No Energy Requirements for Pump Station Operation. Only Routine (Annual) Maintenance / Flushing. ◔ 1	Bridge piers in floodplain (within WWTP site) and near steep river valley slope. ◕ 3	4	No pump station or air relief valves required. No noise or odour issues. ◔ 1	Service Bridge would be visible from Grand River / Trail. Impedes traditional vista from the Grand River to historic Pioneer Tower. Provides opportunity for new artistic feature / landmark. ◕ 3	4	Neglible operational requirements. Pipe not under pressure. Lowest Risk of failure. Most likely failure mode (pipe leak) easiest to detect and repair. Secondary containment for leakage easily achieved within bridge structure. ◔ 1	Periodic flushing of gravity sewer (more often during early years). ◔ 1	2	10

11.3 PART 2 – QUANTITATIVE EVALUATION

The quantitative assessment considers the financial impacts of each alternative. This includes the initial capital construction costs as well as the long-term O&M costs. For the purposes of this assessment, preliminary estimates of probable costs for each alternative were developed, and broken down into the following components:

- Cost of pipeline (i.e. forcemain or sewer)
- Cost of crossing the Grand River (i.e. under vs. over)
- Cost of conveyance method (i.e. pumping station versus gravity)
- Cost of O&M (assuming a 50-year life cycle)

Since the timing for construction of the preferred servicing solution for the East Side Lands is currently unknown, the estimated costs were converted to a net present value (NPV) using an assumed interest rate of 5%. Details of the cost estimates are provided in **Appendix G**.

To evaluate the financial impact of each alternative solution, a cost-weighting analysis was applied using the following steps:

1. The total cost of each alternative solution's components was estimated.
2. A cost weighting factor was determined by dividing the total cost of each solution by the average cost of all solutions. Solutions whose cost is greater than the average will have a cost weighting factor greater than 1.0, whereas solutions whose cost is less than the average will have a cost weighting factor less than 1.0.
3. The final weighted impact score of each alternative solution is determined by multiplying the total qualitative impact score by the cost weighting factor.

Table 11-6 provides a summary of the estimate costs and resultant cost weighting factors for each alternative solution. It also provides the final cost-weighted impact scores for Part 2 of the evaluation process (i.e. the combination of the qualitative and quantitative criteria).

Alternative Solution #3 has the lowest overall cost and therefore the lowest cost weighting factor. Applying the cost weighting factors to the qualitative scores reinforces the determination that Alternative #3 is the preferred solution.

Table 11-6
Part 2 – Quantitative Evaluation of Alternative Solutions

East Side Lands Sanitary Servicing Class EA

May 2017

		Sum of Qualitative Impact Scores (Table 11-5)	2.4 Financial Impact							Cost Weighted Impact Score [2]
			2.4.1 Pipe ($ Mil)	2.4.2 Grand River Crossing ($ Mil)	2.4.3 Conveyance Method ($ Mil)	2.4.4 O & M for 50 Yrs ($ Mil)	2.4.5 Contingency Allowance (15%)	Total Cost for Alternative ($ Million)	Cost Weighting Factor [1]	
Route B1 - At River Crossing #1 - Pioneer Tower Pumping Station										
Alternative 1	Gravity Sewer + PS#2 within Deer Ridge / beside ex. Pioneer Tower PS + Short Forcemain Crossing Grand River to WWTP Influent Channel	19	$21.0	$3.5	$7.6	$3.4	$5.3	$40.8	1.11	21.1
Alternative 2	Gravity Sewer Crossing Grand River + PS#3 at WWTP + Short Forcemain to WWTP Influent Channel	14	$20.8	$3.5	$7.7	$2.8	$5.2	$40.0	1.09	15.2
Route B2 - At River Crossing #2 - Pioneer Tower / Lookout Lane										
Alternative 3	Gravity Sewer + Service Bridge Crossing Grand River to WWTP Influent Channel	10	$20.0	$5.1	$0.0	$0.5	$3.8	$29.5	0.80	8.0

Notes:

[1] "Cost Weighting Factor" is calculated as: Alternative Cost / Average Cost of Alternatives

[2] Cost Weighted Impact Score = "Sum of Qualitative Impact Scores" x "Cost Weighting Factor"

11.4 SENSITIVITY ANALYSIS AND EVALUATION CRITERIA WEIGHTING

Similar to Part 1 of the evaluation process, the Part 2 model includes a weighting mechanism whereby the relative importance of one criteria or category over another can be tested. Applying such a weighting to any one criteria or category would affect the scoring of all alternative solutions.

For the initial evaluation, each criteria and category was given an equal rating of 1.0. Adjustment of the weighting factor up (or down) from the initial value of 1.0 will increase (or decrease) the relative importance of each criteria category. Applying a weighting factor of 0.0 eliminates the category from the evaluation process and can be used to assess the impacts of each category in isolation.

Through testing of the various weighting factors and discussion with the project team and stakeholders, it was confirmed that adjusting the weighting of any criteria or category does not substantially change the results of the evaluation. This hold true for all aspects of the project and all evaluation criteria, including the noted concerns regarding visual impacts to the heritage features. Therefore, it is concluded that, regardless of different criteria weighting scenarios, Alternative #3 is consistently the best (lowest) scoring solution. Alternative #3 is also the solution with the lowest estimated cost.

Therefore, Alternative #3 is recommended as the preferred solution for providing sanitary servicing to the East Side Lands.

12 Preferred Solution, Impacts & Mitigation

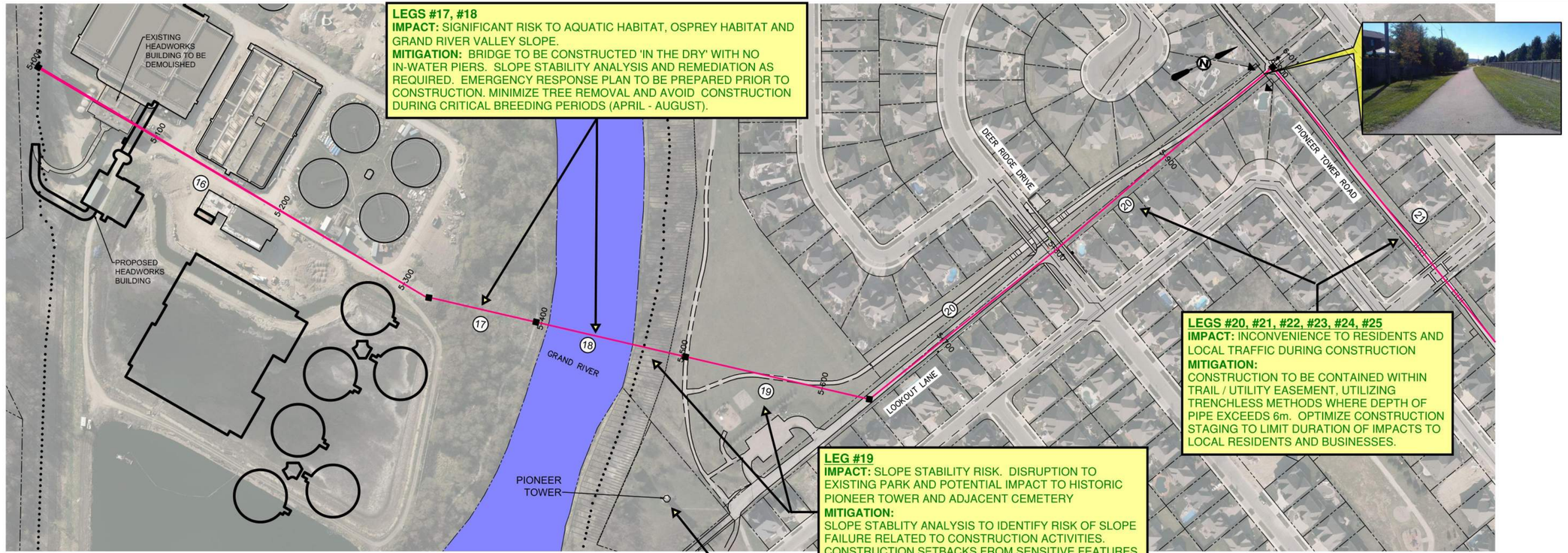
Alternative #3 has been identified as the preferred solution for providing sanitary servicing to the East Side Lands. This section provides further details of the solution, along with a discussion of key impacts and potential mitigation measures to abate the severity of those impacts.

12.1 SUMMARY OF THE PREFERRED SOLUTION

The preferred solution (Alternative #3) consists of the following components:

- Approximately 3.6 km of 975 mm diameter **gravity sewer** extending from the pipeline origin point (north of Freeport Creek) to River Crossing Location #2 at the south end of Lookout Lane, including:
    - Approximately 1,060 m of trenchless construction of the sewer pipes across the CP Rail / Hwy #8 / King Street corridors, and along Grand Hill Drive to Deer Ridge Drive, assuming micro-tunnelling techniques are utilized. Approximate depth ranges from 8 m to 20 m.
    - Approximately 400 m of trenchless construction of the sewer pipes through the deeper section of the community trail / hydro corridor along the former Pioneer Tower Road alignment, assuming micro-tunnelling techniques. Approximate depth ranges from 6 m to 8 m.
    - Open cut excavation and construction of the sewer pipe along the remainder of the pipeline route, at a nominal depth ranging between 2 m to 6 m of cover.
- A new **service bridge crossing the Grand River,** approximately 120 m in length, and for the purposes of this Study was assumed to be a Cast in Place (CIP) concrete deck on “I” Girder – (1800 mm Depth – Single Span WWF 1800 x 575 Steel Girders) that will span the entire width of the Grand River without intermediate support. The wastewater pipe will be supported by a series of rollers spaced evenly along a concrete deck to allow for differential thermal expansion.
- After crossing the Grand River, an additional length of approximately 350 m would be required for the service bridge to cross the WWTP property and connect to the elevated influent channel. This additional structure would use shorter spans (approximately 30 m) with intermediate supports. Similar to above, it was assumed for the purposes of this Study, the structure would consist of Cast in Place (CIP) concrete deck on “I” Girder – (1100 mm Depth – Single Span WWF 1800 x 575 Steel Girders).

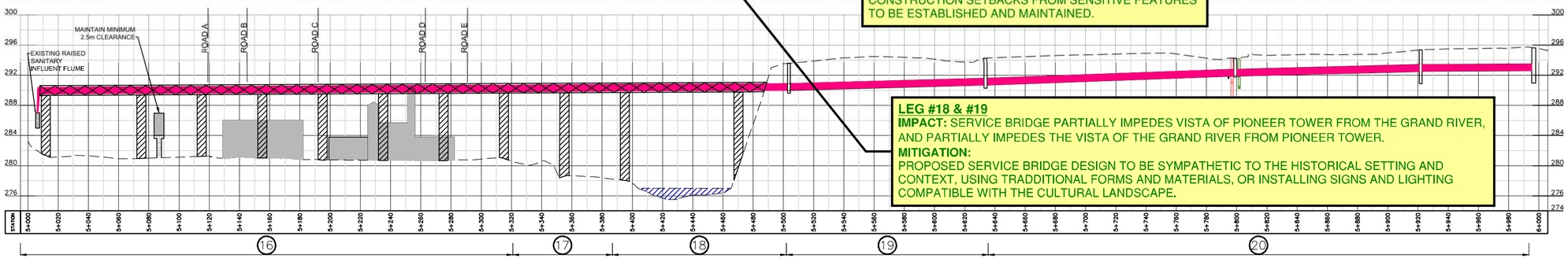
Figure 12-1 (Sheets 1 -4) illustrates the preferred solution in plan and profile view. These drawings also illustrate the key impacts that will need to be mitigated.



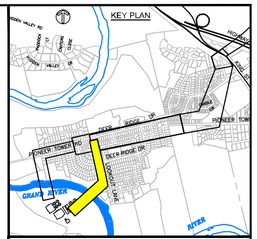
LEGS #17, #18
IMPACT: SIGNIFICANT RISK TO AQUATIC HABITAT, OSPREY HABITAT AND GRAND RIVER VALLEY SLOPE.
MITIGATION: BRIDGE TO BE CONSTRUCTED 'IN THE DRY' WITH NO IN-WATER PIERS. SLOPE STABILITY ANALYSIS AND REMEDIATION AS REQUIRED. EMERGENCY RESPONSE PLAN TO BE PREPARED PRIOR TO CONSTRUCTION. MINIMIZE TREE REMOVAL AND AVOID CONSTRUCTION DURING CRITICAL BREEDING PERIODS (APRIL - AUGUST).

LEGS #20, #21, #22, #23, #24, #25
IMPACT: INCONVENIENCE TO RESIDENTS AND LOCAL TRAFFIC DURING CONSTRUCTION
MITIGATION:
CONSTRUCTION TO BE CONTAINED WITHIN TRAIL / UTILITY EASEMENT, UTILIZING TRENCHLESS METHODS WHERE DEPTH OF PIPE EXCEEDS 6m. OPTIMIZE CONSTRUCTION STAGING TO LIMIT DURATION OF IMPACTS TO LOCAL RESIDENTS AND BUSINESSES.

LEG #19
IMPACT: SLOPE STABILITY RISK. DISRUPTION TO EXISTING PARK AND POTENTIAL IMPACT TO HISTORIC PIONEER TOWER AND ADJACENT CEMETERY
MITIGATION:
SLOPE STABLITY ANALYSIS TO IDENTIFY RISK OF SLOPE FAILURE RELATED TO CONSTRUCTION ACTIVITIES. CONSTRUCTION SETBACKS FROM SENSITIVE FEATURES TO BE ESTABLISHED AND MAINTAINED.



LEG #18 & #19
IMPACT: SERVICE BRIDGE PARTIALLY IMPEDES VISTA OF PIONEER TOWER FROM THE GRAND RIVER, AND PARTIALLY IMPEDES THE VISTA OF THE GRAND RIVER FROM PIONEER TOWER.
MITIGATION:
PROPOSED SERVICE BRIDGE DESIGN TO BE SYMPATHETIC TO THE HISTORICAL SETTING AND CONTEXT, USING TRADDITIONAL FORMS AND MATERIALS, OR INSTALLING SIGNS AND LIGHTING COMPATIBLE WITH THE CULTURAL LANDSCAPE.



LEGEND
- PROPOSED GRAVITY SEWER
- PROPOSED FORCEMAIN
- PROPOSED SIPHON
- EXISTING SANITARY
- EXISTING STORM
- EXISTING WATERMAIN
- FLOODPLAIN
- (##) PIPELINE ROUTE "LEG" NUMBER
- LEG NODE
- TRENCHLESS SHAFT (7mØ)
- AIR/VACCUM RELIEF CHAMBER
- FLOODPLAIN

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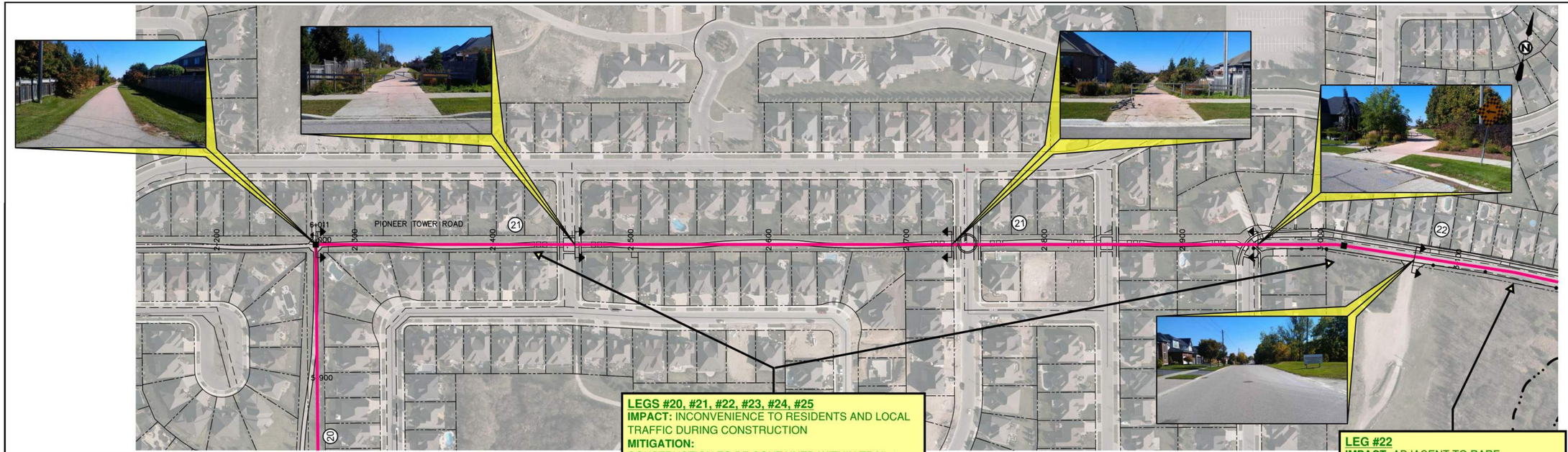
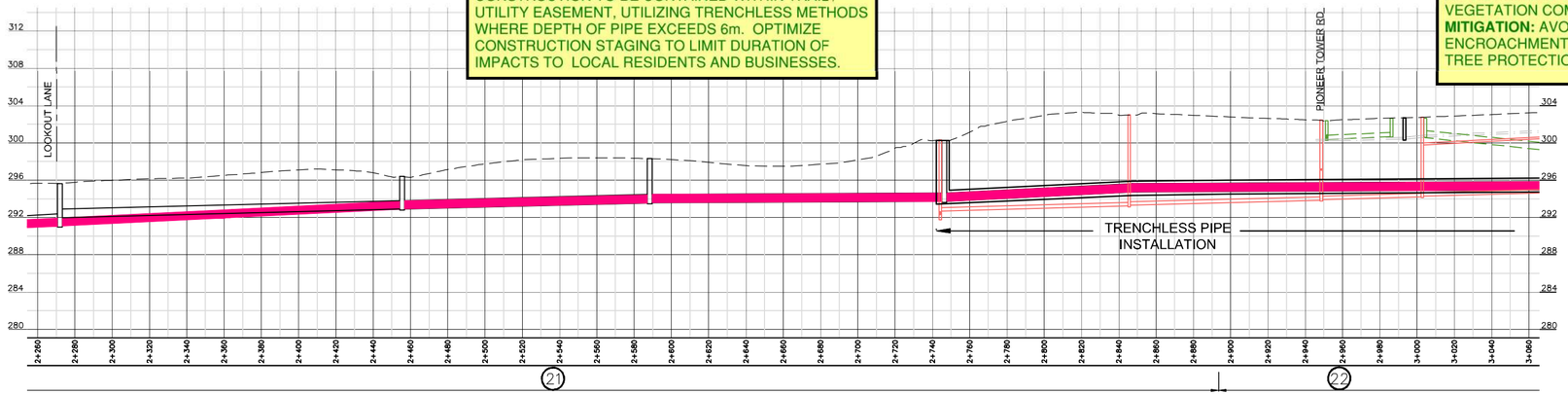
FIGURE 12-1

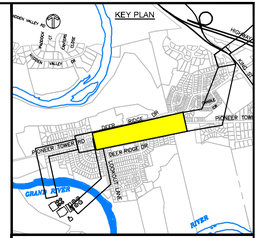
PREFERRED SOLUTION & KEY IMPACTS
(SHEET 1 of 4)



LEGS #20, #21, #22, #23, #24, #25
IMPACT: INCONVENIENCE TO RESIDENTS AND LOCAL TRAFFIC DURING CONSTRUCTION
MITIGATION:
CONSTRUCTION TO BE CONTAINED WITHIN TRAIL / UTILITY EASEMENT, UTILIZING TRENCHLESS METHODS WHERE DEPTH OF PIPE EXCEEDS 6m. OPTIMIZE CONSTRUCTION STAGING TO LIMIT DURATION OF IMPACTS TO LOCAL RESIDENTS AND BUSINESSES.

LEG #22
IMPACT: ADJACENT TO RARE VEGETATION COMMUNITY.
MITIGATION: AVOID CONSTRUCTION ENCROACHMENT INTO VEGETATION. TREE PROTECTION FENCING.





LEGEND
- PROPOSED GRAVITY SEWER
- PROPOSED FORCEMAIN
- PROPOSED SIPHON
- EXISTING SANITARY
- EXISTING STORM
- EXISTING WATERMAIN
- FLOODPLAIN
- (##) PIPELINE ROUTE "LEG" NUMBER
- LEG NODE
- TRENCHLESS SHAFT (7mØ)
- AIR/VACCUM RELIEF CHAMBER
- FLOODPLAIN

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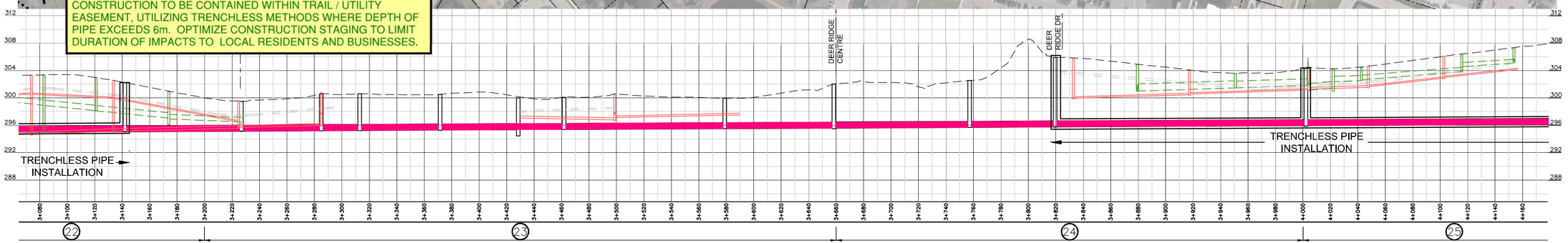
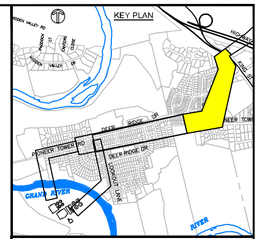
FIGURE 12-1

PREFERRED SOLUTION & KEY IMPACTS
(SHEET 2 of 4)





LEGEND

- PROPOSED GRAVITY SEWER
- PROPOSED FORCEMAIN
- PROPOSED SIPHON
- EXISTING SANITARY
- EXISTING STORM
- EXISTING WATERMAIN
- FLOODPLAIN
- ## PIPELINE ROUTE "LEG" NUMBER
- LEG NODE
- TRENCHLESS SHAFT (7mØ)
- AIR/VACCUM RELIEF CHAMBER
- FLOODPLAIN

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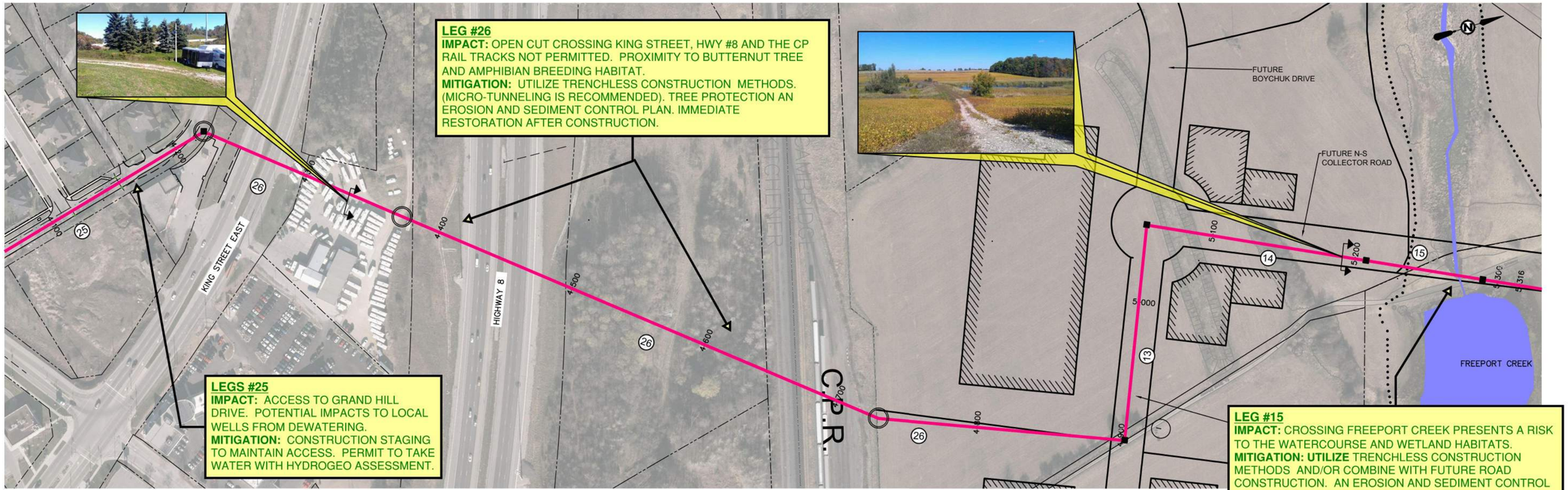
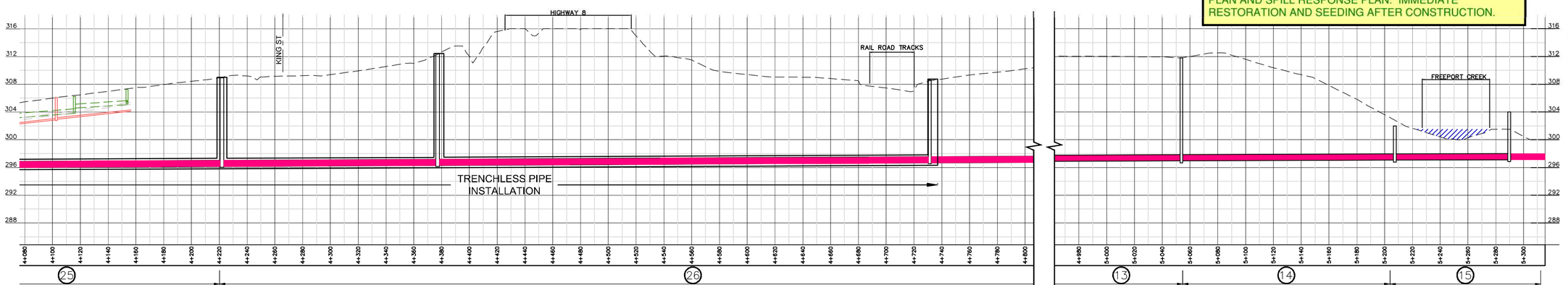
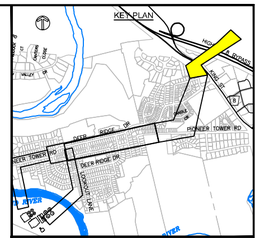
FIGURE 12-1

PREFERRED SOLUTION & KEY IMPACTS
(SHEET 3 of 4)







LEGEND

- PROPOSED GRAVITY SEWER
- PROPOSED FORCEMAIN
- PROPOSED SIPHON
- EXISTING SANITARY
- EXISTING STORM
- EXISTING WATERMAIN
- FLOODPLAIN
- ## PIPELINE ROUTE "LEG" NUMBER
- LEG NODE
- TRENCHLESS SHAFT (7mØ)
- AIR/VACCUM RELIEF CHAMBER
- FLOODPLAIN

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FIGURE 12-1

PREFERRED SOLUTION & KEY IMPACTS
(SHEET 4 of 4)

12.2 IMPACTS AND MITIGATION MEASURES

Construction of the proposed preferred solution will have both temporary and permanent impacts. These include:

- The gravity sewer and service bridge construction will require property acquisition and will result in permanent structures on public and privately owned lands.
- Operation of the gravity sewer will require periodic O&M activities. Specifically, in the early years when sanitary flows are low, routine flushing of the sewer may be needed to prevent clogging.
- Location of the service bridge will be visible by recreational users of the Grand River and/or the Grand River trail system, and may partially impede desirable vistas, particularly the view of the historic Pioneer Tower, from the river and/or trail. It is noted that the river is not visible from the base of the Tower, and currently entry into the tower is not permitted.

Through the detailed design process, opportunities to minimize and mitigate the impacts shall be identified and implemented to reduce the overall impact of the project as much as possible. The design should be sympathetic to the historical setting and context, utilizing traditional forms and materials, and/or installing signs and lighting compatible with the cultural landscape.

Impacts related to the physical construction of the proposed infrastructure are expected to be relatively short term and of a temporary nature (i.e. during construction only). By incorporating proper best management practices/construction techniques and controls, these impacts can be minimized.

The following sections provide a general overview of anticipated impacts along with some suggested mitigating measures to be considered. More detailed descriptions of the site specific impacts and mitigation measures as they relate to each of the legs along the preferred solution's alignment are presented in **Appendix H**.

12.2.1 Impacts to Terrestrial Habitats

Potential impacts to natural features and their functions may arise where the proposed work overlaps with identified natural features, including wetlands, woodlands, Areas of Natural and Scientific Interest (ANSI), Environmentally Sensitive Areas (ESA), and other designated natural areas. Direct impacts can be avoided through recommending that construction be limited to occur outside of identified natural features.

Potential indirect impacts may also occur as a result of future works through encroachment into natural feature buffers/setbacks, changes to groundwater and surface

water flow patterns, changes to water quality, sedimentation and erosion, and indirect impacts to wildlife.

The proposed works may also potentially impact SAR habitat and/or Significant Wildlife habitats. Consultation with agencies, including GRCA, and MNRF will be required where SAR and/or their habitats are identified to obtain required permits and develop appropriate mitigation measures and any required compensation.

Impacts and detailed mitigation measures will be provided following the analyses of the proposed development and its proximity to any identified natural features and confirmed SAR and associated habitats. Prior to, during and post-construction monitoring may be recommended where impacts are identified and mitigation and/or compensation is required.

It should be noted that the ecological inventory work completed to date was in support of evaluating alternatives and confirming their technical feasibility. Depending on current field conditions at the time of implementation, additional analyses and field investigations may be required to confirm the impacts to the defined natural features and their functions.

12.2.2 Impacts to Aquatic Habitats

Although long-term permanent impacts to aquatic habitats are not expected, through consultation with GRCA, Department of Fisheries and Oceans Canada (DFO) and MNRF, it is anticipated that mitigation measures will be necessary to minimize short term impacts during construction. This will be especially focussed on the required crossing of the Grand River, as well as areas located within floodplains and/or near existing wetlands. Mitigation measures may include:

- Preparation of construction staging, erosion and sediment control plans;
- Development of emergency management plans related to the application of trenchless technologies (eg. frac-out response plan, etc.);
- Restrictions on work to be within accepted MNRF timing windows to avoid impacts to fish species during spawning and nursery periods; and
- Possible fisheries habitat restoration and compensation plan (to replace lost habitat)

DFO's No Net Loss policy requires that an equivalent amount of habitat be replaced for every square metre that is lost. Therefore, compensation planning is specific to each water crossing.

Habitat compensation options must be suited to the aquatic species inhabiting the affected area, and can include the removal of in-water debris, enhancement of substrate, creation of refuge areas, addition of spawning beds, addition of riparian vegetation, etc.

Preference should be given to restoring aquatic habitat to original or better conditions having regard for upstream and downstream habitat, which will promote habitat consistency. Specifically, as potential impacts to SAR mussels in the Grand River are possible, relocation efforts may be employed to minimize impacts to these organisms during the construction phase. DFO has advised however that if in-water work is avoided (i.e. via the use of trenchless technologies), then impacts to mussels should be negligible.

12.2.3 Impacts to Vegetation

Where trees are to be retained, protection fencing must be installed before work begins. A protection fence must be 1.2 m in height; erected on or outside the drip line of the protected tree; and made of (1) plastic snow fencing securely mounted on wooden posts or (2) wooden or chain link fencing mounted on wooden or metal posts. Signage indicating the tree protection zones should be affixed to the fencing approximately every 30 m.

Excavation around the protection fence (to accommodate underground services, footings, etc.) should be done by hand. Trees inside the protection fence should be cared for throughout the construction process (i.e. tree roots must be watered sufficiently, particularly if a portion of the root system has been disturbed by excavation).

In order to minimize root damage, soil erosion, and tree disturbance, a temporary root curtain (i.e. a material that helps retain the roots and soil in place) should be wrapped around the root zone to retain and protect the exposed area. The root curtain should consist of heavy wire mesh or similar material lined with burlap (to retain moisture) and supported by posts. Backfill should be provided as required to ensure that none of the roots are left exposed. Only hand excavation should be used in the root zone area.

The area surrounding the tree should be kept free of construction materials, as well as pedestrian and vehicular traffic, to avoid soil compaction.

12.2.4 Erosion & Sedimentation Control

Areas of highly erodible soils (associated with locations where there is a high potential for sediment discharge to sensitive areas, such as watercourses) will be identified and investigated. An understanding of the local site conditions will then be integrated with the following protection principals to develop an erosion and sediment control plan for the project:

- Apply timing restrictions for work;
- Minimize soil exposure duration;
- Retain existing vegetation, where feasible;
- Encourage re-vegetation;

- Divert runoff away from exposed soil;
- Keep runoff velocities low; and
- Trap sediment as close to the source as possible.

The erosion and sediment control plan will ensure that grading, drainage, and structural operations during construction prevent sedimentation of sensitive areas. Specific items to be incorporated into the plan include:

- Silt fencing should be provided (i.e. according to Ontario Provincial Standard Drawing (OPSD) 219.110) adjacent to construction areas to prevent runoff from migrating toward watercourses within the Study Area.
- Rock checks (OPSD 219.210) or silt fence flow checks (OPSD 219.190) should be placed in all ditches flowing toward watercourses and immediately upstream of their drainage into a watercourse.
- All excavated materials requiring stockpiling should be placed in pre-determined locations. The perimeters of stockpiles should be encircled with silt fencing according to OPSD 219.110.
- All exposed surfaces susceptible to erosion should be re-vegetated through the placement of seeding, mulching or sodding immediately upon completion of construction activities.
- Excess silt fence, straw bales and rip-rap should be maintained on site, prior to the commencement of grading operations and throughout the duration of construction, in case of an emergency (sediment spill, etc.)
- The integrity of all sediment trapping devices should be monitored regularly (weekly and following rain events) and properly maintained. Such structures should be removed only after the soils of the construction areas have been stabilized and then only after the trapped sediments have been removed.
- In addition to the above, standard wetland mitigation measures include:
  - Silt fencing (OPSD 219.110) adjacent to marsh communities; and
  - Silt fencing and/or a barrier for tree protection (OPSD 220.010) adjacent to swamp communities.

12.2.5 Impacts to Local Residents, Traffic & Existing Infrastructure

Although often temporary in nature, the construction of public infrastructure in urban areas will impact the local communities, residents and traffic. To mitigate the undesirable impacts of construction, best management practices should be utilized. Such mitigation measures include:

- Application of trenchless technologies (e.g. micro-tunneling, horizontal directional drilling) to reduce surface disruption and necessary restoration of sensitive areas;

- Shoring of excavations to minimize construction footprints and to avoid adverse impacts to existing infrastructure adjacent to open excavations;
- Development and management of effective traffic safety plans and detours;
- Application of vibration dust control measures;
- Limitations on hours of work to minimize construction noise impacts; and
- Development and management of comprehensive consultation plans to keep affected stakeholders informed and to manage conflicts.

Wherever possible, it is recommended that the proposed works be coordinated / combined with works of other current or planned infrastructure projects.

12.2.6 Property Acquisition

Where proposed infrastructure is required to be placed on lands that are privately owned, property rights and/or easements will need to be acquired from the land owners. Through the Class EA, the need and justification for the works and associated lands provide the Region with the legal ability to acquire the necessary lands. Land acquisition can be achieved through various means, depending on timing and costs. The following approaches are listed in a suggested order of preference:

1. Acquisition of lands through dedication, as part of the appropriate approval process for various development applications (i.e. Section 41 – Site Plan Approval).
2. Acquisition of lands through amenable purchase and sale agreement, subject to negotiations with the land owner and based on fair market value.
3. Acquisition through expropriation.

12.2.7 Compatibility with Adjacent Land Uses

Where the proposed works are to be located on lands that are adjacent to or in close proximity to sensitive neighbouring land uses, efforts must be made to minimize impacts of the proposed works so as to not be detrimental to the existing, adjacent uses. Examples include:

- **Noise / Odour** – Since the preferred solution does not include a pumping station or air/vacuum relief valves, noise and/or odour related to long-term sanitary sewage conveyance are not expected to be an issue. However, during construction, noise and dust control measures should be implemented to minimize the impacts of construction on the adjacent residents and/or businesses.

- **Operational Access** – routes to routinely access the proposed works for operational purposes must maximize use of existing transportation routes (e.g. roads, approved

easements). The majority of the preferred solution's pipeline alignment (Route 'B') is within or in close proximity to publicly owned land.

- **Visual Aesthetics** – The majority of the preferred solution will consist of underground pipes and manhole structures and will not be readily visible from the surface. However, the service bridge crossing the Grand River and the Kitchener WWTP site will present a new and significant feature on the existing landscape. Due to the proposed pipe profile and elevations as well as existing vegetation cover, the service bridge will not be visible from the Deer Ridge residences. It would only be visible from the top edge of the steep Grand River valley slope, from select portions of the Walter Bean Trail, from within river itself, or from within the WWTP property.

  The aesthetic impact (or appeal) of a bridge structure crossing the Grand River is a subjective issue. On one hand a bridge presents the opportunity for artistic expression through the development of a distinct landmark. Conversely, some may prefer to maintain the existing natural vistas clear of any further obstructions by man-made structures.

  While the implementation of a new service bridge crossing the Grand River will most certainly impact the existing vistas, there are opportunities to mitigate those impacts and make the bridge an aesthetically pleasing landmark that compliments and works well with other nearby features such as the historic Pioneer Tower. One such opportunity would be to incorporate the existing high-voltage hydro cables currently crossing over the Grand River into the bridge structure, and possibly burying them as they cross nearby to the Pioneer Tower and through Kuntz Park.

  As noted as part of the Cultural Heritage discussions earlier in this study (refer to section 4.6), the design and material of the proposed service bridge across the Grand River should be suitably designed to minimize visual impacts as much as possible and to be sympathetic to the historical setting and context of the area, specifically the historic Pioneer Tower. Efforts should be made to conserve heritage value and character-defining elements when creating any new additions to an historic place or any related new construction, and any new work should be made physically and visually compatible with, subordinate to, and distinguishable from the historic place.

  To illustrate the impact of the new service bridge across the river, artist renderings of potential design concepts have been prepared and are presented in **Figure 12-2**, **Figure 12-3** and **Figure 12-4**. It can be noted that the concepts are just for illustrative purposes on what the bridge could look like. The preferred look of the bridge will not be finalized until the detailed design stage.

Figure 12-2
Rendering #1 –Steel Truss Bridge

Figure 12-3
Rendering #2 – Modern Arch Bridge

Figure 12-4
Rendering #3 – Steel Truss Bridge with Covered Bridge Exterior

- **Connectivity with Pedestrian Facilities**

  Since the preferred solution includes a bridge crossing of the Grand River, it is reasonable to consider ancillary uses for the bridge structure. Vehicle traffic across the bridge is not deemed to be a viable use as there are not roadways on either side of the river crossing that would warrant being connected.

  Currently, there are multi-use trails that run along both sides of the Grand River in the area of the proposed service bridge crossing. Consideration was given to the potential to connect these two trails by providing pedestrian access across the service bridge. On detailed review, the connection between trails was determined to be both un-necessary and impractical. A pedestrian bridge was recently constructed in 2012, approximately 1 km downstream of the WWTP, that already provides a trail connection across the river. Furthermore, due to the significant elevation difference (approximately 10 m) between the proposed service bridge and the trail on the WWTP side of the river, providing access from the bridge to the trail would require a significant system of stairs and or ramps, and to provide barrier free access would require long ramps and/or an elevator system.

  Another option would be to provide partial pedestrian access from the Deer Ridge side only to a lookout platform somewhere along the middle of the bridge. This could be a desirable amenity and could be implemented in the final design stage. However, adding pedestrian amenities to the bridge would present significant additional capital costs, additional long-term O&M costs as well as added safety concerns related to pedestrians on the bridge.

13 Approval Requirements

Considering the type and nature some of the impacts noted above, approvals for the proposed works will be required. Granting of those approvals by the various agencies will be contingent on the proponent demonstrating that reasonable measures have been taken to avoid and/or mitigate impacts, as appropriate. The following summarizes some of the known approvals that will be required for the implementation of the preferred solution.

13.1 GRAND RIVER CONSERVATION AUTHORITY (GRCA)

Through Ontario Regulation 150/06 (Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulation) made under the Conservation Authorities Act, the GRCA has the authority to regulate activities in natural and hazardous areas (e.g., watercourses, floodplains, wetlands, slopes and shorelines) and their regulated allowances. A permit would be required from the GRCA prior to any future construction, development and/or site alteration within regulated areas.

Furthermore, it is recommended that as part of the detailed design scope of work, additional site visits and field mapping be conducted with the GRCA to confirm the limits of wetlands and other natural features in close proximity to the proposed construction footprint. A scoped Envioronmental Impact Study (EIS) as well as a detailed Geotechnical study and slope stability analysis will also be required at final design. Refer to **Appendix K** and the GRCA's letter of February 28, 2018 outlining their requirements for future works.

13.2 MINISTRY OF NATURAL RESOURCES & FORESTRY (MNRF)

A permit under the Lake and Rivers Improvement Act may be required for any open cut crossings of existing watercourses. Erosion and sediment controls (to be detailed on the engineering drawings submitted to MNRF) will be required prior to any works occurring at the water crossing sites. Details on timing and staging of construction, pumping and dewatering of the work sites (including diversion channels, etc.) will also be required for each crossing. All open cut disturbances will require channel restoration to natural conditions.

Permits related to SAR (Overall Benefit, Section 17 Permit) may be required to conduct work in areas where SAR have been observed and where impacts to these species are unavoidable. Refer to **Appendix K** and the MNRF's letter of February 27, 2018 outlining their requirements for future works.

13.3 DEPARTMENT OF FISHERIES & OCEANS (DFO)

In 2014, the DFO has revised the Fisheries Act, specifically Section 35 that includes a key environmental provision which, prohibited carrying on “any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat” – known as a “HADD” – unless authorized to do so by the Minister or under regulations. This provision was introduced in 1977 and remained essentially the same until the recent amendments. Of particular note is a new paragraph (c), which allows “a prescribed person or entity” to authorize a HADD.

Under the new legislation, it is incumbent upon and within the authority of the proponent to determine whether a HADD actually exists, and therefore whether Authorization from the DFO is required. For this project, and to be conservative, ongoing consultation with the DFO is being recommended to ensure the appropriate measures are taken in relation to any impacts to fish habitat.

13.4 MINISTRY OF THE ENVIRONMENT & CLIMATE CHANGE (MOECC)

Under the Environmental Protection Act and the Ontario Water Resources Act, approvals from the MOECC will be required prior to construction of the proposed works. Specifically, the following approvals will be required:

- MOECC approval and filing of the Class EA Study for trunk sanitary sewer system;
- MOECC Environmental Compliance Approvals for sewage, noise and air.
- MOECC Permit to Take Water (Category 2 or 3) required for any significant dewatering processes required to install the proposed works.

13.5 MINISTRY OF TRANSPORTATION (MTO)

The proposed pipe crossing of Highway 8 requires the review, approval and permits from the MTO prior to any construction taking place, which also includes any additional field investigations that may be required. Open cut crossing of the highway will not be permitted. Appropriate construction staging, traffic control and emergency response plans are required for any work planned within the highway right-of-way limits.

Although the proposed service bridge is not intended to convey traffic, it still must comply with the Canadian Highway Bridge Design Code (CHBDC) (2001), as administered by the MTO. Approval requirements include, but are not limited to:

- Approval of the design criteria.
- Approval of deviations from requirements of the CHBDC (2001), if applicable; and
- Approval of the preliminary and detailed designs, including an appropriate hydrology report (as required).

13.6 MINISTRY OF CULTURE, TOURISM & SPORT (MCTS)

It is an offence under Sections 48 and 69 of the Ontario Heritage Act for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological field work on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeology Reports referred to in Section 65.1 of the Ontario Heritage Act.

Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48 (1) of the Ontario Heritage Act. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with Sec. 48 (1) of the Ontario Heritage Act.

Lands within ten metres of the documented extent of the cemetery require a Cemetery Investigation, in accordance with the regulations under the Funeral, Burial and Cremation Services Act and the Ontario Heritage Act.

As noted in section 4.6, a cultural heritage impact assessment (HIA) should be carried out for BHR 1, CHL 1, CHL 2, and CHL 7. The HIA should follow the Region of Waterloo Implementation Guidelines for Cultural Heritage Landscape Conservation (October 2013). The HIA should also be developed based on the heritage provisions contained in the 2014 Provincial Policy Statement, the Ontario Heritage Act (2005), the Standards and Guidelines for the Conservation of Historic Places in Canada (2010), and the Ministry of Tourism, Culture and Sport's Ontario Heritage Toolkit (2006).

The HIA should include consultation with Parks Canada, MTCS, the Region of Waterloo, and the City of Kitchener to help form appropriate mitigation measures in order to minimize impacts to the resources.

13.7 TRANSPORT CANADA

Transport Canada is responsible for the administration of the Navigable Waters Protection Act (NWPA), which prohibits the construction or placement of any works in navigable waters without first obtaining approval. If any of the related project undertakings cross or affect a potentially navigable waterway, the proponent should prepare and submit an application in accordance with the requirements NPWA.

Transport Canada is also responsible for inspecting and auditing federally regulated railway companies that are subject to the Railway Safety Act. Transport Canada also

regulates some provincial shorelines from the Province of Ontario that are part of an Agreement between the Federal Government and the Province of Ontario. The Railway Safety Act, with related regulations and rules, provides the legislative and regulatory framework for safe railway operations in Canada. The rail safety program develops, implements and promotes safety policy, regulations, standards and research, and in the case of railway grade crossings, subsidizes safety improvements.

14 Anticipated Project Timing and Staging

Based on the scope of work, it is estimated that the detailed design and approvals for the proposed works will take approximately two to three years, including additional investigations, engineering design, property acquisitions and utility relocations. Construction is anticipated to be completed using a multi-stage approach and could potentially be completed within a 2-year time frame. This results in a design and construction duration of approximately five years.

It can be noted that the proposed infrastructure of the preferred solution is intended to service the future development needs of the broader East Side Lands. As such, the timing for implementation of the preferred solution identified herein is subject to the actual rate of development within the East Side Lands.

An interim solution provides sanitary servicing for the Stage 1 lands via treatment at the Preston WWTP. Long-term, the Preston WWTP does not have adequate capacity to treat all flows from the East Side Lands. The Region will continue monitoring to determine when the long-term servicing solution for treatment via the Kitchener WWTP should be implemented. This includes ongoing monitoring of wastewater flows from the East Side Lands area to the Preston WWTP, as well as monitoring development plan approvals.

For budgeting and long-term planning purposes, it is suggested that implementation of the preferred solution be considered to be in the ten to twenty-year time frame.

15 Stakeholder Consultation

15.1 SUMMARY OF STAKEHOLDER ENGAGEMENT

Stakeholder correspondence and communication was a key component of this Class EA Study. At the onset, a Steering Committee was formed, made up of key Region, City, Township and agency staff. A stakeholder contact list was also compiled at the beginning of the project, based on the list from the MESP.

Formal notices of the Study were issued by direct mail and local media, along with additional project update notices during the project. Project team and stakeholder meetings were conducted throughout the duration of the Study, culminating with at Project Consultation Centre in November of 2016.

Table 15-1 summarizes the key points of stakeholder engagement in the project.

A listing of contact info for project stakeholders and for affected and/or interested members of the public is provided in **Appendix I**

15.2 PUBLIC CONSULTATION CENTRE

A formal Public Consultation Centre (PCC) was held on November 8, 2016 at the Deer Ridge Golf and Country Club. Copies of the display boards and information regarding the PCC, as well as summary of comments received and project team responses are provided in **Appendix J.**

15.3 STAKEHOLDER CORRESPONDENCE

Throughout the Study, and subsequent to the recent Public Consultation Centre, formal (written) input from public and agency stakeholders was compiled and documented. Copies of relevant correspondence including formal project notices are provided in **Appendix K.**

On February 28th, 2018 a request for a Part II Order was filed with the MOECC. The Region provided responses to the comments received in the request, which were then reviewed by the Ministry. Notification was provided by the Ministry on October 13, 2018 that the Part II Order request was not granted. The decision was based on careful consideration of the project documentation, the provisions of the Municipal Class Environmental Assessment, the comments received in the request, and relevant matters under the Environmental Assessment Act.

During the review, it was noted that further work is to be completed in the next stages of the project, prior to construction, to fully address comments received. This includes the preparation of both a construction management plan and risk management plan prior to construction. Details regarding these conditions are provided in Appendix K. The Project Team reviewed the conditions and considered them to be reasonable and in good alignment with best management practises.

Table 15-1
Summary of Stakeholder Engagement

EVENT	DATE	ATTENDEES	BRIEF DESCRIPTION
Mtg #3 - Steering Committee Meeting 1	2013/04/17	**Region of Waterloo:** T. Schmidt, J. Cavalcante, N. Kodousek, B. MacKinnon, D. Arsenault **City of Cambridge:** K. Dedman, D. Reid **City of Kitchener:** B. Robinson, S. Allen **Twp of Woolwich:** J. Scarfone, A. Poffenroth, T. Cowan, **GRCA:** B. Brown **AE:** D. Lindner, C. Clark	An introduction of the project team and an overview of the project. A draft of the problem statement and previous relevant studies were reviewed.
Mtg #11 – Grand River Conservation Authority Input	2013/08/13	**GRCA:** B. Brown, T. Zammit **Region of Waterloo:** D. Arsenault **NRSI:** E. Reneker **AE:** D. Lindner	AE provided an overview of the existing conditions and areas contributing to wastewater flows. The potential forcemain routes and pumping station locations were discussed in relation to natural features to identify any GRCA concerns.
Mtg #14 - Steering Committee Meeting 2	2013/09/18	**Region of Waterloo:** T. Schmidt, J. Cavalcante, N. Kodousek, B. MacKinnon, D. Arsenault, K. Dolishny, N. Corbett **City of Cambridge:** S. Austin **City of Kitchener:** S. Allen **Twp of Woolwich:** A. Poffenroth, **GRCA:** B. Brown **AE:** D. Lindner, C. Clark	The meeting began with a brief project overview, with particular focus to the preliminary findings of the Draft Tech Memo #1, including the redefining of the project study boundary. A round table discussion to answer critical questions, including the need for an overflow storage system and which areas should contribute to the initial design flow rates.
Mtg #24 – Department of Fisheries and Oceans/ Ministry of Natural Resources and Forestry/ Grand River Conservation Authority	2014/03/13	**DFO:** D. Balint (via Web) **MNRF:** G. Buck **GRCA:** B. Brown, T. Zammit **NRSI:** E. Renecker, H. Fotherby **Region of Waterloo:** D. Arsenault **AE:** D. Lindner	A review of the project and existing mapping / information. An opportunity for each organization to provide input and voice any concerns regarding environmental features. Discussed next steps regarding the staging of fieldwork needed.

EVENT	DATE	ATTENDEES	BRIEF DESCRIPTION
Mtg #31 - Steering Committee Meeting 3	2014/06/25	**Region of Waterloo:** T. Schmidt, J. Cavalcante, N. Kodousek, B. MacKinnon, D. Arsenault, K. Dolishny, N. Corbett **City of Cambridge:** S. Austin, D. Reid, **City of Kitchener:** S. Allen **Twp of Woolwich:** J. Scarfone, A. Poffenroth, T. Cowan **GRCA:** B. Brown, **AE:** D. Lindner, E. Salieneks	AE provided a PowerPoint presentation to summarize Tech Memo #1 (Base Conditions) and Tech Memo #2 (Alternative Solutions). Next steps involving evaluation criteria for Tech Memo #3 were discussed as well as detailing the upcoming environmental fieldwork needed.
Mtg #36 - Steering Committee Meeting 4	2014/09/25	**Region of Waterloo:** J. Cavalcante, D. Arsenault, B. MacKinnon, K. Dolishny **City of Cambridge:** G. Elliott, S. Austin, D. Reid **City of Kitchener:** S. Allen **Twp of Woolwich:** J. Scarfone **GRCA:** B. Brown, K. Smith **AE:** D. Lindner, D. McBrayne, J. Linton (NRSI), D.Hardy (HSAL)	The purpose of this meeting was to review the contents of Tech Memo #3 and explain the detailed evaluation process to be used for this project, in preparation for the November workshop. NRSI provided an environmental update of their field studies to date.
Mtg #40 – Councillor Gazzola Briefing	2014/10/31	**Region of Waterloo:** N. Kodousek, D. Arsenault **City of Kitchener:** J. Gazzola*, H. Gross, S. Allen **AE:** D. Lindner * Councillor Gazzola was present during the first part of the meeting, not the second part.	Councillor Gazzola was briefed on the development of the Class EA. The scope, history, alternatives and stakeholder involvement was discussed. Immediately following the briefing, a secondary meeting took place where the notion of a trunk gravity sewer as a viable alternative was proposed. Although it was agreed that this was a plausible solution, pursuing a gravity sewer option could require a separate, extensive Class EA Study.
Discussons with Six Nations	April 2016	**Region of Waterloo:** T.Schmidt	
Mtg #47 - Steering Committee Meeting 5	2015/06/22	**Region of Waterloo:** T. Schmidt, J. Cavalcante, K. Dolishny, N. Kodousek, B. MacKinnon, D. Arsenault, T. Brown, N. Corbett **City of Cambridge:** S. Austin, D. Reid, G.Elliott **City of Kitchener:** S. Allen **Twp of Woolwich:** J. Scarfone, M. Martin	Discussion of recent developments including the significant cost variance due to technical challenges with the deep pumping station configuration. The possibility of a gravity sewer solution was identified, along with new

EVENT	DATE	ATTENDEES	BRIEF DESCRIPTION
		GRCA: B. Brown, K. Smith **AE:** D. Lindner, K. Murray	alternatives to consider and an updated project scope / schedule.
Mtg #56 - Grand River Conservation Authority	2016/05/06	**GRCA:** B. Brown, K. Smith, **Region of Waterloo:** J. Cavalcante, N. Ritchie, **AE:** D. Lindner	The primary focus was discussing the issues and concerns the GRCA has with the crossing of the Grand River. Techniques such as open cut, micro-tunnelling and a service bridge were deliberated.
Mtg #58 - Steering Committee Meeting 6	2016/08/23	**Region of Waterloo:** T.Schmidt, N. Kodousek, N. Ritchie, J. Cavalcante, B. MacKinnon, J. Ing, T. Van Hinte, K. Dolishny **Twp of Woolwich:** R. Miller **GRCA:** A. Laven, B. Brown **City of Cambridge:** D. Reid, S. Austin **NRSI:** H. Fotherby **AE:** D. Lindner, A. Connell	All in attendance were provided with a draft of the ESR to prepare comments for the meeting. AE outlined the specific details and changes leading to the simplified evaluation process. General comments and critiques were discussed.
Public Consultation Centre	2016/11/8	**Region of Waterloo:** N. Kodousek, N. Sapeta, J. Cavalcante, K. Dolishny, Moorthy Darmalingum **City of Kitchener:** S. Allen **City of Cambridge:** S. Austin **AE:** D. Lindner, A. Connell	Project information regarding the alternatives, evaluation and the preferred solution were on display and presented to the public. Refer to Appendix I for details.
Consultation with City of Kitchener, MTCS, Parks Canada	July – Sept 2017	**Region of Waterloo** - N. Sapeta **City of Kitchener** – L. Bensasson **MTCS** – J. Muller **Parks Canada** – **ASI** – A. Vieulleux **AE – D. Lindner**	Various emails, telephone conversations and in person meetings to discuss and address comments received for the Cultural Heritage Assessment Report
Discussons with Six Nations	September 2017	**Region of Waterloo:** T.Schmidt	

16 Conclusions and Recommendations

16.1 CONCLUSIONS AND QUALIFICATIONS

1. The Stage 1 Archaeological Assessment determined that ten previously registered archaeological sites are located within one kilometre of the Study Area. A review of the geography of the Study Area suggested that the Study Area has potential for the identification of Aboriginal and Euro-Canadian archaeological resources, depending on the degree to which soils have been disturbed.

   Furthermore, the property inspection determined that some lands within the Study Area possess archaeological potential. These lands require Stage 2 Archaeological Assessment by test-pit survey at five metre intervals. Other lands are determined to possess potential for deeply buried deposits. This potential exists despite some lands being documented to possess conditions which preclude further assessment. These include steeply sloping conditions and previous disturbance.

2. The Cultural Heritage Assessment indicated that the Study Area was originally located within a rural landscape dating back to the late eighteenth century, with major roadways connecting various settlements located in the vicinity of the Study Area. The area has been subject to considerable residential and road development in the early twenty-first century. The field review confirmed that this area retains eight cultural heritage resources.

3. The Geotechnical Investigation completed for this Study included a high level review of previous geotechnical investigations, as well as site specific borehole investigations along the preferred route. The information contained in this Study provides a general indication of subsurface conditions to inform the evaluation process and future design efforts. Additional geotechnical investigation and analysis is required for the detailed design, especially in the context of bridge foundation design, deep excavations and/or trenchless construction.

4. The Ecological Impact Study provides a detailed characterization of existing natural features and habitats that was used to inform an analysis of the significance and sensitivity of natural features within the Study Area. This information was then used to evaluate several alternative routes/locations for the pipeline and conveyance methodologies from a natural heritage perspective. Recommendations for mitigation measures have been proposed to offset negative impacts on the natural environment and species occupying the Study Area. Potential enhancements or compensation measures that can be achieved will be developed through detailed design and permitting.

5. The ultimate design flow rate for the East Side Lands sanitary servicing infrastructure has been determined to be of 627 L/s. This flow rate was calculated based on various assumptions regarding land use and population projections defined in the MESP, and relies on assumptions regarding water usage and conservation, per comments from Regional staff.

6. The Region will be responsible for ownership and maintenance of the sanitary infrastructure between the origin point described in this Class EA (just north of Freeport Creek) and the Kitchener WWTP.

7. Additional studies will be required for infrastructure upstream (north) of the origin point for the East Side Lands trunk (just north of Freeport Creek). An important consideration in determining the approach for the infrastructure upstream of the East Side Lands trunk sewer will be how development progresses.

8. Five alternative pipeline alignments were considered, all of which start at the future North-South Collector Road north of Freeport Creek, and must eventually cross the Grand River to the Kitchener WWTP. Route 'B' has been identified as the preferred alignment for the wastewater pipeline from the East Side Lands to the Kitchener WWTP.

9. Various alternative conveyance methodologies were considered, including pumping station and forcemain configurations, gravity sewers and combinations thereof. Considering that the development of the East Side Lands will likely happen slowly and over a number of decades, the design and operation of a pumping station and forcemain configuration was identified as being particularly problematic, requiring extensive analysis and ongoing system upgrades to accommodate a wide range of flow rates (0 L/s to 627 L/s).

10. All of the alternative solutions considered include a necessary and unavoidable crossing of the Grand River at one of two river crossing locations that were identified in this Study. All of the river crossing options are considered to be similarly invasive and will require mitigation of impacts.

11. A preferred solution has been identified consisting of a gravity sewer only, including a service bridge over the Grand River and part of the Kitchener WWTP site. This solution is deemed to have the least overall impact to the natural and social environments, be the best technical solution from a design, operations and maintenance perspective, and have the lowest overall cost.

12. The timing for construction of the proposed gravity sewer and service bridge is dependent on the actual rate of development within the East Side Lands. It is anticipated that implementation of the preferred solution will be within the ten to twenty year time frame.

13. The scope of this Study, and specifically the preliminary bridge assessment and the geotechnical investigation, were intended to provide a high level assessment for the purposes of confirming feasibility and evaluating alternatives. The proposed bridge option and trenchless options are considered to be technically feasible, noting that specific measures to address the potential slope stability issues will need to be included during the detailed design and construction.

    Specifically, the slope to the west of the Pioneer Tower appears to have already experienced significant surficial failures. Any work completed at the top of this slope as well as the south slope at the Pioneer Tower site may experience failures during construction and appropriate measures will need to be in place to ensure long-term stability of the slope during construction. This may include lengthening of the main span across the river (i.e. to extend beyond the slope setbacks); deepening of the bridge foundation elements (i.e. to extend below the stable slip surface), and/or other remedial works to further stabilize the existing slope.

16.2 RECOMMENDATIONS AND NEXT STEPS

In consideration of all the foregoing, it is recommended that:

1. A comprehensive detailed design assignment be undertaken by the Region for the proposed gravity sewer and service bridge.

2. A detailed slope stability analysis by a qualified geotechnical engineer be completed prior to and in concert with the detailed design for the proposed service bridge. The analysis should include a comprehensive field investigation and appropriate remedial actions to accommodate the bridge foundation elements and associated construction activities, to ensure the long-term stability of the slope and adjacent lands.

3. Future site visit(s) with GRCA staff be undertaken during detailed design to confirm and document the presence/boundary of existing wetland and/or other natural features in the vicinity of the proposed works and the associated construction footprint.

    More specifically, a GRCA permit pursuant to Ontario Regulation 150/06 is required for implementation of the preferred alternative and a more detailed (i.e.

quantitative) assessment of impacts is required by the GRCA. The required permit application should include the following documentation:

d. Scoped Environmental Impact Study (EIS) that addresses GRCA regulatory policies and incorporates and interprets the findings of related studies where required. A detailed Terms of Reference should be submitted to the GRCA for review and comment prior to commencement of fieldwork.

e. A geotechnical investigation that addresses slope stability issues along the Grand River corridor, including a construction site plan that will determine what type(s) of temporary and permanent slope stabilization measures are required (i.e. as recommended in Section 6.2 in **Appendix E** of the ESR). 0.

f. Detailed construction drawings, including: access, staging/sequencing, grading, erosion and sediment control, dewatering, contingency, and emergency response plans.

Furthermore, a self-assessment is recommended to address Federal Fisheries Act and Species At Risk Act requirements. For further details, please consult with Department of Fisheries and Oceans (DFO) directly. Refer to the February 28, 2018 letter from the GRCA (located in **Appendix K**) regarding further requirements and recommendations.

4. Future consultation with MNRF staff be undertaken during detailed design to confirm and further document the presence/boundary of existing natural features in the vicinity of the proposed works and the associated construction footprint. Specifically:

d. The MNRF notes that a Crown Easement under the Public Lands Act (PLA) will likely be required to support the proposed bridge crossing of the Grand River. Please be advised that the review process for an easement application can take some time to complete.

e. The stretch of the Grand River near the proposed bridge crossing is known habitat for aquatic species at risk (e.g. Wavy-Rayed Lampmussel) that are protected under the Endangered Species Act (ESA). If no in-water works will be required to support the bridge construction and appropriate mitigation is implemented (e.g. sedimentation and erosion control), there may be an opportunity to avoid impacts to aquatic species at risk and their habitats. It is recommended that during detailed design an Information Gathering Form (IGF) be completed to address the proposed bridge crossing. The purpose of the IGF is to provide the MNRF with the necessary information to inform

whether or not the proposed activity will likely contravene the ESA, and whether an authorization under the Act may be required.

f. If the servicing will be installed within 50 m of the identified Butternut tree, it is recommended that a Butternut Health Assessment (BHA) be completed during detailed design to inform the potential implications of the ESA.

a. If tree removal in the study area is required when bats are potentially residing in the area, it is recommended that the MNRF be consulted for further advice under the ESA during detailed design.

It is recommended that a Crown Easement application be submitted to the MNRF for review as early as possible in the detailed design phase of the project. To help inform the potential implications of the ESA, it is also recommended that an IGF for aquatic species at risk and a BHA be submitted to the MNRF for review during detailed design. Refer to the March 1, 2018 letter from the MNRF (located in Appendix K) for further details.

5. Where trenchless pipe installation is to be employed, it should be conducted by a contractor who specializes in Trenchless Technology. The subsurface stratigraphy should be further analyzed and considered by the design engineer and bidding contractors when assessing production rates and project costs. It is recommended that the trenchless installation system be left to the contractor's discretion, but the contractor must be required to submit a detailed summary of the procedures for review and approval.

6. Lands within the Study Area that are considered to possess archaeological potential should be subject to Stage 2 Archaeological Assessment by test-pit survey prior to any proposed impacts by the projects.

7. The lands associated with the Doon Pioneer Tower and Cemetery should be subject to Protection and Avoidance from any proposed impacts by the project. Lands within ten metres of the documented extent of the cemetery require Cemetery Investigation, in accordance with the regulations under the Funeral, Burial and Cremation Services Act and the Ontario Heritage Act. The potential exists for Aboriginal human remains within and beyond the cemetery. The Cemetery Investigation should involve engagement with Aboriginal communities to ensure that there are no unaddressed Aboriginal archaeological interests with the cemetery.

8. A cultural Heritage Impact Assessment (HIA) should be carried out for BHR 1, CHL 1, CHL 2, CHL 3, and CHL 7 at the earliest stage possible of detail design. The

HIA will, at a minimum address the various recommendations identified in the CHRA prepared for this EA Study (refer to Section 4.6).

Summarizing, the HIA will confirm the cultural heritage value and cultural heritage attributes of the resources, include evaluation of significant views and vistas, and develop appropriate mitigation measures, including setbacks, vibration analyses and post construction maintenance. As these resources are linked and generally encompassed within the limits of the Pioneer Tower West Cultural Heritage Landscape (CHL 7), all resources should be addressed in one HIA report. The HIA should follow the Region of Waterloo Implementation Guidelines for Cultural Heritage Landscape Conservation (October 2013). The Ministry of Tourism and Culture and Parks Canada should be consulted to help form appropriate mitigation measures in order to minimize impacts to the resources.

9. Any proposed service bridge across the Grand River should be suitably designed to be sympathetic to the historical setting and context of the area. Additionally, the Standards and Guidelines for the Conservation of Historic Places in Canada (2010) recommend general design guidelines in relation to new additions in CHLs, particularly in relation to areas with significant visual relationships, ecological features, or built features. The results of the HIA should help guide the design of any proposed service bridge across the Grand River.
10. In addition to mitigating impacts to important vistas the proposed bridge design should also address public access and safety concerns regarding possible pedestrian use of the structure. Furthermore, considering the proximity of the proposed service bridge to the existing power lines crossing the Grand River, consideration should be given during detailed design to attach or enclose the power lines within the proposed structure.
11. Hydro One has high voltage transmission facilities within the study area that may be affected by the proposed works. Further consultation is required with Hydro One and any design developments should not reduce line clearances or limit access to Hydro One facilities at any time. Any construction activities must maintain the electrical clearance from the transmission line conductors as specified in the Ontario Health and Safety Act for the respective line voltage.

    The integrity of the structure foundations must be maintained at all times, with no disturbance of the earth around the poles, guy wires and tower footings. There must not be any grading, excavating, filling or other civil work close to the structures. Once it is confirmed whether the proposed works will affect Hydro One facilities including the rights of way, submit detailed plans to Hydro One Real Estate Management, 185 Clegg Road, Markham L6G 1B7. Please refer to the February 28, 2018 letter from Liping (Philip) Wu, P.Eng. of Hydro-One (located in Appendix K) for details.

12. A hydrogeological investigation is required to confirm and/or address impacts to the groundwater system and to accurately assess dewatering rates required for construction. Perched groundwater conditions in the saturated sands and gravels above the relatively impermeable glacial till will require dewatering where excavations extend into these deposits. It is envisaged that Category 2 or 3 Permits to Take Water will be needed for sections of the work. In particular, impacts to the private wells within the Grand Hill Drive subdivision must be considered where construction activity and related dewatering may be of impact.
13. A trunk sanitary sewer system Study should be undertaken to identify and confirm the future alignments and depths of the sewers that will connect to and convey flow into the preferred solution of this Study.
14. In response to the requested Part II Order for this project, the Ministry of Environment, Parks & Conservation imposes the following conditions:
    a. Prior to construction, the Region shall prepare a risk management plan to ensure the sewage is not released into the Grand River. This plan shall include information on technical design components, spill response and maintenance.
    b. Prior to construction, the Region shall prepare a construction management plan.
        i. The plan shall include mitigation measures that consider but are not limited to: noise, traffic, and other construction impacts.
        ii. The Region shall hold one public meeting on the plan prior to finalization.
        iii. The plan shall be posted on the Region's website for a minimum of 60 days
    c. Once conditions a. and b. have been satisfied, the Region shall notify in writing the Director of the Environmental Assessment and Permissions Branch.

Respectfully submitted,

Associated Engineering (Ont.) Ltd.

Duane Lindner, P.Eng.
Project Manager

Alannah Connell. B.E.S.
Environmental Technician

Appendix A – Geotechnical Investigation

Alternate formats of this document are available upon request. Please contact Nicole Sapeta at nsapeta@regionofwaterloo.ca, 519-575-4757 ext. 3682, TTY: 519-575-4608 to request an alternate format.

Appendix B – Environmental Impact Study

Alternate formats of this document are available upon request. Please contact Nicole Sapeta at nsapeta@regionofwaterloo.ca, 519-575-4757 ext. 3682, TTY: 519-575-4608 to request an alternate format.

Appendix C - Archeological Assessment

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Appendix D - Cultural Heritage Assessment

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Appendix E – Preliminary Bridge Design Brief

Alternate formats of this document are available upon request. Please contact Nicole Sapeta at nsapeta@regionofwaterloo.ca, 519-575-4757 ext. 3682, TTY: 519-575-4608 to request an alternate format.

Appendix F - Short List of Alternatives - Plan and Profile Schematics

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Appendix G – Cost Estimates

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Appendix H - Impacts & Mitigation Measures (Preferred Solution)

Alternate formats of this document are available upon request. Please contact Nicole Sapeta at nsapeta@regionofwaterloo.ca, 519-575-4757 ext. 3682, TTY: 519-575-4608 to request an alternate format.

Appendix I – Stakeholder Contact Info

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Appendix J - Public Consultation Centre Info

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Appendix K – Relevant Stakeholder Correspondence

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