MUNICIPALITY OF KINCARDINE

WATER AND WASTEWATER MASTER PLAN

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MUNICIPALITY OF KINCARDINE

WATER AND WASTEWATER MASTER PLAN

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LIST OF ABBREVIATIONS

ANSI	Area of Natural and Scientific Interest
ATRIS	Aboriginal and Treaty Rights Information System
BEC	Bruce Energy Centre
BMROSS	B.M. Ross and Associates Limited
BPS	Booster Pumping Station
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
DWWP	Drinking Water Works Permit
EA	Environmental Assessment
EBA	Event Based Area
ECA	Environmental Compliance Approval
ERU	Equivalent Residential Unit
ESR	Environmental Study Report
GIS	Geographic Information System
GUDI	Groundwater Under the Direct Influence of surface water
HSM	Historic Saugeen Métis
HST	Harmonized Sales Tax
HVA	Highly Vulnerable Aquifer
ICI	Institutional Commercial Industrial
IPP	Inverhuron Provincial Park
IPZ	Intake Protection Zone
KDWS	Kincardine Drinking Water System
KSDS	Kincardine Shoreline Distribution System
MDWL	Municipal Drinking Water Licence
MEA	Municipal Engineers Association
MH	Maintenance Hole
MNRF	Ministry of Natural Resources and Forestry
MOECC	Ministry of Environment and Climate Change
MOF	Ministry of Finance
MTO	Ministry of Transportation

PIC	Public Information Centre
PPS	Provincial Policy Statement
PPU	Persons per Unit
PTTW	Permit to Take Water
SGRA	Significant Groundwater Recharge Area
SPS	Sewage Pumping Station
TDWS	Tiverton Drinking Water System
TM	Technical Memo
UV	Ultraviolet
WHPA	Wellhead Protection Area
WTP	Water Treatment Plan
WWTP	Wastewater Treatment Plant

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MUNICIPALITY OF KINCARDINE
WATER AND WASTEWATER SERVICING
MASTER PLAN

EXECUTIVE SUMMARY

ES1.0 INTRODUCTION

The Municipality of Kincardine initiated a Master Plan study to identify the infrastructure needs related to water and wastewater servicing for existing development, as well as future development needs associated with the communities of Kincardine and Tiverton, the Lakeshore area from Inverhuron to West Ridge on the Lake, the Bruce Energy Centre (BEC) industrial lands, and servicing the Bruce Power site. The study is based on projected needs to 2067.

ES2.0 KEY FINDINGS

ES2.1 Growth and Development

Based on information obtained from the 2016 Census, it was determined that the current (2016) population of the Municipality of Kincardine is approximately 11,389.

Analysis of existing development and customer information established that the following values apply to each major development area as of 2016:

- Kincardine (Town)
  - 2.31 persons per dwelling
  - Population of 8,315
  - 4,114 households and 3,595 occupied dwellings
- Tiverton
  - 2.19 persons per dwelling
  - Population of 725
  - 384 households and 330 occupied dwellings
- Lakeshore Area
  - 2.30 persons per dwelling
  - Population of 1,439
  - 996 households and 625 occupied dwellings

A number of growth forecast sources were consulted, including the Ministry of Finance, Kincardine Development Charges, and the Municipal Official Plan. Where necessary, growth projections were extrapolated from current forecast limit to year 2067. Table ES2.1 summarizes the population growth forecast results.

Table ES2.1: Summary of Population Growth Projections to 2067

Forecast Methodology	Kincardine (Town)	Tiverton	Lakeshore
Existing (2016)	8,315	725	1,439
Ministry of Finance	9,362	816	1,620
Development Charges	11,730	1,023	2,031
Official Plan – Low Growth	18,915	1,364	3,124
Official Plan – High Growth	22,509	1,544	3,511

ES2.2 Equivalent Residential Units

Water and wastewater servicing is expressed in terms of Equivalent Residential Units (ERUs). The table below summarizes the current ERUs, and development commitments relevant to each of the major water and wastewater treatment facilities included in the Master Plan.

Table ES2.2: Current ERUs and Commitments for Treatment Facilities

Facility Description	General Service Areas	Existing ERUs Serviced	Commitments as ERUs
Kincardine Water Treatment Plant	Kincardine (Town), Huronville area of Township of Huron-Kinloss, Lakeshore, Inverhuron	4,244	1,340
Tiverton Water Supply and Treatment	Tiverton	394	30
Kincardine Wastewater Treatment Plant	Kincardine (Town), Huronville area of Township of Huron-Kinloss	3,945	1,140
BEC Wastewater Treatment Plant	BEC Industrial Park, Inverhuron, Tiverton	477, plus 6 industrial services	1,005

It is anticipated that non-residential growth, and related water demands and wastewater flows, will generally occur in proportion to residential growth. An exception to this assumption relates to BEC WWTP customer growth, which may have significant industrial customer growth that is not linked to residential growth, and was therefore analyzed independently.

ES2.3 Kincardine Water System

ES2.3.1 Treatment Capacity

The Kincardine Water Treatment Plant (WTP) has a rated capacity of 11,563 m^3/day. Water is supplied to a single pressure zone.

The existing maximum day demand is estimated to be 6,965 m^3/day, which corresponds to 1.64 m^3/day/ERU. The plant has an estimated uncommitted reserve capacity for 1,463 ERUs. Using the highest growth rate considered in the Master Plan, additional supply and treatment capacity would be required by 2032 if including a future reserve for the same number of commitments that is currently assumed to apply.

At this time there is no immediate need to consider further expansion of the Kincardine WTP. A Class EA related to a new north WTP is currently underway, primarily driven by potential interest from Bruce Power to be serviced by Municipal water. If a new WTP proceeds to construction, it may be connected to the existing Kincardine Drinking Water System (KDWS) with the opportunity to augment supply.

ES2.3.2 Water Storage

There is currently approximately 7,370 m^3 of total water storage capacity, provided by a combination of the WTP reservoir and the Kincardine standpipe. Of this, approximately 3,221 m^3 is readily available for use (i.e. effective volume). Ministry of Environment and Climate Change (MOECC) Design Guidelines recommend 4,703 m^3 of water storage for the current service population, therefore there is currently a water storage deficit. Surplus available treatment and pumping capacity at the WTP currently augments storage, but the opportunity to do this will diminish as system demand increases.

It is recommended that disinfection process modifications at the WTP, and rehabilitation of the booster pumping station (BPS) at the standpipe be carried out to make the current total volume available for use. Using the highest growth rate considered in the Master Plan, this would provide adequate storage to 2031.

Future additional water storage should be considered. At this time, a recommended location for a new facility is generally north of the existing urban limit on Gary Street, generally as far north and east as development is planned at that time. Infrastructure in that general vicinity would be subject to height restrictions due to the Municipal airport.

ES2.3.3 Water Distribution

A WaterCAD® model of the distribution system was developed and used to identify potential flow and pressure issues. The existing system is a single pressure zone, and the future system was modeled on the basis of a new BPS at the north end of Gary Street and associated trunk watermain upgrades being complete, as this work is planned for 2018, which will create a second pressure zone. Key findings are:

Some locations (1.5% of system) may experience pressures above the MOECC recommended maximum of 700 kPa when WTP high lift pumps are in operation. These locations are generally limited to the north and south lakeshore areas adjacent to the WTP.

Some residential locations (1% of system) have fire flows less than the 40 L/s criteria used in the Master Plan. These are generally along the lakeshore, north of the community of Kincardine, and at the end of dead-end watermain. These could be addressed by watermain improvements in conjunction with development or road reconstruction.

ES2.4 Tiverton Water System

ES2.4.1 Treatment Capacity

The Tiverton water supply and treatment facilities consist of three wells and two pumphouses, with a combined rated capacity of 774.66 m^3/day in the Permit to Take Water (PTTW). The Municipal Drinking Water Licence (MDWL) states a rated capacity of 1,114.56 m^3/day, but currently the PTTW value governs.

The existing maximum day demand is estimated to be 659 m^3/day, which corresponds to 1.67 m^3/day/ERU. The supply has an estimated uncommitted reserve capacity for 39 ERUs. Using the highest growth rate considered in the Master Plan, additional supply and treatment capacity would be required by 2023 if including a future reserve for the same number of commitments that is currently assumed to apply.

At this time it is recommended that supply capacity be increased. This should initially involve engaging a hydrogeologist to assist with reviewing the basis for the PTTW rated capacity and making a determination as to whether or not a re-rating is possible.

ES2.4.2 Water Storage

There is currently 1,500 m^3 of total water storage capacity within the Tiverton standpipe. Of this, approximately 350 m^3 is effective volume. MOECC Design Guidelines recommend 654 m^3 of water storage for the current service population, therefore there is currently a water storage deficit.

It is recommended that rehabilitation of the BPS at the standpipe be carried out in order to make the current total volume available for use. To do so would provide adequate effective storage volume beyond 2067 for all growth rates considered in the Master Plan.

ES2.4.3 Water Distribution

A WaterCAD® model of the distribution system was developed and used to identify potential flow and pressure issues. Key findings are:

Several locations (26% of system) have fire flows less than the 40 L/s criteria used in the Master Plan with the well pumps off. The majority are in the northern part of the community, and others are at the ends of small diameter watermain dead-ends. Flow to the northern part of the community could be improved by construction of a parallel or larger diameter watermain along King Street, north of Stanley/Cameron Streets.

ES2.5 Kincardine Wastewater System

ES2.5.1 Wastewater Flows

The Kincardine wastewater system currently experiences average day wastewater flows estimated to be 3,811 m^3/day, which corresponds to 0.97 m^3/day/ERU. A maximum day factor of approximately 4 has been observed based on Wastewater Treatment Plant (WWTP) flows.

ES2.5.2 Collection System

SewerCAD® models of the six major Sewage Pumping Station (SPS) catchment areas were developed and used to identify potential sanitary sewage pipe capacity issues. The SPSs were also evaluated based on a comparison of current rated capacities to estimated current and future peak flows. All collection system analysis was carried out on the basis of full development of the SPS catchment areas. Key findings for each SPS are:

- Connaught Park SPS:
    - The SPS and key trunk sewer are to be replaced in 2018. There are no further upgrades within the catchment area recommended at this time.
- Durham Street SPS:
    - Sanitary sewer upgrades on Gary Street, Sutton Street, Mechanics Avenue, and James Street are planned for 2018, in relation to the proposed development north of Gary Street; and
    - The existing SPS rated capacity is 27 L/s, while future peak flow is estimated to be 120 L/s. It is recommended that further station testing be carried out, and an assessment of pump replacement options be completed in relation to increasing station capacity.
- Huron Terrace SPS:
    - The future catchment area expansion includes relatively large land areas north of the existing urban boundary, up to Concession 5. It may take many years for development in these lands to significantly affect flows;
    - Sanitary sewer upgrades on Durham, Queen, and Kingsway Streets will be required for servicing future development. At this time there is likely no urgency associated with the upgrades, and they should be carried out as part of road reconstruction projects or as development warrants; and
    - The existing SPS rated capacity is 115 L/s, while future peak flow is estimated to be 439 L/s. It is recommended that forcemain replacement be considered as a means to increase station capacity, which would not fully accommodate future design flow but would gain years of capacity.
- Park Street SPS:
    - Sanitary sewer upgrades on Russell Street were recommended in the Kincardine Business Park Servicing Master Plan; and
    - The Business Park Master Plan also identified SPS pump replacement as the preferred method for increasing station rated capacity. The existing rated capacity is 99 L/s, while future peak flow is estimated to be 195 L/s.
- Goderich Street SPS:
    - The existing SPS rated capacity is 46 L/s, while future peak flow is estimated to be 63 L/s. There is currently not a need to increase station capacity.

- Kincardine Avenue SPS:
  - The existing SPS rated capacity is 49 L/s, while future peak flow is estimated to be 64 L/s. There is currently not a need to increase station capacity.

ES2.5.3 Treatment Capacity

The Kincardine WWTP has a rated capacity of 5,910 m^3/day. The plant has an estimated uncommitted reserve capacity for 1,024 ERUs. Using the highest growth rate considered in the Master Plan, additional treatment capacity would be required by 2028 if including a future reserve for the same number of commitments that is currently assumed to apply.

At this time there is no immediate need to consider further expansion of the Kincardine WWTP. It is recommended that the reserve capacity calculations be reviewed 5 years following completion of this Master Plan, and the potential need to expand the WWTP be reconsidered.

ES2.6 BEC & Service Area Wastewater Systems

ES2.6.1 BEC WWTP Wastewater Flows

The BEC WWTP services the BEC industrial lands, IPP, a portion of the Inverhuron community, and Tiverton. The BEC WWTP currently experiences average day wastewater flows estimated to be 805 m^3/day, which corresponds to 0.72 m^3/day/ERU for residential and small commercial customers, and 20.9 m^3/day/hectare for industrial lands. A maximum day factor of approximately 4.9 has been observed.

ES2.6.2 Tiverton Collection System

A SewerCAD® model including both SPS catchment areas was developed and used to identify potential sanitary sewage pipe capacity issues. The SPSs were also evaluated based on a comparison of current rated capacities to estimated current and future peak flows. All collection system analysis was carried out on the basis of full development of the SPS catchment areas. Key findings for each SPS are:

- King Street SPS:
  - Sanitary sewer and SPS rated capacity are considered adequate for future flows.
- Maple Street SPS:
  - The SPS was originally designed for ultimate flow conditions similar to the currently projected peak flow, but initially equipped with pumps for shorter term capacity requirements; and
  - The existing SPS rated capacity is 30 L/s, while future peak flow is estimated to be 71 L/s. It is recommended that further station testing be carried out, and an assessment of pump replacement options be completed in relation to increasing station capacity.

ES2.6.3 Treatment Capacity

The BEC WWTP has a rated capacity of 2,200 m^3/day. The plant has an estimated uncommitted reserve capacity for 932 ERUs. Using the highest growth rate considered in the Master Plan, additional treatment capacity would be required by 2038 if including a future reserve for the same number of commitments that is currently assumed to apply.

It is noted that there is significant development potential associated with the BEC and Concession 2 industrial lands. BEC lands have been considered as commitments, while the Concession 2 lands would have a future design flow value in excess of 4,000 m^3/day based on current BEC values. Additionally, Bruce Power has expressed interest in becoming a customer with estimated requirements for up to 1,500 m^3/day capacity. A Class EA related to expansion of the BEC WWTP is currently underway.

ES3.0 RECOMMENDED WORKS AND ACTIVITIES

The following table summarizes the recommended servicing improvements, any EA requirements, and additional work that may be required in relation to implementation of works related to future servicing.

Table ES3.1: Summary of Recommended Works

Project	Description	Probable Cost (2018 $)[1]	EA Requirements	Timing
Kincardine Drinking Water System				
Modify WTP Disinfection Process	Convert primary disinfection to UV process, allowing volume currently used for chlorine contact to be available for customer use	$1,000,000	Schedule A	Within next 5 years.
Rehabilitate Standpipe BPS	Rehabilitate BPS by installing new booster pump, standby diesel generator and controls	$450,000	Schedule A	Within next 5 years.
Trunk Watermain Upgrades – Sutton St; Russell St., Kincardine Ave.	Trunk watermain upgrades to support future development	$2,100,000	Schedule A+	2018
Gary Street Booster Pumping Station	Booster Pumping Station will be required to service lands north of Gary Street.	BPS funded by Developer	Schedule A - completed as part of site plan, consent, or plan of subdivision.	2018

Table ES3.1: Summary of Recommended Works

Project	Description	Probable Cost (2018 $)[1]	EA Requirements	Timing
Tiverton Drinking Water System				
Review of PTTW and MDWL	Engage a hydrogeologist to investigate discrepancy between the PTTW and MDWL, and potential rerating	$10,000	Not Applicable	Within next 3 years
Rehabilitate Standpipe BPS	Rehabilitate BPS by installing new booster pump, standby diesel generator and controls	$425,000	Schedule A	Within next 5 years
King St. Watermain	Parallel or replace existing watermain to improve fire flow to north	$475,000	Schedule A+	In response to development needs or in conjunction with planned road reconstruction.
Kincardine Wastewater System				
Durham Street SPS Upgrades	Durham Street SPS – pump replacement design and approvals	$60,000	Schedule A+	2018
Huron Terrace SPS Upgrades	Huron Terrace SPS – forcemain replacement design and approvals	$80,000	Schedule A+	2018
Park Street SPS Upgrades	Park Street SPS – pump replacement design and approvals	$60,000	Schedule A+	2018
SPS and WWTP Control Upgrades	Provision of SCADA for WWTP and SPSs	$800,000	Schedule A	At discretion of Municipality

Table ES3.1: Summary of Recommended Works

Project	Description	Probable Cost (2018 $)[1]	EA Requirements	Timing
Durham St. Sewer Upgrades	Sewer upgrades on Durham Street, to accommodate future Durham Street SPS flows	$450,000	Schedule A+	In response to development needs or in conjunction with planned road reconstruction
Queen St. and Kingsway Street Sewer Upgrades	Sewer upgrades on Queen Street North and Kingsway Street, to accommodate future development north of the existing Huron Terrace SPS catchment area	$850,000	Schedule A+	In response to development needs or in conjunction with planned road reconstruction
Russell St. Sewer Upgrades	Sewer upgrades on Russell Street, to accommodate future Business Park development flows	$800,000	Schedule A+	In response to development needs or in conjunction with planned road reconstruction
Gary St., Sutton St., Mechanics Ave. and James St. Sewer Upgrades	Sewer upgrades on Gary Street, Sutton Street, Mechanics Avenue, and James Street, to accommodate future development north of Gary Street	$1,700,000	Schedule A+	2018
BEC and Service Area Wastewater Systems				
Maple Street SPS Upgrades	Maple Street SPS – pump replacement design and approvals	$40,000	Schedule A+	Within next 5 years
SPS Control Upgrades	Provision of SCADA for WWTP and SPSs	$300,000	Schedule A	At discretion of Municipality

[1]The following assumptions and limitations relate to the probable costs shown:

- All costs should be considered as order of magnitude, ±25%.
- All costs exclude HST.

- Construction items include construction and engineering.
- Costs related to watermain or sanitary sewer construction are related to the specific utility considered and restoration only. No cost has been included for other infrastructure replacement, curb and gutter, or full road reconstruction, which the Municipality may elect to do as part of a watermain replacement project.
- SCADA costs are estimates only based on similar projects in similar communities, without detailed review and preliminary assessment of facilities included in this Master Plan.

ES4.0 CONSULTATION

The consultation program developed for this study was directed towards stakeholders, adjacent property owners and provincial review agencies. Comments received during the public meeting generally focused on infrastructure needs to allow development as well as dealing with risks in existing service areas.

1.0 INTRODUCTION

1.1 Study Objectives

The Municipality of Kincardine initiated a Master Plan to identify infrastructure requirements associated with the existing water treatment, storage, and distribution and wastewater collection and treatment systems to support existing and proposed growth within the Municipality. The Water and Wastewater Servicing Master Plan will establish a framework for servicing needs for the following areas within the Municipality of Kincardine: the Bruce Energy Centre Industrial Park, Concession 2 Industrial Lands, Tiverton, the Town of Kincardine, and the lakeshore area west of Bruce Road 23, including Inverhuron to the north end of the Town of Kincardine.

The purpose of this Master Plan study is to document the investigations completed related to existing and future infrastructure needs and to identify the timing and sequence of future infrastructure improvements or expansions. This Master Plan provides a broad assessment of the existing water and wastewater systems and will serve as a long-term tool to support water and wastewater infrastructure planning activities within the Municipality of Kincardine.

This report documents the Master Plan process followed and includes the following major components:

- An overview of the study context and related previous studies;
- A description of the general area considered as part of this Master Plan;
- A review of potential growth and development within the Municipality of Kincardine;
- Assessments of the existing water systems; including analyses of capacity, storage and the distribution systems;
- Assessments of the existing wastewater systems; including analyses of flows, future demands, treatment plants and collection systems;
- Identification of future water and wastewater infrastructure projects and projected costs;
- A synopsis of the consultation undertaken; and
- A recommended servicing strategy that identifies potential timing and costs and additional studies required.

The Servicing Master Plan established through this process sets out a long-term strategy for water and wastewater infrastructure within the Municipality. In this regard, the Master Plan will become the basis for, and used in support of future investigations for specific projects required to implement this strategy.

1.2 Municipal Class Environmental Assessment Process

The Municipality of Kincardine Water and Wastewater Servicing Master Plan has been completed in accordance with the planning and design process of the Municipal Class Environmental Assessment (Class EA). The Class EA, which includes Master Plans, is an approved planning document that describes the environmental assessment process that proponents must follow in order to meet the requirements of the Environmental Assessment Act (EA Act) (Municipal Engineers Association, 2000).

The Class EA process is divided into five phases, which are described below and illustrated in Figure 1.1:

Figure 1.1: Municipal Class Environmental Assessment Process

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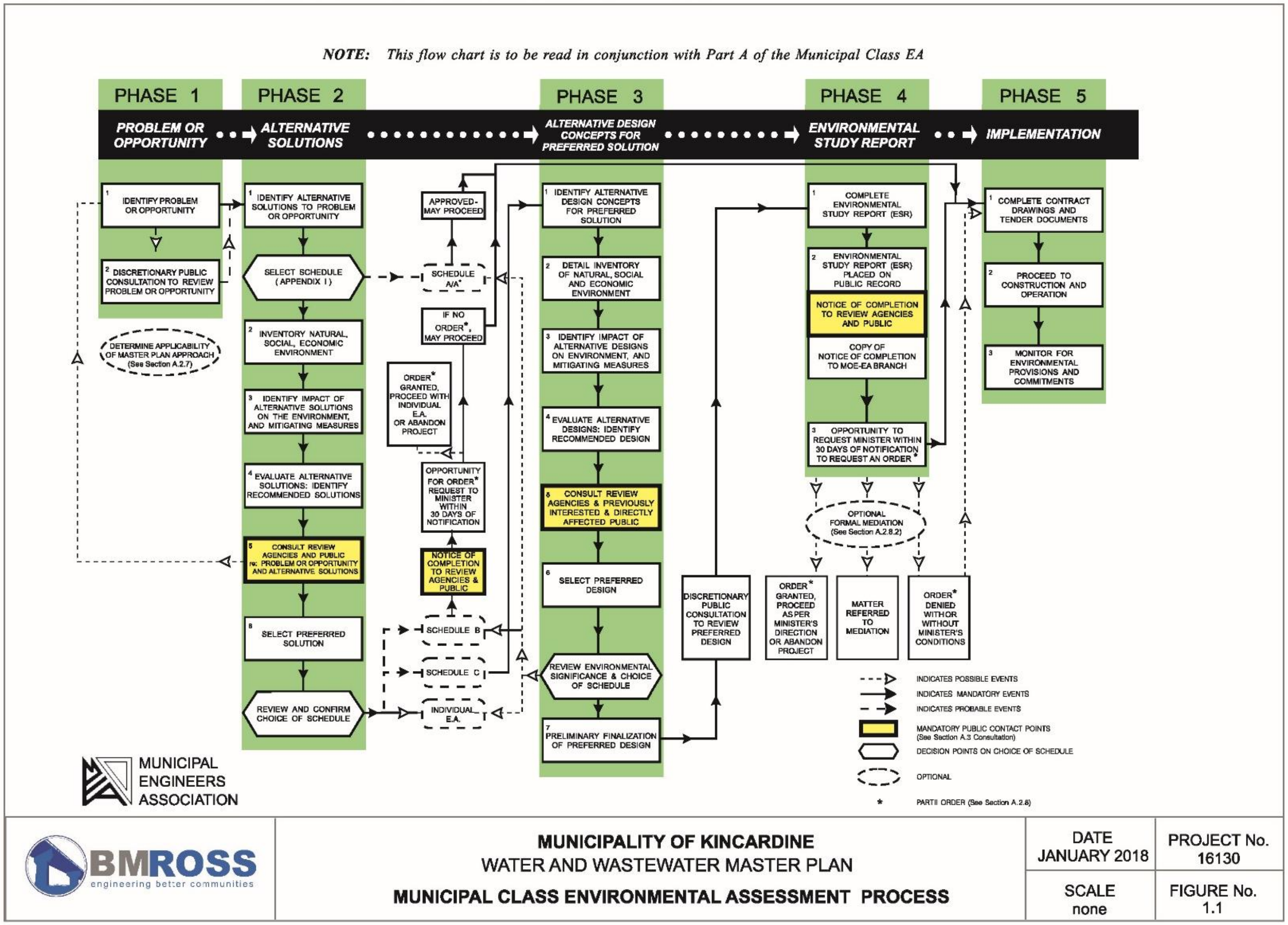


- Phase 1 – Problem and/or opportunity identification;
- Phase 2 – Evaluation of alternative solutions to the defined problems/opportunities and a selection of a preferred solution;
- Phase 3 – Identification and evaluation of alternative design concepts in selection of a preferred design concept;
- Phase 4 – Preparation and submission of an Environmental Study Report (ESR) for public and government agency review; and
- Phase 5- Implementation of the preferred alternative and monitoring of any impacts.

Under the Class EA, projects are classified to different project schedules according to the potential complexity and the degree of potential environmental impacts that could be associated with the project. There are four levels of schedules:

- Schedule A – Projects that are approved with no need to follow the Class EA process;
- Schedule A+ - Projects that are pre-approved but require some form of public notification;
- Schedule B – Projects that are approved following the completion of a screening process that incorporates Phases 1 and 2 of the Class EA processes, as a minimum; and
- Schedule C – Projects that are approved subject to following the full Class EA process.

The Class EA process is self-regulatory, and municipalities are expected to identify the appropriate level of environmental assessment based upon the projects they are considering.

1.3 Master Plans

Master Plans are long range plans that, through the Class EA process, integrate infrastructure requirements for existing and future land uses with environmental assessment planning principles (Municipal Engineers Association, 2000). These types of plans are often used when considering a group of related projects or integrated systems, such as water and wastewater infrastructure systems, and allow needs to be defined over a broader context, such as large geographic area. Master Plans typically exhibit the following characteristics:

- Address the key principles of successful environmental planning;
- Provide a strategic level of assessment of various options to better address overall system needs, potential impacts and mitigation;
- Address at least the first two phases of the Municipal Class EA process;
- Allow for an integrated process with other planning initiatives;
- Are generally long-term in nature;
- Apply a system-wide approach to planning, that related infrastructure either geographically or by a particular function;
- Recommend an infrastructure servicing plan, which can be implemented through the completion of separate projects; and
- Include a description of the specific projects needed to implement the Master Plan.

1.4 Master Plan Approaches

The Class EA document provides proponents with four approaches for conducting Master Plan investigations, given the broad nature and scope of these types of studies. Proponents are encouraged to adapt and tailor the Master Plan process to suit the needs of the study being undertaken, provided that at a minimum, the assessments involve an evaluation of servicing deficiencies followed by a review of possible solutions (that is, Phases 1 and 2 of the Class EA process).

Table 1.1 summarizes the primary components associated with the four Master Plan approaches that are outlined within the Municipal Class EA document.

Table 1.1: Summary of Master Planning Approaches

Approach	Key Characteristics	Project Implementation
1	• Master Plan prepared at the conclusion of Phases 1 and 2 of the Class EA process. • A broad-level assessment. • Serves as a basis for future investigations associated with specific Schedule B and C projects.	• Schedule B and C projects require further Class EA investigations.
2	• Master Plan prepared at the conclusion of Phases 1 and 2 of the MEA Class EA process. • More detailed level of investigation and consultation completed, such that it satisfies requirements for Schedule B screenings. • Final public notices for Master Plan serves as Notice of Completion for individual Schedule B projects.	• Schedule B projects are approved. • Schedule C projects must complete Phases 3 and 4 of the Class EA process.
3	• Master Plan prepared at the conclusion of Phase 4 of the Class EA process. • The level of review and consultation encompasses Phases 1 to 4 of the Class EA process. • Final public notice for Master Plan serves as Notice of Completion for Schedule B and C projects reviewed through the Master Plan.	• Class EA investigations are not required for projects reviewed through the Master Plan.
4	• Integration of Master Plan with associated Planning Act approvals. • Establishes need and justification in a very broad context. • Best suited when planning for a significant geographical area in the long term.	• Depending on the level of investigation associated with the Master Plan, Class EA investigations may be required for specific projects.

For the purposes of the Municipality of Kincardine Water and Wastewater Servicing Master Plan, it was determined during the course of investigations that Approach 1 would be the most appropriate Master Plan framework to utilize for this assessment. This Master Plan will document the processes followed to complete Phases 1 and 2 of the Municipal Class EA process and will identify projects that require further Class EA investigations.

The decision to apply Approach 1 for this Master Plan was based upon the following rationale:

- The level of review and consultation completed in conjunction with the Master Plan was not sufficient to satisfy the Class EA;
- The scope of the study is broad, both spatially and temporally and does not include site specific studies or investigations that may be required for individual projects; and
- This study is intended to serve as a strategy for planning infrastructure growth and improvements in the future.

Upon completion, this Master Plan document will form the basis for any additional assessments required in support of the Schedule B or Schedule C projects identified as part of the preferred infrastructure plan.

1.5 Approval Requirements

The Master Plan is subject to approval from the Municipality of Kincardine but does not require formal approval under the EA Act. The Master Plan will be made available for public review. Subject to consideration of the proposed works and any comments received during the public review period, the Master Plan will be approved by Municipal Council.

Schedule B or C projects identified within the Master Plan will be subject to additional review through subsequent Class EA processes. If significant environmental impacts are identified during subsequent Class EA processes to implement Schedule B or C projects specified within the Master Plan, a person/party may request that the Municipality of Kincardine voluntarily elevate the project(s) to a higher level of environmental assessment. If the proponent declines, or if it is believed that the concerns are not properly dealt with, any individual or organization has the right to request that the Minister of the Environment make an order for the project(s) to comply with Part II of the EA Act which addresses individual environmental assessments. This request must be submitted to the Minister within 30 days of the publication of the Notice of Completion of the Class EA process for the specific project.

2.0 STUDY CONTEXT

2.1 Existing Water Infrastructure

2.1.1 Kincardine Drinking Water System

The Kincardine Drinking Water System (KDWS) services approximately 3,300 connections within the former Town of Kincardine, the Huronville area in the northwestern area of the Township of Huron-Kinloss, and the Kincardine Shoreline Distribution System (KSDS). Detailed descriptions of the principal treatment, storage, and distribution infrastructure are provided within section 7.2 of this Master Plan, and generally shown on Figures 2.1 and 2.2.

2.1.2 Tiverton Drinking Water System

The Tiverton Drinking Water System (TDWS) services approximately 320 connections within the community of Tiverton. Detailed descriptions of the principal treatment, storage, and distribution infrastructure are provided within section 7.3 of this Master Plan, and generally shown on Figure 2.3

Figure 2.1: Kincardine Drinking Water System

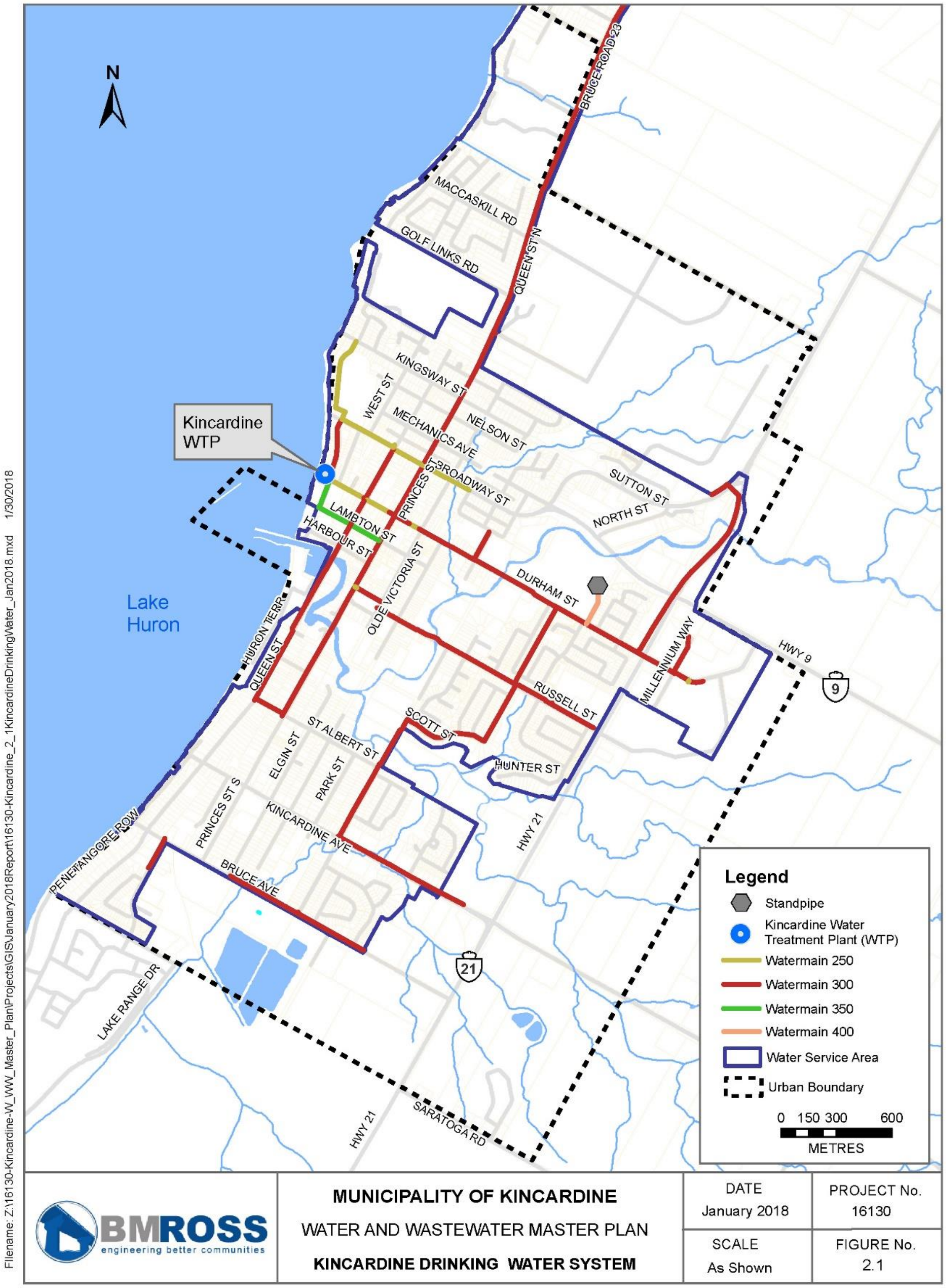
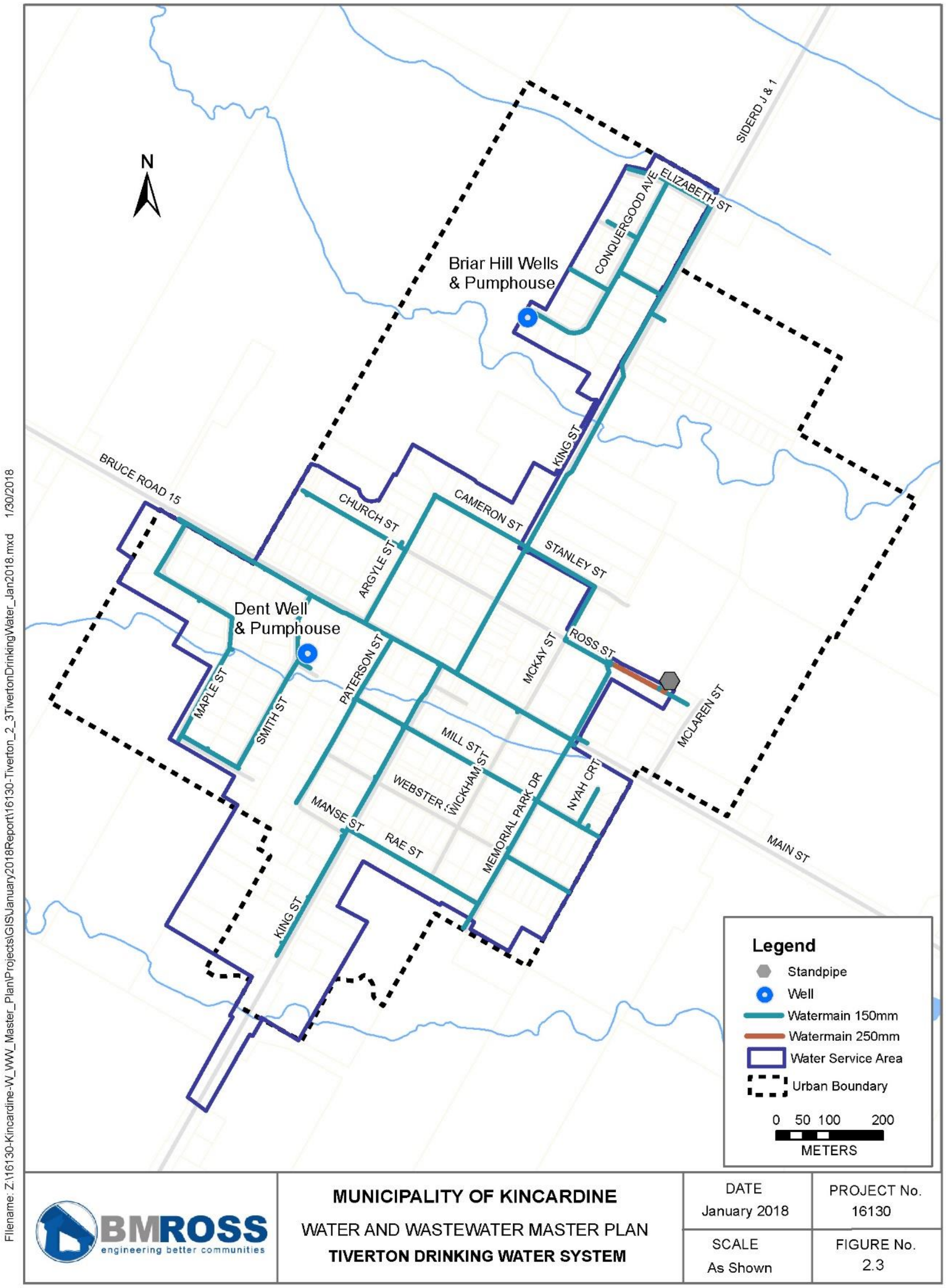


Figure 2.2: Kincardine Shoreline Distribution System

Figure 2.3: Tiverton Drinking Water System



2.2 Existing Wastewater Infrastructure

2.2.1 Kincardine Wastewater Treatment and Collection System

The Kincardine Wastewater Treatment and Collection system services the former Town of Kincardine and Huronville subdivision in the northwestern area of the Township of Huron-Kinloss. The extent of the wastewater collection system is shown in Figure 2.4, and detailed descriptions of the principal collection and treatment infrastructure are provided within section 8.2 of this Master Plan.

2.2.2 Tiverton Wastewater Collection System

The Tiverton Wastewater Collection system services the community of Tiverton. The extent of the wastewater collection system is shown in Figure 2.5, and detailed descriptions of the principal collection infrastructure are provided within section 8.3 of this Master Plan.

2.2.3 Bruce Energy Centre Wastewater Treatment System

The Bruce Energy Centre (BEC) Wastewater Treatment Plant (WWTP) services the BEC Industrial Park, Inverhuron, Tiverton and Inverhuron Provincial Park (IPP). The WWTP location is shown in Figure 2.6, and a detailed description of the treatment infrastructure is provided within section 8.3 of this Master Plan.

2.3 Past Studies and Investigations

The Municipality has undertaken numerous studies and investigations relating to water and wastewater, growth and long-term infrastructure planning in recent years. These studies include:

- Class Environmental Assessment for Extension of Municipal Water and Sanitary Sewer Servicing for the Community of Inverhuron;
- Class Environmental Assessment for Connaught Park Area Sewage Upgrades;
- Kincardine Business Park Servicing Master Plan;
- Asset Management Plan for the Municipality of Kincardine; and
- Kincardine Municipal Airport – Airport Strategic Plan;

The Water and Wastewater Servicing Master Plan will incorporate and build on the findings of these previous studies. The Master Plan includes an examination of potential growth and development in order to develop a servicing strategy that includes future infrastructure expansions in conjunction with existing constraints and opportunities. This approach will provide a plan that can be used to identify, plan and prioritize infrastructure investments to ensure water and wastewater services are expanded and improved efficiently and effectively.

Figure 2.4: Kincardine Wastewater Treatment and Collection System

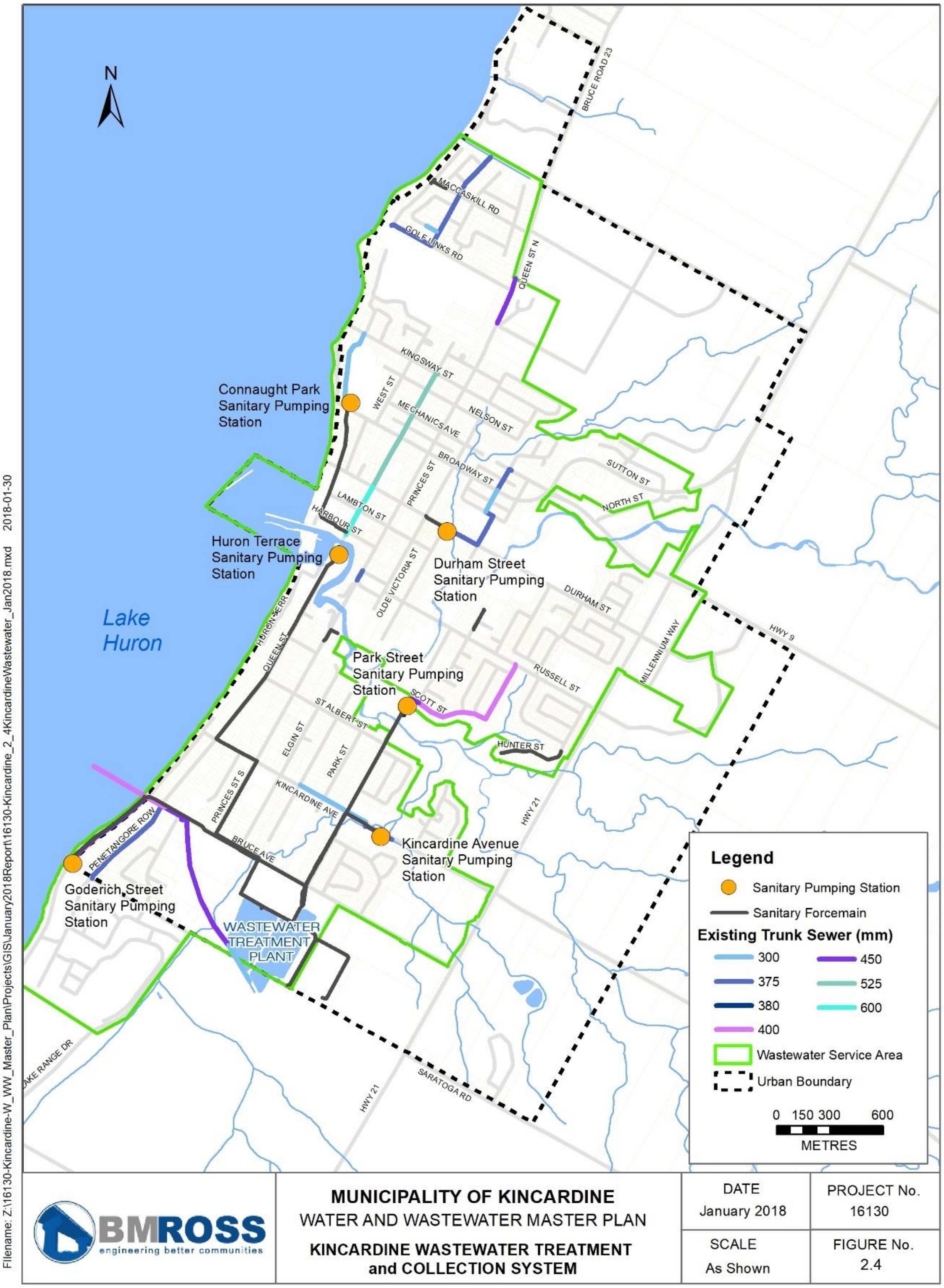


Figure 2.5: Tiverton Wastewater Collection System

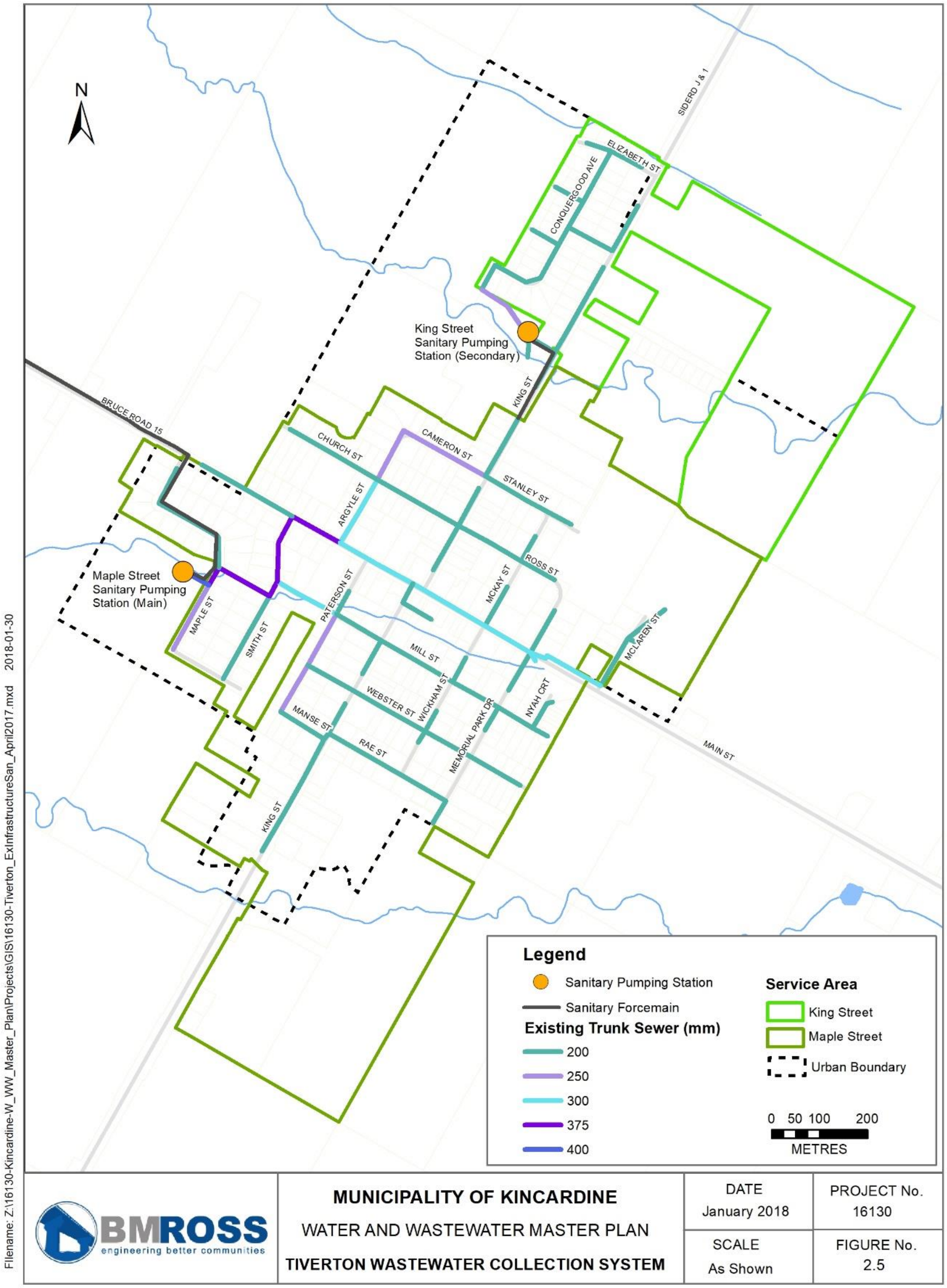
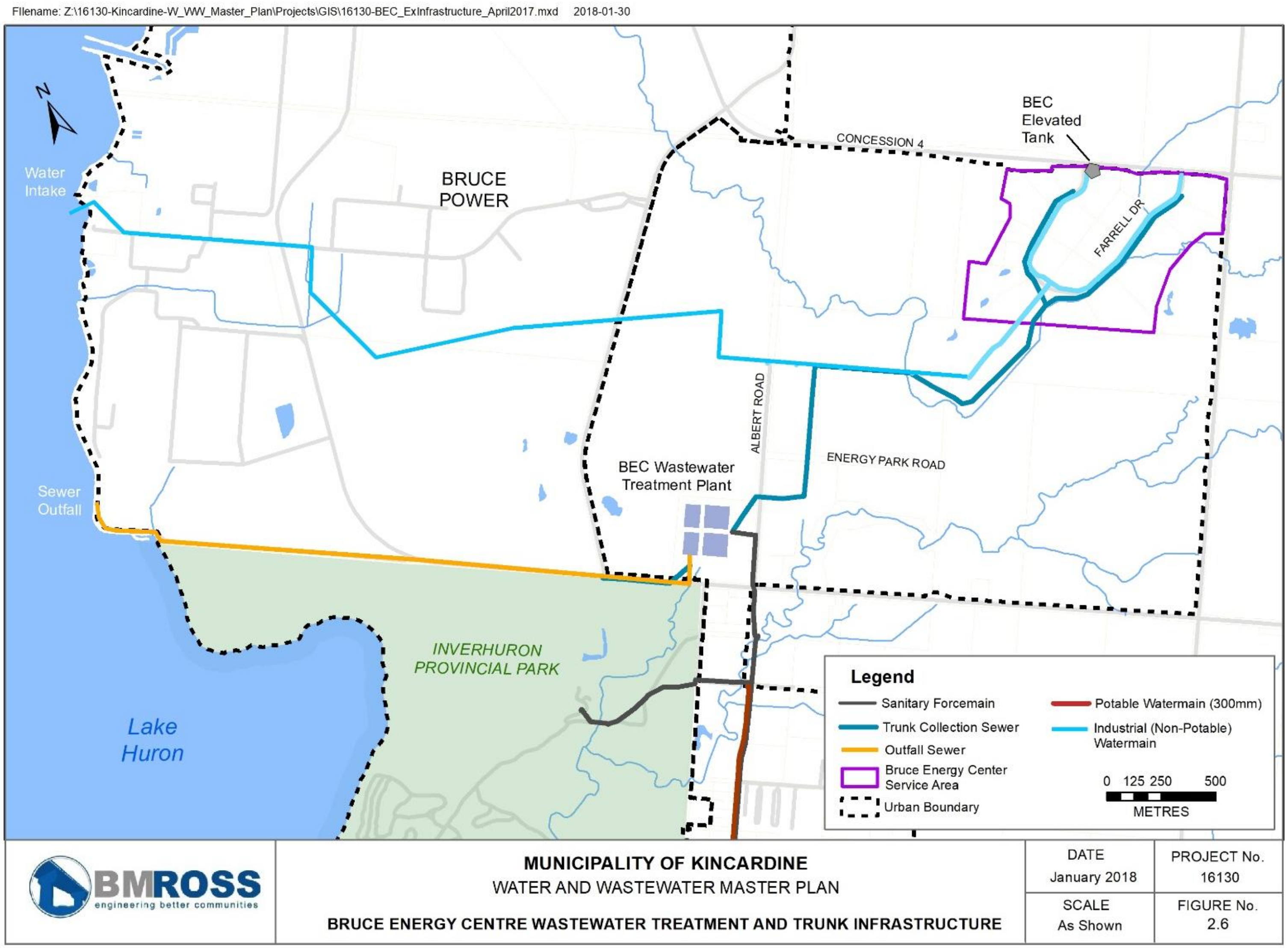


Figure 2.6: Bruce Energy Centre Wastewater Treatment and Trunk Infrastructure



3.0 THE STUDY AREA AND EXISTING CONDITIONS

3.1 Study Area

The areas examined as part of the Water and Wastewater Servicing Master Plan include the former Town of Kincardine; former Village of Tiverton; the lakeshore area north of Kincardine to the north end of Inverhuron; and the Bruce Energy Centre and Concession 2 Industrial Parks. These areas represent the largest areas of existing water and wastewater servicing within the Municipality, as well as areas of potential growth and development. The study area for this Master Plan is shown in Figure 3.1.

The former Town of Kincardine roughly extends from Saratoga Road north to Wickham Cove Lane, and east from Lake Huron to the Kincardine Business Park, located on the east side of the Bluewater Highway (Highway 21). The majority of existing development within Kincardine is located between the Bluewater Highway and Lake Huron.

Tiverton is located approximately 12 km north of Kincardine, at the intersection of Bruce Road 15 and the Bluewater Highway (Highway 21). It generally includes the lands east of Maple Street to McLaren Street and from Elizabeth Street south to the end of King Street.

The lakeshore area included in this Master Plan encompasses the lands north of Kincardine, between Lake Huron and Bruce Road 23, to Alma Street in the northern portion of the community of Inverhuron.

The Bruce Energy Centre Industrial Park is located southwest of the intersection of Bruce Road 23 and Bruce Road 20. The Industrial Park includes the lands fronting on Farrell Drive. South of the BEC, along Concession 2 are additional Industrial Park lands.

3.2 Natural Environment

The Municipal Class Environmental Assessment process requires an inventory of the environment. For the purposes of this Master Plan, a review of the environment was completed. Given the large spatial scale of this study, as well as broad scope, the environmental review as summarized in this section represents a general overview of local conditions. Any projects identified through this Master Plan that require additional investigations through the Class EA process will require more detailed environmental inventories specific to their locations.

3.2.1 Physiography

There are two distinct physiographic regions within the study area, the Huron Fringe and the Huron Slope (Chapman & Putnam, 1984). The Huron Fringe, located immediately adjacent to Lake Huron, is the narrow strip of wave cut terraces of glacial Lake Algonquin and Lake Nipissing. The Huron Fringe stretches from Sarnia to Tobermory along the Lake Huron shoreline. The lakeshore area of the Municipality, Inverhuron and the western-most portion of Kincardine are located within the Huron Fringe.

The Huron Slope encompasses the lands between the Algonquin shore cliff to the west (Huron Fringe) and Wyoming Moraine to the east. It is a clay plain, modified by a narrow strip of sand and the twin beaches of glacial Lake Warren on the eastern side (Chapman & Putnam, 1984). The till in the area is formed from brown calcareous clay and has minimal pebbles and boulders. It is approximately 1.5 m to 3 m thick and overlays brown stratified clay. The plain is deeply trenched by the Penetangore River as it flows through Kincardine to river outlet at Lake Huron.

Figure 3.1: Water and Wastewater Servicing Master Plan Study Area

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Tiverton, the BEC Industrial Park and the majority of the former Town of Kincardine are located within the Huron Slope.

3.2.2 Soils

Within the study area, the predominate soil groups are grey-brown podzolic soils (Hoffman & Richards, 1954). South of Inverhuron, the soils are sandy loams of the Brady soil series or the Perth soil series. These soils are sandy loams or clay loams, formed from outwash material and shale till. The soils are considered to have imperfect drainage. In the vicinity of Inverhuron, the Elderslie soil type is found. This soil is formed from lacustrine deposits and ranges from a clay loam to a silty clay loam. Similar to the Brady and Perth soils, the Elderslie soil also has imperfect drainage. In the Lorne Beach area, the presence of Marsh soils is noted. The thickness of the surficial deposits generally increases from west to east, from 5 m thick to 10-50 m thick throughout of the majority of the Municipality of Kincardine.

3.2.3 Vegetation and Wildlife

The study area for this Master Plan encompasses a large area that includes lakeshore, agricultural and urban areas. Within the urban areas of Kincardine and Tiverton, vegetation and wildlife habitats are limited; however, there are corridors and parklands that provide opportunity for habitation. Generally, the study area is within Ecoregion 6, which is characterized by communities of sugar maple-beech-hemlock; sugar maple-oak-ash; and oak-ash in drier areas and hemlock, yellow cedar, spruce and cedar in wetter areas where the land has not been cleared for agriculture. Along the lakeshore, vegetation communities tend to be in later stages of succession (North-South Environmental Inc. and Dougan & Associates, 2009).

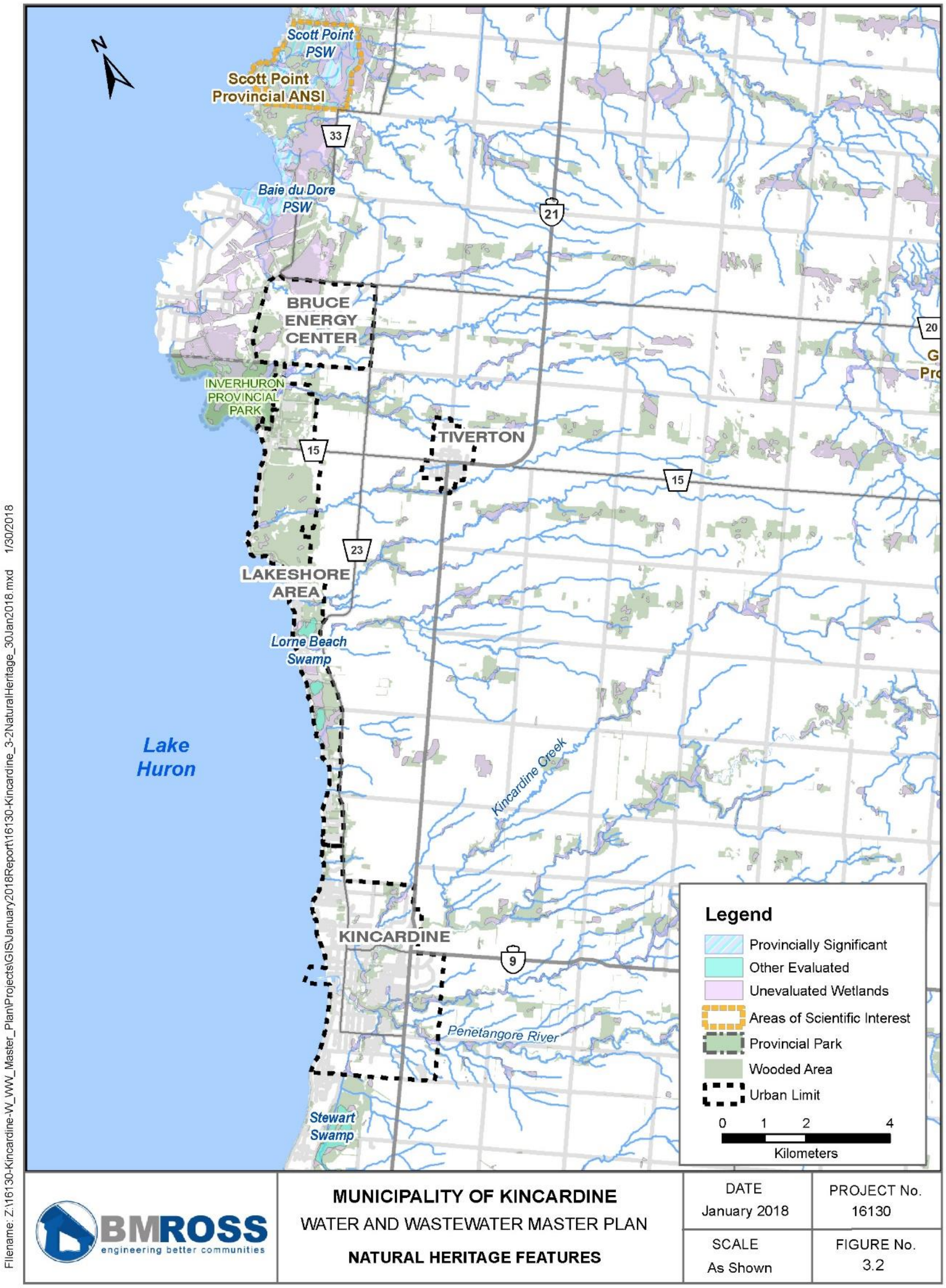
The Natural Heritage Study for the Municipality of Kincardine (2009) identified a number of species listed by Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as potentially occurring in the Municipality of Kincardine (North-South Environmental Inc. and Dougan & Associates, 2009). There are a number of plant, amphibian, bird, mammal and fish species with potential habitat in the Municipality. Given that this study will only identify potential future water and wastewater infrastructure projects, more detailed investigations for species at risk will occur during later studies to reflect conditions at specific locations.

3.2.4 Significant Natural Features

The Ministry of Natural Resources and Forest (MNRF) maintains an inventory of Areas of Natural and Scientific Interest (ANSIs) in Ontario. These life science or earth science features are recognized for their importance related to natural heritage, scientific study or education. To identify any ANSIs within the vicinity of the study area, the MNRF Map a Make: Natural Heritage Areas application was consulted (Ministry of Natural Resources and Forestry, 2017). The review did not identify any ANSI sites within the study area. It is noted that there is an ANSI (Scott Point ANSI) located several kilometers north of the study area. Natural heritage features in the vicinity of the study area are shown in Figure 3.2.

The Penetangore River is the largest watercourse in the study area. It drains approximately 192 km^2 of land, including Kincardine and the lands northeast and east via its two major tributaries: the North Penetangore and Main Penetangore. It drains into Lake Huron, south of Harbour Street in Kincardine. The majority of the watershed is in agricultural areas. The last watershed report card for the Penetangore River, produced by the Saugeen Valley Conservation Authority in 2011, identified average total phosphorus concentrations above the Provincial Water Quality.

Figure 3.2: Natural Heritage Features



Objective of 0.03 mg/L (Saugeen Valley Conservation Authority, 2013). Other watercourses in the study area include the Little Sauble River in Inverhuron and Tiverton Creek

North of the community of Inverhuron is Inverhuron Provincial Park (IPP). Originally established in 1967, the Park has been reclassified a historical park due to the presence of sites dating from Archaic Indians to European Settlement. In addition to the historic features, the park also includes a former glacial lake shoreline, sand dune system, wetland and young hardwood forest. The Park is open to campers and day-users, outside of the winter months. A boat launch provides access to Lake Huron from the parklands.

3.3 Population

3.3.1 Municipality of Kincardine

The Municipality of Kincardine has experienced some growth since 2001, as shown in Table 3.1. The population of the Municipality (from the 2016 Census) is 11,389 (Statistics Canada, 2017). The population increased by 360 persons from 2001 to 2016, which is an increase of 3.3% from the 2001 population. The average annual growth rate since 2001 is 0.2%. Overall, data for the Municipality indicates a decrease in the rural population and growth in the urban areas.

Table 3.1: Population, Dwellings and Household Density for the Municipality of Kincardine

Year	Population	Total Dwellings	Occupied Dwellings	Persons Per Unit
2001	11,029	5,257	4,315	2.56
2006	11,173	5,447	4,586	2.44
2011	11,174	5,789	4,829	2.31
2016	11,389	5,883	4,855	2.35

Census data also shows a steady increase in the number of dwellings within the Municipality since 2001. The increase of 626 new dwellings over the last 15 years aligns with the observed increase in population, as well as other general demographic trends including an aging population and decreases in family size. The decline in family size and increase in single-person occupied homes is also reflected in the decrease in the average number of Persons Per Unit (PPU) throughout the Municipality. The average number of persons per unit has decreased from 2.56 persons/occupied unit in 2001 to 2.35 persons/occupied unit in 2016.

3.3.2 Kincardine (Town)

The Town of Kincardine has been identified as a population centre through the Census and as such, census population counts are available for the Town from 1991 forward. The changes in population, dwellings and persons per unit from 1991 to 2016 in the Town of Kincardine are shown in Table 3.2 (Statistics Canada, 2017).

Table 3.2: Population, Dwellings and Household Density for Kincardine (Town)

Year	Population	Households	Occupied Dwellings	Persons Per Unit
1991	6,601	N/A	N/A	N/A
1996	6,620	N/A	2,515	2.63
2001	6,113	2,713	2,495	2.45
2006	6,449	N/A	2,764	2.33
2011	7,802	3,349	2,951	2.64
2016	8,315	4,114	3,595	2.31

The Town has experienced relatively steady growth, with an additional 2,200 persons added to the population since 2001. The 2016 population, as reported in the Census, is 8,315 persons. The increase in population observed equates to a 36% increase in population from 2001, or an average annual growth rate of 2%. The number of houses in the Town has also increased with an additional 1,400 dwellings built since 2001. Growth in the number of dwellings has slightly outpaced population growth, with an average annual growth rate of 2.8%. The average number of persons in occupied homes has declined, following the trend observed for the entire Municipality. The current average number of people per occupied dwelling is 2.31 persons.

3.3.3 Tiverton

The population of Tiverton has generally experienced a decline over the last 20 years. Data from the 1996 Census suggests the village's population peaked at 824 persons and has declined to 725 persons as of the last Census in 2016. However, the most recent data shows an increase in population between the last two census periods, indicating that the population of Tiverton may be rebounding. The change in the population and number of households, from 1991 to 2016, in Tiverton is shown in Table 3.3 (Statistics Canada, 2017).

In the past 15 years, the population of Tiverton has decreased by 15 persons (or by 2.4%); however, over the same period, the total number of dwellings has increased by 46. The increase in the number of dwellings is likely attributable to declining family size, the aging population, and the influence of employment at Bruce Power on demand for housing. Similar to the trends observed for the Municipality and the Town of Kincardine, the average number of people per occupied household has declined over the past 15 years. The current average density for occupied dwellings in Tiverton is 2.19 persons per unit.

Table 3.3: Population, Dwellings and Household Density for Tiverton

Year	Population	Households	Occupied Dwellings	Persons Per Unit
1991	814	N/A	N/A	N/A
1996	824	300	N/A	N/A
2001	743	338	300	2.47
2006	748	N/A	N/A	N/A
2011	705	356	301	2.34
2016	725	384	330	2.19

3.3.4 Lakeshore Area

The current population for the lakeshore area between IPP and Kincardine is estimated based on the 2016 census tract counts. The census tracts include Inverhuron, as well as the lands between Lake Huron and Bruce County Road 23 from Bruce Road 15 south to the northern limit of Kincardine. Data from the 2011 and 2016 census programs is shown in Table 3.4 (Statistics Canada, 2017).

Table 3.4: Population, Dwellings and Household Density for the Lakeshore Area

Year	Population	Households	Occupied Dwellings	Persons Per Unit
2011	1,360	982	596	2.28
2016	1,439	996	625	2.30

The population along the lakeshore area has increased in the 5-year period since the 2011 census, as has the total number of dwellings and number of regularly occupied dwellings. Along the lakeshore, 63% of the dwellings are occupied regularly, indicating approximately 37% are used seasonally.

3.4 Cultural Heritage and Archaeological Resources

The Municipality of Kincardine has a Municipal Heritage Committee, with a mission to “identify and preserve built structures, historical artifacts, ruins and lands of cultural historical significance or historical value” (Municipality of Kincardine, 2017). The committee also advises Council on designation and alteration to designated or historic properties. Presently, there are 46 heritage designated properties within the Municipality. The majority of these sites are located within the former Town of Kincardine.

There have been a number of archaeological assessments completed throughout the Municipality in conjunction with past environmental assessments. Archaeological resources have been found as a result of these assessments and include both First Nation and early European artifacts. Given the potential for archaeological resources throughout the Municipality, any projects identified as part of this Master Plan will need to complete the appropriate screening for cultural, built heritage, and archaeological resources as part of any required EA processes.

3.5 Planning Policies

3.5.1 Provincial Planning Policies

Under the Planning Act (Section 3), the Provincial Policy Statement (PPS) guides the policies in relation to land use and development applications within the Province of Ontario. Decisions surrounding land use and development must be consistent with the policies contained within the PPS in order to support the overarching provincial interest. Given the intent of the Water and Wastewater Servicing Master Plan, the following policies of the PPS have been identified to support consideration of a servicing strategy (Ministry of Munical Affairs and Housing, 2014):

Section 1.1: Managing and Directing Land Use to Achieve Efficient and Resilient Development and Land Use Patterns

- The Water and Wastewater Master Plan will sustain a healthy, liveable and safe community by promoting efficient development and land use patterns through a servicing strategy;
- The servicing strategy identified in the Master Plan will promote development and land use patterns that will not prevent the potential expansion of any settlement area to adjacent areas;
- The Master Plan will provide a servicing strategy that will promote cost-effective development patterns to minimize servicing costs; and
- The intent of the Master Plan is to ensure the necessary water and wastewater infrastructure is available to meet current and future needs.

Section 1.1.3: Settlement Areas

- The Master Plan, and identified servicing strategy, will provide a basis for planning land use patterns that are appropriate for, and efficiently use existing and planned infrastructure; and
- It will assist in the development and implementation of phasing policies to ensure the orderly progression of development and timely provision of infrastructure.

Section 1.6.1: Infrastructure and Public Service Facilities

- The servicing strategy identified in the Master Plan will allow for the provision of coordinated, efficient and cost-effective infrastructure that accommodates need; and
- The development of the servicing strategy was coordinated with land use planning principles to ensure infrastructure is financially viable and able to meet current and future needs.

Section 1.6.6: Sewage, Water and Stormwater

- The Master Plan incorporates expected growth and development and the servicing strategy will promote the efficient use and optimization of existing municipal water and sewage services; and
- Development of the servicing strategy considered feasibility, financial viability, regulatory compliance requirements, and protection of human health and the natural environment.

3.5.2 Local Planning Policies

The Bruce County Official Plan (Approved June 2013) serves as the upper-tier planning policy framework for municipalities within the County. The County Official Plan provides guidance on development, as well as population projections for the lower-tier municipalities (County of Bruce, 2013). In addition to providing general planning policies for growth and protection of the natural environment, the Official Plan outlines specific requirements related to multi-year sewage and water servicing plans. For municipalities with sewage and water services, the Official Plan requires the preparation of a servicing plan to support any new Local Official Plans or as part of a review of update to an existing Local Official Plan. The Local Official Plan will incorporate the conclusions or recommendations of the servicing plan. A Sewage and Water Servicing Plan will also support:

- Local Official Plan Amendments for major new developments;
- Applications to expand settlement area boundaries;
- Planning applications with potential for significant environmental health risks that need to be addressed; or
- Any planning application with the potential to affect the carrying capacity of a regional groundwater system or the assimilative capacity of a receiving body.

Under the Bruce County Official Plan, a Sewer and Water Servicing Study must be completed to the satisfaction of the County and local municipality and may include the following:

- An assessment of appropriate types and levels of servicing to support growth, including financing, phasing and administrative requirements;
- An analysis of hydrology and hydrogeology to determine sufficient water quantity and quality, and assimilative capacity in relation to the ecological function of the water resources;
- An assessment of existing servicing systems, including capacities, condition, required upgrades and/or expansions;
- The long-term suitability of soil conditions where subsurface sewage treatment and disposal is considered;
- Identification of existing and potential restrictions to future growth and development;
- An assessment of impacts of growth on the natural environment; and
- An examination of the economic feasibility of any proposed servicing.

The Municipality of Kincardine has a local Official Plan that outlines policies for the settlement areas of Kincardine, Tiverton, Shoreline and BEC Industrial Park. Policies for the remainder of the Municipality come from the Bruce County Official Plan. The intent of the Municipality of Kincardine Official Plan is to provide a coordinated, integrated and comprehensive approach to planning matters (Meridian Planning Consultants Inc, 2012). Aside from planning policies related to residential, commercial, industrial, environmental and other land uses, the Official Plan identifies growth projections and policies relating to the provision of municipal services. Generally, the Official Plan promotes optimizing the long-term availability and use of land, resources, infrastructure and public facilities. It also states support for the continued development of the BEC Industrial Park and associated residential and commercial growth.

The Official Plan specifies that the Municipality will plan to complete a long-term sewage and water servicing plan. The intent of the sewage and water servicing plan is to ensure growth is accommodated in a manner that considers the efficiency of the existing systems. The servicing plan will also provide direction for future extensions or expansions of the existing water and sewage systems. With respect to the BEC WWTP, the Official Plan states the Municipality will continue to utilize treatment capacity at the site (Meridian Planning Consultants Inc, 2012).

3.5.3 Source Water Protection

The Municipality of Kincardine is located in the Saugeen Valley Protection Area, within the Saugeen, Grey and Northern Bruce Peninsula Source Protection Region. The Source Protection Plan for this source protection region came into effect in July 2016, under the direction of the Clean Water Act (2006). The Source Protection Plan outlines policies developed to protect municipal drinking water sources from threats and the Approved Assessment Report summarizes the watershed characteristics and drinking water threats.

Water quantity throughout the Saugeen Valley Protection Area was assessed as part of the work completed for the Approved Assessment Report. The investigation examined water quantities and the potential future stress to aquifers as a result of water takings. Surface water intakes that use Lake Huron as a source, such as the KDWS, were excluded from the stress assessment. For the Tier I stress assessment, the degree of stress for the identified subwatersheds was calculated. The Huron Shore subwatershed, which encompasses the study area for this Master Plan, was determined to have low potential stress to groundwater takings from the average demand and the monthly maximum demands (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2015).

The Assessment Report also identifies and describes areas within the Protection Area in terms of the intrinsic susceptibility of the underlying aquifers to contamination. In the Municipality of Kincardine, the areas along the shoreline near Kincardine, Inverhuron and the Douglas Point area, as shown in Figure 3.3, have high intrinsic susceptibility. The higher intrinsic susceptibility in these areas is attributed to uppermost aquifer being located in the overburden materials, with little or no natural protection.

The Highly Vulnerable Areas (HVA) and Significant Groundwater Recharge Areas (SGRA) within the Municipality were also delineated for the Assessment Report. HVAs were found along the sandy shoreline areas, with vulnerabilities ranging from two to six. The areas of higher vulnerabilities correspond to areas where intrinsic susceptibility was high. The total area of HVAs in the Municipality is 24.6 km^2 (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2015). Generally, the SGRA within the Municipality were inland, in areas with gravel-like sand overburden.

The Well Head Protection Area (WHPA) delineated for the Tiverton wells are shown in Figure 3.4. The Briar Hill WHPA, which generally extend southeast of the well, includes approximately 0.31 km^2 of land. The Dent Well WHPA also extends southeast but only encompasses 0.25 km^2 of land. The WHPA areas include residential, commercial, municipal and agricultural land uses. Within the WHPA for the two wells, 22 significant drinking water threats were identified (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2015). These threats are found within WHPA-A and pertain to septic systems, sewer lines, fuel storage, waste disposal, applications of agricultural source material to land, application of non-agricultural source material to land, and the application of pesticide to land. With respect to water quality, it was noted the source aquifer for the Tiverton wells has naturally high fluoride and iron levels, but are dealt with during treatment. There were no drinking water quality issues resulting from ongoing or past activities identified for the Tiverton wells.

The Intake Protection Zone (IPZ) for the Kincardine Drinking Water System intake is shown in Figure 3.5 and includes both offshore and onshore components. The onshore area of IPZ-1 and IPZ-2 totals 6.9 km^2. Additionally, an IPZ-3 and Event Based Area (EBA) were delineated to model spill scenarios.It is noted that the modelling of the EBA areas examined transport pathways, including stormwater infrastructure and future significant changes to the stormwater collection system could impact the modelling results. Three EBA categories were identified: 3,000 L and greater; 5,000 L and greater; and 10,000 L and greater. The vulnerability scores

Figure 3.3: Intrinsic Susceptibility of Groundwater Aquifers in Study Area

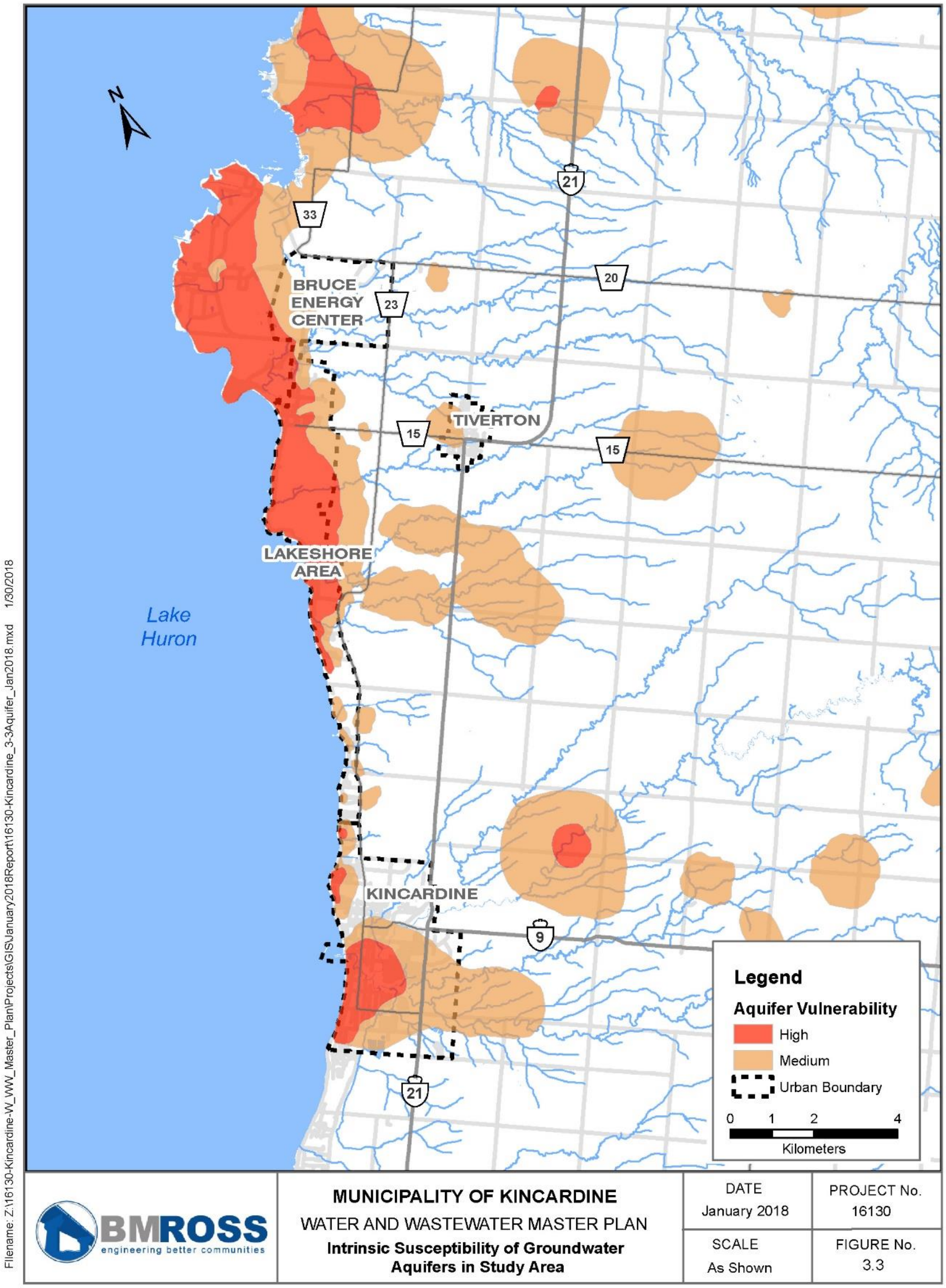


Figure 3.4: Well Head Protection Areas for Tiverton Wells

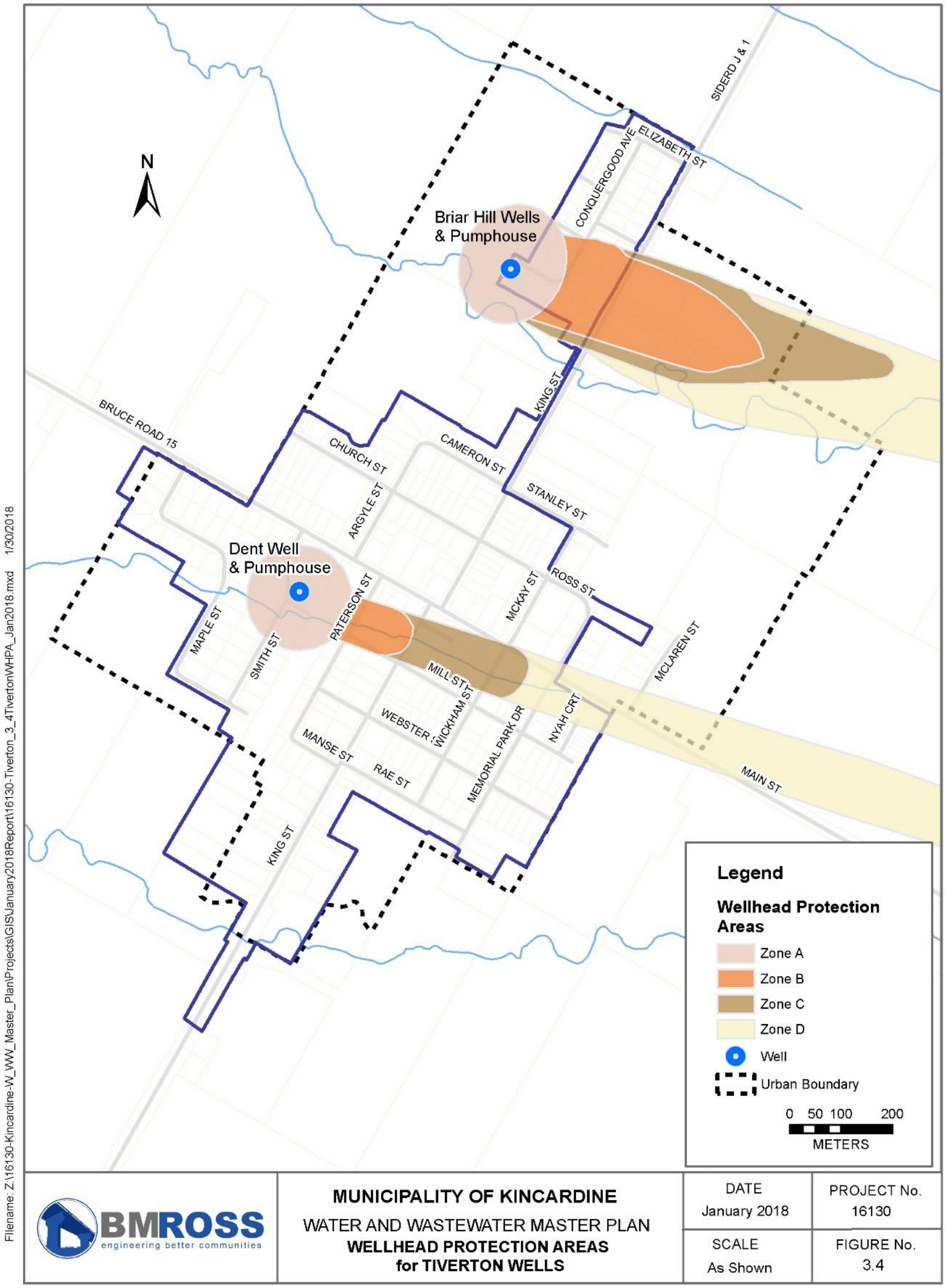
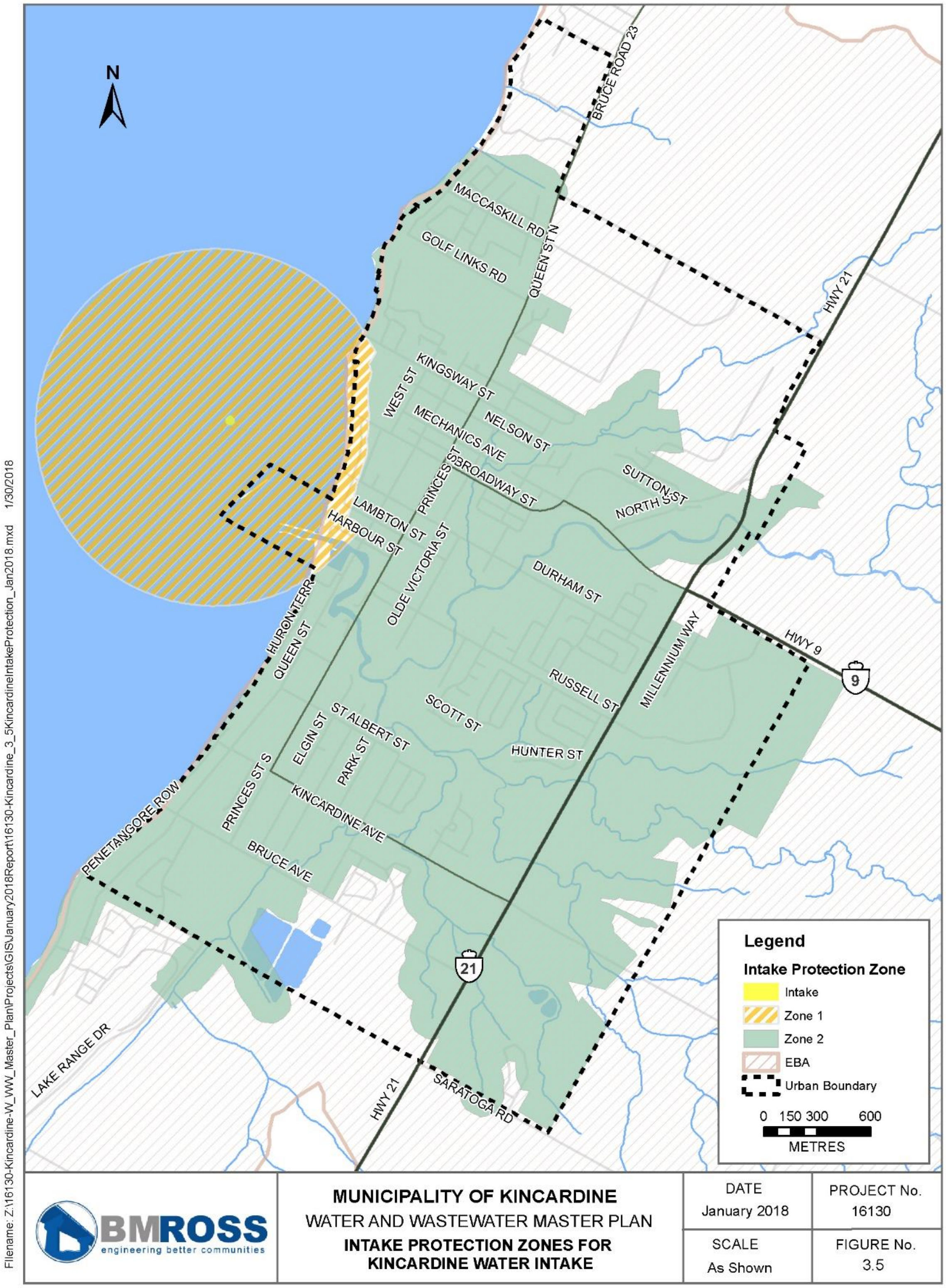


Figure 3.5: Intake Protection Zones for Kincardine Water Intake



assigned to IPZ-1 and IPZ-2 are 6 and 4.8, respectively. Five existing significant drinking water threats were identified relating to the events-based modeling for fuel handling and storage. There were no drinking water quality issues identified relating to ongoing or past activities for the KDWS (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2015).

The Source Protection Plan defines the policies in place within vulnerable areas to protect sources from significant drinking water threats. Vulnerable areas within the Water and Wastewater Servicing Master Plan study area include: the EBA-3000, EBA-5000 and EBA-10000 around Kincardine; WHPA-A, B and C for the Tiverton wells. With respect to the Master Plan, the following threats or activity categories relate to activities associated with water and wastewater servicing (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2015):

- Establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage;
- Fuel Handling and Storage; and
- Transportation Pathways.

The policies that apply to these threats are briefly summarized in Table 3.5.

Table 3.5: Source Water Policies relating to the Water and Wastewater Servicing

Policy	Policy Description
02-01 Sewer Connection Bylaw	Municipalities with a sewer line in a vulnerable area or within 100 m of a vulnerable area will enact a sewer connection by-law.
02-03 Constraint on Environmental Compliance Approvals for On-site Sewage System	Installation of an on-site sewage system is not permitted in locations where there is a sewer connection bylaw; installation of a treatment unit may be permitted provided the approval contains appropriate terms and conditions to ensure the sewage system never becomes a significant drinking water threat.
02-05 Sewer Requirement for New Lots	Where a future septic system would be a significant drinking water threat, new lots created through severance or Plan of Subdivision will only be permitted where lots will be serviced by a municipal sewage system or where a septic system can be located outside of a vulnerable area.
02-07 Review of Environmental Compliance Approvals for Sewage Works	For industrial effluent discharge, sewage treatment plant bypass discharge to surface water, storage of sewage (e.g. treatment plant tanks) and sewage treatment plant effluent discharge (including lagoons) in vulnerable areas, the MOECC shall: review existing approvals and determine whether the approvals contain appropriate terms and conditions.
02-08 Constraints on Environmental Compliance Approvals for Sewage Works	No future sewage works (industrial effluent discharge, sewage treatment plant bypass discharge to surface water, storage of sewage (e.g. treatment plant tanks) and sewage treatment plant effluent discharge (including lagoons)) in vulnerable areas shall be established. Approvals for an expansion of an existing sewage works or renewal/updating of a previous approval may be approved upon certain conditions.
02-09 Sewer Maintenance	In all vulnerable areas, where establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage (future and existing), municipalities shall inspect and maintain municipal sanitary sewers and related pipes to uphold high standards of performance and minimize the risk of leaks.

Table 3.5: Source Water Policies relating to the Water and Wastewater Servicing

Policy	Policy Description
02-10 Sewer Locating Program	In all areas where establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage (existing and future), Municipalities will consider establishing or continuing a program that will: collect information and document the location of sewage lines, and document how properties are serviced.
02-12 Separation of Combined Sewers	In all vulnerable areas, where there is combined sewer discharge to surface water; or sewage treatment plant bypass discharge to surface water, Municipalities will give due consideration to establishing or continuing a program to separate combined sewers.
02-13 Infiltration Prevention	In all vulnerable areas, with existing sanitary sewers and related pipes, and/or discharge of Stormwater from a stormwater management facility, Municipalities shall give due consideration to establishing or continuing programs that reduce infiltration of wastewater into groundwater aquifers that are used as drinking water sources.
15-04 Prohibition of Fuel near Great Lakes Intakes	Applies where storage of fuel would be a significant drinking water threat (future activity) in EBA for the Kincardine Drinking Water System where fuel is stored in quantity of 3,000 L or more. Establishment of new fuel storage is prohibited.
15-05 Risk Management Plan for Fuel near Great Lakes Intakes	Where the existing storage of fuel is a significant threat (3,000 L or more in EBA-3000) or existing or future storage of 5,000 L or more (in EBA-5000) or 10,000 L or more (EBA-10000), establishment of a Risk Management Plan is required.
TP-02 Municipal By-law for Water Connection	Municipalities shall give due consideration to enacting a water connection by-law in WHPA A or WHPA B vulnerable areas (for existing or future activities).
TP-03 Circulation of Proposals with New Transport Pathways	Municipalities are obligated to provide information on any proposals involving future transport pathways to the source protection authority and source protection committee.
TP-04 Water Services for New Lots	Municipalities will give consideration to including in their official plan a provision regarding the servicing of new lots (future activity) in WHPA A or WHPA B vulnerable area that stipulates new lots are only permitted where the property will be connected to a municipal water system.

4.0 POPULATION GROWTH AND FUTURE DEVELOPMENT

4.1 Residential Growth Forecasting

4.1.1 Methodology

For the Servicing Master Plan, potential long-term (50-year) growth within the Municipality was assessed. To estimate potential residential and non-residential growth within the Town of Kincardine, Tiverton, and Lakeshore areas of the Municipality to 2067, a number of existing forecasts were consulted. These include:

- Ministry of Finance – Ontario Population Projection Update 2015-2041, for the County of Bruce;
- 2016 Municipality of Kincardine Development Charges population growth forecast by Hemson Consulting Limited; and
- Municipality of Kincardine Official Plan, high and low growth population projections.

The Ministry of Finance (MOF) produces population projections for upper-tier municipalities in Ontario on a regular basis. The latest projection (2015) estimates yearly population growth for the County of Bruce to 2041 (Ministry of Finance, 2017). The proportion of the County's population within the Municipality of Kincardine (16.71%) was assumed to remain consistent with current values and forecasted growth would be distributed proportionally throughout the County over the forecast period. For the period 2042-2067, the average annual growth rate associated with the MOF forecast (0.23%) was used to extrapolate growth. The population forecast for the Municipality was then applied proportionally to the Town of Kincardine (73.0% of municipal population), Tiverton (6.4%), and the Lakeshore (12.6%), based on current population distribution.

The Official Plan for the Municipality of Kincardine contains high and low growth forecasts for Kincardine, Tiverton and the Lakeshore area. The Official Plan forecasts estimate population growth to 2026 (Meridian Planning Consultants Inc, 2012). For the purposes of the Master Plan, these forecasts were extrapolated forward to 2067 using the growth rate calculated from 2012-2026. Table 4.1 identifies the growth rates used for the Official Plan forecasts.

Table 4.1: Growth Rates to Extrapolate the Official Plan Growth Scenarios

Area	Low Growth (%)	High Growth (%)
Town of Kincardine	1.62	1.97
Tiverton	1.24	1.48
Lakeshore	1.53	1.76

Residential and non-residential growth in the Municipality from 2016-2031 was forecasted by Hemson Consulting as part of the 2016 Municipality of Kincardine Development Charges Background Study (Hemson Consulting Ltd, 2016). The forecast produced by Hemson was then extrapolated forward, based on a linear trend, to 2067.

4.1.2 Buildout Population and Development Density

To determine the maximum build-out population within the current settlement areas, the amount of vacant residential land was determined based on current zoning. For the Town of Kincardine, the assessment of developable lands included consideration of properties that could be redeveloped and current development commitments. In Kincardine, it was assumed that the average number of units per hectare would increase to meet the target identified in the Official Plan (11 units/ha) by 2027 and that this trend would continue in the future to an average of 15 units/ha by 2067. It was also assumed that the lands with draft or approved plans of subdivision will develop prior to other vacant lands. Given the amount of vacant residential lands; the Municipality's desired housing mix targets (70% low density, 25% medium and 5% high); and the average number of persons per units for the three housing types, an expanded urban boundary build-out population for Kincardine, encompassing the lands between the current settlement boundary and Concession 5 between Bruce Road 23 and Highway 21, was also forecasted. The extent of the expanded urban boundary was established through discussions with senior Municipal staff and policies directing growth to areas adjacent to existing settlement areas with the potential to be serviced.

A similar methodology for Tiverton and the Lakeshore area was used to identify the build-out population. For Tiverton, the average number of units/ha was forecast to increase to 12 units/ha, as it is expected that the village will have less medium and high-density types of development. For the lakeshore area, south of Inverhuron, it was assumed that future development will be in the form of single-family units with water servicing but not sewage servicing. Given this, the density of units was limited to 7 units/ha to accommodate private septic systems.

4.1.3 Town of Kincardine Forecasts

It is expected that over the next 50 years, the majority of population growth within the Municipality will occur within the Town of Kincardine. The population increase is expected to result from employment growth generated by Bruce Power as well as retirees from the surrounding rural areas. It is estimated that the current supply of vacant residential lands will accommodate a population increase up to a total of approximately 16,789 people (based on projected density targets and housing mixes) within the current urban boundary. Figure 4.1 shows the development areas within Kincardine. An expanded settlement area that includes lands north to Concession 5 between Bruce Road 23 and Highway 21, could accommodate approximately 7,973 additional residents. The potential expanded settlement area is shown in Figure 4.2.

The various population growth forecasts for the Town of Kincardine, based on the different forecast methodologies, are shown in Figure 4.3.

There is significant variation in the population growth projected by the different forecasts over the 50-year period. The Ministry of Finance projection anticipates slight growth, with an additional 1,047 persons over the forecast period. Given recent growth trends (an increase of over 500 residents between 2011 and 2016), the Ministry of Finance forecast is believed to be too low to accurately represent potential growth at least in the short term.

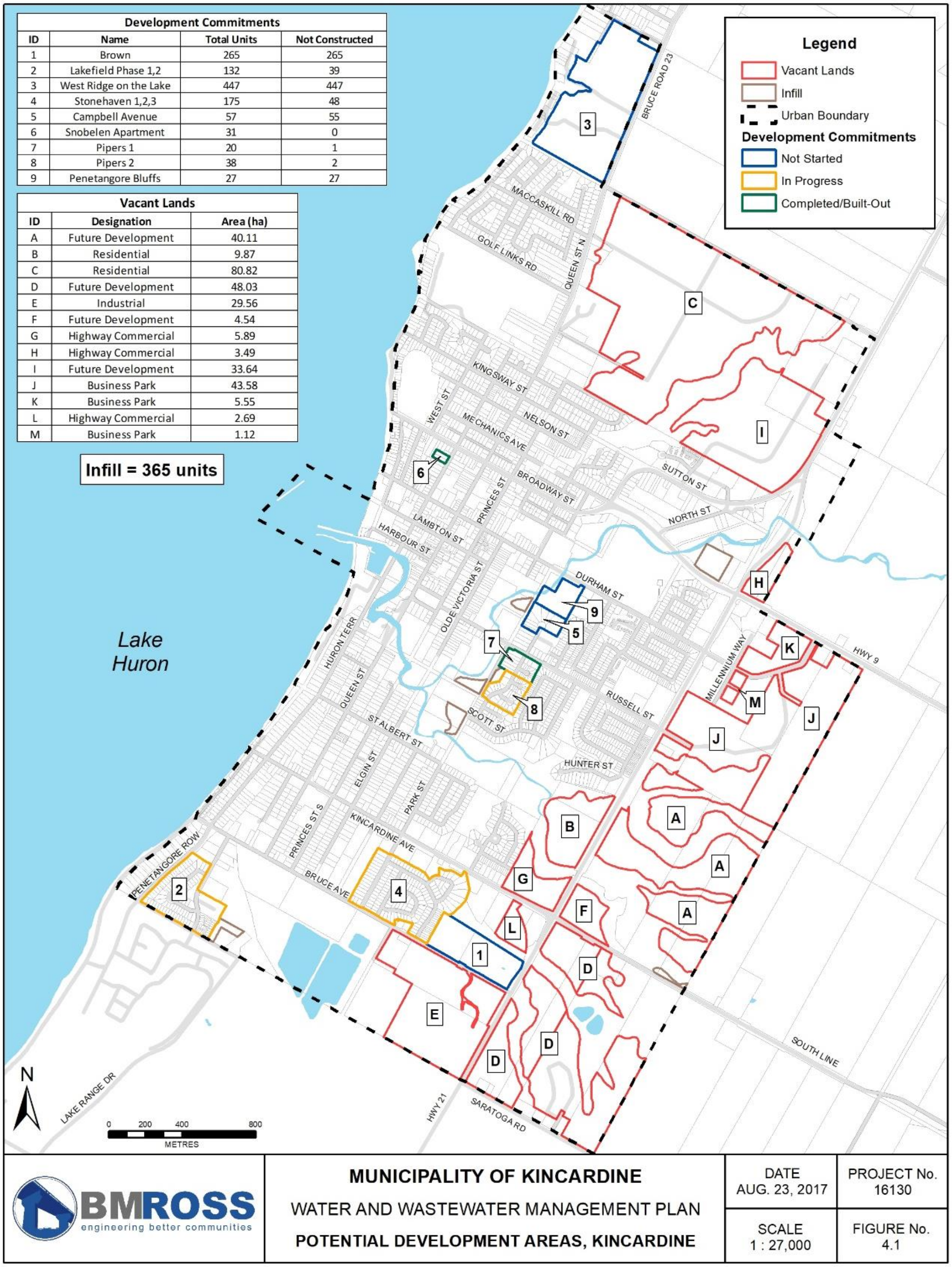
The forecast derived from the most recent 2016 Development Charges study predicts moderate growth over the next 50 years. The population of the Town is expected to increase by approximately 3,415 persons to 11,730 by 2067. This equates to a 40% increase from the current population. In terms of the number of residences, it is expected the total number of dwellings in the Town would increase to 5,807.

The growth forecasts derived from the Official Plan growth targets predict more significant increases in population, ranging from an increase of approximately 10,600 persons (5,247 units) in the low growth scenario to an increase of 14,194 persons (7,027 units) in the high growth scenario. Under these scenarios, it is anticipated that additional residential lands or an expansion of the settlement area will be required by 2052 in the high growth scenario and by 2059 under the low growth scenario.

4.1.4 Tiverton Forecasts

Presently, there is approximately 26.9 hectares of vacant residential land in Tiverton and an additional 8.5 hectares that could be redeveloped to accommodate residences, as shown in Figure 4.3. Given this, it is estimated that the build-out population of the village is 1,780 people, as shown in Figure 4.4.

Figure 4.1: Potential Development Areas, Kincardine

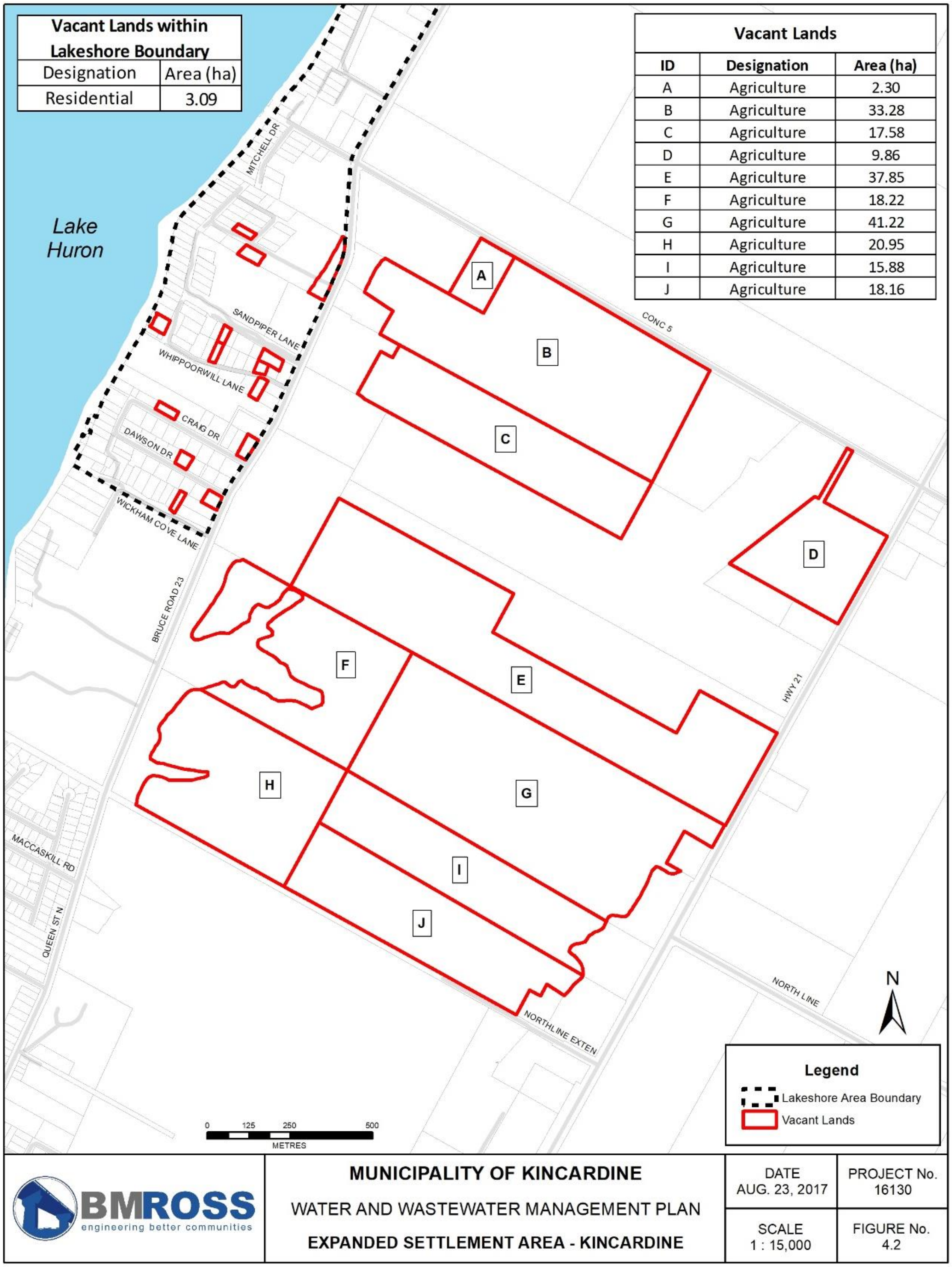


Development Commitments			
ID	Name	Total Units	Not Constructed
1	Brown	265	265
2	Lakefield Phase 1,2	132	39
3	West Ridge on the Lake	447	447
4	Stonehaven 1,2,3	175	48
5	Campbell Avenue	57	55
6	Snobelen Apartment	31	0
7	Pipers 1	20	1
8	Pipers 2	38	2
9	Penetangore Bluffs	27	27

Vacant Lands		
ID	Designation	Area (ha)
A	Future Development	40.11
B	Residential	9.87
C	Residential	80.82
D	Future Development	48.03
E	Industrial	29.56
F	Future Development	4.54
G	Highway Commercial	5.89
H	Highway Commercial	3.49
I	Future Development	33.64
J	Business Park	43.58
K	Business Park	5.55
L	Highway Commercial	2.69
M	Business Park	1.12

Infill = 365 units

Figure 4.2: Expanded Settlement Area - Kincardine



Vacant Lands within Lakeshore Boundary

Designation	Area (ha)
Residential	3.09

Vacant Lands

ID	Designation	Area (ha)
A	Agriculture	2.30
B	Agriculture	33.28
C	Agriculture	17.58
D	Agriculture	9.86
E	Agriculture	37.85
F	Agriculture	18.22
G	Agriculture	41.22
H	Agriculture	20.95
I	Agriculture	15.88
J	Agriculture	18.16

Figure 4.3: Population Growth Forecasts, Kincardine

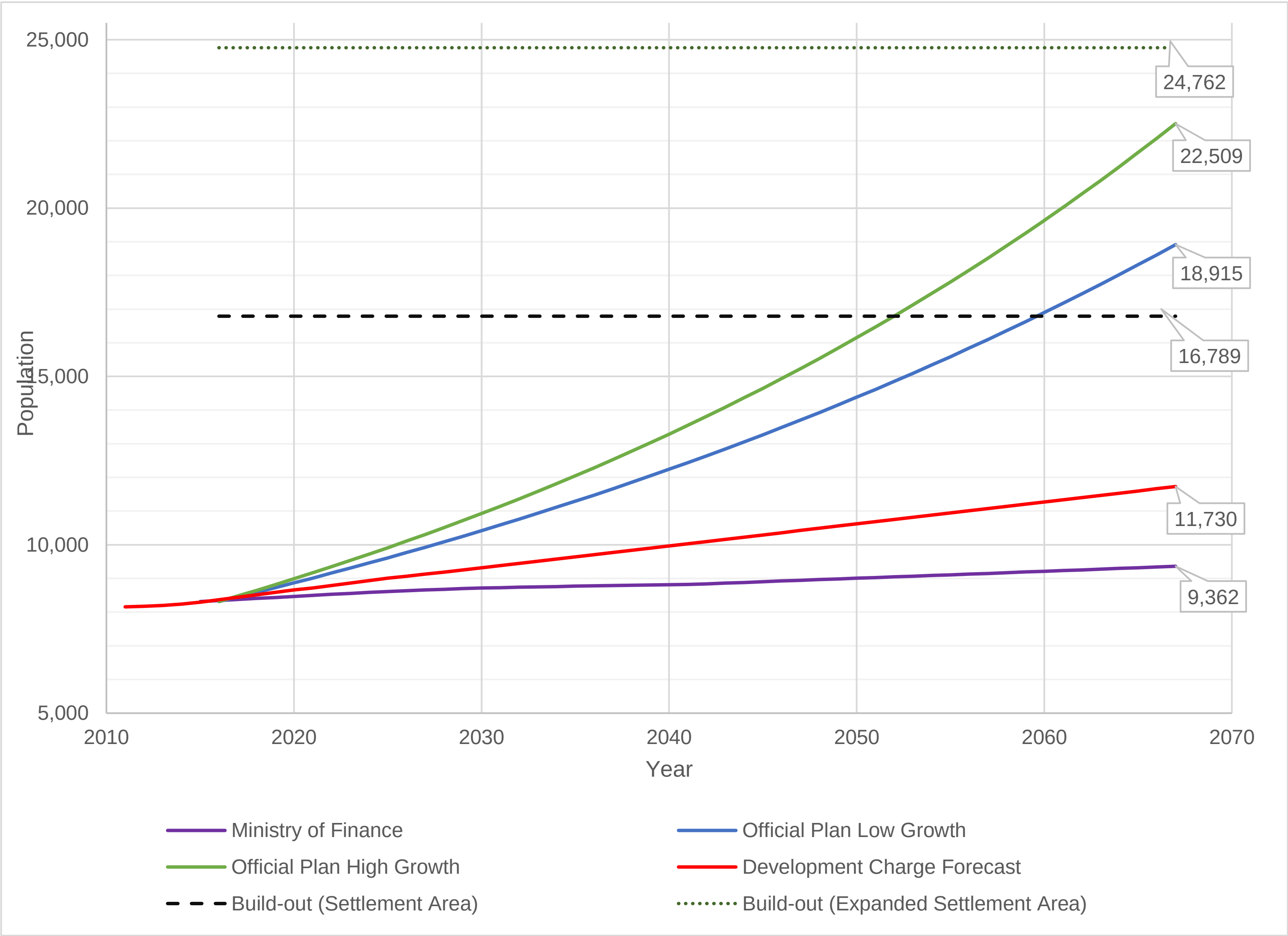
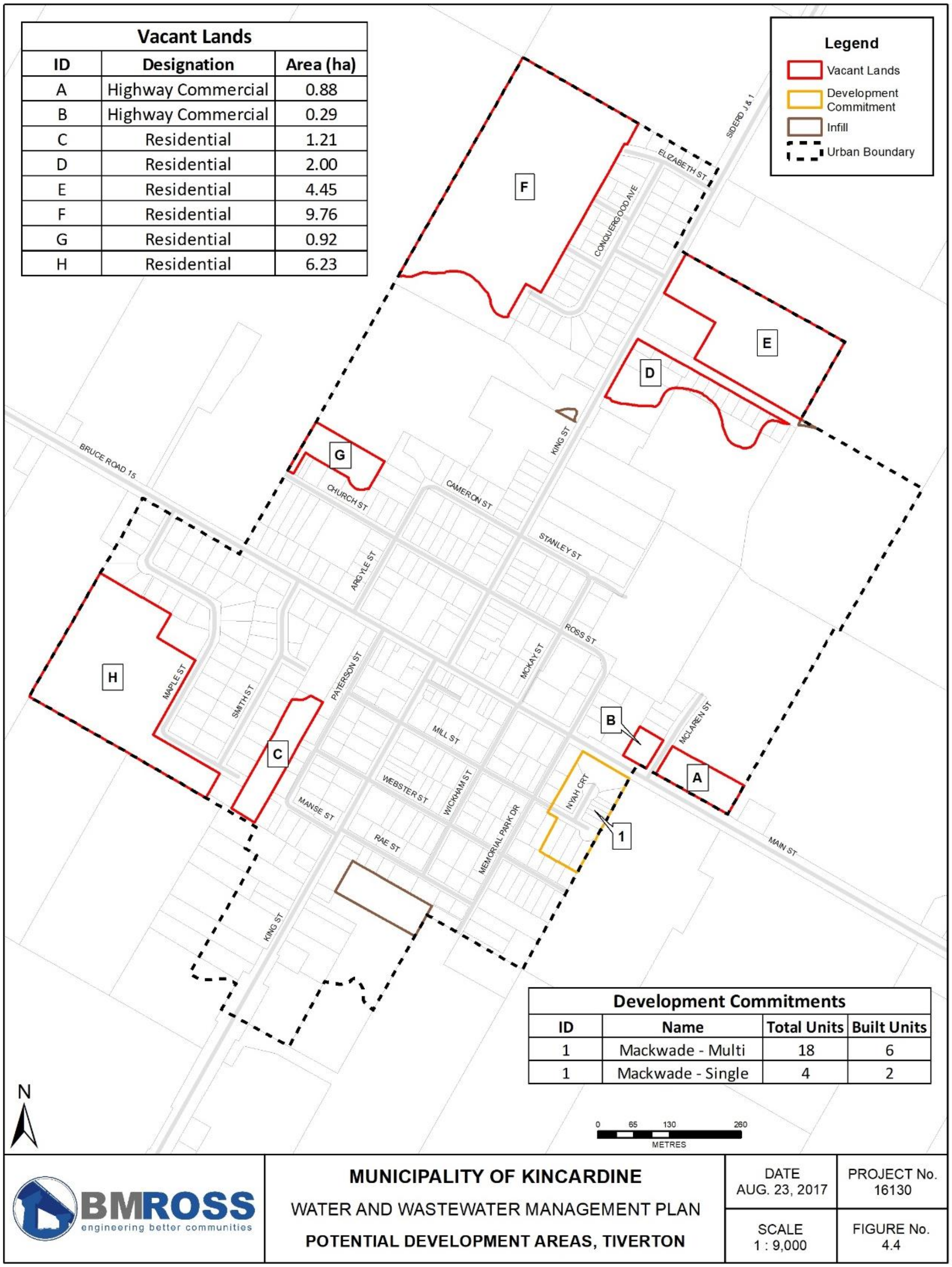


Figure 4.4: Potential Development Areas, Tiverton



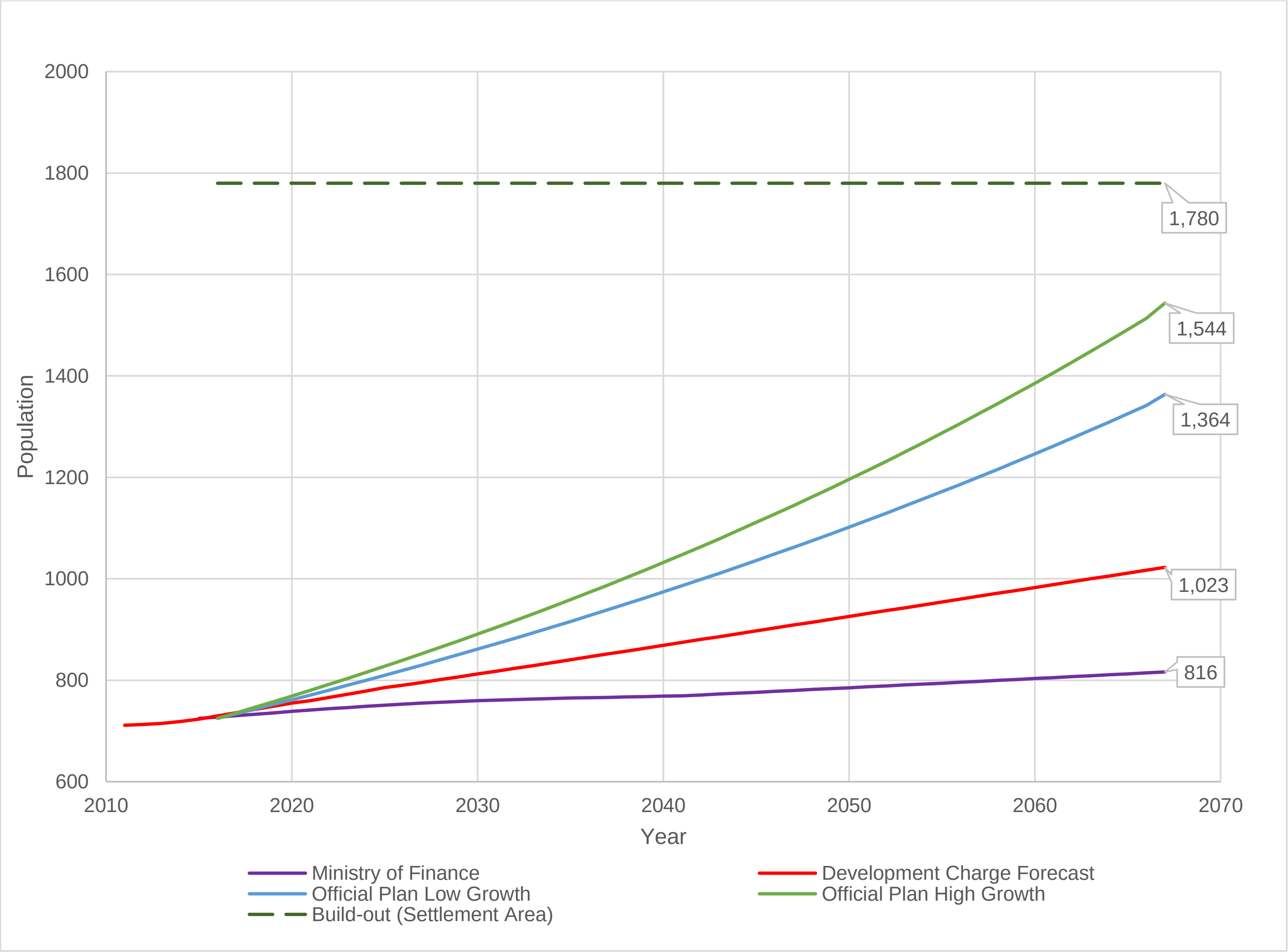
Vacant Lands

ID	Designation	Area (ha)
A	Highway Commercial	0.88
B	Highway Commercial	0.29
C	Residential	1.21
D	Residential	2.00
E	Residential	4.45
F	Residential	9.76
G	Residential	0.92
H	Residential	6.23

Development Commitments

ID	Name	Total Units	Built Units
1	Mackwade - Multi	18	6
1	Mackwade - Single	4	2

Figure 4.5: Population Growth Forecasts, Tiverton



Similar to the forecast for the Town of Kincardine, the Ministry of Finance forecast predicts very conservative growth in the village, with a total increase of 91 persons by year 2067. The Official Plan High Growth scenario predicts the greatest amount of growth within the village, with an increase of 819 people (455 residential units) over the next 50 years. The Official Plan Low Growth and Development Charges forecast predict 2067 populations of 1,364 and 1,023 respectively. This growth equates to an additional 355 units under the Official Plan Low Growth scenario and 184 units for the Development Charges forecast. Given this, in the next 50 years it does not appear likely that Tiverton will reach the build-out population.

4.1.5 Lakeshore Forecasts

The lakeshore area, which includes Inverhuron and the lands south to the Kincardine urban boundary between Lake Huron and Bruce Road 23 (see Official Plan Schedule C, enclosed in Appendix A), is also an area predicted to experience residential growth over the next 50 years. To identify the potential build-out population, an inventory of vacant and potentially developable land was undertaken. There are approximately 506 hectares of undeveloped land zoned ‘Shoreline Development’ (see Figure 4.6). Assuming land in the shoreline area will continue to develop primarily in the form of low-density, semi-serviced, single family units the estimated total build out population is approximately 10,298 persons (Figure 4.7). Given the current population of 1,439 persons, it is not expected that the build-out population will be reached within the next 50 years.

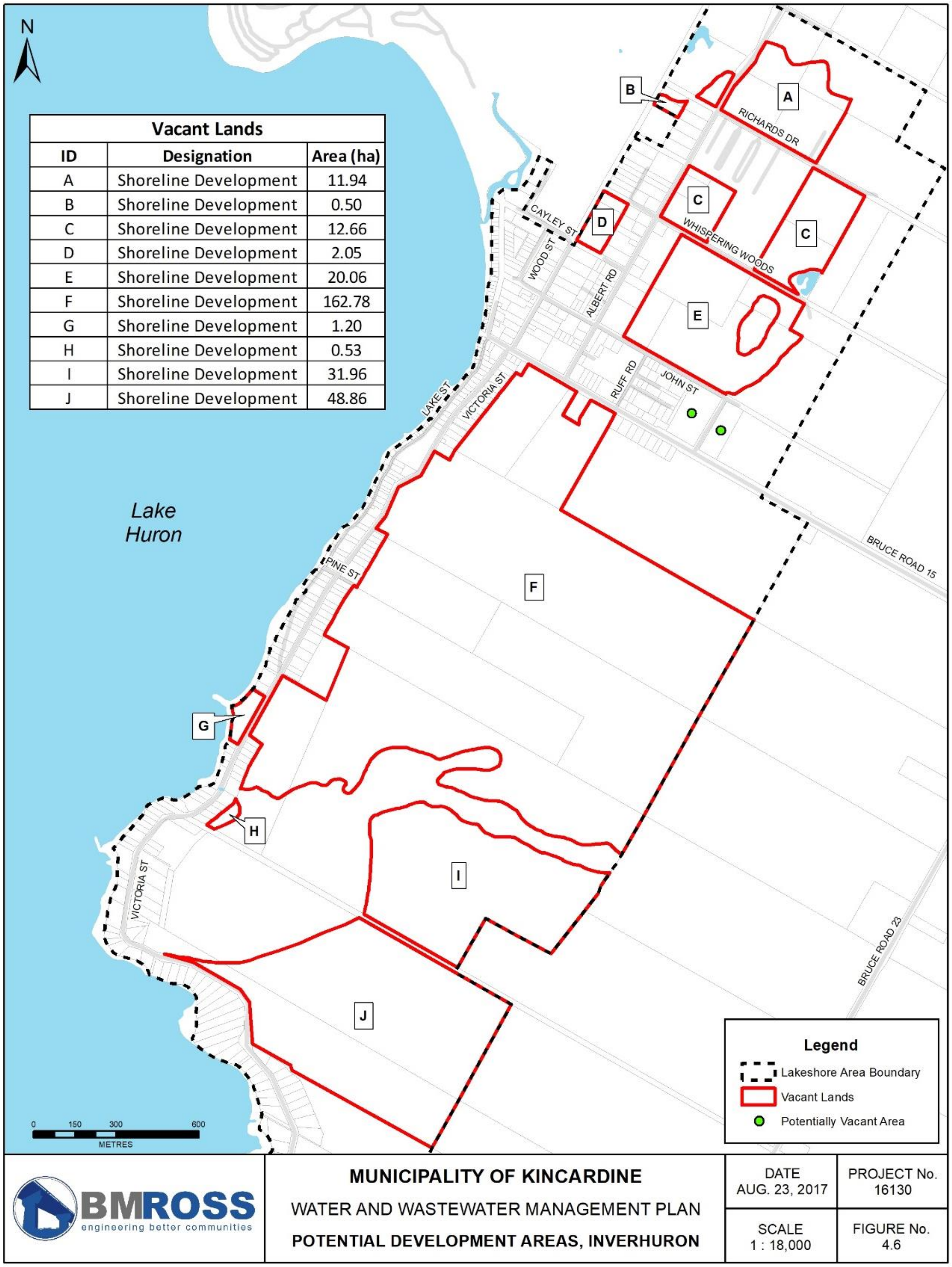
The forecasts of population growth include a very conservative estimate, provided by the Ministry of Finance projection. The Ministry of Finance projections estimates total growth of approximately 181 persons over the 50-year forecast period. Given recent growth trends and the availability of vacant residential land in the lakeshore area, the Ministry of Finance forecast is considered too low a prediction of potential growth.

The Official Plan High and Low Growth scenarios predict a greater amount of growth in the lakeshore area than the Ministry of Finance and Development Charge forecasts. The high growth forecast predicts an additional 2,072 persons (1,480 residential units) and the low growth predicts an additional 1,685 residents or 1,204 residential units.

4.1.6 Residential Growth Summary

Table 4.2 provides a summary of population growth projections to 2067 based on the various forecast methodologies, extrapolated as necessary. Table 4.3 shows the number of residences in Kincardine, Tiverton and the Lakeshore area, in 5-year intervals, based on the population projections.

Figure 4.6: Potential Development Areas, Inverhuron Area



Vacant Lands

ID	Designation	Area (ha)
A	Shoreline Development	11.94
B	Shoreline Development	0.50
C	Shoreline Development	12.66
D	Shoreline Development	2.05
E	Shoreline Development	20.06
F	Shoreline Development	162.78
G	Shoreline Development	1.20
H	Shoreline Development	0.53
I	Shoreline Development	31.96
J	Shoreline Development	48.86

Figure 4.7: Population Growth Forecasts, Lakeshore Area

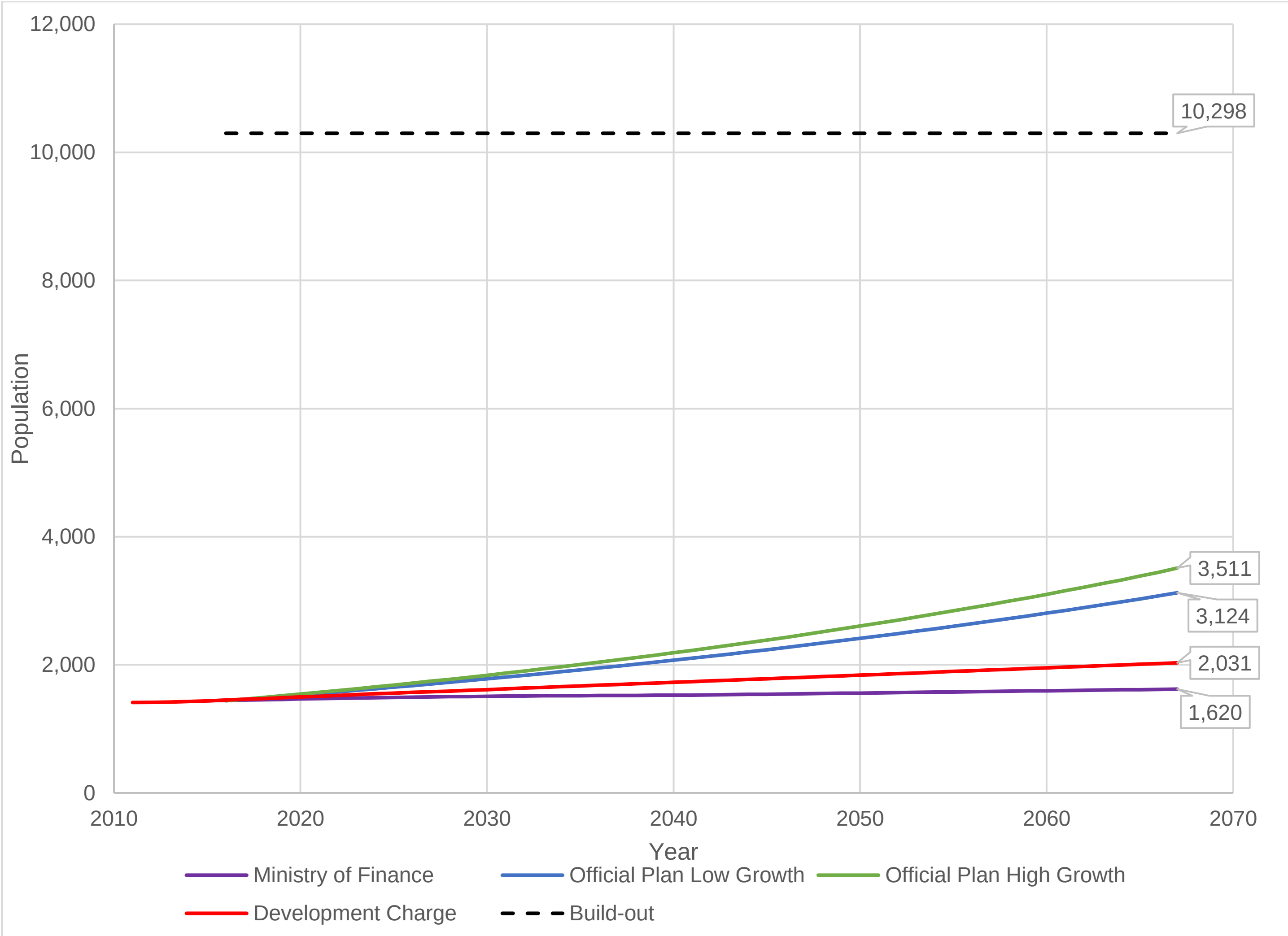


Table 4.2: Summary of Growth Population Projections to 2067

Forecast Methodology[1]	Kincardine (Town)	Tiverton	Lakeshore
Existing Population (2016)	8,315	725	1,439
Ministry of Finance	9,362	816	1,620
Development Charges	11,730	1,023	2,031
Official Plan – Low Growth	18,915	1,364	3,124
Official Plan – High Growth	22,509	1,544	3,511
Build-out	16,791[2]	1,780	10,298

[1]Forecasts extrapolated for 50-year period as necessary.
[2]An expanded urban boundary to Concession 5 between Bruce Road 23 and Highway 21 would increase build-out population potential to 24,762.

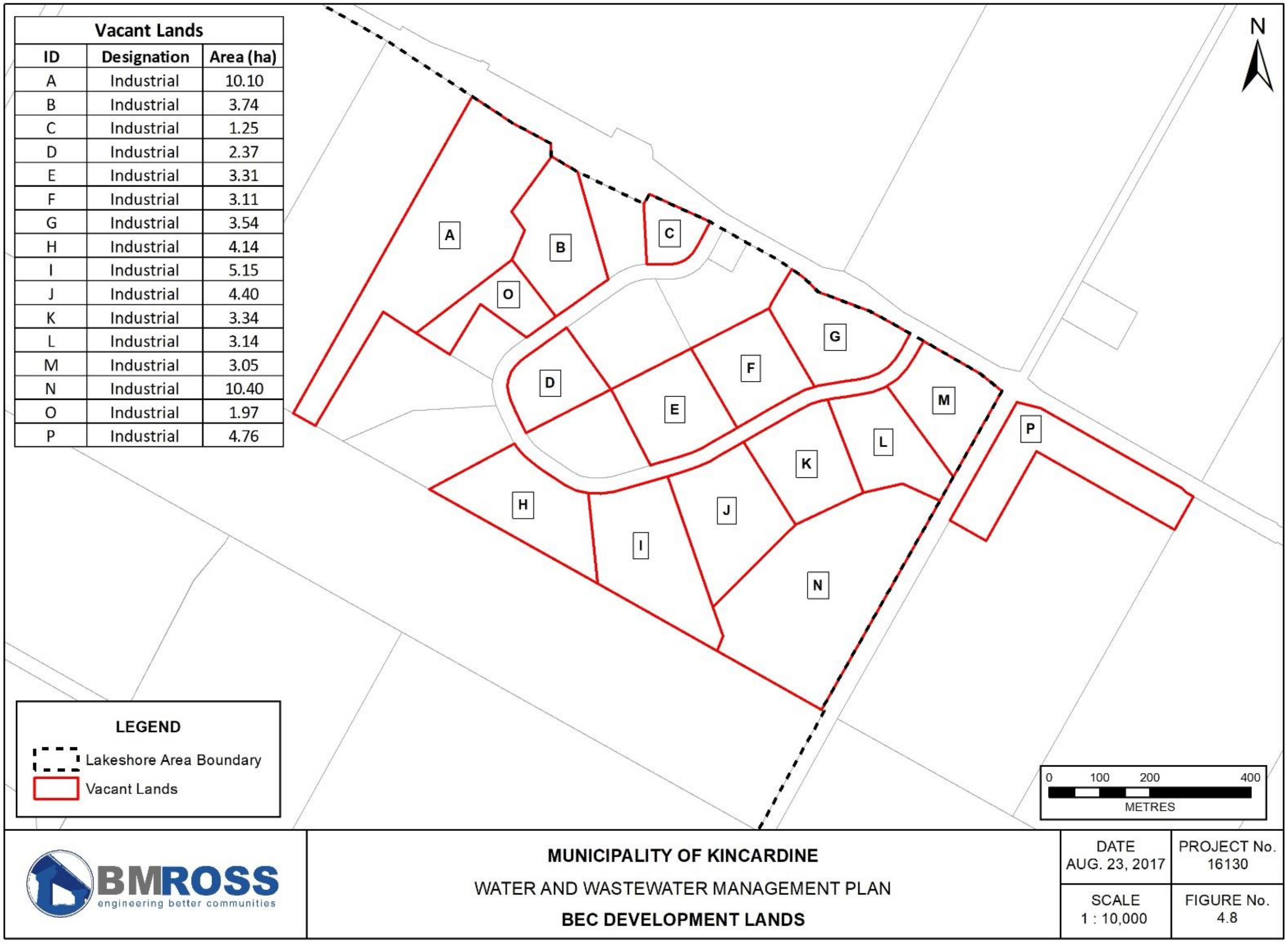
Table 4.3: Total Number of Residences, Based on Population Growth

	Total Number of Residences Based on Development Charge Forecast			Total Number of Residences Based on Official Plan - High Growth Forecast		
Year	Town of Kincardine	Tiverton	Lakeshore	Town of Kincardine	Tiverton	Lakeshore
2017	4,179	409	1,044	4,198	409	1,046
2022	4,350	426	1,086	4,628	440	1,141
2027	4,518	442	1,128	5,103	474	1,245
2032	4,675	457	1,168	5,626	510	1,359
2037	4,837	473	1,209	6,203	549	1,483
2042	4,999	489	1,249	6,839	591	1,618
2047	5,160	505	1,289	7,540	636	1,765
2052	5,322	521	1,330	8,314	684	1,926
2057	5,484	537	1,370	9,166	737	2,102
2062	5,645	552	1,411	10,107	793	2,293
2067	5,807	568	1,451	11,143	858	2,508

4.2 Non-Residential Growth Forecasting

For non-residential growth in Kincardine and Tiverton, it was assumed growth would increase with population growth in proportion to the existing ratios. For the BEC lands, it was assumed that full build-out of the available lands will occur gradually over the next 50 years. The development lands at the BEC and Concession 2 are shown in Figures 4.8 and 4.9.

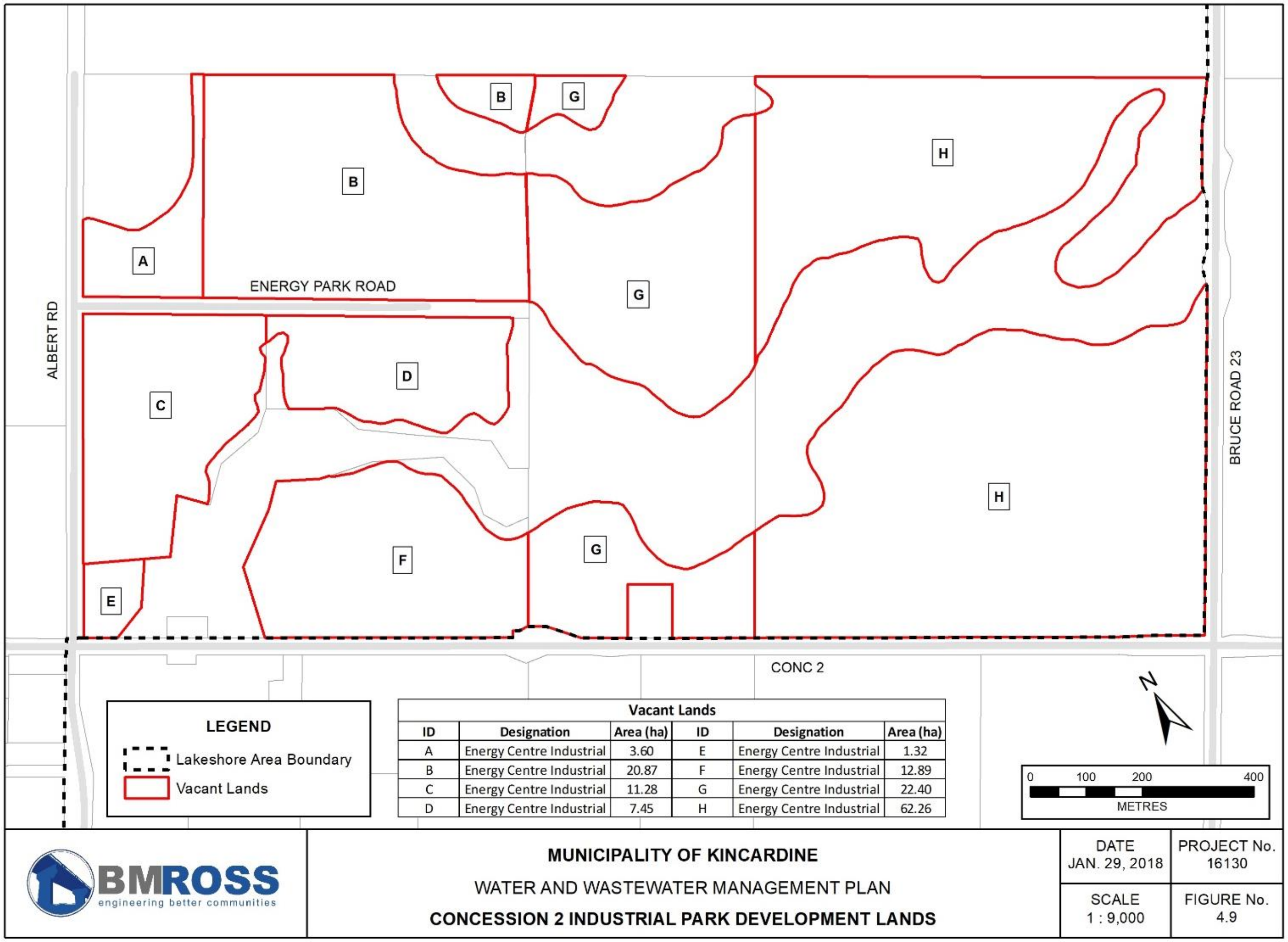
Figure 4.8: BEC Development Lands



Vacant Lands

ID	Designation	Area (ha)
A	Industrial	10.10
B	Industrial	3.74
C	Industrial	1.25
D	Industrial	2.37
E	Industrial	3.31
F	Industrial	3.11
G	Industrial	3.54
H	Industrial	4.14
I	Industrial	5.15
J	Industrial	4.40
K	Industrial	3.34
L	Industrial	3.14
M	Industrial	3.05
N	Industrial	10.40
O	Industrial	1.97
P	Industrial	4.76

Figure 4.9: Concession 2 Industrial Park Development Lands



Vacant Lands

ID	Designation	Area (ha)	ID	Designation	Area (ha)
A	Energy Centre Industrial	3.60	E	Energy Centre Industrial	1.32
B	Energy Centre Industrial	20.87	F	Energy Centre Industrial	12.89
C	Energy Centre Industrial	11.28	G	Energy Centre Industrial	22.40
D	Energy Centre Industrial	7.45	H	Energy Centre Industrial	62.26

4.3 Bruce Power Servicing

4.3.1 Background

In accordance with a request from the Municipality of Kincardine and Bruce Power, BMROSS commenced analysis related to the feasibility of providing water and wastewater services to Bruce Power. The analysis is a component of the overall Water and Wastewater Master Plan. Sections 7.2 (water) and 8.3 (wastewater) provide some summary details and general conclusions related to servicing Bruce Power. Refer to Technical Memo No. 1 (B. M. Ross and Associates Limited, 2017) for full results of the analysis.

The remainder of this section provides a summary of how design criteria related to servicing Bruce Power can be described in terms of growth.

4.3.2 Water

In terms of water usage, several scenarios were considered in accordance with design requirements provided by Bruce Power staff, namely provision of water at peak rates of 40 L/s, 95 L/s, or 133 L/s. In summary, dedicated water treatment ranging from 30% to 100% of the current Kincardine WTP rated capacity would be required to meet the Bruce Power supply requirements.

Sections 7.1 and 7.2.1 provide an explanation of how water usage is defined in terms of per residential unit. The water supply requested by Bruce Power would be equivalent to as few as approximately 2,100 and as many as 7,000 residential dwellings.

4.3.3 Wastewater

Bruce Power provided two wastewater flow scenarios, corresponding to existing flow and future design flow of 1,113 and 1,513 m^3/day, respectively

In terms of wastewater flow, using the capacity requirements provided by Bruce Power and the same methodology described above for water (refer to Section 8.3.1 for wastewater usage per residential unit), the wastewater capacity requested by Bruce Power would be equivalent to as few as approximately 1,550 and as many as 2,100 residential dwellings.

5.0 OPPORTUNITY STATEMENT

5.1 Overview

The Municipality of Kincardine initiated a Water and Wastewater Servicing Master Plan study to investigate existing water and wastewater infrastructure and develop a strategy for the provision of required future services. The following areas are included within the scope of the Servicing Master Plan: the town of Kincardine, Tiverton, Bruce Energy Centre Industrial Park, Concession 2 Industrial Park, and the lakeshore area west of Bruce Road 23, including Inverhuron to the northern extent of Kincardine.

The major components of the study include:

- A review of existing water and wastewater infrastructure;
- Identifying the potential scale of growth and development within the study area;
- Determining the infrastructure requirements to provide water and wastewater services to Bruce Power; and

- Determining the timing and sequence of future expansions of major facilities (including treatment, storage, sewage pumping stations, and trunk mains).

The following sections of this report document the process conducted during the Master Plan, as well as identification of a preferred servicing strategy. The key components of the process are summarized below:

- Identification of a problem or opportunity statement;
- Identification of practical alternatives to address the identified problem or opportunity;
- An evaluation of potential impacts associated with the identified servicing strategy;
- Selection of a preferred servicing strategy; and
- Identification of projects requiring further investigations.

5.2 Defined Opportunity Statement

Under Approach 1 of the Master Plan process (as outlined in Section 1.4), the first two phases of the Class EA process must be completed. The first phase of the Class EA process involves the identification of the problems or opportunities that needs to be addressed. The following Opportunity Statement has been identified to provide direction for this Master Plan:

The Municipality of Kincardine is investigating infrastructure and servicing needs related to municipal water and wastewater to accommodate anticipated future growth and development, and existing unserviced development within Kincardine, Tiverton and the Lakeshore area. There is also an opportunity to investigate the integration of water and wastewater services to service Bruce Power.

6.0 APPROACH TO EVALUATION OF ALTERNATIVES

6.1 Overview

Phase 2 of the Class EA process involves the evaluation of alternatives. The purpose of this phase is to examine the potential environmental impacts and to examine potential mitigation for any identified impacts. A preferred solution or series of solutions is then selected. This Master Plan is utilizing Approach 1 for a broad assessment tool for the water and wastewater systems, and as such, any projects identified within this Master Plan will require additional investigations through the EA process. Given this, the evaluation of alternatives in this Master Plan is a broad assessment of impacts, practicality and overall feasibility, designed to guide further investigations.

6.2 Evaluation Methodology

The evaluation of the identified alternatives was carried out using a comparative assessment methodology to assess the relative merits or impacts of the alternative solutions. This method of evaluation allows for the incorporation of environmental factors into the decision-making process and minimization of potential environmental effects. The evaluation method involved the following tasks:

- General assessment of existing land use activities, infrastructure, natural features and socioeconomic characteristics;
- Review of proposed alternatives and related works;
- Determination of the level of complexity required to complete the impact assessment;

- Identification of the environmental components and subcomponents that may be affected by the alternative (i.e., define the evaluation criteria);
- Prediction of environmental impacts, both positive and negative from construction and operation of the alternatives; and
- Selection of a preferred alternative following the comparative analysis of the relative merits of each alternative.

Under the terms of the EA Act, the environment is divided into four general components:

- Natural environment;
- Social and cultural environment;
- Economic environment; and
- Technical environment

The identified environmental components can be further subdivided into specific elements. The following table provides an overview of the specific environments that were considered relevant to this study. For the purposes of this study, where there is a specific impact to an environmental element, it is identified in the comparison table.

Table 6.1: Environmental Factors Included in Evaluation

Environmental Component	Sub-Components
Natural	• Significant Natural Features • Species at Risk • Surface Water Quantity and Quality • Source Water Quantity and Quality • Vegetation • Air Quality
Social and Cultural	• Agreement with Planning Policies • Adjacent Land Uses • Noise • Heritage and Cultural Resources • Archaeological Features • Development and Growth
Economic	• Capital Costs • Operational and Maintenance Costs
Technical	• Compatibility and Integration with Existing Infrastructure • Need for Maintenance • Life-Cycle • Technical Complexity

The overall potential impact for each environmental component was assigned a rating as part of the comparative analysis. The criteria for the assigned impact levels is summarized in Table 6.2.

Table 6.2: Criteria for Impact Levels Used in Evaluation

Impact Rating	General Criteria
High	Implementation of the alternative could threaten sustainability of the environmental component/feature and should be considered a concern. Additional remediation, monitoring and research may be required to reduce impact potential.
Moderate	Implementation of the alternative could result in a decline of the resource below baseline, but impact levels should stabilize following project completion and into the foreseeable future. Additional management actions may be required for mitigation.
Low	Implementation of the alternative could have a limited impact upon the environmental component/feature during the lifespan on the project. Research, monitoring and/or recovery initiatives may be required for mitigation purposes.
Minimal/Nil	Implementation of the alternative could impact upon the environmental component/feature during the construction phase of the project but would have negligible impact during the operation phase.

7.0 WATER SERVICING

7.1 Definition of an Equivalent Residential Unit

For the purposes of quantifying servicing requirements for current development commitments and future growth, water demands, and wastewater flows are described in terms of Equivalent Residential Units (ERUs). An ERU is defined as the unit flow design value for an individual residential unit, including single detached, semi-detached, apartments, condominiums, etc.

Values per ERU are calculated in Sections 7.2.1 and 7.3.1 for water, and Sections 8.2.1 and 8.3.1 for wastewater.

An analysis of the water usage of the 16 largest water customers in Kincardine, for 2013 to 2015, indicates that the inclusion of large non-residential users will affect resultant ERU values by less than 3%. The impact for the Tiverton system is anticipated to be even less, as a result of there being a smaller proportion of non-residential flows. Therefore, values used in the calculation of Kincardine water and wastewater ERUs, and the Tiverton water ERUs, include non-residential flows and customers for simplicity. This will result in a slight overestimation of each residential unit servicing requirements. Tiverton wastewater ERUs are calculated more specifically to residential and small commercial customer flows, with industrial flows separated, because there are significant industrial wastewater contributions for the BEC WWTP service area as described in Section 8.3

7.2 Kincardine Drinking Water System

The KDWS is approved by the Ministry of Environment and Climate Change and described in Drinking Water Works Permit (DWWP) No. 088-202 Issue No. 3 and Municipal Drinking Water License (MDWL) No. 088-102 Issue No. 2.

The KDWS services the former town of Kincardine, a portion of the community of Inverhuron, IPP, and portions of the Lakeshore between Kincardine and Inverhuron. The locations of major facilities in the existing KDWS are shown in Figures 2.1 and 2.2. The major facilities include a single water treatment plant (WTP), standpipe, chlorine booster station at Inverhuron, and distribution watermain.

The Kincardine WTP, located at 155 Durham Street in Kincardine, has had significant upgrades and expansions in the 1970's, 1990's, and 2007-2008. The plant is a surface water supply, with Lake Huron as the source.

The Kincardine Standpipe and associated booster pumping station (BPS) were constructed in 1984-1985. Currently, the BPS facilities at the site are not in use and would require rehabilitation in order to contribute to the supply.

7.2.1 Population Growth and Water Demands

7.2.1.1 EXISTING CUSTOMER BASE

Section 4 identifies the existing and projected populations for Kincardine. The projected population growth for areas serviced by the KDWS is provided on Figures 4.1, 4.2 and 4.6.

To establish the existing customer base, the Municipality provided the current number of metered/billed properties as of April 2017. Some condominium and apartment buildings have one water meter for multiple users, and in those cases the known number of individual housing units (in lieu of one service representing a single customer) were added to the total number of meters in order to determine an equivalent number of residential units.

For the KDWS:

- No. of metered customers = 3,839
- Additional for condo/apartments = 405
- Calculated total customers = 4,244
- Inverhuron Provincial Park = 1 service

It is assumed the IPP water and wastewater servicing requirements in the future will be consistent with agreements for servicing, rather than growing annually.

7.2.1.2 EXISTING DEMANDS

The volume of treated water discharged from the Kincardine WTP is less than the volume of raw water that enters the plant as a portion of the treated water produced is used for in-plant processes such as backwashing. A WTP's reported capacity is based on its net drinking water production rate. This is equivalent to the difference between gross treated water production and losses due to in-plant processes and demand. Treated water demands were therefore used as the basis for water demand calculations. Table 7.1 summarizes treated water demands from 2014 to 2016.

Table 7.1 Summary of Kincardine WTP Water Demands

	Kincardine WTP Demand (m^3/d)	
Year	**Average Day**	**Maximum Day**
2014	2,911	6,335
2015	3,531	6,965
2016	2,965	5,760
Average or Maximum	3,136	6,965

Given that the principal design basis for water supply is maximum day, the critical value is 6,965 m^3/day. Dividing the demands by the total number of customers provides values per ERU, and on this basis the KDWS has demand values of:

- Average day: 0.74 m^3/day per ERU
- Maximum day: 1.64 m^3/day per ERU

7.2.1.3 DEVELOPMENT COMMITMENTS

Existing commitments, including servicing agreements and approved developments, should be considered when planning for infrastructure expansion. The Municipality may consider that maintaining a certain quantity of uncommitted plant capacity is necessary. This could impact timing decisions related to infrastructure expansion. For instance, the Municipality would not want to be in a position where a potential development is not able to proceed due to insufficient water or wastewater treatment capacity. That scenario is prevented by maintaining a proportion of uncommitted plant capacity and carrying out expansion of key facilities before the uncommitted capacity is fully utilized.

For the KDWS, the following are considered to be development commitments at this time.

- Residential development commitments (B. M. Ross and Associates Limited, 2017) = 859 ERUs;
- Inverhuron (B. M. Ross and Associates Limited, 2017) = 200 ERUs;
- Business Park = assume 281 ERUs[1]; and
- Total commitments = 1,340 ERUs.

The 1,340 ERUs correspond to a maximum day water demand of 2,198 m^3/day.

7.2.1.4 FUTURE DEMANDS

As described in Section 4.1, population projections for a 50-year period were established using a variety of methodologies based on available forecasts. To demonstrate the significance of the variation in forecasts, as it relates to water and wastewater, additional demands based on the Development Charges forecast and the Official Plan High Growth scenario, each extrapolated for the 50-year period were calculated. These two scenarios were considered because they cover the range of development potential that we assume the Municipality would consider planning for, as the Ministry of Finance forecast is considered unrealistically low. We note the build-out forecast for the Lakeshore is, at this point, considered unrealistically high, while the Official Plan High Growth scenario for the Town of Kincardine assumes an increase to the build-out area.

To project water demand and storage requirements, the projected future population for each year up to 2067 was calculated. Existing demands were then extrapolated, assuming non-residential demands would increase with population growth in proportion to existing ratios. It is anticipated that this approach will result in a conservative projection (i.e. slight over estimate) of future demands. This is based largely on the experience that as population increases, the maximum day factor for water demand decreases. Also, conservation measures related to

[1] Based on MOECC Design Guideline (2008) design water demand value of 28 m^3/ha/d as average for commercial and light industry, a maximum day factor of 2.0, and 15% of the 59.3 ha Business Park as committed.

water use are gaining popularity. The result is that the demand per ERU is anticipated to decline with growth.

Table 7.2 provides a summary of the forecasted future water demands, based on the two growth scenarios utilized. The data is provided graphically on Figure 7.1. Analysis data, on a year by year basis, is provided within Appendix B.

It is noted that the 1,340 ERUs considered to be commitments would correspond to development to 2031 under the Official Plan High Growth scenario, and to 2056 under the Development Charges scenario. In either case, there is a relatively significant timeframe before committed capacity at the WTP would be fully utilized. It is not necessarily recommended that the Municipality plan to always maintain reserve for 1,340 ERUs as commitments.

Table 7.2: Forecasted Maximum Day Water Demands - KDWS

	Maximum Day Water Demand (m^3/d)	
Item	**Official Plan High Growth Scenario (Extrapolated to 2067)**	**Development Charges (Extrapolated to 2067)**
Current demand	6,965	6,965
Development commitments demand	2,198	2,198
Increase in demand to 2067	11,615	2,796
Total demand in 2067 without commitments	18,580	9,761
Total demand in 2067 plus commitments[1]	20,778	11,959

[1]Assumes same current commitments applies in 2067.

7.2.1.5 BRUCE POWER DEMAND

It is important to note, concurrent with the Master Plan process, the Municipality has been in discussion with Bruce Power related to the feasibility of providing water and wastewater servicing. Refer to TM1 (B. M. Ross and Associates Limited, 2017) for a discussion related to water supply feasibility, including potential quantities and infrastructure requirements associated with servicing Bruce Power. Through this assessment work and discussions with Municipal and Bruce Power staff, a new WTP at the north end of the Municipality was identified as preferred method for servicing Bruce Power. A Class EA related to a new north WTP is currently underway.

7.2.2 WTP Existing and Forecasted Capacity Requirements

The rated capacity of the Kincardine WTP is established in the MDWL as 11,563 m^3/day. The plant currently has an uncommitted reserve of 2,400 m^3/day. This corresponds to an uncommitted capacity for 1,463 ERUs.

Figure 7.1 shows the relationship between existing plant capacity and forecasted demand throughout the study period. Projected timing for the WTP requiring expansion varies significantly based on scenario, and therefore expansion will be driven by actual growth rates experienced in the service area. Table 7.3 provides a summary of the year at which plant capacity would be fully utilized for the scenarios considered.

Figure 7.1: Kincardine WTP Forecasted Maximum Day Water Demands

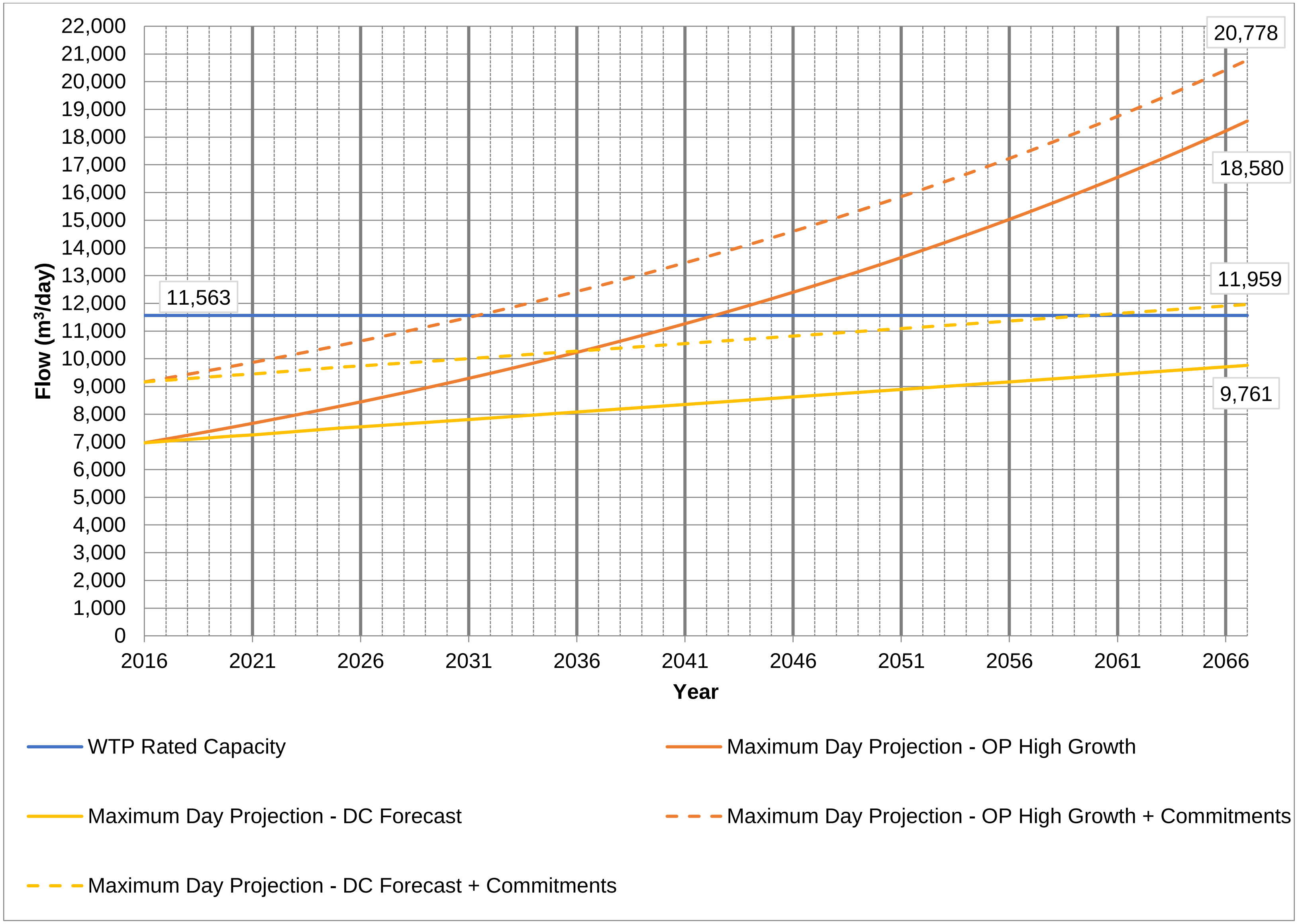


Table 7.3: Kincardine WTP Forecasted Utilization of Current Capacity

Scenario (Extrapolated)	Existing Capacity Fully Utilized by Year
Official Plan High Growth	2043
Official Plan High Growth + Commitments	2032
Development Charges	Beyond 2067
Development Charges + Commitments	2060

7.2.3 Capacity Alternatives

At this time, in our opinion there is no immediate need to consider further expansion of the Kincardine WTP. In the future, depending on the levels of growth, there may be a need to provide increased water treatment in order to meet demands.

There are three potential alternatives for the provision of increased capacity that have been identified. These alternatives are:

I. A new WTP at the north end of the Municipality;
II. Expansion of the Existing Kincardine WTP; and
III. Do Nothing.

Initial technical investigations done in response to a request from Bruce Power for municipal water services identified that servicing from a new WTP, generally within the northern area of the Municipality, would be the most practical approach to providing water to the site. A new WTP could be interconnected to the KDWS at Inverhuron. A Schedule C Class EA was initiated to further investigate the feasibility, alternatives and impacts associated with a new WTP.

Capacity may also be increased through an expansion of the existing WTP. A physical expansion of the plant is limited by the lack of available vacant lands around the existing WTP; however, modifications to some plant treatment processes and potential use of Kincardine Pavilion lands to the south for buried infrastructure could be considered. Even with potential changes to treatment processes to optimize the existing footprint and/or expansion into adjacent lands to the south, there will be a practical limitation for a WTP capacity increase without acquisition of additional land. Establishing an actual value for this limit would require significant preliminary design, which is beyond the scope of this Master Plan. Upgrades to specific plant processes would be required, including but not necessarily limited to the following:

- Increase raw water pumping capacity at the low-lift pumping station:
    - The existing raw water intake is rated for 18,750 m^3/day, which was based on design low water lake levels using data available in 1975. During 2000 to 2015, minimum lake levels in some months were below the original intake design low water level, which means that in some months the intake may not be capable of supplying at 18,750 m^3/day. During the last one to two years, lake levels have been increasing but any future plan to increase WTP capacity will need to consider how current lake levels relate to original intake design.
- Add a third high-rate sedimentation unit in a new building expansion;
- Install a fifth filter, complete with associated piping modifications;
- Increase treated water pumping capacity by replacing some or all high-lift pumps; and
- Add UV disinfection treatment to allow the use of more treated water storage volume, as described above.

Under the Municipal Class EA process, the Do Nothing alternative is always presented as an option. It may be implemented if the environmental impacts of the other alternatives are significant and cannot be mitigated.

Table 7.4 summarizes the impact evaluation of the three alternatives:

Table 7.4: Impact Assessment for Kincardine Water Capacity Alternatives

Environmental Component	Alternative I – New WTP	Alternative II – Expansion of Existing WTP	Alternative III – Do Nothing
Natural	Moderate – impacts mostly related to construction of new WTP. Mitigation would include avoiding sensitive areas.	Minimal/Nil	Minimal/Nil
Social and Cultural	Low – supports continued growth and development in Municipality. -Would create new source protection areas. -No interruption in service likely.	Low – may be interruptions to service during construction of any expansion.	Moderate – will not support continued growth and development.
Economic	Moderate – high capital costs for new WTP. Costs could be mitigated through cost sharing agreements, grants. -Will have ongoing maintenance and operation costs.	Moderate – capital costs would be dependent on updates required. -Will have ongoing maintenance and operation costs.	Minimal/Nil
Technical	Low – if a new WTP is constructed, could be interconnected with existing KDWS and would eliminate need to expand existing WTP. -Provides redundancy in system. -Existing lakeshore distribution system is in place and would allow for interconnection.	Moderate – limited by lack of available space for physical plant expansion -Technically most complex option. -Potential capacity increase unknown and would require significant preliminary design before known. -Need to consider current and recent historical lake levels versus original intake design	Minimal/Nil
Summary	Most preferred	Preferred in absence of Alternative I	Least preferred

In the event that a new north WTP proceeds to construction, it will significantly defer and possibly eliminate any need to further consider expansion of the existing WTP. Given the above, the preferred alternative for increasing supply capacity is connection to a new WTP in the north end of the Municipality. Following the Class EA for the new WTP, if the project does not proceed, the Municipality should re-evaluate Alternative II – Expansion of the Existing WTP, once increase demand associated with development warrants this.

7.2.4 Water Storage Capacity Assessment

7.2.4.1 PURPOSE OF STORAGE

Treated water storage is required for three purposes:

A. Fire protection (volume is based on duration and rate per MOECC Table 8-2);
B. Peak flow equalization (assumed to be 25% of maximum day demand); and
C. Emergencies (25% of A + B).

The method of establishing the amount of storage required is more fully set out in the MOECC “Design Guidelines for Drinking Water Systems 2008”. The total quantity required is generally a function of population served and daily usage.

7.2.4.2 AVAILABLE STORAGE

Table 7.5 identifies the existing storage facilities in the KDWS and their volumes. Effective volume is considered to be the volume that is readily available for use under typical operational conditions.

Table 7.5: Kincardine Water Storage Facilities

Facility	Total Volume (m^3)	Effective Volume (m^3)
Kincardine WTP Reservoir	4,120	2,788[1]
Kincardine Standpipe	3,250	433[2]
Kincardine Total	7,370	3,221

[1]The balance of the volume is retained for chlorine contact purposes. Actual required volume will vary with operational parameters such as water temperature and pH, but the value shown is typical for worst case (i.e. winter) conditions with the current chlorine residual setpoint.
[2]Currently only the top 5 m of the standpipe is available by gravity.

7.2.4.3 OPERATIONAL DESCRIPTION

Within the WTP there is a three-compartment clear well, each compartment having a different volume with total combined volume of 4,120 m^3. Three vertical turbine high lift pumps, each rated 130 L/s, cycle to pump water from the clear well to maintain water levels in the standpipe. While the WTP is rated to treat up to 11,563 m^3/day (134 L/s), the DWWP does not limit the rate at which water may be supplied from the WTP to the distribution system. Therefore, water may be supplied at a rate greater than 134 L/s (i.e. with more than one high lift pump in operation), but the duration for which this is possible is limited by the available volume in the clear well that is not required for chlorine contact purposes. For example, a review of annual data for 2011 through 2016 indicates that, on a maximum daily basis (i.e. over a 24 hour period), the WTP has supplied up to 172 L/s.

172 L/s (considered to be the historical maximum day) – 134 L/s (WTP treatment capacity) = 38 L/s, which over a 24-hour period equates to 3,283 m^3. This is slightly more than what is considered to be the effective volume of the WTP clear well. For the purposes of this analysis, we have assumed:

- On a daily basis, 2,788 m^3 (32 L/s) is available from the clear well; and
- On a short-term peak basis, the high lifts may supply up to 195 L/s (assumes 50% increase in supply by activating second high lift pump).

Adjacent to the standpipe is a BPS, which was originally designed to activate if the water level in the standpipe dropped below a specified setpoint. This would allow stored water in the standpipe, which is unavailable by gravity, to become available. Currently the BPS is not in service, limiting the volume of water that is effectively available in the standpipe.

7.2.4.4 REQUIRED VOLUMES

Table 7.6 provides a summary of the required storage categories for the current serviced population in the KDWS. The values are provided based on MOECC Guidelines. Refer to Appendix B for detailed calculations and descriptions.

Table 7.6: Current Kincardine Water Storage Requirements

Storage Description	Recommended Volume per MOECC Guidelines (m^3)	Notes
A – Fire Protection	2,021	187 L/s for 3 hrs, per MOECC Table 8-2
B – Equalization	1,741	25% of maximum day demand
C - Emergencies	941	25% of A + B
Total A + B + C	4,703	

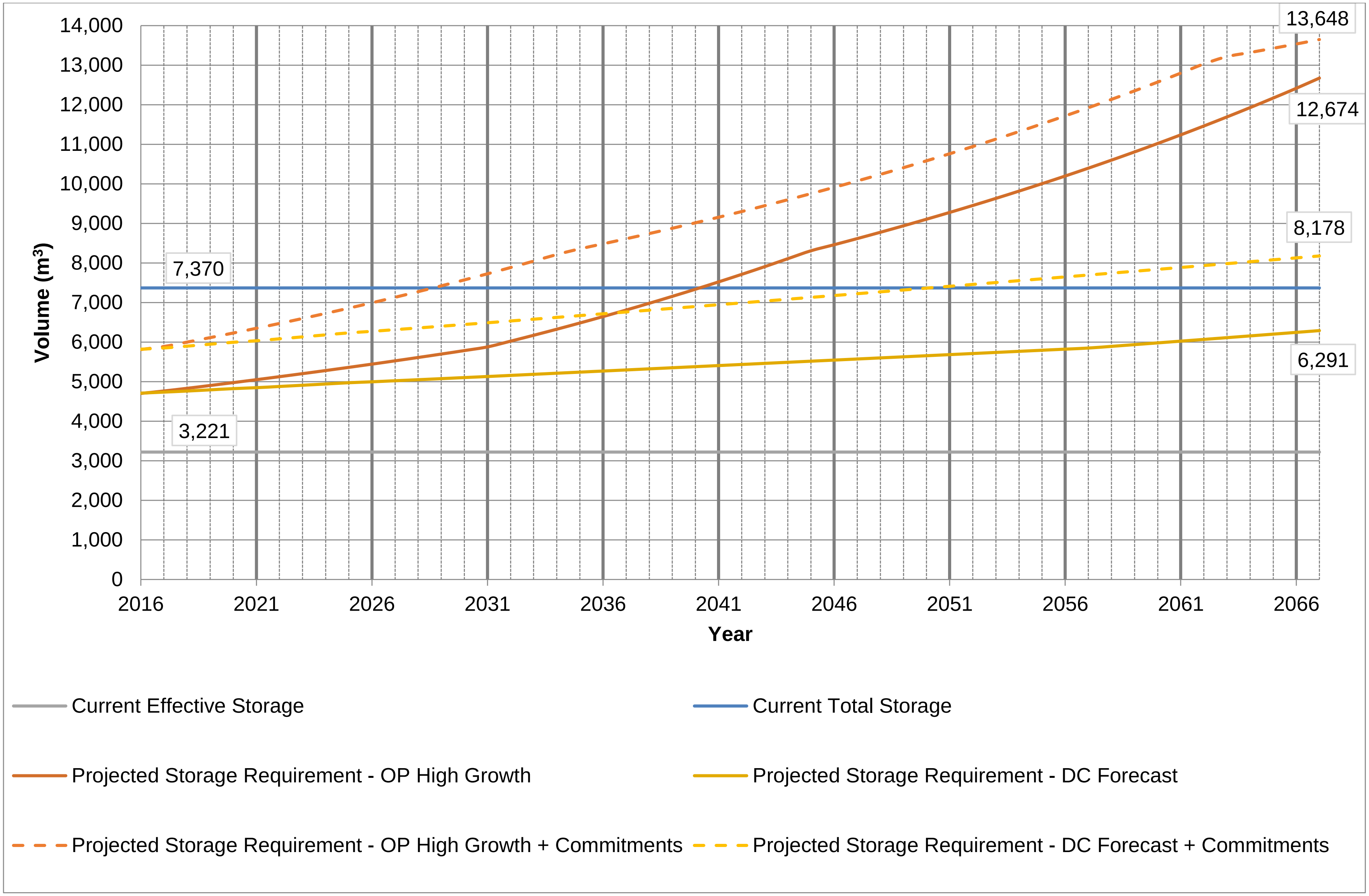
At this time, there is approximately 3,221 m^3 of effective storage, compared to the 4,703 m^3 recommended in accordance with MOECC Guidelines. This represents a deficit of approximately 1,482 m^3. Factoring in development commitments, the recommended storage volume becomes 5,692 m^3. Figure 7.2 shows the relationship between existing storage and forecasted requirements throughout the study period.

7.2.4.5 RESPONSE OF STORAGE DURING VARIOUS DEMAND SCENARIOS

MOECC Guidelines generally estimate peak demands to be 50% greater than maximum day demands. For the current situation in Kincardine, peak demand would therefore be estimated to be 150% of 6,965 m^3/day, which is equivalent to 121 L/s. At this demand, once the standpipe minimum water level setpoint is reached, a single high lift pump at the WTP will be called to activate and can produce 130 L/s, which will satisfy the peak demand and allow the standpipe to begin refilling, albeit at a low rate. Because the clear well can replenish at up to 134 L/s, under this demand scenario both the WTP and standpipe can function without depleting storage beyond the effective volumes, though there is a difference of only 13 L/s between the estimated peak demand and the rated capacity of the WTP.

From historical records, as previously described, it is known that at times the WTP has supplied at a rate of 172 L/s over a 24-hour period. At any supply rate in excess of 134 L/s (i.e. the treatment capacity of the plant), the duration for which this can occur is limited. Assuming the standpipe effective volume has been exhausted and water is coming only from the WTP, at 172 L/s the effective volume of the clear well would be exhausted in approximately 4.5 hours. At 195 L/s, the estimated discharge with two high lift pumps running, the effective volume of the clear well would be exhausted in approximately 4 hours.

Figure 7.2: Kincardine Water Storage Forecasted Requirements



Typical practice is to assume that a fire occurs when the storage facility's equalization volume is exhausted and simultaneous with maximum day demand. For the current Kincardine demands, based on MOECC Guidelines, the total demand would be 187 L/s for fire flow + 81 L/s maximum day demand = 268 L/s. Retained volume within the clear well effective storage at the start of the fire condition would be 3,221 – 1,741 = 1,480 m^3. Assuming the clear well is replenishing at a rate of 134 L/s, the net flow out of the clear well would be 268 – 134 = 134 L/s. At this rate, the 1,480 m^3 of remaining effective volume would be utilized in 3 hours. The MOECC Guidelines recommend using a 3-hour fire duration for the current KDWS service population.

7.2.4.6 STORAGE ALTERNATIVES

The current effective volume of the Kincardine storage facilities is sufficient to meet peak flow equalization and a portion of the recommended fire storage, but not emergency design values. In situations where storage facilities, external to the treatment facilities, have insufficient volume to meet peak flow equalization requirements, then peak flow must be met from other sources. For the case of Kincardine, this is currently occurring and the WTP is being utilized for this purpose. As community growth continues and water demands increase accordingly, the opportunity to augment the storage deficit from the WTP will diminish.

It is noted that the following alternatives exist to increase the effective storage of the Kincardine WTP reservoir and standpipe. They include:

I. Modifications to the WTP and rehabilitation of the existing BPS;
II. New Storage Facility; and
III. Do Nothing.

For Alternative I, several modifications at the WTP could be considered to decrease the volume of storage required for disinfection purposes, including: real time monitoring of chlorine residual, provision of baffling within the reservoir cells, or use of advanced primary disinfection practices [e.g. ultraviolet (UV); ozone]. At this time, we understand the Municipality is considering the use of UV for primary disinfection. Use of UV would reduce the requirement for the reservoir to provide chlorine contact time, thus making storage available for peak flow equalization and fire conditions. Additionally, for the standpipe, the stored water below the top 5 m of the structure is available if a booster pump located at the base of the structure is operated. The pump does not currently operate automatically. Rehabilitating the BPS could increase the volume of water readily available.

Alternative II involves the construction of an additional storage facility. Potential storage facilities include: an elevated tower, in-ground reservoir, or standpipe.

Under the Municipal Class EA process, the Do Nothing alternative is always presented as an option. It may be implemented if the environmental impacts of the other alternatives are significant and cannot be mitigated.

Table 7.7 summarizes the impact evaluation of the three alternatives:

Table 7.7: Impact Evaluation for Kincardine Water Storage

Environmental Component	Alternative I – Modifications to WTP and BPS	Alternative II – New Storage Facility	Alternative III – Do Nothing
Natural	Minimal/Nil – construction would be within existing facilities.	Moderate – size of footprint of storage facility dependent on type: small footprint (standpipe or elevated tower) or larger (reservoir). May be site impacts depending on location.	Minimal/Nil
Social and Cultural	Low – supports continued growth and development in Municipality. -No interruption in service likely.	Moderate – impacts to adjacent property owners during construction. -standpipe or elevated tank type storage have impacts related to shading and visual intrusion.	Moderate – will not support continued growth and development.
Economic	Low – capital costs associated with modifications to existing facilities are less than construction of a new facility. -Will have ongoing maintenance and operation costs.	Moderate – most expensive option in terms of capital costs. -Will have ongoing maintenance and operation costs.	Minimal/Nil
Technical	Low – makes use of and improves existing infrastructure.	Moderate – requires investigation to site new facility and integrate it into the existing system.	Minimal/Nil
Summary	Most preferred	Preferred in absence of Alternative I	Least preferred

7.2.4.7 CONCLUSIONS RELATING TO STORAGE

Assuming that the WTP and standpipe modifications are carried out such that total current storage becomes effective storage, the total volume of effective storage would increase to 7,370 m^3. Table 7.8 provides a summary identifying the year by which storage would be fully utilized for the scenarios considered, on this basis. Analysis data, on a year by year basis, is provided within Appendix B.

Table 7.8: Kincardine Water Storage[1] Forecasted Utilization of Total Capacity

Scenario (Extrapolated)	Total Storage Fully Utilized by Year
Official Plan High Growth	2041
Official Plan High Growth + Commitments	2031
Development Charges	Beyond 2067
Development Charges + Commitments	2056

[1] Assumes 7,370 m^3 total storage is made effective storage.

At this time, it is recommended the Municipality continue to pursue the WTP disinfection modifications and standpipe BPS rehabilitation to increase effective storage. These are anticipated to be the most cost and time effective means to achieve the recommended storage quantities. Next steps for this alternative will include preliminary design, approvals, final design and construction.

In the future, additional water storage will be required and will require a new facility separate from the existing WTP or standpipe. Based on a preliminary review of the system, it is recommended that a new storage facility be situated to the north of the existing urban limit, for the following reasons:

- The focus for development is currently to the north of the existing community, and situating storage within the development areas provides benefit by having the storage close to customers;
- There is operational benefit to locating additional storage more remote from existing source of supply and existing storage;
- There is operational advantage to having storage within the new pressure zone being planned for areas north of Gary Street;
- Topography generally increases in elevation to the north, and locating storage at higher elevations has operational benefit; and
- Vacant land will be available in this area.

A new storage facility to the north would be subject to review of policy for lands adjacent to the Municipal airport. For example, there are height restrictions for buildings which would be applicable to an elevated water storage tank.

7.2.5 Water Distribution System Modelling

7.2.5.1 BACKGROUND

The Kincardine water distribution system was modelled using WaterCAD®. The purpose of the modelling was to identify potential flow and pressure issues during periods of high demand and to determine requirements for supplying future development areas.

7.2.5.2 MODEL DETAILS

7.2.5.2.1 Software

BMROSS used Bentley® WaterCAD® V8i (SELECTseries 6) for the water distribution system modelling. The model contains 441 pipes and 348 junctions for the existing system. Refer to Appendix C for model details.

7.2.5.2.2 Sources of Data

In order to produce a WaterCAD® model for the Kincardine watermain network, several sources of information were used. In summary:

- Watermain installation locations and diameters were obtained from distribution system mapping (i.e. GIS database) provided by the Municipality;
- Watermain C-factors were assigned in accordance with values provided in the MOECC Guidelines, as summarized in the table below. For 100 mm diameter pipe, not listed in the MOECC Guidelines, a C factor of 100 was used:

Diameter (mm)	C
150	100
200-250	110
300-600	120

- Elevation information was obtained from GIS data provided by the Municipality;
- Pump and storage characteristics were obtained from a combination of existing BMROSS records from past projects, the DWWP for the KDWS, and Municipal staff comments;
- Water demand information was developed as part of this Master Plan (B. M. Ross and Associates Limited, 2017); and
- Assessments for fire protection capability were made using typical fire flow values including:
    - 40 to 50 L/s for residential areas;
    - 100 to 150 L/s for dispersed commercial development such as highway commercial, as well as institutional locations; and
    - 200 L/s for older, contiguous construction commercial areas.

All fire flows were assessed at 140 kPa minimum system residual pressure.

7.2.5.2.3 Establishing Flows at Junctions

WaterCAD® model "junctions" are created at every pipe intersection or dead-end. Water demands for the system are applied at these junctions. For the existing Kincardine model, the total system demand was divided by the total number of model junctions in order to calculate the demand per junction. This demand value was assigned to each junction.

For the future development model, the assumed locations for future trunk watermains were incorporated into the model, creating a series of additional pipes and junctions within the development lands. Demands for existing development were left unchanged, and the incremental future demand was applied amongst the nearest model junctions within or adjacent to the development lands. For the model, incremental future demand (2067) was estimated to be an additional 5,280 m^3/d for average day and 11,615 m^3/d for maximum day, in accordance with the Official Plan High Growth scenario as described in TM2 (B. M. Ross and Associates Limited, 2017).

7.2.5.3 ANALYSES RUN

In general, the model was used under steady-state analysis to determine system pressures under average and peak demands, and available fire flows under maximum day demands, for both existing and future development scenarios under different storage and pumping configurations. Various water treatment plant high-lift pump (HLP) statuses (i.e. on/off) and water storage levels in the standpipe were analyzed, in order to determine a range of operational conditions. A detailed list of all model scenarios includes:

- Existing development demands (average, peak) with standpipe at a nominal (i.e. average of normal high and low) water level, all HLPs off;
- Existing development demands (maximum day) plus fire flow:
  - Standpipe at nominal water level, all HLPs off;
  - Standpipe at low water level, HLP3 on;
  - Standpipe at low water level, HLP1 and HLP3 on;
- 2067 development demands (average, peak) with standpipe at a nominal water level, all HLPs off; and
- 2067 development demands (maximum day) plus fire flow:
  - Standpipe at nominal water level, HLPs off;
  - Standpipe at low water level, HLP3 on; and
  - Standpipe at low water level, HLP1 and HLP3 on.

7.2.5.4 QUALIFICATIONS ON RESULTS

7.2.5.4.1 Limited Calibration

Results of the distribution system modelling are based on the system information as described above. Limited work was completed to calibrate/verify the model by way of comparison to actual field data. In the event that future distribution system modifications are to be based on the results of system modelling, it is recommended that a field testing program be carried out for the purpose of comparing actual field measurements to model predictions. The field testing can be limited to the general location of the system expansion being evaluated.

7.2.5.4.2 Treatment and Storage Capacity

An extended period simulation (EPS) for maximum and peak demand scenarios confirms what was presented in Sections 7.2.2 and 7.2.3 regarding treatment and storage capacities, namely that expansions to treatment capacity and storage volume will be required to meet the Official Plan High Growth supply and storage design requirements. The expansions would be required well before full development is realized. The 2067 demand scenarios are analyzed on the basis of having adequate treatment and storage capacity provided.

7.2.5.4.3 Development Lands North of Gary Street

As illustrated in Figure 4.1, Municipal staff requested that the analysis include lands generally north of Gary Street and up to Concession 5, between Highway No. 21 and Bruce Road 23.

Ongoing analysis related to a proposed office and training centre north of Gary Street has already identified the need for a water BPS to service these lands with adequate pressure, primarily due to topographical constraints (i.e. increasing ground elevation). Additionally, watermain improvements within the existing system are required to provide adequate flow to the north end of Gary Street.

The 2067 model scenario was created on the basis of the BPS at the north end of Gary Street, and related watermain improvements, having been constructed. This will effectively create two pressure zones within the KDWS. The BPS, and the watermain upgrades related to supplying water up to the BPS, are being designed on the basis that this new pressure zone would service:

- A proposed office building at the north end of Gary Street;
- Approximately 32.8 ha of industrial, commercial, and institutional (ICI) development land, representing 1,100 ERUs; and
- Approximately 1,500 residential units.

7.2.5.5 RESULTS OF ANALYSIS

The results of the WaterCAD® analysis for both the existing and future (i.e. 2067) conditions are presented in Table 7.9.

Table 7.9: Summary of WaterCAD® Analysis - Kincardine

Analysis[1,2] and Criteria[3]	**Existing Demands**	**2067 Demands**
Average Flow		
No. of junctions with kPa > 700	5	1
No. of junctions with kPa > 480 and <= 700	221	197
No. of junctions with kPa > 350 and <= 480	115	145
No. of junctions with kPa > 275 and <= 350	7	10
No. of junctions with kPa < 275	0	0
Peak Flow		
No. of junctions with kPa > 700	1	0
No. of junctions with kPa > 480 and <= 700	171	51
No. of junctions with kPa > 350 and <= 480	164	255
No. of junctions with kPa > 275 and <= 350	12	36
No. of junctions with kPa < 275	0	11
Fire Flows – All HLPs Off		
No. of junctions with Q < 40 L/s at 140 kPa	4	10
No. of junctions with Q > 40 and < 50 L/s at 140 kPa	13	19
No. of junctions with Q > 50 and < 100 L/s at 140 kPa	108	113
Fire Flows –HLP1 and HLP3 On		
No. of junctions with Q < 40 L/s at 140 kPa	1	5
No. of junctions with Q > 40 and < 50 L/s at 140 kPa	8	12
No. of junctions with Q > 50 and < 100 L/s at 140 kPa	88	90

[1]For peak/average flow kPa > 700 used "HLP3 on". For other ranges, used "all HLPs off".
[2]2067 scenario assumes no changes in location or size of existing watermain.
[3]Pressure and flow criteria base on MOECC Guidelines 2008:

Pressures
> 350 kPa but < 480 kPa is optimum
> 700 kPa not recommended
> 480 kPa but < 700 kPa, and > 275 kPa but < 350 kPa, are acceptable
< 275 kPa unacceptable

Fire Flows
< 40 L/s not recommended for residential areas

The flow and pressure conditions have been presented on four figures within Appendix C. They are:

- Pressures at Average Day Demand for Existing Conditions;
- Pressures at Peak Demand for Existing Conditions;
- Fire Flows for Existing Conditions, All HLPs Off; and
- Fire Flows for Existing Conditions, HLP1 and HLP3 On.

7.2.5.5.1 Findings for Existing System

The WaterCAD® model identified the following conditions for the existing system:

- There are no junctions with pressures, during average or peak flows, < 275 kPa;
- 5 junctions (≈ 1.5% of system) may experience pressures > 700 kPa when high-lift pumps operate at the WTP. These locations are generally to the south and north of the WTP, at the western (i.e. lakeshore) limits of the system;
- Approximately 33 to 50% of the system is in the optimum pressure range (350 kPa to 480) during average and peak flows; and
- 4 junctions (≈ 1%) have <40 L/s fire flow. These are generally along the lakeshore, north of the community of Kincardine, and at the end of dead-end watermain.

7.2.5.5.2 Findings for Future Scenario

The model predicts the following for 2067:

- Operating pressures under 2067 average and peak demand conditions generally decrease as compared to existing average and peak demand conditions;
- Under average day demand, no junctions decrease to unacceptable pressures (i.e. below 275 kPa). An additional 5 junctions (≈ 1.5% of system), compared to existing conditions, decrease to below the lower end of the optimum range (i.e. 350 kPa);
- Under peak demand, 11 junctions (≈ 3% of system) decrease to unacceptable pressures (i.e. below 275 kPa). An additional 24 junctions (≈ 7% of system), compared to existing conditions, decrease to below the lower end of the optimum range (i.e. 350 kPa); and
- Available fire at each junction will generally decrease, with the exception of locations where watermain improvements are planned. For most locations, the decrease in available fire flow would not cause available flow to be less than target values because currently available flows are more than required by the criteria.

7.2.6 Kincardine Shoreline Distribution System

The KSDS generally refers to the sections of watermain in the KDWS that are north of the former Township of Kincardine/Town of Kincardine boundary and the Huron Ridge subdivision. Refer to Figure 2.2. The KSDS provides water service to the lakeshore areas from the community of Kincardine to Inverhuron, including the Inverhuron area and IPP. The system was designed with capacity allocation for the community of Tiverton, which is not currently utilized. The KSDS terminates at the intersection of Albert Road and Alma Street in the community of Inverhuron. The total length of watermain, from the Huron Ridge subdivision to the northerly terminus, is nearly 14 km.

Currently, there are approximately 392 connections to the KSDS along the section between the Town of Kincardine and Inverhuron inclusive (the Lakeshore). This represents approximately 60% of the originally planned 645 services along the same section (note 720 services are currently installed). It is therefore estimated that current demand is approximately 60% of the original design demand along the Lakeshore. The current demand at IPP allocated as 7.5 L/s, in accordance with an agreement between the Park and the Municipality. Tiverton is not connected to the KSDS. A summary of the current estimated water demand is provided in Table 7.10:

Table 7.10: KSDS Water Demands (Design Values and Current Use)

Location	Design Flow[1] (L/s)	Estimated Current Use (L/s)
County Rd. 23 & Concession 5 (to Port Head Estates)	6.81	4.1
County Rd. 23 & Concession 7 (to Kin-Huron Subdivision)	3.40	2.0
Concession 9 & Upper Lorne Beach Rd. (to Lake Huron Highlands)	5.42	3.3
Concession 10 & Victoria St. (to Lorne Beach Subdivision)	5.87	3.5
Inverhuron	7.67	4.6
Inverhuron Provincial Park	14.68	7.5
Tiverton	11.57[2]	0.0
Total	55.42	25.0

[1]Original KSDS design value.
[2]For current Master Plan projections, this would correspond to year 2045 for the high growth scenario and beyond 2067 for the low growth scenario.

Based on the above information, the unused design demand associated with the KSDS is approximately 30.4 L/s. Based on a recent Class EA related to water and wastewater servicing within Inverhuron (B. M. Ross and Associates Limited, 2014), development commitments of 200 ERUs are assumed for the community. Based on the per ERU maximum demand of 1.64 m^3/day, the 200 ERU commitments equates to 3.8 L/s, slightly greater than the difference between Inverhuron design and estimated current flow in Table 7.8 of 3.1 L/s. In general, it is concluded that foreseeable demand within the KSDS is in line with historical design values and at this time there are no apparent needs related to upgrading of the KSDS.

The contemplated addition of a new north WTP would have the potential to benefit the KSDS by way of providing redundancy in the supply, assuming the new north WTP would be connected to the KDWS.

7.2.7 Distribution System Alternatives

From the modelling, it was determined that there are two alternatives related to the provision of water distribution infrastructure as part of the KDWS and KSDS. These alternatives are:

I. Expansion of the distribution system; and
II. Do Nothing.

Presently, the water distribution system in Kincardine operated as a single-pressure zone. To expand the distribution system to service additional lands north of Gary Street and east of Bruce Road 23, a BPS and creation of a second pressure zone will be required. The other alternative under consideration is Do Nothing, which would maintain status quo.

Table 7.11 summarizes the impact evaluation of the three alternatives:

Table 7.11: Impact Evaluation of Kincardine Water Distribution System Alternatives

Environmental Component	Alternative I – Expansion of the Distribution System	Alternative II– Do Nothing
Natural	Low – construction would be primarily within road allowances and would avoid sensitive areas. Booster pumping stations would also be sited to avoid sensitive areas.	Minimal/Nil
Social and Cultural	Low – supports continued growth and development in Municipality. -No interruption in service likely -Supports planning policies related to the provision of municipal services within settlement areas.	Moderate – will not support continued growth and development. Does not support planning policies related to the provision of municipal services in settlement areas.
Economic	Low – capital costs for servicing within new subdivisions is borne by developer and costs for improvements related to future growth may be recouped through development charges. -Will have ongoing maintenance and operation costs.	Minimal/Nil
Technical	Low – can be integrated with existing system. May be opportunities to loop system and improve redundancy.	Minimal/Nil
Summary	Most preferred	Least preferred

Given the results of the impact evaluation, it is recommended that the Municipality proceed with Alternative I – Expansion of the distribution system.

7.2.8 Conclusions and Recommendations

The following are general conclusions and recommendations reached as a result of the modelling.

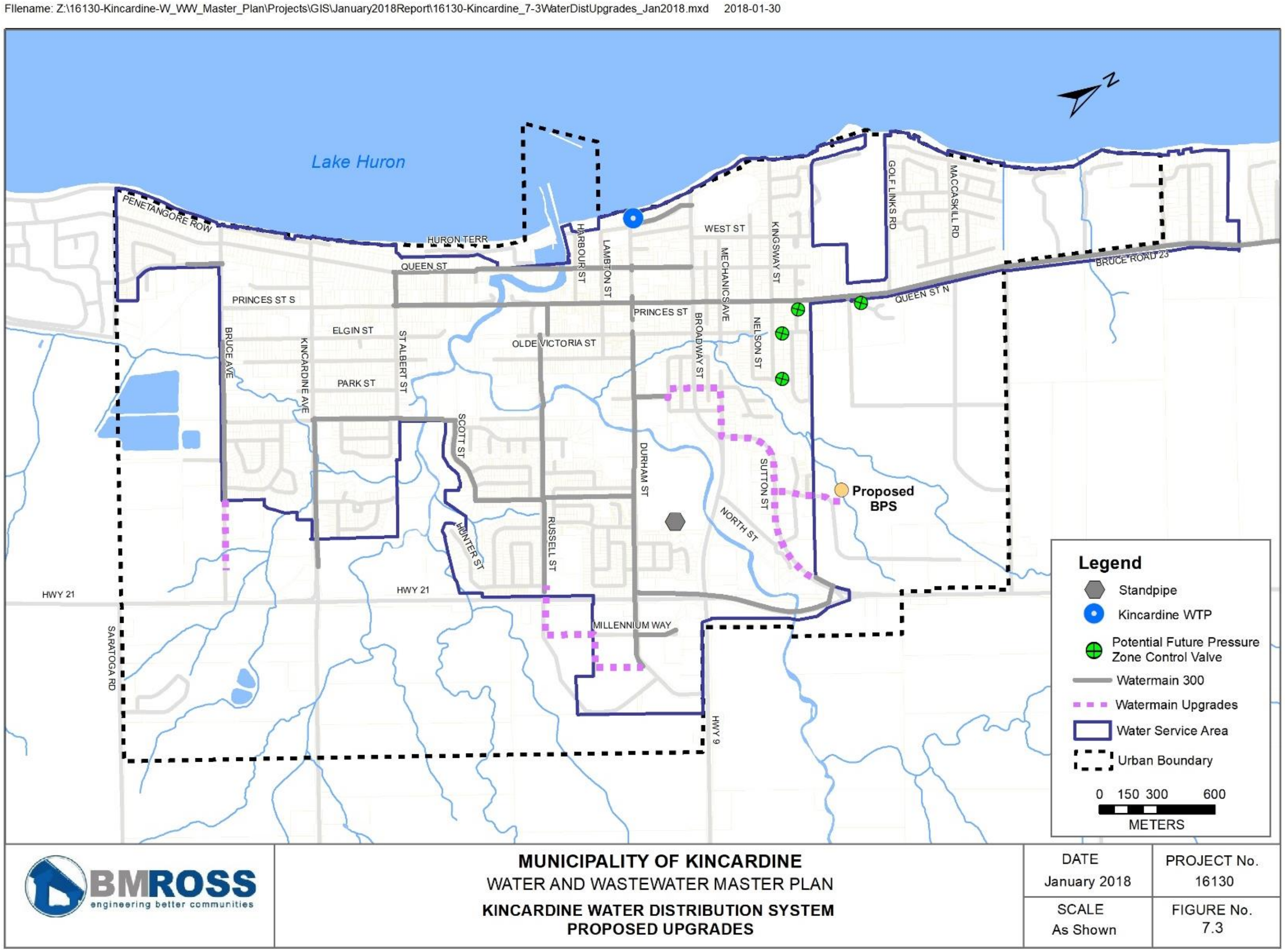
- A WaterCAD® model was created for the Kincardine distribution network. The model was used for general analysis of existing and potential future system conditions. Should the model be used for specific system modifications, it is recommended that a calibration/verification exercise be carried out, including the collection of data from a field testing program specific to the location being modified;
- The Kincardine system is currently operated as a single pressure zone. Servicing of lands generally to the north of Gary Street and east of Bruce Road 23 will require provision of booster pumping facilities and the creation of a second pressure zone;
- In order to meet future maximum day and peak demands, increases to both treatment and storage capacities will be required; and
- Fire flow analyses indicate generally acceptable results. In areas where less than target fire flow is available, this is typically a result of dead-end watermain or remote proximity from available storage or supply. Such situations are not considered to be unusual for a system such as the KDWS, but as opportunities arise (e.g. road reconstruction in relevant areas) the Municipality should consider addressing low flow areas.

Figure 7.3 provides suggested trunk watermain sizing, and an approximate BPS location, to accommodate the future development areas. It is important to note that the required watermain sizing is dependent on the actual scale and sequence of development. The watermain sizes indicated on the figures are considered sufficient provided there is internal looping. Watermain design within the proposed second pressure zone is outside the scope of the Master Plan but should consider potential connection points to the existing system in the vicinity of Bruce Road 23 and McLeod Avenue as illustrated in Figure 7.3. The intent of the connection points would be to provide control valves to allow flow from Zone 2 to Zone 1, or vice-versa, in emergency situations.

It is noted that:

- The locations are presented schematically;
- No specific watermain improvements have been identified for existing development, other than those connecting to the north limit of Gary Street;
- The MTO requires that any future Class EA related to the expansion of the water distribution system consider all viable alternatives to placing utilities inside the Highway No. 21 corridor. The MTO currently does not support or endorse utilities placed within the Highway No. 21 corridor;
- Any expansions to the water distribution system will also be subject to screenings for cultural heritage and archeological resources; and
- Based on discussion with Municipal staff, development potential should focus on the areas north of the existing limits of urban development and the Highway No. 9 Business Park area.

Figure 7.3: Kincardine Water Distribution System Proposed Upgrades



A relatively short watermain extension on Bruce Avenue, east of the current watermain limit, is proposed to service development within that vicinity. The exact route and size of the watermain is currently under review but, based on current planning the watermain extension will likely remain a dead-end watermain in that area. Lands to the east of this area (see Figure 4.1) have not experienced significant development interest (B. M. Ross and Associates Limited, 2017). To service such areas via extensions of watermain on Kincardine and/or Bruce Avenues would be possible, at least to a limited extent, subject to topographical constraints, or more fully with provision of a BPS.

7.2.9 Conclusions for Kincardine Drinking Water System

7.2.9.1 SUPPLY AND STORAGE

The Kincardine WTP is currently operating during maximum day demands at approximately 60% of its rated capacity. Development areas currently considered as commitments would represent approximately 19% of the WTP rated capacity. Figure 7.1 and Table 7.3 provide summaries of current and projected WTP utilization. At the highest project growth rate, WTP capacity would be fully utilized by 2032 assuming the same current value of commitments is carried forward to the future, which is not necessarily recommended. At the lowest projected growth rate, the capacity would be fully utilized by 2060. A key consideration is that the uncommitted reserve capacity is currently estimated to be sufficient for 1,463 ERUs.

There is currently a deficit in water storage volume, based on a comparison of effective storage to MOECC Design Guideline values. Modifications to the WTP disinfection process, and rehabilitation of the standpipe BPS are recommended as the most expedient and cost-effective methods to increase effective storage. Figure 7.2 illustrates the current and projected water storage requirements for Kincardine, and Table 7.8 provides a summary of projected timelines for full utilization of the storage capacity assuming that the WTP disinfection and standpipe BPS upgrades are carried out. Under this assumption, and factoring in development commitments, the existing storage would be fully utilized by 2031 under the highest growth forecast and by 2056 under the lowest growth forecast. It is recommended that future additional storage be located generally north of the existing urban limit, within the new pressure zone north of Gary Street. This additional storage may be an elevated tank or reservoir, but elevated storage may be affected by building height limitations in lands adjacent to the Municipal airport.

7.2.9.2 WATER DISTRIBUTION

Figure 7.3 identifies several proposed trunk watermain upgrades and a proposed BPS related to servicing development lands generally north/northwest of Gary Street. The proposed upgrades will create a second pressure zone within the KDWS. As development progresses within the second pressure zone, consideration may be given to connecting to the existing pressure zone in the vicinity of County Road 23 and McLeod Avenue as shown.

In general, as opportunities arise (e.g. road reconstruction), aged watermain should continue to be replaced in areas where the condition is known to be poor based on operator experience.

7.2.10 Suggested Projects and Capital Costs

The projects listed in Table 7.12 relate to opportunities to increase effective storage within the KDWS. All costs are based on 2018 $ and include construction and engineering, exclude HST, and should be considered ±25%.

Watermain upgrades related to the proposed BPS at Gary Street, and the BPS itself, are not included as the design, approval, and preparation for tender are currently underway.

Table 7.12: KDWS - Capital Projects

Project Purpose	Description	Probable Cost (2018 $)
Increase effective storage at WTP	Convert primary disinfection to UV process, allowing volume currently used for chlorine contact to be available for customer use	$1,000,000
Increase effective storage at standpipe	Rehabilitate BPS by installing new booster pump, standby diesel generator and controls	$450,000

7.2.11 Previously Identified Projects - Inverhuron Servicing

In 2014, the Municipality of Kincardine completed a Schedule B Class EA for the extension of municipal water and sanitary servicing for the community of Inverhuron. Through preliminary investigations and consultation, it was identified the age and condition of existing services pose a potential health risk based on current density and the environmental setting. Receipt of a two-thirds grant represented an opportunity to address the ongoing servicing issues and reduce financial impacts to residents.

The preferred alternative identified and evaluated through the Class EA process is to extend both water and sanitary sewage services to all residents of Inverhuron not already serviced by either municipal water or sanitary sewers.

The Class EA was approved by the Ministry of Environment and Climate Change in December 2014. Following approval of the Class EA, the project proceeded to detailed design and approvals were obtained from the required review agencies. The project proceeded to tender in April 2015; however, due to costs, Council at the time decided not to proceed to construction.

It is recommended that the Municipality pursue funding or grant opportunities for this project to allow it to proceed to construction. It is noted that should construction be delayed beyond 10 years from the date of approval, the planning and design processes and environmental setting must be reviewed to ensure the project and mitigation measures are still valid.

7.3 Tiverton Drinking Water System

The TDWS is approved by the MOECC and described within DWWP No. 088-204 Issue No. 2 and MDWL No. 088-104 Issue No. 2.

The TDWS services the community of Tiverton. The locations of major facilities in the existing TDWS are shown in Figure 2.3. The major facilities include two groundwater well sites complete with pumphouses (Dent Well No.2, and Briar Hill Well Nos. 1 and 2), standpipe, and distribution watermain.

The Dent Well is located at 6 Smith Street, and the Briar Hill Wells are located at 36 Conquergood Avenue in Tiverton. Each well is a drilled groundwater production well.

The Tiverton Standpipe and associated BPS were constructed in 1984-1985. Currently, the BPS facilities at the site are not in use and would require rehabilitation in order to function as intended.

7.3.1 Population Growth and Water Demands

7.3.1.1 EXISTING CUSTOMER BASE

Section 4 identifies the existing and projected populations for Tiverton. The future projected population growth for areas serviced by the TDWS is provided on Figure 4.4.

Refer to Section 7.2.1 for additional background relating to establishing the number of services.

For the TDWS:

- No. of metered customers = 363
- Additional for condo/apartments = 31
- Calculated total customers = 394

7.3.1.2 EXISTING DEMANDS

Table 7.13 summarizes treated water demands from 2014 to 2016.

Table 7.13: Summary of Tiverton Water Demands

	Tiverton Water Demand (m^3/d)	
Year	**Average Day**	**Maximum Day**
2014	209	599
2015	212	504
2016	220	659
Average or Maximum	214	659

Given that the principal design basis for water supply is maximum day, the critical value is 659 m^3/day. Expressed per ERU, the TDWS has demand values of:

- Average day: 0.54 m^3/day per ERU
- Maximum day: 1.67 m^3/day per ERU

7.3.1.3 DEVELOPMENT COMMITMENTS

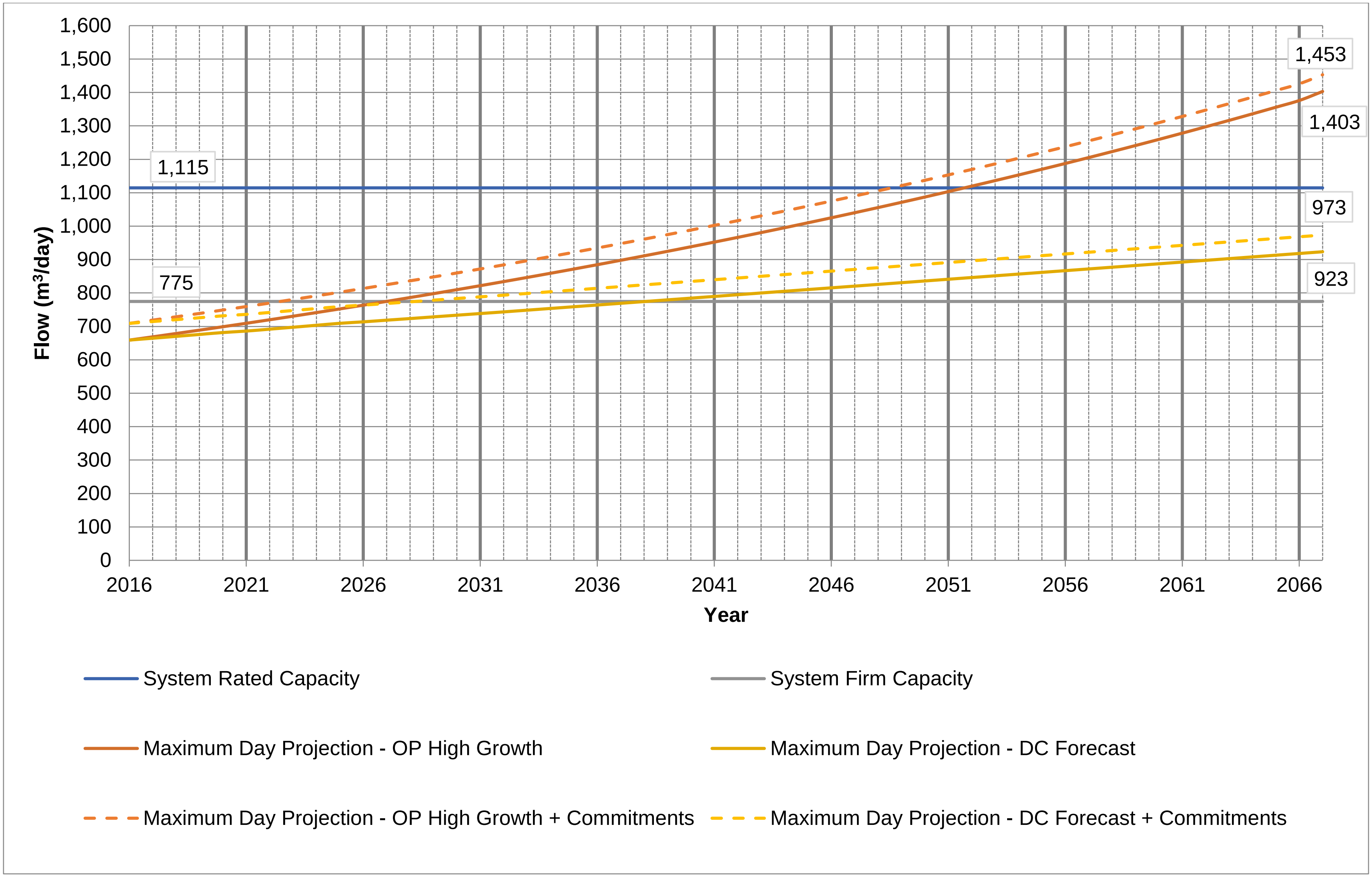
Refer to Section 7.2.1 for a general discussion relating to inclusion of development commitments in the analyses. For the purposes of this study, an infill allowance of 30 units is assumed as a commitment. The 30 ERUs correspond to a maximum day water demand of 50 m^3/day.

7.3.1.4 FUTURE DEMANDS

Refer to Section 7.2.1 for a description of future demand scenarios. We note the build-out forecast for Tiverton is, at this point, considered unrealistically high.

Table 7.14 provides a summary of the forecasted future water demands, based on the two growth scenarios utilized. The data is provided graphically on Figure 7.4. Analysis data, on a year by year basis, is provided within Appendix B. 5. It is noted that the 30 ERUs considered to

Figure 7.4: Tiverton Water Supply Forecasted Maximum Day Water Demands



be commitments would correspond to development to 2021 under the Official Plan High Growth scenario, and to 2025 under the Development Charges scenario.

Table 7.14: Forecasted Maximum Day Water Demands - TDWS

Item	Maximum Day Water Demand (m^3/d)	
	Official Plan High Growth Scenario (Extrapolated to 2067)	**Development Charges (Extrapolated to 2067)**
Current demand	659	659
Development commitments demand	50	50
Increase in demand to 2067	744	264
Total demand in 2067 without commitments	1,403	923
Total demand in 2067 plus commitments[1]	1,453	973

[1]Assumes same current commitments apply in 2067.

7.3.2 Treatment Capacity Assessment

The two pumphouses, Briar Hill and Dent, have MDWL rated capacities of 717.12 and 397.44 m^3/d, respectively, for a total of 1,114.56 m^3/d. However, Permit to Take Water (PTTW) No. 4771-74RRCJ for the Wells restricts water takings from the Briar Hill and Dent wells to 524.16 and 250.5 m^3/d, respectively. It is noted that the Briar Hill Pumphouse is supplied by Briar Hill Well Nos. 1 and 2, and the Dent Pumphouse is supplied by Dent Well No. 2. The firm capacity of the system would normally be the capacity with the largest well out of service (i.e. 924.48 m^3/d), but due to the PTTW restriction the firm capacity of the Tiverton system is considered to be 774.66 m^3/d. Table 7.15 summarizes the difference between the MDWL rated capacity and the PTTW values.

Table 7.15: Well Capacity Summary

Well Supply	Capacity per PTTW (m^3/d)	Capacity per MDWL (m^3/d)	Difference Between PTTW and MDWL
Briar Hill	524.16	717.12	192.96
Dent	250.5	397.44	146.94
Total	774.66	1,114.56	339.9

The plant currently has an uncommitted reserve of 66 m^3/day. This corresponds to an uncommitted capacity for 39 ERUs.

Figure 7.4 shows the relationship between existing plant capacity and forecasted demand throughout the study period. Table 7.16 provides a summary of the year by which plant capacity would be fully utilized for the scenarios considered.

Table 7.16: Tiverton Wells Forecasted Utilization of Current Capacity

Scenario (Extrapolated)	Existing Capacity Fully Utilized by Year
Official Plan High Growth	2027
Official Plan High Growth + Commitments	2023
Development Charges	2039
Development Charges + Commitments	2029

7.3.3 Capacity Alternatives

To provide an increase in capacity to meet potential future demands in Tiverton, three alternatives were identified:

I. Rerating of the system (using the existing wells);
II. Expansion of the system (with an additional well(s)); and
III. Do Nothing

The first two alternatives involve investigating available background hydrogeological data, and the current differences between the approved daily water taking as set out in the PTTW and the rated capacity of the MDWL. Both alternatives are expected to require a hydrogeologist to examine the feasibility of rerating either with the existing wells, or increased capacity with the addition of another well(s). The Do Nothing alternative is also included in the consideration of impacts, should the impacts of the other alternatives be too significant and bar their implementation.

It is noted that the original design of the KSDS included capacity for Tiverton. It is also probable that the EA for a new WTP at the north end of the Municipality will consider servicing Tiverton. Given there is currently sufficient capacity and the potential to meet future needs through the above-listed alternatives, servicing Tiverton via the KSDS or a new WTP should be viewed as future alternatives, pending the outcome of the WTP EA and inability to meet needs through rerating.

The potential impacts of the identified alternatives are summarized in Table 7.17:

Table 7.17: Impact Evaluation for Tiverton Water Capacity Alternatives

Environmental Component	Alternative I – Rerate with Existing Wells	Alternative II – Expand with Additional Well(s)	Alternative III – Do Nothing
Natural	Minimal/Nil – no impacts anticipated.	Low – new well site would be sited to avoid sensitive areas. -Introduces another transport pathway to the local groundwater aquifer.	Minimal/Nil
Social and Cultural	Low – supports continued growth and development in Municipality. -No interruption in service likely.	Moderate – may be impacts to adjacent property owners during construction of a new well (noise, drilling wastewater). -may have to re-evaluate vulnerable areas if pumping rates are different than rates used to delineate WHPAs.	Moderate – will not support continued growth and development.
Economic	Low – costs associated with rerating study are less than cost of new well.	Moderate – most expensive option in terms of capital costs. -New well have ongoing maintenance and operation costs.	Minimal/Nil
Technical	Low – completion of study will identify if additional capacity is required.	Moderate – requires investigation to site new well and integrate it into system.	Minimal/Nil
Summary	Most preferred	Preferred in absence of Alternative I	Least preferred

At this time, given the potential impacts, there should be further investigation related to the discrepancy between the approved daily water taking per the PTTW and the rated capacity per the MDWL. The Municipality may want to consider having a hydrogeologist review potential to have the PTTW rerated, which should include:

- Potential to rerate using only existing wells; and/or
- Potential to expand with an additional standby well(s).

Aquifer limitations may affect the opportunity to rerate in either of the above cases. It would be beneficial to determine this sooner than later, because as growth requires additional water supply it will be important to establish potential sources. If the Municipality proceeds with a rerating study, it is recommended that the study incorporate consultation with Source Protection staff as any changes in the pumping rate at the Tiverton wells may require updates to the groundwater model assumptions used to delineate the WHPAs.

7.3.4 Water Storage Capacity Assessment

7.3.4.1 PURPOSE OF STORAGE

Refer to Section 7.2.4.1 for a general description.

7.3.4.2 AVAILABLE STORAGE

Table 7.18 identifies the details of the Tiverton standpipe. Effective volume is considered to be the volume that is readily available for use under typical operational conditions.

Table 7.18: Tiverton Water Storage Facilities

Facility	Total Volume (m^3)	Effective Volume (m^3)
Tiverton Standpipe	1,500	350[1]

[1]Approximate volume available by gravity. The booster pump at the standpipe site is called to activate for the balance, though Operators report there are presently issues related to booster pump operation.

7.3.4.3 OPERATIONAL DESCRIPTION

The well supplies in Tiverton cycle on/off in response to standpipe water level setpoints.

As described in Section 7.3.2, water takings from each well are limited per the terms of the PTTW. The difference between the PTTW rating and the historical maximum day is 774.66 – 659 = 115.66 m^3/day, or 1.3 L/s. Short term supply (i.e. less than 24 hours) up to the rated capacity per the MDWL is possible, provided that the daily maximum total per the PTTW is not exceeded.

7.3.4.4 REQUIRED VOLUMES

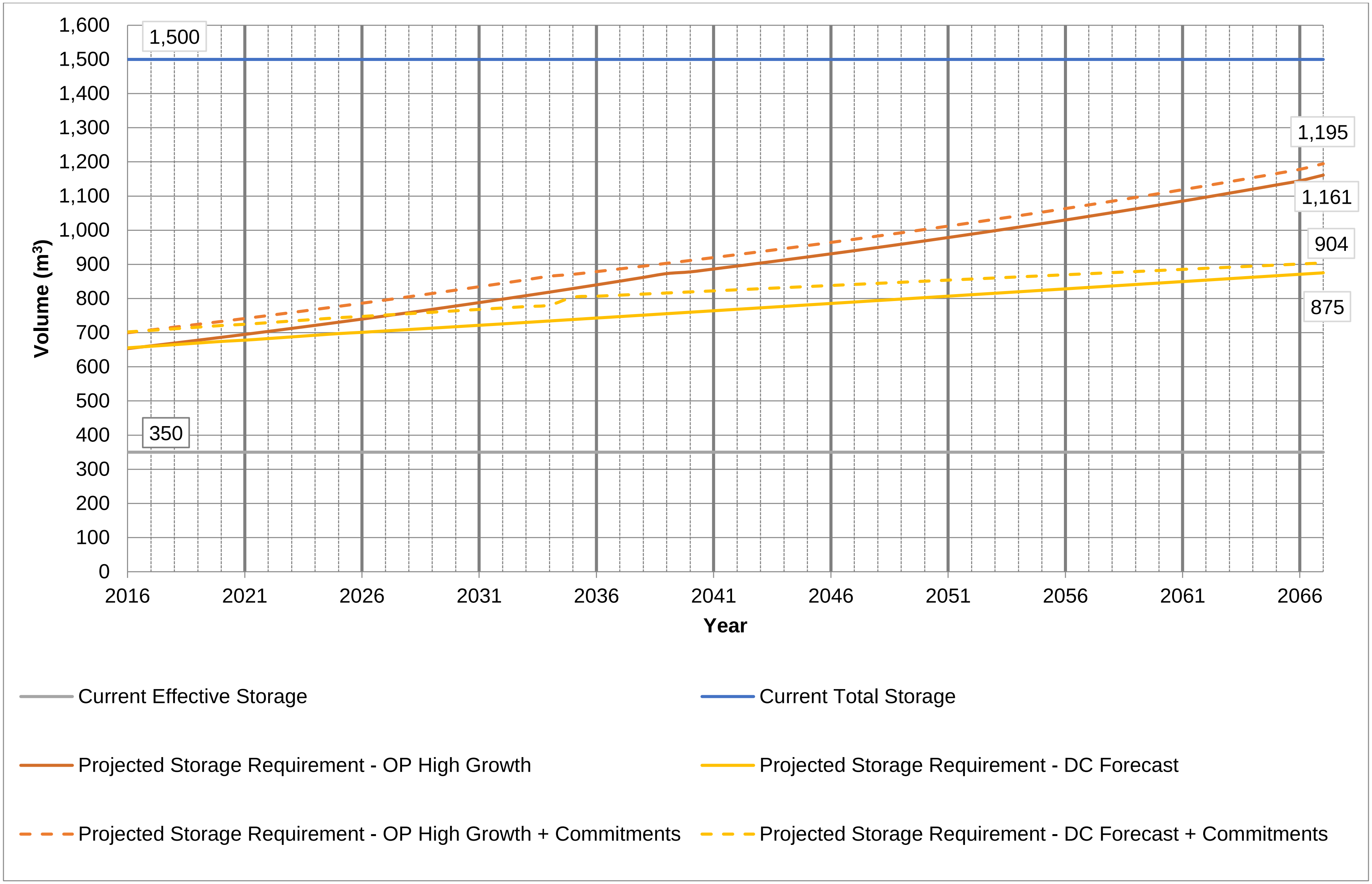
Table 7.19 provides a summary of the required storage categories for the current situation in Tiverton. The values provided are based on MOECC Guidelines. Refer to Appendix B for detailed calculations and descriptions.

Table 7.19: Current Tiverton Water Storage Requirements

Storage Description	Recommended Volume per MOECC Guidelines (m^3)	Notes
A – Fire Protection	358	49.7 L/s for 2 hrs, per MOECC Table 8-2
B – Equalization	165	25% of maximum day demand
C - Emergencies	131	25% of A + B
Total A + B + C	654	

At this time, there is approximately 350 m^3 of effective storage, as compared to the 654 m^3 recommended in accordance with MOECC Guidelines. This represents a deficit of approximately 304 m^3. Factoring in development commitments, the recommended storage volume becomes 700 m^3. Figure 7.5 shows the relationship between existing storage and forecasted requirements throughout the study period.

Figure 7.5: Tiverton Water Storage Forecasted Requirements



7.3.4.5 RESPONSE OF STORAGE DURING VARIOUS DEMAND SCENARIOS

Peak demand in Tiverton would currently be estimated to be 150% of the maximum day volume of 659 m^3/day, which is equivalent to 11.4 L/s. The rated capacity of the system per the MDWL is 1,114.56 m^3/day, or 12.9 L/s, but this would only be available up to the maximum daily permitted volume of 774.66 m^3.

Assuming the wells are producing at the maximum rate per the PTTW (approximately 9 L/s), under a peak demand of 11.4 L/s the entire effective storage would provide sufficient volume for more than one day.

Typical practice is to assume that a fire occurs when the storage facility's equalization volume is exhausted and simultaneous with maximum day demand. For the current Tiverton demands, based on MOECC Guidelines the total demand would be 49.7 L/s for fire flow + 7.6 L/s maximum day demand = 57.3 L/s. Retained volume within the standpipe effective storage at the start of the fire condition would be 350 – 165 = 185 m^3. Assuming wells are providing 9 L/s, the net flow out of storage would be 57.3 – 9 = 48.3 L/s. At this rate, the 185 m^3 of remaining effective volume would be utilized in a little over 1 hour. The recommended duration for fire flow, based on MOECC Guidelines, is 2 hours for the current Tiverton population.

7.3.4.6 STORAGE ALTERNATIVES

It is noted that the following alternatives exist to increase the effective storage of the Tiverton standpipe to meet emergency design flows. They include:

I. Rehabilitation of the existing BPS;
II. New Storage Facility; and
III. Do Nothing

Alternative I is the rehabilitation of the existing BPS. Improvements to the pump within the standpipe structure could make the full volume of water stored available. The second alternative is the construction of an additional storage facility. Potential storage facilities include: an elevated tower, in-ground reservoir, or standpipe.

Under the Municipal Class EA process, the Do Nothing alternative is always presented as an option. It may be implemented if the environmental impacts of the other alternatives are significant and cannot be mitigated.

Table 7.20 summarizes the impact evaluation of the three alternatives:

Table 7.20: Impact Evaluation of Tiverton Storage Alternatives

Environmental Component	Alternative I – Modifications to the BPS	Alternative II – New Storage Facility	Alternative III – Do Nothing
Natural	Minimal/Nil – construction would be within existing facilities.	Moderate – size of footprint of storage facility dependent on type: small footprint (standpipe or elevated tower) or larger (reservoir). May be site impacts depending on location.	Minimal/Nil
Social and Cultural	Low – supports continued growth and development in Municipality. -No interruption in service likely.	Moderate – impacts to adjacent property owners during construction. -standpipe or elevated tank type storage have impacts related to shading and visual intrusion.	High – system will not meet emergency flow designs.
Economic	Low – capital costs associated with modifications to existing facilities are less than construction of a new facility. -Will have ongoing maintenance and operation costs.	Moderate – most expensive option in terms of capital costs. -Will have ongoing maintenance and operation costs.	Minimal/Nil
Technical	Low – makes use of and improves existing infrastructure.	Moderate – requires investigation to site new facility and integrate it into the existing system.	Minimal/Nil
Summary	Most preferred	Preferred in absence of Alternative I	Least preferred

7.3.4.7 CONCLUSIONS RELATING TO STORAGE

In summary, the current effective volume of the Tiverton standpipe is sufficient to meet peak flow equalization and a portion of the recommended fire storage, but not emergency design values.

It is noted that the effective storage of the standpipe could be increased if a booster pump located at the base of the structure is operated. The pump does not currently operate automatically. At this time, we understand the Municipality is considering rehabilitation of the BPS.

Assuming the standpipe BPS rehabilitation is carried out such that the total current storage becomes effective storage, the total volume of effective storage would become 1,500 m^3. Table 7.21 provides a summary of the period by which storage would be fully utilized for the scenarios considered, on this basis. Analysis data, on a year by year basis, is provided in Appendix B.

Table 7.21: Tiverton Water Storage[1] - Forecasted Utilization of Total Capacity

Scenario (Extrapolated)	Total Storage Fully Utilized by Year
Official Plan High Growth	Beyond 2067 for all scenarios
Official Plan High Growth + Commitments	
Development Charges	
Development Charges + Commitments	

[1]Assumes 1,500 m^3 total storage is made effective storage.

At this time, it is recommended the Municipality continue to pursue the standpipe BPS rehabilitation to increase effective storage.

7.3.5 Water Distribution System

7.3.5.1 BACKGROUND

The Tiverton water distribution system was modelled using WaterCAD®. The purpose of the modelling was to identify potential flow and pressure issues during periods of high demand and to determine requirements for supplying future development areas.

7.3.5.2 MODEL DETAILS

In general, the same methodology described in Section 7.2.4 for Kincardine was used for the Tiverton water model. The Tiverton model contains 72 pipes and 57 junctions. Refer to Appendix D for details.

7.3.5.3 ANALYSES RUN

Refer to Section 7.2.4 for a general description of methodology. A detailed list of all model scenarios includes:

- Existing development demands (average, peak) with standpipe at a nominal water level, all well pumps off;
- Existing development demands (maximum day) plus fire flow:
  - Standpipe at nominal water level, all well pumps off;
  - Standpipe at low water level, Dent Well No. 2 and Briar Hill Well No. 1 on;
- 2067 development demands (average, peak) with standpipe at a nominal water level, all well pumps off; and
- 2067 development demands (maximum day) plus fire flow:
  - Standpipe at nominal water level, well pumps off; and
  - Standpipe at low water level, Dent Well No. 2 and Briar Hill Well No. 1 on.

7.3.5.4 QUALIFICATIONS ON RESULTS

7.3.5.4.1 Limited Calibration

Refer to Section 7.2.4.

7.3.5.4.2 Treatment and Storage Capacity

As explained in Sections 7.3.2 and 7.3.3, additional treatment and effective storage capacity would be required for future growth projections. The 2067 demand scenarios are analyzed for watermain only, on the basis of having adequate treatment and storage capacity provided.

7.3.5.5 RESULTS OF ANALYSIS

The results of the WaterCAD® analysis for both the existing and future (i.e. 2067) conditions are presented in Table 7.22.

Table 7.22: Summary of WaterCAD® Analysis - Tiverton

Analysis[1,2] and Criteria[3]	**Existing Demands**	**2067 Demands**
Average Flow		
No. of junctions with kPa > 700	0	0
No. of junctions with kPa > 480 and <= 700	0	0
No. of junctions with kPa > 350 and <= 480	39	39
No. of junctions with kPa > 275 and <= 350	18	18
No. of junctions with kPa < 275	0	0
Peak Flow		
No. of junctions with kPa > 700	0	0
No. of junctions with kPa > 480 and <= 700	0	0
No. of junctions with kPa > 350 and <= 480	39	38
No. of junctions with kPa > 275 and <= 350	18	19
No. of junctions with kPa < 275	0	0
Fire Flows – All Well Pumps Off		
No. of junctions with Q < 40 L/s at 140 kPa	15	15
No. of junctions with Q > 40 and < 50 L/s at 140 kPa	2	2
No. of junctions with Q > 50 and < 100 L/s at 140 kPa	31	32
Fire Flows – Dent 2 and Briar Hill 1 On		
No. of junctions with Q < 40 L/s at 140 kPa	4	4
No. of junctions with Q > 40 and < 50 L/s at 140 kPa	10	11
No. of junctions with Q > 50 and < 100 L/s at 140 kPa	29	28

[1]For peak/average flow kPa > 700 used "HLP3 on". For other ranges, used "all HLPs off".
[2]2067 scenario assumes no changes in location or size of existing watermain.
[3]Pressure and flow criteria base on MOECC Guidelines 2008:

Pressures
> 350 kPa but < 480 kPa is optimum
> 700 kPa not recommended
> 480 kPa but < 700 kPa, and > 275 kPa but < 350 kPa, are acceptable
< 275 kPa unacceptable
Fire Flows
< 40 L/s not recommended for residential areas

The flow and pressure conditions have been presented on four figures within Appendix D. They are:

- Pressures at Average Day Demand for Existing Conditions;
- Pressures at Peak Demand for Existing Conditions;
- Fire Flows for Existing Conditions, All Well Pumps Off; and
- Fire Flows for Existing Conditions, Dent Well No. 2 and Briar Hill Well No. 1 On.

7.3.5.5.1 Findings for Existing System

The WaterCAD® model identified the following conditions for the existing system:

- There are no junctions with normal pressures < 275 kPa;
- Approximately 68% of the system is in the optimum pressure range (350 kPa to 480) during average and peak flows; and
- 15 junctions (≈ 26%) have <40 L/s fire flow with the well pumps off. It is noted:
  - The majority of these junctions are in the north part of the community, where a single watermain on King Street connects to the southern portion of the system. The marginal benefit from the Briar Hill well pump is sufficient to increase most junctions to greater than 40 L/s, but still less than 50 L/s; and
  - 4 junctions at the end of 100 mm diameter dead-end lines have extremely poor fire flow (i.e. 10 L/s or less) regardless of pump status.

7.3.5.5.2 Findings for Future Scenario

The model predicts the following for 2067:

- Operating pressures under 2067 average and peak demand conditions are very similar (i.e. typically within 5 kPa, some junctions decrease by up to 10 kPa) to existing average and peak demand conditions; and
- Available fire at each junction is generally similar to existing conditions, decreasing only by as much as 4 L/s.

7.3.5.6 DISTRIBUTION SYSTEM ALTERNATIVES

From the modelling, it was determined that there are two alternatives related to the provision of water distribution infrastructure in Tiverton. These alternatives are:

I. Expand/upgrade the distribution system; and
II. Do Nothing.

From the modelling undertaken as part of this study, it was identified there are opportunities to improve fire flows in the northern area of the village. Expansion or upgrades to watermains in conjunction with development present an opportunity to improve fire flows. The other alternative under consideration is Do Nothing, which would maintain status quo.

Table 7.23 summarizes the impact evaluation of the three alternatives:

Table 7.23: Impact Evaluation for Tiverton Distribution System Alternatives

Environmental Component	Alternative I – Expand/Upgrade the Distribution System	Alternative II– Do Nothing
Natural	Low – construction would be primarily within road allowances and would avoid sensitive areas.	Minimal/Nil
Social and Cultural	Low – supports continued growth and development in Municipality. -No interruption in service likely. -Improved fire flows for emergencies. -Supports planning policies related to the provision of municipal services within settlement areas.	Moderate – will not support continued growth and development. Does not support planning policies related to the provision of municipal services in settlement areas. -Fire flows in northern part of Tiverton would remain an issue.
Economic	Moderate – costs associated with watermain replacement or upgrades. If expanded for future development, costs could be recouped through future development. -Will have ongoing maintenance and operation costs.	Minimal/Nil
Technical	Low – can be integrated with existing system. May be opportunities to loop system and improve redundancy. -Improves fire flows.	Minimal/Nil
Summary	Most preferred	Least preferred

Given the results of the impact evaluation, it is recommended that the Municipality proceed with Alternative I – Expand/upgrade the distribution system. However, there is likely no urgency in completing this and the work should be considered in conjunction with development progress and road reconstruction projects.

7.3.5.7 CONCLUSIONS AND RECOMMENDATIONS

The following are general conclusions reached as a result of the modelling.

- A WaterCAD® model was created for the Tiverton distribution network. The model was used for general analysis of existing and potential future system conditions. Should the model be used for specific system modifications, it is recommended that a calibration/verification exercise be carried out, including the collection of data from a field testing program;
- In order to meet future maximum day and peak demands, an increase to water supply and treatment capacity will be required; and
- Fire flow analyses indicate generally acceptable results, except for areas in the north part of the system that are fed by a single 150 mm diameter watermain, and other locations at the end of dead-end 100 mm diameter watermains. Such situations are not considered to be unusual, but in the event that development to the north part of the community progresses, consideration should be given to increasing available fire flow. This could be accomplished by paralleling the single watermain on King Street, from Stanley/Cameron Streets to Lois Street with minimum 150 mm diameter watermain or fully replacing with minimum 200 mm diameter watermain.

Figure 7.6 illustrates the King Street watermain which could be paralleled or replaced, as well as locations of dead-end 100 mm diameter watermains which currently limit fire flow.

7.3.6 Conclusions for Tiverton Drinking Water System

7.3.6.1 SUPPLY AND STORAGE

The Tiverton water supply and treatment works are currently operating during maximum day demands at approximately 85% of the rated capacity. An infill allowance of 30 units, considered as commitments, would represent approximately 6% of the WTP rated capacity. Figure 7.4 and Table 7.15 provide summaries of current and projected water treatment utilization. At the highest projected growth rate, treatment capacity would be fully utilized by 2023 assuming the same current value of commitments applies in the future. At the lowest projected growth rate, the capacity would be fully utilized by 2029. There is a significant discrepancy between the rated capacities in the well PTTW versus the MDWL. We recommend the Municipality engage a hydrogeologist to assist in determining if a rerating of the PTTW using only existing wells is possible or, if necessary, by adding another well.

There is currently a water storage volume deficit, based on a comparison of effective storage to MOECC Design Guideline values. Rehabilitation of the standpipe BPS is recommended as the most expedient and cost-effective method to increase effective storage. Figure 7.5 illustrates the current and projected water storage requirements for Tiverton, and Table 7.21 provides a summary of projected timelines for full utilization of the storage capacity assuming that the standpipe BPS upgrades are carried out. Under this assumption, the existing storage would be adequate beyond the study period for all growth forecasts.

7.3.6.2 WATER DISTRIBUTION

Figure 7.6 identifies several watermain upgrades that could be considered in order to increase available fire flow to the north portion of the community, as well as areas currently serviced by dead-end 100 mm diameter watermain.

In general, as opportunities arise (e.g. road reconstruction), these locations could be addressed, or may need to be addressed in response to development progress.

7.3.7 Suggested Projects and Capital Costs

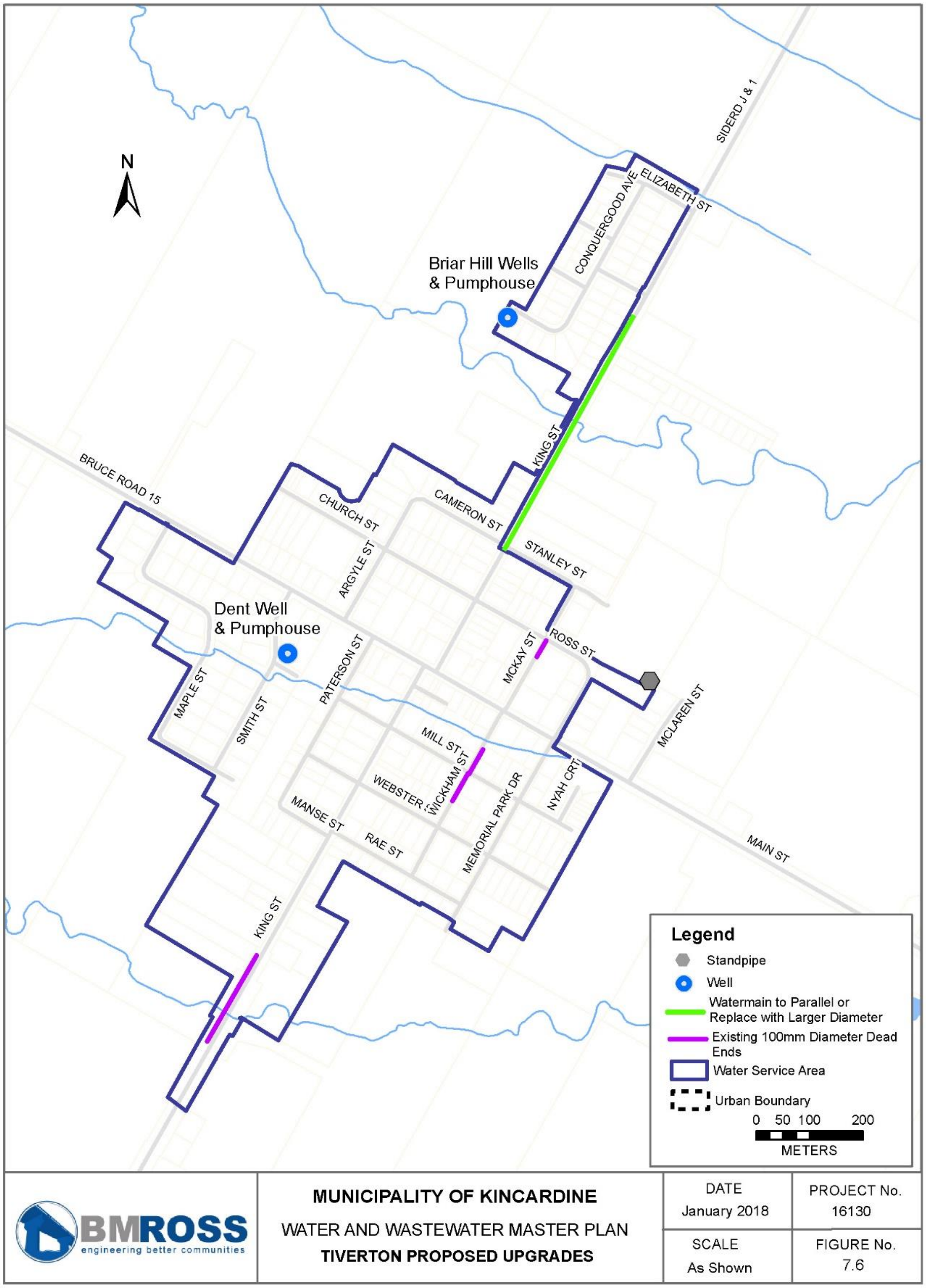
The projects listed in Table 7.24 relate to opportunity to increase effective storage and improving fire flows. All costs are based on 2018 $ and include construction and engineering, exclude HST, and should be considered ±25%.

Table 7.24: TDWS Water System - Capital Projects

Project Purpose	Description	Probable Cost (2018 $)
Increase effective storage at standpipe	Rehabilitate BPS by installing new booster pump, standby diesel generator and controls	$425,000
Increase fire flow at north end of community	Parallel or replace watermain on King Street from Stanley/Cameron Sts. to Lois St.	$475,000[1]

[1]Costs shown are for watermain construction and restoration only. No cost has been included for sanitary or storm sewers, curb and gutter, or full road reconstruction, which the Municipality may elect to do as part of a watermain replacement project.

Figure 7.6: Tiverton Water Distribution System Upgrade Considerations



Filename: Z:\16130-Kincardine-W_WW_Master_Plan\Projects\GIS\January2018Report\16130-Tiverton_7_6TivertonProposedUpgrades_Jan2018.mxd 1/30/2018

8.0 WASTEWATER SERVICING

8.1 Definition of an ERU

Refer to Section 7.1 for the definition of an ERU.

The BEC WWTP analysis in Section 8.3 separates the industrial flow component from the ERU calculations because it is significant relative to non-industrial flows.

8.2 Kincardine Wastewater System

The Kincardine wastewater system consists of a single WWTP, nine SPSs and two landfill related pumping stations (i.e. groundwater and leachate) and their associated forcemains, and a gravity sewer collection network. Of the SPSs, six major stations which typically pump >95% of the total sewage flow for the community are included within the context of this Master Plan. The following Environmental Compliance Approval (ECA) documents, issued by the MOECC, apply to the major infrastructure considered in this analysis:

- Kincardine WWTP – ECA No. 4648-8DVSSR;
- Connaught SPS – ECA No. 3066-APUHY9;
- Durham St. SPS – ECA No. 3-0430-79-006;
- Huron Terrace SPS – ECA No. 3-0430-79-006;
- Park St. SPS – ECA No. 3-0178-76-006;
- Goderich St. SPS – ECA No. 3-1042-77-001; and
- Kincardine Avenue SPS – ECA No. 3-0979-7.

The system services the former town of Kincardine. The locations of major facilities in the existing system are shown in Figure 2.4.

The WWTP, located at 520 Bruce Avenue, generally consists of one aerated and two conventional lagoon cells, with phosphorus removal and UV disinfection equipment. Effluent is discharged to Lake Huron.

8.2.1 Population Growth and Wastewater Flows

8.2.1.1 EXISTING CUSTOMER BASE

Section 4 identifies the existing and projected populations for Kincardine. The future projected population growth for areas serviced by the wastewater system is provided on Figure 4.2.

The existing customer base was established using the same methodology described for the water system in Section 7.2.1. For the Kincardine wastewater system, the following values apply:

- No. of billed customers = 3,540
- Additional for condo/apartments = 405
- Calculated total customers = 3,945

8.2.1.2 EXISTING FLOWS

Table 8.1 summarizes average daily wastewater flows from 2014 to 2016.

Table 8.1: Summary of Kincardine WWTP Flows

Year	Kincardine WWTP Average Day Flow (m^3/d)
2014	4,085
2015	3,473
2016	3,874
Average	3,811

The WWTP capacity is defined as an average daily value on an annual basis. The critical value for the analysis is therefore 3,811 m^3/day. Expressed per ERU, the Kincardine wastewater system has flow values of:

- Average day: 0.97 m^3/day per ERU

Maximum day flows to the WWTP have been in excess of 15,000 m^3/day in recent years, representing a maximum day factor of 4 or greater.

8.2.2 Development Commitments

Refer to Section 7.2.1 for a general discussion related to development commitments. For the Kincardine wastewater system, the following are considered to be development commitments at this time.

- Residential development commitments (Town) = 859 ERUs;
- Business Park = assume 281 ERUs[2]; and
- Total commitments = 1,140 ERUs.

The 1,140 ERUs correspond to an average wastewater flow of 1,106 m^3/day.

8.2.2.1 FUTURE FLOWS

Refer to Section 7.2.1 for a general discussion related to future growth projections.

It is anticipated that the approach used will result in a conservative projection (i.e. slight over estimate) of future flows. For sewer flows, this is based on the experience that modern sewers are less prone to infiltration and inflow relative to portions of the existing system. Water conservation measures will impact wastewater flows as well. The result is that the flow per ERU should decline with growth.

Table 8.2 provides a summary of the forecasted future wastewater flows, based on the two growth scenarios utilized. The data is provided graphically on Figure 8.1. Analysis data, on a year by year basis, is provided within Appendix B.

It is noted that the 1,140 ERUs considered to be commitments would correspond to development to 2030 under the Official Plan High Growth scenario, and to 2053 under the Development Charges scenario. In either case, there is a relatively significant timeframe before committed capacity at the WWTP would be fully utilized. It is not necessarily recommended that the Municipality plan to always maintain reserve for 1,140 ERUs as commitments.

[2] Based on MOECC Design Guideline (2008) design water demand value of 28 m^3/ha/d as average for commercial and light industry, a maximum day factor of 2.0, and 15% of the 59.3 ha Business Park as a commitment.

Table 8.2: Forecasted Average Day Wastewater Flow - Kincardine

Item	Average Day Wastewater Flow (m^3/d)	
	Official Plan High Growth Scenario (Extrapolated to 2067)	Development Charges (Extrapolated to 2067)
Current flow	3,811	3,811
Development commitments flow	1,106	1,106
Increase in flow to 2067	6,506	1,530
Total flow in 2067 without commitments	10,317	5,341
Total flow in 2067 plus commitments[1]	11,423	6,447

[1]Assumes same current commitments applies in 2067.

Assuming a maximum day factor of 4, the future design maximum day values would range in the order of 26,000 to 46,000 m^3/day. Several factors will affect how the maximum day factor may vary in the future, including items such as:

- Newer sewers are not expected to allow infiltration and inflow (I&I) at similar rates to existing aged pipe;
- New development should not be provided with illegal storm drain connections such as some existing development areas have; and
- In general, water conservation measures are anticipated to provide a net reduction in wastewater flows.

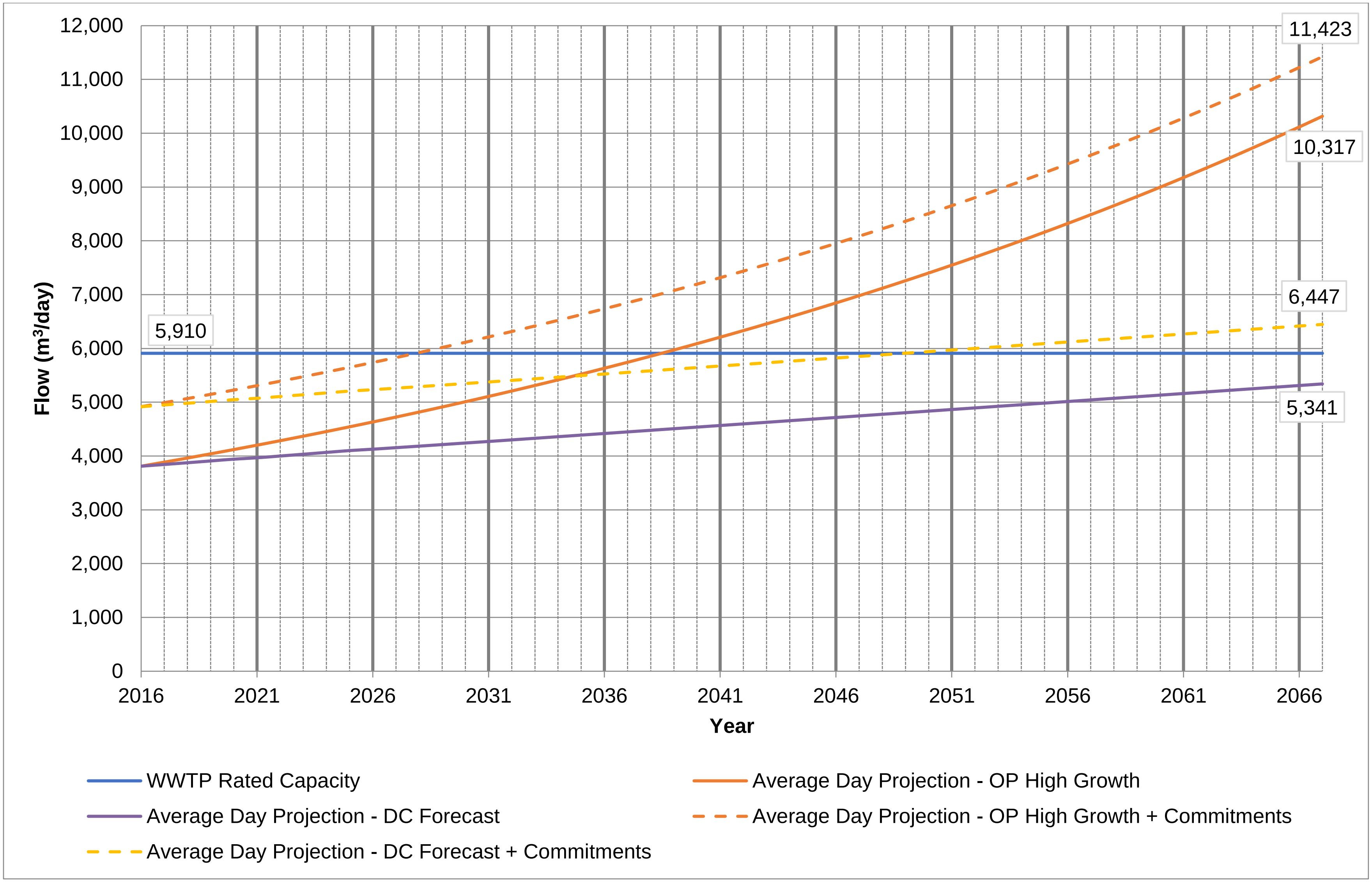
Therefore, assuming that existing maximum day factors will apply in the future may result in overestimated future wastewater flows. For the purposes of this analysis, WWTP capacity is evaluated on the basis of average day flow as that is the principal design and rated capacity basis for the plant. Wastewater collection and SPS facilities are evaluated on the basis of projected peak flows, generally taken as approximately 150% of maximum day values, which may provide a factor of safety if using overestimated values.

8.2.3 Wastewater Collection System Modelling

8.2.3.1 BACKGROUND

The Kincardine wastewater collection system was modelled using SewerCAD®. The purpose of the modelling was to identify potential pipe capacity constraints during periods of peak flow and to determine requirements for servicing future development areas.

Figure 8.1: Kincardine Wastewater Forecasted Average Day Wastewater Flows



8.2.3.2 MODEL DETAILS

8.2.3.2.1 Software

BMROSS used Bentley® SewerCAD® V8i (SELECTseries 5) for the wastewater collection system modelling. Six separate models were created, one for each of the major SPS catchment areas considered in the Master Plan. Refer to Appendix E for model details for each SPS.

8.2.3.2.2 Sources of Data

In order to produce a SewerCAD® model for the Kincardine wastewater network, several sources of information were used. In summary:

- Sanitary sewer and maintenance (MH) hole installation locations, elevations, and diameters were obtained from collection system mapping (i.e. GIS database) provided by the Municipality;
- Following creation of the model, data validation found several sources of error related to pipe and MH elevations. The model was corrected using BMROSS and other Municipal records, where available;
- A Manning's n value of 0.013 was used for all gravity sewer pipe;
- Wastewater flows for each catchment area were developed as part of this Master Plan (refer to Appendix E); and
- Assessments of sanitary sewer pipe was completed on the basis of comparing calculated flow in the pipe to full-flow capacity. Pipes were identified where the ratio of flow to capacity exceeded 80%.

8.2.3.2.3 Establishing Flows at Maintenance Holes

Wastewater flows in the SewerCAD® model may be applied at MHs (i.e. point loads) or over the length of a sewer pipe (i.e. linear loads). For the existing Kincardine model, the total catchment area wastewater flow was divided by the total number of model MHs in order to calculate the flow per MH. This flow value was assigned to each MH and generally corresponds to dividing the total flow for the catchment area over the catchment area evenly.

It is noted that, for the six SPS catchment areas analyzed, the total design peak flow for all stations is approximately 405 L/s (nearly 35,000 m^3/day). While this is greater than the peak flow observed at the WWTP for the combined system, the analysis recognizes that not all stations would necessarily experience peak flows at the same time. In other words, the cumulative total of all individual station design flows can be expected to be greater than the total system flow at any one time. Appendix E provides detailed calculations for each catchment area.

For the future development model, the assumed locations for future trunk sanitary sewers were incorporated into the model, as applicable, creating a series of additional pipes and MHs within the development lands. Flows for existing development were left unchanged, and the incremental future flows were added to applicable adjacent or new MHs. For the model, incremental future demand was estimated to be an additional 356 L/s (30,760 m^3/day). Again, the total value for the entire system is unlikely to be achieved. Refer to Appendix E for detailed calculations.

8.2.3.3 ANALYSES RUN

The model was used to calculate the flow in each sanitary sewer pipe, and percentage of full-flow capacity utilized, for peak flow conditions in the following scenarios:

- Existing development flows; and
- Future flows based on full development of future service areas.

8.2.3.4 QUALIFICATIONS ON RESULTS

Results of the wastewater system modelling are based on the system information as described above. Limited work was completed in relation to verification of the model by way of confirming elevation data from GIS to actual field measurements. Peak flows were calculated based on methodology described in Appendix E and no work was completed to monitor actual flow in the sanitary sewers.

8.2.3.5 CONNAUGHT PARK SPS CATCHMENT AREA

Table 8.3 summarizes the results of the SewerCAD® analysis for the existing system, as well as the future conditions. Full details are provided in Appendix E.

The future system model was analyzed on the basis of including all trunk sewer upgrades currently under construction within Connaught Park, Kingsway/Shevchenko/Cedar Lane, and the Golf Course. Figures 8.2 and 8.3 illustrate the existing and future catchment areas for the Connaught Park SPS, respectively.

Table 8.3: Summary of SewerCAD® Analysis - Connaught Park SPS Catchment Area

Analysis and Criteria	**Existing System and Flows**	**Future System and Flows**
No. of pipes with flow <80% design capacity	95	110
No. of pipes with flow >80% and <100% design capacity	5	0
No. of pipes with flow >100% design capacity	4	0

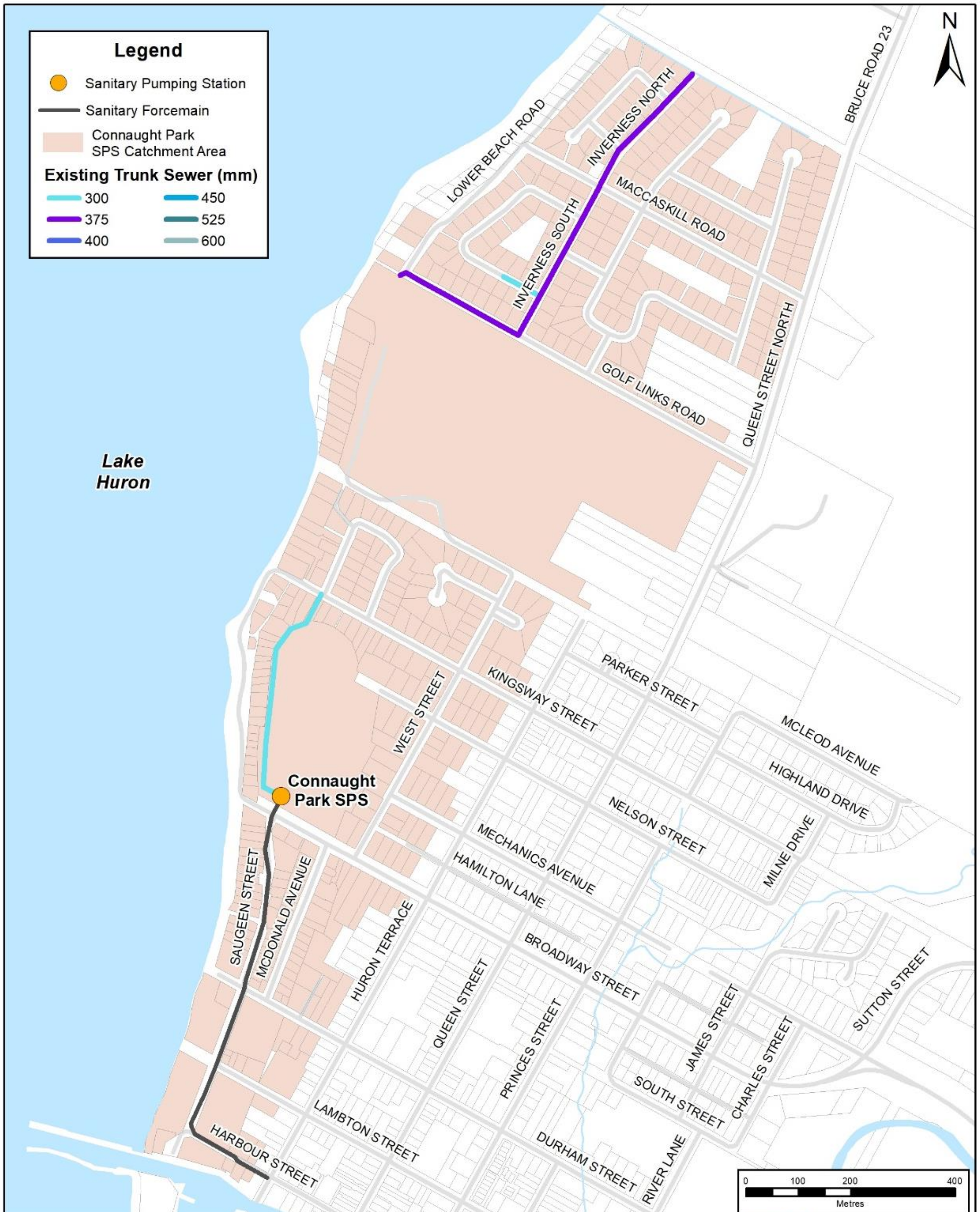
It is concluded that, with the proposed sewer upgrades currently under construction, the wastewater collection network for the Connaught Park SPS catchment area will be adequate for future design conditions and no further upgrades are recommended at this time.

8.2.3.6 DURHAM ST. SPS CATCHMENT AREA

Table 8.4 summarizes the results of the SewerCAD® analysis for the existing system, as well as the future conditions. Full details are provided in Appendix E.

The future system model was analyzed on the basis of including all trunk sewer upgrades currently being designed along Gary Street, Sutton Street, Mechanics Avenue, and James Street in relation to the proposed office building and ICI development lands north of Gary Street. Figures 8.4 and 8.5 illustrate the existing and future catchment areas for the Durham Street SPS, respectively.

Figure 8.2: Connaught Park SPS Existing Catchment Area



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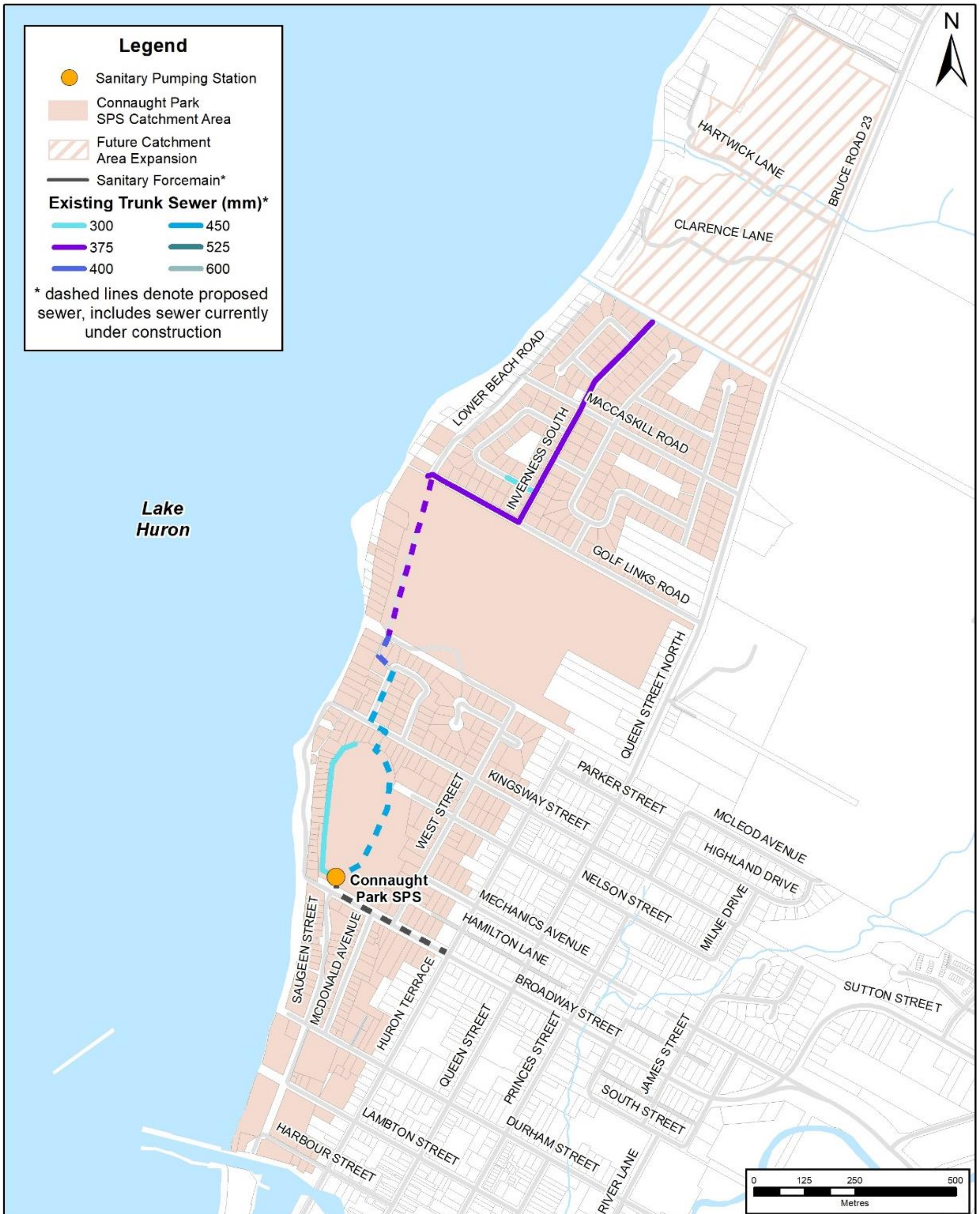
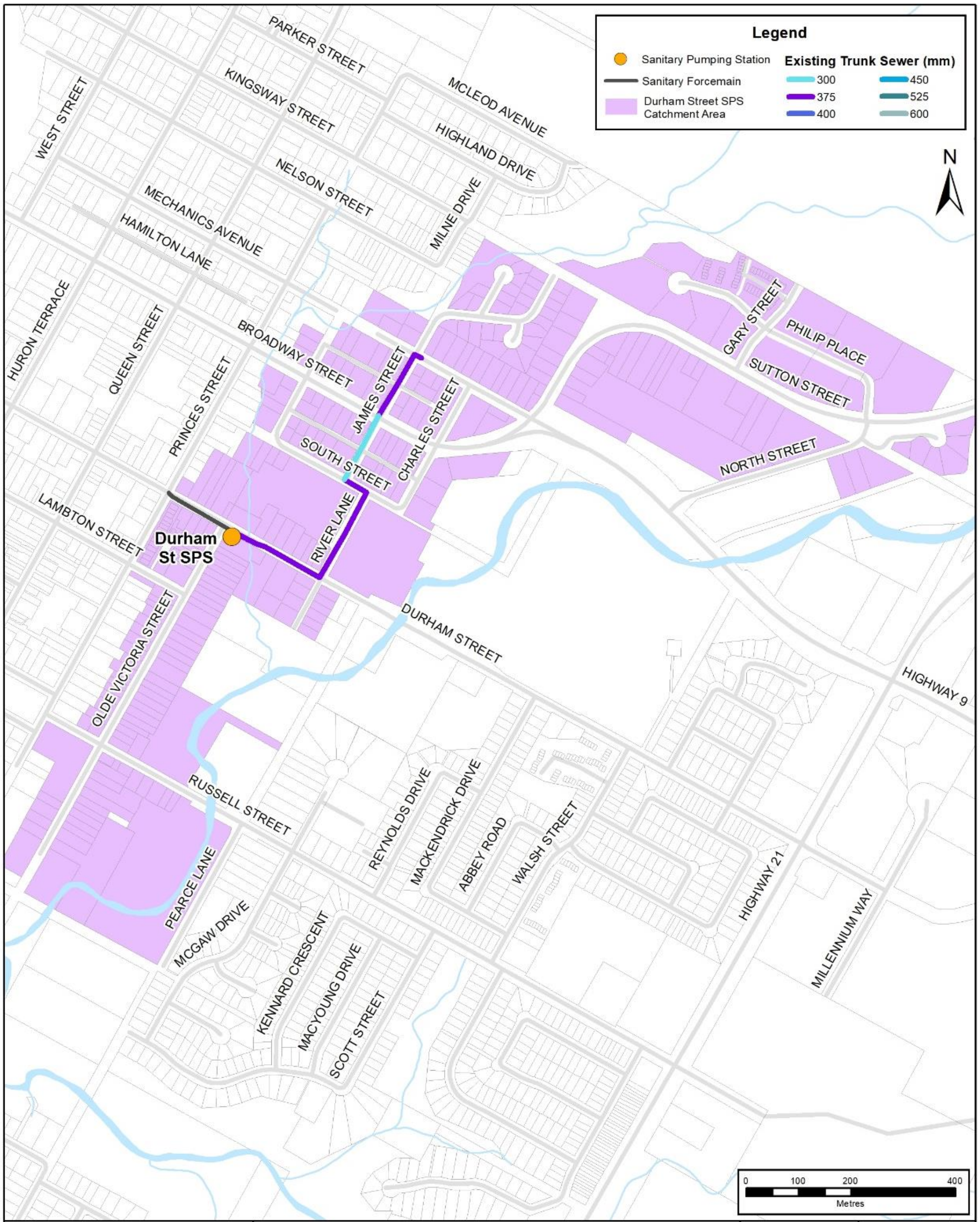
		SCALE 1 :10,000	FIGURE No. 8.2

Figure 8.3: Connaught Park SPS Future Catchment Area



BMROSS engineering better communities	**MUNICIPALITY OF KINCARDINE** WATER AND WASTEWATER MASTER PLAN **CONNAUGHT PARK SPS FUTURE CATCHMENT AREA**	DATE JAN. 09, 2018	PROJECT No. 16130
		SCALE 1 :13,000	FIGURE No. 8.3

Figure 8.4: Durham St. SPS Existing Catchment Area



BMROSS engineering better communities	MUNICIPALITY OF KINCARDINE WATER AND WASTEWATER MASTER PLAN DURHAM STREET SPS EXISTING CATCHMENT AREA	DATE JAN. 09, 2018	PROJECT No. 16130
		SCALE 1:10,000	FIGURE No. 8.4

Figure 8.5: Durham St. SPS Future Catchment Area

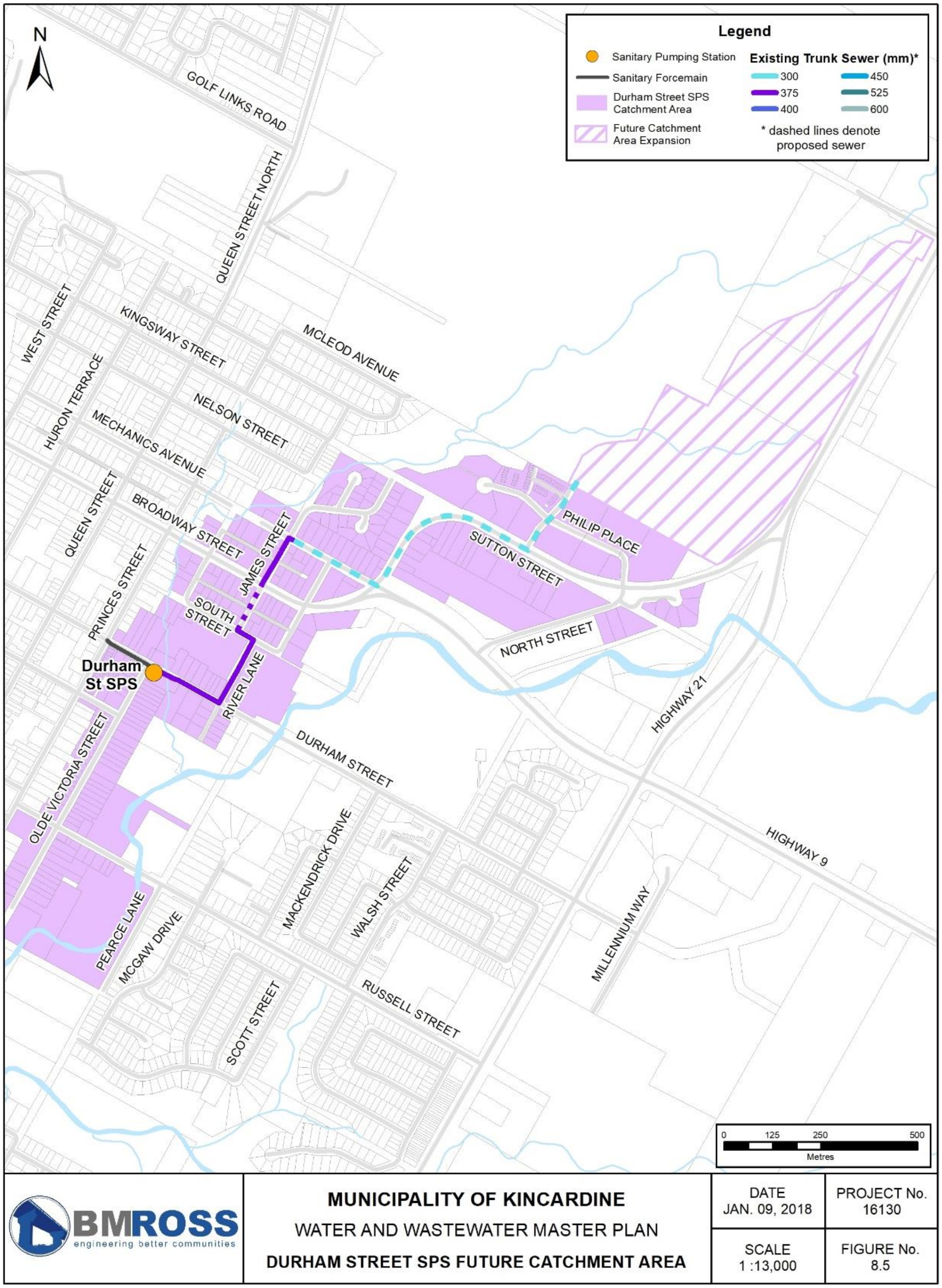


Table 8.4: Summary of SewerCAD® Analysis - Durham St. SPS Catchment Area

Analysis and Criteria	Existing System and Flows	Future System and Flows
No. of pipes with flow <80% design capacity	66	62
No. of pipes with flow >80% and <100% design capacity	0	11
No. of pipes with flow >100% design capacity	0	3

For the future system, three pipes are predicted to have flows up to 22% greater than full-flow capacity (i.e. 25.2 L/s calculated flow versus 20.7 calculated full-flow capacity). In our opinion, these exceedances are limited in nature and location, and may result in limited surcharging events, and at this point in time would not justify planning to replace sewer in these areas. At this time, recommended upgrades are limited to those illustrated in Figure 8.5.

8.2.3.7 HURON TERRACE SPS CATCHMENT AREA

Table 8.5 summarizes the results of the SewerCAD® analysis for the existing system, as well as the future conditions. Full details are provided in Appendix E.

The Huron Terraced SPS catchment area includes a gravity collection sewer system, as well as receiving flows from the Connaught and Durham Street SPSs.

Several iterations of the future system model were carried out in order to confirm sanitary sewer upgrade requirements on Durham Street (to respond to future flow increases from the Durham Street SPS) and on Queen and Kingsway Streets (to respond to future flow increases from development north of the existing system limits on Queen Street North). Figures 8.6 and 8.7 illustrate the existing and future catchment area for the Huron Terrace SPS, respectively.

Table 8.5: Summary of SewerCAD® Analysis - Huron Terrace SPS Catchment Area

Analysis and Criteria	Existing System and Flows	Future System and Flows
No. of pipes with flow <80% design capacity	133	115
No. of pipes with flow >80% and <100% design capacity	3	13
No. of pipes with flow >100% design capacity	4	13

It is noted that the development lands north of the existing service area, as shown in Figure 8.7b, represent an extremely significant increase to the design catchment area for the Huron Terrace SPS. The future design flow associated with the expanded catchment area is a 180% increase from existing calculated flow and will likely take many years to occur. Refer to Section 8.2.4 for details of SPS capacities. It is noted:

- General topography in the area north and east of the existing sanitary sewer terminus on Queen Street north is increasing in elevation, which would allow much of the expanded catchment area to be serviced by gravity sanitary sewer. However, some areas with localized lower points may require provision of pumping facilities to convey wastewater; and

Figure 8.6: Huron Terrace SPS Existing Catchment Area

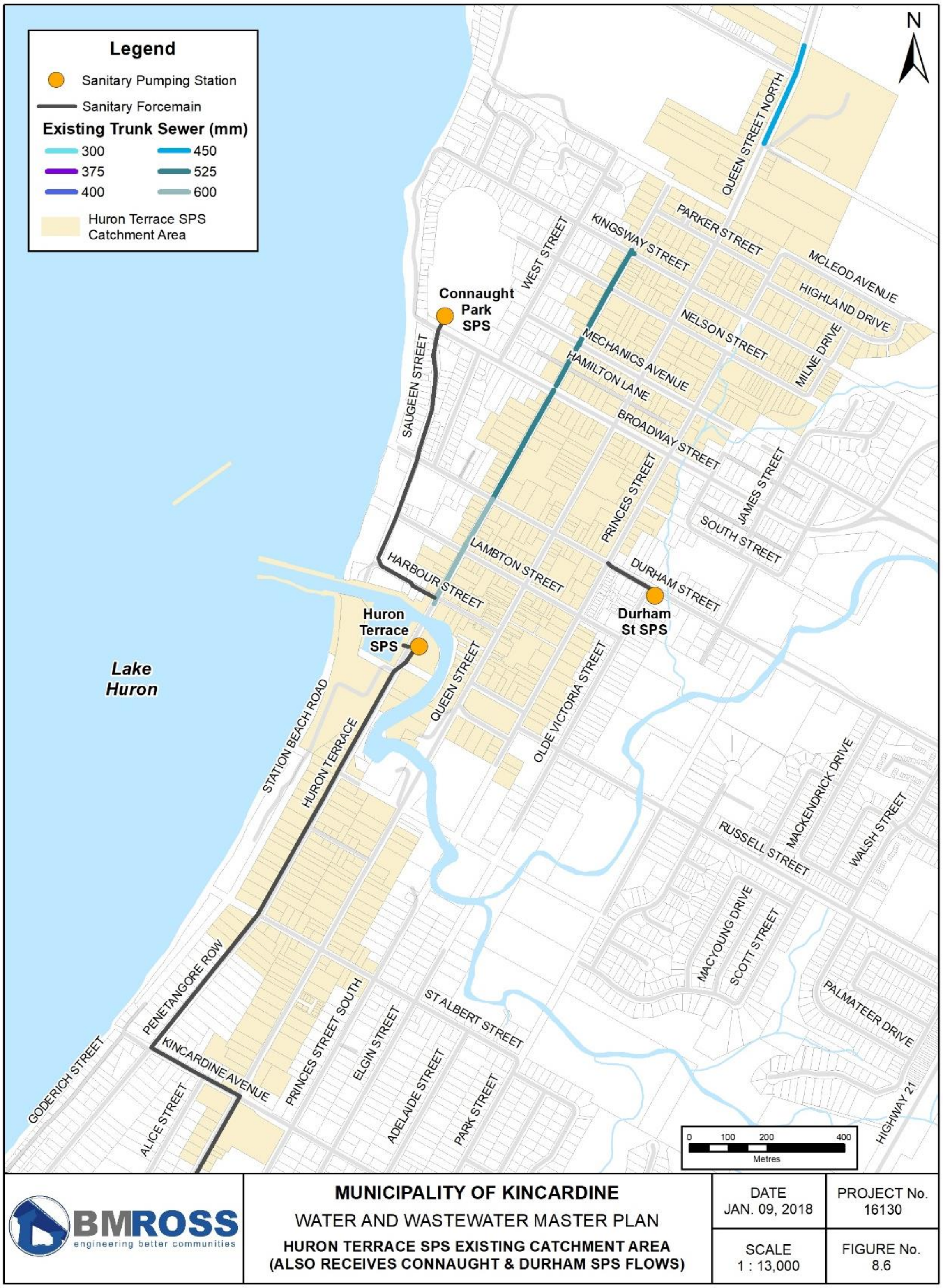


Figure 8.7a: Huron Terrace SPS Future Catchment Area

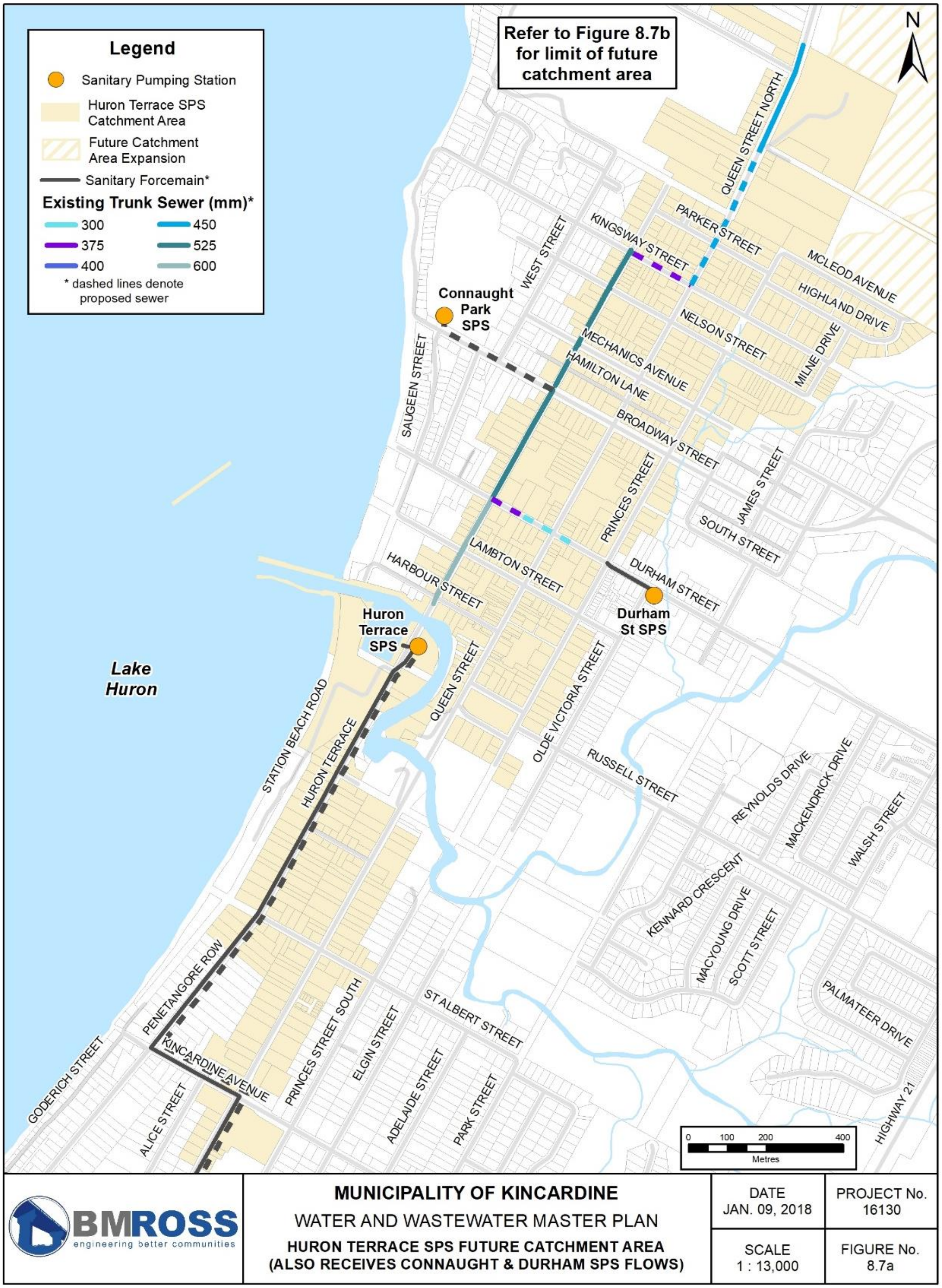
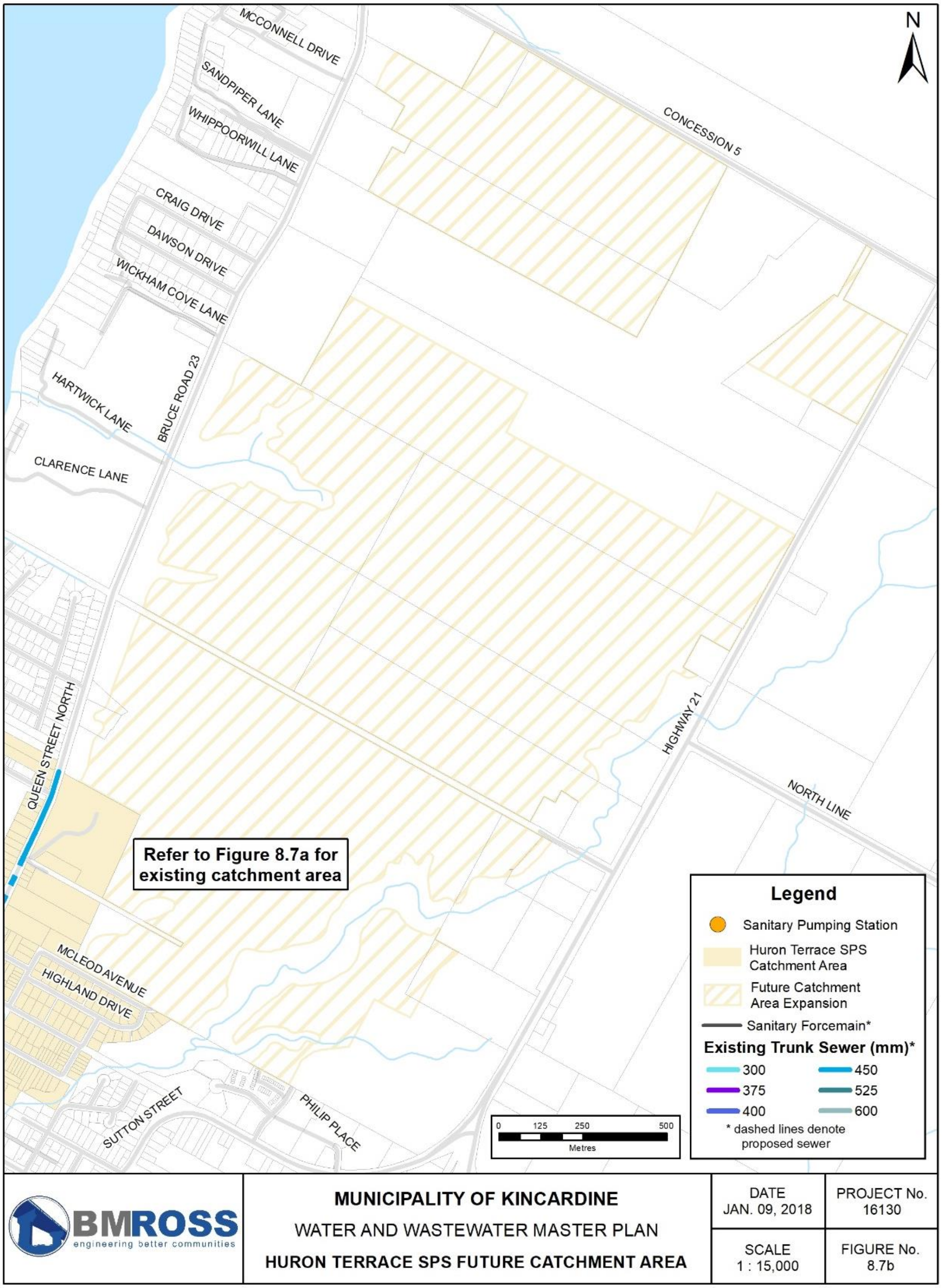


Figure 8.7b: Huron Terrace SPS Future Catchment Area



- The recommendations provided in the Master Plan are limited to upgrades within the existing wastewater collection system, in order to provide capacity for future flows. Design of wastewater collection works within the development lands would have to be considered in conjunction with subdivision/development design in each specific area.

For the future system, 13 pipes have been identified as having calculated flows greater than the full-flow capacity of the pipe. Of these, 5 have negligible exceedances (i.e. up to 5% greater). The remaining pipes are generally large diameter and capacity, relative to the rest of the system, with current calculated flows at less than half capacity. At this time, recommended upgrades are limited to those shown on Figure 8.7a, and even these upgrades are not considered to have urgency. They should be considered when street reconstruction is planned for these locations, or in response to development progressing to the north of the existing system limits.

8.2.3.8 PARK ST. SPS CATCHMENT AREA

Table 8.6 summarizes the results of the SewerCAD® analysis for the existing system, as well as the future conditions. Full details are provided in Appendix E.

The future system model was analyzed on the basis of including trunk sewer upgrades on Russell Street and Highway 21, as recommended in the Kincardine Business Park Servicing Master Plan (B. M. Ross and Associates Limited, 2017). Figures 8.8 and 8.9 illustrate the existing and future catchment areas for the Park Street SPS, respectively.

Table 8.6: Summary of SewerCAD® Analysis - Park St. SPS Catchment Area

Analysis and Criteria	Existing System and Flows	Future System and Flows
No. of pipes with flow <80% design capacity	118	107
No. of pipes with flow >80% and <100% design capacity	8	7
No. of pipes with flow >100% design capacity	3	15

For the future system, 15 pipes have been identified as having calculated flows above the full-flow capacity of the pipe. Of these, 5 have negligible exceedances (i.e. up to 10% or 5 L/s greater). The Kincardine Business Park Servicing Master Plan also identified that several pipes could be in a surcharge condition under future peak design flows but confirmed that the extent of the surcharge would be limited in nature and not adversely impact the system based on the analysis. At this time, the recommended upgrades are limited to those identified in Figure 8.9.

8.2.3.9 GODERICH ST. SPS CATCHMENT AREA

Table 8.7 summarizes the results of the SewerCAD® analysis for the existing system, as well as the future conditions. Full details are provided in Appendix E.

The future system model was analyzed assuming the same collection system as existing. Figure 8.10 illustrates the existing and future catchment areas for the Goderich Street SPS.

Figure 8.8: Park St. SPS Existing Catchment Area

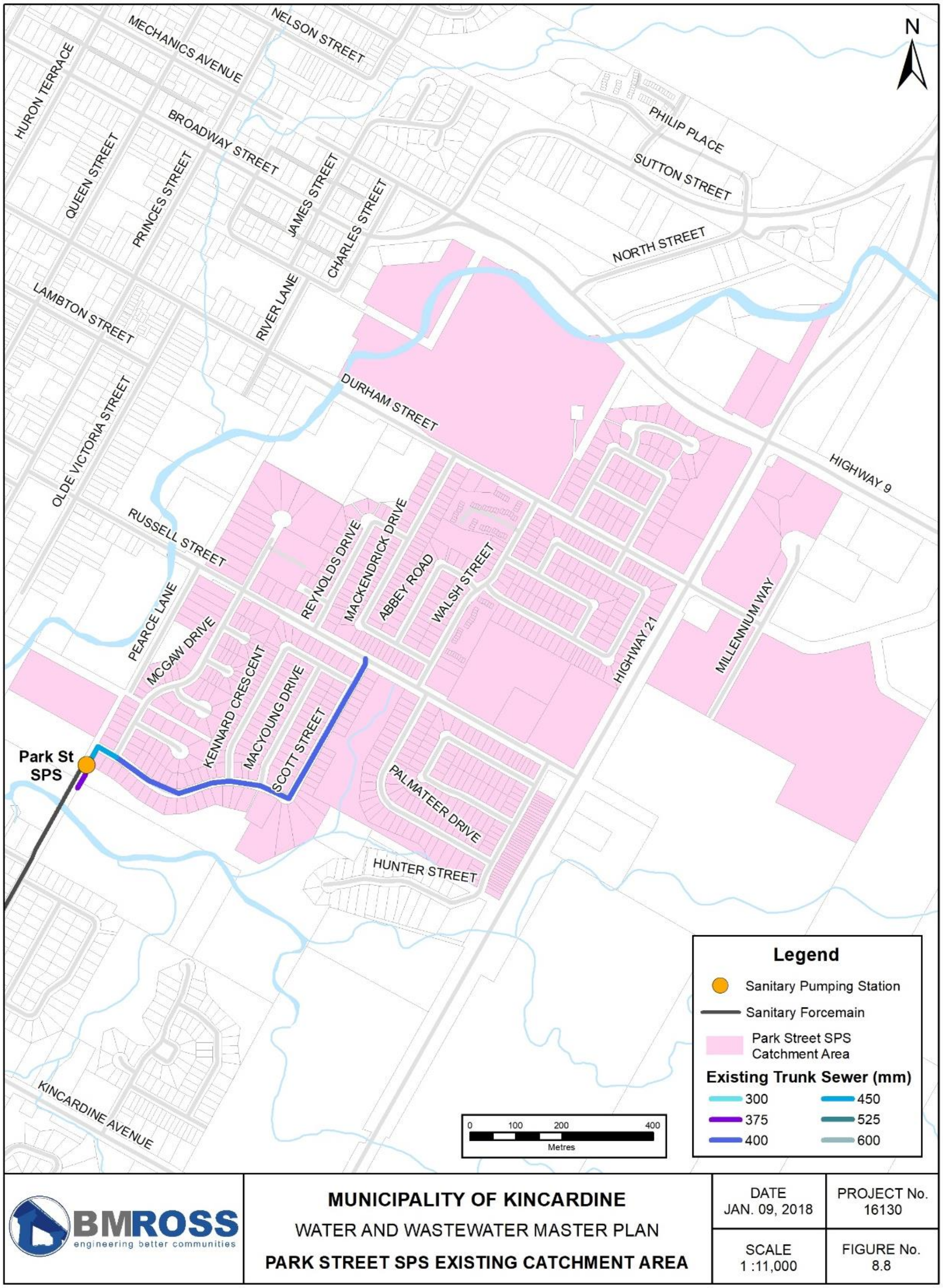


Figure 8.9: Park St. SPS Future Catchment Area

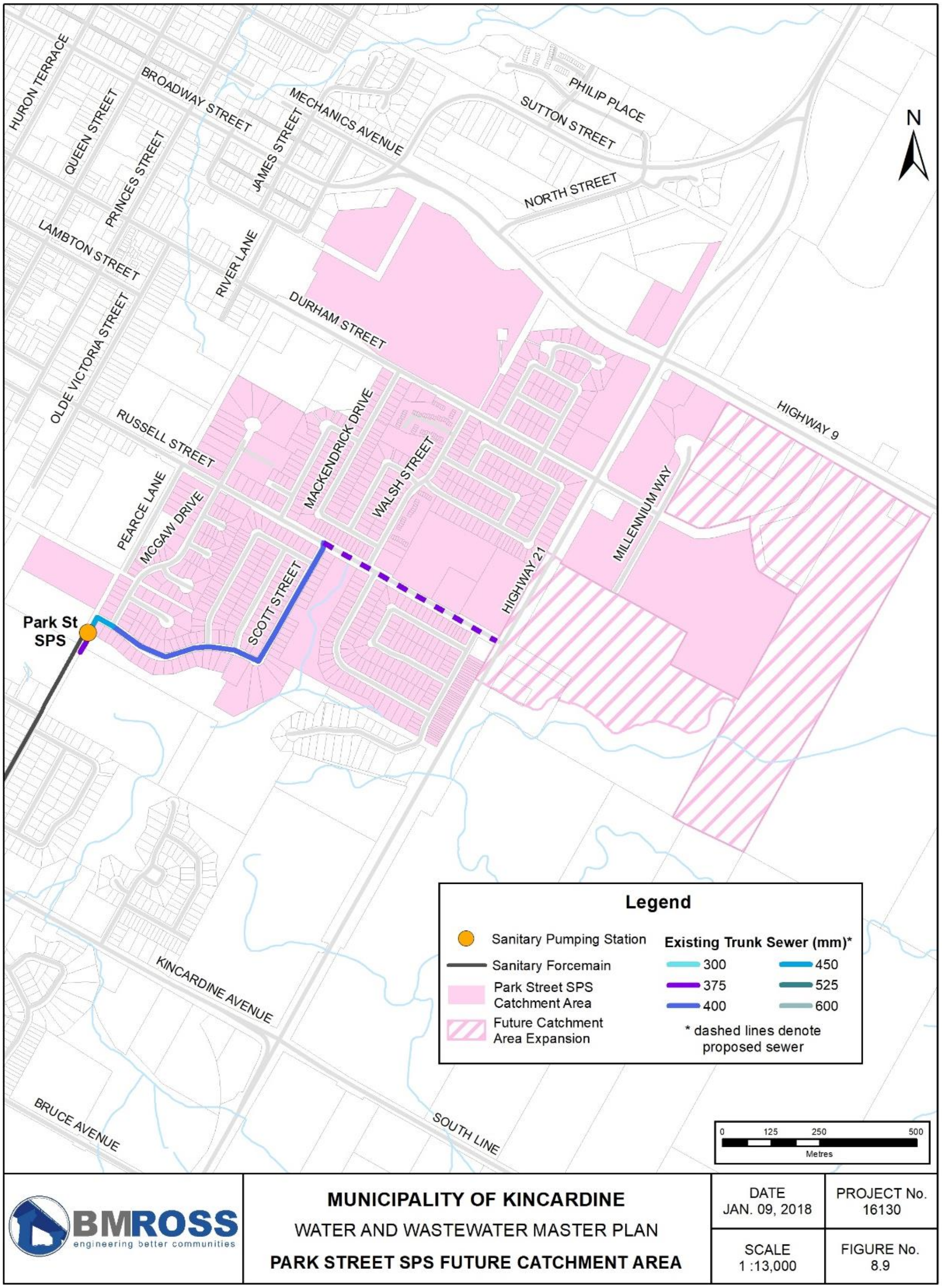
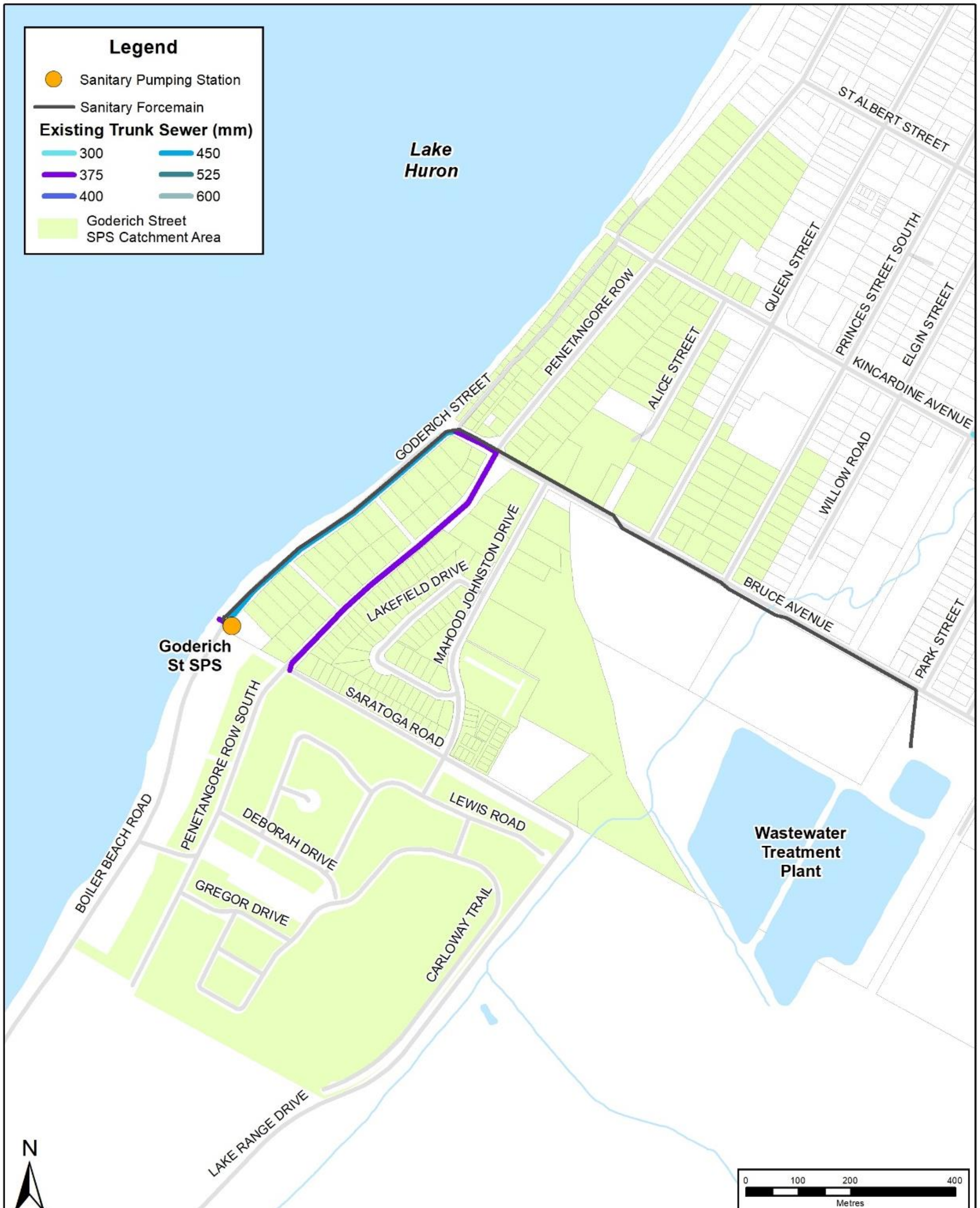


Figure 8.10: Goderich St. SPS Existing and Future Catchment Area



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	GODERICH STREET SPS EXISTING & FUTURE CATCHMENT AREA	SCALE 1 :10,000	FIGURE No. 8.10

Table 8.7: Summary of SewerCAD® Analysis - Goderich St. SPS Catchment Area

Analysis and Criteria	Existing System and Flows	Future System and Flows
No. of pipes with flow <80% design capacity	116	114
No. of pipes with flow >80% and <100% design capacity	3	5
No. of pipes with flow >100% design capacity	0	0

The wastewater collection system capacity is considered adequate for the existing and future conditions, and no upgrades were identified as being required at this time.

8.2.3.10 KINCARDINE AVE. SPS CATCHMENT AREA

Table 8.8 summarizes the results of the SewerCAD® analysis for the existing system, as well as the future conditions. Full details are provided in Appendix E.

The future system model was analyzed assuming the same collection system as existing. Figure 8.11 illustrates the existing and future catchment area for the Kincardine Avenue SPS.

Table 8.8: Summary of SewerCAD® Analysis - Kincardine Ave. SPS Catchment Area

Analysis and Criteria	Existing System and Flows	Future System and Flows
No. of pipes with flow <80% design capacity	106	105
No. of pipes with flow >80% and <100% design capacity	0	0
No. of pipes with flow >100% design capacity	1	2

For the future system, 2 pipes were identified as having calculated flow greater than full-flow capacity, but the extent of the exceedances is not considered significant to the point of requiring upgrades in those locations. The wastewater collection system capacity is considered adequate for the existing and future conditions, and no upgrades were identified as being required at this time.

8.2.4 Sewage Pumping Stations and Forcemains

8.2.4.1 BACKGROUND

An SPS receives wastewater flows from gravity sewer(s) and may also receive pumped wastewater from other SPSs. Section 8.2 lists the ECAs applicable to each of the six SPSs considered in the Master Plan. Each ECA defines the rated capacity of the station. Figures 8.2 through 8.11 illustrate the locations of the SPSs and their catchment areas. Table 8.9 provides a summary of the station capacities and discharge locations.

Figure 8.11: Kincardine Ave. SPS Existing and Future Catchment Area

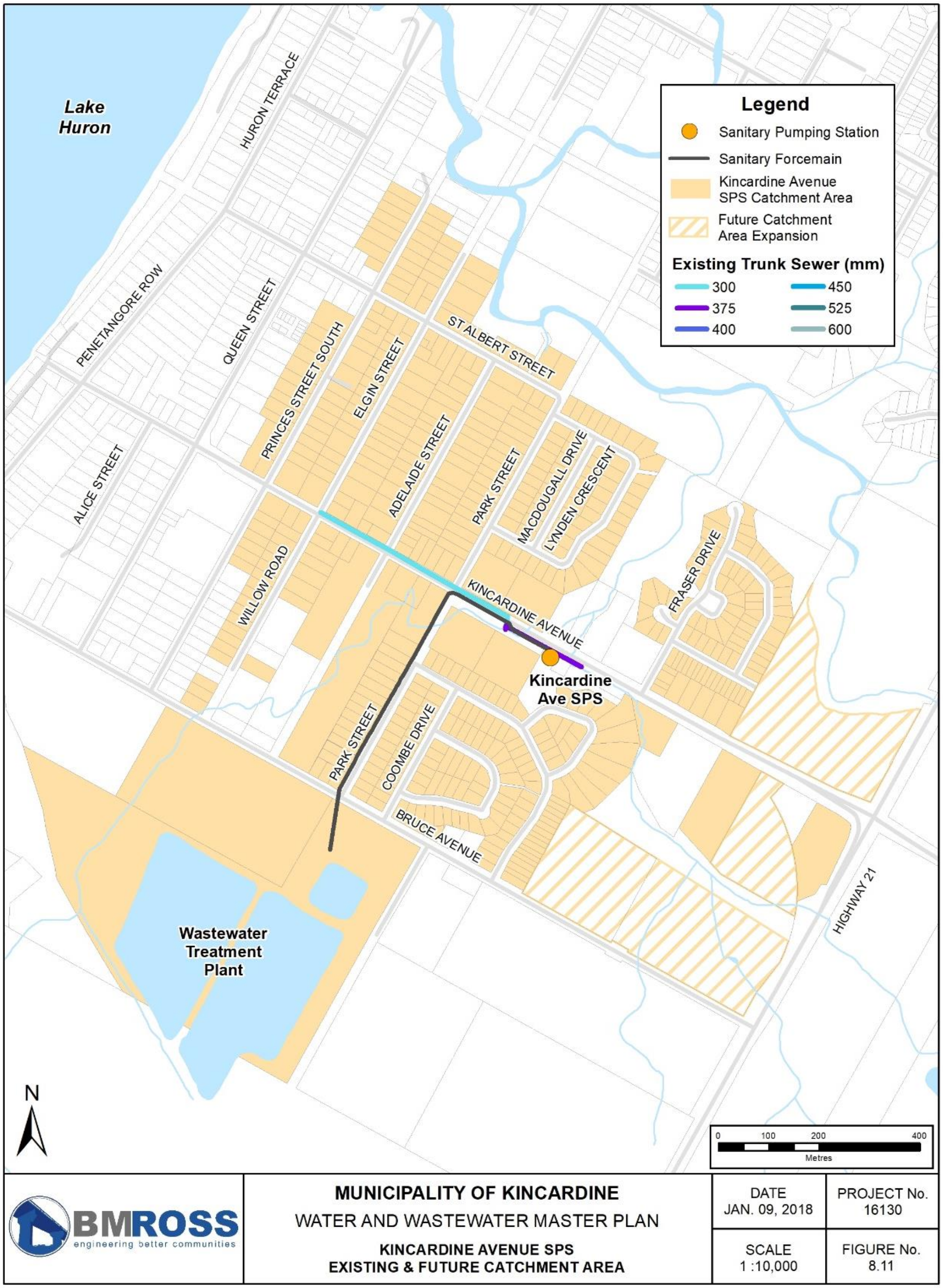


Table 8.9: Kincardine SPS Capacities and Discharge Locations

Station	Rated Capacity per ECA (L/s)	Forcemain Discharge Location
Connaught Park	89[1]	Gravity sewer at Huron Terrace and Broadway Street[1], ultimately flows to Huron Terrace SPS
Durham Street	27	Gravity sewer at Durham and Princes Streets, ultimately flows to Huron Terrace SPS
Huron Terrace	115	Kincardine WWTP
Park Street	99	Kincardine WWTP
Goderich Street	46	Kincardine WWTP
Kincardine Avenue	49	Kincardine WWTP

[1]The Connaught SPS currently discharges to a gravity sewer at Huron Terrace and Harbour Street, but 2018 construction will relocate discharge to Huron Terrace and Broadway Street. The SPS is also being replaced in 2018, with a new rated capacity of 89 L/s.

In some cases, actual SPS capacity differs from rated capacity. This can happen for a variety of reasons, which could include, for example, mechanical wear to pumps or degradation of forcemain interior over time. For example, drawdown testing (i.e. a field determination of station capacity) at the Park Street SPS during 2008 identified a station capacity of approximately 82 L/s, less than the rated capacity of 99 L/s. The analyses and conclusions provided in this Master Plan are generally based on SPS rated capacity, and should known capacity differ from the rated capacity, the Municipality should consider station rehabilitation (e.g. pump replacement) in order to restore station capacity.

It is known from operator experience that the Connaught, Durham Street, Park Street, and Huron Terrace stations all experience high peak flows due to I&I and have surcharged to high levels, in some cases causing station bypasses.

8.2.4.2 PROJECTED STATION CAPACITY REQUIREMENTS

Section 8.2.2 provides a summary, for each SPS, of future catchment area changes. Table 8.10 summarizes the station estimated current peak flows, and projected future peak flows. The future values correspond to full development of the expanded catchment areas for each station as shown in Section 8.2.2 figures. Detailed calculations related to flows for each SPS, for both existing and future conditions, are provided in Appendix E.

Table 8.10: Kincardine SPS Existing and Future Peak Flows

Station	Estimated Current Peak Flow (L/s)	Calculated Future Peak Flow (L/s)
Connaught Park	41	69
Durham Street	58	120
Huron Terrace	188	439
Park Street	115	195
Goderich Street	62	63
Kincardine Avenue	40	64

8.2.4.3 CAPACITY CONSTRAINTS AND RECOMMENDATIONS

A comparison of the SPS rated capacities in Table 8.9 to the peak flow values provided in Table 8.10 demonstrates that Durham Street, Huron Terrace, Park Street, and Goderich Street are undersized for estimated current peak flows. These same stations, plus the Kincardine Avenue SPS, would also be undersized for future peak flows.

As previously discussed, it is possible that future peak flows will be overestimated. It is also anticipated that it will take many years for development in some areas, especially to the north of the current urban boundary, to occur to a significant level. The following comments are intended to summarize general prioritization of upgrades related to the SPSs on the basis of full development.

8.2.4.4 CONNAUGHT PARK SPS

Replacement of the SPS and associated forcemain will occur in 2018. At this time, no other upgrades related to the SPS are required for existing or future conditions.

8.2.4.5 DURHAM STREET SPS

Estimated current peak flows are approximately 200% of station rated capacity. Based on a review of station piping and forcemain details, an increase of this magnitude could be accommodated by replacing existing pumps with larger capacity units, without significant station mechanical upgrades. A larger standby generator may be required for larger pumps; this would have to be confirmed as part of a detailed assessment and design.

Assuming full development of the future catchment area, a capacity increase of 93 L/s would be required. An increase of this magnitude would require many new components (e.g. pumps, piping, electrical upgrades, and forcemain replacement or parallel forcemain), to such an extent that the station is effectively replaced.

Given the above, there are three alternatives for increasing capacity at the Durham Street SPS:

I. Replace pumps with larger units;
II. Replace the SPS; and
III. Do Nothing.

The potential impacts of the alternatives are summarized in Table 8.11:

Table 8.11: Impact Evaluation for Durham St. SPS Alternatives

Environmental Component	Alternative I – Replace Pumps	Alternative II – Replace SPS	Alternative III – Do Nothing
Natural	Minimal/Nil – construction would be within existing facilities.	Moderate – May be site impacts depending on location.	High - Surcharging could result in bypasses which would impact natural environment.
Social and Cultural	Low – supports continued growth and development in Municipality. -May be temporary disruption in service during replacement. -Will allow municipality to meet policy objectives for servicing and growth.	Moderate – impacts to adjacent property owners during construction. -Will allow municipality to meet policy objectives for servicing and growth.	High – surcharging could result in sewage backups. -will not allow Municipality to meet policy objectives for servicing and growth.
Economic	Low – capital costs associated with modifications to existing facilities are less than construction of a new facility. -Will have ongoing maintenance and operation costs.	Moderate – most expensive option in terms of capital costs. -Will have ongoing maintenance and operation costs.	Minimal/Nil
Technical	Low – makes use of and improves existing infrastructure.	Moderate – requires investigation to site new facility and integration into the existing system.	High – does not address capacity exceedance.
Summary	Most preferred	Preferred in absence of Alternative I	Least preferred

Given that existing peaks exceed station capacity and the potential impacts, it is recommended that the Municipality proceed with further detailed investigation and analysis related to expanding station capacity either through pump replacement or station replacement. The Municipality will need to make a determination related to how much capacity for future development should be planned for.

Increase to station capacity by way of providing new pumps is categorized as a Schedule A+ project under the Municipal Class EA process. A full station replacement would require a Schedule B Class EA.

8.2.4.6 HURON TERRACE SPS

Estimated current peak flows are approximately 163% of station rated capacity. Based on a review of station piping and forcemain details, increasing capacity to the estimated current peak flow could be accommodated by replacing or paralleling the existing 300 mm diameter forcemain. This would provide additional capacity without any significant modifications to the SPS mechanical or electrical works. Based on Municipal operator comment, the existing forcemain has experienced breaks on several occasions and it would be preferred to replace it rather than keep it in service parallel to a new forcemain.

Assuming full development of the future catchment area, a capacity increase of 324 L/s would be required. An increase of this magnitude would require many new components (e.g. pumps, piping, electrical upgrades, and forcemain replacement or parallel forcemain), to such an extent that the station is effectively replaced.

Given the above, there are three alternatives for increasing capacity at the Huron Terrace SPS:

I. Replace the existing forcemain;
II. Replace the SPS; and
III. Do Nothing.

The potential impacts of the alternatives are summarized in Table 8.12:

Table 8.12: Impact Evaluation for Huron Terrace SPS Alternative

Environmental Component	Alternative I – Replace Forcemain	Alternative II – Replace SPS	Alternative III – Do Nothing
Natural	Low – construction would be within an existing road allowance. -Replacing the old forcemain should reduce likelihood of breaks.	Moderate – May be site impacts depending on location.	High - Surcharging could result in bypasses which would impact natural environment.
Social and Cultural	Low – supports continued growth and development in Municipality -May be traffic disruptions and other temporary construction related impacts. -May be temporary disruption in service during replacement. -Will allow municipality to meet policy objectives for servicing and growth.	Moderate – impacts to adjacent property owners during construction. -Will allow municipality to meet policy objectives for servicing and growth.	High – surcharging could result in sewage backups. -will not allow Municipality to meet policy objectives for servicing and growth
Economic	Low – capital costs associated with replacement of forcemain are less than construction of a new facility. -Will have ongoing maintenance and operation costs.	Moderate – most expensive option in terms of capital costs. -Will have ongoing maintenance and operation costs.	Minimal/Nil
Technical	Low – can be integrated with existing station equipment. -Will reduce likelihood of breaks through replacement of older infrastructure.	Moderate – requires investigation to site new facility and integration into the existing system.	High – does not address capacity exceedance.
Summary	Most preferred	Preferred in absence of Alternative I	Least preferred

Given that existing peaks exceed station capacity and the identified potential impacts, it is recommended that the Municipality proceed with further detailed investigation and analysis related to expanding station capacity by way of forcemain replacement. Based on preliminary assessment, a new forcemain of 400 mm diameter would nearly double the existing station capacity, while a forcemain of 500 mm diameter should be considered (in conjunction with other station upgrades/replacement) if planning for full development of the potential future service area. The Municipality will need to make a determination related to how much capacity for future development should be planned for. In either case, forcemain replacement for this SPS is a recommended priority as a means to immediately gain station capacity, while further station upgrades may be carried out later.

Increase to station capacity by way of forcemain replacement is considered a Schedule A+ project, while full station replacement requires additional screening as a Schedule B project.

8.2.4.7 PARK STREET SPS

Estimated current peak flows are approximately 116% of station rated capacity, while full development of the future catchment area would require a capacity increase of 96 L/s (i.e. approximately double existing).

The Kincardine Business Park Servicing Master Plan (B. M. Ross and Associates Limited, 2017) identified replacement of the existing pumps at the SPS as the preferred alternative to provide capacity for future design flows. It is recommended that the Municipality proceed with carrying out the recommendations of that Master Plan, which at this point would be proceeding to design and construction of the upgrades.

8.2.4.8 GODERICH STREET SPS

The estimated current peak, and design future flow, for the Goderich Street SPS are similar values due to the limited additional development projected for that catchment areas. The future design flow is 17 L/s greater than the existing station rated capacity, which represents at 37% increase in capacity.

Given there have not been reports of high flows and surcharging at this station, this may indicate the peak flow calculations are overestimating actual flows. At this time, it is recommended that flows to the station continue to be monitored, but there are no recommended upgrades to plan for at this time.

8.2.4.9 KINCARDINE AVENUE SPS

Estimated current peak flows are approximately 82% of station rated capacity, while full development of the future catchment area would require a capacity increase of 15 L/s.

Given that existing station capacity is sufficient for estimated current peaks, there is currently no need for a capacity increase. Should peak flows increase in the future such that a capacity increase is required, based on a review of station piping and forcemain details, an increase could be achieved by way of replacing the pumps with larger capacity units.

At this time, it is recommended that flows to the station continue to be monitored, but there are no recommended upgrades to plan for at this time.

8.2.4.10 CONTROL AND MONITORING

It is noted that SPSs are currently equipped with alarm dialers to contact operations staff under specific emergency conditions (e.g. high liquid level, generator failure, etc.). The stations are not equipped to be connected to a SCADA system for remote control and continuous data monitoring and recording. It is recommended that the Municipality consider equipping the SPSs with SCADA. In addition to assisting operations staff with control and supervision of the stations, the opportunity to collect and record additional data may be beneficial for stations where future expansion timing decisions will be influenced by actual flows being experienced at the stations.

Either as part of implementing SCADA, or as a stand-alone initial work program, it is recommended that the Municipality consider installation of a flow meter that is capable of logging peak instantaneous and daily totalized flows. This would provide data that is useful for evaluating station capacity requirements.

8.2.5 Wastewater Treatment Plant

The rated capacity of the Kincardine WWTP is 5,910 m^3/day, on the basis of annual average daily flow. The plant currently has an uncommitted reserve of 993 m^3/day, which corresponds to an uncommitted capacity for 1,024 ERUs.

In addition to providing a rated capacity based on annual average day flow, the ECA for the WWTP also stipulates monthly performance criteria in terms of effluent concentrations and loadings for several parameters. A 2014 plant performance review is enclosed as Appendix F. The review notes that there have been intermittent exceedances of effluent concentration for some parameters, most probably linked to algae blooms in late summer, but no loading exceedances. Loading values were well under limits and would continue to be even if flows increased to 100% of plant rated capacity. Based on this, for the purposes of the Master Plan, evaluating plant capacity on the basis of flow is considered to be the limiting factor rather than effluent concentrations and loadings.

Figure 8.1 and Table 8.2 provide the current and forecasted average day flows, each with or without development commitments included. It can be seen from Figure 8.1 that projected timing varies based on scenario, and therefore expansion will be driven by actual growth rates. Table 8.13 provides a summary of the period by which plant capacity would be fully utilized for the scenarios considered.

Table 8.13: Kincardine WWTP Forecasted Utilization of Current Capacity

Scenario (Extrapolated)	Existing Capacity Fully Utilized by Year
Official Plan High Growth	2039
Official Plan High Growth + Commitments	2028
Development Charges	Beyond 2067
Development Charges + Commitments	2049

It is noted, that while there is no legislation that dictates when a municipality must commence with work toward water or wastewater infrastructure capacity increases, some municipalities have a practice of initiating work toward expansion when infrastructure has reached 80% utilization of capacity. It is important to consider the expected rate of growth when establishing a trigger for expansion. 80% may be relevant in a rapidly growing community but premature when growth is slow. An important consideration is that it can take 5 years from initial planning to commissioning for a major facility expansion, including establishing financing.

For the Kincardine WWTP, current average flows represent 64% of the plant rated capacity. With development commitments included, 83% of the plant capacity is committed. It is our opinion that there is not an immediate urgency to commence with planning for the expansion of the WWTP. We recommend that 5 years from now the reserve capacity be reviewed and the need to commence planning for a WWTP be reconsidered. An expansion to the WWTP or new WWTP are subject to the screening process followed for Schedule C projects under the Class EA.

Similar to the SPSs, the WWTP is not equipped with SCADA. It is recommended that the Municipality consider equipping the WWTP with SCADA in conjunction with the SPSs.

8.2.6 Conclusions for Kincardine Wastewater System

8.2.6.1 WASTEWATER COLLECTION

The wastewater collection system consists of multiple catchment areas, each with its own SPS. Each catchment area was analyzed on the basis of future peak wastewater flows in each sewer pipe versus sewer pipe full-flow capacity. Figures 8.3, 8.5, 8.7, and 8.9 identify several proposed trunk sewer upgrades within the existing collection system, which are recommended to address future capacity requirements.

In general, as opportunities arise (e.g. road reconstruction), aged sewer pipe should continue to be replaced in areas where condition is known to be poor based on operator experience.

8.2.6.2 SEWAGE PUMPING STATIONS

The six major SPSs within the Kincardine wastewater system are operating at various proportions of their rated capacities. The Durham Street, Huron Terrace, and Park Street SPSs all have estimated peak flows that are greater than their rated capacities. This situation is anticipated to worsen as development within each station catchment area continues. Recommended next steps related to each SPS are described in Section 8.2.3, and summarized as follows:

- Connaught Park SPS:
    - Station and forcemain are planned for replacement during 2018. No further issues to address at this time.
- Durham Street SPS:
    - Capacity increase for existing and future conditions is recommended; and
    - Proceed with station draw-down testing, an assessment of pump replacement options, design and MOECC approvals.
- Huron Terrace SPS:
    - Capacity increase for existing and future conditions is recommended; and
    - Proceed with design and approvals for station forcemain replacement.
- Park Street SPS:
    - Capacity increase for existing and future conditions is recommended;
    - Proceed with design and approvals for station pump replacement as recommended in the Kincardine Business Park Servicing Master Plan (B. M. Ross and Associates Limited, 2017).

- Goderich Street SPS:
    - Continue to monitor flows. No capacity increase recommended at this time.
- Kincardine Avenue SPS:
    - Continue to monitor flows. No capacity increase recommended at this time.
- General – all SPSs:
    - Consider implementation of SCADA and improved flow monitoring.

8.2.6.3 WASTEWATER TREATMENT

The Kincardine WWTP is currently operating during average day flows at approximately 64% of its rated capacity. Development areas currently considered as commitments would represent approximately 19% of the WWTP rated capacity. Figure 8.1 and Table 8.2 provide summaries of current and projected WWTP capacity use. At the highest projected growth rate, WWTP capacity would be fully committed by 2028 assuming the same current value of commitments applies in the future. At the lowest projected growth rate, the capacity would be fully committed by 2049. A key consideration is that the uncommitted reserve capacity is currently estimated to be sufficient for 1,024 ERUs.

8.2.7 Suggested Projects and Capital Costs

Investigations have identified a number of potential capital projects and actions related to the Kincardine wastewater system. Table 8.14 summarizes these. All costs are based on 2018 $ and include construction (where applicable) and engineering, exclude HST, and should be considered ±25%.

Table 8.14: Kincardine Wastewater System – Projects

Project or Activity	Suggested Timing	Probable Cost (2018 $)
Durham Street SPS – pump replacement design and approvals	2018	$60,000
Huron Terrace SPS – forcemain replacement design and approvals	2018	$80,000
Park Street SPS – pump replacement design and approvals	2018	$60,000
Provision of SCADA for WWTP and SPSs	At discretion of Municipality	$800,000[1]
Sewer upgrades on Durham Street, to accommodate future Durham Street SPS flows	In response to development needs or in conjunction with planned road reconstruction	$450,000[2]
Sewer upgrades on Queen Street North and Kingsway Street, to accommodate future development north of the existing Huron Terrace SPS catchment area	In response to development needs or in conjunction with planned road reconstruction	$850,000[2]

Table 8.14: Kincardine Wastewater System – Projects

Project or Activity	Suggested Timing	Probable Cost (2018 $)
Sewer upgrades on Russell Street, to accommodate future Business Park development flows	In response to development needs or in conjunction with planned road reconstruction	$800,000[2]
Sewer upgrades on Gary Street, Sutton Street, Mechanics Avenue, and James Street, to accommodate future development north of Gary Street	2018	$1,700,000[2]

[1]Probable cost is based on similar project in similar community, without detailed review and preliminary assessment of Kincardine SPS and WWTP equipment
[2]Costs shown are for sanitary sewer construction and restoration only. No costs have been included for watermain, storm sewer, curb & gutter, or full width road reconstruction, which the Municipality may elect to do as part of a sanitary sewer replacement project.

It is noted that any physical infrastructure work may be subject to assessments for heritage and archaeological resources, as well as MOECC approvals.

8.3 BEC & Service Area Wastewater Systems

The BEC WWTP services the BEC industrial lands, IPP, a portion of the Inverhuron community, and Tiverton. BEC industrial lands direct wastewater flows via a trunk gravity sewer directly to the BEC WWTP. IPP and the Inverhuron community are serviced by a small collection system and SPS that pumps to the BEC WWTP. The Tiverton wastewater system consists of a gravity sewer collection network and two SPSs. The Tiverton Maple Street SPS (Main SPS) pumps to the BEC WWTP.

The following ECA documents apply to the major infrastructure considered in this analysis:

- BEC WWTP – ECA No. 3-1657-88-907;
- BEC trunk sewer – ECA No. 3-1471-88-006;
- BEC WWTP outfall sewer – ECA No. 3-0583-88-006;
- Tiverton Maple Street SPS – ECA No. 3-2417-89-906; and
- Tiverton King Street SPS – ECA No. 3-2417-89-906.

The locations of major facilities are shown in Figures 2.5 and 2.6.

The WWTP, located at 1842 Concession Road 2 (northwest corner of Concession Road 2 and Albert Road), generally consists of four aerated lagoon cells, with phosphorus removal equipment. Effluent is discharged to Lake Huron via the Bruce Power "B" water cooling channel.

8.3.1 Population Growth and Wastewater Flows

8.3.1.1 EXISTING CUSTOMER BASE

Section 4 identifies the existing and projected populations for Tiverton and the Lakeshore area. The future projected population growth for areas serviced by the BEC WWTP is provided on Figure 4.4.

The existing customer base was established using the same general methodology described for the water system in Section 7.2.1, except that because of the significant industrial contribution to wastewater generation, the BEC industrial customers were separated from residential flows. For the BEC WWTP, as well as the BEC industrial park and Tiverton wastewater collection systems, the following values apply:

- No. of billed customers = 453;
- Additional for Tiverton condo/apartments = 31;
- Calculated total customers = 484;
- Inverhuron Provincial Park = 1 service; and
- BEC Energy Park = 6 services.

8.3.1.2 EXISTING FLOWS

Table 8.15 summarizes average daily wastewater flows at the BEC WWTP from 2014 to 2016. Two values are provided; one based on the plant influent flow meter and the other based on the plant effluent flow meter.

Table 8.15: Summary of BEC WWTP Flows

Year	BEC WWTP Average Day Flow – Influent Basis (m^3/d)	BEC WWTP Average Day Flow – Effluent Basis (m^3/d)
2014	1,126	796
2015	1,318	916
2016	1,465	702
Average	1,303	805

With respect to the two different flow meters, although it is expected there may be some variation from month to month, on the basis of an annual average it is expected that the values would be relatively close (i.e. within 5%). The totalized customer and collection system flows, that comprise all sewage flow to the BEC WWTP, are within 5% of the BEC effluent flow values (and therefore significantly different than the BEC influent flow values) for the past several years. For the purpose of this analysis it is assumed the BEC effluent flow values are a more accurate representation of actual flow to the plant than the influent flow values.

The WWTP capacity is defined as an average day value on an annual basis. The critical value for the analysis is therefore 805 m^3/day. Of this value, 344 m^3/day applies to the 477 residential and small commercial customers (i.e. Tiverton and Inverhuron collection systems), and 436 m^3/day applies to the six industrial customers. The balance comes from landfill leachate.

Expressed per ERU, the residential contribution has a flow value of:

- Average day (residential/commercial): 0.72 m^3/day per ERU

Industrial land flow rates are often expressed in terms of flow per unit area, as are provided in MOECC Design Guidelines for Water (Ministry of Environment and Climate Change, 2008) or Sewage (Ministry of Environment and Climate Change, 2008). The six industries currently directing flows to the BEC WWTP occupy parcels totalling approximately 209 ha. Expressed per unit area, the flow for these industries is:

- Average day (industrial): 20.9 m^3/day per hectare

Maximum day flow to the WWTP has been up to 4,468 m^3/day in recent years, which represents a maximum day factor of approximately 4.9 for that year.

8.3.1.3 DEVELOPMENT COMMITMENTS

Refer to Section 7.2.1 for a general discussion related to development commitments.

For the Tiverton wastewater system, the following are considered to be development commitments at this time:

- Residential development (infill allowance) = 30 ERUs

For the BEC WWTP, the following are considered to be development commitments at this time. The Inverhuron servicing relates to a sanitary sewer collection system that has been designed and approved but not yet constructed, and the future design sewage flow for that area comes from the Environmental Screening Report (B. M. Ross and Associates Limited, 2014) for that Class EA process. Provision of municipal wastewater servicing to existing, unserviced development within the Inverhuron area may help mitigate risks associated with inadequate private sewage systems. The Bruce Power reserve relates to a quantity held in reserve as part of the BEC WWTP asset transfer from Bruce Power to the Municipality.

- Residential (Tiverton – from above) = 30 ERUs;
- Inverhuron servicing = 502 m^3/day = 697 ERUs;
- Bruce Power reserve = 200 m^3/day = 278 ERUs; and
- Total commitments = 1,005 ERUs.

The 1,005 ERUs correspond to an average wastewater flow of 724 m^3/day.

8.3.1.4 FUTURE FLOWS

Refer to Section 7.2.1 for a general discussion related to future growth projections.

It is anticipated that the approach used will result in a conservative projection (i.e. slight over estimate) of future flows. For sewer flows, this is based on the experience that modern sewers are less prone to infiltration and inflow relative to portions of the existing system. Water conservation measures will impact wastewater flows as well. The result is that the flow per ERU should decline with growth.

Table 8.16 provides a summary of the forecasted future wastewater flows, based on the two growth scenarios utilized, for the BEC WWTP. It is noted that, in addition to residential growth in the future projections, the BEC industrial lands have been included by assuming a consistent annual increment in developed area, up to full development by 2067. The data is provided graphically on Figure 8.12. Analysis data, on a year by year basis, is provided within Appendix G. It is noted that the 1,005 ERUs considered to be commitments would correspond to development to 2040 under the Official Plan High Growth scenario, and to 2042 under the Development Charges scenario. In either case, there is a relatively significant timeframe before committed capacity at the WWTP would be fully utilized, though development status of the BEC industrial lands may impact this.

Table 8.16: Forecasted Average Day Wastewater Flow - BEC WWTP and Service Area

Item	**Average Day Wastewater Flow (m^3/d)**	
	Official Plan High Growth Scenario (Extrapolated to 2067)	Development Charges (Extrapolated to 2067)
Current flow	805	805
Development commitments flow	724	724
Increase in flow to 2067	1,691	1,423
Total flow in 2067 without commitments	2,496	2,228
Total flow in 2067 plus commitments[1]	3,220	2,952

[1]Assumes same current commitments applies in 2067.

In addition to the above, the Municipality has requested that consideration be given to full development of Concession 2 development lands (refer to Figure 4.9). Using the unit flow per area described above for the existing BEC lands, and applying it to these additional industrial development lands, would result in an additional average day wastewater flow of approximately 4,000 m^3/day. As discussed further in Section 8.3.4, Bruce Power is another potential wastewater customer that could represent a further capacity requirement of approximately 1,500 m^3/day.

8.3.2 Wastewater Collection System Modelling

8.3.2.1 BACKGROUND

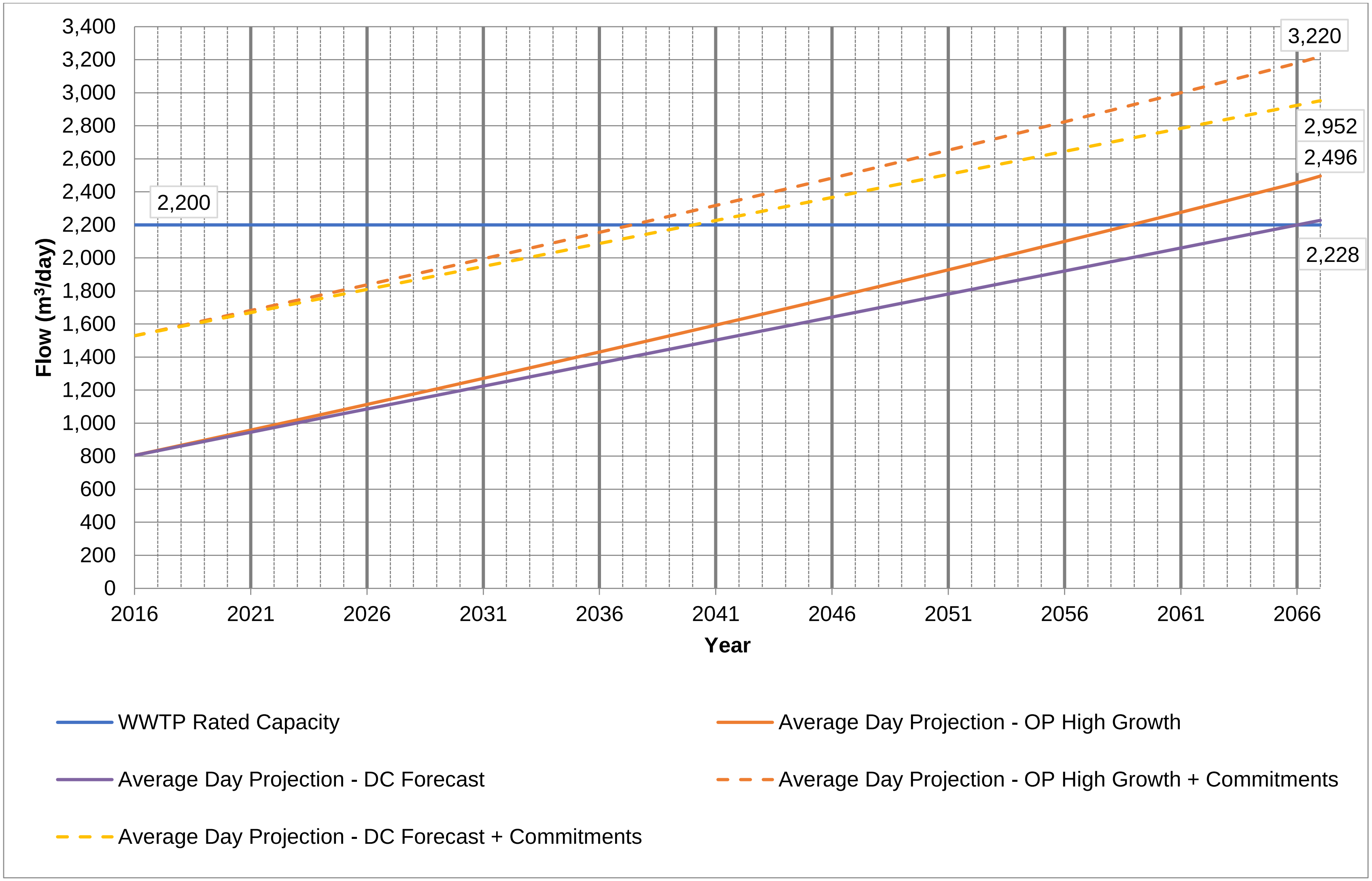
The Tiverton wastewater collection system was modelled using SewerCAD®. The purpose of the modelling was to identify potential pipe capacity constraints during periods of peak flow and to determine requirements for servicing future development areas.

8.3.2.2 MODEL DETAILS

A single model, incorporating both SPS catchment areas, was created. Refer to Appendix G for model details.

Refer to Section 8.2.2 for additional details regarding methodology for model creation for the Kincardine system. The same methodology was generally used for Tiverton, though due to apparent errors in pipe and MH elevations in the GIS data, record drawings were primarily used for establishing model elevation information.

Figure 8.12: BEC WWTP & Service Area Wastewater Forecasted Average Day Wastewater Flows



8.3.2.3 ANALYSES RUN

The model was used to calculate the flow in each sanitary sewer pipe, and percentage of full-flow capacity used, for peak flow conditions in the following scenarios:

- Existing development flows; and
- Future flows based on full development of future service areas.

8.3.2.4 QUALIFICATIONS ON RESULTS

Results of the wastewater system modelling are based on the system information as described above. Limited work was completed in relation to verification of the model by way of comparing elevation data to actual field measurements. Peak flows were calculated based on methodology described in Appendix G and no work was completed to monitor actual flow in sanitary sewers.

8.3.2.5 MAPLE STREET AND KING STREET SPS CATCHMENT AREAS

Table 8.17 summarizes the results of the SewerCAD® analysis for the existing system, as well as the future conditions. Full details are provided in Appendix G.

The future system model was analyzed assuming the same collection system as existing. Figure 8.13 illustrates the existing and future catchment areas for the SPSs.

Table 8.17: Summary of SewerCAD® Analysis - Maple and King Street SPSs Catchment Areas

Analysis and Criteria	Existing System and Flows	Future System and Flows
No. of pipes with flow <80% design capacity	94	93
No. of pipes with flow >80% and <100% design capacity	0	1
No. of pipes with flow >100% design capacity	0	0

It is concluded that the existing collection system is also adequate for future design conditions and no upgrades are recommended at this time.

8.3.3 Sewage Pumping Stations and Forcemains

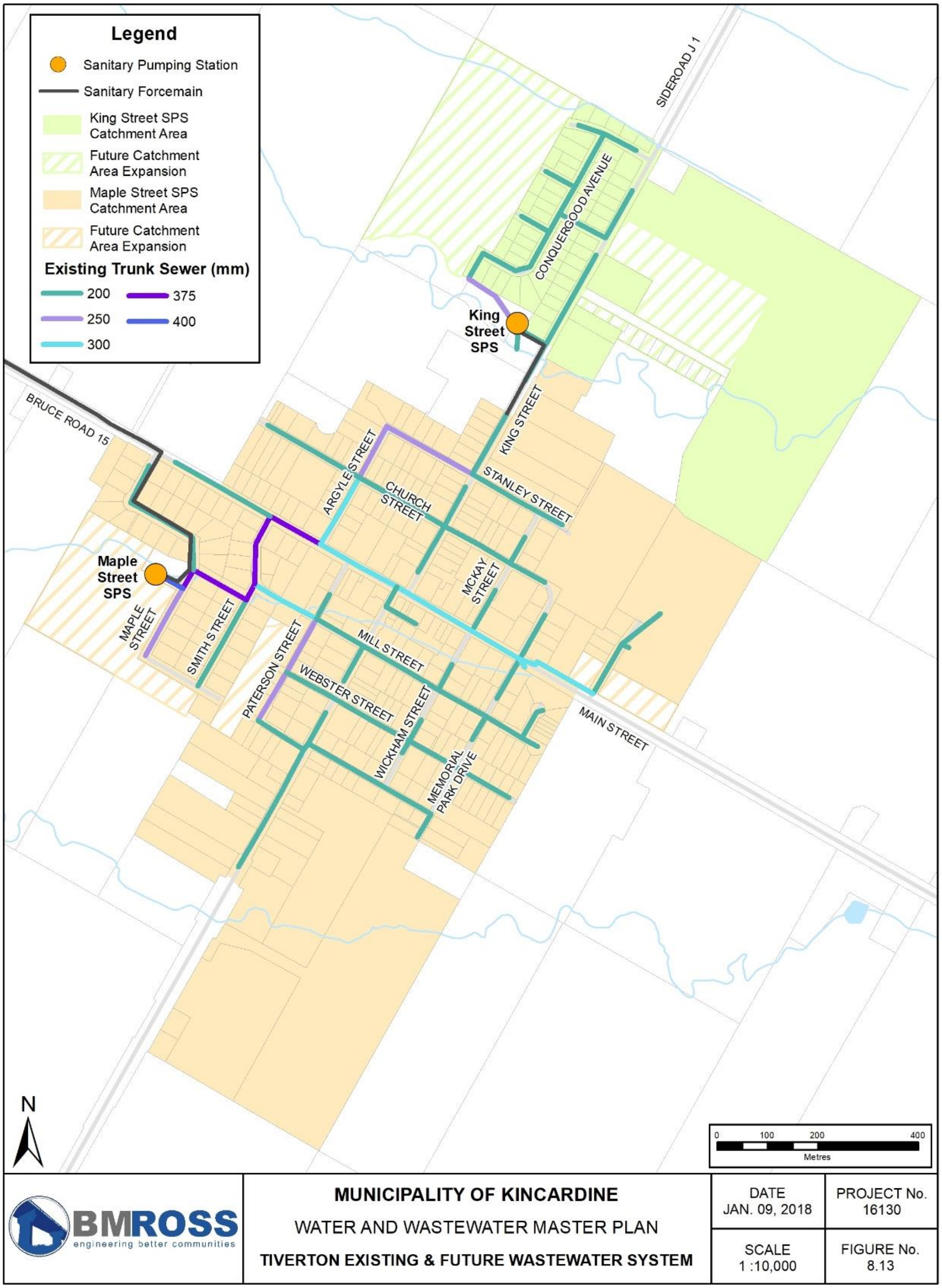
8.3.3.1 BACKGROUND

The two SPSs in Tiverton receive each flow from gravity sewer. Section 8.3 lists the ECA applicable to these SPSs, and the ECA defines the rated capacity of each station. Figure 8.13 illustrates the location of the SPSs and their catchment areas. Table 8.18 provides a summary of the station capacities and discharge locations.

Table 8.18: Tiverton SPS Capacities and Discharge Locations

Station	Rated Capacity per ECA (L/s)	Forcemain Discharge Location
King Street (Secondary)	14	Gravity sewer on King Street, north of Cameron/Stanley Streets, ultimately flows to Maple Street SPS
Maple Street (Main)	30	BEC WWTP

Figure 8.13: Tiverton Existing and Future Wastewater System



On some occasions in recent years, the Maple Street SPS has experienced high peak flows and bypassed.

8.3.3.2 PROJECTED STATION CAPACITY REQUIREMENTS

Table 8.19 summarizes the station estimated current peak flows, and projected future peak flows. The future values correspond to full development of the expanded catchment areas as shown in Figure 8.13. Detailed calculations related to flows for each SPS, for both existing and future conditions, are provided in Appendix G.

Table 8.19: Tiverton SPS Existing and Future Peak Flows

Station	Estimated Current Peak Flow (L/s)	Calculated Future Peak Flow (L/s)
King Street (Secondary)	5	16
Maple Street (Main)	50	71

8.3.3.3 CAPACITY CONSTRAINTS AND RECOMMENDATIONS

A comparison of the SPS rated capacities in Table 8.16 to the peak flow values provided in Table 8.19 demonstrates that the Maple Street SPS is undersized for currently estimated peak flow. This is supported by observations that the station will bypass under peak flow conditions.

The original 1988 design notes (B. M. Ross and Associates Limited, 1988) for the stations provided the following ultimate peak flow values:

- King Street – 14 L/s; and
- Maple Street – 80 L/s.

The King Street SPS has estimated current peak flows well under the station rated capacity. The currently estimated future peak is only marginally greater than the rated capacity, and therefore it is anticipated that no upgrades will be required to accommodate future peak flows. In the event that a small amount of additional capacity is required, it is anticipated that slightly larger capacity pumps would be sufficient.

The Maple Street SPS has estimated current peak flows that exceed station rated capacity. The station structure, process piping, and forcemain were constructed for the originally estimated ultimate peak flow value of 80 L/s, but the station was equipped with smaller capacity pumps to better match initial short-term capacity needs. Because the station was originally designed considering a future design flow that exceeds the currently estimated future peak (i.e. 80 L/s versus 71 L/s), it is expected that pump and possibly generator replacement would be the only upgrades required to satisfy future peak capacity requirements.

Given that existing peaks exceed the Maple Street SPS capacity, it is recommended that the Municipality proceed with further detailed investigation and analysis related to expanding station capacity. The work is anticipated to generally include draw-down testing and review of pump replacement options.

Increase to station capacity by way of providing new pumps would be subject to a Schedule A+ Class EA process, provided the pumps are housed within the existing structure.

8.3.3.4 CONTROL AND MONITORING

Refer to Section 8.2.3.

8.3.4 BEC Wastewater Treatment Plant

8.3.4.1 WWTP

The rated capacity of the BEC WWTP is 2,200 m^3/day, on the basis of annual average daily flow. The plant currently has an uncommitted reserve of 671 m^3/day, which corresponds to an uncommitted capacity for 932 ERUs. One hectare of industrial land, on the basis of existing BEC industrial unit rates, would be equivalent to approximately 29 ERUs.

In addition to providing a rated capacity based on annual average day flow, the ECA for the WWTP also stipulates monthly performance criteria in terms of effluent concentrations and loadings for several parameters. The BEC Infrastructure Review (B. M. Ross and Associates Limited, 2009) generally concluded that flow is considered to be the limiting factor rather than concentrations and loadings. The Master Plan evaluation is carried out on this same basis.

Figure 8.12 and Table 8.14 provide the current and forecasted average day flows, each with or without development commitments included. It can be seen from Figure 8.12 that projected timing varies based on scenario, and therefore expansion will be driven by actual growth rates. Table 8.20 provides a summary of the period by which plant capacity would be fully utilized for the scenarios considered.

Table 8.20: BEC WWTP Forecasted Utilization of Current Capacity

Scenario (Extrapolated)	Existing Capacity Fully Utilized by Year
Official Plan High Growth	2059
Official Plan High Growth + Commitments	2038
Development Charges	2066
Development Charges + Commitments	2041

As described in Section 8.3.1, there are significant commitments related to Inverhuron servicing and the Bruce Power reserve, and the Municipality is also interested in providing capacity for BEC and Concession 2 industrial lands.

Additionally, as described in Section 4.3, Bruce Power and the Municipality have been engaged with preliminary discussion related to provision of Municipal wastewater service to Bruce Power. To add Bruce Power as a wastewater customer would have the effect of triggering immediate need to upgrade and expand the BEC WWTP. This would be the most practical method to add Bruce Power as a wastewater customer, given the relatively close proximity of the Bruce Power site to the BEC WWTP and the observation that to establish a new WWTP site would take longer and cost significantly more than upgrading and expanding an existing site. For this reason, expansion of the BEC WWTP is being further assessed through a Class EA that is currently underway. It is recommended that the Class EA consider wastewater treatment needs for existing customers (i.e. Tiverton, Inverhuron area, BEC) including projected growth, further development of the BEC industrial lands, development of the Concession 2 industrial lands, and Bruce Power servicing needs.

Similar to the Kincardine WWTP, the BEC WWTP is not equipped with SCADA. It is recommended that the Municipality consider equipping the BEC WWTP with SCADA in conjunction with any Kincardine SCADA work.

8.3.4.2 TRUNK AND OUTFALL SEWERS

The trunk and outfall sewers for the BEC WWTP were reviewed as part of a 2009 BEC Water and Wastewater Infrastructure Review (B. M. Ross and Associates Limited, 2009). That review established the following capacities:

- Trunk sewer – 98 L/s (8,473 m^3/day); and
- Outfall sewer – 101 L/s (8,719 m^3/day)

These sewer capacities are more than adequate for the existing WWTP rated capacity but should be considered as part of the Class EA related to WWTP expansion.

8.3.5 Conclusions for BEC & Service Area Wastewater Systems

8.3.5.1 WASTEWATER COLLECTION

The Tiverton wastewater collection system consists of two catchment areas, each with its own SPS. The system was analyzed on the basis of future peak wastewater flows in each sewer pipe versus sewer pipe full-flow capacity. It is concluded that the existing collection system is also adequate for future design conditions and no upgrades are recommended at this time.

In general, as opportunities arise (e.g. road reconstruction), aged sewer pipe should continue to be replaced in areas where condition is known to be poor based on operator experience.

8.3.5.2 SEWAGE PUMPING STATIONS

The two Tiverton SPSs are operating at various proportions of their rated capacities. The Maple Street station experiences flows, from time to time, that exceed the existing station rated capacity. Recommended next steps related to the SPSs are described in Section 8.3.3, and summarized as follows:

- King Street SPS:
  - No capacity issues to address at this time.
- Maple Street SPS:
  - Capacity increase for existing and future conditions is recommended; and
  - Proceed with station draw-down testing, an assessment of pump replacement options, design and MOECC approvals.
- General – both SPSs:
  - Consider implementation of SCADA.

8.3.5.3 WASTEWATER TREATMENT

The BEC WWTP is currently operating during average day flows at approximately 37% of its rated capacity. Development areas currently considered as commitments would represent approximately 33% of the WWTP rated capacity. Figure 8.12 and Table 8.16 provide summaries of current and projected WWTP capacity use. At the highest projected growth rate, WWTP capacity would be fully committed by 2038 assuming the same current value of commitments applies in the future. At the lowest projected growth rate, the capacity would be fully committed by 2041. Key considerations at this time are:

- The uncommitted reserve capacity is currently estimated to be sufficient for 932 ERUs.
- A Class EA related to expansion and upgrading of the WWTP is currently underway.

8.3.6 Suggested Projects and Capital Costs

Investigations have identified a number of potential capital projects and actions related to the BEC WWTP and Tiverton wastewater system. Table 8.21 summarizes these. All costs are based on 2018 $ and include construction (where applicable) and engineering, exclude HST, and should be considered ±25%.

Table 8.21: Tiverton Wastewater System - Projects

Project or Activity	Suggested Timing	Probable Cost (2018 $)
Maple Street SPS – pump replacement design and approvals	Within next 5 years	$40,000
Provision of SCADA for WWTP and SPSs	At discretion of Municipality	$300,000[1]

[1]Probable cost is based on similar project in similar community, without detailed review and preliminary assessment of Tiverton SPS and BEC WWTP equipment.

It is noted that any physical infrastructure work may be subject to assessments for heritage and archaeological resources, as well as MOECC approvals.

8.3.7 Previously Identified Projects - Inverhuron Servicing

In 2014, the Municipality of Kincardine completed a Schedule B Class EA for the extension of municipal water and sanitary servicing for the community of Inverhuron. Through preliminary investigations and consultation, it was identified the age and condition of existing services pose a potential health risk based on current density and the environmental setting. Receipt of a two-thirds grant represented an opportunity to address the ongoing servicing issues and reduce financial impacts to residents. The preferred alternative identified and evaluated through the Class EA process is to extend both water and sanitary sewage services to all residents of Inverhuron not already serviced by either municipal water or sanitary sewers.

The Class EA was approved by the Ministry of Environment and Climate Change in December 2014. Following approval of the Class EA, the project proceeded to detailed design and approvals were obtained from the required review agencies. The project proceeded to tender in April 2015; however, due to costs, Council at the time decided not to proceed to construction.

It is recommended that the Municipality pursue funding or grant opportunities for this project to allow it to proceed to construction. It is noted that should construction be delayed beyond 10 years from the date of approval, the planning and design processes and environmental setting must be reviewed to ensure the project and mitigation measures are still valid.

9.0 CONSULTATION

9.1 General

Public consultation is an integral component of the Class EA process. Public consultation allows for an exchange of information, which assists the proponent in making informed decisions during the evaluation of alternative solutions. During Phases 1 and 2 of the study process, consultation was undertaken to obtain input from the general public, First Nation and Métis communities, and review agencies that might have an interest in the project. The components of the public consultation program employed during the initial phase of the Master Plan are summarized in this section of the report and in Appendix H. Comments received through the consultation program and related correspondence are also discussed below and documented in the appendix.

9.2 Initial Public Notice

Contents: General description of study, EA process, information on consultation
Issued: August 9, 2017
Placed In: Kincardine Independent, Kincardine News and on Municipal website

There were no comments received from the public as a result of the Initial Notice.

9.3 Review Agency Circulation

Input into the Class EA Master process was solicited from government review agencies by way of direct mail correspondence. Agencies that might have an interest in the project were sent an information package detailing the scope of the study and outline of the assessment process being completed. The information was circulated to seven review agencies on August 3, 2017. Appendix H contains a copy of the information that was circulated to the review organizations and a list of the agencies that were requested to comment on this project. The following table (Table 9.1) summarizes the comments received.

Table 9.1: Review Agency Comments Received

Review Agency	Comments	Action Taken
Ministry of Environment and Climate Change (letter dated September 8, 2017)	• Received Notice of Commencement • MOECC delegates procedural aspects of rights-based consultation to the proponent. • Provided list of First Nation and Métis communities to contact. • Provided direction on the inclusion of Source Water Protection information. • Provided direction for future correspondence.	Comments noted. Section for Source Water Protection is included in the Master Plan (Section 3.5.3)
Ministry of Tourism, Culture and Sport	• Acknowledged receipt of Notice of Completion. • Provided information on screening projects for archaeological and built heritage and cultural heritage landscapes.	Comments noted. Given broad scope of this Master Plan, Section 3.4 of this report recommends appropriate screening is done for any projects identified as part of the servicing strategy.
Saugeen Valley Conservation Authority (email dated November 11, 2017)	• SVCA would like to review infrastructure works when determined a permit may be required pursuant to Regulation 169/06 as amended. • Would like to receive information regarding status of the EA and any information related	Comments noted. Will provide a copy of the Master Plan for review.

Table 9.1: Review Agency Comments Received

Review Agency	Comments	Action Taken
	to wetlands, watercourses and any other areas that may fall under Regulation.	
Drinking Water Source Protection (email dated Feb. 5, 2018)	• Two items of interest would be: potential changes to stormwater upgrades in Kincardine and review of the PTTW in Tiverton. • Any significant changes to the stormwater system in Kincardine could impact EBA modelling. • If there were a change in upper limit of water drawn from aquifer, would need to update the groundwater model assumptions used to delineate Tiverton WHPAs.	Comments noted. Included text in Section 3.5.3 about stormwater system and EBAs. Added text to recommend continued consultation with Drinking Water Source Protection and the Tiverton rerating study.

9.4 Aboriginal and Métis Consultation

To identify First Nation and Métis communities that may have an interest in the Water and Wastewater Servicing Master Plan, the Aboriginal and Treaty Rights Information System (ATRIS) was consulted. The MOECC response to the Notice of Commencement also provided a list of aboriginal and Métis communities to contact. The following communities were sent a letter outlining the project (included in Appendix H) on August 3, 2017:

- Métis Nation of Ontario;
- Chippewas of Saugeen First Nation;
- Chippewas of Nawash Unceded First Nation;
- Great Lakes Métis Council;
- Historic Saugeen Métis; and
- Chippewas of Kettle and Stony Point First Nation (sent September 13, 2017).

The letter included information regarding the proposed Servicing Master Plan. A log of correspondence with First Nation and Métis communities is provided in Table 9.2. Copies of all correspondence sent is included in Appendix H.

Upon finalization of the Master Plan document, First Nations and Métis communities were mailed a copy of the Notice of Completion.

9.5 Public Information Meeting

A Public Information Centre (PIC) was held on October 24, 2017 at the Municipality of Kincardine Municipal Administration Centre from 7 PM to 8:30 PM. The meeting included an open house component with display boards explaining the study process and other project components. A formal presentation was given at 7:15 pm. Representatives from the Municipality of Kincardine and BMROSS were available to answer questions from those in attendance.

There were approximately one dozen people in attendance. A copy of the presentation is provided in Appendix H. Table 9.3 summarizes the questions and comments raised following the presentation.

Table 9.2: First Nation and Metis Community Consultation Log

No.	Community	Date	Type of Contact	Details	Response/Action Taken
1	Chippewas of Saugeen	August 3, 2017	Letter and email from BMROSS	Initial letter sent	
2	Chippewas of Nawash	August 3, 2017	Letter and email from BMROSS	Initial letter sent	
3	Saugeen Ojibway Nation Environment Office	August 3, 2017	Letter from BMROSS	Initial letter sent	
4	Great Lakes Métis Council	August 3, 2017	Letter from BMROSS	Initial letter sent	
5	Métis Nation of Ontario	August 3, 2017	Letter from BMROSS	Initial letter sent	
6	Chippewas of Kettle and Stony Point First Nation	September 13, 2017	Letter from BMROSS	Initial letter sent	
7	Historic Saugeen Metis	August 3, 2017	Letter from BMROSS	Initial letter sent	- Email response received August 9, 2017 (see No. 8)
8	Historic Saugeen Métis	August 9, 2017	Email from HSM	Acknowledge receipt of initial latter (dated August 3, 2017) Have reviewed the description of the Water and Wastewater Master Plan study and have no concerns with the project. No further consultation is required.	
	Chippewas of Saugeen	February 21, 2018	Letter from BMROSS	Notice of Completion sent	
	Chippewas of Nawash	February 21, 2018	Letter from BMROSS	Initial letter sent	

Table 9.2: First Nation and Metis Community Consultation Log

No.	Community	Date	Type of Contact	Details	Response/Action Taken
	Saugeen Ojibway Nation Environment Office	February 21, 2018	Letter from BMROSS	Notice of Completion sent	
	Great Lakes Métis Council	February 21, 2018	Letter from BMROSS	Notice of Completion sent	
	Métis Nation of Ontario	February 21, 2018	Letter from BMROSS	Notice of Completion sent	
	Chippewas of Kettle and Stony Point First Nation	February 21, 2018	Letter from BMROSS	Notice of Completion sent	

Table 9.3: Questions and Comments from the Public Information Centre

Question and/or Comment	Response
What is the current population of the Town of Kincardine? Has the population increased from the last census?	Current population is 8,315, which is an increase from the 2011 census. Population data for the Town is available on the Census website.
Does the problem/opportunity statement include consideration of existing users?	Noted. Will revise to it clear that existing development is also being considered as part of the Master Plan.
How are existing, unserviced residential lots considered in terms of commitments for water and wastewater?	Existing, unserviced residential lots are considered existing commitments where previous study work has identified an intent to provide service, and are factored into the demands for water and wastewater
Any consideration of connecting Tiverton to the Kincardine water supply?	Future provision of water to Tiverton via connection to a second water treatment plant at the north end of the Municipality will be considered as part of the Class EA related to that potential plant. At this time, there is no identified need to expedite such a connection to a new supply.
Raised concern about cost of infrastructure. Will cost be on taxpayers (i.e., build it and hope development comes)?	Noted. Generally, development contributes to infrastructure costs through the collection of development charges and agreements negotiated with the Municipality.
If nothing is done, development will go other places.	Noted.
What's the timeline for completion of the Master Plan?	Hope to have a draft of the Master Plan prepared by the end of 2017.
Is there any opportunity to include triggers to require underserviced areas to connect to municipal systems? Requested that the Master Plan address risks associated with existing underserviced areas.	Noted – can look at including risks associated with existing underserviced areas
Has substantial lands north of Kincardine with intention to develop. Noted that lands were not included in the Master Plan.	Noted. The Master Plan includes developments that have at least initiated discussions with the Municipality and Bruce County Planning. Advised to contact the Municipality and Bruce County Planning.
Municipality should not pay to service Bruce Power with water.	Noted.
Municipality should not accept wastewater flows from Bruce Power because it will contain chemicals.	The Municipality currently has sewer connection by-law that regulates what can be discharged into the sanitary sewers. The EA for the wastewater project will assess the risk associated with sewage form the Bruce Power site.
Suggested installing a sewer line along Bruce Road 23 to Bruce Road 20 and extended the water line along Bruce Road 23 to Bruce Road 20.	Noted.

9.6 Notice of Completion

The Notice of Completion for the Master Plan was issued on February 21, 2018. The Notice summarized the projects included in the Master Plan, the appropriate Class EA schedule, and approximate timing. The Notice was placed in the February 21 and February 28 issues of the Kincardine Independent and Kincardine News. Copies were mailed to review agencies and it was also placed on the municipal website. The Notice detailed where the Master Plan document was available for review (the municipal website, Kincardine Library and Tiverton Library). The 30-day review period for the Master Plan concluded on March 23, 2018. A copy of the Notice of Completion is included in Appendix H.

During the review period, the following comments were received:

Table 9.4 : Comments Received During Review Period

Commenter	Comments	Action Taken
Saugeen Valley Conservation Authority (SVCA) – March 22, 2018	• SVCA staff have identified several areas in the Master Plan where SVCA input will be required; • Of immediate interest are the projects identified for 2018, where additional details will be required for further detailed review; • The following 2018 projects will require more detailed SVCA staff review: ○ Trunk watermain upgrades for Russell St., Sutton St., and Kincardine Ave; ○ Durham St. Sewage Pumping Station (SPS) upgrades; ○ Huron Terrace SPS upgrades; and ○ Park St. SPS upgrades. • For other works identified in the Master Plan proposed for the future at the discretion of the Municipality or in response to development, SVCA requests preliminary design and construction drawings for further review as the information becomes available.	Comments noted. The Municipality will continue to consult with SVCA on projects.
Resident – March 22, 2018 (telephone call)	• Referred to Table 9.3 and expressed appreciation for including comment regarding existing, unserviced residential lots and their inclusion into demands for water and wastewater; • Asked about the appeal process for Master Plans; • Referred to comments from public meeting (Table 9.3) regarding including triggers to require underserviced areas to connect to municipal system and risks associated with the unserviced areas. Does not feel that triggers or risks for unserviced areas were	Added Section 7.2.11 and 8.3.7 which highlight previously identified water and wastewater projects in Inverhuron.

Table 9.4 : Comments Received During Review Period

Commenter	Comments	Action Taken
	included in the Master Plan and would like to see the Master Plan address this; • There is nothing in the Master Plan to address how risks to water quality (for both ground and surface water) associated with unserviced areas, such as Inverhuron, can be addressed or trigger points that would move the current status beyond status quo; • Noted the lakeshore area has significant developable lands, but there is no method in the Master Plan for monitoring risks associated with unserviced development; • Would like to see the Master Plan include a long-term plan for addressing unserviced areas and their associated risks; • Expressed concern that if providing sewage service in Inverhuron is not included in the Master Plan, it may be overlooked or considered less of a priority.	
Ministry of Tourism, Culture and Sport (MTCS) – March 23, 2018	• MTCS recommends any additional work associated with this Master Plan considers cultural heritage resources. As seen in Section 3.4 of this report, MTCS recommends that appropriate screening is done for any projects identified as part of the servicing strategy. This includes screening for archaeological resources, as well as Built Heritage and Cultural Heritage Landscapes	Noted

9.7 Consultation Summary

The consultation program developed for this study was directed towards the public, review agencies and First Nation and Métis communities. Comments received during the public meeting indicated interest in the project and ongoing development within the Municipality.

10.0 MASTER PLAN RECOMMENDATIONS

10.1 Recommended Works

It is anticipated that development within the Municipality of Kincardine will continue over the foreseeable future. The information included in this report provides direction for infrastructure improvements and expansions to service existing and future users. It will also provide the background context for any additional studies (e.g., environmental assessments) required prior to implementation of the recommended works. Any projects identified as Schedule B or C projects under the Municipal Class EA process will require additional screening to meet the investigative requirements.

The following table summarizes the recommended servicing improvements, any EA requirements, and additional work that may be required prior to their implementation.

Table 10.1: Summary of Recommended Works

Project	Description	Probable Cost (2018 $)[1]	EA Requirements	Timing
Kincardine Drinking Water System				
Modify WTP Disinfection Process	Convert primary disinfection to UV process, allowing volume currently used for chlorine contact to be available for customer use	$1,000,000	Schedule A	Within next 5 years.
Rehabilitate Standpipe BPS	Rehabilitate BPS by installing new booster pump, standby diesel generator and controls	$450,000	Schedule A	Within next 5 years.
Trunk Watermain Upgrades – Sutton St; Russell St., Kincardine Ave.	Trunk watermain upgrades to support future development	$2,100,000	Schedule A+	2018
Gary Street Booster Pumping Station	Booster Pumping Station will be required to service lands north of Gary Street.	BPS funded by Developer	Schedule A - completed as part of site plan, consent, or plan of subdivision.	2018
Tiverton Drinking Water System				
Review of PTTW and MDWL	Engage a hydrogeologist to investigate discrepancy between the PTTW and MDWL, and potential rerating	$10,000	Not Applicable	Within next 3 years
Rehabilitate Standpipe BPS	Rehabilitate BPS by installing new booster pump, standby diesel generator and controls	$425,000	Schedule A	Within next 5 years

Table 10.1: Summary of Recommended Works

Project	**Description**	**Probable Cost (2018 $)**[1]	**EA Requirements**	**Timing**
King St. Watermain	Parallel or replace existing watermain to improve fire flow to north	$475,000	Schedule A+	In response to development needs or in conjunction with planned road reconstruction.
Kincardine Wastewater System				
Durham Street SPS Upgrades	Durham Street SPS – pump replacement design and approvals	$60,000	Schedule A+	2018
Huron Terrace SPS Upgrades	Huron Terrace SPS – forcemain replacement design and approvals	$80,000	Schedule A+	2018
Park Street SPS Upgrades	Park Street SPS – pump replacement design and approvals	$60,000	Schedule A+	2018
SPS and WWTP Control Upgrades	Provision of SCADA for WWTP and SPSs	$800,000	Schedule A	At discretion of Municipality
Durham St. Sewer Upgrades	Sewer upgrades on Durham Street, to accommodate future Durham Street SPS flows	$450,000	Schedule A+	In response to development needs or in conjunction with planned road reconstruction
Queen St. and Kingsway Street Sewer Upgrades	Sewer upgrades on Queen Street North and Kingsway Street, to accommodate future development north of the existing Huron Terrace SPS catchment area	$850,000	Schedule A+	In response to development needs or in conjunction with planned road reconstruction
Russell St. Sewer Upgrades	Sewer upgrades on Russell Street, to accommodate future Business Park development flows	$800,000	Schedule A+	In response to development needs or in conjunction with planned road reconstruction

Table 10.1: Summary of Recommended Works

Project	Description	Probable Cost (2018 $)[1]	EA Requirements	Timing
Gary St., Sutton St., Mechanics Ave. and James St. Sewer Upgrades	Sewer upgrades on Gary Street, Sutton Street, Mechanics Avenue, and James Street, to accommodate future development north of Gary Street	$1,700,000	Schedule A+	2018
BEC and Service Area Wastewater Systems				
Maple Street SPS Upgrades	Maple Street SPS – pump replacement design and approvals	$40,000	Schedule A+	Within next 5 years
SPS Control Upgrades	Provision of SCADA for WWTP and SPSs	$300,000	Schedule A	At discretion of Municipality

[1]Refer to previous sections for assumptions and limitations for cost estimates

10.2 Implementation

Most of the projects identified through this Master Plan are categorized as Schedule A+. Under the Municipal Class EA process, these projects are considered pre-approved; however, the public is to be advised prior to implementation. It is recommended that the Municipality review the scope of these projects prior to implementation to ensure the appropriate Class EA process is followed.

The construction of a new booster pumping station is a Schedule B project and will require further investigation and site-specific studies through the Class EA process. The timing of this project is dependent on development occurring north of Gary Street.

It is also recommended that the Master Plan is reviewed on a regular basis to evaluate the accuracy of key assumptions and to confirm the suitability of the implementation sequence. The Master Plan should be modified as required to address changes in the local conditions.

10.3 Master Plan Completion and Approval

The following activities represent the final steps in completion and approval of this Master Plan:

- Issue a Notice of Study Completion for the Master Plan;
- Make the Master Plan Report available for public review in conjunction with the Notice of Study Completion;
- Obtain feedback from the public, stakeholders and agencies;
- Revise the Master Plan as necessary; and
- Provide the Master Plan to Kincardine Council for adoption;

11.0 SUMMARY

The Municipality of Kincardine initiated a Master Plan study to identify infrastructure needs related to water and wastewater servicing for existing development, as well as future growth. The general approach was to consider infrastructure needs related to development potential to year 2067, based on several growth forecast methodologies. The following areas were considered in the context of Master Plan:

- The former town of Kincardine, including existing customers, as well as the Highway 9 and 21 Business Park and development lands between County Road 23 and Highway 21 up to Concession 5;
- The community of Tiverton;
- The Lakeshore area from Inverhuron to West Ridge on the Lake;
- The Bruce Energy Centre industrial lands;
- The Concession 2 industrial lands; and
- The Bruce Power site.

This Master Plan documents the process followed to establish potential needs associated with growth and development, analyzing current infrastructure capabilities compared to current and future projected needs, and identifying recommended next steps related to addressing constraints. The major water and wastewater infrastructure facilities considered as part of the Master Plan are listed below, along with key outcomes of the evaluation and recommended next steps:

- Kincardine WTP:
    - Under the highest growth rate considered, and factoring in development commitments, the WTP capacity may be fully utilized by 2032. There is currently uncommitted reserve for 1,463 ERUs;
    - A new WTP within the northern portion of the Municipality was identified as the preferred alternative to service potential customers including Bruce Power, additional development within the BEC industrial lands, and Concession 2 industrial lands. A Schedule C Class EA related to a new north WTP is currently underway; and
    - A new north WTP, connected to the existing KDWS, could significantly defer and possibly eliminate the need to further consider expansion of the existing Kincardine WTP.
- Kincardine Water Storage:
    - Treated water storage is provided within the Kincardine WTP clear wells and the Kincardine standpipe. The current effective storage is less than MOECC Guidelines recommend for the existing service population;
    - Conversion of the WTP primary disinfection process would increase the effective volume of storage that could be available for peak demands and fire flows. Rehabilitation of the standpipe BPS would increase the effective volume of storage available there. It is recommended that both these be carried out, and assuming this is done, the existing total storage capacity would be utilized by 2031 assuming the highest growth rate considered plus commitments; and

  - When additional water storage is required in the future, it is recommended that such a facility be located to the north of the existing urban limit, in order to provide greatest operational benefit and take advantage of generally higher ground elevations. Such a facility would be subject to a review of land uses adjacent to the Municipal airport.
- Kincardine Water Distribution:
  - The Kincardine water distribution system currently operates as a single pressure zone. A BPS at the north limit of Gary Street is currently planned for 2018 construction, and will create a second pressure zone in the system; and
  - Watermain upgrades in the vicinity of Gary and Sutton Streets are also planned for 2018 construction. These upgrades will increase the available flow to the second pressure zone north of Gary Street.
- Kincardine Shoreline Distribution System:
  - Current usage is less than original design values, and there is no apparent need to upgrade and expand. The Class EA related to a north WTP should consider connection to the KSDS as a means for providing redundant supply.
- Tiverton Water Supply and Treatment:
  - Under the highest growth rate considered, and factoring in development commitments, the water supply and treatment capacity may be fully utilized by 2023. There is currently uncommitted reserve for 39 ERUs; and
  - It is recommended that the Municipality engage a hydrogeologist to assist in reviewing the discrepancy between the rated capacities provided in the PTTW and MDWL. A re-rating, if possible, could increase reserve capacity with minimal or no additional infrastructure requirements.
- Tiverton Water Storage:
  - Treated water storage is provided within the Tiverton standpipe. The current effective storage is less than MOECC Guidelines recommend for the existing service population; and
  - Rehabilitation of the standpipe BPS would increase the effective volume of storage available there. It is recommended that this be carried out, and assuming it is, the existing total storage capacity would be sufficient for all future growth scenarios considered.
- Tiverton Water Distribution:
  - Available fire flows in the north part of the system, and in some locations serviced by small diameter watermain, are less than target values. Upgrading of watermain on King Street, north of Stanley/Cameron Streets, could be considered to improve fire flows to the north.
- Kincardine Wastewater Collection System:
  - Trunk sewer upgrades within the Durham Street SPS catchment area are currently proposed for 2018 construction, generally related to future servicing of development lands north of Gary Street;
  - For the Huron Terrace SPS catchment area, future trunk sewer upgrades may include replacements on Durham, Queen, and Kingsway Streets. The timing will generally be linked to development requirements; and
  - Trunk sewer construction on Russell Street, west of Highway 21, are recommended as per the Kincardine Business Park Servicing Master Plan.

- Kincardine SPSs:
    - It is recommended that the Durham Street, Huron Terrace, and Park Street SPSs be upgraded to increase capacity. Capacity increases may be accomplished by pump and/or forcemain replacement for each station.
- Kincardine WWTP:
    - Under the highest growth rate considered, and factoring in development commitments, the WTP capacity may be fully utilized by 2028. There is currently uncommitted reserve for 1,024 ERUs; and
    - It is recommended that the reserve capacity calculations be reviewed in 5 years. Once additional capacity is required, an upgrade and expansion at the existing WWTP site is the likely approach, which will be a Schedule C Class EA project.
- Tiverton Wastewater Collection System:
    - The system was found to be adequate for the future servicing scenarios.
- Tiverton SPSs:
    - It is recommended that the Maple Street SPS capacity bed increased by replacement of the pumps.
- BEC WWTP:
    - Under the highest growth rate considered, and factoring in development commitments, the WTP capacity may be fully utilized by 2038. There is currently uncommitted reserve for 932 ERUs. Industrial customers are a key consideration for the BEC WWTP, and on the basis of existing BEC industrial unit rates, one hectare of industrial land is equivalent to 29 ERUs;
    - The Municipality has been asked to review wastewater servicing for Bruce Power. The BEC WWTP is the probable location to treat flows from Bruce Power, and to add them as a customer would cause a need to expand and upgrade the WWTP; and
    - A Schedule C Class EA related to the BEC WWTP is currently underway.

The consultation program developed for this study was directed towards stakeholders, adjacent property owners and provincial review agencies. Comments received during the public meeting generally focused on infrastructure needs to allow development as well as dealing with risks in existing service areas.

As an outcome of this assessment, a series of projects have been identified to implement the Master Plan. These projects are classified as Schedule 'A', 'A+', 'B', or 'C' activities under the terms of the Municipal Class EA document.

It is anticipated that development within the future services areas considered in the Master Plan will take a number of years and will therefore need to follow a phased-in infrastructure plan. In general, watermain and sewer upgrades should be carried out with planned road reconstruction when possible, in order to most cost effectively carry out the upgrades. Treatment and pumping infrastructure can be carried out in response to increases in required capacity, but an important consideration for items like major treatment works is that it can take 5 years from initial planning to final commissioning of an expanded facility.

The Kincardine Water and Wastewater Master Plan has been completed in accordance with the planning and design process of the Municipal Class Environmental Assessment (Class EA Approach 1). For this study, the Master Plan process incorporated the completion of Phases 1 and 2 of the Class EA process. The Master Plan will be approved for implementation subject to the adoption by the Council of the Municipality of Kincardine.

All of which is respectfully submitted.

Yours very truly

B. M. ROSS AND ASSOCIATES LIMITED

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REGISTERED PROFESSIONAL PLANNER
R.P.P.
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Per ______________________

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LICENSED PROFESSIONAL ENGINEER
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Per ______________________

Andrew J. Garland, P. Eng.

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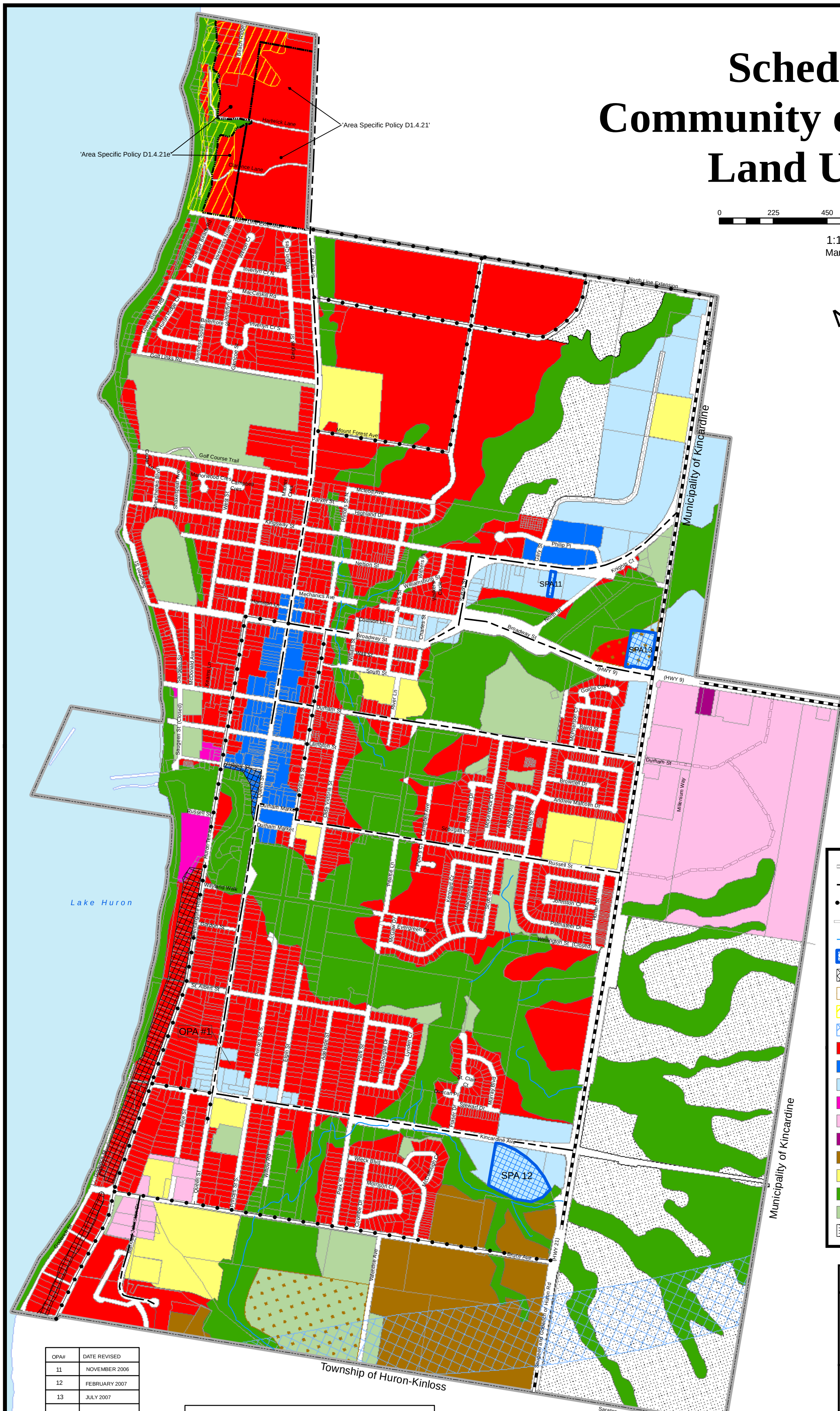
APPENDIX A
OFFICIAL PLAN SCHEDULES

Schedule 'A'
Community of Kincardine
Land Use Plan

0 225 450 675 900 1,125 Metres

1:11,500
March 2006



Note 1

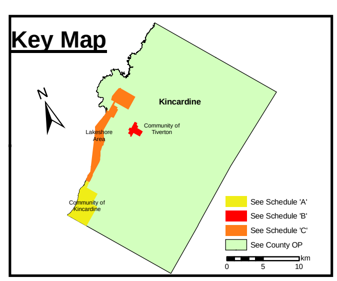
The erection of buildings or structures or filling within some portions of the Natural Environment designation requires a Fill and Construction Permit from the Saugeen Valley Conservation Authority before construction, excavation, regrading or filling begins (R.R.O. #169/90). For permit information and for accurate location of floodplains and fill lines refer to the SVCA.

Note 2

The erection of buildings or structures or filling within some portions of the fill and construction regulation overlay requires a Fill and Construction Permit from the Saugeen Valley Conservation Authority before construction, excavation, regrading or filling begins (R.R.O. #169/90). For permit information and for accurate location of floodplains and fill lines refer to the SVCA.

- Provincial Highway
- Arterial Road
- Collector Road
- Proposed Road
- River
- Special Policy Area
- Development constraint
- Fill and Construction Regulation - (Note 2)
- Significant Woodlands
- Wellhead Protection
- Residential
- General Commercial
- Highway Commercial
- Resort Commercial
- Business Park
- Business Park Special
- Industrial
- Institutional
- Natural Environment-(Note 1)
- Open Space
- Future Development

Key Map

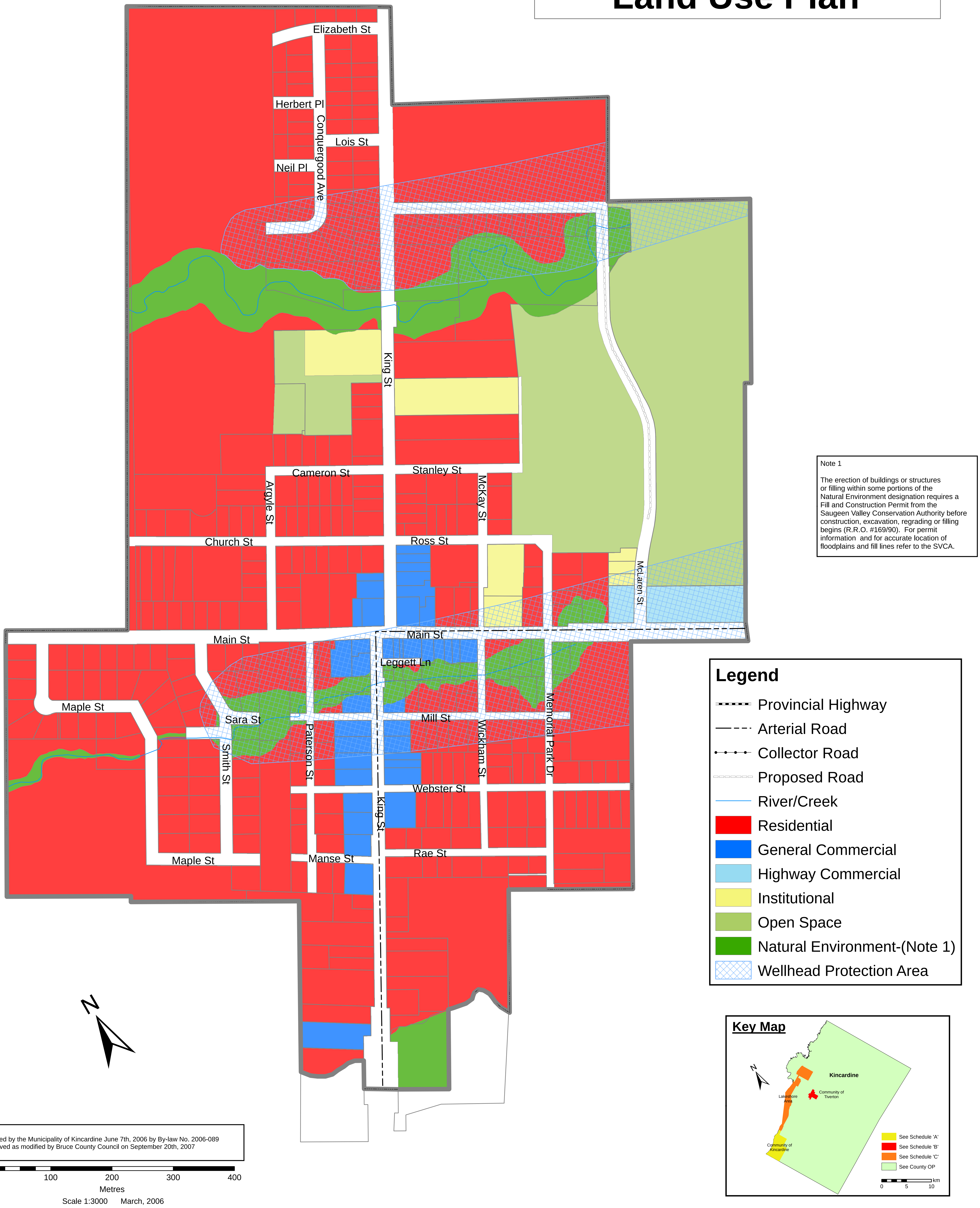


OPA#	DATE REVISED
11	NOVEMBER 2006
12	FEBRUARY 2007
13	JULY 2007

Adopted by the Municipality of Kincardine on June 7th, 2006 by By-law No. 2006-089

Approved as modified by Bruce County on September 20th, 2007

Schedule 'B'
Community of Tiverton
Land Use Plan



OPA#	DATE REVISED
1	January 2009

Adopted by the Municipality of Kincardine on June 7th, 2006 by By-law No. 2006-089.
Approved as modified by Bruce County Council on September 20th, 2007.

APPENDIX B

TREATMENT AND STORAGE REQUIREMENT FORECASTS

Municipality of Kincardine
WWTP and WTP Projected Flow Graphs
Based on Official Plan High Growth, 2016-2067

Job # :	16130
Date :	April 27, 2017
Revised :	January 26, 2018

1.0 Background

The Municipality of Kincardine initiated a Master Plan process to evaluate water and wastewater servicing needs for Kincardine, Tiverton, and the Lakeshore

The purpose of these notes is to summarize current water and wastewater demands, treatment facility capacities, and projections for future treatment requirements to 2067 based on the Official Plan High Growth forecast, extrapolated for the future design period. All future year data is based on current per capita values, applied to future population projections, with the exception of BEC industrial land wastewater flows which are based on current per hectare

2.0 Data

Year	Kincardine WWTP		BEC WWTP		Kincardine WTP			Tiverton Water System			
	Average Day[1] (m^3/d)	ECA Rated Capacity (m^3/d)	Average Day[2] (m^3/d)	ECA Rated Capacity (m^3/d)	Average Day[1] (m^3/d)	Maximum Day[3] (m^3/d)	DWWP Rated Capacity (m^3/d)	Average Day[1] (m^3/d)	Maximum Day[3] (m^3/d)	Firm Capacity[4] (m^3/d)	DWWP Rated Capacity (m^3/d)
2016	3811	5910	805	2200	3136	6965	11563	214	659	774.66	1114.56
2017	3886	5910	835	2200	3197	7100	11563	217	669	774.66	1114.56
2018	3963	5910	866	2200	3259	7238	11563	220	679	774.66	1114.56
2019	4041	5910	897	2200	3322	7378	11563	224	689	774.66	1114.56
2020	4121	5910	927	2200	3387	7522	11563	227	699	774.66	1114.56
2021	4202	5910	958	2200	3452	7668	11563	230	709	774.66	1114.56
2022	4285	5910	989	2200	3519	7816	11563	234	720	774.66	1114.56
2023	4369	5910	1020	2200	3588	7968	11563	237	731	774.66	1114.56
2024	4455	5910	1051	2200	3657	8123	11563	241	741	774.66	1114.56
2025	4543	5910	1082	2200	3728	8280	11563	244	752	774.66	1114.56
2026	4633	5910	1113	2200	3801	8441	11563	248	764	774.66	1114.56
2027	4724	5910	1145	2200	3874	8605	11563	252	775	774.66	1114.56
2028	4817	5910	1176	2200	3950	8772	11563	255	786	774.66	1114.56
2029	4912	5910	1208	2200	4026	8942	11563	259	798	774.66	1114.56
2030	5009	5910	1239	2200	4104	9116	11563	263	810	774.66	1114.56
2031	5108	5910	1271	2200	4184	9293	11563	267	822	774.66	1114.56
2032	5209	5910	1303	2200	4265	9473	11563	271	834	774.66	1114.56
2033	5311	5910	1335	2200	4348	9657	11563	275	846	774.66	1114.56
2034	5416	5910	1367	2200	4433	9845	11563	279	859	774.66	1114.56
2035	5523	5910	1399	2200	4519	10036	11563	283	872	774.66	1114.56
2036	5632	5910	1431	2200	4606	10231	11563	287	885	774.66	1114.56
2037	5743	5910	1463	2200	4696	10429	11563	292	898	774.66	1114.56
2038	5856	5910	1496	2200	4787	10632	11563	296	911	774.66	1114.56
2039	5972	5910	1528	2200	4880	10838	11563	300	925	774.66	1114.56

Year	Kincardine WWTP		BEC WWTP		Kincardine WTP			Tiverton Water System			
	Average Day[1] (m^3/d)	ECA Rated Capacity (m^3/d)	Average Day[2] (m^3/d)	ECA Rated Capacity (m^3/d)	Average Day[1] (m^3/d)	Maximum Day[3] (m^3/d)	DWWP Rated Capacity (m^3/d)	Average Day[1] (m^3/d)	Maximum Day[3] (m^3/d)	Firm Capacity[4] (m^3/d)	DWWP Rated Capacity (m^3/d)
2040	6089	5910	1561	2200	4975	11049	11563	305	938	774.66	1114.56
2041	6209	5910	1594	2200	5071	11263	11563	309	952	774.66	1114.56
2042	6332	5910	1627	2200	5170	11482	11563	314	966	774.66	1114.56
2043	6457	5910	1660	2200	5270	11705	11563	318	981	774.66	1114.56
2044	6584	5910	1693	2200	5373	11932	11563	323	995	774.66	1114.56
2045	6714	5910	1726	2200	5477	12164	11563	328	1010	774.66	1114.56
2046	6846	5910	1759	2200	5583	12400	11563	333	1025	774.66	1114.56
2047	6981	5910	1793	2200	5692	12641	11563	338	1040	774.66	1114.56
2048	7119	5910	1827	2200	5802	12887	11563	343	1056	774.66	1114.56
2049	7259	5910	1860	2200	5915	13137	11563	348	1071	774.66	1114.56
2050	7402	5910	1894	2200	6030	13392	11563	353	1087	774.66	1114.56
2051	7548	5910	1928	2200	6147	13652	11563	358	1103	774.66	1114.56
2052	7697	5910	1962	2200	6266	13918	11563	364	1120	774.66	1114.56
2053	7849	5910	1997	2200	6388	14188	11563	369	1136	774.66	1114.56
2054	8004	5910	2031	2200	6512	14464	11563	374	1153	774.66	1114.56
2055	8162	5910	2066	2200	6639	14745	11563	380	1170	774.66	1114.56
2056	8322	5910	2100	2200	6768	15031	11563	386	1188	774.66	1114.56
2057	8487	5910	2135	2200	6899	15323	11563	391	1205	774.66	1114.56
2058	8654	5910	2170	2200	7033	15621	11563	397	1223	774.66	1114.56
2059	8825	5910	2205	2200	7170	15924	11563	403	1241	774.66	1114.56
2060	8999	5910	2240	2200	7309	16234	11563	409	1260	774.66	1114.56
2061	9176	5910	2276	2200	7451	16549	11563	415	1278	774.66	1114.56
2062	9357	5910	2311	2200	7596	16871	11563	421	1297	774.66	1114.56
2063	9541	5910	2347	2200	7744	17198	11563	428	1316	774.66	1114.56
2064	9730	5910	2383	2200	7894	17533	11563	434	1336	774.66	1114.56
2065	9921	5910	2419	2200	8047	17873	11563	440	1356	774.66	1114.56
2066	10117	5910	2455	2200	8204	18221	11563	447	1376	774.66	1114.56
2067	10317	5910	2496	2200	8366	18580	11563	456	1403	774.66	1114.56

Notes:

1. 2016 value is three year average, 2014 to 2016. Future values based on current per capita flow, applied to future population projection.
2. 2016 value is three year average, 2014 to 2016. Future values based on current per capita flow, applied to future population projection for residential areas. BEC industrial contribution based on current per hectare flow of 20.9 $m^3/d/ha$, applied to future developed area projection
3. 2016 value is three year maximum day, 2014 to 2016. Future values based on current per capita flow, applied to future population projection.
4. Capacity per Permit to Take Water with largest well out of service.

Municipality of Kincardine
Kincardine and Tiverton Water Storage Requirement Projections
Based on Official Plan High Growth, 2016-2067

Job # :	16130
Date :	May 2, 2017
Revised :	January 26, 2018

1.0 Background

The Municipality of Kincardine initiated a Master Plan process to evaluate water and wastewater servicing needs for Kincardine, Tiverton, and the Lakeshore Area.

The purpose of these notes is to summarize current water storage requirements, and projections for future requirements to 2067 based on the Official Plan High Growth forecast, extrapolated for the future design period. The storage calculations are based on MOECC Design Guidelines for Drinking-Water Systems - 2008.

2.0 Data

MOECC 2008 Guidelines Table 8-1 - Excerpts

Population	Fire Flow Rate (L/s)	Duration (hrs)
500	38	2
1000	64	2
1500	79	2
2000	95	2
3000	110	2
4000	125	2
5000	144	2
6000	159	3
10000	189	3
13000	220	3
17000	250	4
27000	318	5

Year	Kincardine Storage											
	Projected Population Town	Projected Population Lakeshore	Projected Population (includes Town + Lakeshore)	Maximum Day Demand (m^3/d)	Design Fire Flow for Storage (L/s)	Design Fire Flow Duration (hrs)	A - Design Fire Storage (m^3)	B - Design Eqlztn. Storage (m^3)	C - Design Emergency Storage (m^3)	A + B + C - Design Total Storage (m^3)	Current Total Storage (m^3)	Current Effective Storage (m^3)
2016	8315	1439	9754	6965	187	3.0	2021	1741	941	4703	7370	3221
2017	8479	1464	9943	7100	189	3.0	2037	1775	953	4765	7370	3221
2018	8646	1490	10136	7238	190	3.0	2056	1809	966	4832	7370	3221
2019	8817	1516	10333	7378	192	3.0	2078	1845	981	4904	7370	3221
2020	8990	1543	10534	7522	195	3.0	2101	1880	995	4976	7370	3221
2021	9168	1570	10738	7668	197	3.0	2124	1917	1010	5051	7370	3221
2022	9349	1598	10946	7816	199	3.0	2147	1954	1025	5126	7370	3221
2023	9533	1626	11159	7968	201	3.0	2171	1992	1041	5203	7370	3221
2024	9721	1655	11375	8123	203	3.0	2195	2031	1056	5282	7370	3221
2025	9913	1684	11596	8280	205	3.0	2219	2070	1072	5362	7370	3221
2026	10108	1713	11821	8441	208	3.0	2244	2110	1089	5443	7370	3221
2027	10307	1743	12051	8605	210	3.0	2270	2151	1105	5527	7370	3221
2028	10511	1774	12285	8772	213	3.0	2296	2193	1122	5611	7370	3221
2029	10718	1805	12523	8942	215	3.0	2323	2236	1140	5698	7370	3221
2030	10929	1837	12766	9116	218	3.0	2350	2279	1157	5786	7370	3221
2031	11145	1869	13014	9293	220	3.0	2380	2323	1176	5879	7370	3221
2032	11364	1902	13267	9473	222	3.1	2451	2368	1205	6024	7370	3221
2033	11589	1936	13524	9657	224	3.1	2524	2414	1235	6173	7370	3221
2034	11817	1970	13787	9845	226	3.2	2600	2461	1265	6326	7370	3221
2035	12050	2005	14055	10036	228	3.3	2678	2509	1297	6483	7370	3221
2036	12288	2040	14328	10231	230	3.3	2758	2558	1329	6645	7370	3221
2037	12530	2076	14606	10429	232	3.4	2841	2607	1362	6811	7370	3221
2038	12777	2112	14889	10632	234	3.5	2927	2658	1396	6981	7370	3221
2039	13029	2149	15178	10838	236	3.5	3016	2710	1431	7157	7370	3221
2040	13286	2187	15473	11049	239	3.6	3107	2762	1467	7337	7370	3221
2041	13548	2226	15774	11263	241	3.7	3202	2816	1504	7522	7370	3221
2042	13815	2265	16080	11482	243	3.8	3299	2871	1542	7712	7370	3221
2043	14087	2305	16392	11705	245	3.8	3400	2926	1582	7908	7370	3221
2044	14365	2345	16711	11932	248	3.9	3504	2983	1622	8109	7370	3221
2045	14648	2387	17035	12164	250	4.0	3607	3041	1662	8310	7370	3221
2046	14937	2429	17366	12400	252	4.0	3669	3100	1692	8462	7370	3221
2047	15232	2471	17703	12641	255	4.1	3733	3160	1723	8617	7370	3221
2048	15532	2515	18047	12887	257	4.1	3799	3222	1755	8776	7370	3221
2049	15838	2559	18398	13137	260	4.1	3867	3284	1788	8940	7370	3221
2050	16151	2604	18755	13392	262	4.2	3937	3348	1821	9107	7370	3221
2051	16469	2650	19119	13652	264	4.2	4009	3413	1856	9278	7370	3221
2052	16794	2697	19491	13918	267	4.2	4083	3479	1891	9453	7370	3221
2053	17125	2744	19869	14188	270	4.3	4159	3547	1927	9633	7370	3221
2054	17463	2792	20255	14464	272	4.3	4238	3616	1963	9817	7370	3221
2055	17807	2842	20649	14745	275	4.4	4318	3686	2001	10006	7370	3221
2056	18158	2892	21050	15031	278	4.4	4401	3758	2040	10199	7370	3221
2057	18516	2943	21459	15323	280	4.4	4487	3831	2079	10397	7370	3221
2058	18881	2994	21876	15621	283	4.5	4574	3905	2120	10600	7370	3221
2059	19254	3047	22301	15924	286	4.5	4665	3981	2161	10807	7370	3221
2060	19633	3101	22734	16234	289	4.6	4758	4058	2204	11021	7370	3221
2061	20021	3155	23176	16549	292	4.6	4854	4137	2248	11239	7370	3221
2062	20415	3211	23626	16871	295	4.7	4953	4218	2293	11463	7370	3221
2063	20818	3267	24085	17198	298	4.7	5054	4300	2338	11692	7370	3221
2064	21228	3325	24553	17533	301	4.8	5159	4383	2386	11928	7370	3221
2065	21647	3383	25030	17873	305	4.8	5267	4468	2434	12169	7370	3221
2066	22074	3443	25517	18221	308	4.9	5378	4555	2483	12416	7370	3221
2067	22509	3511	26020	18580	311	4.9	5494	4645	2535	12674	7370	3221

Year	Tiverton Water System									
	Projected Population	Maximum Day Demand (m^3/d)	Design Fire Flow for Storage (L/s)	Design Fire Flow Duration (hrs)	A - Design Fire Storage (m^3)	B - Design Eqlztn. Storage (m^3)	C - Design Emergency Storage (m^3)	A + B + C - Design Total Storage (m^3)	Current Total Storage (m^3)	Current Effective Storage (m^3)
2016	725	659	50	2.0	358	165	131	653	1500	350
2017	736	669	50	2.0	362	167	132	661	1500	350
2018	747	679	51	2.0	366	170	134	670	1500	350
2019	758	689	51	2.0	370	172	136	678	1500	350
2020	769	699	52	2.0	374	175	137	686	1500	350
2021	780	709	53	2.0	379	177	139	695	1500	350
2022	792	720	53	2.0	383	180	141	704	1500	350
2023	804	731	54	2.0	387	183	142	712	1500	350
2024	816	741	54	2.0	392	185	144	721	1500	350
2025	828	752	55	2.0	396	188	146	730	1500	350
2026	840	764	56	2.0	401	191	148	740	1500	350
2027	852	775	56	2.0	406	194	150	749	1500	350
2028	865	786	57	2.0	410	197	152	759	1500	350
2029	878	798	58	2.0	415	200	154	768	1500	350
2030	891	810	58	2.0	420	202	156	778	1500	350
2031	904	822	59	2.0	425	205	158	788	1500	350
2032	918	834	60	2.0	430	209	160	798	1500	350
2033	931	846	60	2.0	435	212	162	808	1500	350
2034	945	859	61	2.0	440	215	164	819	1500	350
2035	959	872	62	2.0	445	218	166	829	1500	350
2036	973	885	63	2.0	451	221	168	840	1500	350
2037	988	898	63	2.0	456	224	170	851	1500	350
2038	1002	911	64	2.0	462	228	172	862	1500	350
2039	1017	925	65	2.0	467	231	175	873	1500	350
2040	1032	938	65	2.0	468	235	176	878	1500	350
2041	1048	952	65	2.0	471	238	177	886	1500	350
2042	1063	966	66	2.0	474	242	179	895	1500	350
2043	1079	981	66	2.0	478	245	181	904	1500	350
2044	1095	995	67	2.0	481	249	183	913	1500	350
2045	1111	1010	67	2.0	485	252	184	922	1500	350
2046	1128	1025	68	2.0	488	256	186	931	1500	350
2047	1144	1040	68	2.0	492	260	188	940	1500	350
2048	1161	1056	69	2.0	496	264	190	949	1500	350
2049	1179	1071	69	2.0	499	268	192	959	1500	350
2050	1196	1087	70	2.0	503	272	194	969	1500	350
2051	1214	1103	70	2.0	507	276	196	978	1500	350
2052	1232	1120	71	2.0	511	280	198	988	1500	350
2053	1250	1136	72	2.0	515	284	200	999	1500	350
2054	1269	1153	72	2.0	519	288	202	1009	1500	350
2055	1287	1170	73	2.0	523	293	204	1019	1500	350
2056	1306	1188	73	2.0	527	297	206	1030	1500	350
2057	1326	1205	74	2.0	531	301	208	1041	1500	350
2058	1346	1223	74	2.0	535	306	210	1051	1500	350
2059	1365	1241	75	2.0	540	310	213	1063	1500	350
2060	1386	1260	76	2.0	544	315	215	1074	1500	350
2061	1406	1278	76	2.0	549	320	217	1085	1500	350
2062	1427	1297	77	2.0	553	324	219	1097	1500	350
2063	1448	1316	77	2.0	558	329	222	1108	1500	350
2064	1470	1336	78	2.0	562	334	224	1120	1500	350
2065	1492	1356	79	2.0	567	339	226	1132	1500	350
2066	1514	1376	79	2.0	572	344	229	1145	1500	350
2067	1544	1403	80	2.0	578	351	232	1161	1500	350

Municipality of Kincardine
WWTP and WTP Projected Flow Graphs
Based on Development Charges, 2016-2067

Job # :	16130
Date :	April 27, 2017
Revised :	January 26, 2018

1.0 Background

The Municipality of Kincardine initiated a Master Plan process to evaluate water and wastewater servicing needs for Kincardine, Tiverton, and the Lakeshore

The purpose of these notes is to summarize current water and wastewater demands, treatment facility capacities, and projections for future treatment requirements to 2067 based on the 2016 Development Charges forecast, extrapolated for the future design period. All future year data is based on current per capita values, applied to future population projections, with the exception of BEC industrial land wastewater flows which are based on current per hectare

2.0 Data

Year	Kincardine WWTP		BEC WWTP		Kincardine WTP			Tiverton Water System			
	Average Day[1] (m^3/d)	ECA Rated Capacity (m^3/d)	Average Day[2] (m^3/d)	ECA Rated Capacity (m^3/d)	Average Day[1] (m^3/d)	Maximum Day[3] (m^3/d)	DWWP Rated Capacity (m^3/d)	Average Day[1] (m^3/d)	Maximum Day[3] (m^3/d)	Firm Capacity[4] (m^3/d)	DWWP Rated Capacity (m^3/d)
2016	3811	5910	805	2200	3136	6965	11563	214	659	774.66	1114.56
2017	3843	5910	833	2200	3163	7024	11563	216	665	774.66	1114.56
2018	3875	5910	861	2200	3189	7083	11563	218	670	774.66	1114.56
2019	3909	5910	889	2200	3216	7144	11563	219	676	774.66	1114.56
2020	3942	5910	918	2200	3244	7204	11563	221	682	774.66	1114.56
2021	3967	5910	945	2200	3265	7251	11563	223	686	774.66	1114.56
2022	4000	5910	973	2200	3292	7311	11563	225	692	774.66	1114.56
2023	4034	5910	1002	2200	3319	7372	11563	227	698	774.66	1114.56
2024	4068	5910	1030	2200	3347	7434	11563	228	703	774.66	1114.56
2025	4101	5910	1058	2200	3375	7496	11563	230	709	774.66	1114.56
2026	4127	5910	1086	2200	3396	7543	11563	232	714	774.66	1114.56
2027	4156	5910	1113	2200	3420	7595	11563	233	719	774.66	1114.56
2028	4184	5910	1141	2200	3443	7647	11563	235	723	774.66	1114.56
2029	4213	5910	1169	2200	3467	7699	11563	237	728	774.66	1114.56
2030	4242	5910	1197	2200	3491	7753	11563	238	734	774.66	1114.56
2031	4271	5910	1224	2200	3514	7805	11563	240	738	774.66	1114.56
2032	4300	5910	1252	2200	3539	7860	11563	241	743	774.66	1114.56
2033	4330	5910	1280	2200	3563	7914	11563	243	749	774.66	1114.56
2034	4360	5910	1308	2200	3588	7968	11563	245	754	774.66	1114.56
2035	4389	5910	1336	2200	3612	8023	11563	246	759	774.66	1114.56
2036	4419	5910	1364	2200	3637	8077	11563	248	764	774.66	1114.56
2037	4449	5910	1391	2200	3661	8131	11563	250	769	774.66	1114.56
2038	4479	5910	1419	2200	3686	8186	11563	251	774	774.66	1114.56
2039	4508	5910	1447	2200	3710	8240	11563	253	779	774.66	1114.56

Year	Kincardine WWTP		BEC WWTP		Kincardine WTP			Tiverton Water System			
	Average Day[1] (m^3/d)	ECA Rated Capacity (m^3/d)	Average Day[2] (m^3/d)	ECA Rated Capacity (m^3/d)	Average Day[1] (m^3/d)	Maximum Day[3] (m^3/d)	DWWP Rated Capacity (m^3/d)	Average Day[1] (m^3/d)	Maximum Day[3] (m^3/d)	Firm Capacity[4] (m^3/d)	DWWP Rated Capacity (m^3/d)
2040	4538	5910	1475	2200	3735	8294	11563	255	785	774.66	1114.56
2041	4568	5910	1503	2200	3759	8349	11563	256	790	774.66	1114.56
2042	4597	5910	1531	2200	3783	8403	11563	258	795	774.66	1114.56
2043	4627	5910	1559	2200	3808	8457	11563	260	800	774.66	1114.56
2044	4657	5910	1587	2200	3832	8512	11563	261	805	774.66	1114.56
2045	4687	5910	1614	2200	3857	8566	11563	263	810	774.66	1114.56
2046	4716	5910	1642	2200	3881	8620	11563	265	815	774.66	1114.56
2047	4746	5910	1670	2200	3906	8675	11563	266	821	774.66	1114.56
2048	4776	5910	1698	2200	3930	8729	11563	268	826	774.66	1114.56
2049	4806	5910	1726	2200	3955	8783	11563	270	831	774.66	1114.56
2050	4835	5910	1754	2200	3979	8838	11563	271	836	774.66	1114.56
2051	4865	5910	1782	2200	4004	8892	11563	273	841	774.66	1114.56
2052	4895	5910	1810	2200	4028	8946	11563	275	846	774.66	1114.56
2053	4924	5910	1837	2200	4053	9001	11563	276	851	774.66	1114.56
2054	4954	5910	1865	2200	4077	9055	11563	278	857	774.66	1114.56
2055	4984	5910	1893	2200	4102	9109	11563	280	862	774.66	1114.56
2056	5014	5910	1921	2200	4126	9164	11563	281	867	774.66	1114.56
2057	5043	5910	1949	2200	4150	9218	11563	283	872	774.66	1114.56
2058	5073	5910	1977	2200	4175	9272	11563	285	877	774.66	1114.56
2059	5103	5910	2005	2200	4199	9327	11563	286	882	774.66	1114.56
2060	5133	5910	2033	2200	4224	9381	11563	288	887	774.66	1114.56
2061	5162	5910	2060	2200	4248	9435	11563	290	893	774.66	1114.56
2062	5192	5910	2088	2200	4273	9490	11563	291	898	774.66	1114.56
2063	5222	5910	2116	2200	4297	9544	11563	293	903	774.66	1114.56
2064	5252	5910	2144	2200	4322	9598	11563	295	908	774.66	1114.56
2065	5281	5910	2172	2200	4346	9653	11563	297	913	774.66	1114.56
2066	5311	5910	2200	2200	4371	9707	11563	298	918	774.66	1114.56
2067	5341	5910	2228	2200	4395	9761	11563	300	923	774.66	1114.56

Notes:

1. 2016 value is three year average, 2014 to 2016. Future values based on current per capita flow, applied to future population projection.
2. 2016 value is three year average, 2014 to 2016. Future values based on current per capita flow, applied to future population projection for residential areas. BEC industrial contribution based on current per hectare flow of 20.9 m^3/d/ha, applied to future developed area projection
3. 2016 value is three year maximum day, 2014 to 2016. Future values based on current per capita flow, applied to future population projection.
4. Capacity per Permit to Take Water with largest well out of service.

Municipality of Kincardine
Kincardine and Tiverton Water Storage Requirement Projections
Based on Development Charges, 2016-2067

Job # :	16130
Date :	May 2, 2017
Revised :	January 26, 2018

1.0 Background

The Municipality of Kincardine initiated a Master Plan process to evaluate water and wastewater servicing needs for Kincardine, Tiverton, and the Lakeshore Area.

The purpose of these notes is to summarize current water storage requirements, and projections for future requirements to 2067 based on the 2016 Development Charges forecast, extrapolated for the future design period. The storage calculations are based on MOECC Design Guidelines for Drinking-Water Systems - 2008.

2.0 Data

MOECC 2008 Guidelines Table 8-1 - Excerpts

Population	Fire Flow Rate (L/s)	Duration (hrs)
500	38	2
1000	64	2
1500	79	2
2000	95	2
3000	110	2
4000	125	2
5000	144	2
6000	159	3
10000	189	3
13000	220	3
17000	250	4
27000	318	5

Year	Kincardine Storage											
	Projected Population Town	Projected Population Lakeshore	Projected Population (includes Town + Lakeshore)	Maximum Day Demand (m^3/d)	Design Fire Flow for Storage (L/s)	Design Fire Flow Duration (hrs)	A - Design Fire Storage (m^3)	B - Design Eqlztn. Storage (m^3)	C - Design Emergency Storage (m^3)	A + B + C - Design Total Storage (m^3)	Current Total Storage (m^3)	Current Effective Storage (m^3)
2016	8370	1449	9819	6965	188	3.0	2027	1741	942	4710	7370	3221
2017	8441	1461	9902	7024	188	3.0	2033	1756	947	4737	7370	3221
2018	8512	1473	9985	7083	189	3.0	2040	1771	953	4763	7370	3221
2019	8585	1486	10071	7144	190	3.0	2049	1786	959	4794	7370	3221
2020	8658	1499	10156	7204	191	3.0	2059	1801	965	4825	7370	3221
2021	8713	1508	10221	7251	191	3.0	2066	1813	970	4848	7370	3221
2022	8786	1521	10307	7311	192	3.0	2075	1828	976	4879	7370	3221
2023	8859	1533	10393	7372	193	3.0	2085	1843	982	4910	7370	3221
2024	8934	1546	10480	7434	194	3.0	2095	1858	988	4942	7370	3221
2025	9008	1559	10567	7496	195	3.0	2105	1874	995	4973	7370	3221
2026	9064	1569	10633	7543	196	3.0	2112	1886	999	4997	7370	3221
2027	9127	1580	10707	7595	196	3.0	2120	1899	1005	5024	7370	3221
2028	9189	1590	10780	7647	197	3.0	2128	1912	1010	5050	7370	3221
2029	9253	1601	10854	7699	198	3.0	2137	1925	1015	5077	7370	3221
2030	9317	1613	10930	7753	199	3.0	2145	1938	1021	5104	7370	3221
2031	9380	1623	11003	7805	199	3.0	2153	1951	1026	5131	7370	3221
2032	9445	1636	11080	7860	200	3.0	2162	1965	1032	5158	7370	3221
2033	9510	1647	11157	7914	201	3.0	2170	1979	1037	5186	7370	3221
2034	9575	1658	11233	7968	202	3.0	2179	1992	1043	5214	7370	3221
2035	9640	1670	11310	8023	203	3.0	2187	2006	1048	5241	7370	3221
2036	9706	1681	11387	8077	203	3.0	2196	2019	1054	5269	7370	3221
2037	9771	1692	11463	8131	204	3.0	2204	2033	1059	5297	7370	3221
2038	9836	1703	11540	8186	205	3.0	2213	2046	1065	5324	7370	3221
2039	9902	1715	11616	8240	206	3.0	2222	2060	1070	5352	7370	3221
2040	9967	1726	11693	8294	206	3.0	2230	2074	1076	5380	7370	3221
2041	10032	1737	11770	8349	207	3.0	2239	2087	1081	5407	7370	3221
2042	10097	1749	11846	8403	208	3.0	2247	2101	1087	5435	7370	3221
2043	10163	1760	11923	8457	209	3.0	2256	2114	1093	5463	7370	3221
2044	10228	1771	11999	8512	210	3.0	2264	2128	1098	5490	7370	3221
2045	10293	1783	12076	8566	210	3.0	2273	2142	1104	5518	7370	3221
2046	10359	1794	12153	8620	211	3.0	2281	2155	1109	5546	7370	3221
2047	10424	1805	12229	8675	212	3.0	2290	2169	1115	5573	7370	3221
2048	10489	1816	12306	8729	213	3.0	2299	2182	1120	5601	7370	3221
2049	10555	1828	12382	8783	214	3.0	2307	2196	1126	5629	7370	3221
2050	10620	1839	12459	8838	214	3.0	2316	2209	1131	5656	7370	3221
2051	10685	1850	12536	8892	215	3.0	2324	2223	1137	5684	7370	3221
2052	10750	1862	12612	8946	216	3.0	2333	2237	1142	5712	7370	3221
2053	10816	1873	12689	9001	217	3.0	2341	2250	1148	5739	7370	3221
2054	10881	1884	12765	9055	218	3.0	2350	2264	1153	5767	7370	3221
2055	10946	1896	12842	9109	218	3.0	2358	2277	1159	5795	7370	3221
2056	11012	1907	12919	9164	219	3.0	2367	2291	1164	5822	7370	3221
2057	11077	1918	12995	9218	220	3.0	2375	2305	1170	5850	7370	3221
2058	11142	1930	13072	9272	221	3.0	2396	2318	1179	5893	7370	3221
2059	11208	1941	13148	9327	221	3.0	2418	2332	1187	5937	7370	3221
2060	11273	1952	13225	9381	222	3.1	2439	2345	1196	5980	7370	3221
2061	11338	1963	13302	9435	222	3.1	2461	2359	1205	6024	7370	3221
2062	11403	1975	13378	9490	223	3.1	2482	2372	1214	6069	7370	3221
2063	11469	1986	13455	9544	223	3.1	2504	2386	1223	6113	7370	3221
2064	11534	1997	13531	9598	224	3.1	2526	2400	1231	6157	7370	3221
2065	11599	2009	13608	9653	225	3.2	2548	2413	1240	6202	7370	3221
2066	11665	2020	13685	9707	225	3.2	2570	2427	1249	6246	7370	3221
2067	11730	2031	13761	9761	226	3.2	2592	2440	1258	6291	7370	3221

Year	Tiverton Water System									
	Projected Population	Maximum Day Demand (m^3/d)	Design Fire Flow for Storage (L/s)	Design Fire Flow Duration (hrs)	A - Design Fire Storage (m^3)	B - Design Eqlztn. Storage (m^3)	C - Design Emergency Storage (m^3)	A + B + C - Design Total Storage (m^3)	Current Total Storage (m^3)	Current Effective Storage (m^3)
2016	730	659	50	2.0	360	165	131	656	1500	350
2017	736	665	50	2.0	362	166	132	660	1500	350
2018	742	670	51	2.0	364	168	133	665	1500	350
2019	749	676	51	2.0	367	169	134	670	1500	350
2020	755	682	51	2.0	369	170	135	674	1500	350
2021	760	686	52	2.0	371	172	136	678	1500	350
2022	766	692	52	2.0	373	173	137	683	1500	350
2023	773	698	52	2.0	376	174	138	688	1500	350
2024	779	703	53	2.0	378	176	138	692	1500	350
2025	786	709	53	2.0	381	177	139	697	1500	350
2026	790	714	53	2.0	382	178	140	701	1500	350
2027	796	719	53	2.0	384	180	141	705	1500	350
2028	801	723	54	2.0	386	181	142	709	1500	350
2029	807	728	54	2.0	388	182	143	713	1500	350
2030	812	734	54	2.0	391	183	143	717	1500	350
2031	818	738	55	2.0	393	185	144	722	1500	350
2032	823	743	55	2.0	395	186	145	726	1500	350
2033	829	749	55	2.0	397	187	146	730	1500	350
2034	835	754	55	2.0	399	188	147	734	1500	350
2035	840	759	56	2.0	401	190	148	738	1500	350
2036	846	764	56	2.0	403	191	149	743	1500	350
2037	852	769	56	2.0	405	192	149	747	1500	350
2038	858	774	57	2.0	407	194	150	751	1500	350
2039	863	779	57	2.0	410	195	151	756	1500	350
2040	869	785	57	2.0	412	196	152	760	1500	350
2041	875	790	57	2.0	414	197	153	764	1500	350
2042	880	795	58	2.0	416	199	154	768	1500	350
2043	886	800	58	2.0	418	200	155	773	1500	350
2044	892	805	58	2.0	420	201	155	777	1500	350
2045	897	810	59	2.0	422	203	156	781	1500	350
2046	903	815	59	2.0	425	204	157	785	1500	350
2047	909	821	59	2.0	427	205	158	790	1500	350
2048	915	826	60	2.0	429	206	159	794	1500	350
2049	920	831	60	2.0	431	208	160	798	1500	350
2050	926	836	60	2.0	433	209	161	803	1500	350
2051	932	841	60	2.0	435	210	161	807	1500	350
2052	937	846	61	2.0	437	212	162	811	1500	350
2053	943	851	61	2.0	439	213	163	815	1500	350
2054	949	857	61	2.0	442	214	164	820	1500	350
2055	954	862	62	2.0	444	215	165	824	1500	350
2056	960	867	62	2.0	446	217	166	828	1500	350
2057	966	872	62	2.0	448	218	166	832	1500	350
2058	971	877	63	2.0	450	219	167	837	1500	350
2059	977	882	63	2.0	452	221	168	841	1500	350
2060	983	887	63	2.0	454	222	169	845	1500	350
2061	989	893	63	2.0	457	223	170	850	1500	350
2062	994	898	64	2.0	459	224	171	854	1500	350
2063	1000	903	64	2.0	461	226	172	858	1500	350
2064	1006	908	64	2.0	463	227	172	862	1500	350
2065	1011	913	65	2.0	465	228	173	867	1500	350
2066	1017	918	65	2.0	467	230	174	871	1500	350
2067	1023	923	65	2.0	469	231	175	875	1500	350

APPENDIX C

KINCARDINE WATER CALCULATIONS AND MODELLING NOTES

Municipality of Kincardine
WaterCAD Modelling for Master Plan
Calculations and Notes for Kincardine

Job # :	16130
Date :	November 10, 2016
Revised :	

1.0 Background

The Municipality of Kincardine is completing a water and wastewater Master Plan process. The water supply component will include a review of servicing existing development, future development, and service to Bruce Power. The purpose of these notes is to summarize data used to create a WaterCAD model, and the results of that modelling for the community of Kincardine.

2.0 Analysis & Model Data

2.1 Data

Reference	Item			
16050	Existing avg. day demand		35.4	L/s
		=	3061	m^3/d
	Existing max. day demand		80.6	L/s
		=	6965	m^3/d
16130	Kincardine town pop. (2015)		6972	persons
MOECC	Peak hour factor - ex. pop.		3.00	
	Peak hour factor - fut. pop.		2.85	
DWWP	WTP High Lift			
	Pump rating (HLP1, HLP3)		130	L/s
		@	79	m TDH
	Pump rating (HLP2)		82	L/s
		@	79	m TDH
	Clearwell volume		4120	m^3
77066	Clearwell midpoint		178.7	mASL
"	Pump discharge		182.4	mASL
Town info	HLP off (tower level)		39.2	m
		=	249.0	mASL
	HLP on (tower level)		37.2	m
		=	247.0	mASL
DWWP/	Standpipe			
78011	Total volume		3360	m^3
	Usable volume		140	m^3
	Diameter		10.5	m
	HWL		249.00	mASL
	Bottom operating range		247.00	mASL
	Grade at base		207.50	mASL

DWWP/ 78011	Standpipe BPS			
	Pump rating		100	L/s
		@	30	m TDH
			140	L/s
		@	25	m TDH
	Floor elevation		207.4	mASL

MOE Guide Pipe C-factors

Pipe Dia. (mm)	C
150	100
200-250	110
300-600	120
>600	130

MOE Guide	Normal operating pressure range target	350 to 480	kPa
MOE Guide	Normal operating pressure minimum	275	kPa
MOE Guide	Fire flow system pressure minimum	140	kPa
MOE Guide	Maximum allowable system pressure	700	kPa

2.2 Water Demands by Junction

(a) Existing Conditions

Number of junctions - existing model	348	
Average day demand per junction	0.102	L/s

See attached map for area junctions. Based on the data above, dividing the average day demand for the system over the total number of existing model junctions would result in a per junction demand of approximately 0.1 L/s. Based on 2013-2015 data provided by the Municipality, the 16 largest water users connected to the system had average day demands ranging from 0.08 to 0.25 L/s each.

Design fire flow demands will vary from about 50 L/s for residential areas to 150 L/s or greater in ICI areas. Considering the relatively small demand associated with consumption as compared to fire flow, and the fact that there are few customers with significant water demand, the total system demand is distributed evenly over all model junctions.

(b) Future Conditions

Demands for existing development are left unchanged, and the incremental future demand for development areas is applied to the nearest model junctions within or adjacent to the development lands.

With reference to 16130 Technical Memo 2 (TM2):

• Development areas are taken from Appendix C figures
• Demand per area is applied based on average of existing & target housing density and existing demand per equivalent residential unit (ERU)

Residential development density	9.9	units/ha
Maximum day demand per unit	1.64	m^3/unit/d
Design water demand for commercial area	28.0	m^3/ha/d
Maximum day factor	2.22	

TM2 Appendix C Figure	Vacant Land or Development Commitment ID	Vacant Land Area (ha)	Projected No. of ERUs	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Model Junction to Apply Demand
C1	1	not applicable - no. of units already defined	265	2.27	5.03	J-155
	2		39	0.33	0.74	J-10
	3		447	3.82	8.48	J-1455
	4		48	0.41	0.91	J-140
	5		57	0.49	1.08	J-565
	6		0	0.00	0.00	n/a
	7		1	0.01	0.02	J-505
	8		2	0.02	0.04	J-460
	A	40.11	397	3.40	7.54	JN-15
	B	9.87	98	0.84	1.85	JN-15
	C	80.82	800	6.84	15.19	J-1250
	D	22.16	219	1.88	4.16	JN-5
	E	3.73	37	0.32	0.70	JN-10
	F	29.56	293	2.50	5.55	JN-5
	G	4.54	not applicable - commercial lands	0.66	1.47	JN-10
	H	5.89		0.86	1.91	JN-10
	I	3.49		0.51	1.13	J-800
	J	33.64		4.91	10.90	J-1250
	K	15.96		2.33	5.17	JN-5
	L	6.18		0.90	2.00	JN-10
	M	43.58		6.36	14.12	J-755
	N	5.55		0.81	1.80	J-770
C2	Lakeshore	8.32	82	0.70	1.56	J-1500
	A	2.3	23	0.19	0.43	J-1250
	B	33.28	329	2.82	6.25	J-1250
	C	17.58	174	1.49	3.30	J-1250
	D	9.86	98	0.83	1.85	J-1250
	E	37.85	375	3.20	7.11	J-1250
	F	18.22	180	1.54	3.42	J-1250
	G	41.22	408	3.49	7.75	J-1250
	H	20.95	207	1.77	3.94	J-1250
	I	15.88	157	1.34	2.98	J-1250
	J	18.16	180	1.54	3.41	J-1250
C4	A	not applicable - no. of units established in Inverhuron EA	50	0.43	0.95	J-1725
	C		50	0.43	0.95	J-1720
	G		50	0.43	0.95	J-1690
	G		50	0.43	0.95	J-1695

(shaded) denotes commercial land; others are residential

Model Junction	Elevation (mASL)	Existing Average Day Demand (L/s)	Existing Maximum Day Demand (L/s)	Future Average Day Demand (L/s)	Future Maximum Day Demand (L/s)
J-5	179.9	0.102	0.232	0.102	0.232
J-10	190.0	0.102	0.232	0.435	0.972
J-15	191.5	0.102	0.232	0.102	0.232
J-20	195.6	0.102	0.232	0.102	0.232
J-25	198.5	0.102	0.232	0.119	0.270
J-30	195.0	0.102	0.232	0.110	0.251
J-35	194.1	0.102	0.232	0.589	1.314
J-40	193.1	0.102	0.232	6.464	14.355
J-45	194.8	0.102	0.232	0.912	2.030
J-50	177.5	0.102	0.232	0.611	1.363
J-55	181.1	0.102	0.232	0.102	0.232
J-60	192.7	0.102	0.232	0.102	0.232
J-65	188.4	0.102	0.232	0.102	0.232
J-70	188.4	0.102	0.232	0.102	0.232
J-75	188.0	0.102	0.232	0.102	0.232
J-80	192.0	0.102	0.232	0.102	0.232
J-85	198.4	0.102	0.232	0.102	0.232
J-90	195.9	0.102	0.232	0.102	0.232
J-95	195.2	0.102	0.232	0.102	0.232
J-100	198.4	0.102	0.232	0.102	0.232
J-105	193.7	0.102	0.232	0.102	0.232
J-110	195.7	0.102	0.232	0.102	0.232
J-115	195.2	0.102	0.232	0.102	0.232
J-120	196.7	0.102	0.232	0.102	0.232
J-125	199.9	0.102	0.232	0.102	0.232
J-130	199.4	0.102	0.232	0.102	0.232
J-135	198.3	0.102	0.232	0.102	0.232
J-140	198.7	0.102	0.232	0.512	1.143
J-145	200.1	0.102	0.232	0.102	0.232
J-150	200.1	0.102	0.232	0.102	0.232
J-155	200.7	0.102	0.232	2.368	5.262
J-160	198.5	0.102	0.232	0.102	0.232
J-165	196.9	0.102	0.232	0.102	0.232
J-170	198.0	0.102	0.232	0.102	0.232
J-175	199.0	0.102	0.232	0.102	0.232
J-180	198.5	0.102	0.232	0.102	0.232
J-185	194.9	0.102	0.232	0.102	0.232
J-190	195.6	0.102	0.232	0.102	0.232
J-195	195.5	0.102	0.232	0.102	0.232
J-200	197.1	0.102	0.232	0.102	0.232
J-205	196.7	0.102	0.232	0.102	0.232
J-210	197.8	0.102	0.232	0.102	0.232
J-215	197.4	0.102	0.232	0.102	0.232
J-220	197.4	0.102	0.232	0.102	0.232
J-225	197.3	0.102	0.232	0.102	0.232
J-230	196.7	0.102	0.232	0.102	0.232
J-235	200.0	0.102	0.232	0.102	0.232
J-240	200.2	0.102	0.232	0.102	0.232
J-245	181.7	0.102	0.232	0.102	0.232
J-250	192.0	0.102	0.232	0.102	0.232
J-255	191.0	0.102	0.232	0.102	0.232

Model Junction	Elevation (mASL)	Existing Average Day Demand (L/s)	Existing Maximum Day Demand (L/s)	Future Average Day Demand (L/s)	Future Maximum Day Demand (L/s)
J-260	197.6	0.102	0.232	0.102	0.232
J-265	191.5	0.102	0.232	0.102	0.232
J-270	191.9	0.102	0.232	0.102	0.232
J-275	194.1	0.102	0.232	0.102	0.232
J-280	200.7	0.102	0.232	0.102	0.232
J-285	197.5	0.102	0.232	0.102	0.232
J-290	197.4	0.102	0.232	0.102	0.232
J-295	200.8	0.102	0.232	0.102	0.232
J-300	200.2	0.102	0.232	0.102	0.232
J-305	198.2	0.102	0.232	0.102	0.232
J-310	199.6	0.102	0.232	0.102	0.232
J-315	198.2	0.102	0.232	0.102	0.232
J-320	199.0	0.102	0.232	0.102	0.232
J-325	191.0	0.102	0.232	0.102	0.232
J-330	196.3	0.102	0.232	0.102	0.232
J-335	192.6	0.102	0.232	0.102	0.232
J-340	194.6	0.102	0.232	0.102	0.232
J-345	194.3	0.102	0.232	0.102	0.232
J-350	199.7	0.102	0.232	0.102	0.232
J-355	201.5	0.102	0.232	0.102	0.232
J-360	201.6	0.102	0.232	0.102	0.232
J-365	194.3	0.102	0.232	0.102	0.232
J-370	194.8	0.102	0.232	0.102	0.232
J-375	196.4	0.102	0.232	0.102	0.232
J-380	198.0	0.102	0.232	0.102	0.232
J-385	196.1	0.102	0.232	0.102	0.232
J-390	195.8	0.102	0.232	0.102	0.232
J-395	195.8	0.102	0.232	0.102	0.232
J-400	195.2	0.102	0.232	0.102	0.232
J-405	200.1	0.102	0.232	0.102	0.232
J-410	196.8	0.102	0.232	0.102	0.232
J-415	192.0	0.102	0.232	0.102	0.232
J-420	191.5	0.102	0.232	0.102	0.232
J-425	195.8	0.102	0.232	0.102	0.232
J-430	199.1	0.102	0.232	0.102	0.232
J-435	195.9	0.102	0.232	0.102	0.232
J-440	195.5	0.102	0.232	0.102	0.232
J-445	193.7	0.102	0.232	0.102	0.232
J-450	192.4	0.102	0.232	0.102	0.232
J-455	195.2	0.102	0.232	0.102	0.232
J-460	196.5	0.102	0.232	0.102	0.232
J-465	196.8	0.102	0.232	0.102	0.232
J-470	193.0	0.102	0.232	0.102	0.232
J-475	195.0	0.102	0.232	0.102	0.232
J-480	196.7	0.102	0.232	0.102	0.232
J-485	197.8	0.102	0.232	0.102	0.232
J-490	201.7	0.102	0.232	0.102	0.232
J-495	189.4	0.102	0.232	0.102	0.232
J-500	196.5	0.102	0.232	0.102	0.232
J-505	196.6	0.102	0.232	0.102	0.232
J-510	196.7	0.102	0.232	0.102	0.232

Model Junction	Elevation (mASL)	Existing Average Day Demand (L/s)	Existing Maximum Day Demand (L/s)	Future Average Day Demand (L/s)	Future Maximum Day Demand (L/s)
J-515	196.8	0.102	0.232	0.102	0.232
J-520	198.4	0.102	0.232	0.102	0.232
J-525	197.4	0.102	0.232	0.102	0.232
J-530	198.0	0.102	0.232	0.102	0.232
J-535	195.1	0.102	0.232	0.102	0.232
J-540	196.1	0.102	0.232	0.102	0.232
J-545	197.7	0.102	0.232	0.102	0.232
J-550	197.1	0.102	0.232	0.102	0.232
J-555	198.7	0.102	0.232	0.102	0.232
J-560	197.4	0.102	0.232	0.102	0.232
J-565	198.4	0.102	0.232	0.102	0.232
J-570	198.4	0.102	0.232	0.102	0.232
J-575	199.1	0.102	0.232	0.102	0.232
J-580	197.7	0.102	0.232	0.102	0.232
J-585	197.4	0.102	0.232	0.102	0.232
J-590	198.7	0.102	0.232	0.102	0.232
J-595	197.5	0.102	0.232	0.102	0.232
J-600	197.6	0.102	0.232	0.102	0.232
J-605	202.2	0.102	0.232	0.102	0.232
J-610	201.1	0.102	0.232	0.102	0.232
J-615	203.0	0.102	0.232	0.102	0.232
J-620	199.4	0.102	0.232	0.102	0.232
J-625	204.0	0.102	0.232	0.102	0.232
J-630	204.2	0.102	0.232	0.102	0.232
J-635	205.4	0.102	0.232	0.102	0.232
J-640	209.5	0.102	0.232	0.102	0.232
J-645	199.1	0.102	0.232	0.102	0.232
J-650	203.9	0.102	0.232	0.102	0.232
J-655	204.7	0.102	0.232	0.102	0.232
J-660	205.5	0.102	0.232	0.102	0.232
J-665	205.7	0.102	0.232	0.102	0.232
J-670	201.7	0.102	0.232	0.102	0.232
J-675	205.7	0.102	0.232	0.102	0.232
J-680	205.1	0.102	0.232	0.102	0.232
J-685	205.9	0.102	0.232	0.102	0.232
J-690	206.0	0.102	0.232	0.102	0.232
J-695	206.4	0.102	0.232	0.102	0.232
J-700	205.1	0.102	0.232	0.102	0.232
J-705	205.4	0.102	0.232	0.102	0.232
J-710	206.9	0.102	0.232	0.102	0.232
J-715	206.9	0.102	0.232	0.102	0.232
J-720	206.3	0.102	0.232	0.102	0.232
J-725	208.4	0.102	0.232	0.102	0.232
J-730	209.5	0.102	0.232	0.102	0.232
J-735	205.4	0.102	0.232	0.102	0.232
J-740	206.7	0.102	0.232	0.102	0.232
J-745	207.3	0.102	0.232	0.102	0.232
J-750	206.9	0.102	0.232	0.102	0.232
J-755	207.8	0.102	0.232	0.102	0.232
J-760	212.8	0.102	0.232	0.102	0.232
J-765	210.9	0.102	0.232	0.102	0.232

Model Junction	Elevation (mASL)	Existing		Future	
		Average Day Demand (L/s)	Maximum Day Demand (L/s)	Average Day Demand (L/s)	Maximum Day Demand (L/s)
J-770	210.4	0.102	0.232	0.102	0.232
J-775	207.9	0.102	0.232	0.102	0.232
J-780	209.5	0.102	0.232	0.102	0.232
J-785	209.3	0.102	0.232	0.102	0.232
J-790	210.1	0.102	0.232	0.102	0.232
J-795	209.4	0.102	0.232	0.102	0.232
J-800	210.5	0.102	0.232	0.102	0.232
J-805	211.4	0.102	0.232	0.102	0.232
J-810	176.7	0.102	0.232	0.102	0.232
J-815	181.7	0.102	0.232	0.102	0.232
J-820	180.2	0.102	0.232	0.102	0.232
J-825	190.1	0.102	0.232	0.102	0.232
J-830	197.1	0.102	0.232	0.102	0.232
J-835	197.0	0.102	0.232	0.102	0.232
J-840	197.1	0.102	0.232	0.102	0.232
J-845	191.3	0.102	0.232	0.102	0.232
J-850	197.2	0.102	0.232	0.102	0.232
J-855	197.2	0.102	0.232	0.102	0.232
J-860	200.6	0.102	0.232	0.102	0.232
J-865	196.8	0.102	0.232	0.102	0.232
J-870	201.0	0.102	0.232	0.102	0.232
J-875	197.2	0.102	0.232	0.102	0.232
J-880	197.9	0.102	0.232	0.102	0.232
J-885	198.9	0.102	0.232	0.102	0.232
J-890	201.4	0.102	0.232	0.102	0.232
J-895	201.3	0.102	0.232	0.102	0.232
J-900	194.6	0.102	0.232	0.102	0.232
J-905	181.9	0.102	0.232	0.102	0.232
J-910	183.1	0.102	0.232	0.102	0.232
J-915	180.7	0.102	0.232	0.102	0.232
J-920	182.9	0.102	0.232	0.102	0.232
J-925	192.6	0.102	0.232	0.102	0.232
J-930	193.7	0.102	0.232	0.102	0.232
J-935	182.5	0.102	0.232	0.102	0.232
J-940	186.5	0.102	0.232	0.102	0.232
J-945	190.1	0.102	0.232	0.102	0.232
J-950	197.6	0.102	0.232	0.102	0.232
J-955	197.8	0.102	0.232	0.102	0.232
J-960	192.8	0.102	0.232	0.102	0.232
J-965	192.0	0.102	0.232	0.102	0.232
J-970	191.9	0.102	0.232	0.102	0.232
J-975	199.0	0.102	0.232	0.102	0.232
J-980	198.9	0.102	0.232	0.102	0.232
J-985	188.8	0.102	0.232	0.102	0.232
J-990	191.3	0.102	0.232	0.102	0.232
J-995	179.9	0.102	0.232	0.102	0.232
J-1000	181.6	0.102	0.232	0.102	0.232
J-1005	181.8	0.102	0.232	0.102	0.232
J-1010	184.3	0.102	0.232	0.102	0.232
J-1015	184.0	0.102	0.232	0.102	0.232
J-1020	190.4	0.102	0.232	0.102	0.232

Model Junction	Elevation (mASL)	Existing Average Day Demand (L/s)	Existing Maximum Day Demand (L/s)	Future Average Day Demand (L/s)	Future Maximum Day Demand (L/s)
J-1025	191.0	0.102	0.232	0.102	0.232
J-1030	192.0	0.102	0.232	0.102	0.232
J-1035	192.3	0.102	0.232	0.102	0.232
J-1040	190.5	0.102	0.232	0.102	0.232
J-1045	192.1	0.102	0.232	0.102	0.232
J-1050	192.1	0.102	0.232	0.102	0.232
J-1055	194.6	0.102	0.232	0.102	0.232
J-1060	195.0	0.102	0.232	0.102	0.232
J-1065	181.6	0.102	0.232	0.102	0.232
J-1070	189.1	0.102	0.232	0.102	0.232
J-1075	189.0	0.102	0.232	0.102	0.232
J-1080	191.3	0.102	0.232	0.102	0.232
J-1085	194.0	0.102	0.232	0.102	0.232
J-1090	195.6	0.102	0.232	0.102	0.232
J-1095	198.2	0.102	0.232	0.102	0.232
J-1100	198.3	0.102	0.232	0.102	0.232
J-1105	199.6	0.102	0.232	0.102	0.232
J-1110	197.4	0.102	0.232	0.102	0.232
J-1115	196.2	0.102	0.232	0.102	0.232
J-1120	202.1	0.102	0.232	0.102	0.232
J-1125	202.1	0.102	0.232	0.102	0.232
J-1130	205.3	0.102	0.232	0.102	0.232
J-1135	200.8	0.102	0.232	0.102	0.232
J-1140	200.5	0.102	0.232	0.102	0.232
J-1145	198.7	0.102	0.232	0.102	0.232
J-1150	201.5	0.102	0.232	0.102	0.232
J-1155	200.0	0.102	0.232	0.102	0.232
J-1160	198.6	0.102	0.232	0.102	0.232
J-1165	200.8	0.102	0.232	0.102	0.232
J-1170	199.9	0.102	0.232	0.102	0.232
J-1175	205.9	0.102	0.232	0.102	0.232
J-1180	204.2	0.102	0.232	0.102	0.232
J-1185	202.6	0.102	0.232	0.102	0.232
J-1190	205.1	0.102	0.232	0.102	0.232
J-1195	203.8	0.102	0.232	0.102	0.232
J-1200	207.2	0.102	0.232	0.102	0.232
J-1205	201.7	0.102	0.232	0.102	0.232
J-1210	206.0	0.102	0.232	0.102	0.232
J-1215	205.5	0.102	0.232	0.102	0.232
J-1220	208.1	0.102	0.232	0.102	0.232
J-1225	206.7	0.102	0.232	0.102	0.232
J-1230	208.5	0.102	0.232	0.102	0.232
J-1235	207.1	0.102	0.232	0.102	0.232
J-1240	210.6	0.102	0.232	0.102	0.232
J-1245	210.9	0.102	0.232	0.102	0.232
J-1250	211.1	0.102	0.232	30.078	66.779
J-1255	209.5	0.102	0.232	0.102	0.232
J-1260	212.7	0.102	0.232	0.102	0.232
J-1265	213.3	0.102	0.232	0.102	0.232
J-1270	214.1	0.102	0.232	0.102	0.232
J-1275	214.3	0.102	0.232	0.102	0.232

Model Junction	Elevation (mASL)	Existing Average Day Demand (L/s)	Existing Maximum Day Demand (L/s)	Future Average Day Demand (L/s)	Future Maximum Day Demand (L/s)
J-1280	215.0	0.102	0.232	0.102	0.232
J-1285	198.8	0.102	0.232	0.102	0.232
J-1290	199.4	0.102	0.232	0.102	0.232
J-1295	202.1	0.102	0.232	0.102	0.232
J-1300	202.9	0.102	0.232	0.102	0.232
J-1305	199.0	0.102	0.232	0.102	0.232
J-1310	199.8	0.102	0.232	0.102	0.232
J-1315	207.4	0.102	0.232	0.102	0.232
J-1320	210.0	0.102	0.232	0.102	0.232
J-1325	211.9	0.102	0.232	0.102	0.232
J-1330	202.9	0.102	0.232	0.102	0.232
J-1335	210.9	0.102	0.232	0.102	0.232
J-1340	210.7	0.102	0.232	0.102	0.232
J-1345	210.0	0.102	0.232	0.102	0.232
J-1350	190.8	0.102	0.232	0.102	0.232
J-1355	195.3	0.102	0.232	0.102	0.232
J-1360	201.7	0.102	0.232	0.102	0.232
J-1365	179.0	0.102	0.232	0.102	0.232
J-1370	181.8	0.102	0.232	0.102	0.232
J-1375	187.2	0.102	0.232	0.102	0.232
J-1380	189.4	0.102	0.232	0.102	0.232
J-1385	189.8	0.102	0.232	0.102	0.232
J-1390	189.9	0.102	0.232	0.102	0.232
J-1395	191.3	0.102	0.232	0.102	0.232
J-1400	190.4	0.102	0.232	0.102	0.232
J-1405	188.5	0.102	0.232	0.102	0.232
J-1410	191.7	0.102	0.232	0.102	0.232
J-1415	195.4	0.102	0.232	0.102	0.232
J-1420	195.3	0.102	0.232	0.102	0.232
J-1425	191.7	0.102	0.232	0.102	0.232
J-1430	191.1	0.102	0.232	0.102	0.232
J-1435	192.7	0.102	0.232	0.102	0.232
J-1440	195.5	0.102	0.232	0.102	0.232
J-1445	184.0	0.102	0.232	0.102	0.232
J-1450	192.2	0.102	0.232	0.102	0.232
J-1455	190.4	0.102	0.232	3.924	8.716
J-1460	197.5	0.102	0.232	0.102	0.232
J-1465	185.6	0.102	0.232	0.102	0.232
J-1470	189.5	0.102	0.232	0.102	0.232
J-1475	191.2	0.102	0.232	0.102	0.232
J-1480	202.4	0.102	0.232	0.102	0.232
J-1485	201.6	0.102	0.232	0.102	0.232
J-1490	203.3	0.102	0.232	0.102	0.232
J-1495	201.8	0.102	0.232	0.102	0.232
J-1500	199.5	0.102	0.232	0.806	1.795
J-1505	202.4	0.102	0.232	0.102	0.232
J-1510	189.5	0.102	0.232	0.102	0.232
J-1515	190.5	0.102	0.232	0.102	0.232
J-1520	196.9	0.102	0.232	0.102	0.232
J-1525	195.1	0.102	0.232	0.102	0.232
J-1530	185.9	0.102	0.232	0.102	0.232

Model Junction	Elevation (mASL)	Existing Average Day Demand (L/s)	Existing Maximum Day Demand (L/s)	Future Average Day Demand (L/s)	Future Maximum Day Demand (L/s)
J-1535	190.9	0.102	0.232	0.102	0.232
J-1540	191.7	0.102	0.232	0.102	0.232
J-1545	193.1	0.102	0.232	0.102	0.232
J-1550	196.3	0.102	0.232	0.102	0.232
J-1555	198.5	0.102	0.232	0.102	0.232
J-1560	188.9	0.102	0.232	0.102	0.232
J-1565	190.2	0.102	0.232	0.102	0.232
J-1570	198.7	0.102	0.232	0.102	0.232
J-1575	182.4	0.102	0.232	0.102	0.232
J-1580	181.7	0.102	0.232	0.102	0.232
J-1585	184.1	0.102	0.232	0.102	0.232
J-1590	201.8	0.102	0.232	0.102	0.232
J-1595	186.6	0.102	0.232	0.102	0.232
J-1600	199.9	0.102	0.232	0.102	0.232
J-1605	183.0	0.102	0.232	0.102	0.232
J-1610	189.9	0.102	0.232	0.102	0.232
J-1615	183.4	0.102	0.232	0.102	0.232
J-1620	183.3	0.102	0.232	0.102	0.232
J-1625	186.6	0.102	0.232	0.102	0.232
J-1630	186.7	0.102	0.232	0.102	0.232
J-1635	180.0	0.102	0.232	0.102	0.232
J-1640	183.7	0.102	0.232	0.102	0.232
J-1645	181.6	0.102	0.232	0.102	0.232
J-1650	182.3	0.102	0.232	0.102	0.232
J-1655	182.0	0.102	0.232	0.102	0.232
J-1660	185.8	0.102	0.232	0.102	0.232
J-1665	185.0	0.102	0.232	0.102	0.232
J-1670	182.0	0.102	0.232	0.102	0.232
J-1675	180.5	0.102	0.232	0.102	0.232
J-1680	180.5	0.102	0.232	0.102	0.232
J-1685	186.6	0.102	0.232	0.102	0.232
J-1690	184.4	0.102	0.232	0.529	1.181
J-1695	185.2	0.102	0.232	0.529	1.181
J-1700	181.6	0.102	0.232	0.102	0.232
J-1705	183.9	0.102	0.232	0.102	0.232
J-1710	184.2	0.102	0.232	0.102	0.232
J-1715	187.2	0.102	0.232	0.102	0.232
J-1720	187.0	0.102	0.232	0.529	1.181
J-1725	189.9	0.102	0.232	0.529	1.181
J-1730	195.6	0.102	0.232	0.102	0.232
J-1735	189.3	0.102	0.232	0.102	0.232
J-1740	188.5	0.102	0.232	0.102	0.232
JN-5	202.0	not applicable for existing model		6.708	14.891
JN-10	199.0			2.740	6.084
JN-15	201.0			4.231	9.392
JN-20	205.0			0.000	0.000
JN-25	215.0			0.000	0.000
Minimum	176.7	0.102	0.232	0.000	0.000
Maximum	215.0	0.102	0.232	30.078	66.779
Total		35.4	80.6	96.5	216.2

3.0 Model Results - 2017 Demands

3.1 Existing Conditions

For average day and peak hour analysis, assume no pumps operating and standpipe water level at nominal operating level of 248.0 mASL. For fire flow analysis, use two scenarios: standpipe nominal water level of 248.0 mASL with no HLPS, and standpipe low water level of 247.0 mASL with HLP3 on.

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s)		
			Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-5	663	644	44	47	45
J-10	565	545	81	91	87
J-15	550	530	82	93	88
J-20	510	490	77	86	82
J-25	481	462	69	77	73
J-30	516	496	79	88	84
J-35	524	505	78	86	82
J-40	535	515	89	101	96
J-45	518	498	71	79	75
J-50	687	667	58	62	59
J-55	652	632	99	110	106
J-60	538	519	91	102	97
J-65	580	560	90	102	97
J-70	581	561	93	105	100
J-75	584	565	94	106	101
J-80	545	525	91	103	98
J-85	483	464	119	137	131
J-90	507	489	104	117	112
J-95	514	496	89	98	94
J-100	483	465	168	203	192
J-105	529	510	168	205	193
J-110	509	490	120	135	130
J-115	514	496	166	202	191
J-120	499	481	163	198	187
J-125	468	449	73	81	78
J-130	473	454	155	186	176
J-135	484	466	160	193	183
J-140	480	461	124	142	136
J-145	466	447	89	100	96
J-150	466	448	151	180	171
J-155	460	441	147	175	166
J-160	481	463	119	136	130
J-165	498	480	181	220	208
J-170	487	469	136	157	151
J-175	477	459	99	111	106
J-180	481	463	99	111	106
J-185	517	498	119	135	130
J-190	511	492	110	124	119
J-195	511	492	128	147	141
J-200	495	477	145	170	162
J-205	499	481	160	189	180
J-210	489	470	161	192	182
J-215	492	474	166	199	189

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s)		
			Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-220	493	475	167	200	190
J-225	494	476	209	261	245
J-230	499	482	233	306	282
J-235	467	450	234	310	285
J-240	465	448	128	147	141
J-245	646	627	106	116	112
J-250	545	526	115	130	125
J-255	555	536	81	89	85
J-260	491	473	259	469	400
J-265	550	532	257	483	417
J-270	546	528	256	496	425
J-275	525	507	254	489	416
J-280	460	442	200	259	240
J-285	491	473	201	255	238
J-290	492	474	258	480	408
J-295	459	441	205	270	250
J-300	466	448	65	73	69
J-305	485	467	201	252	236
J-310	471	454	248	334	306
J-315	485	468	251	341	311
J-320	477	459	89	100	95
J-325	555	537	252	500	432
J-330	504	486	256	494	418
J-335	539	521	255	500	443
J-340	520	504	66	72	69
J-345	523	506	254	500	457
J-350	470	453	97	109	105
J-355	453	436	181	227	214
J-360	452	435	280	415	366
J-365	523	505	184	226	213
J-370	518	500	70	76	73
J-375	502	484	71	77	74
J-380	487	469	169	203	193
J-385	506	488	64	70	67
J-390	508	490	87	96	93
J-395	509	491	83	92	88
J-400	514	496	75	82	79
J-405	466	449	98	110	105
J-410	499	482	136	155	149
J-415	546	527	72	78	75
J-420	551	532	65	70	67
J-425	508	490	67	73	70
J-430	476	458	164	195	185
J-435	508	493	43	45	44
J-440	511	495	286	411	366
J-445	529	513	185	217	207
J-450	542	526	194	226	216
J-455	515	499	84	90	88
J-460	501	486	90	98	95
J-465	499	484	300	433	389

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s)		
			Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-470	536	521	188	223	212
J-475	516	500	203	244	231
J-480	500	484	228	282	264
J-485	489	473	284	445	388
J-490	451	433	256	487	405
J-495	572	556	290	485	418
J-500	502	486	301	445	399
J-505	501	486	105	115	111
J-510	500	485	125	139	134
J-515	499	485	96	105	102
J-520	483	469	86	93	90
J-525	493	479	309	500	453
J-530	487	473	302	438	387
J-535	515	500	298	492	432
J-540	506	491	110	121	118
J-545	491	476	306	500	471
J-550	496	481	177	207	198
J-555	481	466	157	179	173
J-560	494	479	95	103	100
J-565	483	467	74	80	77
J-570	483	467	71	77	75
J-575	476	461	67	73	70
J-580	490	475	313	500	457
J-585	493	479	312	500	447
J-590	481	467	319	500	475
J-595	492	479	228	267	254
J-600	491	477	209	246	234
J-605	446	433	158	179	173
J-610	457	442	96	105	102
J-615	439	424	106	118	114
J-620	473	459	285	402	359
J-625	428	414	118	133	128
J-630	427	412	228	295	272
J-635	416	411	128	133	131
J-640	376	371	87	89	88
J-645	477	463	93	100	97
J-650	431	422	99	104	102
J-655	422	413	129	137	134
J-660	415	409	157	166	162
J-665	414	408	153	161	158
J-670	452	446	142	148	145
J-675	414	408	194	205	200
J-680	419	414	114	118	116
J-685	411	406	100	102	101
J-690	410	404	180	190	186
J-695	407	402	178	187	184
J-700	418	407	356	500	500
J-705	416	405	374	500	500
J-710	402	398	500	500	500
J-715	402	398	476	500	500

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s) Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-720	407	403	377	464	424
J-725	387	382	142	146	144
J-730	376	371	98	100	99
J-735	416	411	185	197	192
J-740	404	398	263	295	280
J-745	397	392	149	156	153
J-750	402	397	308	366	339
J-755	393	387	238	264	252
J-760	343	338	204	222	214
J-765	362	357	101	104	102
J-770	368	363	215	234	225
J-775	392	387	143	147	146
J-780	376	371	101	103	102
J-785	378	374	72	73	72
J-790	370	366	49	50	49
J-795	377	372	258	301	281
J-800	366	360	224	257	242
J-805	357	352	204	221	214
J-810	695	677	111	121	118
J-815	646	628	92	102	98
J-820	661	643	249	500	445
J-825	564	546	246	500	438
J-830	496	478	253	500	455
J-835	496	478	250	500	446
J-840	495	477	250	500	444
J-845	553	535	244	500	433
J-850	495	477	244	500	435
J-855	494	476	248	500	439
J-860	462	444	185	242	226
J-865	499	482	139	161	155
J-870	457	440	214	300	271
J-875	495	478	183	228	215
J-880	488	470	245	500	431
J-885	478	461	246	500	432
J-890	453	436	249	500	439
J-895	454	438	256	500	450
J-900	520	504	262	500	462
J-905	644	626	241	500	431
J-910	633	615	242	500	429
J-915	656	638	241	500	432
J-920	634	616	240	500	424
J-925	540	522	243	500	429
J-930	529	511	243	500	429
J-935	638	620	238	500	414
J-940	599	581	238	500	412
J-945	564	546	238	500	411
J-950	491	473	236	500	396
J-955	488	470	242	500	408
J-960	537	519	239	500	412
J-965	546	527	232	447	385

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s)		
			Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-970	546	528	231	438	378
J-975	477	459	226	482	368
J-980	477	459	215	429	338
J-985	577	558	95	107	102
J-990	552	534	199	255	238
J-995	664	645	137	155	150
J-1000	647	628	226	346	315
J-1005	645	626	221	323	297
J-1010	621	602	201	249	234
J-1015	624	605	195	239	226
J-1020	561	542	198	251	235
J-1025	555	536	187	236	221
J-1030	546	527	223	445	361
J-1035	543	524	220	366	325
J-1040	560	541	57	64	60
J-1045	544	525	76	85	81
J-1050	544	526	70	78	74
J-1055	520	501	140	167	159
J-1060	516	497	95	108	103
J-1065	647	628	215	286	266
J-1070	574	553	178	253	237
J-1075	574	553	177	232	219
J-1080	552	531	175	244	229
J-1085	526	511	98	107	104
J-1090	510	495	272	500	486
J-1095	484	467	194	249	232
J-1100	484	468	213	281	260
J-1105	471	454	198	258	239
J-1110	493	477	268	499	430
J-1115	504	488	151	177	170
J-1120	447	430	205	278	254
J-1125	446	430	124	145	139
J-1130	417	406	59	62	60
J-1135	459	442	247	401	347
J-1140	463	445	140	167	160
J-1145	480	462	235	356	315
J-1150	452	435	176	222	209
J-1155	467	450	159	191	182
J-1160	481	463	224	315	285
J-1165	459	441	159	199	188
J-1170	468	450	196	258	239
J-1175	409	391	186	253	233
J-1180	426	409	106	123	116
J-1185	442	425	110	127	121
J-1190	418	401	118	136	129
J-1195	430	413	165	200	190
J-1200	397	382	77	85	80
J-1205	450	433	184	228	215
J-1210	409	391	181	243	225
J-1215	413	395	126	154	146

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s)		
			Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-1220	388	370	80	94	88
J-1225	404	404	500	500	500
J-1230	385	375	48	52	49
J-1235	399	386	50	54	51
J-1240	364	352	77	87	81
J-1245	362	351	76	84	79
J-1250	359	347	52	58	54
J-1255	376	370	181	204	193
J-1260	345	336	108	120	114
J-1265	338	330	126	140	133
J-1270	330	322	135	151	143
J-1275	329	322	160	178	170
J-1280	322	315	161	180	171
J-1285	479	460	206	390	314
J-1290	472	453	194	348	288
J-1295	446	428	154	197	186
J-1300	439	420	108	127	121
J-1305	476	456	167	265	232
J-1310	469	448	165	261	228
J-1315	394	374	74	88	81
J-1320	368	348	108	141	131
J-1325	350	330	92	117	108
J-1330	438	417	169	273	237
J-1335	360	340	83	103	94
J-1340	362	342	89	112	103
J-1345	369	349	70	85	78
J-1350	557	535	152	180	173
J-1355	512	491	110	127	122
J-1360	450	428	170	237	217
J-1365	673	652	191	237	225
J-1370	645	623	86	94	91
J-1375	592	569	89	99	95
J-1380	571	549	175	221	210
J-1385	566	545	175	221	209
J-1390	565	544	174	231	218
J-1395	551	530	173	232	218
J-1400	561	538	133	154	148
J-1405	579	556	110	125	120
J-1410	547	525	121	139	134
J-1415	512	490	172	232	217
J-1420	512	490	117	136	130
J-1425	548	526	123	142	136
J-1430	553	530	117	135	129
J-1435	538	516	72	80	76
J-1440	511	489	69	78	74
J-1445	623	599	67	73	70
J-1450	542	519	116	134	128
J-1455	561	537	124	143	138
J-1460	491	468	140	179	168
J-1465	607	583	58	64	60

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s)		
			Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-1470	569	545	127	160	151
J-1475	553	529	131	165	155
J-1480	443	419	129	162	153
J-1485	450	426	126	157	148
J-1490	434	410	123	153	144
J-1495	449	424	116	143	135
J-1500	471	446	114	139	131
J-1505	443	417	108	130	123
J-1510	568	542	62	69	65
J-1515	559	533	64	71	67
J-1520	497	471	100	120	113
J-1525	514	488	97	116	109
J-1530	604	576	39	43	40
J-1535	555	528	40	45	42
J-1540	547	519	56	63	59
J-1545	533	506	81	92	87
J-1550	502	475	91	108	101
J-1555	480	453	87	104	97
J-1560	574	547	47	52	48
J-1565	562	535	52	58	55
J-1570	479	451	81	96	89
J-1575	638	609	35	39	36
J-1580	645	616	39	42	40
J-1585	621	593	39	43	40
J-1590	448	419	75	89	82
J-1595	596	567	73	85	79
J-1600	467	438	73	85	79
J-1605	632	603	73	85	79
J-1610	564	535	63	70	66
J-1615	627	598	72	82	77
J-1620	629	599	71	81	76
J-1625	597	567	71	82	77
J-1630	595	566	71	82	77
J-1635	661	631	70	80	75
J-1640	625	595	67	77	72
J-1645	646	616	67	77	72
J-1650	639	609	67	77	72
J-1655	641	611	55	61	57
J-1660	604	574	55	61	57
J-1665	612	582	66	75	70
J-1670	641	611	62	71	66
J-1675	656	626	58	66	62
J-1680	656	626	57	64	60
J-1685	597	566	60	68	64
J-1690	618	587	54	62	57
J-1695	610	579	52	59	55
J-1700	645	614	49	54	51
J-1705	623	592	51	59	54
J-1710	619	589	45	49	47
J-1715	590	559	51	58	54

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s)		
			Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-1720	593	562	50	57	53
J-1725	564	534	49	56	52
J-1730	508	478	40	46	42
J-1735	570	539	48	54	50
J-1740	577	547	49	55	51
Min	322	315			
Max	695	677			

Notes:

- (red) denotes operating pressure less than 275 kPa
- (yellow) denotes operating pressure above 275 kPa but less than 350 kPa
- (green) denotes operating pressure greater than 480 kPa
- (orange) denotes fire flow of less than 50 L/s at 140 kPa minimum system pressure

3.0 Model Results - 2017 Demands

3.2 300mm Dia. Extension to Bruce Power

Consider an incremental peak hour demand at Bruce Power to determine the effect on pressures throughout the rest of the system. Use peak hour demand through the rest of the system and use standpipe at nominal water level.

	No Bruce Power Demand		Bruce Power Demand at: 10 L/s	20 L/s	30 L/s	40 L/s
Junction	P at Q_{MAX} (kPa)	P at Q_{PEAK} (kPa)	P at Q_{MAX} (kPa)	P at Q_{MAX} (kPa)	P at Q_{MAX} (kPa)	P at Q_{MAX} (kPa)
J-5	644	644	640	635	631	625
J-10	545	545	541	536	532	527
J-15	530	530	526	522	517	512
J-20	490	490	486	482	477	472
J-25	462	462	458	453	449	443
J-30	496	496	492	488	483	478
J-35	505	505	500	496	491	486
J-40	515	515	511	506	502	497
J-45	498	498	494	490	485	480
J-50	667	667	663	659	654	649
J-55	632	632	628	623	619	614
J-60	519	519	515	510	506	501
J-65	560	560	556	552	547	542
J-70	561	561	557	553	548	543
J-75	565	565	561	556	551	546
J-80	525	525	521	517	512	507
J-85	464	464	460	456	451	446
J-90	489	489	484	480	475	470
J-95	496	496	492	488	483	478
J-100	465	465	461	456	452	447
J-105	510	510	506	502	497	492
J-110	490	490	486	482	477	473
J-115	496	496	492	487	483	478
J-120	481	481	477	473	468	463
J-125	449	449	445	441	436	432
J-130	454	454	450	446	441	436
J-135	466	466	462	457	453	448
J-140	461	461	457	453	448	443
J-145	447	447	443	439	434	429
J-150	448	448	444	439	435	430
J-155	441	441	437	433	429	424
J-160	463	463	459	455	450	445
J-165	480	480	476	472	467	462
J-170	469	469	465	460	456	451
J-175	459	459	455	450	446	441
J-180	463	463	459	455	450	445
J-185	498	498	494	489	484	479
J-190	492	492	488	484	479	474
J-195	492	492	488	483	478	473
J-200	477	477	473	468	463	458
J-205	481	481	477	472	468	463
J-210	470	470	466	462	457	452
J-215	474	474	470	466	461	456
J-220	475	475	471	466	462	457

Junction	No Bruce Power Demand		Bruce Power Demand at: 10 L/s	20 L/s	30 L/s	40 L/s
	P at Q_{MAX} (kPa)	P at Q_{PEAK} (kPa)	P at Q_{MAX} (kPa)	P at Q_{MAX} (kPa)	P at Q_{MAX} (kPa)	P at Q_{MAX} (kPa)
J-225	476	476	472	468	463	459
J-230	482	482	478	474	470	465
J-235	450	450	446	442	438	433
J-240	448	448	444	440	436	431
J-245	627	627	623	618	614	608
J-250	526	526	522	518	513	508
J-255	536	536	532	528	523	518
J-260	473	473	469	464	459	454
J-265	532	532	528	523	518	513
J-270	528	528	524	519	514	509
J-275	507	507	503	498	493	488
J-280	442	442	438	434	429	424
J-285	473	473	469	465	460	455
J-290	474	474	470	465	460	455
J-295	441	441	437	432	427	422
J-300	448	448	443	439	434	429
J-305	467	467	463	459	455	450
J-310	454	454	450	446	442	437
J-315	468	468	465	461	456	452
J-320	459	459	455	450	446	441
J-325	537	537	533	528	523	518
J-330	486	486	481	477	472	466
J-335	521	521	517	512	507	502
J-340	504	504	500	496	492	487
J-345	506	506	501	497	492	486
J-350	453	453	449	445	441	436
J-355	436	436	432	428	424	419
J-360	435	435	432	428	423	419
J-365	505	505	501	497	493	488
J-370	500	500	496	492	488	483
J-375	484	484	480	476	472	467
J-380	469	469	465	461	457	452
J-385	488	488	484	480	475	471
J-390	490	490	487	482	478	473
J-395	491	491	487	483	478	474
J-400	496	496	492	488	483	479
J-405	449	449	445	441	437	432
J-410	482	482	478	474	470	465
J-415	527	527	524	520	515	510
J-420	532	532	529	525	520	515
J-425	490	490	486	482	478	473
J-430	458	458	454	450	446	441
J-435	493	493	490	487	483	479
J-440	495	495	492	488	484	480
J-445	513	513	510	506	502	498
J-450	526	526	523	519	515	511
J-455	499	499	495	492	488	483
J-460	486	486	482	479	475	471
J-465	484	484	480	477	473	469
J-470	521	521	517	514	510	506
J-475	500	500	497	493	489	485

Junction	No Bruce Power Demand		Bruce Power Demand at: 10 L/s	20 L/s	30 L/s	40 L/s
	P at Q_{MAX} (kPa)	P at Q_{PEAK} (kPa)	P at Q_{MAX} (kPa)	P at Q_{MAX} (kPa)	P at Q_{MAX} (kPa)	P at Q_{MAX} (kPa)
J-480	484	484	481	477	473	469
J-485	473	473	469	465	461	456
J-490	433	433	429	424	419	414
J-495	556	556	552	548	544	540
J-500	486	486	483	480	476	472
J-505	486	486	482	479	475	470
J-510	485	485	481	478	474	470
J-515	485	485	482	478	475	471
J-520	469	469	466	463	459	455
J-525	479	479	476	472	469	465
J-530	473	473	470	466	463	459
J-535	500	500	496	493	489	485
J-540	491	491	487	483	480	475
J-545	476	476	473	469	466	462
J-550	481	481	477	474	470	466
J-555	466	466	463	460	456	452
J-560	479	479	476	473	469	465
J-565	467	467	464	460	457	452
J-570	467	467	464	460	456	452
J-575	461	461	457	454	450	446
J-580	475	475	472	469	465	462
J-585	479	479	476	472	469	465
J-590	467	467	464	461	458	454
J-595	479	479	476	472	469	466
J-600	477	477	474	471	468	464
J-605	433	433	430	427	424	420
J-610	442	442	439	436	432	428
J-615	424	424	421	418	414	410
J-620	459	459	456	452	449	445
J-625	414	414	411	408	404	400
J-630	412	412	409	406	402	398
J-635	411	411	410	409	408	407
J-640	371	371	370	369	368	367
J-645	463	463	460	457	453	449
J-650	422	422	420	418	416	414
J-655	413	413	411	409	407	405
J-660	409	409	407	406	404	403
J-665	408	408	407	406	404	403
J-670	446	446	445	444	443	441
J-675	408	408	407	406	405	404
J-680	414	414	413	412	410	409
J-685	406	406	405	404	403	402
J-690	404	404	403	402	401	399
J-695	402	402	401	400	399	397
J-700	407	407	405	402	399	396
J-705	405	405	403	401	398	395
J-710	398	398	397	396	395	394
J-715	398	398	397	396	395	394
J-720	403	403	402	401	400	398
J-725	382	382	382	381	380	378
J-730	371	371	370	369	368	367

Junction	No Bruce Power Demand		Bruce Power Demand at: 10 L/s	20 L/s	30 L/s	40 L/s
	P at Q_{MAX} (kPa)	P at Q_{PEAK} (kPa)	P at Q_{MAX} (kPa)	P at Q_{MAX} (kPa)	P at Q_{MAX} (kPa)	P at Q_{MAX} (kPa)
J-735	411	411	410	409	408	407
J-740	398	398	397	396	395	394
J-745	392	392	391	390	389	388
J-750	397	397	396	394	393	392
J-755	387	387	386	385	384	383
J-760	338	338	337	336	335	334
J-765	357	357	356	355	354	353
J-770	363	363	362	360	359	358
J-775	387	387	386	385	384	383
J-780	371	371	370	369	368	367
J-785	374	374	373	372	371	370
J-790	366	366	365	364	363	361
J-795	372	372	371	370	368	367
J-800	360	360	359	358	357	356
J-805	352	352	351	350	349	348
J-810	677	677	673	668	663	657
J-815	628	628	624	619	614	608
J-820	643	643	639	634	629	623
J-825	546	546	542	537	532	527
J-830	478	478	474	469	464	459
J-835	478	478	474	469	464	459
J-840	477	477	473	468	463	458
J-845	535	535	530	525	520	515
J-850	477	477	473	468	463	457
J-855	476	476	472	467	462	457
J-860	444	444	440	435	430	425
J-865	482	482	478	474	470	465
J-870	440	440	436	431	427	421
J-875	478	478	474	470	465	460
J-880	470	470	466	461	456	450
J-885	461	461	456	451	446	441
J-890	436	436	431	427	422	416
J-895	438	438	433	429	424	419
J-900	504	504	500	495	491	486
J-905	626	626	622	617	612	606
J-910	615	615	610	606	600	595
J-915	638	638	634	629	624	618
J-920	616	616	612	607	602	596
J-925	522	522	517	512	507	502
J-930	511	511	506	502	496	491
J-935	620	620	616	611	605	599
J-940	581	581	577	572	566	561
J-945	546	546	541	537	531	525
J-950	473	473	468	463	458	452
J-955	470	470	466	461	456	450
J-960	519	519	515	510	504	499
J-965	527	527	523	518	512	506
J-970	528	528	523	518	513	507
J-975	459	459	454	449	444	438
J-980	459	459	454	449	443	436
J-985	558	558	553	548	542	536

Junction	No Bruce Power Demand P at Q_{MAX} (kPa)	No Bruce Power Demand P at Q_{PEAK} (kPa)	Bruce Power Demand at: 10 L/s P at Q_{MAX} (kPa)	20 L/s P at Q_{MAX} (kPa)	30 L/s P at Q_{MAX} (kPa)	40 L/s P at Q_{MAX} (kPa)
J-990	534	534	529	524	518	512
J-995	645	645	640	635	629	623
J-1000	628	628	624	618	612	606
J-1005	626	626	621	616	610	603
J-1010	602	602	597	592	585	579
J-1015	605	605	600	594	588	581
J-1020	542	542	537	532	526	519
J-1025	536	536	531	526	520	513
J-1030	527	527	522	517	511	505
J-1035	524	524	519	514	508	501
J-1040	541	541	536	530	524	518
J-1045	525	525	520	515	509	502
J-1050	526	526	521	515	509	503
J-1055	501	501	495	490	483	477
J-1060	497	497	492	486	480	473
J-1065	628	628	623	617	611	604
J-1070	553	553	545	537	528	517
J-1075	553	553	546	537	528	517
J-1080	531	531	524	516	506	496
J-1085	511	511	507	503	499	494
J-1090	495	495	491	487	483	478
J-1095	467	467	463	458	453	448
J-1100	468	468	464	459	455	450
J-1105	454	454	450	446	441	435
J-1110	477	477	474	470	465	461
J-1115	488	488	484	480	476	471
J-1120	430	430	426	421	416	411
J-1125	430	430	426	421	417	411
J-1130	406	406	403	401	398	395
J-1135	442	442	437	433	428	422
J-1140	445	445	441	436	431	426
J-1145	462	462	458	453	447	441
J-1150	435	435	431	426	421	416
J-1155	450	450	446	441	436	431
J-1160	463	463	458	453	448	442
J-1165	441	441	436	430	424	418
J-1170	450	450	445	440	435	429
J-1175	391	391	387	382	376	370
J-1180	409	409	405	400	395	390
J-1185	425	425	420	416	411	405
J-1190	401	401	397	393	388	383
J-1195	413	413	409	405	400	394
J-1200	382	382	378	375	371	366
J-1205	433	433	429	424	419	414
J-1210	391	391	386	381	375	369
J-1215	395	395	390	385	379	372
J-1220	370	370	365	359	353	347
J-1225	404	404	404	404	404	404
J-1230	375	375	372	370	367	364
J-1235	386	386	383	380	377	373
J-1240	352	352	349	346	342	339

Junction	No Bruce Power Demand P at Q_{MAX} (kPa)	No Bruce Power Demand P at Q_{PEAK} (kPa)	Bruce Power Demand at: 10 L/s P at Q_{MAX} (kPa)	Bruce Power Demand at: 20 L/s P at Q_{MAX} (kPa)	Bruce Power Demand at: 30 L/s P at Q_{MAX} (kPa)	Bruce Power Demand at: 40 L/s P at Q_{MAX} (kPa)
J-1245	351	351	349	346	344	341
J-1250	347	347	344	341	337	334
J-1255	370	370	369	367	366	364
J-1260	336	336	334	332	329	327
J-1265	330	330	328	326	324	322
J-1270	322	322	320	318	316	314
J-1275	322	322	320	319	317	316
J-1280	315	315	314	312	311	309
J-1285	460	460	455	450	443	437
J-1290	453	453	448	442	435	428
J-1295	428	428	423	417	411	405
J-1300	420	420	415	410	404	397
J-1305	456	456	450	443	435	426
J-1310	448	448	442	435	427	418
J-1315	374	374	368	361	353	344
J-1320	348	348	342	335	327	318
J-1325	330	330	324	317	309	300
J-1330	417	417	410	402	393	383
J-1335	340	340	334	327	319	310
J-1340	342	342	336	329	321	312
J-1345	349	349	342	335	327	318
J-1350	535	535	528	519	509	498
J-1355	491	491	483	474	464	453
J-1360	428	428	420	411	401	389
J-1365	652	652	646	638	630	621
J-1370	623	623	616	606	596	585
J-1375	569	569	561	550	539	525
J-1380	549	549	541	533	523	512
J-1385	545	545	537	528	518	507
J-1390	544	544	536	527	517	505
J-1395	530	530	522	513	503	491
J-1400	538	538	530	520	508	495
J-1405	556	556	547	537	525	512
J-1410	525	525	516	505	493	479
J-1415	490	490	483	473	463	452
J-1420	490	490	483	474	463	452
J-1425	526	526	519	510	499	488
J-1430	530	530	521	509	496	481
J-1435	516	516	509	499	489	478
J-1440	489	489	481	472	462	450
J-1445	599	599	589	578	564	548
J-1450	519	519	509	497	483	468
J-1455	537	537	527	514	500	484
J-1460	468	468	458	447	433	418
J-1465	583	583	573	561	546	530
J-1470	545	545	534	520	504	486
J-1475	529	529	518	505	490	472
J-1480	419	419	409	396	380	363
J-1485	426	426	415	402	386	368
J-1490	410	410	398	385	368	349
J-1495	424	424	412	396	378	357

Junction	No Bruce Power Demand		Bruce Power Demand at: 10 L/s	20 L/s	30 L/s	40 L/s
	P at Q_{MAX} (kPa)	P at Q_{PEAK} (kPa)	P at Q_{MAX} (kPa)	P at Q_{MAX} (kPa)	P at Q_{MAX} (kPa)	P at Q_{MAX} (kPa)
J-1500	446	446	434	418	399	378
J-1505	417	417	404	387	367	343
J-1510	542	542	528	509	486	460
J-1515	533	533	517	498	474	446
J-1520	471	471	456	437	414	388
J-1525	488	488	472	452	429	401
J-1530	576	576	559	537	509	477
J-1535	528	528	513	493	469	441
J-1540	519	519	502	480	452	420
J-1545	506	506	489	466	439	406
J-1550	475	475	459	437	411	380
J-1555	453	453	436	413	386	353
J-1560	547	547	530	507	479	447
J-1565	535	535	517	495	467	435
J-1570	451	451	432	407	376	340
J-1575	609	609	588	561	526	486
J-1580	616	616	595	568	533	493
J-1585	593	593	572	544	510	469
J-1590	419	419	399	371	337	296
J-1595	567	567	544	512	472	425
J-1600	438	438	415	385	347	302
J-1605	603	603	579	546	505	456
J-1610	535	535	509	474	430	378
J-1615	598	598	573	538	494	442
J-1620	599	599	574	539	494	441
J-1625	567	567	542	507	463	410
J-1630	566	566	540	505	461	409
J-1635	631	631	606	570	524	470
J-1640	595	595	568	530	482	424
J-1645	616	616	589	551	503	445
J-1650	609	609	582	544	496	438
J-1655	611	611	585	547	499	441
J-1660	574	574	547	508	458	398
J-1665	582	582	554	515	465	405
J-1670	611	611	581	539	485	419
J-1675	626	626	594	548	488	414
J-1680	626	626	593	545	482	406
J-1685	566	566	536	492	434	365
J-1690	587	587	553	502	435	353
J-1695	579	579	543	489	418	329
J-1700	614	614	579	525	453	365
J-1705	592	592	556	502	429	339
J-1710	589	589	553	498	425	336
J-1715	559	559	523	468	394	303
J-1720	562	562	525	468	393	299
J-1725	534	534	496	438	361	265
J-1730	478	478	440	380	301	203
J-1735	539	539	501	442	362	264
J-1740	547	547	509	449	370	272
JN-North Access	not in scneario	503	462	395	304	189
JN-Park & Road 2	not in scneario	503	464	403	321	219

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Junction	No Bruce Power Demand		Bruce Power Demand at: 10 L/s	20 L/s	30 L/s	40 L/s
	P at Q_{MAX} (kPa)	P at Q_{PEAK} (kPa)	P at Q_{MAX} (kPa)	P at Q_{MAX} (kPa)	P at Q_{MAX} (kPa)	P at Q_{MAX} (kPa)
JN-South Access	not in scneario	522	483	421	337	232
Min	315	315	314	312	301	203
Max	677	677	673	668	663	657

Notes:
- (red) denotes operating pressure less than 275 kPa
- (yellow) denotes operating pressure above 275 kPa but less than 350 kPa
- (green) denotes operating pressure greater than 480 kPa
- (orange) denotes fire flow of less than 50 L/s at 140 kPa minimum system pressure

4.0 Model Results - 2067 Demands

4.1 Existing Watermain Conditions + Business Park and Hwy. 21 Connections

Initial trial for 2067 demand conditions is performed with existing watermain installations remaining at existing diameters. Add new watermain:
• within Business Park and at Russell Street per BMROSS project 08055 (PN-25, PN-30, PN-35)
• 300 mm diameter watermain along Highway 21 and connect to existing at Bruce and Kincardine Avenues (PN-5, PN-10, PN-15, PN-20, PN-40)

Per the results summarized below, under future maximum day demand, pressures in the vicinity of Gary and Sutton Streets will drop to below acceptable levels. This is due to significant demand in northern development lands being fed via watermain in this area, per preliminary design details in BMROSS project 17055/17094. That project identifies the need for watermain upgrades in pipe feeding this location, as well as a booster pumping station to service a new pressure zone in the northern part of the system. Refer to 17055/17094 for additional details.

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s)		
			Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-5	649	589	No fire flow analysis carried out for this scenario, as required pressures cannot be met under maximum day demand conditions.		
J-10	550	489			
J-15	535	474			
J-20	495	434			
J-25	467	405			
J-30	501	439			
J-35	509	448			
J-40	520	458			
J-45	503	441			
J-50	672	613			
J-55	637	578			
J-60	524	463			
J-65	565	505			
J-70	566	506			
J-75	570	510			
J-80	530	470			
J-85	471	419			
J-90	496	445			
J-95	504	458			
J-100	472	426			
J-105	518	472			
J-110	498	452			
J-115	503	457			
J-120	489	443			
J-125	457	411			
J-130	462	416			
J-135	473	427			
J-140	469	423			
J-145	455	409			
J-150	456	410			
J-155	449	403			
J-160	471	425			
J-165	488	442			
J-170	476	431			

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s)		
			Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-175	466	421			
J-180	471	425			
J-185	505	454			
J-190	500	453			
J-195	499	448			
J-200	484	434			
J-205	488	442			
J-210	478	432			
J-215	482	436			
J-220	482	437			
J-225	484	439			
J-230	489	446			
J-235	457	414			
J-240	456	413			
J-245	633	578			
J-250	533	479			
J-255	543	490			
J-260	481	435			
J-265	540	494			
J-270	536	490			
J-275	515	469			
J-280	450	404			
J-285	481	436			
J-290	482	436			
J-295	449	403			
J-300	455	410			
J-305	475	431			
J-310	461	419			
J-315	476	433			
J-320	466	421			
J-325	545	499			
J-330	493	448			
J-335	529	483			
J-340	511	470			
J-345	513	468			
J-350	460	418			
J-355	443	401			
J-360	442	401			
J-365	513	469			
J-370	508	464			
J-375	492	448			
J-380	477	433			
J-385	496	451			
J-390	498	454			
J-395	499	454			
J-400	504	460			
J-405	456	413			
J-410	489	446			
J-415	535	491			
J-420	540	496			

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s)		
			Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-425	498	454			
J-430	466	422			
J-435	499	463			
J-440	502	462			
J-445	520	481			
J-450	533	494			
J-455	505	466			
J-460	492	454			
J-465	490	452			
J-470	527	488			
J-475	507	468			
J-480	491	452			
J-485	479	439			
J-490	440	396			
J-495	562	523			
J-500	493	455			
J-505	492	454			
J-510	491	453			
J-515	491	454			
J-520	475	439			
J-525	485	448			
J-530	479	442			
J-535	506	468			
J-540	497	459			
J-545	482	445			
J-550	487	449			
J-555	472	436			
J-560	485	449			
J-565	474	436			
J-570	474	436			
J-575	467	429			
J-580	481	445			
J-585	485	448			
J-590	473	438			
J-595	484	450			
J-600	483	448			
J-605	438	405			
J-610	448	412			
J-615	430	394			
J-620	465	429			
J-625	420	384			
J-630	418	382			
J-635	410	385			
J-640	370	345			
J-645	469	433			
J-650	425	399			
J-655	416	390			
J-660	410	389			
J-665	409	389			
J-670	447	427			

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s)		
			Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-675	409	389			
J-680	414	394			
J-685	407	390			
J-690	405	386			
J-695	403	386			
J-700	411	383			
J-705	409	382			
J-710	399	386			
J-715	398	382			
J-720	402	382			
J-725	383	365			
J-730	371	353			
J-735	410	385			
J-740	397	372			
J-745	391	366			
J-750	395	371			
J-755	386	361			
J-760	336	310			
J-765	356	330			
J-770	361	336			
J-775	387	368			
J-780	371	353			
J-785	374	355			
J-790	366	347			
J-795	370	344			
J-800	359	331			
J-805	351	325			
J-810	685	639			
J-815	636	590			
J-820	650	604			
J-825	554	508			
J-830	485	440			
J-835	486	441			
J-840	485	439			
J-845	542	496			
J-850	484	439			
J-855	484	438			
J-860	451	407			
J-865	489	447			
J-870	447	403			
J-875	485	443			
J-880	477	432			
J-885	468	422			
J-890	443	398			
J-895	444	401			
J-900	510	468			
J-905	633	587			
J-910	622	576			
J-915	646	600			
J-920	624	577			

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s)		
			Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-925	529	483			
J-930	518	472			
J-935	627	581			
J-940	589	542			
J-945	553	507			
J-950	480	434			
J-955	478	431			
J-960	527	480			
J-965	535	488			
J-970	536	488			
J-975	466	419			
J-980	466	418			
J-985	566	518			
J-990	541	494			
J-995	653	606			
J-1000	636	589			
J-1005	634	587			
J-1010	610	562			
J-1015	613	565			
J-1020	549	502			
J-1025	544	496			
J-1030	535	487			
J-1035	532	484			
J-1040	549	501			
J-1045	533	485			
J-1050	533	485			
J-1055	508	460			
J-1060	505	456			
J-1065	636	588			
J-1070	562	510			
J-1075	562	510			
J-1080	540	489			
J-1085	517	477			
J-1090	501	461			
J-1095	474	429			
J-1100	474	431			
J-1105	461	416			
J-1110	484	443			
J-1115	495	453			
J-1120	437	391			
J-1125	436	392			
J-1130	410	381			
J-1135	449	402			
J-1140	452	405			
J-1145	469	422			
J-1150	441	394			
J-1155	455	405			
J-1160	470	422			
J-1165	448	398			
J-1170	456	407			

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s)		
			Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-1175	397	346			
J-1180	414	362			
J-1185	429	377			
J-1190	405	351			
J-1195	416	359			
J-1200	384	331			
J-1205	437	383			
J-1210	397	346			
J-1215	401	351			
J-1220	376	326			
J-1225	404	404			
J-1230	372	321			
J-1235	356	205			
J-1240	322	170			
J-1245	348	298			
J-1250	279	0			
J-1255	368	335			
J-1260	327	262			
J-1265	325	275			
J-1270	317	268			
J-1275	319	281			
J-1280	312	275			
J-1285	468	419			
J-1290	461	412			
J-1295	435	385			
J-1300	427	377			
J-1305	465	414			
J-1310	457	406			
J-1315	383	332			
J-1320	357	306			
J-1325	339	288			
J-1330	426	375			
J-1335	349	298			
J-1340	351	300			
J-1345	357	307			
J-1350	545	493			
J-1355	500	448			
J-1360	438	385			
J-1365	661	610			
J-1370	633	580			
J-1375	580	525			
J-1380	559	506			
J-1385	554	502			
J-1390	553	501			
J-1395	539	487			
J-1400	548	494			
J-1405	566	512			
J-1410	535	480			
J-1415	500	447			
J-1420	500	447			

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s)		
			Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-1425	536	483			
J-1430	541	485			
J-1435	526	473			
J-1440	499	446			
J-1445	610	553			
J-1450	529	473			
J-1455	548	491			
J-1460	479	423			
J-1465	594	537			
J-1470	556	499			
J-1475	540	483			
J-1480	430	374			
J-1485	437	381			
J-1490	421	364			
J-1495	436	378			
J-1500	458	400			
J-1505	430	371			
J-1510	555	496			
J-1515	546	487			
J-1520	483	425			
J-1525	501	442			
J-1530	591	531			
J-1535	542	483			
J-1540	533	473			
J-1545	520	460			
J-1550	489	429			
J-1555	467	407			
J-1560	561	501			
J-1565	549	489			
J-1570	465	405			
J-1575	624	563			
J-1580	631	570			
J-1585	608	547			
J-1590	434	373			
J-1595	583	521			
J-1600	453	391			
J-1605	618	556			
J-1610	551	488			
J-1615	614	551			
J-1620	615	552			
J-1625	583	520			
J-1630	581	519			
J-1635	647	584			
J-1640	611	548			
J-1645	632	569			
J-1650	625	562			
J-1655	628	564			
J-1660	591	527			
J-1665	598	535			
J-1670	627	563			

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s)		
			Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-1675	642	578			
J-1680	642	577			
J-1685	583	519			
J-1690	604	539			
J-1695	595	530			
J-1700	631	566			
J-1705	609	544			
J-1710	605	540			
J-1715	576	511			
J-1720	578	513			
J-1725	550	485			
J-1730	494	429			
J-1735	556	490			
J-1740	563	498			
JN-5	437	391			
JN-10	467	423			
JN-15	448	406			
JN-20	410	374			
JN-25	314	281			
Min	279	0			
Max	685	639			

Notes:

(red)	denotes operating pressure less than 275 kPa
(yellow)	denotes operating pressure above 275 kPa but less than 350 kPa
(green)	denotes operating pressure greater than 480 kPa
(orange)	denotes fire flow of less than 50 L/s at 140 kPa minimum system pressure

4.0 Model Results - 2067 Demands

4.2 As Per Note 4.1 + Increase Feed to Gary & Sutton Location

Provide watermain upgrades per Note 4.1, plus increase watermain diameter in sections feeding the Gary & Sutton Location as per BMROSS 17055/17094 details:

• increase pipes P-25, P-345, P-350, P-360, P-365, P-385, P-395, P-420, P-1325, P-1765, P-1975, P-2085, P-2090

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s)		
			Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-5	650	592	38	42	41
J-10	550	491	61	74	70
J-15	536	476	61	74	70
J-20	496	436	58	70	66
J-25	467	408	52	63	60
J-30	501	442	59	71	67
J-35	510	450	59	71	67
J-40	520	460	66	80	76
J-45	503	443	55	65	62
J-50	673	615	50	55	53
J-55	638	580	72	90	84
J-60	524	465	67	82	77
J-65	566	508	66	81	77
J-70	567	509	68	84	79
J-75	570	512	69	85	80
J-80	531	472	67	83	78
J-85	471	422	100	125	116
J-90	496	447	90	108	102
J-95	504	460	85	98	94
J-100	473	428	184	248	225
J-105	519	474	190	257	233
J-110	499	454	114	137	129
J-115	504	459	195	267	241
J-120	489	445	199	279	250
J-125	458	413	70	81	78
J-130	462	418	193	267	240
J-135	474	429	197	274	246
J-140	470	425	124	154	144
J-145	456	411	85	101	96
J-150	456	412	191	266	240
J-155	450	405	189	263	236
J-160	471	427	118	144	136
J-165	488	444	193	255	233
J-170	477	433	138	173	161
J-175	467	423	96	114	108
J-180	471	427	96	114	108
J-185	505	456	104	126	118
J-190	500	456	103	122	116
J-195	499	450	110	135	127
J-200	484	437	126	159	148
J-205	489	444	149	190	176
J-210	479	434	150	192	178
J-215	482	438	157	200	185

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s) Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-220	483	439	157	201	186
J-225	484	441	204	274	249
J-230	490	448	240	371	323
J-235	458	416	240	353	311
J-240	456	414	118	145	136
J-245	634	580	85	104	99
J-250	533	481	87	110	103
J-255	544	493	70	81	78
J-260	481	438	203	447	374
J-265	540	497	201	462	393
J-270	536	493	201	474	400
J-275	515	472	199	464	390
J-280	450	407	183	254	229
J-285	481	438	187	254	230
J-290	482	439	203	457	381
J-295	449	406	185	262	235
J-300	456	412	59	69	66
J-305	475	433	190	254	231
J-310	462	421	240	365	322
J-315	476	435	240	372	327
J-320	467	424	81	96	91
J-325	545	502	197	483	397
J-330	494	451	201	468	391
J-335	529	486	200	497	404
J-340	511	472	61	70	67
J-345	514	471	198	500	399
J-350	461	420	87	106	100
J-355	444	403	160	218	198
J-360	443	403	218	393	338
J-365	513	471	233	331	297
J-370	508	466	66	75	72
J-375	492	450	67	76	73
J-380	477	434	228	324	290
J-385	496	453	60	69	66
J-390	499	456	83	97	93
J-395	499	456	80	92	88
J-400	504	461	71	82	79
J-405	456	415	90	107	101
J-410	489	448	127	154	145
J-415	536	493	68	77	74
J-420	541	498	62	69	67
J-425	498	456	63	72	69
J-430	466	424	225	321	287
J-435	499	464	40	44	43
J-440	502	464	243	422	373
J-445	521	482	170	210	196
J-450	533	495	179	219	205
J-455	506	468	77	88	85
J-460	493	455	83	95	92
J-465	490	453	242	430	378

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s)		
			Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-470	528	490	172	215	200
J-475	507	470	185	235	218
J-480	491	454	208	272	249
J-485	480	441	221	422	360
J-490	441	398	200	455	371
J-495	563	524	227	462	389
J-500	493	456	242	441	377
J-505	493	455	96	112	107
J-510	491	454	114	135	128
J-515	491	456	90	103	99
J-520	475	440	80	92	88
J-525	485	449	243	476	376
J-530	479	444	235	453	361
J-535	507	469	236	477	397
J-540	497	460	101	118	113
J-545	482	446	243	498	389
J-550	487	451	162	200	187
J-555	472	437	144	174	164
J-560	485	450	88	100	97
J-565	474	437	67	77	75
J-570	474	437	65	75	72
J-575	467	430	62	71	68
J-580	482	446	246	487	382
J-585	485	449	244	479	377
J-590	473	439	252	500	393
J-595	484	451	209	258	241
J-600	483	449	192	239	222
J-605	438	405	143	175	164
J-610	448	413	89	103	99
J-615	431	395	99	118	112
J-620	465	430	231	439	352
J-625	420	385	110	135	127
J-630	418	383	215	381	314
J-635	410	385	117	136	130
J-640	370	345	78	89	86
J-645	469	434	85	97	94
J-650	425	399	91	101	98
J-655	416	391	118	133	128
J-660	410	389	143	162	155
J-665	409	389	140	157	151
J-670	447	427	132	145	140
J-675	409	388	174	201	192
J-680	414	394	105	116	112
J-685	407	390	93	101	98
J-690	405	386	164	185	178
J-695	403	385	164	183	176
J-700	411	383	283	500	479
J-705	409	382	296	500	491
J-710	399	386	493	500	500
J-715	398	382	365	500	500

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s)		
			Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-720	402	382	300	500	441
J-725	383	365	130	145	139
J-730	371	353	90	99	96
J-735	409	384	168	212	197
J-740	397	372	248	391	339
J-745	391	366	134	163	153
J-750	395	371	255	470	380
J-755	386	360	236	358	313
J-760	336	310	214	312	276
J-765	356	330	90	106	101
J-770	361	335	205	280	254
J-775	387	368	130	146	141
J-780	371	353	93	102	99
J-785	374	355	66	72	70
J-790	366	347	46	49	48
J-795	370	344	209	385	313
J-800	359	330	183	327	271
J-805	351	325	192	259	235
J-810	685	642	104	119	114
J-815	636	593	86	99	95
J-820	651	608	194	500	389
J-825	554	511	192	500	383
J-830	486	443	198	500	397
J-835	486	443	195	500	388
J-840	485	442	195	500	387
J-845	543	499	190	500	377
J-850	485	442	191	500	378
J-855	484	441	193	500	382
J-860	452	409	163	233	209
J-865	489	449	125	157	147
J-870	448	405	188	284	249
J-875	486	444	164	220	200
J-880	478	435	191	500	375
J-885	468	425	192	500	375
J-890	443	401	194	500	380
J-895	445	403	199	500	387
J-900	511	469	203	500	390
J-905	634	591	187	500	373
J-910	623	580	188	500	374
J-915	646	603	187	500	375
J-920	624	581	186	500	366
J-925	530	486	189	500	373
J-930	519	475	190	500	373
J-935	628	585	184	500	356
J-940	589	546	184	500	355
J-945	554	511	184	500	354
J-950	481	437	184	484	344
J-955	478	435	190	493	358
J-960	527	484	186	500	357
J-965	536	492	180	423	334

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s) Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-970	536	492	179	414	330
J-975	467	423	176	434	317
J-980	467	423	167	385	290
J-985	567	522	87	103	98
J-990	542	498	180	246	223
J-995	654	609	127	152	144
J-1000	637	593	172	331	296
J-1005	635	591	168	310	279
J-1010	611	566	168	240	221
J-1015	614	569	164	231	213
J-1020	550	506	175	243	220
J-1025	545	500	169	228	207
J-1030	536	491	172	420	309
J-1035	533	488	169	347	301
J-1040	550	505	53	61	58
J-1045	534	489	69	82	78
J-1050	534	490	64	75	71
J-1055	509	464	126	162	150
J-1060	506	461	86	105	99
J-1065	637	592	163	274	249
J-1070	563	515	135	238	210
J-1075	563	515	134	219	200
J-1080	541	493	132	229	208
J-1085	517	477	89	105	100
J-1090	501	461	209	500	385
J-1095	475	432	185	259	233
J-1100	474	432	202	461	347
J-1105	461	419	199	444	337
J-1110	483	442	204	473	353
J-1115	495	453	137	173	161
J-1120	437	395	196	430	329
J-1125	437	394	112	144	134
J-1130	410	382	54	60	59
J-1135	450	406	195	404	338
J-1140	453	410	133	175	161
J-1145	470	426	184	339	292
J-1150	442	399	191	405	315
J-1155	457	414	188	388	306
J-1160	471	427	181	303	265
J-1165	449	404	140	194	175
J-1170	458	413	176	254	226
J-1175	399	354	167	264	228
J-1180	416	372	182	359	287
J-1185	432	387	105	133	124
J-1190	407	363	174	326	266
J-1195	420	375	168	305	252
J-1200	386	342	71	88	83
J-1205	440	395	181	306	267
J-1210	398	354	160	249	217
J-1215	403	358	109	150	137

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s) Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-1220	378	333	68	90	83
J-1225	404	404	500	500	500
J-1230	374	332	41	49	47
J-1235	387	340	50	61	58
J-1240	353	306	147	246	209
J-1245	351	308	64	82	76
J-1250	347	297	129	206	178
J-1255	367	333	152	260	220
J-1260	333	289	144	239	204
J-1265	327	285	120	182	160
J-1270	319	277	139	233	198
J-1275	318	278	141	233	199
J-1280	312	272	138	229	196
J-1285	469	424	159	349	269
J-1290	462	417	149	311	245
J-1295	436	391	130	192	173
J-1300	429	384	95	123	114
J-1305	466	419	126	238	195
J-1310	458	411	125	234	193
J-1315	384	337	63	82	76
J-1320	358	311	85	131	116
J-1325	340	293	74	109	97
J-1330	427	380	128	244	200
J-1335	350	303	67	95	86
J-1340	352	305	72	104	94
J-1345	358	312	58	79	72
J-1350	546	497	132	172	159
J-1355	502	453	97	121	113
J-1360	439	390	129	215	187
J-1365	662	615	144	228	211
J-1370	634	585	79	90	87
J-1375	581	530	79	93	89
J-1380	560	511	133	209	192
J-1385	556	507	132	208	191
J-1390	555	506	131	216	191
J-1395	541	492	131	217	192
J-1400	549	499	116	145	135
J-1405	568	517	97	118	111
J-1410	536	485	104	129	121
J-1415	501	452	130	216	191
J-1420	501	452	102	129	120
J-1425	537	488	108	135	126
J-1430	542	490	100	124	116
J-1435	527	478	64	76	72
J-1440	500	451	62	74	70
J-1445	611	558	60	69	66
J-1450	531	478	98	122	114
J-1455	549	495	104	129	121
J-1460	480	428	111	161	144
J-1465	595	542	52	59	57

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s) Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-1470	557	504	100	143	128
J-1475	541	488	103	147	132
J-1480	432	379	102	145	130
J-1485	438	385	99	140	126
J-1490	422	369	97	136	123
J-1495	437	383	92	127	116
J-1500	459	405	90	124	113
J-1505	431	376	85	116	106
J-1510	556	501	55	64	61
J-1515	547	492	56	66	62
J-1520	485	430	79	106	98
J-1525	502	447	77	102	94
J-1530	592	535	35	40	38
J-1535	543	487	36	42	40
J-1540	535	478	49	58	55
J-1545	521	465	69	84	79
J-1550	490	434	72	95	88
J-1555	468	412	69	92	85
J-1560	562	506	42	48	46
J-1565	550	494	46	54	51
J-1570	466	410	64	84	78
J-1575	625	568	32	36	35
J-1580	632	575	35	40	38
J-1585	609	551	35	40	38
J-1590	435	378	60	78	72
J-1595	584	525	59	75	70
J-1600	454	396	59	75	70
J-1605	619	561	59	75	70
J-1610	552	493	54	64	60
J-1615	615	556	59	72	68
J-1620	616	557	58	72	67
J-1625	584	525	58	72	68
J-1630	583	524	58	72	68
J-1635	649	589	57	71	66
J-1640	612	553	55	68	63
J-1645	633	573	55	68	64
J-1650	626	567	55	68	64
J-1655	629	569	49	56	53
J-1660	592	532	48	55	53
J-1665	599	540	54	66	62
J-1670	628	568	51	62	58
J-1675	643	583	47	58	54
J-1680	643	582	46	56	53
J-1685	584	524	49	60	56
J-1690	605	544	44	54	50
J-1695	597	535	42	51	48
J-1700	632	571	42	48	46
J-1705	610	549	42	51	48
J-1710	606	545	39	45	43
J-1715	577	516	42	50	47

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s)		
			Standpipe 248.0 mASL, HLPs Off	Standpipe 247.0 mASL, HLP1 & 3 On	Standpipe 247.0 mASL, HLP3 On
J-1720	579	518	41	49	46
J-1725	551	490	40	49	46
J-1730	495	434	33	40	38
J-1735	557	495	39	47	44
J-1740	564	503	40	48	45
JN-5	437	393	189	267	239
JN-10	467	425	220	327	287
JN-15	448	408	227	328	292
JN-20	411	375	210	367	304
JN-25	314	282	166	256	223
Min	312	272			
Max	685	642			

Notes:

(red) denotes operating pressure less than 275 kPa

(yellow) denotes operating pressure above 275 kPa but less than 350 kPa

(green) denotes operating pressure greater than 480 kPa

(orange) denotes fire flow of less than 50 L/s at 140 kPa minimum system pressure

APPENDIX D

TIVERTON WATER CALCULATIONS AND MODELLING NOTES

Municipality of Kincardine
WaterCAD Modelling for Master Plan
Calculations and Notes for Tiverton

Job # :	16130
Date :	January 22, 2018
Revised :	

1.0 Background

The Municipality of Kincardine is completing a water and wastewater Master Plan process. The water supply component will include a review of servicing existing development, future development, and service to Bruce Power. The purpose of these notes is to summarize data used to create a WaterCAD model, and the results of that modelling, for the community of Tiverton.

2.0 Analysis & Model Data

2.1 Data

Reference	Item			
16050	Existing avg. day demand		2.5	L/s
		=	214	m^3/d
	Existing max. day demand		7.6	L/s
		=	659	m^3/d
16130	Tiverton town pop. (2015)		725	persons
MOECC	Peak hour factor - ex. pop.		4.13	
	Peak hour factor - fut. pop.		3.75	
DWWP	Dent Well No. 2 Pump rating		4.6	L/s
		@	50.6	m TDH
	Briar Hill Well No. 1 Pump		6.1	L/s
		@	50.6	m TDH
	Briar Hill Well No. 2 Pump		8.3	L/s
		@	50.6	m TDH
Town info	Pumps off (tower level)		279.2	mASL
	Pumps on (tower level)		278.2	mASL
DWWP/	Standpipe			
78071	Total volume		1500	m^3
	Usable volume		350	m^3
	Diameter		8	m
	HWL		279.20	mASL
	Grade at base		244.30	mASL

MOE Guide — Pipe C-factors

Pipe Dia. (mm)	C
150	100
200-250	110
300-600	120
>600	130

MOE Guide	Normal operating pressure range target	350 to 480	kPa
MOE Guide	Normal operating pressure minimum	275	kPa
MOE Guide	Fire flow system pressure minimum	140	kPa
MOE Guide	Maximum allowable system pressure	700	kPa

2.2 Water Demands by Junction

(a) Existing Conditions

Number of junctions - existing model	57	
Average day demand per junction	0.043	L/s

See attached map for area junctions.

Design fire flow demands will vary from about 50 L/s for residential areas to 150 L/s or greater in ICI areas. Considering the relatively small demand associated with consumption as compared to fire flow, and the fact that there are few customers with significant water demand, the total system demand is distributed evenly over all model junctions.

(b) Future Conditions

Demands for existing development are left unchanged, and the incremental future demand for development areas is applied to the nearest model junctions within or adjacent to the development lands.

With reference to 16130 Technical Memo 2 (TM2):

• Development areas are taken from Appendix C figures
• Demand per area is applied based on average of existing & target housing density and existing demand per equivalent residential unit (ERU)

Residential development density	9.9	units/ha
Maximum day demand per unit	1.67	m^3/unit/d
Design water demand for commercial area	28.0	m^3/ha/d
Maximum day factor	3.08	

TM2 Appendix C Figure	Vacant Land or Development Commitment ID	Vacant Land Area (ha)	Projected No. of ERUs	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Model Junction to Apply Demand
C3	1	n/a	14	0.09	0.27	J-245
	A	0.88	9	0.05	0.17	J-195
	B	0.29	3	0.02	0.06	J-195
	C	1.21	12	0.08	0.23	J-205
	D	2	20	0.12	0.38	J-65
	E	4.45	44	0.28	0.85	J-55
	F	9.76	97	0.61	1.87	J-25/J-35

(shaded) denotes commercial land; others are residential

Model Junction	Elevation (mASL)	Existing Average Day Demand (L/s)	Existing Maximum Day Demand (L/s)	Future Average Day Demand (L/s)	Future Maximum Day Demand (L/s)
J-5	235.0	0.043	0.134	0.043	0.134
J-10	239.0	0.043	0.134	0.043	0.134
J-15	239.0	0.043	0.134	0.043	0.134
J-20	239.0	0.043	0.134	0.043	0.134
J-25	240.0	0.043	0.134	0.347	1.068
J-30	241.0	0.043	0.134	0.043	0.134
J-35	241.0	0.043	0.134	0.347	1.068
J-40	241.0	0.043	0.134	0.043	0.134
J-45	241.0	0.043	0.134	0.043	0.134
J-50	238.0	0.043	0.134	0.043	0.134
J-55	242.0	0.043	0.134	0.320	0.985
J-60	238.0	0.043	0.134	0.043	0.134
J-65	241.0	0.043	0.134	0.168	0.517
J-70	242.0	0.043	0.134	0.043	0.134
J-75	240.0	0.043	0.134	0.043	0.134
J-80	241.0	0.043	0.134	0.043	0.134
J-85	240.0	0.043	0.134	0.043	0.134
J-90	243.0	0.043	0.134	0.043	0.134
J-95	242.0	0.043	0.134	0.043	0.134
J-100	245.0	0.043	0.134	0.043	0.134
J-105	240.0	0.043	0.134	0.043	0.134
J-110	244.0	0.043	0.134	0.043	0.134
J-115	237.0	0.043	0.134	0.043	0.134
J-120	241.0	0.043	0.134	0.043	0.134
J-125	241.0	0.043	0.134	0.043	0.134
J-130	245.0	0.043	0.134	0.043	0.134
J-135	245.0	0.043	0.134	0.043	0.134
J-140	237.0	0.043	0.134	0.043	0.134
J-145	245.0	0.043	0.134	0.043	0.134
J-150	241.0	0.043	0.134	0.043	0.134
J-155	245.0	0.043	0.134	0.043	0.134
J-160	237.0	0.043	0.134	0.043	0.134
J-165	241.0	0.043	0.134	0.043	0.134
J-170	236.0	0.043	0.134	0.043	0.134
J-175	245.0	0.043	0.134	0.043	0.134
J-180	239.0	0.043	0.134	0.043	0.134
J-185	241.0	0.043	0.134	0.043	0.134
J-190	237.0	0.043	0.134	0.043	0.134
J-195	243.0	0.043	0.134	0.116	0.358
J-200	241.0	0.043	0.134	0.043	0.134
J-205	239.0	0.043	0.134	0.119	0.365
J-210	242.0	0.043	0.134	0.043	0.134
J-215	242.0	0.043	0.134	0.043	0.134
J-220	242.0	0.043	0.134	0.043	0.134
J-225	244.0	0.043	0.134	0.043	0.134
J-230	244.0	0.043	0.134	0.043	0.134
J-235	241.0	0.043	0.134	0.043	0.134
J-240	243.0	0.043	0.134	0.043	0.134
J-245	246.0	0.043	0.134	0.131	0.404
J-250	242.0	0.043	0.134	0.043	0.134
J-255	242.0	0.043	0.134	0.043	0.134

Model Junction	Elevation (mASL)	Existing Average Day Demand (L/s)	Existing Maximum Day Demand (L/s)	Future Average Day Demand (L/s)	Future Maximum Day Demand (L/s)
J-260	246.0	0.043	0.134	0.043	0.134
J-265	245.0	0.043	0.134	0.043	0.134
J-270	247.0	0.043	0.134	0.043	0.134
J-275	245.0	0.043	0.134	0.043	0.134
J-280	245.0	0.043	0.134	0.043	0.134
J-285	240.0	0.043	0.134	0.043	0.134
Minimum	235.0	0.043	0.134	0.043	0.134
Maximum	247.0	0.043	0.134	0.347	1.068
Total		2.5	7.6	3.7	11.5

3.0 Model Results - 2017 Demands

3.1 Existing Conditions

For average day and peak hour analysis, assume no pumps operating and standpipe water level at nominal operating level of 278.7 mASL. For fire flow analysis, use two scenarios: standpipe nominal water level of 278.7 mASL with no HLPS, and standpipe low water level of 278.2 mASL with Dent Well 2 and Briar Hill Well 1 on.

Junction	P at Q_{AVG} (kPa)	P at Q_{PEAK} (kPa)	Available Fire Flow at 140 kPa (L/s)	
			Standpipe 278.7 mASL, HLPs Off	Standpipe 278.2 mASL, DW2 & BH1 On
J-5	427	423	37	47
J-10	388	384	37	48
J-15	388	384	37	49
J-20	388	384	38	49
J-25	378	374	36	46
J-30	369	365	37	48
J-35	369	365	34	45
J-40	369	365	37	50
J-45	369	365	36	48
J-50	398	394	4	4
J-55	359	355	38	50
J-60	398	394	33	46
J-65	369	365	44	57
J-70	359	356	63	76
J-75	379	376	53	57
J-80	369	366	84	94
J-85	379	375	53	60
J-90	349	346	102	119
J-95	359	356	82	92
J-100	330	328	106	116
J-105	379	375	66	77
J-110	339	337	94	106
J-115	408	405	52	59
J-120	369	366	90	104
J-125	369	366	98	112
J-130	330	329	134	143
J-135	330	329	135	144
J-140	408	405	60	71
J-145	330	328	10	10
J-150	369	366	106	120
J-155	330	329	221	221
J-160	408	405	57	68
J-165	369	366	108	122
J-170	418	415	58	68
J-175	330	330	221	221
J-180	388	385	92	103
J-185	369	366	99	111
J-190	408	405	53	59
J-195	349	347	113	128
J-200	369	366	9	9
J-205	388	385	52	60
J-210	359	356	87	94

Junction	P at Q_{AVG} (kPa)	P at Q_{PEAK} (kPa)	Available Fire Flow at 140 kPa (L/s)	
			Standpipe 278.7 mASL, HLPs Off	Standpipe 278.2 mASL, DW2 & BH1 On
J-215	359	356	87	95
J-220	359	356	82	89
J-225	339	337	59	62
J-230	339	337	90	99
J-235	369	366	58	61
J-240	349	346	8	8
J-245	320	317	67	72
J-250	359	356	75	81
J-255	359	356	77	82
J-260	320	317	61	64
J-265	330	327	74	80
J-270	310	307	54	57
J-275	330	327	72	77
J-280	330	327	63	67
J-285	379	376	49	51
Min	310	307		
Max	427	423		

Notes:

(red)	denotes operating pressure less than 275 kPa
(yellow)	denotes operating pressure above 275 kPa but less than 350 kPa
(green)	denotes operating pressure greater than 480 kPa
(orange)	denotes fire flow of less than 50 L/s at 140 kPa minimum system pressure

4.0 Model Results - 2067 Demands

4.1 Existing Conditions

For average day and peak hour analysis, assume no pumps operating and standpipe water level at nominal operating level of 278.7 mASL. For fire flow analysis, use two scenarios: standpipe nominal water level of 278.7 mASL with no HLPS, and standpipe low water level of 278.2 mASL with Dent Well 2 and Briar Hill Well 1 on.

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s)	
			Standpipe 278.7 mASL, HLPs Off	Standpipe 278.2 mASL, DW2 & BH1 On
J-5	427	414	34	45
J-10	387	375	34	45
J-15	387	375	34	46
J-20	387	375	35	46
J-25	378	365	33	43
J-30	368	355	34	45
J-35	368	355	32	42
J-40	368	355	34	47
J-45	368	355	33	46
J-50	398	392	4	4
J-55	358	346	35	47
J-60	397	385	31	43
J-65	368	358	41	54
J-70	358	351	59	73
J-75	378	373	53	56
J-80	368	363	82	92
J-85	378	373	52	59
J-90	349	344	99	116
J-95	359	353	80	91
J-100	329	326	103	113
J-105	378	373	65	76
J-110	339	334	91	103
J-115	408	402	51	58
J-120	368	363	88	102
J-125	368	363	95	110
J-130	330	327	131	141
J-135	330	328	133	142
J-140	408	402	59	70
J-145	330	327	10	10
J-150	368	363	103	117
J-155	330	329	221	221
J-160	408	402	56	67
J-165	368	363	105	119
J-170	417	412	57	67
J-175	330	330	221	221
J-180	388	383	90	101
J-185	368	363	96	109
J-190	408	402	52	59
J-195	349	345	109	125
J-200	368	362	8	8
J-205	388	383	51	59
J-210	359	354	84	92

Junction	P at Q_{AVG} (kPa)	P at Q_{MAX} (kPa)	Available Fire Flow at 140 kPa (L/s)	
			Standpipe 278.7 mASL, HLPs Off	Standpipe 278.2 mASL, DW2 & BH1 On
J-215	359	354	85	93
J-220	359	354	80	87
J-225	339	334	58	61
J-230	339	334	88	97
J-235	368	363	57	60
J-240	349	344	8	8
J-245	320	315	66	70
J-250	359	354	73	79
J-255	359	354	75	81
J-260	320	315	60	63
J-265	329	324	73	79
J-270	310	305	53	56
J-275	329	324	70	76
J-280	329	324	62	66
J-285	378	373	48	50
Min	310	305		
Max	427	414		

Notes:

- (red) denotes operating pressure less than 275 kPa
- (yellow) denotes operating pressure above 275 kPa but less than 350 kPa
- (green) denotes operating pressure greater than 480 kPa
- (orange) denotes fire flow of less than 50 L/s at 140 kPa minimum system pressure

APPENDIX E

KINCARDINE WASTEWATER CALCULATIONS AND MODELLING NOTES

Municipality of Kincardine
SPS Considerations for Master Plan
Kincardine Area and Flow Notes

Job # :	16171
Date :	October 3, 2016
Revised :	January 3, 2018

1.0 Background

The Municipality of Kincardine initiated a Master Plan process to evaluate water and wastewater servicing needs for Kincardine, Tiverton, and the Lakeshore Area.

The purpose of these notes is to summarize catchment area and design flow information for the Connaught Park, Durham Street, Huron Terrace, Park Street, Goderich Street, and Kincardine Avenue SPSs, as well as the SPSs in Tiverton.

2.0 Design Data

Reference	Item		
16130 TM2	Persons per household	2.31	p/hhld
16130 TM2	Per household average day sewage flow	970	L/hhld/day
	I/I allowance	0.28	L/ha/s
	Industrial flow allowance	0.405	L/ha/s
	Commercial/Institutional flow allowance	0.324	L/ha/s

3.0 Connaught SPS (BMROSS 16171)

Future scenario is based on existing information plus the West Ridge on the Lake development, and an allowance of an additional 120 properties for potential development within existing golf course land (100 units) and further to the north of West Ridge (assume 20 units). The October 29, 2015 Functional Service Report for the West Ridge development indicates a plan for 373 to 447 residential units (use 447) and a developed area (residential + roads) of 20.43 ha. Assume 4 ha for the additional 120 units within golf course and to the north.

Item	Existing	Future	Units	
Residential Area	49.81	74.24	ha	
Industrial Area	0	0	ha	
Commercial/Institutional Area	0.54	0.54	ha	
Residential Properties	552	1119		
Calculate				
Residential Population	1275	2585	people	
Peaking factor	3.73	3.50		
Average day residential flow	6.20	12.56	L/s	
Average day industrial flow	0.00	0.00	L/s	
Average day commercial/institutional flow	0.17	0.17	L/s	
Average day flow; total	6.4	12.7	L/s	
I/I allowance	14.1	20.9	L/s	
Allocation for WWTP sludge discharge	3.5	3.5	L/s	(BMROSS 89176)
Peak instantaneous flow; total incl. I/I	41.4	69.0	L/s	

4.0 Durham SPS (BMROSS 79017)

Future scenario is based on additional flow contribution from industrial/commercial lands as detailed in BMROSS 17094 design notes. All additional future sewage flow is to north end of Gary Street.

Item	Existing	Future	Units
Residential Area	32.42	Refer to 17094 Sanitary Sewer Design Notes. Total peak design flow for development lands is 61.9 L/s.	ha
Industrial Area	0		ha
Commercial/Institutional Area	20.53		ha
Residential Properties	409		
Calculate			
Residential Population	945		people
Peaking factor	3.82		
Average day residential flow	4.59		L/s
Average day industrial flow	0.00		L/s
Average day commercial/institutional flow	6.65		L/s
Average day flow; total	11.2		L/s
I/I allowance	14.8		L/s
Peak instantaneous flow; total incl. I/I	57.7	119.6	L/s

5.0 Huron Terrace SPS (BMROSS 79016)

The Huron Terrace SPS service area includes its own catchment area and discharge from the Connaught and Durham SPS's. Calculate catchment area flow and then add Connaught and Durham SPS flows. Future residential is calculated on the basis that all development lands north to Concession 5, and between Hwy. 21 and Cty. Rd. 23 will direct sanitary sewage to Queen Street Sewer.

5.1 Huron Terrace Catchment Area Data

Item	Existing	Future	Units
Residential Area	73.18	372.39	ha
Industrial Area	0	0	ha
Commercial/Institutional Area	29.23	29.23	ha
Residential Properties	612	3114	
Calculate			
Residential Population	1414	7193	people
Peaking factor	3.70	3.10	
Average day residential flow	6.87	34.96	L/s
Average day industrial flow	0.00	0.00	L/s
Average day commercial/institutional flow	9.47	9.47	L/s
Average day flow; total	16.3	44.4	L/s
I/I allowance	28.7	112.5	L/s
Peak instantaneous flow; total incl. I/I	89.1	250.0	L/s

5.2 Huron Terrace SPS Total Flow - Catchment Area + Connaught & Durham SPS Flows

Peak instantaneous flow; total incl. I/I	188.2	438.6	L/s

6.0 Park SPS (BMROSS 75056B)

See 08055 Master Plan Tables 4.4 and Section 4.4.9.2 for future development info. Information below summarizes theoretical results, as well as data developed as part of 08055.

Item	Existing	Future	Units
Residential Area	51.81	60.41	ha
Industrial Area	0	28.4	ha
Commercial/Institutional Area	3.99	63.69	ha
Residential Properties	829	967	
Calculate			
Residential Population	1915	2233	people
Peaking factor	3.60	3.55	
Average day residential flow	9.31	10.85	L/s
Average day industrial flow	0.00	11.50	L/s
Average day commercial/institutional flow	1.29	20.64	L/s
Average day flow; total	10.6	43.0	L/s
I/I allowance	15.6	42.7	L/s
Peak instantaneous flow; total incl. I/I	53.8	195.2	L/s
Peak from 08055 data	115.0	199.0	L/s

7.0 Goderich SPS (BMROSS 76007-2)

Future residential properties from 39 remaining units in Lakefield Phase 1, 2.

Item	Existing	Future	Units
Residential Area	59.1	59.1	ha
Industrial Area	3.89	3.89	ha
Commercial/Institutional Area	11.55	11.55	ha
Residential Properties	501	540	
Calculate			
Residential Population	1157	1247	people
Peaking factor	3.76	3.74	
Average day residential flow	5.62	6.06	L/s
Average day industrial flow	1.58	1.58	L/s
Average day commercial/institutional flow	3.74	3.74	L/s
Average day flow; total	10.9	11.4	L/s
I/I allowance	20.9	20.9	L/s
Peak instantaneous flow; total incl. I/I	62.0	63.4	L/s

6.0 Kincardine Avenue SPS (BMROSS 76007-2)

Future residential properties from 265 for Brown, 48 remaining in Stonehaven 1, 2, 3.

Item	Existing	Future	Units
Residential Area	52.57	52.57	ha
Industrial Area	0	0	ha
Commercial/Institutional Area	3.99	12.57	ha
Residential Properties	442	755	
Calculate			
Residential Population	1021	1744	people
Peaking factor	3.79	3.63	
Average day residential flow	4.96	8.48	L/s
Average day industrial flow	0.00	0.00	L/s
Average day commercial/institutional flow	1.29	4.07	L/s
Average day flow; total	6.3	12.5	L/s
I/I allowance	15.8	18.2	L/s
Peak instantaneous flow; total incl. I/I	39.6	63.8	L/s

Municipality of Kincardine
SewerCAD Modelling for Master Plan
Kincardine - Calculations and Notes

Job # :	16130
Date :	November 15, 2017
Revised :	January 3, 2018

1.0 Background

The Municipality of Kincardine is completing a water and wastewater Master Plan process. The sewage servicing component will include a review of servicing existing development and future development. The purpose of these notes is to summarize data used to create a SewerCAD model, and the results of that modelling.

2.0 Analysis & Model Data

2.1 Data

	Reference	Item		
a.	16130	*Connaught SPS Catchment Area*		
		Ex. peak sewage flow	27.3	L/s
		Ex. I&I allowance	14.1	L/s
		Ex. total peak flow	41.4	L/s
		Fut. peak sewage flow	48.1	L/s
		Fut. I&I allowance	20.9	L/s
		Fut. total peak flow	69.0	L/s
b.	16130/ 17094	*Durham SPS Catchment Area*		
		Ex. peak sewage flow	42.9	L/s
		Ex. I&I allowance	14.8	L/s
		Ex. total peak flow	57.7	L/s
		Fut. peak sewage flow	86.0	L/s
		Fut. I&I allowance	33.6	L/s
		Fut. total peak flow	119.6	L/s
c.	16130	*Huron Terrace SPS Catchment Area (**w/o Connaught, Durham SPSs**)*		
		Ex. peak sewage flow	60.4	L/s
		Ex. I&I allowance	28.7	L/s
		Ex. total peak flow	89.1	L/s
		Fut. peak sewage flow	137.5	L/s
		Fut. I&I allowance	112.5	L/s
		Fut. total peak flow	250.0	L/s
		*Huron Terrace SPS Catchment Area (**with Connaught, Durham SPSs**)*		
		Ex. total peak flow	188.2	L/s
		Fut. total peak flow	438.6	L/s

d.	16130/ 08055	*Park SPS Catchment Area*	
		Ex. peak sewage flow	38.2 L/s
		Ex. I&I allowance	15.6 L/s
		Ex. total peak flow - calcs	53.8 L/s
		Ex. total peak flow - 08055	115.0 L/s
		Fut. peak sewage flow	152.5 L/s
		Fut. I&I allowance	42.7 L/s
		Fut. total peak flow	195.2 L/s
e.	16130	*Goderich SPS Catchment Area*	
		Ex. peak sewage flow	41.1 L/s
		Ex. I&I allowance	20.9 L/s
		Ex. total peak flow	62.0 L/s
		Fut. peak sewage flow	42.5 L/s
		Fut. I&I allowance	20.9 L/s
		Fut. total peak flow	63.4 L/s
f.	16130	*Kincardine SPS Catchment Area*	
		Ex. peak sewage flow	23.8 L/s
		Ex. I&I allowance	15.8 L/s
		Ex. total peak flow	39.6 L/s
		Fut. peak sewage flow	45.6 L/s
		Fut. I&I allowance	18.2 L/s
		Fut. total peak flow	63.8 L/s

2.2 Sewage Flows by Manhole

For the existing system model, sewage flows to each manhole are calculated by dividing total peak flow for the catchment area by the number of maintenance holes.

For future flows, the sewage flow that is additional to existing is assigned to specific manholes based on future service area location in relation to existing manholes.

a.	*Connaught SPS Catchment Area*	
	Ex. No. of manholes in model	103 MHs
	Ex. Peak flow per manhole	0.402 L/s/MH
	Additional future peak flow	27.6 L/s
	Assume:	
	20% to SMH-543 (Golf Course	5.5 L/s
	80% to SMH-921 (Westridge)	22.1 L/s
b.	*Durham SPS Catchment Area*	
	Ex. No. of manholes in model	65 MHs
	Ex. Peak flow per manhole	0.888 L/s/MH
	Additional future peak flow	61.9 L/s
	Assume all applied to MH-N2	

c. *Huron Terrace SPS Catchment Area (* ***w/o Connaught, Durham SPSs*** *)*

Ex. No. of manholes in model	134	MHs
Ex. Peak flow per manhole	0.665	L/s/MH

For Connaught, add to gravity sewer on Huron Terrace per 16171 design (SMH-495)
41.4 L/s

For Durham, add to gravity sewer at Durham & Princess (SMH-469)
57.7 L/s

Additional future peak flow	250.4	L/s
Assume:		
Additional to SMH-495	27.6	L/s
Additional to SMH-469	61.9	L/s
Balance to north end of Queen Street (SMH-762)		
	160.9	L/s

d. *Park SPS Catchment Area*

Ex. No. of manholes in model	127	MHs
Ex. Peak flow per manhole	0.906	L/s/MH

Additional future peak flow 80.2 L/s
All applied at SMH-41 in accordance with 08055 conclusions.

e. *Goderich SPS Catchment Area*

Ex. No. of manholes in model	119	MHs
Ex. Peak flow per manhole	0.521	L/s/MH

Additional future peak flow	1.4	L/s
Assume even distribution over all MHs		
Future Peak flow per manhole	0.533	

f. *Kincardine SPS Catchment Area*

Ex. No. of manholes in model	105	MHs
Ex. Peak flow per manhole	0.377	L/s/MH

Additional future peak flow	24.2	L/s
Assume:		
50% to SMH-380 (east limit ex	12.1	L/s
(east limit existing Kincardine Ave.)		
50% to SMH-814 (Westridge)	12.1	L/s
(east limit Stonehaven)		

Connaught SPS Results

Conduit ID	Existing Conditions					Future Conditions				
	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)
CO-N1	not applicable - being constructed 2018					116.9	0.002	450	54.9	47.0
CO-N2						109.0	0.001	450	54.9	50.4
CO-N3						107.7	0.001	450	54.9	51.0
CO-N5						242.6	0.007	450	54.9	22.6
CO-N6						132.2	0.002	450	54.9	41.6
SM-9	14.2	0.002	200	21.7	153.3	114.3	0.003	400	49.3	43.1
SM-10	21.4	0.004	200	21.3	99.5	133.3	0.004	400	48.9	36.7
SM-101	28.5	0.008	200	0.4	1.4	28.5	0.008	200	0.4	1.4
SM-102	32.8	0.01	200	1.2	3.7	32.8	0.010	200	1.2	3.7
SM-103	26.1	0.002	250	23.3	89.4	109.7	0.001	450	50.9	46.4
SM-104	61.5	0.004	300	27.7	45.1	61.5	0.004	300	0.4	0.7
SM-108	34.1	0.001	300	28.1	82.6	34.1	0.001	300	0.8	2.4
SM-109	43.1	0.002	300	28.5	66.3	43.1	0.002	300	1.2	2.8
SM-110	42.2	0.002	300	28.9	68.6	42.2	0.002	300	1.6	3.8
SM-111	46.7	0.002	300	29.3	62.9	46.7	0.002	300	2.0	4.3
SM-113	13.4	0.002	200	0.4	3.0	13.4	0.002	200	0.4	3.0
SM-116	20.2	0.004	200	0.8	4.0	20.2	0.004	200	0.8	4.0
SM-117	19.9	0.004	200	1.2	6.1	19.9	0.004	200	1.2	6.1
SM-119	33.1	0.003	250	10.1	30.4	33.1	0.003	250	10.1	30.4
SM-120	27.3	0.002	250	10.5	38.3	27.3	0.002	250	10.5	38.3
SM-121	22.4	0.005	200	2.8	12.5	22.4	0.005	200	2.8	12.5
SM-122	21.3	0.004	200	3.2	15.1	21.3	0.004	200	3.2	15.1
SM-123	19.2	0.003	200	3.6	18.8	19.2	0.003	200	3.6	18.8
SM-124	20.3	0.004	200	4.0	19.8	20.3	0.004	200	4.0	19.8
SM-125	26.4	0.006	200	0.8	3.1	26.4	0.006	200	0.8	3.1
SM-127	19.3	0.003	200	2.8	14.6	19.3	0.003	200	2.8	14.6
SM-128	23.3	0.005	200	1.6	6.9	23.3	0.005	200	1.6	6.9
SM-129	80.9	0.061	200	0.4	0.5	80.9	0.061	200	0.4	0.5
SM-130	108.5	0.109	200	1.6	1.5	108.5	0.109	200	1.6	1.5
SM-135	28.6	0.008	200	0.4	1.4	28.6	0.008	200	0.4	1.4
SM-137	32.2	0.01	200	0.4	1.2	32.2	0.010	200	0.4	1.2
SM-138	40.2	0.015	200	0.4	1.0	40.2	0.015	200	0.4	1.0
SM-139	30.2	0.008	200	1.6	5.3	30.2	0.008	200	1.6	5.3
SM-140	106.3	0.105	200	2.4	2.3	106.3	0.105	200	2.4	2.3
SM-141	19.5	0.004	200	6.0	30.9	19.5	0.004	200	6.0	30.9
SM-142	39.1	0.004	250	9.6	24.7	39.1	0.004	250	9.6	24.7
SM-143	19.2	0.003	200	3.2	16.8	19.2	0.003	200	3.2	16.8
SM-144	118.2	0.13	200	0.4	0.3	118.2	0.130	200	0.4	0.3
SM-145	47.1	0.021	200	0.8	1.7	47.1	0.021	200	0.8	1.7

Connaught SPS Results

Conduit ID	Existing Conditions					Future Conditions				
	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)
SM-146	74.3	0.051	200	0.4	0.5	74.3	0.051	200	0.4	0.5
SM-148	48.3	0.022	200	0.8	1.7	48.3	0.022	200	0.8	1.7
SM-150	24.0	0.005	200	1.2	5.0	24.0	0.005	200	1.2	5.0
SM-151	25.5	0.002	250	23.7	92.9	108.2	0.001	450	51.3	47.4
SM-152 (A)	25.7	0.006	200	3.2	12.5	106.5	0.001	450	51.7	48.6
SM-152B	not applicable - being constructed 2018					42.5	0.017	200	3.2	7.6
SM-153	52.6	0.003	300	27.3	52.0	52.6	0.003	300	(N/A)	(N/A)
SM-154	79.5	0.059	200	2.8	3.5	79.5	0.059	200	2.8	3.5
SM-156	79.7	0.059	200	2.4	3.0	79.7	0.059	200	2.4	3.0
SM-157	39.9	0.015	200	2.0	5.0	39.9	0.015	200	2.0	5.0
SM-158	40.1	0.015	200	0.4	1.0	40.1	0.015	200	0.4	1.0
SM-160	27.8	0.007	200	0.4	1.4	27.8	0.007	200	0.4	1.4
SM-161	98.2	0.09	200	0.8	0.8	98.2	0.090	200	0.8	0.8
SM-162	33.4	0.003	250	10.9	32.5	33.4	0.003	250	10.9	32.5
SM-163	29.2	0.002	250	11.3	38.5	29.2	0.002	250	11.3	38.5
SM-238	36.2	0.012	200	1.6	4.4	36.2	0.012	200	1.6	4.4
SM-239	21.7	0.004	200	2.0	9.3	21.7	0.004	200	2.0	9.3
SM-287	48.3	0.022	200	0.4	0.8	48.3	0.022	200	0.4	0.8
SM-288	26.7	0.007	200	0.8	3.0	26.7	0.007	200	0.8	3.0
SM-289	30.1	0.008	200	1.2	4.0	30.1	0.008	200	1.2	4.0
SM-432	30.0	0.008	200	0.4	1.3	30.0	0.008	200	0.4	1.3
SM-441	155.2	0.068	250	11.7	7.5	155.2	0.068	250	11.7	7.5
SM-450	103.2	0.003	375	4.8	4.7	103.2	0.003	375	26.9	26.1
SM-567	160.1	0.008	375	12.1	7.5	160.1	0.008	375	34.2	21.3
SM-571	150.5	0.024	300	29.7	19.8	150.5	0.024	300	2.4	1.6
SM-572	18.7	0.003	200	1.2	6.5	18.7	0.003	200	1.2	6.5
SM-615	30.9	0.009	200	0.8	2.6	30.9	0.009	200	0.8	2.6
SM-616	29.1	0.008	200	1.2	4.1	29.1	0.008	200	1.2	4.1
SM-617	22.5	0.005	200	0.4	1.8	22.5	0.005	200	0.4	1.8
SM-618	19.2	0.003	200	2.0	10.5	19.2	0.003	200	2.0	10.5
SM-620	28.2	0.007	200	0.4	1.4	28.2	0.007	200	0.4	1.4
SM-621	26.5	0.007	200	2.4	9.1	26.5	0.007	200	2.4	9.1
SM-622	40.1	0.015	200	0.4	1.0	40.1	0.015	200	0.4	1.0
SM-623	25.9	0.006	200	0.4	1.6	25.9	0.006	200	0.4	1.6
SM-624	35.8	0.012	200	1.2	3.4	35.8	0.012	200	1.2	3.4
SM-625	34.8	0.011	200	1.6	4.6	34.8	0.011	200	1.6	4.6
SM-627	39.1	0.014	200	1.2	3.1	39.1	0.014	200	1.2	3.1
SM-628	43.3	0.017	200	1.6	3.7	43.3	0.017	200	1.6	3.7
SM-629	27.2	0.007	200	2.0	7.4	27.2	0.007	200	2.0	7.4

Connaught SPS Results

Conduit ID	Existing Conditions					Future Conditions				
	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)
SM-630	21.8	0.004	200	4.8	22.2	21.8	0.004	200	4.8	22.2
SM-631	25.0	0.006	200	0.4	1.6	25.0	0.006	200	0.4	1.6
SM-632	23.9	0.005	200	0.8	3.4	23.9	0.005	200	0.8	3.4
SM-633	42.5	0.017	200	0.4	0.9	42.5	0.017	200	0.4	0.9
SM-634	25.2	0.006	200	0.8	3.2	25.2	0.006	200	0.8	3.2
SM-635	22.0	0.004	200	1.2	5.5	22.0	0.004	200	1.2	5.5
SM-636	24.3	0.005	200	1.6	6.6	24.3	0.005	200	1.6	6.6
SM-637	31.3	0.009	200	6.8	21.8	31.3	0.009	200	6.8	21.8
SM-734	20.6	0.004	200	19.7	95.7	99.3	0.003	375	47.3	47.6
SM-735	17.7	0.003	200	20.1	113.5	85.1	0.002	375	47.7	56.0
SM-736	20.2	0.004	200	20.5	101.5	105.6	0.004	375	48.1	45.6
SM-737	18.0	0.003	200	20.9	116.0	94.7	0.003	375	48.5	51.2
SM-778	35.0	0.011	200	1.2	3.4	35.0	0.011	200	1.2	3.4
SM-779	173.6	0.01	375	19.3	11.1	173.6	0.010	375	41.4	23.8
SM-780	177.5	0.01	375	18.9	10.6	177.5	0.010	375	41.0	23.1
SM-781	331.6	0.036	375	18.5	5.6	331.6	0.036	375	40.6	12.2
SM-782	87.7	0.003	375	15.7	17.9	87.7	0.003	375	37.8	43.1
SM-783	92.6	0.003	375	15.3	16.5	92.6	0.003	375	37.4	40.4
SM-784	79.7	0.059	200	2.4	3.0	79.7	0.059	200	2.4	3.0
SM-789	121.6	0.005	375	4.4	3.6	121.6	0.005	375	26.5	21.8
SM-790	105.9	0.004	375	12.5	11.8	105.9	0.004	375	34.6	32.6
SM-843	37.5	0.013	200	2.4	6.4	37.5	0.013	200	2.4	6.4
SM-929	47.7	0.002	300	0.0	0.0	47.7	0.002	300	0.0	0.0
SM-931	51.4	0.025	200	0.8	1.6	51.4	0.025	200	0.8	1.6
SM-932	53.8	0.027	200	0.4	0.7	53.8	0.027	200	0.4	0.7
SM-933	19.1	0.003	200	1.6	8.4	19.1	0.003	200	1.6	8.4
SM-935	29.7	0.002	250	0.4	1.4	29.7	0.002	250	0.4	1.4
SM-936	104.6	0.004	375	3.6	3.5	104.6	0.004	375	25.7	24.6
SM-937	119.3	0.005	375	0.8	0.7	119.3	0.005	375	22.9	19.2
SM-938	104.5	0.004	375	0.4	0.4	104.5	0.004	375	22.5	21.5
SM-939	98.8	0.091	200	2.4	2.4	98.8	0.091	200	2.4	2.4
SM-948	23.2	0.005	200	0.4	1.7	23.2	0.005	200	0.4	1.7

Notes:

Denotes greater than 80% capacity utilized.

Denotes greater than 100% capacity utilized (i.e. surcharging).

Durham SPS Results

Conduit ID	Existing Conditions					Future Conditions				
	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)
CO-N1	not applicable - being constructed 2018					73.2	0.006	300	50.0	68.3
CO-N2						74.3	0.006	300	62.8	84.5
CO-N3						86.3	0.008	300	62.8	72.8
SM-7	83.6	0.065	200	0.9	1.1	83.6	0.065	200	0.9	1.1
SM-11	20.7	0.004	200	12.4	60.1	20.7	0.004	200	25.2	121.9
SM-11A	not applicable - being constructed 2018					73.6	0.006	300	50.0	67.9
SM-12	21.5	0.004	200	13.3	62.0	21.5	0.004	200	26.1	121.6
SM-12A	not applicable - being constructed 2018					77.7	0.006	300	50.0	64.3
SM-13	20.7	0.004	200	16.0	77.4	83.9	0.008	300	78.8	93.9
SM-14	23.0	0.005	200	14.2	61.8	23.0	0.005	200	27.0	117.5
SM-14A	not applicable - being constructed 2018					74.9	0.006	300	50.0	66.7
SM-15	0.0	0.000	200	15.1	∞	33.6	0.010	200	27.9	83.1
SM-166	41.0	0.016	200	0.9	2.2	41.0	0.016	200	0.9	2.2
SM-167	28.9	0.008	200	1.8	6.2	28.9	0.008	200	1.8	6.2
SM-168	25.3	0.006	200	2.7	10.5	25.3	0.006	200	15.5	61.1
SM-169	36.0	0.012	200	3.6	9.9	36.0	0.012	200	16.3	45.4
SM-172	23.8	0.005	200	4.4	18.7	23.8	0.005	200	17.2	72.4
SM-178A	14.6	0.002	200	6.2	42.5	20.5	0.004	200	19.0	92.5
SM-178B	not applicable - being constructed 2018					20.8	0.004	200	19.0	91.2
SM-182	30.8	0.009	200	0.9	2.9	30.8	0.009	200	0.9	2.9
SM-183	30.5	0.009	200	1.8	5.8	30.5	0.009	200	1.8	5.8
SM-184	31.7	0.009	200	2.7	8.4	31.7	0.009	200	2.7	8.4
SM-185	37.0	0.013	200	3.6	9.6	37.0	0.013	200	3.6	9.6
SM-185A	not applicable - being constructed 2018					73.8	0.006	300	50.0	67.7
SM-186	36.7	0.012	200	4.4	12.1	36.7	0.012	200	4.4	12.1
SM-186A	not applicable - being constructed 2018					72.4	0.006	300	50.0	69.1
SM-187	33.2	0.010	200	5.3	16.1	33.2	0.010	200	5.3	16.1
SM-187A	not applicable - being constructed 2018					72.4	0.006	300	50.0	69.0
SM-188	20.5	0.004	200	0.9	4.3	20.5	0.004	200	0.9	4.3
SM-189	23.1	0.005	200	1.8	7.7	23.1	0.005	200	1.8	7.7
SM-190	20.7	0.004	200	2.7	12.8	20.7	0.004	200	2.7	12.8
SM-191	20.4	0.004	200	3.6	17.4	20.4	0.004	200	3.6	17.4
SM-194	22.4	0.005	200	4.4	19.8	22.6	0.005	200	4.4	19.7
SM-195	27.7	0.007	200	16.9	60.8	89.5	0.009	300	79.7	89.0
SM-196	23.6	0.005	200	17.8	75.2	85.2	0.008	300	80.5	94.5
SM-197	42.8	0.017	200	18.6	43.6	94.3	0.010	300	81.4	86.4
SM-199	104.5	0.004	375	24.0	22.9	104.5	0.004	375	86.8	83.0
SM-200	119.8	0.005	375	24.9	20.8	119.8	0.005	375	87.7	73.2
SM-201	26.8	0.007	200	0.9	3.3	26.8	0.007	200	0.9	3.3
SM-202	31.7	0.009	200	2.7	8.4	31.7	0.009	200	2.7	8.4
SM-203	22.9	0.005	200	5.3	23.3	22.9	0.005	200	5.3	23.3
SM-204	22.2	0.005	200	6.2	28.0	22.2	0.005	200	6.2	28.0

Durham SPS Results

Conduit ID	Existing Conditions					Future Conditions				
	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)
SM-205	21.4	0.004	200	7.1	33.2	21.4	0.004	200	7.1	33.2
SM-206	51.2	0.024	200	3.6	6.9	51.2	0.024	200	3.6	6.9
SM-207	124.0	0.005	375	34.6	27.9	124.0	0.005	375	97.4	78.6
SM-208	104.9	0.012	300	25.8	24.6	201.1	0.013	375	88.5	44.0
SM-209	107.1	0.012	300	26.6	24.9	166.3	0.009	375	89.4	53.8
SM-210	45.6	0.019	200	1.8	3.9	45.6	0.019	200	1.8	3.9
SM-211	32.9	0.010	200	2.7	8.1	32.9	0.010	200	2.7	8.1
SM-212	124.0	0.005	375	39.1	31.5	124.0	0.005	375	101.9	82.1
SM-213	123.6	0.005	375	40.0	32.3	123.6	0.005	375	102.7	83.1
SM-214	22.8	0.005	200	0.9	3.9	22.8	0.005	200	0.9	3.9
SM-216	25.8	0.006	200	0.9	3.4	25.8	0.006	200	0.9	3.4
SM-217	52.5	0.026	200	0.0	0.0	52.5	0.026	200	0.0	0.0
SM-218	30.5	0.009	200	0.9	2.9	30.5	0.009	200	0.9	2.9
SM-219	20.2	0.004	200	0.9	4.4	20.2	0.004	200	0.9	4.4
SM-220	22.0	0.005	200	1.8	8.1	22.0	0.005	200	1.8	8.1
SM-221	19.8	0.004	200	1.8	9.0	19.8	0.004	200	1.8	9.0
SM-222	56.4	0.030	200	0.9	1.6	56.4	0.030	200	0.9	1.6
SM-223	24.8	0.006	200	4.4	17.9	24.8	0.006	200	4.4	17.9
SM-224	15.3	0.002	200	5.3	34.9	15.3	0.002	200	5.3	34.9
SM-225	20.2	0.004	200	6.2	30.8	20.2	0.004	200	6.2	30.8
SM-226	21.5	0.004	200	8.9	41.3	21.5	0.004	200	8.9	41.3
SM-228	25.2	0.006	200	5.3	21.2	25.2	0.006	200	18.1	72.0
SM-229	25.2	0.006	200	0.9	3.5	25.2	0.006	200	0.9	3.5
SM-230	122.1	0.005	375	41.7	34.2	122.1	0.005	375	104.5	85.6
SM-231	135.6	0.006	375	42.6	31.4	135.6	0.006	375	105.4	77.7
SM-232	160.8	0.008	375	43.5	27.1	160.8	0.008	375	106.3	66.1
SM-233	60.5	0.034	200	0.9	1.5	60.5	0.034	200	0.9	1.5
SM-234	44.3	0.018	200	11.5	26.0	44.3	0.018	200	11.5	26.0
SM-235	72.1	0.048	200	12.4	17.3	72.1	0.048	200	12.4	17.3
SM-236	356.9	0.041	375	57.7	16.2	356.9	0.041	375	120.5	33.8
SM-237	20.8	0.004	200	9.8	46.9	20.8	0.004	200	9.8	46.9
SM-275	28.7	0.008	200	4.4	15.5	28.7	0.008	200	4.4	15.5
SM-777	40.4	0.015	200	0.9	2.2	40.4	0.015	200	0.9	2.2
SM-802	252.9	0.021	375	44.4	17.6	252.9	0.021	375	107.2	42.4

Notes:

Denotes greater than 80% capacity utilized.

Denotes greater than 100% capacity utilized (i.e. surcharging).

Huron Terrace SPS Results

Conduit ID	Existing Conditions					Future Conditions				
	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)
CO-N1	not applicable - proposed for future service area					224.5	0.016	375	165.0	73.5
SM-97	341.5	0.027	400	188.2	55.1	341.5	0.027	400	438.6	128.4
SM-147	102.9	0.098	200	0.7	0.6	102.9	-0.098	200	0.7	0.6
SM-241	25.7	0.006	200	4.0	15.5	223.5	0.006	450	164.9	73.8
SM-242	26.0	0.006	200	5.3	20.5	225.9	0.006	450	166.2	73.6
SM-243	18.8	0.003	200	6.0	31.8	163.4	0.003	450	166.9	102.1
SM-244	21.0	0.004	200	18.0	85.4	21.0	0.004	200	13.9	65.9
SM-245	26.7	0.007	200	18.6	69.7	26.7	0.007	200	14.5	54.3
SM-246	18.5	0.003	200	19.3	104.3	18.5	0.003	200	15.2	82.2
SM-247	18.2	0.003	200	29.9	164.2	18.2	0.003	200	25.8	141.7
SM-248	26.6	0.007	200	30.6	115.0	26.6	0.007	200	26.5	99.6
SM-249	23.0	0.005	200	0.7	2.9	23.0	0.005	200	0.7	2.9
SM-250	21.6	0.004	200	0.0	0.0	21.6	0.004	200	0.0	0.0
SM-251	20.9	0.004	200	0.7	3.2	20.9	0.004	200	0.7	3.2
SM-252	34.5	0.011	200	0.7	1.9	34.5	0.011	200	0.7	1.9
SM-253	26.1	0.006	200	1.3	5.1	26.1	0.006	200	1.3	5.1
SM-254	27.3	0.007	200	6.7	24.3	27.3	0.007	200	6.7	24.3
SM-256	111.3	0.004	375	3.3	3.0	111.3	0.004	375	3.3	3.0
SM-257	35.1	0.003	250	6.0	17.0	35.1	0.003	250	6.0	17.0
SM-258	37.3	0.004	250	5.3	14.3	37.3	0.004	250	5.3	14.3
SM-259	18.7	0.003	200	0.0	0.0	18.7	0.003	200	0.0	0.0
SM-260	20.8	0.004	200	0.7	3.2	20.8	0.004	200	0.7	3.2
SM-261	21.5	0.004	200	1.3	6.2	21.5	0.004	200	1.3	6.2
SM-262	19.8	0.004	200	0.7	3.4	19.8	0.004	200	0.7	3.4
SM-263	41.5	0.005	250	2.7	6.4	41.5	0.005	250	2.7	6.4
SM-264	39.0	0.004	250	4.0	10.2	39.0	0.004	250	4.0	10.2
SM-265	20.5	0.004	200	2.0	9.7	20.5	0.004	200	2.0	9.7
SM-266	20.5	0.004	200	1.3	6.5	20.5	0.004	200	1.3	6.5
SM-267	23.8	0.005	200	0.7	2.8	23.8	0.005	200	0.7	2.8
SM-270	27.1	0.007	200	1.3	4.9	27.1	0.007	200	1.3	4.9
SM-326	19.8	0.004	200	0.7	3.4	19.8	0.004	200	0.7	3.4
SM-332	38.9	0.014	200	0.7	1.7	38.9	0.014	200	0.7	1.7
SM-333	21.9	0.004	200	2.7	12.2	21.9	0.004	200	2.7	12.2
SM-334	48.9	0.022	200	0.7	1.4	48.9	0.022	200	0.7	1.4
SM-335	22.5	0.005	200	1.3	5.9	22.5	0.005	200	1.3	5.9
SM-336	34.0	0.011	200	2.7	7.8	34.0	0.011	200	2.7	7.8
SM-337	19.8	0.004	200	6.0	30.2	19.8	0.004	200	6.0	30.2
SM-338	18.7	0.003	200	6.7	35.5	18.7	0.003	200	6.7	35.5
SM-339	22.8	0.005	200	0.7	2.9	22.8	0.005	200	0.7	2.9

Huron Terrace SPS Results

Conduit ID	Existing Conditions					Future Conditions				
	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)
SM-340	53.3	0.026	200	1.3	2.5	53.3	0.026	200	1.3	2.5
SM-341	33.2	0.010	200	8.6	26.1	33.2	0.010	200	8.6	26.1
SM-342	62.3	0.036	200	0.7	1.1	62.3	0.036	200	0.7	1.1
SM-343	40.5	0.015	200	1.3	3.3	40.5	0.015	200	1.3	3.3
SM-344	32.8	0.010	200	2.0	6.1	32.8	0.010	200	2.0	6.1
SM-345	28.6	0.008	200	2.7	9.3	28.6	0.008	200	2.7	9.3
SM-346	26.3	0.006	200	0.7	2.5	26.3	0.006	200	0.7	2.5
SM-347	18.5	0.003	200	4.0	21.6	18.5	0.003	200	4.0	21.6
SM-348	14.4	0.002	200	4.7	32.3	14.4	0.002	200	4.7	32.3
SM-349	21.4	0.004	200	3.3	15.6	21.4	0.004	200	3.3	15.6
SM-350	49.4	0.023	200	2.7	5.4	49.4	0.023	200	2.7	5.4
SM-353	21.2	0.004	200	10.6	50.2	21.2	0.004	200	10.6	50.2
SM-354	63.1	0.037	200	0.7	1.1	63.1	0.037	200	0.7	1.1
SM-355	22.4	0.005	200	9.3	41.6	22.4	0.005	200	9.3	41.6
SM-356	51.7	0.025	200	0.0	0.0	51.7	0.025	200	0.0	0.0
SM-357	46.2	0.020	200	0.7	1.4	46.2	0.020	200	0.7	1.4
SM-358	33.5	0.010	200	1.3	4.0	33.5	0.010	200	1.3	4.0
SM-359	41.0	0.016	200	0.7	1.6	41.0	0.016	200	0.7	1.6
SM-360	38.2	0.014	200	1.3	3.5	38.2	0.014	200	1.3	3.5
SM-361	33.7	0.011	200	33.3	98.7	33.7	0.011	200	29.2	86.5
SM-362	237.1	0.003	525	7.3	3.1	237.1	0.003	525	172.3	72.7
SM-363	109.2	0.001	525	8.0	7.3	109.2	0.001	525	173.0	158.4
SM-364	274.9	0.004	525	10.0	3.6	274.9	0.004	525	175.0	63.6
SM-365	142.5	0.001	525	10.6	7.5	142.5	0.001	525	175.6	123.2
SM-366	280.6	0.004	525	86.0	30.6	280.6	0.004	525	274.5	97.8
SM-367	282.3	0.004	525	86.6	30.7	282.3	0.004	525	275.1	97.5
SM-368	285.6	0.004	525	87.3	30.6	285.6	0.004	525	275.8	96.6
SM-369	85.8	0.021	250	52.7	61.3	139.6	0.021	300	113.7	81.4
SM-370	84.1	0.020	250	50.7	60.3	136.7	0.020	300	111.7	81.7
SM-371	111.3	0.035	250	50.0	44.9	111.3	0.035	250	111.0	99.8
SM-372	22.9	0.005	200	8.4	36.5	22.9	0.005	200	9.3	40.4
SM-373	12.3	0.001	200	9.0	73.3	12.3	0.001	200	9.9	80.7
SM-374	61.9	0.036	200	9.7	15.7	61.9	0.036	200	10.6	17.1
SM-375	51.1	0.024	200	10.4	20.3	51.1	0.024	200	11.3	22.0
SM-376	51.2	0.024	200	11.0	21.6	51.2	0.024	200	11.9	23.3
SM-377	42.7	0.017	200	11.7	27.4	42.7	0.017	200	12.6	29.5
SM-378	32.2	0.010	200	12.4	38.4	32.2	0.010	200	13.3	41.2
SM-379	42.1	0.005	250	53.3	126.6	124.2	0.005	375	114.3	92.1
SM-380	266.2	0.004	525	141.3	53.1	266.2	0.004	525	390.8	146.8

Huron Terrace SPS Results

Conduit ID	Existing Conditions					Future Conditions				
	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)
SM-381	288.8	0.005	525	141.9	49.1	288.8	0.005	525	391.4	135.5
SM-382	19.2	0.003	200	0.7	3.5	19.2	0.003	200	0.7	3.5
SM-383	34.1	0.011	200	1.3	3.9	34.1	0.011	200	1.3	3.9
SM-384	65.8	0.040	200	2.0	3.0	65.8	0.040	200	2.0	3.0
SM-385	19.5	0.004	200	0.0	0.0	19.5	0.004	200	0.0	0.0
SM-386	24.1	0.005	200	0.7	2.8	24.1	0.005	200	0.7	2.8
SM-387	23.6	0.005	200	0.7	2.8	23.6	0.005	200	0.7	2.8
SM-388	55.3	0.028	200	1.3	2.4	55.3	0.028	200	1.3	2.4
SM-389	41.1	0.016	200	11.3	27.5	41.1	0.016	200	11.3	27.5
SM-390	24.0	0.005	200	2.7	11.1	24.0	0.005	200	2.7	11.1
SM-391	19.5	0.004	200	4.0	20.5	19.5	0.004	200	4.0	20.5
SM-392	225.5	0.003	525	5.3	2.4	225.5	0.003	525	170.3	75.5
SM-393	38.8	0.014	200	0.7	1.7	207.4	0.014	375	165.7	79.9
SM-394	34.3	0.011	200	32.6	95.1	34.3	0.011	200	28.5	83.2
SM-395	45.7	0.019	200	0.7	1.5	45.7	0.019	200	0.7	1.5
SM-396	43.7	0.005	250	8.0	18.3	43.7	0.005	250	8.0	18.3
SM-397	103.5	0.030	250	8.6	8.4	103.5	0.030	250	8.6	8.4
SM-398	36.7	0.004	250	10.0	27.2	36.7	0.004	250	10.0	27.2
SM-399	38.6	0.004	250	10.6	27.6	38.6	0.004	250	10.6	27.6
SM-400	32.4	0.003	250	11.3	34.9	32.4	0.003	250	11.3	34.9
SM-401	38.9	0.014	200	2.7	6.8	38.9	0.014	200	2.7	6.8
SM-402	48.7	0.022	200	3.3	6.8	48.7	0.022	200	3.3	6.8
SM-403	38.9	0.004	250	15.3	39.3	38.9	0.004	250	15.3	39.3
SM-404	38.7	0.004	250	16.0	41.3	38.7	0.004	250	16.0	41.3
SM-406	92.6	0.024	250	16.6	18.0	92.6	0.024	250	16.6	18.0
SM-407	123.0	0.043	250	17.3	14.1	123.0	0.043	250	17.3	14.1
SM-408	61.8	0.011	250	18.0	29.1	61.8	0.011	250	18.0	29.1
SM-409	72.4	0.015	250	18.6	25.7	72.4	0.015	250	18.6	25.7
SM-410	1056.9	0.030	600	167.6	15.9	1056.9	0.030	600	418.0	39.6
SM-411	345.3	0.003	600	166.9	48.3	345.3	0.003	600	417.3	120.9
SM-412	0.0	0.000	250	1.3	∞	0.0	0.000	250	1.3	∞
SM-413	139.3	0.055	250	9.3	6.7	139.3	0.055	250	9.3	6.7
SM-414	379.2	0.008	525	155.0	40.9	379.2	0.008	525	405.4	106.9
SM-415	811.9	0.036	525	155.6	19.2	811.9	0.036	525	406.0	50.0
SM-416	77.0	0.055	200	0.7	0.9	77.0	0.055	200	0.7	0.9
SM-417	16.2	0.002	200	3.3	20.6	16.2	0.002	200	3.3	20.6
SM-418	20.6	0.004	200	0.7	3.2	20.6	0.004	200	0.7	3.2
SM-419	29.2	0.008	200	0.7	2.3	29.2	0.008	200	0.7	2.3
SM-420	32.7	0.010	200	2.0	6.1	32.7	0.010	200	2.0	6.1

Huron Terrace SPS Results

Conduit ID	Existing Conditions					Future Conditions				
	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)
SM-421	44.2	0.018	200	0.7	1.5	44.2	0.018	200	0.7	1.5
SM-422	21.8	0.004	200	0.7	3.0	21.8	0.004	200	0.7	3.0
SM-423	24.0	0.005	200	1.3	5.5	24.0	0.005	200	1.3	5.5
SM-424	39.6	0.015	200	0.7	1.7	39.6	0.015	200	0.7	1.7
SM-425	42.6	0.017	200	2.0	4.7	42.6	0.017	200	2.0	4.7
SM-426	38.5	0.014	200	2.7	6.9	38.5	0.014	200	2.7	6.9
SM-427	21.2	0.004	200	0.0	0.0	21.2	0.004	200	0.0	0.0
SM-428	26.7	0.007	200	1.3	5.0	26.7	0.007	200	1.3	5.0
SM-429	24.6	0.006	200	10.0	40.6	24.6	0.006	200	10.0	40.6
SM-433	59.8	0.033	200	0.7	1.1	59.8	0.033	200	0.7	1.1
SM-434	46.5	0.020	200	1.3	2.9	46.5	0.020	200	1.3	2.9
SM-767	155.5	0.003	450	0.7	0.4	155.5	0.003	450	161.6	103.9
SM-768	156.9	0.003	450	1.3	0.8	156.9	0.003	450	162.2	103.4
SM-769	156.3	0.003	450	2.0	1.3	156.3	0.003	450	162.9	104.2
SM-770	20.4	0.004	200	2.7	13.0	177.7	0.004	450	163.6	92.1
SM-771	15.5	0.002	200	3.3	21.4	135.1	0.002	450	164.2	121.6
SM-808	49.8	0.007	250	8.6	17.4	49.8	0.007	250	8.6	17.4
SM-922	37.4	0.004	250	4.7	12.5	37.4	0.004	250	4.7	12.5
SM-944	1925.9	0.098	600	168.3	8.7	1925.9	0.098	600	418.7	21.7
SM-945	2378.4	0.150	600	168.9	7.1	2378.4	0.150	600	419.3	17.6
SM-951	39.1	0.004	250	3.3	8.5	39.1	0.004	250	3.3	8.5
SM-977	21.1	0.004	200	2.0	9.4	21.1	0.004	200	2.0	9.4
SM-978	38.6	0.014	200	1.3	3.4	38.6	0.014	200	1.3	3.4
SM-979	40.4	0.015	200	0.7	1.6	40.4	0.015	200	0.7	1.6

Notes:

Denotes greater than 80% capacity utilized.

Denotes greater than 100% capacity utilized (i.e. surcharging).

Park St. SPS Results

Conduit ID	Existing Conditions					Future Conditions				
	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)
SM-2	76.2	0.054	200	0.9	1.2	76.2	0.054	200	0.9	1.2
SM-3	56.1	0.029	200	1.8	3.2	56.1	0.029	200	1.8	3.2
SM-6	75.7	0.053	200	2.7	3.6	75.7	0.053	200	2.7	3.6
SM-91	35.4	0.012	200	0.9	2.6	35.4	0.012	200	0.9	2.6
SM-95	36.7	0.004	250	0.9	2.5	36.7	0.004	250	0.9	2.5
SM-444	39.0	0.014	200	1.8	4.6	39.0	0.014	200	1.8	4.6
SM-445	40.6	0.015	200	2.7	6.7	40.6	0.015	200	2.7	6.7
SM-446	40.2	0.015	200	3.6	9.0	40.2	0.015	200	3.6	9.0
SM-447	39.4	0.014	200	4.5	11.5	39.4	0.014	200	4.5	11.5
SM-448	25.8	0.006	200	2.7	10.5	25.8	0.006	200	2.7	10.5
SM-449	25.1	0.006	200	1.8	7.2	25.1	0.006	200	1.8	7.2
SM-451	37.0	0.013	200	0.9	2.5	37.0	0.013	200	0.9	2.5
SM-452	26.6	0.007	200	0.9	3.4	26.6	0.007	200	0.9	3.4
SM-453	49.7	0.023	200	1.8	3.6	49.7	0.023	200	1.8	3.6
SM-454	25.9	0.006	200	2.7	10.5	25.9	0.006	200	2.7	10.5
SM-455	26.1	0.006	200	4.5	17.3	26.1	0.006	200	4.5	17.3
SM-456	27.2	0.007	200	5.4	20.0	27.2	0.007	200	5.4	20.0
SM-457	26.4	0.006	200	6.3	24.0	26.4	0.006	200	6.3	24.0
SM-458	26.7	0.007	200	7.2	27.1	26.7	0.007	200	7.2	27.1
SM-459	26.9	0.007	200	8.2	30.3	26.9	0.007	200	8.2	30.3
SM-460	25.5	0.006	200	9.1	35.6	25.5	0.006	200	9.1	35.6
SM-461	25.9	0.006	200	10.0	38.5	25.9	0.006	200	10.0	38.5
SM-462	26.7	0.007	200	1.8	6.8	26.7	0.007	200	1.8	6.8
SM-463	40.5	0.015	200	0.9	2.2	40.5	0.015	200	0.9	2.2
SM-464	33.3	0.01	200	8.2	24.5	33.3	0.01	200	8.2	24.5
SM-466	143.6	0.005	400	61.6	42.9	143.6	0.005	400	141.8	98.7
SM-467	144.3	0.005	400	68.9	47.7	144.3	0.005	400	149.1	103.3
SM-468	148.9	0.005	400	69.8	46.8	148.9	0.005	400	150.0	100.7
SM-469	130.6	0.004	400	93.3	71.4	130.6	0.004	400	173.5	132.8
SM-470	133.0	0.004	400	94.2	70.9	133.0	0.004	400	174.4	131.2
SM-471	141.2	0.005	400	95.1	67.4	141.2	0.005	400	175.3	124.1
SM-472	161.2	0.006	400	96.0	59.6	161.2	0.006	400	176.2	109.3
SM-473	137.4	0.004	400	99.7	72.5	137.4	0.004	400	179.9	130.9
SM-474	131.2	0.004	400	100.6	76.7	131.2	0.004	400	180.8	137.8
SM-475	121.9	0.003	400	101.5	83.3	121.9	0.003	400	181.7	149.1
SM-476	115.2	0.003	400	102.4	88.9	115.2	0.003	400	182.6	158.5
SM-477	175.4	0.004	450	114.2	65.1	175.4	0.004	450	194.4	110.8
SM-478	171.1	0.004	450	115.1	67.3	171.1	0.004	450	195.3	114.2
SM-479	26.4	0.006	200	0.9	3.4	26.4	0.006	200	0.9	3.4

Park St. SPS Results

Conduit ID	Existing Conditions					Future Conditions				
	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)
SM-480	16.7	0.003	200	20.8	124.6	16.7	0.003	200	20.8	124.6
SM-481	27.2	0.007	200	22.7	83.2	27.2	0.007	200	22.7	83.2
SM-482	24.6	0.006	200	21.7	88.4	24.6	0.006	200	21.7	88.4
SM-483	27.1	0.007	200	2.7	10.0	27.1	0.007	200	2.7	10.0
SM-484	45.6	0.019	200	1.8	4.0	45.6	0.019	200	1.8	4.0
SM-485	22.8	0.005	200	0.9	4.0	22.8	0.005	200	0.9	4.0
SM-486	24.0	0.005	200	0.0	0.0	24.0	0.005	200	0.0	0.0
SM-487	25.7	0.006	200	0.9	3.5	25.7	0.006	200	0.9	3.5
SM-488	21.7	0.004	200	1.8	8.4	21.7	0.004	200	1.8	8.4
SM-489	27.2	0.007	200	2.7	10.0	27.2	0.007	200	2.7	10.0
SM-490	24.9	0.006	200	6.3	25.4	24.9	0.006	200	6.3	25.4
SM-491	26.7	0.007	200	2.7	10.2	26.7	0.007	200	2.7	10.2
SM-492	22.4	0.005	200	1.8	8.1	22.4	0.005	200	1.8	8.1
SM-493	21.6	0.004	200	0.9	4.2	21.6	0.004	200	0.9	4.2
SM-496	22.8	0.005	200	10.0	43.7	22.8	0.005	200	10.0	43.7
SM-497	106.1	0.105	200	10.9	10.2	106.1	0.105	200	10.9	10.2
SM-498	24.5	0.006	200	9.1	37.0	24.5	0.006	200	9.1	37.0
SM-499	27.2	0.007	200	4.5	16.6	27.2	0.007	200	4.5	16.6
SM-500	39.1	0.004	250	43.5	111.2	39.1	0.004	250	43.5	111.2
SM-501	38.0	0.013	200	0.9	2.4	38.0	0.013	200	0.9	2.4
SM-502	49.9	0.023	200	1.8	3.6	49.9	0.023	200	1.8	3.6
SM-503	26.2	0.006	200	7.2	27.7	26.2	0.006	200	7.2	27.7
SM-504	24.4	0.006	200	8.2	33.4	24.4	0.006	200	8.2	33.4
SM-509	39.2	0.014	200	0.9	2.3	39.2	0.014	200	0.9	2.3
SM-510	32.9	0.01	200	1.8	5.5	32.9	0.01	200	1.8	5.5
SM-511	32.9	0.01	200	2.7	8.3	32.9	0.01	200	2.7	8.3
SM-512	26.6	0.007	200	4.5	17.0	26.6	0.007	200	4.5	17.0
SM-513	21.0	0.004	200	0.9	4.3	21.0	0.004	200	0.9	4.3
SM-515	29.0	0.008	200	3.6	12.5	29.0	0.008	200	3.6	12.5
SM-516	38.9	0.004	250	36.2	93.1	38.9	0.004	250	36.2	93.1
SM-518	64.5	0.012	250	21.7	33.7	64.5	0.012	250	21.7	33.7
SM-519	42.1	0.005	250	22.7	53.8	42.1	0.005	250	22.7	53.8
SM-520	36.8	0.004	250	35.3	96.1	36.8	0.004	250	35.3	96.1
SM-521	31.5	0.009	200	0.9	2.9	31.5	0.009	200	0.9	2.9
SM-522	32.6	0.01	200	2.7	8.3	32.6	0.01	200	2.7	8.3
SM-523	35.9	0.012	200	3.6	10.1	35.9	0.012	200	3.6	10.1
SM-524	36.3	0.012	200	4.5	12.5	36.3	0.012	200	4.5	12.5
SM-525	40.7	0.015	200	0.9	2.2	40.7	0.015	200	0.9	2.2
SM-526	39.1	0.014	200	0.9	2.3	39.1	0.014	200	0.9	2.3

Park St. SPS Results

Conduit ID	Existing Conditions					Future Conditions				
	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)
SM-527	35.9	0.012	200	1.8	5.1	35.9	0.012	200	1.8	5.1
SM-528	26.4	0.006	200	2.7	10.3	26.4	0.006	200	2.7	10.3
SM-529	26.0	0.006	200	3.6	13.9	26.0	0.006	200	3.6	13.9
SM-530	25.7	0.006	200	4.5	17.6	25.7	0.006	200	4.5	17.6
SM-531	24.4	0.006	200	10.0	40.9	24.4	0.006	200	10.0	40.9
SM-532	24.4	0.006	200	10.9	44.5	24.4	0.006	200	10.9	44.5
SM-533	26.2	0.006	200	11.8	44.9	26.2	0.006	200	11.8	44.9
SM-534	34.1	0.011	200	0.9	2.7	34.1	0.011	200	0.9	2.7
SM-535	37.6	0.013	200	1.8	4.8	37.6	0.013	200	1.8	4.8
SM-536	26.5	0.007	200	2.7	10.3	26.5	0.007	200	2.7	10.3
SM-537	28.6	0.008	200	8.2	28.5	28.6	0.008	200	8.2	28.5
SM-538	25.8	0.006	200	9.1	35.1	25.8	0.006	200	9.1	35.1
SM-539	23.1	0.005	200	10.9	47.1	23.1	0.005	200	10.9	47.1
SM-540	46.1	0.02	200	0.9	2.0	46.1	0.02	200	0.9	2.0
SM-541	33.8	0.011	200	0.9	2.7	33.8	0.011	200	0.9	2.7
SM-542	38.8	0.004	250	59.8	154.3	38.8	0.004	250	59.8	154.3
SM-543	183.1	0.008	400	60.7	33.1	183.1	0.008	400	60.7	33.1
SM-544	141.2	0.056	250	1.8	1.3	141.2	0.056	250	1.8	1.3
SM-545	51.0	0.007	250	2.7	5.3	51.0	0.007	250	2.7	5.3
SM-546	50.6	0.007	250	3.6	7.2	50.6	0.007	250	3.6	7.2
SM-547	52.7	0.008	250	5.4	10.3	52.7	0.008	250	5.4	10.3
SM-548	46.8	0.006	250	6.3	13.6	46.8	0.006	250	6.3	13.6
SM-549	51.5	0.008	250	7.2	14.1	51.5	0.008	250	7.2	14.1
SM-550	41.3	0.005	250	19.9	48.2	41.3	0.005	250	19.9	48.2
SM-551	37.4	0.004	250	20.8	55.7	37.4	0.004	250	20.8	55.7
SM-552	31.5	0.003	250	3.6	11.5	31.5	0.003	250	3.6	11.5
SM-553	29.8	0.008	200	4.5	15.2	29.8	0.008	200	4.5	15.2
SM-554	39.6	0.015	200	6.3	16.0	39.6	0.015	200	6.3	16.0
SM-555	26.6	0.007	200	7.2	27.3	26.6	0.007	200	7.2	27.3
SM-556	22.9	0.005	200	19.0	83.1	22.9	0.005	200	19.0	83.1
SM-557	42.9	0.005	250	37.1	86.7	42.9	0.005	250	37.1	86.7
SM-558	75.4	0.016	250	38.1	50.5	75.4	0.016	250	38.1	50.5
SM-559	39.3	0.014	200	0.9	2.3	39.3	0.014	200	0.9	2.3
SM-560	89.4	0.074	200	2.7	3.0	89.4	0.074	200	2.7	3.0
SM-561	36.1	0.012	200	3.6	10.0	36.1	0.012	200	3.6	10.0
SM-562	23.6	0.005	200	4.5	19.2	23.6	0.005	200	4.5	19.2
SM-563	37.4	0.013	200	0.0	0.0	37.4	0.013	200	0.0	0.0
SM-578	20.6	0.004	200	0.9	4.4	20.6	0.004	200	0.9	4.4
SM-580	31.6	0.003	250	1.8	5.7	31.6	0.003	250	1.8	5.7

Park St. SPS Results

Conduit ID	Existing Conditions					Future Conditions				
	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)
SM-581	26.9	0.002	250	2.7	10.1	26.9	0.002	250	2.7	10.1
SM-582	36.8	0.004	250	4.5	12.3	36.8	0.004	250	4.5	12.3
SM-583	30.0	0.003	250	5.4	18.1	30.0	0.003	250	5.4	18.1
SM-584	30.0	0.003	250	7.2	24.2	30.0	0.003	250	7.2	24.2
SM-585	26.4	0.002	250	8.2	30.8	26.4	0.002	250	8.2	30.8
SM-607	31.4	0.003	250	1.8	5.8	31.4	0.003	250	1.8	5.8
SM-608	31.6	0.003	250	2.7	8.6	31.6	0.003	250	2.7	8.6
SM-613	47.1	0.006	250	1.8	3.8	47.1	0.006	250	1.8	3.8
SM-803	27.8	0.002	250	6.3	22.8	27.8	0.002	250	6.3	22.8
SM-804	23.4	0.002	250	3.6	15.5	23.4	0.002	250	3.6	15.5
SM-847	43.7	0.018	200	0.9	2.1	43.7	0.018	200	0.9	2.1
SM-980	48.5	0.007	250	4.5	9.3	48.5	0.007	250	4.5	9.3

Notes:

Denotes greater than 80% capacity utilized.

Denotes greater than 100% capacity utilized (i.e. surcharging).

Goderich SPS Results

Conduit ID	Existing Conditions					Future Conditions				
	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)
SAN 1	33.5	0.003	250	0.5	1.6	33.5	0.003	250	0.5	1.6
SAN 2	32.5	0.003	250	12.5	38.5	32.5	0.003	250	12.8	39.3
SAN 3	24.0	0.002	250	13.0	54.3	24.0	0.002	250	13.3	55.5
SAN 4	23.2	0.005	200	10.9	47.1	23.2	0.005	200	11.2	48.2
SAN 193	32.7	0.003	250	1.0	3.2	32.7	0.003	250	1.1	3.3
SAN 194	31.4	0.003	250	25.0	79.7	31.4	0.003	250	25.6	81.5
SAN 195	26.9	0.002	250	13.5	50.4	26.9	0.002	250	13.9	51.5
SAN 278	39.4	0.014	200	10.4	26.4	39.4	0.014	200	10.7	27.0
SAN 279	18.7	0.003	200	5.7	30.7	18.7	0.003	200	5.9	31.4
SAN 280	21.0	0.004	200	5.2	24.9	21.0	0.004	200	5.3	25.4
SAN 281	32.0	0.010	200	0.5	1.6	32.0	0.010	200	0.5	1.7
SAN 282	23.6	0.005	200	0.5	2.2	23.6	0.005	200	0.5	2.3
SAN 283	21.1	0.004	200	3.1	14.8	21.1	0.004	200	3.2	15.1
SAN 284	19.7	0.004	200	1.6	7.9	19.7	0.004	200	1.6	8.1
SAN 285	20.3	0.004	200	1.0	5.1	20.3	0.004	200	1.1	5.3
SAN 286	23.0	0.005	200	0.5	2.3	23.0	0.005	200	0.5	2.3
SAN 287	23.4	0.005	200	0.5	2.2	23.4	0.005	200	0.5	2.3
SAN 288	20.7	0.004	200	1.0	5.0	20.7	0.004	200	1.1	5.2
SAN 289	20.6	0.004	200	1.6	7.6	20.6	0.004	200	1.6	7.8
SAN 290	19.1	0.003	200	2.1	10.9	19.1	0.003	200	2.1	11.2
SAN 291	20.0	0.004	200	2.6	13.0	20.0	0.004	200	2.7	13.3
SAN 292	20.0	0.004	200	3.1	15.6	20.0	0.004	200	3.2	16.0
SAN 293	19.7	0.004	200	2.1	10.6	19.7	0.004	200	2.1	10.8
SAN 294	19.2	0.003	200	2.6	13.6	19.2	0.003	200	2.7	13.9
SAN 295	25.0	0.006	200	3.6	14.6	25.0	0.006	200	3.7	14.9
SAN 296	21.2	0.004	200	3.6	17.2	21.2	0.004	200	3.7	17.6
SAN 297	20.2	0.004	200	4.2	20.7	20.2	0.004	200	4.3	21.1
SAN 298	21.3	0.004	200	4.7	22.0	21.3	0.004	200	4.8	22.5
SAN 299	22.6	0.005	200	7.3	32.3	22.6	0.005	200	7.5	33.0
SAN 300	21.0	0.004	200	1.6	7.5	21.0	0.004	200	1.6	7.6
SAN 301	21.0	0.004	200	2.1	9.9	21.0	0.004	200	2.1	10.1
SAN 302	37.5	0.013	200	2.6	7.0	37.5	0.013	200	2.7	7.1
SAN 303	24.0	0.005	200	1.0	4.4	24.0	0.005	200	1.1	4.5
SAN 304	50.8	0.024	200	0.5	1.0	50.8	0.024	200	0.5	1.0
SAN 305	25.8	0.006	200	1.0	4.0	25.8	0.006	200	1.1	4.1
SAN 306	27.5	0.007	200	1.6	5.7	27.5	0.007	200	1.6	5.8
SAN 307	34.3	0.011	200	2.1	6.1	34.3	0.011	200	2.1	6.2
SAN 311	31.9	0.009	200	4.7	14.7	31.9	0.009	200	4.8	15.0
SAN 312	34.7	0.011	200	5.2	15.0	34.7	0.011	200	5.3	15.4

Goderich SPS Results

Conduit ID	Existing Conditions Full-Flow Capacity (L/s)	Existing Conditions Slope (m/m)	Existing Conditions Diameter (mm)	Existing Conditions Calculated Flow (L/s)	Existing Conditions Flow/Capacity (%)	Future Conditions Full-Flow Capacity (L/s)	Future Conditions Slope (m/m)	Future Conditions Diameter (mm)	Future Conditions Calculated Flow (L/s)	Future Conditions Flow/Capacity (%)
SAN 313	46.6	0.020	200	5.7	12.3	46.6	0.020	200	5.9	12.6
SAN 314	20.8	0.004	200	10.4	50.2	20.8	0.004	200	10.7	51.3
SAN 315	37.5	0.004	250	2.6	6.9	37.5	0.004	250	2.7	7.1
SAN 317	57.9	0.009	250	3.1	5.4	57.9	0.009	250	3.2	5.5
SAN 321	49.3	0.023	200	2.1	4.2	49.3	0.023	200	2.1	4.3
SAN 322	25.7	0.006	200	2.6	10.1	25.7	0.006	200	2.7	10.4
SAN 323	20.9	0.004	200	3.1	15.0	20.9	0.004	200	3.2	15.3
SAN 324	20.8	0.004	200	1.0	5.0	20.8	0.004	200	1.1	5.1
SAN 325	32.7	0.010	200	0.5	1.6	32.7	0.010	200	0.5	1.6
SAN 326	46.2	0.020	200	0.5	1.1	46.2	0.020	200	0.5	1.2
SAN 327	20.9	0.004	200	4.2	19.9	20.9	0.004	200	4.3	20.4
SAN 328	85.2	0.021	250	3.6	4.3	85.2	0.021	250	3.7	4.4
SAN 329	74.4	0.016	250	4.2	5.6	74.4	0.016	250	4.3	5.7
SAN 330	28.7	0.002	250	26.6	92.7	28.7	0.002	250	27.2	94.8
SAN 331	32.7	0.003	250	26.1	79.8	32.7	0.003	250	26.7	81.6
SAN 332	31.6	0.003	250	25.5	80.8	31.6	0.003	250	26.1	82.6
SAN 333	47.2	0.006	250	14.1	29.8	47.2	0.006	250	14.4	30.5
SAN 334	20.8	0.004	200	0.5	2.5	20.8	0.004	200	0.5	2.6
SAN 341	29.5	0.008	200	0.5	1.8	29.5	0.008	200	0.5	1.8
SAN 342	27.4	0.007	200	4.2	15.2	27.4	0.007	200	4.3	15.6
SM-81	48.9	0.022	200	0.5	1.1	48.9	0.022	200	0.5	1.1
SM-82	19.9	0.004	200	1.0	5.2	19.9	0.004	200	1.1	5.3
SM-83	21.7	0.004	200	1.6	7.2	21.7	0.004	200	1.6	7.4
SM-268	21.5	0.004	200	1.0	4.9	21.5	0.004	200	1.1	5.0
SM-269	21.7	0.004	200	0.5	2.4	21.7	0.004	200	0.5	2.5
SM-271	24.0	0.005	200	0.5	2.2	24.0	0.005	200	0.5	2.2
SM-272	25.7	0.006	200	1.0	4.1	25.7	0.006	200	1.1	4.1
SM-274	18.4	0.003	200	1.6	8.5	18.4	0.003	200	1.6	8.7
SM-276	33.5	0.003	250	2.1	6.2	33.5	0.003	250	2.1	6.4
SM-277	34.3	0.003	250	2.6	7.6	34.3	0.003	250	2.7	7.8
SM-278	35.4	0.004	250	3.1	8.8	35.4	0.004	250	3.2	9.0
SM-279	31.2	0.003	250	3.6	11.7	31.2	0.003	250	3.7	12.0
SM-280	35.5	0.004	250	4.2	11.7	35.5	0.004	250	4.3	12.0
SM-281	215.8	0.006	450	59.4	27.5	215.8	0.006	450	60.8	28.2
SM-282	161.0	0.003	450	59.9	37.2	161.0	0.003	450	61.3	38.1
SM-283	146.6	0.003	450	60.4	41.2	146.6	0.003	450	61.8	42.2
SM-284	149.5	0.003	450	61.0	40.8	149.5	0.003	450	62.4	41.7
SM-285	137.1	0.002	450	61.5	44.9	137.1	0.002	450	62.9	45.9
SM-286	146.2	0.003	450	62.0	42.4	146.2	0.003	450	63.4	43.4

Goderich SPS Results

Conduit ID	Existing Conditions					Future Conditions				
	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)
SM-294	148.1	0.007	375	31.3	21.1	148.1	0.007	375	32.0	21.6
SM-295	75.1	0.002	375	31.8	42.3	75.1	0.002	375	32.5	43.3
SM-296	138.1	0.006	375	32.3	23.4	138.1	0.006	375	33.0	23.9
SM-297	93.1	0.003	375	39.1	42.0	93.1	0.003	375	40.0	42.9
SM-298	126.8	0.005	375	39.6	31.2	126.8	0.005	375	40.5	32.0
SM-299	124.0	0.005	375	42.2	34.0	124.0	0.005	375	43.2	34.8
SM-300	246.0	0.020	375	54.2	22.0	246.0	0.020	375	55.4	22.5
SM-301	459.5	0.069	375	54.7	11.9	459.5	0.069	375	56.0	12.2
SM-302	21.9	0.004	200	4.7	21.5	21.9	0.004	200	4.8	22.0
SM-303	21.5	0.004	200	5.2	24.2	21.5	0.004	200	5.3	24.8
SM-304	21.6	0.004	200	5.7	26.5	21.6	0.004	200	5.9	27.1
SM-305	19.8	0.004	200	6.3	31.5	19.8	0.004	200	6.4	32.3
SM-306	45.5	0.019	200	4.2	9.2	45.5	0.019	200	4.3	9.4
SM-307	46.0	0.020	200	4.7	10.2	46.0	0.020	200	4.8	10.4
SM-308	55.2	0.028	200	5.2	9.4	55.2	0.028	200	5.3	9.6
SM-309	23.9	0.005	200	0.5	2.2	23.9	0.005	200	0.5	2.2
SM-310	39.8	0.004	250	0.5	1.3	39.8	0.004	250	0.5	1.3
SM-311	42.0	0.005	250	1.6	3.7	42.0	0.005	250	1.6	3.8
SM-312	167.7	0.079	250	2.1	1.2	167.7	0.079	250	2.1	1.3
SM-313	55.9	0.029	200	0.5	0.9	55.9	0.029	200	0.5	1.0
SM-314	48.6	0.022	200	2.1	4.3	48.6	0.022	200	2.1	4.4
SM-315	47.1	0.021	200	2.6	5.5	47.1	0.021	200	2.7	5.7
SM-316	21.1	0.004	200	0.5	2.5	21.1	0.004	200	0.5	2.5
SM-317	20.9	0.004	200	1.0	5.0	20.9	0.004	200	1.1	5.1
SM-327	21.3	0.004	200	0.5	2.5	21.3	0.004	200	0.5	2.5
SM-328	20.2	0.004	200	1.0	5.2	20.2	0.004	200	1.1	5.3
SM-329	20.1	0.004	200	1.6	7.8	20.1	0.004	200	1.6	7.9
SM-431	23.5	0.005	200	2.1	8.9	23.5	0.005	200	2.1	9.1
SM-570	21.5	0.004	200	2.6	12.1	21.5	0.004	200	2.7	12.4
SM-797	44.0	0.001	375	38.6	87.6	44.0	0.001	375	39.4	89.6
SM-911	47.4	0.021	200	0.5	1.1	47.4	0.021	200	0.5	1.1
SM-912	42.1	0.016	200	1.0	2.5	42.1	0.016	200	1.1	2.5
SM-913	25.8	0.006	200	1.6	6.1	25.8	0.006	200	1.6	6.2
SM-914	22.4	0.005	200	2.1	9.3	22.4	0.005	200	2.1	9.5
SM-915	33.3	0.010	200	2.6	7.8	33.3	0.010	200	2.7	8.0
SM-916	43.0	0.017	200	2.6	6.1	43.0	0.017	200	2.7	6.2
SM-917	46.8	0.020	200	2.1	4.5	46.8	0.020	200	2.1	4.6
SM-918	43.3	0.017	200	1.6	3.6	43.3	0.017	200	1.6	3.7
SM-919	36.7	0.013	200	1.0	2.8	36.7	0.013	200	1.1	2.9

Goderich SPS Results

Conduit ID	Existing Conditions					Future Conditions				
	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)
SM-920	20.8	0.004	200	0.5	2.5	20.8	0.004	200	0.5	2.6
SM-921	13.3	0.002	200	5.7	43.0	13.3	0.002	200	5.9	44.0

Notes:
Denotes greater than 80% capacity utilized.
Denotes greater than 100% capacity utilized (i.e. surcharging).

Kincardine SPS Results

Conduit ID	Existing Conditions					Future Conditions				
	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)
SM-18	20.7	0.004	200	0.4	1.8	20.7	0.004	200	0.4	1.8
SM-19	20.6	0.004	200	0.8	3.7	20.6	0.004	200	0.8	3.7
SM-20	30.1	0.008	200	0.0	0.0	30.1	0.008	200	0.0	0.0
SM-21	21.8	0.004	200	0.4	1.7	21.8	0.004	200	0.4	1.7
SM-22	21.3	0.004	200	0.8	3.5	21.3	0.004	200	0.8	3.5
SM-23	34.8	0.011	200	1.1	3.3	34.8	0.011	200	1.1	3.3
SM-24	20.5	0.004	200	0.4	1.8	20.5	0.004	200	0.4	1.8
SM-26	48.9	0.022	200	1.9	3.9	48.9	0.022	200	1.9	3.9
SM-27	21.5	0.004	200	0.4	1.8	21.5	0.004	200	0.4	1.8
SM-28	20.6	0.004	200	0.8	3.7	20.6	0.004	200	0.8	3.7
SM-29	20.7	0.004	200	1.1	5.5	20.7	0.004	200	1.1	5.5
SM-30	31.6	0.009	200	0.4	1.2	31.6	0.009	200	0.4	1.2
SM-31	23.1	0.005	200	0.8	3.3	23.1	0.005	200	0.8	3.3
SM-32	21.6	0.004	200	1.1	5.2	21.6	0.004	200	1.1	5.2
SM-33	24.8	0.006	200	0.0	0.0	24.8	0.006	200	0.0	0.0
SM-34	13.7	0.002	200	0.4	2.8	13.7	0.002	200	0.4	2.8
SM-35	20.6	0.004	200	0.8	3.7	20.6	0.004	200	0.8	3.7
SM-36	58.4	0.032	200	1.1	1.9	58.4	0.032	200	1.1	1.9
SM-37	18.8	0.003	200	2.3	12.1	18.8	0.003	200	2.3	12.1
SM-38	19.2	0.003	200	2.6	13.7	19.2	0.003	200	2.6	13.7
SM-39	30.1	0.003	250	3.4	11.3	30.1	0.003	250	3.4	11.3
SM-40	31.9	0.003	250	3.8	11.8	31.9	0.003	250	3.8	11.8
SM-41	33.5	0.003	250	4.1	12.4	33.5	0.003	250	4.1	12.4
SM-42	30.4	0.003	250	4.5	14.9	30.4	0.003	250	4.5	14.9
SM-43	56.1	0.003	300	4.5	8.1	56.1	0.003	300	4.5	8.1
SM-44	49.4	0.003	300	4.9	9.9	49.4	0.003	300	4.9	9.9
SM-45	50.8	0.003	300	9.8	19.3	50.8	0.003	300	9.8	19.3
SM-46	50.7	0.003	300	10.2	20.1	50.7	0.003	300	10.2	20.1
SM-47	20.9	0.004	200	1.9	9.0	20.9	0.004	200	1.9	9.0
SM-48	21.8	0.004	200	2.3	10.4	21.8	0.004	200	2.3	10.4
SM-49	19.2	0.003	200	2.6	13.8	19.2	0.003	200	2.6	13.8
SM-50	21.9	0.004	200	4.9	22.4	21.9	0.004	200	4.9	22.4
SM-51	33.1	0.01	200	5.3	16.0	33.1	0.010	200	5.3	16.0
SM-52	23.2	0.005	200	1.5	6.5	23.2	0.005	200	1.5	6.5
SM-53	19.5	0.004	200	0.4	1.9	19.5	0.004	200	0.4	1.9
SM-54	20.9	0.004	200	1.1	5.4	20.9	0.004	200	1.1	5.4
SM-55	20.8	0.004	200	0.8	3.6	20.8	0.004	200	0.8	3.6
SM-56	23.4	0.005	200	0.4	1.6	23.4	0.005	200	0.4	1.6
SM-57	42.6	0.017	200	0.8	1.8	42.6	0.017	200	0.8	1.8

Kincardine SPS Results

Conduit ID	Existing Conditions					Future Conditions				
	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)
SM-58	24.1	0.005	200	1.9	7.8	24.1	0.005	200	1.9	7.8
SM-59	20.7	0.004	200	0.4	1.8	20.7	0.004	200	0.4	1.8
SM-60	20.6	0.004	200	0.8	3.7	20.6	0.004	200	0.8	3.7
SM-61	32.5	0.01	200	0.4	1.2	32.5	0.010	200	0.4	1.2
SM-62	27.6	0.007	200	1.5	5.5	27.6	0.007	200	1.5	5.5
SM-63	27.4	0.007	200	1.9	6.9	27.4	0.007	200	1.9	6.9
SM-64	24.1	0.005	200	2.3	9.4	24.1	0.005	200	2.3	9.4
SM-65	23.3	0.005	200	2.6	11.3	23.3	0.005	200	2.6	11.3
SM-67	20.8	0.004	200	3.4	16.3	20.8	0.004	200	3.4	16.3
SM-68	29.0	0.008	200	6.0	20.8	29.0	0.008	200	6.0	20.8
SM-69	30.3	0.009	200	6.4	21.1	30.3	0.009	200	6.4	21.1
SM-72	32.4	0.01	200	0.4	1.2	32.4	0.010	200	0.4	1.2
SM-73	28.6	0.008	200	0.8	2.6	28.6	0.008	200	0.8	2.6
SM-74	35.5	0.012	200	0.4	1.1	35.5	0.012	200	0.4	1.1
SM-75	26.1	0.006	200	0.8	2.9	26.1	0.006	200	0.8	2.9
SM-76	25.9	0.006	200	1.1	4.4	25.9	0.006	200	1.1	4.4
SM-77	33.7	0.011	200	0.4	1.1	33.7	0.011	200	0.4	1.1
SM-78	23.9	0.005	200	1.9	7.9	23.9	0.005	200	1.9	7.9
SM-79	24.6	0.006	200	2.3	9.2	24.6	0.006	200	2.3	9.2
SM-80	46.5	0.02	200	0.4	0.8	46.5	0.020	200	0.4	0.8
SM-84	132.3	0.006	375	23.0	17.4	132.3	0.006	375	47.2	35.7
SM-86	70.2	0.014	250	0.4	0.5	70.2	0.014	250	12.5	17.8
SM-88	80.0	0.018	250	1.1	1.4	80.0	0.018	250	13.2	16.5
SM-89	78.1	0.017	250	7.9	10.1	78.1	0.017	250	20.0	25.6
SM-90	41.4	0.005	250	8.3	20.0	41.4	0.005	250	20.4	49.2
SM-92	91.5	0.003	375	23.4	25.6	91.5	0.003	375	47.6	52.0
SM-98	102.9	0.011	300	15.8	15.4	102.9	0.011	300	15.8	15.4
SM-99	188.8	0.038	300	23.8	12.6	188.8	0.038	300	48.0	25.4
SM-576	81.2	0.019	250	0.8	0.9	81.2	0.019	250	12.9	15.8
SM-586	20.4	0.004	200	0.4	1.8	20.4	0.004	200	0.4	1.8
SM-587	20.7	0.004	200	1.9	9.1	20.7	0.004	200	1.9	9.1
SM-588	20.8	0.004	200	2.3	10.9	20.8	0.004	200	2.3	10.9
SM-589	20.7	0.004	200	2.6	12.7	20.7	0.004	200	2.6	12.7
SM-590	20.8	0.004	200	3.0	14.5	20.8	0.004	200	3.0	14.5
SM-591	20.8	0.004	200	8.3	39.9	20.8	0.004	200	8.3	39.9
SM-592	20.8	0.004	200	8.7	41.6	20.8	0.004	200	8.7	41.6
SM-593	21.1	0.004	200	11.3	53.5	21.1	0.004	200	23.4	110.8
SM-594	11.1	0.001	200	11.7	104.9	11.1	0.001	200	23.8	213.6
SM-595	49.9	0.023	200	13.6	27.2	49.9	0.023	200	25.7	51.4

Kincardine SPS Results

Conduit ID	Existing Conditions					Future Conditions				
	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)
SM-596	58.7	0.032	200	13.9	23.7	58.7	0.032	200	26.0	44.3
SM-597	43.9	0.018	200	14.3	32.7	43.9	0.018	200	26.4	60.2
SM-599	88.7	0.073	200	1.1	1.3	88.7	0.073	200	1.1	1.3
SM-810	20.5	0.004	200	1.5	7.3	20.5	0.004	200	1.5	7.3
SM-811	16.6	0.003	200	1.1	6.8	16.6	0.003	200	1.1	6.8
SM-812	31.1	0.009	200	0.8	2.4	31.1	0.009	200	0.8	2.4
SM-813	46.7	0.02	200	0.4	0.8	46.7	0.020	200	0.4	0.8
SM-814	20.8	0.004	200	2.3	10.9	20.8	0.004	200	14.4	68.9
SM-815	23.8	0.005	200	0.4	1.6	23.8	0.005	200	12.5	52.5
SM-816	21.0	0.004	200	0.8	3.6	21.0	0.004	200	12.9	61.1
SM-817	18.5	0.003	200	1.1	6.1	18.5	0.003	200	13.2	71.7
SM-818	26.1	0.006	200	1.5	5.8	26.1	0.006	200	13.6	52.2
SM-819	20.7	0.004	200	1.9	9.1	20.7	0.004	200	14.0	67.6
SM-834	17.1	0.013	150	0.4	2.2	17.1	0.013	150	0.4	2.2
SM-835	18.8	0.015	150	0.8	4.0	18.8	0.015	150	0.8	4.0
SM-841	26.6	0.007	200	3.0	11.3	26.6	0.007	200	3.0	11.3
SM-963	29.7	0.008	200	4.9	16.5	29.7	0.008	200	4.9	16.5
SM-964	21.6	0.004	200	4.5	21.0	21.6	0.004	200	4.5	21.0
SM-965	25.8	0.006	200	2.6	10.2	25.8	0.006	200	2.6	10.2
SM-966	21.2	0.004	200	2.3	10.7	21.2	0.004	200	2.3	10.7
SM-967	21.9	0.004	200	0.4	1.7	21.9	0.004	200	0.4	1.7
SM-969	45.6	0.019	200	0.4	0.8	45.6	0.019	200	0.4	0.8
SM-970	45.6	0.019	200	0.8	1.7	45.6	0.019	200	0.8	1.7
SM-971	45.0	0.019	200	1.1	2.5	45.0	0.019	200	1.1	2.5
SM-972	43.6	0.018	200	1.5	3.5	43.6	0.018	200	1.5	3.5
SM-973	42.7	0.017	200	0.4	0.9	42.7	0.017	200	0.4	0.9
SM-974	39.5	0.015	200	0.8	1.9	39.5	0.015	200	0.8	1.9
SM-975	38.8	0.014	200	1.1	2.9	38.8	0.014	200	1.1	2.9
SM-976	39.7	0.015	200	1.5	3.8	39.7	0.015	200	1.5	3.8

Notes:

Denotes greater than 80% capacity utilized.

Denotes greater than 100% capacity utilized (i.e. surcharging).

Municipality of Kincardine
Huron Terrace SPS
Station and Forcemain Summary

Job # :	16130
Date :	October 3, 2016
Revised :	

1.0 Background

The Huron Terrace SPS was constructed under BMROSS project 79016.
2 pumps were replaced under BMROSS project 97092.

2.0 Existing Station Data

Existing pump curve:

Pump Model	1 Pump		2 Pumps - Parallel	
	Q (L/s)	TDH (m)	Q (L/s)	TDH (m)
Crane-Deming Pumps - Dry Pit, non-clog centrifugal pumps vertical Size 6x4x15x3 Code 4276 (3 pumps originally installed in 1979; 2 replaced with the same pumps in 1999)	0	73.2	0	73.2
	12.6	71	25.2	71
	25.2	68.9	50.4	68.9
	37.9	66.4	75.8	66.4
	50.5	64	101	64
	63.1	60.7	126.2	60.7
	75.7	56.4	151.4	56.4
	88.3	52.3	176.6	52.3
	100.9	46.3	201.8	46.3
	107.3	41.5	214.6	41.5
	113.6	25.9	227.2	25.9

Elevations:	Forcemain discharge elevation	198.90	mASL
	Wetwell LWL	176.00	mASL
	Wetwell HWL	177.67	mASL
	Wetwell nominal	176.84	mASL
	Forcemain length	2950	m
	Forcemain diameter	300	mm

3.0 Pumping Station Configuration

The station is a 2+1 (2 duty + 1 standby).

4.0 Forcemain Velocity

From the MOE Design Guidelines, a minimum velocity of 0.6m/s should be maintained. The maximum velocity in the forcemain should not exceed 3.0m/s.

Check headloss at C=120, 130, and 140.

Flow - minimum for design scenarios	100	L/s
Flow - maximum for design scenarios	450	L/s
Diameter	300	mm
Velocity (minimum)	1.41	m/s
Velocity (maximum)	6.37	m/s

5.0 Station Piping Velocity

From MOE Design Guidelines, velocity in discharge piping should be in the range of 0.8 to 4.0 m/s.

Flow - minimum for design scenarios	100	L/s
Flow - maximum for design scenarios	450	L/s

Pipe Diameter	Velocity at Min. Scenario	Velocity at Max. Scenario
(mm)	(m/s)	(m/s)
250	2.04	9.17

6.0 System Curve - Existing

6.1 Discharge Piping (Assume all 250 mm diameter)

Fittings - 250 mm dia.	Quantity	"k" value	Total "k"
100x250 increaser	1	27.56	27.56
Check valve	1	2.00	2.00
Gate valve	1	0.06	0.06
90 degree bends	1	0.25	0.25
250x350 increaser	1	0.09	0.09
Total "k"			29.97

Pipe diameter:	250	mm
Pipe length (assume):	8.5	m

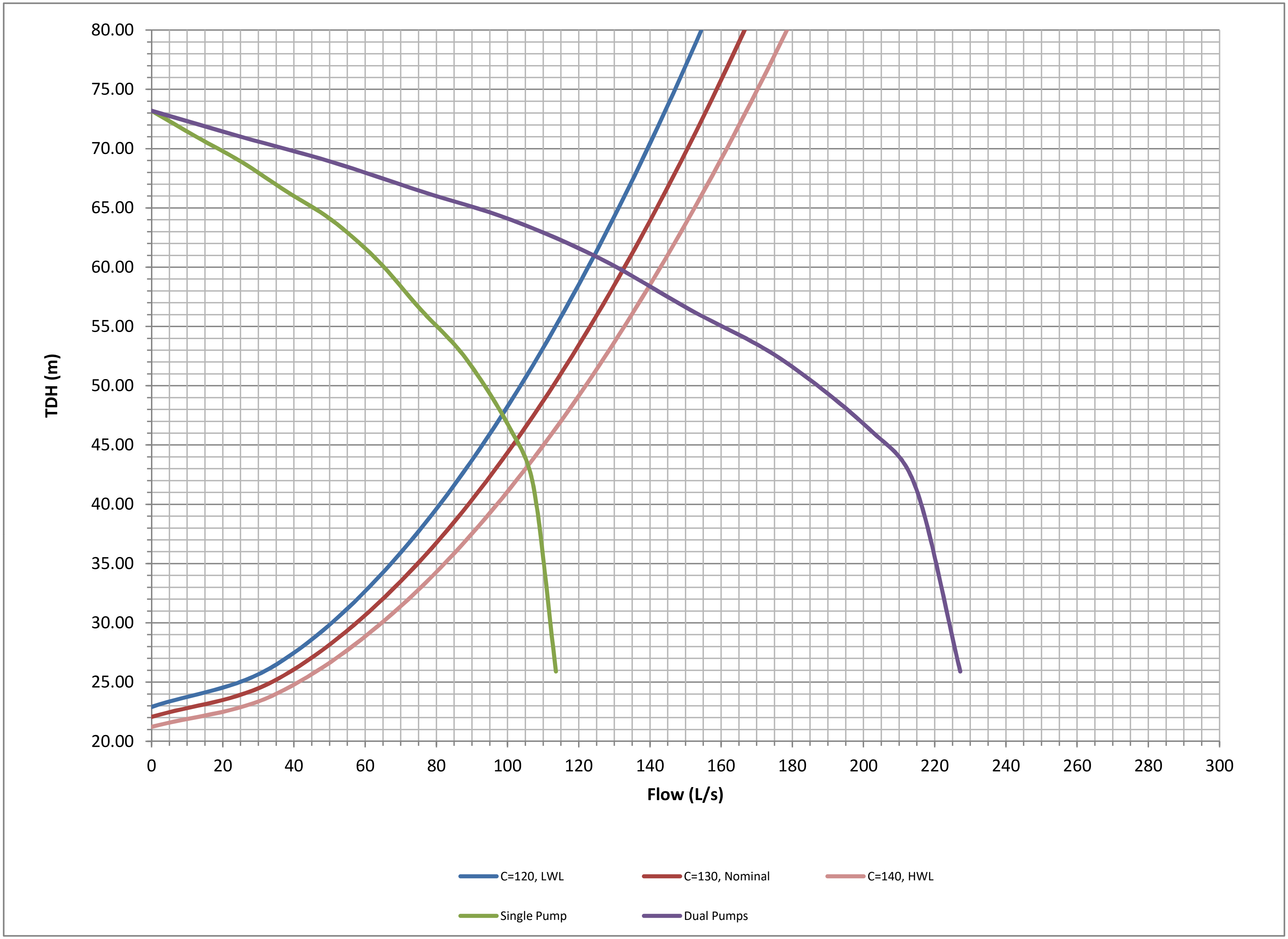
Discharge (L/s)	Flow Velocity (m/s)	Headloss (m)		
		In Pipe	In Fittings	Total
35	0.50	0.02	0.37	0.39
70	0.99	0.07	1.50	1.57
105	1.49	0.15	3.37	3.52
140	1.98	0.25	5.99	6.24
175	2.48	0.38	9.37	9.74
210	2.97	0.53	13.49	14.01
245	3.47	0.70	18.36	19.06
280	3.96	0.90	23.97	24.87
315	4.46	1.12	30.34	31.46
350	4.95	1.36	37.46	38.82
385	5.45	1.62	45.33	46.95
420	5.94	1.90	53.94	55.85
455	6.44	2.21	63.31	65.51

6.2 Forcemain - Existing

Wetwell LWL	176.00	mASL
Wetwell HWL	177.67	mASL
Wetwell nominal WL	176.84	mASL
Maximum static head	22.90	m
Minimum static head	21.23	m
Nominal static head	22.07	m

Flow (L/s)	Friction Loss C=120 (m)	Friction Loss C=130 (m)	Friction Loss C=140 (m)	Station Loss (m)
0	0.00	0.00	0.00	0.00
35	3.18	2.74	2.39	0.39
70	11.45	9.87	8.61	1.57
105	24.24	20.91	18.23	3.52
140	41.28	35.60	31.04	6.24
175	62.37	53.79	46.90	9.74
210	87.40	75.37	65.71	14.01
245	116.24	100.24	87.40	19.06
280	148.81	128.33	111.89	24.87
315	185.04	159.57	139.13	31.46
350	224.86	193.91	169.07	38.82
385	268.22	231.30	201.67	46.95
420	315.06	271.70	236.89	55.85
455	365.35	315.06	274.70	65.51

Flow (L/s)	TDH LWL, C=120 (m)	TDH Nom, C=130 (m)	TDH HWL, C=140 (m)
0	22.90	22.07	21.23
35	26.47	25.20	24.01
70	35.92	33.51	31.41
105	50.66	46.49	42.98
140	70.42	63.90	58.51
175	95.02	85.60	77.87
210	124.31	111.45	100.95
245	158.19	141.36	127.68
280	196.58	175.27	157.99
315	239.40	213.10	191.82
350	286.58	254.79	229.12
385	338.07	300.31	269.85
420	393.81	349.61	313.97
455	453.76	402.64	361.44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75.00
70.00
65.00
60.00
55.00
50.00
45.00
40.00
35.00
30.00
25.00
20.00
TDH (m)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
Flow (L/s)
C=120, LWL
C=130, Nominal
C=140, HWL
Single Pump
Dual Pumps

Municipality of Kincardine
Durham Street SPS
Station and Forcemain Summary

Job # :	16130
Date :	October 3, 2016
Revised :	

1.0 Background

The Durham St SPS was constructed under BMROSS project 79017.

2.0 Existing Station Data

Existing pump curve:

Pump Model	1 Pump		2 Pumps - Parallel	
	Q (L/s)	TDH	Q (L/s)	TDH
Crane-Deming 7370 size 4x10x3 10HP 1750rpm code 438 Curve Number 31248	0	25	0	25
	6.3	22.3	12.6	22.3
	12.6	20.6	25.2	20.6
	18.9	19.1	37.8	19.1
	25.2	17.7	50.4	17.7
	31.5	16.3	63	16.3
	37.9	14.6	75.8	14.6
	44.2	13	88.4	13
	50.5	11	101	11

Elevations:	Forcemain discharge elevation	199.90	mASL
	Wetwell LWL	189.20	mASL
	Wetwell HWL	190.22	mASL
	Wetwell nominal	189.71	mASL
	Forcemain length	152	m
	Forcemain diameter	150	mm

3.0 Pumping Station Configuration

The station is a 1+1 (duty + standby).

4.0 Forcemain Velocity

From the MOE Design Guidelines, a minimum velocity of 0.6m/s should be maintained. The maximum velocity in the forcemain should not exceed 3.0m/s.

Check headloss at C=120, 130, and 140.

Flow - minimum for design scenarios	20	L/s
Flow - maximum for design scenarios	120	L/s
Diameter	150	mm
Velocity (minimum)	1.13	m/s
Velocity (maximum)	6.79	m/s

5.0 Station Piping Velocity

From MOE Design Guidelines, velocity in discharge piping should be in the range of 0.8 to 4.0 m/s.

Flow - minimum for design scenarios	20	L/s
Flow - maximum for design scenarios	120	L/s

Pipe Diameter	Velocity at Min. Scenario	Velocity at Max. Scenario
(mm)	(m/s)	(m/s)
150	1.13	6.79

6.0 System Curve

6.1 Discharge Piping (Assume all 150 mm diameter)

Fittings - 150 mm dia.	Quantity	"k" value	Total "k"
90 degree bends	2	0.29	0.58
100x150 increaser	1	1.56	1.56
Gate valve	1	0.11	0.11
Check valve	1	2.00	2.00
Tee; branch	2	0.62	1.24
Total "k"			5.49

Pipe diameter:	150	mm
Pipe length (assume):	6.0	m

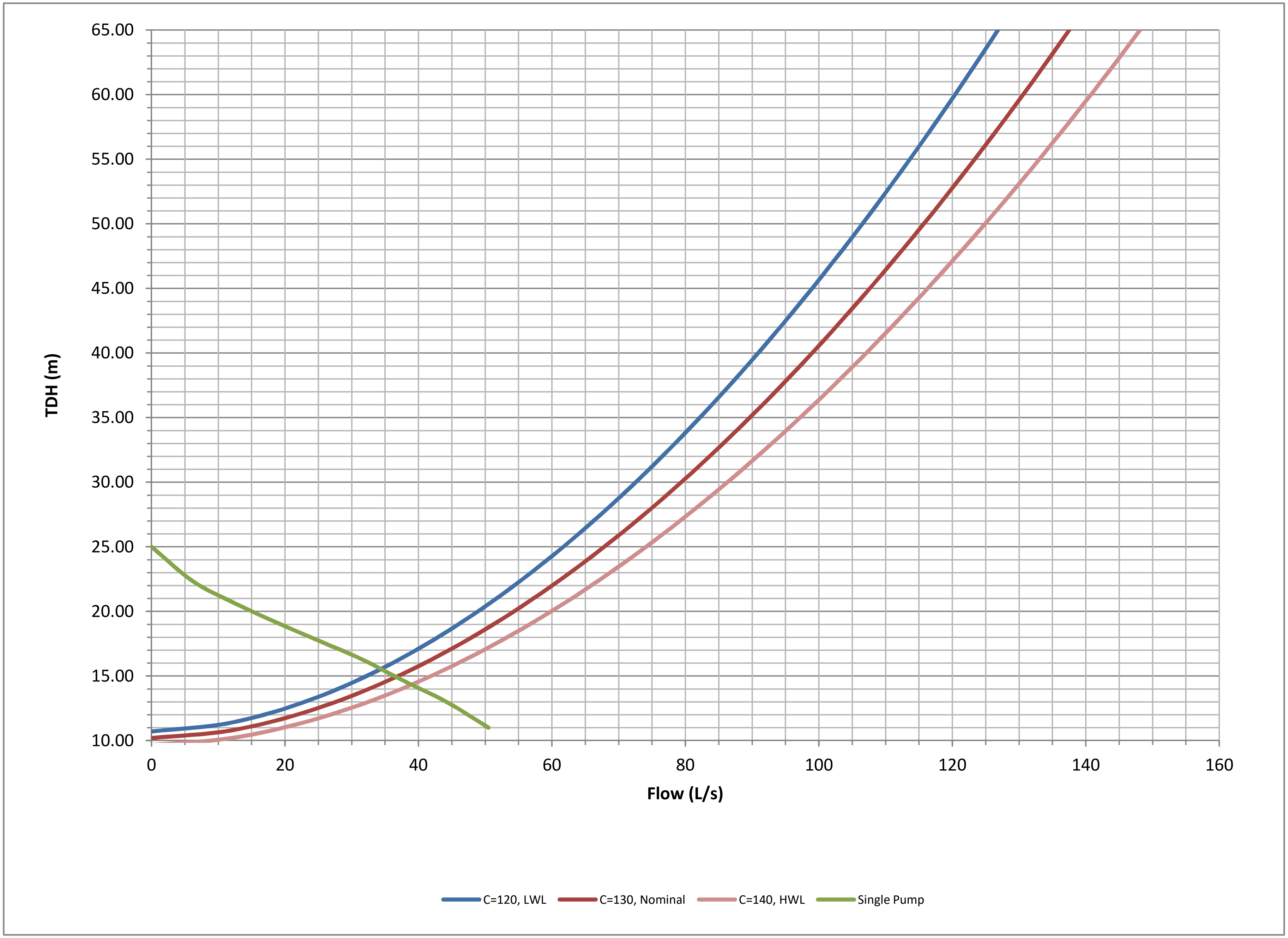
Discharge (L/s)	Flow Velocity (m/s)	Headloss (m)		
		In Pipe	In Fittings	Total
12	0.17	0.02	0.01	0.03
24	0.34	0.08	0.03	0.11
36	0.51	0.17	0.07	0.24
48	0.68	0.29	0.13	0.42
60	0.85	0.44	0.20	0.64
72	1.02	0.62	0.29	0.91
84	1.19	0.82	0.40	1.22
96	1.36	1.05	0.52	1.57
108	1.53	1.31	0.65	1.96
120	1.70	1.59	0.81	2.40
132	1.87	1.90	0.98	2.88
144	2.04	2.23	1.16	3.39
156	2.21	2.59	1.36	3.95

6.2 Forcemain

Wetwell LWL	189.20	mASL
Wetwell HWL	190.22	mASL
Wetwell nominal WL	189.71	mASL
Maximum static head	10.70	m
Minimum static head	9.68	m
Nominal static head	10.19	m

Flow (L/s)	Friction Loss C=120 (m)	Friction Loss C=130 (m)	Friction Loss C=140 (m)	Station Loss (m)
0	0.00	0.00	0.00	0.00
12	0.66	0.57	0.50	0.03
24	2.37	2.05	1.78	0.11
36	5.03	4.33	3.78	0.24
48	8.56	7.38	6.43	0.42
60	12.93	11.15	9.72	0.64
72	18.12	15.62	13.62	0.91
84	24.09	20.78	18.12	1.22
96	30.85	26.60	23.19	1.57
108	38.36	33.08	28.84	1.96
120	46.61	40.19	35.05	2.40
132	55.60	47.95	41.80	2.88
144	65.31	56.32	49.10	3.39
156	75.73	65.31	56.94	3.95

Flow (L/s)	TDH LWL, C=120 (m)	TDH Nom, C=130 (m)	TDH HWL, C=140 (m)
0	10.70	10.19	9.68
12	11.39	10.79	10.21
24	13.19	12.35	11.58
36	15.97	14.77	13.70
48	19.68	17.99	16.53
60	24.27	21.98	20.04
72	29.73	26.72	24.21
84	36.01	32.19	29.01
96	43.12	38.36	34.44
108	51.02	45.23	40.48
120	59.71	52.78	47.12
132	69.17	61.01	54.36
144	79.40	69.90	62.18
156	90.38	79.45	70.57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60.00
55.00
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
TDH (m)
0
20
40
60
80
100
120
140
160
Flow (L/s)
C=120, LWL
C=130, Nominal
C=140, HWL
Single Pump

Municipality of Kincardine
Park Street SPS
Station and Forcemain Summary

Job # :	16130
Date :	October 3, 2016
Revised :	

1.0 Background

The Park St. SPS was constructed under BMROSS project 75056B.

2.0 Existing Station Data

Existing pump curve:

Pump Model	1 Pump		2 Pumps - Parallel	
	Q (L/s)	TDH	Q (L/s)	TDH
Fairbanks Morse 30HP 1750 rpm 575 volts 4" model number 5443	0	35.4	0	35.4
	12.6	31.1	25.2	31.1
	25.2	29	50.4	29
	37.9	27	75.8	27
	50.5	24.4	101	24.4
	63.1	22.9	126.2	22.9
	75.7	19.8	151.4	19.8
	88.3	17.2	176.6	17.2

Elevations:	Forcemain discharge elevation	201.20	mASL
	Wetwell LWL	187.30	mASL
	Wetwell HWL	188.70	mASL
	Wetwell nominal	188.00	mASL
	Forcemain length	1280	m
	Forcemain diameter	300	mm

3.0 Pumping Station Configuration

The station is a 2+1 (2 duty + 1 standby).

4.0 Forcemain Velocity

From the MOE Design Guidelines, a minimum velocity of 0.6m/s should be maintained. The maximum velocity in the forcemain should not exceed 3.0m/s.

Check headloss at C=120, 130, and 140.

Flow - minimum for design scenarios	20	L/s
Flow - maximum for design scenarios	200	L/s
Diameter	300	mm
Velocity (minimum)	0.28	m/s
Velocity (maximum)	2.83	m/s

5.0 Station Piping Velocity

From MOE Design Guidelines, velocity in discharge piping should be in the range of 0.8 to 4.0 m/s.

Flow - minimum for design scenarios	20	L/s
Flow - maximum for design scenarios	200	L/s

Pipe Diameter	Velocity at Min. Scenario	Velocity at Max. Scenario
(mm)	(m/s)	(m/s)
250	0.41	4.07

6.0 System Curve

6.1 Discharge Piping (Assume all 250 mm diameter)

Fittings - 250 mm dia.	Quantity	"k" value	Total "k"
Bellmouth inlet - suction	1	0.05	0.05
90 degree bends	1	0.25	0.25
250 to 300 increaser	1	0.09	0.09
100x250 increaser	1	27.56	27.56
Gate valve	1	0.06	0.06
Check valve	1	2.00	2.00
45 degree bend	1	0.16	0.16
Tee; run	2	0.09	0.18
Total "k"			30.36

Pipe diameter:	250	mm
Pipe length (assume):	7.0	m

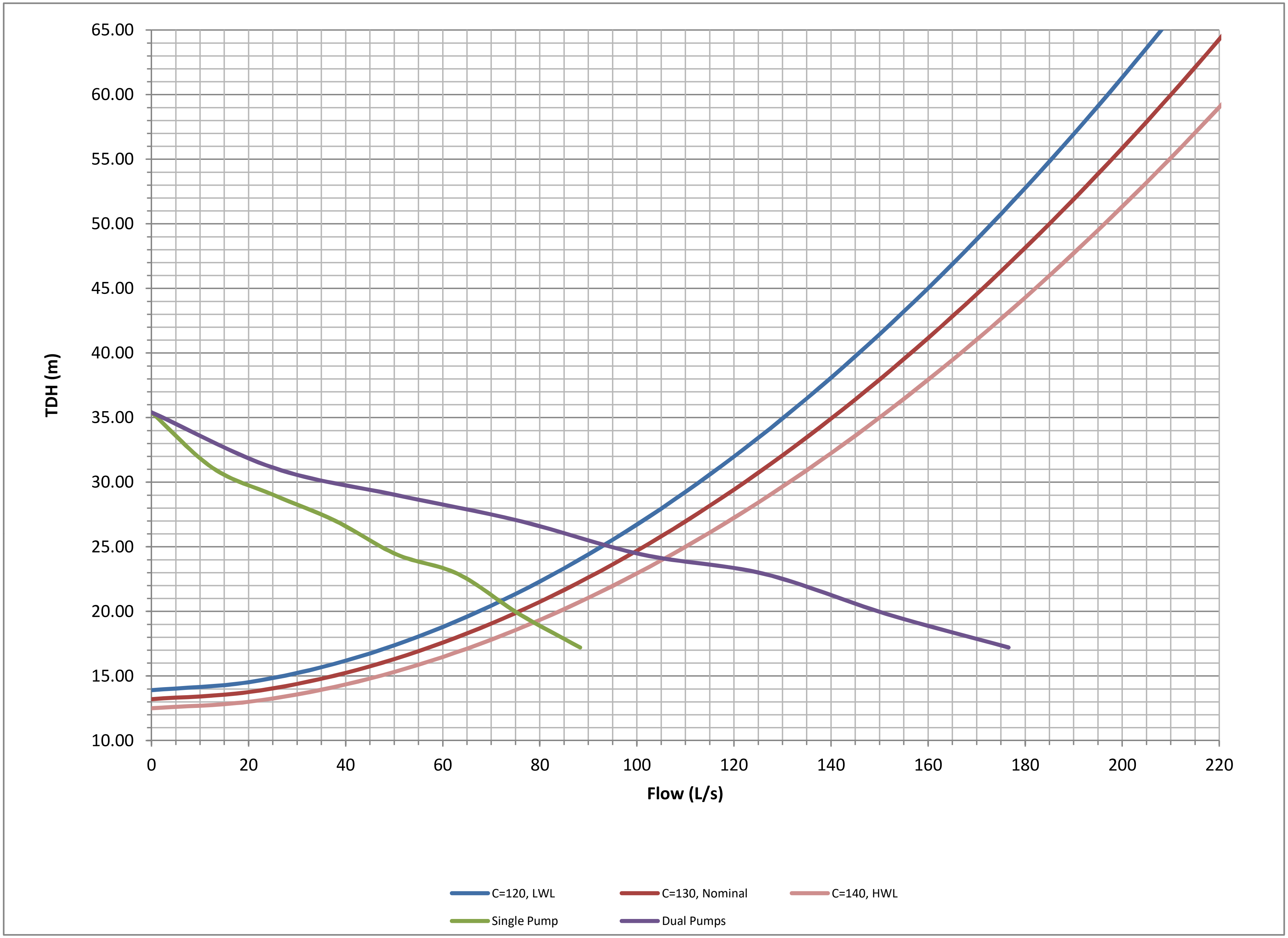
Discharge	Flow Velocity	Headloss (m)		
(L/s)	(m/s)	In Pipe	In Fittings	Total
20	0.28	0.01	0.12	0.13
40	0.57	0.02	0.50	0.52
60	0.85	0.04	1.12	1.16
80	1.13	0.07	1.98	2.06
100	1.41	0.11	3.10	3.21
120	1.70	0.15	4.46	4.62
140	1.98	0.21	6.07	6.28
160	2.26	0.26	7.93	8.19
180	2.55	0.33	10.04	10.36
200	2.83	0.40	12.39	12.79
220	3.11	0.47	14.99	15.47
240	3.40	0.56	17.84	18.40
260	3.68	0.65	20.94	21.59

6.2 Forcemain

Wetwell LWL	187.30	mASL
Wetwell HWL	188.70	mASL
Wetwell nominal WL	188.00	mASL
Maximum static head	13.90	m
Minimum static head	12.50	m
Nominal static head	13.20	m

Flow (L/s)	Friction Loss C=120 (m)	Friction Loss C=130 (m)	Friction Loss C=140 (m)	Station Loss (m)
0	0.00	0.00	0.00	0.00
20	0.49	0.42	0.37	0.13
40	1.76	1.52	1.33	0.52
60	3.74	3.22	2.81	1.16
80	6.36	5.49	4.78	2.06
100	9.61	8.29	7.23	3.21
120	13.47	11.61	10.13	4.62
140	17.91	15.45	13.47	6.28
160	22.93	19.77	17.24	8.19
180	28.51	24.59	21.44	10.36
200	34.65	29.88	26.05	12.79
220	41.33	35.64	31.07	15.47
240	48.55	41.87	36.50	18.40
260	56.30	48.55	42.33	21.59

Flow (L/s)	TDH LWL, C=120 (m)	TDH Nom, C=130 (m)	TDH HWL, C=140 (m)
0	13.90	13.20	12.50
20	14.52	13.75	13.00
40	16.18	15.24	14.34
60	18.79	17.58	16.47
80	22.32	20.74	19.34
100	26.72	24.70	22.93
120	31.98	29.43	27.24
140	38.09	34.92	32.24
160	45.02	41.17	37.93
180	52.78	48.15	44.30
200	61.34	55.87	51.34
220	70.70	64.31	59.04
240	80.85	73.47	67.40
260	91.78	83.33	76.41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60.00
55.00
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
TDH (m)
0
20
40
60
80
100
120
140
160
180
200
220
Flow (L/s)
C=120, LWL
C=130, Nominal
C=140, HWL
Single Pump
Dual Pumps

Municipality of Kincardine
Goderich Street SPS
Station and Forcemain Summary

Job # : 16130
Date : October 3, 2016
Revised :

1.0 Background

The Goderich St. SPS was constructed under BMROSS project 76007-2.

2.0 Existing Station Data

Existing pump curve:

Pump Model	1 Pump		2 Pumps - Parallel	
	Q (L/s)	TDH	Q (L/s)	TDH
not sure about impeller diameter, assumed 12", curve 4WD	0	57.9	0	57.9
	12.6	51.8	25.2	51.8
	25.2	48.8	50.4	48.8
	37.8	46.6	75.6	46.6
	50.4	45	100.8	45
	63	42.4	126	42.4

Elevations:	Forcemain discharge elevation	201.50	mASL
	Wetwell LWL	175.03	mASL
	Wetwell HWL	175.86	mASL
	Wetwell nominal	175.45	mASL
	Forcemain length	1455	m
	Forcemain diameter	250	mm

3.0 Pumping Station Configuration

The station is a 1+1 (duty + standby).

4.0 Forcemain Velocity

From the MOE Design Guidelines, a minimum velocity of 0.6m/s should be maintained. The maximum velocity in the forcemain should not exceed 3.0m/s.

Check headloss at C=120, 130, and 140.

Flow - minimum for design scenarios	15	L/s
Flow - maximum for design scenarios	65	L/s
Diameter	250	mm
Velocity (minimum)	0.31	m/s
Velocity (maximum)	1.32	m/s

5.0 Station Piping Velocity

From MOE Design Guidelines, velocity in discharge piping should be in the range of 0.8 to 4.0 m/s.

Flow - minimum for design scenarios	15	L/s
Flow - maximum for design scenarios	65	L/s

Pipe Diameter	Velocity at Min. Scenario	Velocity at Max. Scenario
(mm)	(m/s)	(m/s)
200	0.48	2.07

6.0 System Curve

6.1 Discharge Piping (Assume all 200 mm diameter)

Fittings - 200 mm dia.	Quantity	"k" value	Total "k"
Bellmouth inlet - suction	1	0.05	0.05
90 degree bends	1	0.27	0.27
150x200 increaser	1	0.61	0.61
200x250 increaser	1	0.13	0.13
Gate valve	1	0.08	0.08
Check valve	1	2.00	2.00
Tee; branch	2	0.58	1.16
Total "k"			4.30

Pipe diameter:	200	mm
Pipe length (assume):	7.0	m

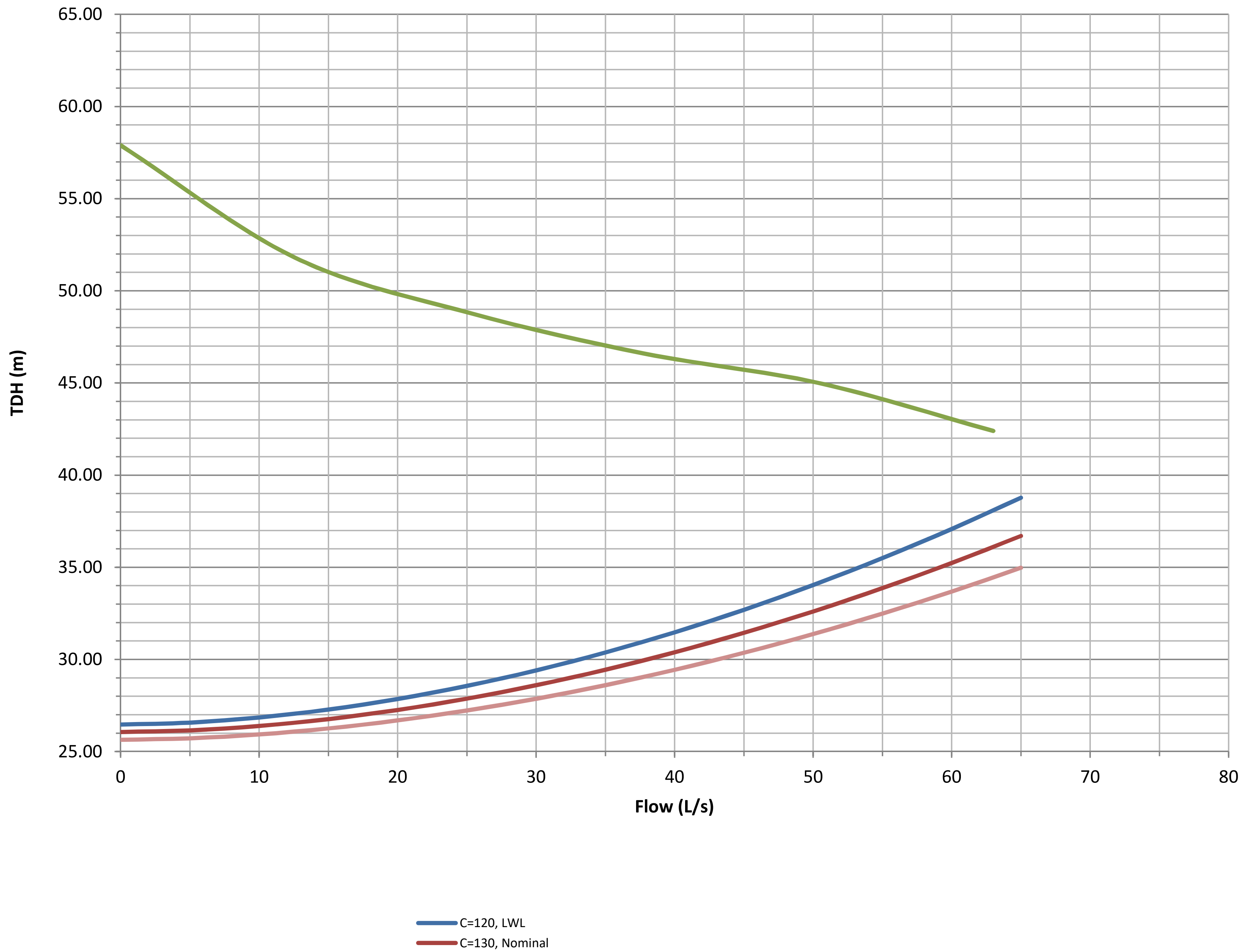
Discharge	Flow Velocity	Headloss (m)		
(L/s)	(m/s)	In Pipe	In Fittings	Total
5	0.07	0.00	0.00	0.00
10	0.14	0.00	0.00	0.01
15	0.21	0.01	0.01	0.02
20	0.28	0.02	0.02	0.03
25	0.35	0.03	0.03	0.05
30	0.42	0.04	0.04	0.07
35	0.50	0.05	0.05	0.10
40	0.57	0.06	0.07	0.13
45	0.64	0.07	0.09	0.16
50	0.71	0.09	0.11	0.20
55	0.78	0.11	0.13	0.24
60	0.85	0.13	0.16	0.28
65	0.92	0.15	0.19	0.33

6.2 Forcemain

Wetwell LWL	175.03	mASL
Wetwell HWL	175.86	mASL
Wetwell nominal WL	175.45	mASL
Maximum static head	26.47	m
Minimum static head	25.64	m
Nominal static head	26.06	m

Flow (L/s)	Friction Loss C=120 (m)	Friction Loss C=130 (m)	Friction Loss C=140 (m)	Station Loss (m)
0	0.00	0.00	0.00	0.00
5	0.10	0.09	0.08	0.00
10	0.38	0.32	0.28	0.01
15	0.79	0.68	0.60	0.02
20	1.35	1.17	1.02	0.03
25	2.04	1.76	1.54	0.05
30	2.86	2.47	2.15	0.07
35	3.81	3.28	2.86	0.10
40	4.87	4.20	3.66	0.13
45	6.06	5.23	4.56	0.16
50	7.36	6.35	5.54	0.20
55	8.78	7.58	6.60	0.24
60	10.32	8.90	7.76	0.28
65	11.97	10.32	9.00	0.33

Flow (L/s)	TDH LWL, C=120 (m)	TDH Nom, C=130 (m)	TDH HWL, C=140 (m)
0	26.47	26.06	25.64
5	26.58	26.15	25.72
10	26.85	26.39	25.93
15	27.28	26.76	26.26
20	27.86	27.25	26.69
25	28.57	27.87	27.23
30	29.41	28.60	27.87
35	30.38	29.44	28.60
40	31.47	30.39	29.43
45	32.69	31.44	30.36
50	34.03	32.61	31.38
55	35.49	33.87	32.49
60	37.07	35.24	33.68
65	38.77	36.71	34.97


65.00
60.00
55.00
50.00
45.00
40.00
35.00
30.00
25.00
TDH (m)
0
10
20
30
40
50
60
70
80
Flow (L/s)
C=120, LWL
C=130, Nominal

Municipality of Kincardine
Kincardine Avenue SPS
Station and Forcemain Summary

Job # :	16130
Date :	October 3, 2016
Revised :	

1.0 Background

The Kincardine Ave. SPS was constructed under BMROSS project 76007-2.

2.0 Existing Station Data

Existing pump curve:

Pump Model	1 Pump		2 Pumps - Parallel	
	Q (L/s)	TDH	Q (L/s)	TDH
not sure about impeller diameter, assumed 11", curve 4WC	0	44.2	0	44.2
	12.6	40.8	25.2	40.8
	25.2	38.1	50.4	38.1
	37.8	35.1	75.6	35.1
	50.4	32.3	100.8	32.3
	63	29.7	126	29.7
	75.6	25.9	151.2	25.9

Elevations:	Forcemain discharge elevation	201.50	mASL
	Wetwell LWL	185.60	mASL
	Wetwell HWL	186.67	mASL
	Wetwell nominal	186.14	mASL
	Forcemain length	821	m
	Forcemain diameter	250	mm

3.0 Pumping Station Configuration

The station is a 1+1 (duty + standby).

4.0 Forcemain Velocity

From the MOE Design Guidelines, a minimum velocity of 0.6m/s should be maintained. The maximum velocity in the forcemain should not exceed 3.0m/s.

Check headloss at C=120, 130, and 140.

Flow - minimum for design scenarios	15	L/s
Flow - maximum for design scenarios	65	L/s
Diameter	250	mm
Velocity (minimum)	0.31	m/s
Velocity (maximum)	1.32	m/s

5.0 Station Piping Velocity

From MOE Design Guidelines, velocity in discharge piping should be in the range of 0.8 to 4.0 m/s.

Flow - minimum for design scenarios	15	L/s
Flow - maximum for design scenarios	65	L/s

Pipe Diameter	Velocity at Min. Scenario	Velocity at Max. Scenario
(mm)	(m/s)	(m/s)
200	0.48	2.07

6.0 System Curve

6.1 Discharge Piping (Assume all 200 mm diameter)

Fittings - 200 mm dia.	Quantity	"k" value	Total "k"
100 to 200 increaser	1	9.00	9.00
90 degree bends	1	0.27	0.27
45 degree bends	1	0.17	0.17
200 to 250 increaser	1	0.13	0.13
Gate valve	1	0.08	0.08
Check valve	1	2.00	2.00
Tee; branch	1	0.58	0.58
Tee; run	1	0.11	0.11
Total "k"			12.34

Pipe diameter:	200	mm
Pipe length (assume):	9.0	m

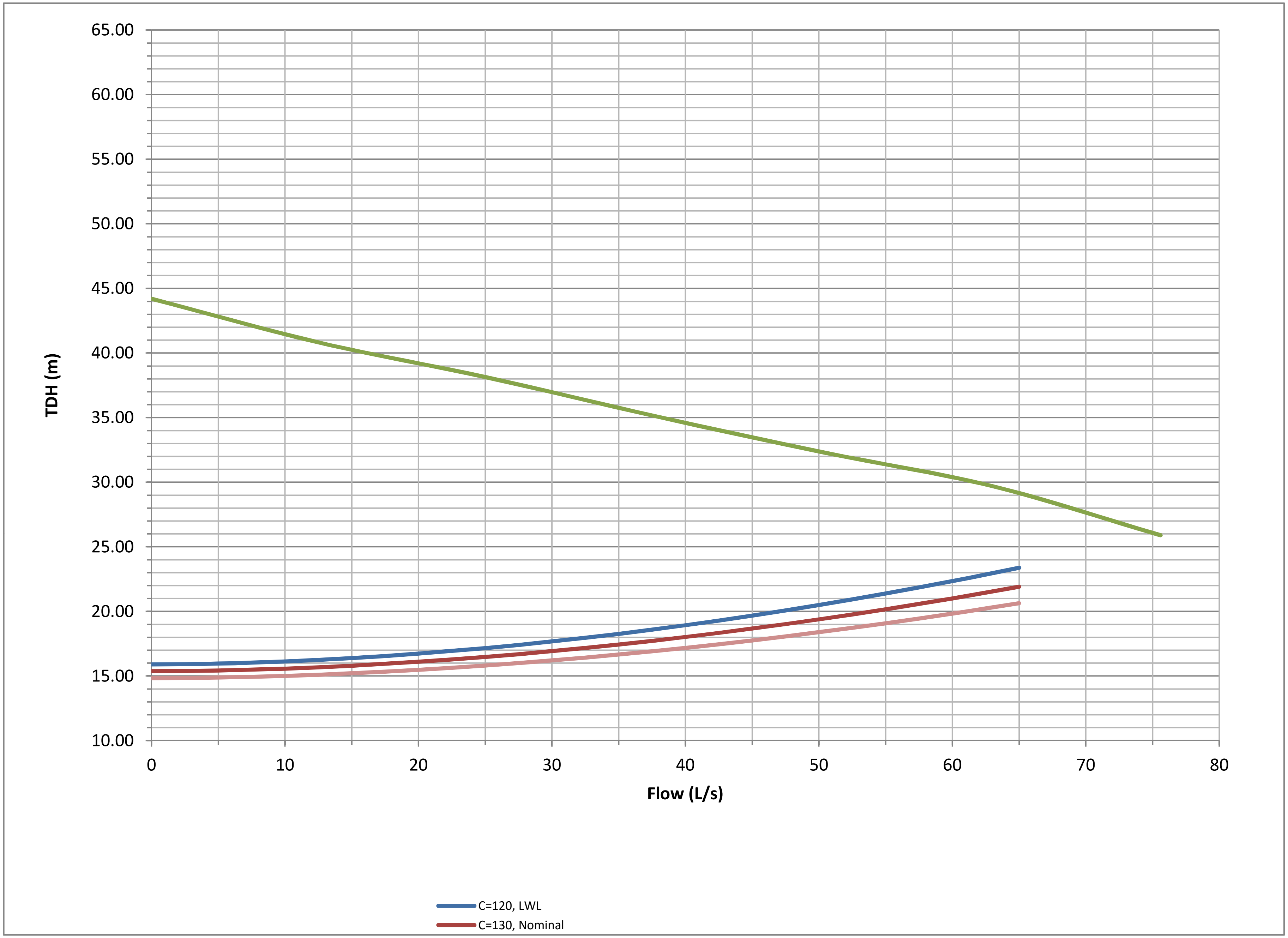
Discharge	Flow Velocity	Headloss (m)		
(L/s)	(m/s)	In Pipe	In Fittings	Total
5	0.07	0.00	0.00	0.00
10	0.14	0.01	0.01	0.02
15	0.21	0.01	0.03	0.04
20	0.28	0.02	0.05	0.07
25	0.35	0.03	0.08	0.11
30	0.42	0.05	0.11	0.16
35	0.50	0.06	0.15	0.21
40	0.57	0.08	0.20	0.28
45	0.64	0.10	0.26	0.35
50	0.71	0.12	0.31	0.43
55	0.78	0.14	0.38	0.52
60	0.85	0.16	0.45	0.62
65	0.92	0.19	0.53	0.72

6.2 Forcemain

Wetwell LWL	185.60	mASL
Wetwell HWL	186.67	mASL
Wetwell nominal WL	186.14	mASL
Maximum static head	15.90	m
Minimum static head	14.83	m
Nominal static head	15.37	m

Flow (L/s)	Friction Loss C=120 (m)	Friction Loss C=130 (m)	Friction Loss C=140 (m)	Station Loss (m)
0	0.00	0.00	0.00	0.00
5	0.06	0.05	0.04	0.00
10	0.21	0.18	0.16	0.02
15	0.45	0.39	0.34	0.04
20	0.76	0.66	0.57	0.07
25	1.15	0.99	0.87	0.11
30	1.62	1.39	1.21	0.16
35	2.15	1.85	1.62	0.21
40	2.75	2.37	2.07	0.28
45	3.42	2.95	2.57	0.35
50	4.16	3.58	3.12	0.43
55	4.96	4.27	3.73	0.52
60	5.82	5.02	4.38	0.62
65	6.75	5.82	5.08	0.72

Flow (L/s)	TDH LWL, C=120 (m)	TDH Nom, C=130 (m)	TDH HWL, C=140 (m)
0	15.90	15.37	14.83
5	15.96	15.42	14.88
10	16.13	15.57	15.01
15	16.39	15.79	15.21
20	16.73	16.09	15.48
25	17.16	16.47	15.81
30	17.67	16.92	16.20
35	18.26	17.43	16.66
40	18.93	18.02	17.18
45	19.67	18.66	17.75
50	20.49	19.38	18.39
55	21.38	20.16	19.08
60	22.34	21.00	19.82
65	23.37	21.91	20.63


65.00
60.00
55.00
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
TDH (m)
0
10
20
30
40
50
60
70
80
Flow (L/s)
C=120, LWL
C=130, Nominal

APPENDIX F

KINCARDINE WWTP PERFORMANCE REVIEW

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Memo

From: Steve Burns
sburns@bmross.net

To:	Murray Clarke, CAO, Municipality of Kincardine
Re:	Kincardine WWTP – Performance Review
File #:	13255
Date:	March 12, 2014

1.0 Introduction

This review was requested by G. Sandhu in an email dated November 1, 2013. The reference was to a possible study of the Kincardine WWTP to address hydraulic capacity and specifically the consequence of 43 reported exceedances of the design capacity from January 2012 to September 2013.

The memo reviews the performance criteria established in the current Environmental Compliance Approval (ECA) No. 4648-8DVSSR dated April 8, 2011 and then compares those criteria to raw sewage flows and effluent quality data for January 2011 to September 2013. The goal was to identify non-compliance and provide recommendations regarding future actions.

2.0 Performance Criteria

2.1 Regulatory Requirements

The Kincardine WWTP currently operates under ECA No. 4648-8DVSSR dated April 8, 2011. This ECA sets out the following performance criteria:

- A hydraulic (i.e. flow) rating of 5,910 m^3/d expressed as an annual "Average Daily Flow". In effect the WWTP is "rated" to receive 2,157,150 m^3 annually.

- Effluent <u>Objectives</u> (Table 1) set out as concentrations and listed as follows:

    - $CBOD_5$ = 25 mg/L
    - TSS = 30 mg/L
    - TP = 1.0 mg/L
    - E.coli = 150 organisms/100 ml

- Effluent Limits (Table 2) set out as both monthly average concentrations and monthly average loadings.

	Concentration (mg/L)	Loading (kg/d)
$CBOD_5$	30.0	177.0
TSS	40.0	236.0
TP	1.0	5.9

The loading limits (i.e. “kg/day”) are determined by multiplying the average daily effluent flow for the month by the average concentration for all samples take in the same month. There are also limits for E. coli and pH.

2.2 Interpretation

Objective values (Table 1) are more stringent and come with the following responsibility:

> “*The Owner shall use best efforts to design, construct and operate the Works with the objective that the concentrations of the materials named below as effluent parameters are not exceeded in the effluent from the Works*.”

Limit values (Table 2) are used to judge compliance. A failure to meet the limit values typically attracts the attention of the MOE and theoretically, but rarely, could result in charges. The responsibility is stated as follows:

> “*The Owner shall ……. operate and maintain the Works such that the concentrations and waste loadings of the materials named below as effluent parameters are not exceeded in the effluent from the Works*.”

The Owner’s responsibility regarding flows or volume is stated as Condition 6(2)(b) of the ECA as follows:

> “*The Owner shall use best efforts to…..Operate the works within the Rated Capacity of the Works*”

It is important to note that the requirement is “best effort” and the “rated capacity” is effectively 2,157,150 m^3/year.

3.0 PERFORMANCE ASSESSMENT

We have evaluated flow and effluent quality data for the period January 2011 to September 2013 (i.e. 33 months). A summary of the data is attached to this memo. We note the following:

- Of the 3 years, we only had a full calendar year of inflow data for 2011. In that year the facility operated at approximately 76% of hydraulic capacity.

- Based on 31 months of flow data, it has been operating at about 75% of capacity
- There have been no flow exceedances.
- The $CBOD_5$ objective (25 mg/L) was exceeded one time (July 2012). There have been no exceedances of the $CBOD_5$ concentration or loading limits. We would consider the one exceedance an anomaly.
- The Total Phosphorus (TP) objectives have consistently been met.
- Over 33 months there have been 8 exceedances of the Total Suspended Solids(TSS) objectives. Of the 8 occasions, there were 6 exceedances of the TSS limit value of 40 mg/L.
- There have been no exceedances of the TSS loading (kg/day) limits. The highest single value was 185 kg/day which is 75% of the allowable. TSS loadings are typically less than 30% of allowable.
- TSS values typically increase in the later part of the summer. (i.e. July to September).

4.0 DISCUSSION

There are no flow exceedances, but there are relatively frequent exceedances of the concentration limits for Total Suspended Solids (TSS). These are occurring in the later part of the summer, typically coincident with low flows not high flows. When the TSS concentrations spike, other parameters (e.g. $CBOD_5$ and TP) usually remain within objective values, well below limits.

The timing of the exceedances, the low flows and the otherwise reasonably good effluent quality are all indicative of algae blooms occurring in the lagoons. This is a natural phenomena and a normal occurrence in lagoon based systems. It is considered to be more of an aesthetic problem than an environmental problem.

The effluent quality required by the current ECA recognizes that the WWTP is essentially 1960's technology. New facilities would have much more stringent requirements. A benefit to the Municipality is the relatively low cost of operation.

The following options are available to the Municipality:

- Investigate alternatives for additional treatment to address the TSS exceedances
- Do nothing

Additional Treatment

Elevated TSS concentrations are generally addressed through the addition of filtration, although current concentrations are such that there could be operational issues due to filter clogging. This would have to be reviewed carefully with equipment suppliers. There may also be options such as temporarily stopping discharging, aeration of the lagoons, or re-circulation.

None of the non-operational alternatives would require an environmental assessment although they would require an amendment to the existing ECA. It is important to note that applying for an amendment to the ECA could trigger expectations from the MOE for a wholesale upgrade. We note that did not happen with the recent conversion to UV disinfection.

Do Nothing

At some point the MOE will conduct an inspection of the works and review its performance. When they do, they may ask the Municipality to comment on the elevated TSS concentrations and they may ask that steps be taken to reduce them.

Part of the Municipality's response could be to point out the probability that exceedances are directly related to algae blooms and more importantly, although concentrations are high, loadings are a fraction of what is permitted. The MOE may accept this position or they may not and if not, require additional investigation.

Essentially the difference between the two alternatives is whether the Municipality wishes to be proactive or reactive in terms of the issue. Sometimes, pressure from the Province and a corresponding paper trail is an asset when applying for financial assistance.

Summary and Conclusions

Flows and effluent quality at the Kincardine WWTP were examined for the period January 2011 to September 2013. Data was compared to the objective and limit criteria in the current ECA. The only exceedances of current performance criteria are for Total Suspended Solids. TSS is exceeded frequently during the later part of the summer. Exceedances are most likely related to algae in the lagoons. There have been no flow exceedances and the facility operates at approximately 75% of capacity.

The options are to investigate additional treatment or to do nothing and wait until the MOE raises the issue. To propose additional treatment for TSS could result in the MOE expecting a wholesale plant upgrade.

Stephen D. Burns, P. Eng.

SDB:hv

KINCARDINE WWTP

EFFLUENT SUMMARY - JAN. 2011 TO SEPT. 2013

Project No. 13255
February 7/14

Actual Effluent Values (2011)

Parameter	C of A Objectives	Limits		January			February			March			April			May			June		
				Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)
Flow	-	2157150 m^3/yr		116361			92807			157954			158859			146039			101546		
$CBOD_5$	25 mg/L	30 mg/L	177.0 kg/d		8.0	30		8.5	28		8.5	43		20.0	106		5.5	26		2.7	9.1
TSS	30 mg/L	40 mg/L	236.0 kg/d		5.0	19		8.0	27		8.5	43		35.0	185		8.5	40		5.7	19
TP	1.0 mg/L	1.0 mg/L	5.9 kg/d		0.13	0.49		0.16	0.53		0.21	1.1		0.16	0.85		0.22	1.0		0.23	0.78
E-Coli	150 cfu/100mL	200 cfu/100mL	-		NA	-		NA	-		NA	-		NA	-		NA	-		NA	-

Parameter	July			August			September			October			November			December			Annual Inflow (m3)
	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	
Flow	70888			65098			61660			102071			109015			65656			1630363
$CBOD_5$		5.0	11		18.5	39		15.0	31		14.0	46		17.5	64		10.7	23	
TSS		11.0	25		43.5	91		45.0	92		27.0	89		17.5	64		15.0	32	
TP		0.18	0.41		0.30	0.63		0.25	0.51		0.40	1.3		0.21	0.76		0.25	0.53	
E-Coli		NA	-		NA	-		NA	-		NA	-		NA	-		NA	-	

Actual Effluent Values (2012)

Parameter	C of A Objectives	Limits		January			February			March			April			May			June		
				Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)
Flow	-	2157150 m^3/yr		0			0			3439			60378			36779			35698		
$CBOD_5$	25 mg/L	30 mg/L	177.0 kg/d		11.0	0		11.0	0		14	1.6		11.0	22		4.3	5.1		13	15.5
TSS	30 mg/L	40 mg/L	236.0 kg/d		13.5	0		16.0	0		23.5	2.6		14.0	28		3.3	3.9		19	23
TP	1.0 mg/L	1.0 mg/L	5.9 kg/d		0.15	0.00		0.14	0.00		0.27	0.030		0.27	0.54		0.20	0.24		0.11	0.13
E-Coli	150 cfu/100mL	200 cfu/100mL	-		NA	-		NA	-		NA	-		NA	-		NA	-		NA	-

Parameter	July			August			September			October			November			December			Annual Inflow (m3)
	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	
Flow	28755			32231			46753			71143			76050			71270			1277244
$CBOD_5$		26.5	25		15.5	16		10.0	16		13.3	31		13.7	35		9.5	22	
TSS		46.0	43		25.3	26		38.0	59		44.5	102		17.3	44		20.5	47	
TP		0.14	0.13		0.16	0.17		0.17	0.26		0.18	0.41		0.13	0.33		0.20	0.46	
E-Coli		NA	-		NA	-		NA	-		NA	-		NA	-		NA	-	

Actual Effluent Values (2013)

Parameter	C of A Objectives	Limits		January			February			March			April			May			June		
				Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)
Flow	-	2157150 m^3/yr		102355			131651			98724			130857			64122			54560		
$CBOD_5$	25 mg/L	30 mg/L	177.0 kg/d		12.5	41		5.5	26		6.0	19		8.0	35		11.3	23		2.5	4.5
TSS	30 mg/L	40 mg/L	236.0 kg/d		20.0	66		9.0	42		12.0	38		12.0	52		15.0	31		3.5	6.4
TP	1.0 mg/L	1.0 mg/L	5.9 kg/d		0.13	0.43		0.06	0.28		0.06	0.2		0.12	0.52		0.16	0.3		0.07	0.13
E-Coli	150 cfu/100mL	200 cfu/100mL	-		NA	-		NA	-		NA	-		NA	-		NA	-		NA	-

Parameter	July			August			September			October			November			December			Annual Inflow (m3)
	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	Flow (m^3)	Conc. (mg/L)	Load. (kg/d)	
Flow	33353			42680			34837												1260054 (Jan - Sep)
$CBOD_5$		9.5	10		17.5	24		12.0	14			0			0			0	
TSS		21.0	23		63.0	87		31.5	37			0			0			0	
TP		0.14	0.15		0.20	0.28		0.29	0.34			0.0			0.00			0.00	
E-Coli		NA	-		NA	-		NA	-		NA	-		NA	-		NA	-	

- Exceeds Objective

- Exceeds Limit

- No Data

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Memo

From: Steve Burns
sburns@bmross.net

To:	Municipality of Kincardine Attn: Murray Clarke, Chief Administrative Officer
Re:	Rainfall and Flow Analysis for the Kincardine Wastewater Treatment Plant
File #:	13255
Date:	July 15, 2014

1.0 Purpose of Analysis

The purpose of this analysis was to determine whether a relationship exists between the occurrence of rainfall events and increased wastewater treatment plant (WWTP) flows and whether rainfall could be a contributing factor to periodic high WWTP flows.

2.0 Methodology

Total daily flow data for the Kincardine WWTP was obtained from monthly flow and test reports for the period from January 2011 to September 2013. Daily rainfall data was obtained from Environment Canada for the “summer” months (April through November) of each year from 2011 to 2013. This data identified most days that a rain event occurred and the associated amount of precipitation. Rainfall data was not available for approximately 20% of the days within the time period of study meaning that it was not possible to determine whether or not a rain event actually occurred or how much precipitation there may have been on those days. The missing data will introduce a source of error into the analysis.

The data was used to compare WWTP flows and precipitation amounts on both a daily and monthly basis. Average flows were calculated on a monthly basis for days without rainfall as well as for days with rainfall. This allowed average and total monthly WWTP flows attributable to rainfall to be determined as well as respective percent contributions. Table 1 provides an example of the calculations performed for the month of April, 2011. Refer to the attached Monthly Review for results over the entire period of study.

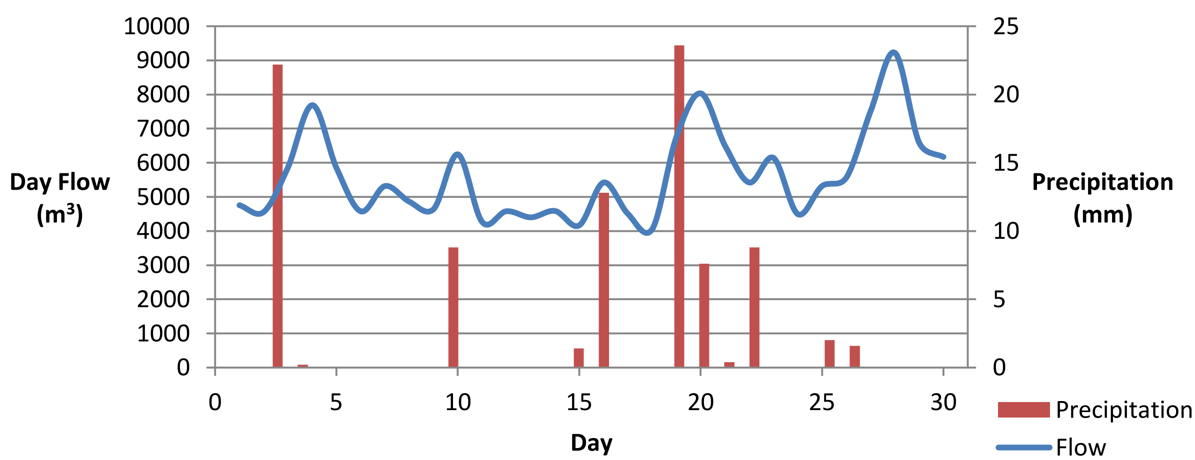
Table 1
Flow Calculations (April, 2011)

Parameter	Value	
(1) Number of Days in Month	30	
(2) Number of Rain-Days	11	
(3) Total Precipitation (mm)	89.4	
(4) Total Monthly Flow (m^3)	168,085	
(5) Average Day Flow over Days with No Rain (m^3/d) *	4,553	
(6) Average Day Flow over Days with Rain (m^3/d) **	5,953	
(7) Maximum Day Flow for Days with rain (m^3/d)	8,031	
(8) Total Monthly Flow Attributable to Rainfall (m^3)	31,492	(4) – [(5) x (1)]
(9) Average Flow Attributable to Rainfall Event (m^3/rain day)	2,863	(8) / (2)
(10) Percent of Total Monthly Flow that is Attributable to Rainfall	19%	[(8) / (4)] x 100

* Does not include the day following directly after a rain event
** Includes the day of and day following directly after a rain event

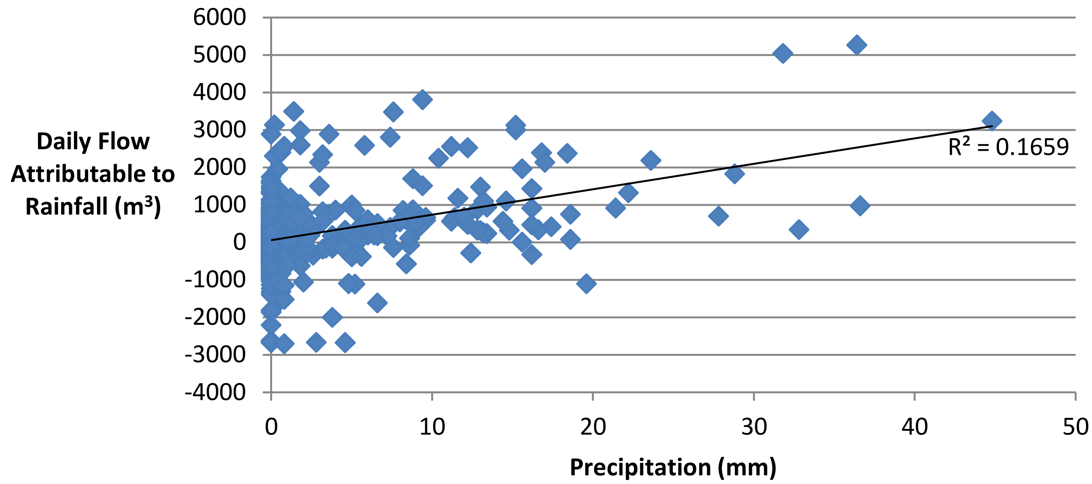
Total day flow and daily precipitation were plotted on a daily basis for each month within the time period of study as demonstrated in Figure 1 for April, 2011 to determine if a relationship exists between the two parameters.

Figure 1
Total Day Flow and Daily Precipitation (April, 2011)



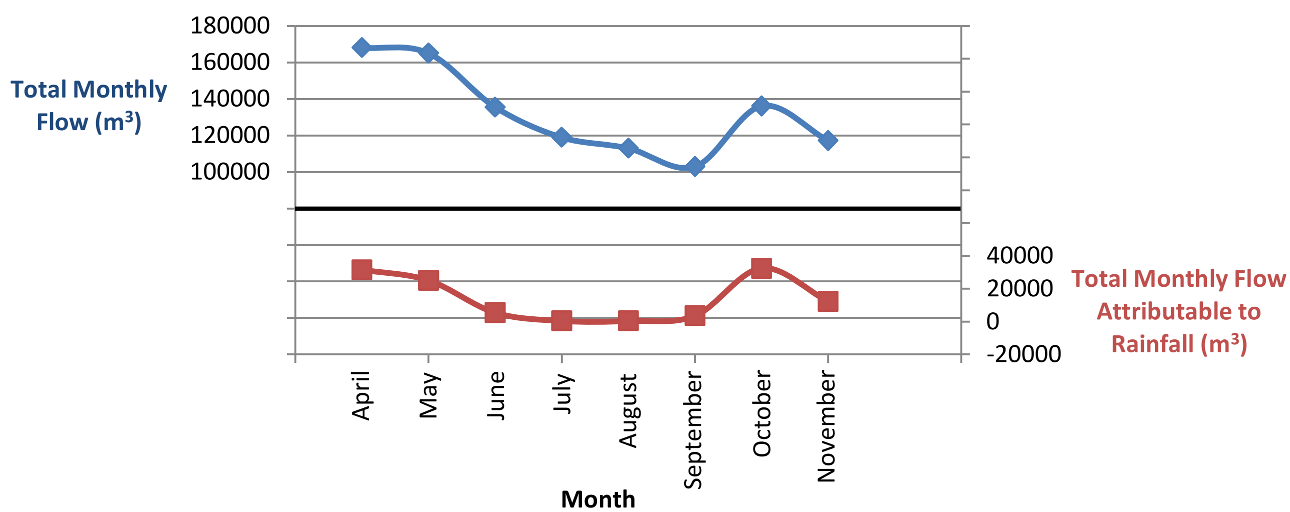
Daily flow attributable to rainfall was calculated by subtracting the average daily flow on non-rain days from the average flow on a rain day plus the flow on the next day. The negative daily flows attributable to rainfall represent days where the daily flows were less than the average daily flow over days with no rain for the respective month. A linear regression (See Figure 2) was performed to determine whether or not a predictable relationship exists between the two parameters.

Figure 2
Daily Flow Attributable to Rainfall versus Daily Precipitation (2011 – 2013)



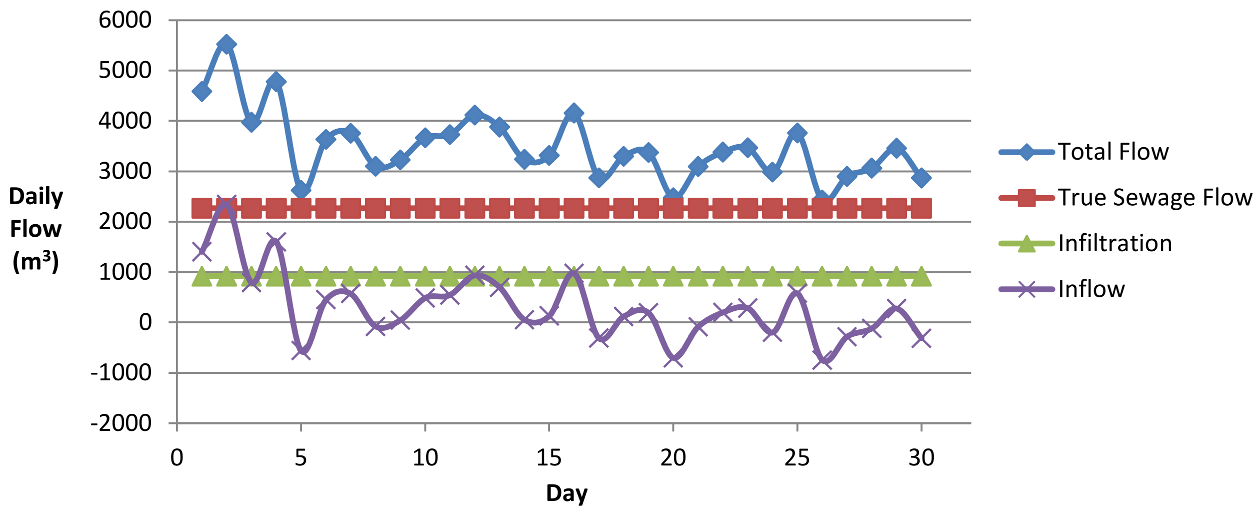
Total monthly flow and total monthly flow attributable to rainfall were plotted on a monthly basis for each year within the time period of study, as demonstrated in Figure 3 for 2011, to determine if a relationship exists between the two parameters.

Figure 3
Total Monthly Flow and Total Monthly Flow Attributable to Rainfall (2011)



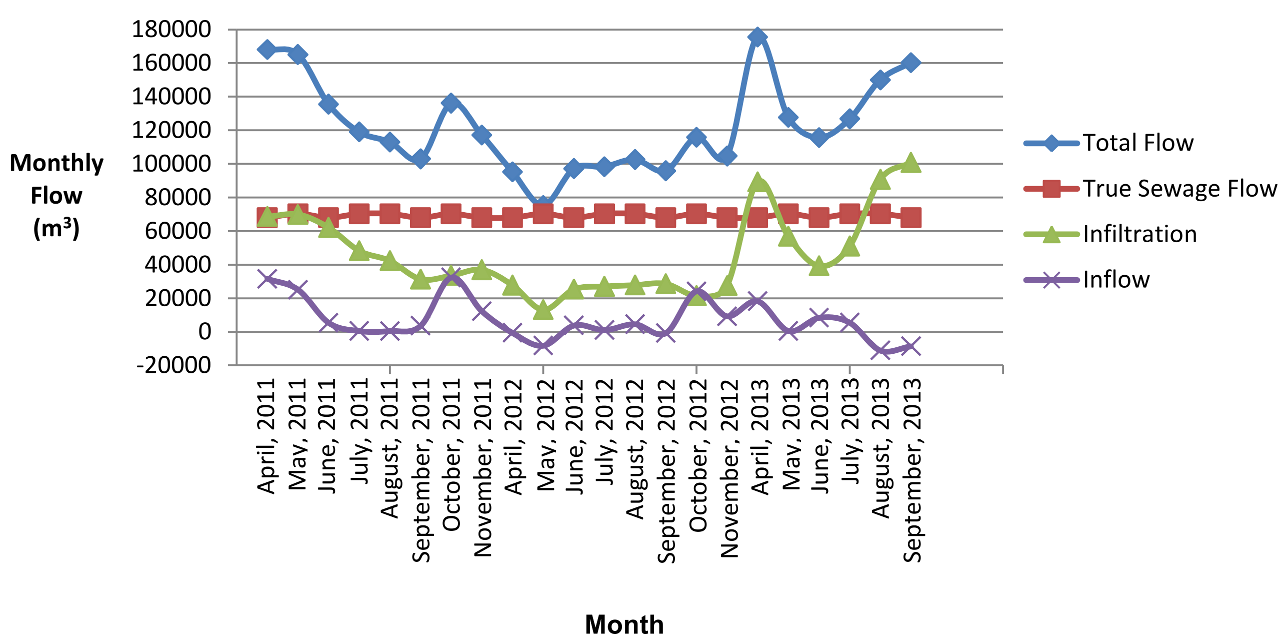
Total WWTP flow, true sewage flow, inflow, and infiltration were each plotted on a daily basis to analyse the contribution of each source to the total flow throughout a month. True sewage flow is defined as 90% of average day treated water pumpage. The true sewage flow for the Municipality of Kincardine was estimated at 2265 m^3/d based on the number of customers and water consumption data. Inflow is defined as flow into a wastewater works as a direct result of rainfall, such as runoff entering a sanitary sewer through holes in a manhole cover, and is equivalent to flow attributable to rainfall. Infiltration is defined as flow into a wastewater works resulting directly from groundwater entering the system through defective sewer pipes or joints. Infiltration is calculated as the difference between total flow and the sum of both true sewage flow and inflow. This calculation has the tendency to overestimate monthly infiltration during peak flow occurrences that are not a direct result of rainfall when true sewage flow is assumed to be constant.   Figure 4 presents this analysis for a typical month (i.e. November 2012)

Figure 4
Inflow and Infiltration Analysis (November, 2012)



Total WWTP flow, true sewage flow, inflow, and infiltration were plotted on a monthly basis, as shown in Figure 5, to analyse the contribution of each source to the total flow throughout the entire period of study. Refer to the attached Monthly Review for monthly flow values over the entire period of study.

Figure 5
Inflow and Infiltration Analysis (2011 – 2013)



Monthly average day flows were compared for each month individually and on a seasonal basis within the period of study to determine whether WWTP flows are higher during winter months where snow melt may be a contributing factor. The results of the seasonal comparison are summarized in Table 2.

Table 2
Summer and Winter Flow Comparison

Summer Months: April - November
Winter Months: January - March, December

Year	Average Summer Daily Flow (m^3/d)	Average Winter Daily Flow (m^3/d)	Percent Increase
2011	4,331	4,718	8.9%
2012	3,215	4,036	26%
2013	4,676	4,490	-4.0%
2011 - 2013	4,074	4,415	8.4%

3.0 Observations

An analysis of the total day flow and daily precipitation plots, as demonstrated by Figure 1, shows that a relationship between the two parameters is identifiable yet inconsistent as WWTP flows often fluctuate despite a lack of rainfall events. It can be seen in Figure 1 that peaks in WWTP flow often occur on either the same day or the day following a rainfall event however this is not always the case. Many rain events also occur which do not result in increased WWTP flow.

An analysis of the daily flow attributable to rainfall versus daily precipitation plots as demonstrated in Figure 2 shows that, although there is a trend, there is no quantifiable relationship between the amount of precipitation and the volumetric increase in WWTP flow.

An analysis of the total monthly flow and total monthly flow attributable to rainfall plots shows that a direct relationship typically exists between the two parameters. It was also determined that total flow attributable to rainfall represents less than 7% of the total flow over the entire period of study.

An analysis of monthly average day flows determined that the majority of high-flow months occur during the spring of each year. It was also determined that, on average, winter day flows are typically higher than summer day flows.

An analysis of inflow and infiltration shows that flow attributable to rainfall is typically less than both true sewage flow and infiltration. It was determined that, over the entire period of study, total WWTP flow consisted of approximately 56% true sewage flow, 6% inflow, and 38% infiltration. Refer to the attached Monthly Review for monthly flow values over the entire period of study.

4.0 Conclusions

The direct relationship between total monthly flow and total monthly flow attributable to rainfall indicates that rainfall is a contributing factor to total WWTP flow. However, a quantifiable relationship between amounts of precipitation and increases in WWTP flow could not be established.

Although the contribution of inflow to total WWTP flow is measurable, flow attributable to rainfall only represents a small portion of total WWTP flow in comparison to infiltration and true sewage flow.

The total day flow and daily precipitation plots provide evidence that peak flows often occur during or directly following rainfall events however, the relationship between the occurrence of rainfall events and peak WWTP flows is inconsistent. Many of these inconsistencies can be attributed to the incomplete rainfall data obtained from Environment Canada. Evidence suggests that snow melt may also be a contributing factor to above average WWTP flows during winter and spring months.

Key findings of the analysis are:

- Rainfall events do contribute to higher WWTP flows, but represent only approximately 7% of the flows received at the plant.

- Groundwater infiltration into the collection system is a much more significant component (i.e. 38%) of the total flow.

Stephen D. Burns, P. Eng.

SDB:hv

Monthly Review

Year	Month	Total Precipitation (mm)	Total Flow (m^3)	True Sewage Flow (m^3)	Total Infiltration (m^3)	Average Day Flow over Days with No Rain (m^3/d)	Average Day Flow over Days with Rain (m^3/d)	Total Flow Attributable to Rainfall (Inflow) (m^3)	Percent of Total Flow that is Attributable to Rainfall
2011	April	89.4	168085	67950	68643	4553	5953	31492	18.7%
	May	104.6	165086	70215	69878	4519	5435	24993	15.1%
	June	57.6	135513	67950	62137	4336	4790	5426	4.0%
	July	29.6	118977	70215	48265	3822	3849	467	0.4%
	August	27.4	112994	70215	42328	3630	3572	451	0.4%
	September	65.4	102938	67950	31371	3311	3474	3617	3.5%
	October	73.8	136125	70215	33542	3347	4669	32368	23.8%
	November	77.0	117161	67950	36949	3497	4057	12262	10.5%
2012	April	31.1	95156	67950	27793	3191	3222	-587	-0.6%
	May	32.8	75162	70215	13154	2689	1923	-8207	-10.9%
	June	58.6	97162	67950	25374	3111	3361	3838	4.0%
	July	39.4	98300	70215	27020	3137	3287	1065	1.1%
	August	44.0	102563	70215	27820	3162	3411	4528	4.4%
	September	98.4	95833	67950	28632	3219	3259	-749	-0.8%
	October	140.4	115749	70215	21496	2958	3760	24038	20.8%
	November	20.2	104650	67950	27467	3181	3688	9233	8.8%
2013	April	139.2	175523	67950	89342	5243	6005	18231	10.4%
	May	57.0	127653	70215	56911	4101	4121	527	0.4%
	June	24.4	115641	67950	39287	3575	3860	8404	7.3%
	July	4.8	126753	70215	51075	3913	3922	5463	4.3%
	August	41.6	149931	70215	90726	5192	4473	-11010	-7.3%
	September	67.2	160221	67950	100810	5625	4990	-8539	-5.3%

Totals over Entire Period of Study

Total Flow (m^3)	2697176
Total Flow Attributable to Rainfall (Inflow) (m^3)	157311
Percent of Total Flow that is Attributable to Rainfall	5.83%

* Includes negative monthly flows attributable to rainfall

* 6.91% if negative monthly flows attributable to rainfall are set to 0

APPENDIX G

BEC AND TIVERTON WASTEWATER CALCULATIONS AND MODELLING NOTES

Municipality of Kincardine
SPS Considerations for Master Plan
Tiverton Area and Flow Notes

Job # :	16171
Date :	October 3, 2016
Revised :	January 3, 2018

1.0 Background

The Municipality of Kincardine initiated a Master Plan process to evaluate water and wastewater servicing needs for Kincardine, Tiverton, and the Lakeshore Area.

The purpose of these notes is to summarize catchment area and design flow information for the King Street SPS (Secondary) and Maple Street SPS (Main) in Tiverton

2.0 Design Data

Reference	Item		
16130 TM2	Persons per household	2.19	p/hhld
	Per household average day sewage flow	720	L/hhld/day
	I/I allowance	0.28	L/ha/s
	Industrial flow allowance	0.405	L/ha/s
	Commercial/Institutional flow allowance	0.324	L/ha/s

3.0 King Street SPS (BMROSS 74026 Briar Hill SPS)

Future scenario is based on full development of areas D, E, F in 16130 Technical Memo No. 2, Figure C3.

Item	Existing	Future	Units
Residential Area	6.42	22.63	ha
Industrial Area	0	0	ha
Commercial/Institutional Area	0.82	0.54	ha
Residential Properties	58	262	
Calculate			
Residential Population	127	575	people
Peaking factor	4.21	3.94	
Average day residential flow	0.48	2.19	L/s
Average day industrial flow	0.00	0.00	L/s
Average day commercial/institutional flow	0.27	0.17	L/s
Average day flow; total	0.7	2.4	L/s
I/I allowance	2.0	6.5	L/s
Peak instantaneous flow; total incl. I/I	5.2	15.8	L/s

4.0 Maple Street SPS (BMROSS 74026 Main SPS)

The Maple SPS service area includes its own catchment area and discharge from the King Street SPS. Calculate catchment area flow and then add King Street contribution. Future scenario is based on full development of all lands shown in 16130 Technical Memo No. 2, Figure C3 including addition of 14 remaining Mackwade units.

4.1 Maple Street SPS Catchment Area

Item	Existing	Future	Units
Residential Area	50.19	51.4	ha
Industrial Area	0	0	ha
Commercial/Institutional Area	13.31	14.48	ha
Residential Properties	296	613	
Calculate			
Residential Population	648	1343	people
Peaking factor	3.91	3.71	
Average day residential flow	2.47	5.11	L/s
Average day industrial flow	0.00	0.00	L/s
Average day commercial/institutional flow	4.31	4.69	L/s
Average day flow; total	6.8	9.8	L/s
I/I allowance	17.8	18.4	L/s
Peak instantaneous flow; total incl. I/I	44.3	54.8	L/s

Municipality of Kincardine
SewerCAD Modelling for Master Plan
Tiverton - Calculations and Notes

Job # :	16130
Date :	November 15, 2017
Revised :	January 3, 2018

1.0 Background

The Municipality of Kincardine is completing a water and wastewater Master Plan process. The sewage servicing component will include a review of servicing existing development and future development. The purpose of these notes is to summarize data used to create a SewerCAD model, and the results of that modelling.

2.0 Analysis & Model Data

2.1 Data

	Reference	Item		
a.	16130	*King Street SPS*		
		Ex. peak sewage flow	3.2	L/s
		Ex. I&I allowance	2.0	L/s
		Ex. total peak flow	5.2	L/s
		Fut. peak sewage flow	9.3	L/s
		Fut. I&I allowance	6.5	L/s
		Fut. total peak flow	15.8	L/s
b.	16130	*Maple Street SPS Catchment Area (* ***w/o King Street SPSs*** *)*		
		Ex. peak sewage flow	26.5	L/s
		Ex. I&I allowance	17.8	L/s
		Ex. total peak flow	44.3	L/s
		Fut. peak sewage flow	36.4	L/s
		Fut. I&I allowance	18.4	L/s
		Fut. total peak flow	54.8	L/s
		Maple Street SPS Catchment Area (***with King Street SPSs*** *)*		
		Ex. total peak flow	49.5	L/s
		Fut. total peak flow	70.6	L/s

2.2 Sewage Flows by Manhole

For the existing system model, sewage flows to each manhole are calculated by dividing total peak flow for the catchment area by the number of maintenance holes.

For future flows, the sewage flow that is additional to existing is assigned to specific manholes based on future service area location in relation to existing manholes.

a. *King Street SPS*

Ex. No. of manholes in model	21	MHs
Ex. Peak flow per manhole	0.248	L/s/MH
Additional future peak flow	10.6	L/s
Assume:		
50% to SMH-680	5.3	L/s
25% to SMH-702	2.7	L/s
25% to SMH-704	2.7	L/s

b. *Maple Street SPS Catchment Area (**w/o King Street SPSs**)*

Ex. No. of manholes in model	73	MHs
Ex. Peak flow per manhole	0.607	L/s/MH
For King, add to gravity sewer on King St. (SMH-672)		
	5.2	L/s
Additional future peak flow	21.1	L/s
Assume:		
Additional to SMH-710	10.5	L/s
Additional to SMH-672	10.6	L/s

Tiverton Combined SPS Results

Conduit ID	Existing Conditions					Future Conditions				
	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)
SM-642	26.2	0.006	200	0.6	2.3	26.2	0.006	200	0.6	2.3
SM-643	38.7	0.014	200	1.2	3.1	38.7	0.014	200	1.2	3.1
SM-644	31.3	0.009	200	0.6	1.9	31.3	0.009	200	0.6	1.9
SM-645	42.5	0.017	200	1.2	2.9	42.5	0.017	200	1.2	2.9
SM-646	49.2	0.023	200	0.6	1.2	49.2	0.023	200	0.6	1.2
SM-647	28.8	0.008	200	0.6	2.1	28.8	0.008	200	0.6	2.1
SM-648	23.6	0.005	200	0.6	2.6	23.6	0.005	200	0.6	2.6
SM-649	36.8	0.013	200	0.6	1.6	36.8	0.013	200	0.6	1.6
SM-650	24.9	0.006	200	0.6	2.4	24.9	0.006	200	0.6	2.4
SM-651	45.3	0.019	200	0.6	1.3	45.3	0.019	200	0.6	1.3
SM-652	22.4	0.005	200	0.6	2.7	22.4	0.005	200	0.6	2.7
SM-653	35.4	0.012	200	0.6	1.7	35.4	0.012	200	0.6	1.7
SM-654	41.6	0.016	200	0.6	1.5	41.6	0.016	200	0.6	1.5
SM-655	42.3	0.017	200	0.6	1.4	42.3	0.017	200	0.6	1.4
SM-656	58.7	0.032	200	0.6	1.0	58.7	0.032	200	0.6	1.0
SM-657	30.4	0.003	250	4.2	14.0	30.4	0.003	250	4.2	14.0
SM-658	30.7	0.003	250	9.1	29.7	30.7	0.003	250	9.1	29.7
SM-659	31.5	0.009	200	0.6	1.9	31.5	0.009	200	0.6	1.9
SM-660	35.3	0.012	200	1.2	3.4	35.3	0.012	200	1.2	3.4
SM-661	182.1	0.011	375	42.8	23.5	182.1	0.011	375	63.9	35.1
SM-662	82.6	0.007	300	14.6	17.6	82.6	0.007	300	14.6	17.6
SM-663	163.6	0.009	375	44.7	27.3	163.6	0.009	375	65.8	40.2
SM-664	30.6	0.003	250	0.6	2.0	30.6	0.003	250	0.6	2.0
SM-665	39.0	0.004	250	1.2	3.1	39.0	0.004	250	1.2	3.1
SM-666	299.1	0.029	375	47.7	15.9	299.1	0.029	375	68.8	23.0
SM-667	183.8	0.008	400	49.5	26.9	183.8	0.008	400	70.6	38.4
SM-668	41.3	0.016	200	2.4	5.9	41.3	0.016	200	2.4	5.9
SM-669	44.2	0.018	200	0.6	1.4	44.2	0.018	200	0.6	1.4
SM-670	36.4	0.012	200	1.2	3.3	36.4	0.012	200	1.2	3.3
SM-671	33.1	0.010	200	1.8	5.5	33.1	0.010	200	1.8	5.5
SM-672	49.7	0.003	300	14.0	28.1	49.7	0.003	300	14.0	28.1
SM-673	49.4	0.023	200	3.6	7.4	49.4	0.023	200	3.6	7.4
SM-674	42.2	0.017	200	3.0	7.2	42.2	0.017	200	3.0	7.2
SM-675	29.1	0.008	200	2.4	8.3	29.1	0.008	200	2.4	8.3
SM-676	39.3	0.014	200	1.2	3.1	39.3	0.014	200	1.2	3.1
SM-677	32.3	0.010	200	3.0	9.4	32.3	0.010	200	3.0	9.4
SM-678	30.7	0.009	200	3.6	11.8	30.7	0.009	200	3.6	11.8
SM-679	32.6	0.010	200	4.2	13.0	32.6	0.010	200	4.2	13.0
SM-680	27.2	0.007	200	3.6	13.4	27.2	0.007	200	3.6	13.4

Tiverton Combined SPS Results

Conduit ID	Existing Conditions					Future Conditions				
	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)
SM-681	50.6	0.024	200	1.8	3.6	50.6	0.024	200	1.8	3.6
SM-682	22.2	0.005	200	2.4	10.9	22.2	0.005	200	2.4	10.9
SM-683	65.8	0.040	200	0.5	0.8	65.8	0.040	200	5.8	8.8
SM-684	46.3	0.020	200	0.2	0.5	46.3	0.020	200	0.2	0.5
SM-685	22.9	0.005	200	0.2	1.1	22.9	0.005	200	2.9	12.9
SM-686	20.9	0.004	200	0.7	3.6	20.9	0.004	200	3.4	16.5
SM-687	24.6	0.006	200	0.2	1.0	24.6	0.006	200	2.9	12.0
SM-688	20.4	0.004	200	1.2	6.1	20.4	0.004	200	6.6	32.5
SM-689	23.5	0.005	200	2.0	8.4	23.5	0.005	200	12.7	54.0
SM-690	68.6	0.044	200	0.2	0.4	68.6	0.044	200	0.2	0.4
SM-691	21.0	0.004	200	2.5	11.8	21.0	0.004	200	13.2	62.7
SM-692	21.9	0.004	200	2.7	12.5	21.9	0.004	200	13.4	61.3
SM-693	21.8	0.004	200	3.0	13.6	21.8	0.004	200	13.7	62.6
SM-694	31.1	0.009	200	0.6	2.0	31.1	0.009	200	0.6	2.0
SM-695	21.6	0.004	200	0.6	2.8	21.6	0.004	200	0.6	2.8
SM-696	37.4	0.013	200	0.2	0.7	37.4	0.013	200	0.2	0.7
SM-697	67.9	0.043	200	0.5	0.7	67.9	0.043	200	0.5	0.7
SM-698	76.6	0.055	200	0.7	1.0	76.6	0.055	200	0.7	1.0
SM-699	65.6	0.040	200	1.2	1.9	65.6	0.040	200	1.2	1.9
SM-700	21.5	0.004	200	0.2	1.2	21.5	0.004	200	5.5	25.9
SM-701	71.5	0.014	250	8.2	11.5	71.5	0.014	250	18.8	26.3
SM-702	50.0	0.007	250	8.8	17.7	50.0	0.007	250	19.4	38.9
SM-703	69.2	0.014	250	9.4	13.6	69.2	0.014	250	20.0	29.0
SM-704	65.4	0.005	300	16.1	24.7	65.4	0.005	300	26.7	40.9
SM-705	59.5	0.004	300	16.7	28.1	59.5	0.004	300	27.3	45.9
SM-706	33.1	0.010	200	0.6	1.8	33.1	0.010	200	0.6	1.8
SM-707	31.5	0.009	200	1.2	3.8	31.5	0.009	200	1.2	3.8
SM-708	22.4	0.005	200	0.6	2.7	22.4	0.005	200	0.6	2.7
SM-709	22.2	0.005	200	1.2	5.5	22.2	0.005	200	1.2	5.5
SM-710	30.4	0.009	200	4.2	14.0	30.4	0.009	200	4.2	14.0
SM-711	39.1	0.014	200	4.9	12.4	39.1	0.014	200	4.9	12.4
SM-712	40.5	0.015	200	1.8	4.5	40.5	0.015	200	1.8	4.5
SM-713	37.5	0.013	200	2.4	6.5	37.5	0.013	200	2.4	6.5
SM-714	166.3	0.009	375	27.7	16.6	166.3	0.009	375	48.8	29.3
SM-715	119.0	0.005	375	25.2	21.2	119.0	0.005	375	46.3	38.9
SM-716	115.9	0.004	375	27.1	23.3	115.9	0.004	375	48.2	41.5
SM-717	63.0	0.004	300	7.9	12.5	63.0	0.004	300	18.4	29.2
SM-718	38.6	0.014	200	0.6	1.6	38.6	0.014	200	0.6	1.6
SM-719	25.1	0.006	200	1.2	4.8	25.1	0.006	200	1.2	4.8

Tiverton Combined SPS Results

Conduit ID	Existing Conditions					Future Conditions				
	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)	Full-Flow Capacity (L/s)	Slope (m/m)	Diameter (mm)	Calculated Flow (L/s)	Flow/Capacity (%)
SM-720	49.2	0.003	300	3.6	7.4	49.2	0.003	300	14.1	28.8
SM-721	87.5	0.008	300	4.9	5.6	87.5	0.008	300	15.4	17.6
SM-722	87.5	0.008	300	5.5	6.2	87.5	0.008	300	16.0	18.2
SM-723	84.3	0.008	300	7.3	8.6	84.3	0.008	300	17.8	21.1
SM-724	30.7	0.009	200	1.2	4.0	30.7	0.009	200	1.2	4.0
SM-727	24.2	0.005	200	3.0	12.5	24.2	0.005	200	3.0	12.5
SM-731	54.2	0.027	200	0.6	1.1	54.2	0.027	200	0.6	1.1
SM-732	37.2	0.013	200	1.2	3.3	37.2	0.013	200	1.2	3.3
SM-733	63.3	0.004	300	1.8	2.9	63.3	0.004	300	12.3	19.5
SM-761	60.6	0.034	200	0.2	0.4	60.6	0.034	200	0.2	0.4
SM-762	20.4	0.004	200	5.8	28.5	20.4	0.004	200	16.4	80.5
SM-763	23.1	0.005	200	6.4	27.8	23.1	0.005	200	17.0	73.7
SM-772	51.6	0.025	200	3.2	6.2	51.6	0.025	200	13.9	27.0
SM-773	35.8	0.004	250	3.5	9.7	35.8	0.004	250	14.2	39.6
SM-774	32.1	0.003	250	3.7	11.6	32.1	0.003	250	14.4	45.0
SM-776	27.8	0.002	250	5.2	18.7	27.8	0.002	250	15.9	57.3

Notes:
Denotes greater than 80% capacity utilized.
Denotes greater than 100% capacity utilized (i.e. surcharging).

APPENDIX H

CONSULTATION MATERIALS

MUNICIPALITY OF KINCARDINE

WATER AND WASTEWATER MASTER PLAN

NOTICE OF STUDY COMMENCEMENT

THE PROJECT:

The Municipality of Kincardine is initiating a Water and Wastewater Master Plan study for Kincardine, Tiverton, the Bruce Energy Centre, and the lakeshore area, to identify future infrastructure and servicing needs related to the municipal water and sewage systems to accommodate anticipated growth.

The Water and Wastewater Master Plan process will involve a review of existing water treatment, storage, and supply infrastructure, and sanitary sewage collection and treatment infrastructure. The study will also include a review of growth projections used to establish potential future water and wastewater servicing requirements as they relate to key infrastructure. Upon completion, the Master Plan update will establish a plan for the implementation of any recommended projects.

THE ENVIRONMENTAL ASSESSMENT PROCESS:

The Water and Wastewater Master Plan is being conducted in accordance with the requirements of the Municipal Class Environmental Assessment (Class EA) which is an approved process under the Environmental Assessment Act. Master Plan studies incorporate Phases 1 & 2 of the Class EA process and also include consultation with the general public, government review agencies and the public.

PUBLIC INVOLVEMENT:

Public consultation is a key component of this study. As a part of the consultation component of this project, a public information meeting will be held during the course of the study. Details regarding the public meeting will be provided in a future notice. Any comments collected will be maintained on file for use during the project and may be included in project documentation. With the exception of personal information, all comments will become part of the public record.

For further information on this project, please contact the consulting engineers: B. M. Ross and Associates, 62 North Street, Goderich Ontario, N7A 2T4. Telephone (519) 524-2641. Fax (519) 524-4403. Attention: Lisa Courtney, Environmental Planner. E-mail: lcourtney@bmross.net

Adam Weishar, Director of Public Works
Municipality of Kincardine

This Notice issued August 9, 2017

MUNICIPALITY OF KINCARDINE
WATER AND WASTEWATER MASTER PLAN
BMROSS FILE NO. 16130

REVIEW AGENCY CIRCULATION LIST

REVIEW AGENCY	INVOLVEMENT
Ministry of the Environment and Climate Change (London) - EA Co-ordinator	Mandatory Contact
Ministry of Natural Resources and Forestry Midhurst	Potential Impact on Natural Features
Ministry of Tourism, Culture and Sport	Toronto
Ministry of Municipal Affairs	General Information (London)
Ministry of Infrastructure	General Information (Toronto)
County of Bruce - Administration Department - Planning & Development Department	- General Information - Implications for Long-Term Development
Saugeen Valley Conservation Authority	Potential Impact on Natural Features
Municipality of Kincardine	Proponent (copy)

BMROSS
engineering better communities

B. M. ROSS AND ASSOCIATES LIMITED
Engineers and Planners
62 North Street, Goderich, ON N7A 2T4
p. (519) 524-2641 • f. (519) 524-4403
www.bmross.net

File No. 16130

August 3, 2017

Agency
(See attached list)

RE: Municipality of Kincardine
Water and Wastewater Servicing Master Plan Study

The Municipality of Kincardine is initiating a Water and Wastewater Master Plan study for Kincardine, Tiverton, the Bruce Energy Centre, and the lakeshore area, to identify future infrastructure and servicing needs related to the municipal water and sewage systems to accommodate anticipated growth.

The Water and Wastewater Master Plan process will involve a review of existing water treatment, storage, and supply infrastructure, and sanitary sewage collection and treatment infrastructure. The study will also include a review of growth projections used to establish potential future water and wastewater servicing requirements as they relate to key infrastructure. Upon completion, the Master Plan update will establish a plan for the implementation of any recommended projects.

The Water and Wastewater Master Plan is being conducted in accordance with the requirements of the Municipal Class Environmental Assessment (Class EA) which is an approved process under the Environmental Assessment Act. Master Plan studies incorporate Phases 1 & 2 of the Class EA process and also include consultation with the general public, government review agencies, First Nation and Métis communities, and the general public.

Your organization has been identified as possibly having an interest in this project and we are soliciting your input. Please forward your response to our office by September 8, 2017. If you have any questions or require further information, please contact the undersigned.

Yours very truly

B. M. ROSS AND ASSOCIATES LIMITED

Per ________________________________
Lisa J. Courtney, MCIP, RPP
Environmental Planner

LJC:hv
c.c. Adam Weishar, Municipality of Kincardine

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MUNICIPALITY OF KINCARDINE
WATER AND WASTEWATER MASTER PLAN
BMROSS FILE NO. 16130

FIRST NATIONS AND MÉTIS CIRCULATION LIST – September 2017

FIRST NATION	CONTACT
Ministry of Indigenous Relations and Reconciliation (by email)	maa.ea.review@ontario.ca
Métis Nation of Ontario	Métis Nation of Ontario 500 Old St. Patrick Street, Unit D Ottawa, ON K1N 9G4
Chippewas of Saugeen (hard copy and email to lanoquot@saugeenfirstnation.ca)	Chief Lester Anoquot Chippewas of Saugeen RR 1 Southampton, ON N0H 2L0
Chippewas of Nawash (hard copy and email to chiefsdesk@nawash.ca)	Chief Gregory Nadjiwon Chippewas of Nawash Unceded First Nation R.R. #5 Wiarton, ON N0H 2T0
Great Lakes Metis Council (email to: jamesw@metisnation.org and consultations@metisnation.org)	Great Lakes Metis Council 380 9th Street East Owen Sound, ON N4K 1P1
Historic Saugeen Métis	Historic Saugeen Métis 204 High Street, Box 1492 Southampton, ON N0H 2L0
Saugeen Ojibway Nation Environment Office	Jenna Skinner Saugeen Ojibway Nation Environment Office 25 Maadookii Subdivision Neyaashiinigmiing, ON N0H 2T0
Chippewas of Kettle and Stony Point First Nation	Chief Thomas Bressette Chippewas of Kettle and Stony Point First Nation 6247 Indian Lane, RR#2 Forest ON N0N 1J1 Valerie George, Consultation Coordinator Valerie.george@kettlepoint.org

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p. (519) 524-2641 • f. (519) 524-4403
www.bmross.net

File No. 16130

August 3, 2017

First Nations
(See attached List)

RE: Municipality of Kincardine
Water and Wastewater Master Plan

The Municipality of Kincardine is initiating a Water and Wastewater Master Plan study for Kincardine, Tiverton, the Bruce Energy Centre, and the lakeshore area, to identify future infrastructure and servicing needs related to the municipal water and sewage systems to accommodate anticipated growth.

The Water and Wastewater Master Plan process will involve a review of existing water treatment, storage, and supply infrastructure, and sanitary sewage collection and treatment infrastructure. The study will also include a review of growth projections used to establish potential future water and wastewater servicing requirements as they relate to key infrastructure. Upon completion, the Master Plan update will establish a plan for the implementation of any recommended projects.

The Water and Wastewater Master Plan is being conducted in accordance with the requirements of the Municipal Class Environmental Assessment (Class EA) which is an approved process under the Environmental Assessment Act. Master Plan studies incorporate Phases 1 & 2 of the Class EA process and also include consultation with the general public, government review agencies, First Nation and Métis communities, and the general public.

Your community has been identified as possibly having an interest in this project. For your convenience, a response form is enclosed along with a self-addressed stamped envelope. Please forward you response to our office by **September 18, 2017**. If you have any questions regarding this project, please contact the undersigned at 1-888-524-2641 or by e-mail at lcourtney@bmross.net.

Yours very truly,

B. M. ROSS AND ASSOCIATES LIMITED

Per ______________________________
Lisa J. Courtney, M.Sc., RPP, MCIP
Environmental Planner

LJC:hv
c.c. Adam Weishar, Municipality of Kincardine

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Response Form

Project Name: Municipality of Kincardine Water and Wastewater Master Plan

Project Description: Master plan study to examine water and wastewater servicing needs in the Municipality of Kincardine over the next 50 years

Project Location: Kincardine, Tiverton, Bruce Energy Centre and lakeshore area of Kincardine

Please Detach and Return in Envelope Provided

Name of Aboriginal Community: ____

Please check appropriate box

☐ **Please send additional information on this project**

☐ **We would like to meet with representatives of this project.**

☐ **We have no concerns with this project and do not wish to be consulted further**

Project Name: Water and Wastewater Master Plan for the Municipality of Kincardine (16130)
Location: Municipality of Kincardine
Proponent: Municipality of Kincardine

Ministry of the Environment and Climate Change

733 Exeter Road
London ON N6E 1L3
Tel': 519 873-5000
Fax: 519 873-5020

Ministère de l'Environnement et de l'Action en matière de changement climatique

733, rue Exeter
London ON N6E 1L3
Tél.: 519 873-5000
Fax: 519 873-5020

Ontario

September 8th, 2017

Municipality of Kincardine
1475 Concession 5
R.R. #5
Kincardine, Ontario
N2Z 2X6

Attention: Mr. Adam Weishar, Director of Public Works

Re: Municipality of Kincardine, Water and Wastewater Servicing Master Plan Study

Dear Mr. Weishar:

This letter acknowledges receipt of the Notice of Commencement for the above noted project.

It is understood that the Municipality of Kincardine is initiating a Water and Wastewater Master Plan study for Kincardine, Tiverton, the Bruce Energy Centre, and the lakeshore area, to identify future infrastructure and servicing needs related to the municipal water and sewage systems to accommodate anticipated growth.

As you know, the Class Environmental Assessment (Class EA) planning process includes consultation with interested stakeholders, evaluation of alternatives, assessment of the effects of the proposed works and identification of measures to mitigate any adverse impacts. In addition to consultation with public agencies and the general public, consultation with Aboriginal communities is required.

Aboriginal Consultation

The Crown has a legal duty to consult Aboriginal communities when it has knowledge, real or constructive, of the existence or potential existence of an Aboriginal or treaty right and contemplates conduct that may adversely impact that right. Before authorizing this project, the Crown must ensure that its duty to consult has been fulfilled, where such a duty is triggered. Although the duty to consult with Aboriginal peoples is a duty of the Crown, the Crown may delegate procedural aspects of this duty to project proponents while retaining oversight of the consultation process.

Your proposed project may have the potential to affect Aboriginal or treaty rights protected under Section 35 of Canada's *Constitution Act* 1982. Where the Crown's duty to consult is triggered in relation to your proposed project**, the MOECC is delegating the procedural aspects of rights-based consultation to you through this letter.** The Crown intends to rely on the delegated consultation process in discharging its duty to consult and maintains the right to participate in the consultation process as it sees fit.

Based on information you have provided to date and the Crown`s preliminary assessment you are required to consult with the following communities who have been identified as potentially affected by your proposed project:

<table>
<tr><th>Nation</th><th colspan="2">Contact Information</th></tr>
<tr><td>Chippewas of Kettle and Stony Point First Nation</td><td colspan="2">Chippewas of Kettle and Stony Point First Nation
6247 Indian Lane, R.R.#2 Forest, ON N0N 1J1 519-786-2125
Chief Tom Bressette thomas.bressette@kettlepoint.org
Other Contact: Valerie George Consultation Coordinator
valerie.george@kettlepoint.org</td></tr>
<tr><td>Saugeen First Nation</td><td rowspan="2">Saugeen Ojibway Nation
Environment Office
25 Maadookii Road
Neyaashiinigmiing, ON
N0H 2T0
519-534-5507
Jenna Skinner
Territorial Resource Coordinator
d.ritchie@saugeenojibwaynation.ca
(Please send hard copy to Doran Ritchie)</td><td>Saugeen First Nation
6493 Highway 21 R.R.#1
Southampton, ON N0H 2L0
519-797-2781
Chief Lester Anoquot
lanoquot@saugeenfirstnation.ca
(Email copy to Chief Anoquot)</td></tr>
<tr><td>Chippewas of Nawash Unceded First Nation</td><td>Chippewas of Nawash Unceded First Nation
R.R.#5 Wiarton, ON N0H 2T0
519-534-1689
Chief Gregory Nadjiwon
chiefsdesk@nawash.ca
(Email copy to Chief Nadjiwon)</td></tr>
<tr><td>Historic Saugeen Metis</td><td colspan="2">Historic Saugeen Metis
204 High Street, Box 1492 Southampton, ON N0H 2L0
President, Archie Indoe Other Contact: George Govier Consultation Coordinator
519-483-4000 saugeenmetisadmin@bmts.com</td></tr>
<tr><td>Great Lakes Metis Council</td><td colspan="2">Great Lakes Metis Council
380 9th Street East Owen Sound, ON N4K 1P1 519-370-0435
Other Contact: James Wagar, Consultation Assessment Coordinator
jamesw@metisnation.org and consultations@metisnation.org
(Please send email copies to email addresses listed above)</td></tr>
</table>

Steps that you may need to take in relation to Aboriginal consultation for your proposed project are outlined in the "Code of Practice for Consultation in Ontario's Environmental Assessment Process" which can be found at the following link:

https://www.ontario.ca/document/consultation-ontarios-environmental-assessment-process

Additional information related to Ontario's Environmental Assessment Act is available online at: www.ontario.ca/environmentalassessments.

You must contact the Director of Environmental Approvals Branch under the following circumstances subsequent to initial discussions with the communities identified by MOECC:

- aboriginal or treaty rights impacts are identified to you by the communities;
- you have reason to believe that your proposed project may adversely affect an aboriginal or treaty right;
- consultation has reached an impasse;
- a Part II Order request or elevation request is expected.

The Director of the Environmental Approvals Branch can be notified either by email with the subject line "Potential Duty to Consult" to EAASIBgen@ontario.ca or by mail or fax at the address provided below:

Email:	EAASIBGen@ontario.ca Subject: Potential Duty to Consult
Fax:	416-314-8452
Address:	Environmental Approvals Branch 135 St. Clair Avenue West, 1st Floor Toronto, ON, M4V 1P5

The MOECC will then assess the extent of any Crown duty to consult for the circumstances and will consider whether additional steps should be taken, including what role you will be asked to play in them.

Source Water Protection

As per the recent amendments to the Municipal Engineers Association (MEA) Class Environmental Assessment parent document approved October 2015, proponents undertaking a Municipal Class EA project must identify early in the process whether a project is occurring within a source water protection vulnerable area. This must be clearly documented in a Project File report or ESR. If the project is occurring in a vulnerable area, then there may be policies in the local Source Protection Plan (SPP) that need to be addressed (requirements under the Clean Water Act). The proponent should contact and consult with the appropriate Conservation Authority/Source Protection Authority (CA/SPA) to discuss potential considerations and policies in the SPP that apply to the project.

Please include a section in the report on Source Water Protection. Specifically, it should discuss whether or not the project is located in a vulnerable area or changes or creates new vulnerable areas, and provide applicable details about the area. If located in a vulnerable area, proponents should document whether any project activities are a prescribed drinking water threat and thus pose a risk to drinking water (this should be consulted on with the appropriate CA/SPA). Where an activity poses a risk to drinking water, the proponent must document and discuss in the Project File Report/ESR how the project adheres to or has regard to applicable policies in the local SPP. If creating or changing a vulnerable area, proponents should document whether any existing uses or activities may potentially be affected by the implementation of source protection policies. This section should then be used to inform and should be reflected in other sections of the report, such as the identification of net positive/ negative effects of alternatives, mitigation measures, evaluation of alternatives etc. As a note, even if the project activities in a vulnerable area are deemed not to be a drinking water risk, there may be other policies that apply and so consultation with the local CA/SPA is important.

Conclusion

Thank you for the opportunity to comment on this project. Please keep this office fully informed of the status of this project as it proceeds through the Class EA process.

Please send all future correspondence with respect to this project to my attention, as I am currently this ministry's one window contact for this project: Craig Newton, Regional Environmental Planner / Regional EA Coordinator at the address below; email address:craig.newton@ontario.ca; telephone number: 519-873-5014.

A draft copy of the Environmental Study Report should be forwarded to my attention prior to the filing of the final report, allowing a minimum of 30 days for the ministry's technical reviewers to provide comments. Please also forward the Notice of Completion and final ESR to me when completed. Thank you in advance.

Yours truly,

Craig Newton
Regional Environmental Planner / Regional EA Coordinator
Ministry of Environment and Climate Change
733 Exeter Road
London ON, N6E 1L3
519 873-5014

Copy: Mr. Scott Abernethy, Group Leader Surface Water, Water Resources Unit, MOECC London
Mr. John Ritchie, Supervisor, Safe Drinking Water Branch, MOECC Owen Sound
Mr. Ian Mitchell, District Engineer, MOECC Owen Sound
Mr. Rick Chappell, District Manager, MOECC Owen Sound
Ms. Lisa Courtney, MCIP, RPP, Environmental Planner, BM Ross and Associates Limited, Goderich

Ministry of Tourism, Culture and Sport

Heritage Program Unit
Programs and Services Branch
401 Bay Street, Suite 1700
Toronto ON M7A 0A7
Tel: 416 341 7133
Fax: 416 212 1802

Ministère du Tourisme, de la Culture et du Sport

Unité des programmes patrimoine
Direction des programmes et des services
401, rue Bay, Bureau 1700
Toronto ON M7A 0A7
Tél: 416 314 7133
Téléc: 416 212 1802

Ontario

September 7, 2017 (EMAIL ONLY)

Lisa Courtney
B.M.Ross and Associates Limited
Engineers and Planners
62 North Street, Goderich, ON N7A2TA
E:

RE:	**MTCS file #:**	**0007259**
	Proponent:	**Municipality of Kincardine**
	Subject:	**Notice of Commencement**
		Water and Wastewater Servicing Master Plan Study
	Location:	**Kincardine, Ontario**

Dear Ms. Courtney:

Thank you for providing the Ministry of Tourism, Culture and Sport (MTCS) with the Notice of Commencement for your project. MTCS's interest in this Environmental Assessment (EA) project relates to its mandate of conserving Ontario's cultural heritage, which includes:

- Archaeological resources, including land-based and marine;
- Built heritage resources, including bridges and monuments; and,
- Cultural heritage landscapes.

Under the EA process, the proponent is required to determine a project's potential impact on cultural heritage resources. Realizing that this is in part a Master Plan Update, developing or reviewing inventories of known and potential cultural heritage resources within the study area can identify specific resources that may play a significant role in guiding the evaluation of alternatives for subsequent project-driven EAs.

While some cultural heritage resources may have already been formally identified, others may be identified through screening and evaluation. Aboriginal communities may have knowledge that can contribute to the identification of cultural heritage resources, and we suggest that any engagement with Aboriginal communities includes a discussion about known or potential cultural heritage resources that are of value to these communities. Municipal Heritage Committees, historical societies and other local heritage organizations may also have knowledge that contributes to the identification of cultural heritage resources.

Archaeological Resources
Your EA project may impact archaeological resources and you should screen the project with the MTCS *Criteria for Evaluating Archaeological Potential* to determine if an archaeological assessment is needed. MTCS archaeological sites data are available at *archaeology@ontario.ca*. If your EA project area exhibits archaeological potential, then an archaeological assessment (AA) should be undertaken by an archaeologist licenced under the *OHA*, who is responsible for submitting the report directly to MTCS for review.

Built Heritage and Cultural Heritage Landscapes
The MTCS *Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes* should be completed to help determine whether your EA project may impact cultural heritage resources. The Clerk/s for the municipality of Kincardine can provide information on property registered or

designated under the *Ontario Heritage Act*. Municipal Heritage Planners can also provide information that will assist you in completing the checklist.

If potential or known heritage resources exist, MTCS recommends that a Heritage Impact Assessment (HIA), prepared by a qualified consultant, should be completed to assess potential project impacts. Our Ministry's *Info Sheet #5: Heritage Impact Assessments and Conservation Plans* outlines the scope of HIAs. Please send the HIA to MTCS municipality of Kincardine for review, and make it available to local organizations or individuals who have expressed interest in review.

Environmental Assessment Reporting
All technical heritage studies and their recommendations are to be addressed and incorporated into EA projects. Please advise MTCS whether any technical heritage studies will be completed for your EA project, and provide them to MTCS before issuing a Notice of Completion. If your screening has identified no known or potential cultural heritage resources, or no impacts to these resources, please include the completed checklists and supporting documentation in the EA report or file.

Thank-you for consulting MTCS on this project: please continue to do so through the EA process, and contact me for any questions or clarification.

Sincerely,

Brooke Herczeg
Heritage Planner
Brooke.Herczeg@Ontario.ca

It is the sole responsibility of proponents to ensure that any information and documentation submitted as part of their EA report or file is accurate. MTCS makes no representation or warranty as to the completeness, accuracy or quality of the any checklists, reports or supporting documentation submitted as part of the EA process, and in no way shall MTCS be liable for any harm, damages, costs, expenses, losses, claims or actions that may result if any checklists, reports or supporting documents are discovered to be inaccurate, incomplete, misleading or fraudulent.

Please notify MTCS if archaeological resources are impacted by EA project work. All activities impacting archaeological resources must cease immediately, and a licensed archaeologist is required to carry out an archaeological assessment in accordance with the Ontario Heritage Act and the Standards and Guidelines for Consultant Archaeologists.

If human remains are encountered, all activities must cease immediately and the local police as well as the Cemeteries Regulation Unit of the Ministry of Government and Consumer Services must be contacted. In situations where human remains are associated with archaeological resources, MTCS should also be notified to ensure that the site is not subject to unlicensed alterations which would be a contravention of the Ontario Heritage Act.

Lisa Courtney

From: Lands and Resources Consultation Coordinator <saugeenmetisadmin@bmts.com>
Sent: August 9, 2017 9:27 AM
To: Lisa Courtney
Subject: Request for Comments - Kincardine (Municipality of Kincardine) Water and Wastewater Master Plan

Your File: 16130
Our File: Bruce County – Kincardine (Projects)

Good Morning Ms. Courtney,

The Historic Saugeen Metis (HSM) Lands, Resources, and Consultation Department has received your letter dated August 3, 2017.

We have reviewed the description of the Water and Wastewater Master Plan Study and have no concerns with this project. No further consultation is required.

I trust this may be helpful.

Regards,

George Govier

Co-ordinator Lands, Resources, and Consultation

Historic Saugeen Metis
204 High Street
Southampton, Ontario
N0H 2L0
Direct Line (519) 483-4001
Fax (519) 483-4002
Email saugeenmetisadmin@bmts.com

MUNICPALITY OF KINCARDINE

WATER AND WASTEWATER SERVICING MASTER PLAN

NOTICE OF PUBLIC MEETING

THE PROJECT:

The Municipality of Kincardine is initiating a Water and Wastewater Master Plan study for Kincardine, Tiverton, the Bruce Energy Centre, and the lakeshore area, to identify future infrastructure and servicing needs related to the municipal water and sewage systems to accommodate anticipated growth.

The Water and Wastewater Master Plan process will involve a review of existing water treatment, storage, and supply infrastructure, and sanitary sewage collection and treatment infrastructure. The study will also include a review of growth projections used to establish potential future water and wastewater servicing requirements as they relate to key infrastructure. Upon completion, the Master Plan update will establish a plan for the implementation of any recommended projects.

THE ENVIRONMENTAL ASSESSMENT PROCESS:

The Water and Wastewater Master Plan is being conducted in accordance with the requirements of the Municipal Class Environmental Assessment (Class EA), dated October 2000, as amended in 2007, which is an approved process under the Environmental Assessment Act. Master Plan studies incorporate Phases 1 & 2 of the Class EA process and also include consultation with the general public, government review agencies and the public.

PUBLIC INVOLVEMENT:

Public consultation is a key component of this study. The proposed consultation plan provides for a public meeting and presentation to be held to review the servicing options and to give interested parties an opportunity to provide input into the project. Details regarding the date and location of the public meeting are as follows:

Date: **Tuesday, October 24, 2017**

Time: **7:00 p.m. – 8:30 p.m.**
(Presentation at 7:15; open-house afterwards)

Location: Municipality of Kincardine Municipal Administration Centre
1475 Concession 5, R.R. 5, Kincardine ON N2Z 2X6

For further information on this project, please contact the consulting engineers: B. M. Ross and Associates, 62 North Street, Goderich Ontario, N7A 2T4. Telephone (519) 524-2641. Fax (519) 524-4403. Attention: Lisa Courtney, Environmental Planner. E-mail: lcourtney@bmross.net

Adam Weishar, Director of Public Works
Municipality of Kincardine

This Notice issued October 4, 2017

Municipality of Kincardine
Water and Wastewater Master Plan

Public Meeting
October 24th, 2017

Agenda

- Scope of Water and Wastewater Master Plan
- Master Plan Process
- Phase 1: Problem/Opportunity
- Background
  - Growth and Development
  - Water Systems
  - Wastewater Systems
- Expansion Timing
- Next Steps

Water and Wastewater Master Plan Scope

- Review of existing:
  - Water treatment, storage and distribution infrastructure
  - Sanitary sewage collection and treatment infrastructure
- Identify potential scale of growth and development in: Kincardine (Town), Tiverton, Lakeshore area, and Bruce Energy Centre (BEC)
- Determine infrastructure requirements to provide W&WW service to Bruce Power
- Determine timing and sequence of expansion of major facilities (treatment, storage, SPS, trunk mains)
- Develop digital water and wastewater models

Master Plan Process

- Long range plans that integrate infrastructure requirements for existing land uses and future land uses with environmental planning principles
- The Master Plan documents the processes followed to complete Phases 1 and 2 of the Municipal Class EA process
- Recommend an infrastructure servicing plan that can be implemented through the completion of separate projects
- Following "Approach 1" – **broad level of assessment, any Schedule B or C projects will require additional investigations**

Master Plan Process

- Consultation is a key component of this study. Consultation throughout the Master Plan process includes:
  - Review agencies
  - Stakeholders
  - Public
  - First Nation and Métis communities
- Initial Public Notice of Study Commencement issued August 9, 2017

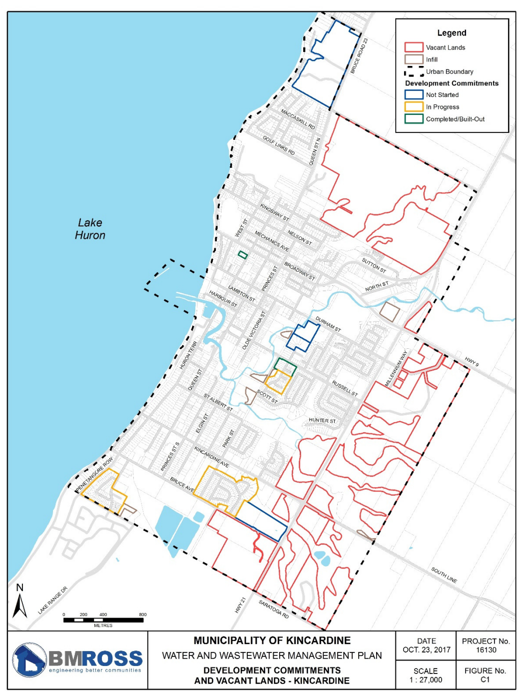
Phase 1: Problem/Opportunity

- The Municipality of Kincardine is investigating infrastructure and servicing needs related to municipal water and wastewater to accommodate anticipated future growth and development within Kincardine, Tiverton and the Lakeshore area.
- There is an opportunity to investigate the integration of water and wastewater services to service Bruce Power.

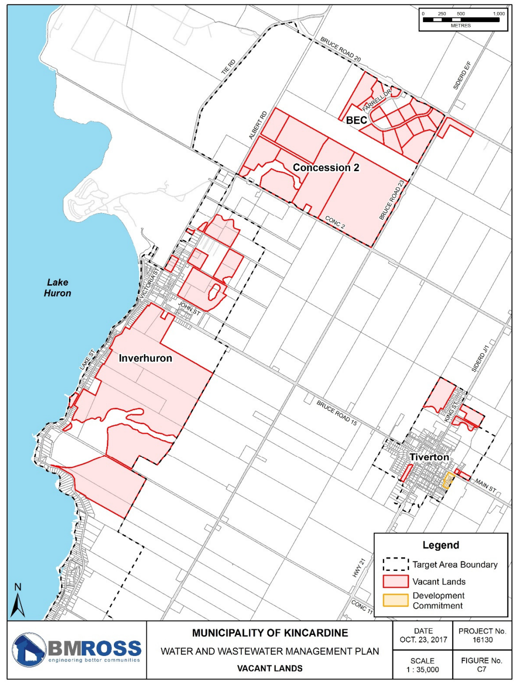
Growth and Development

- Examined population trends and forecasts for Kincardine, Tiverton, Lakeshore areas to identify potential future needs for water and wastewater servicing
- Trends show increases in the number of dwellings and decreases in the number of persons per unit
- Examined 50 year growth scenarios, extrapolated from the Official Plan, Development Charges
- Reviewed vacant residential lands to estimate maximum build-out populations

Growth and Development



Growth and Development



Summary of Population Forecasts to 2067

Forecast Methodology[1]	Kincardine (Town)	Tiverton	Lakeshore
Existing (2016)	8,315	725	1,439
Ministry of Finance	9,362	816	1,620
Development Charges	11,730	1,023	2,031
Official Plan – Low Growth	18,915	1,364	3,124
Official Plan – High Growth	22,509	1,544	3,511
Build-out	16,791[2]	1,780	10,298

Notes: 1. Forecasts extrapolated for 50 year period as necessary.
2. An expanded urban boundary to Concession 5 between Bruce Road 23 and Highway 21would increase build-out population potential to 24,762.

Water & Wastewater Quantities

- Generally looked at treatment infrastructure in terms of "Equivalent Residential Unit" (ERU)
- ERU = unit flow design value for an individual residential unit, including single detached, semi-detached, apartments, condominiums, etc.
- Most instances, assume industrial/commercial/institutional (ICI) grows in proportion to residential
- Exceptions – BEC WWTP

Water & Wastewater Quantities

- Kincardine WTP
  - 1.64 m^3/d/ERU as maximum day
- Tiverton Water System
  - 1.67 m^3/d/ERU as maximum day

- Kincardine WWTP
  - 0.97 m^3/d/ERU as average day
- BEC WWTP
  - 0.72 m^3/d/ERU as average day PLUS
  - 20.9 m^3/d/ha of industrial land as average

Water System Considerations

- Water source
- Treatment plant capacity
- Storage for peak flow equalization, fire protection and emergencies
- Distribution
- 2 systems
  - Kincardine Water System
  - Tiverton Water System

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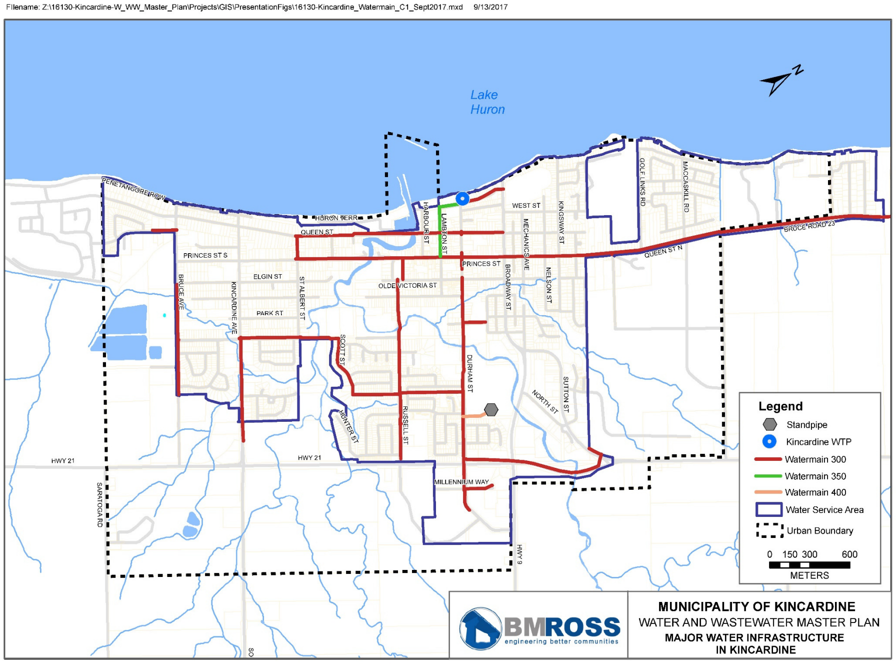


Kincardine WTP

- Services: Kincardine, Lakeshore, Inverhuron, Inverhuron Provincial Park
- Capacity is 11,563 m^3/d
  - 7,050 ERUs (maximum day basis)
- Current reserve capacity is 4,598 m^3/d
  - 2,792 ERUs (maximum day basis)
- Uncommitted reserve capacity is 2,728 m^3/d
  - 1,663 ERUs (maximum day basis)

Kincardine WTP – Projected Expansion Considerations

- Consider two extrapolated growth forecasts:
  - Official Plan High Growth + Commitments – Expand by 2033
  - Development Charges + Commitments – Expand by 2064
- Actual timing will depend on rate of development
- Limited opportunity to expand WTP at existing site; currently reviewing potential treatment modifications
- Bruce Power servicing – 2nd WTP at north

New WTP at North End of Municipality

- Feasibility analysis compared extension of existing system vs. new WTP. Identified cost, operational benefits of new WTP.
- Early stages of Class EA
- Possibility to incorporate supply to other customers

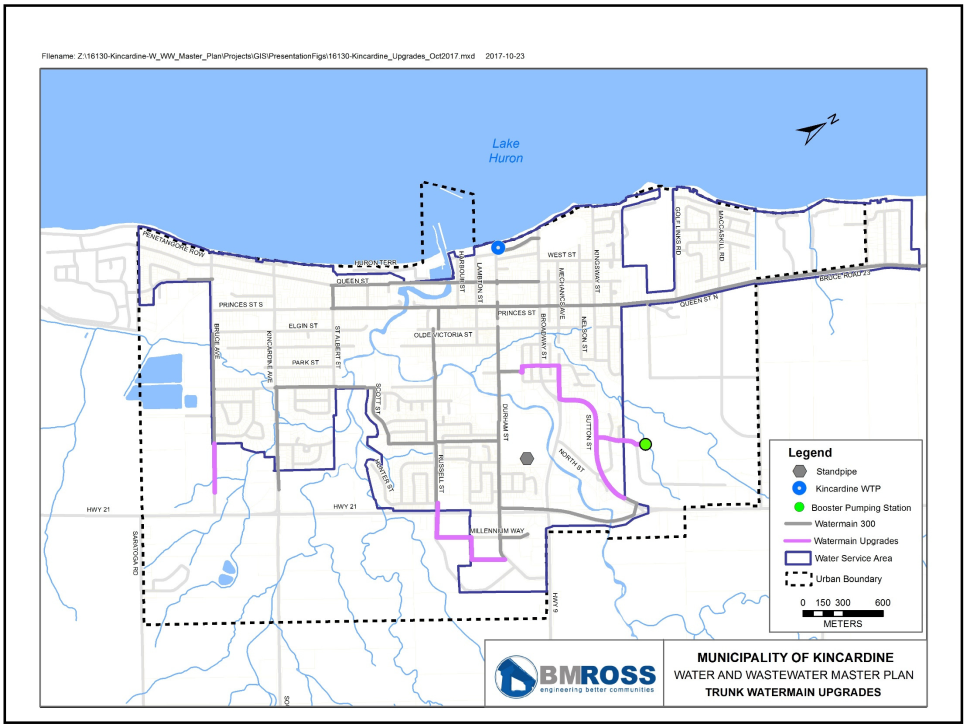
- Concurrent with process, reviewing wastewater servicing as separate Class EA

Kincardine Water Storage

- WTP reservoir, standpipe
- Available storage is allocated entirely to existing customers
- To gain storage, initial steps:
  - Rehabilitate existing standpipe booster pumping station (BPS)
  - Modify disinfection process at WTP
- Assuming BPS and disinfection modifications – under fastest growth rate, additional storage needed in approximately 15 years

Kincardine Water Distribution

- Planned upgrades to increase water supply to north end of Gary Street and beyond:
  - BPS at north end of Gary Street
  - Increased watermain size on Gary Street, and to south in both east & west
- Preliminary conclusion that BPS would service lands north of current Gary Street, between Hwy. 21 and Cty. Rd. 23 in 2^{nd} pressure zone
- Business Park connections


Lake
Huron
Legend
Standpipe
Kincardine WTP
Booster Pumping Station
Watermain 300
Watermain Upgrades
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TRUNK WATERMAIN UPGRADES
BMROSS
engineering better communities
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ELGIN ST
PARK ST
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MILLENNIUM WAY
DURHAM ST
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PRINCES ST
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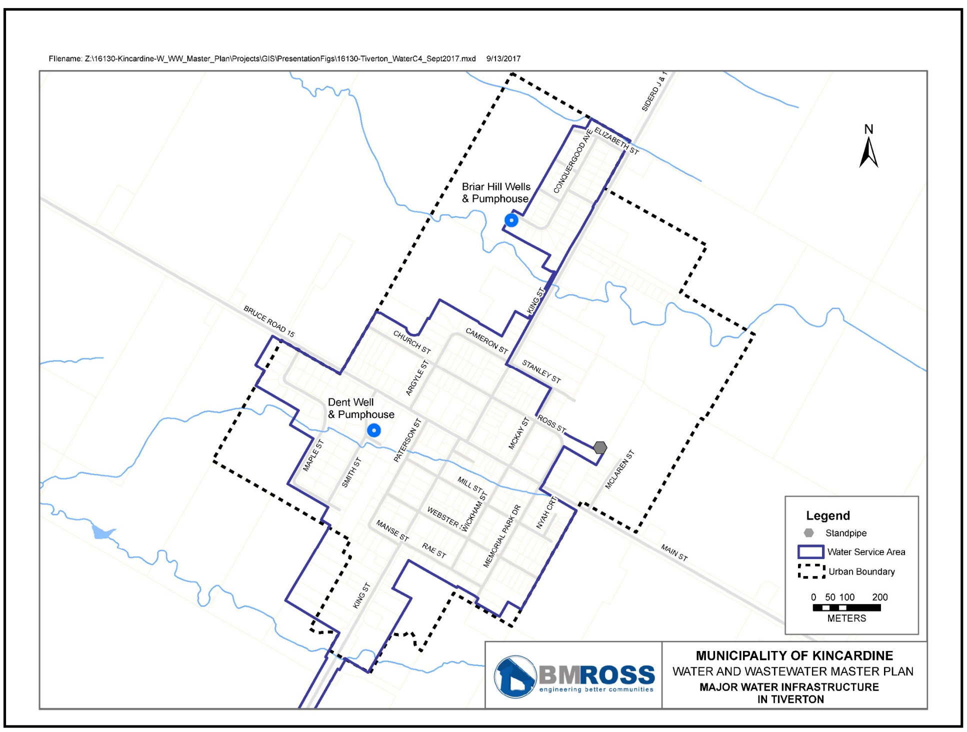
OLDE VICTORIA ST


N
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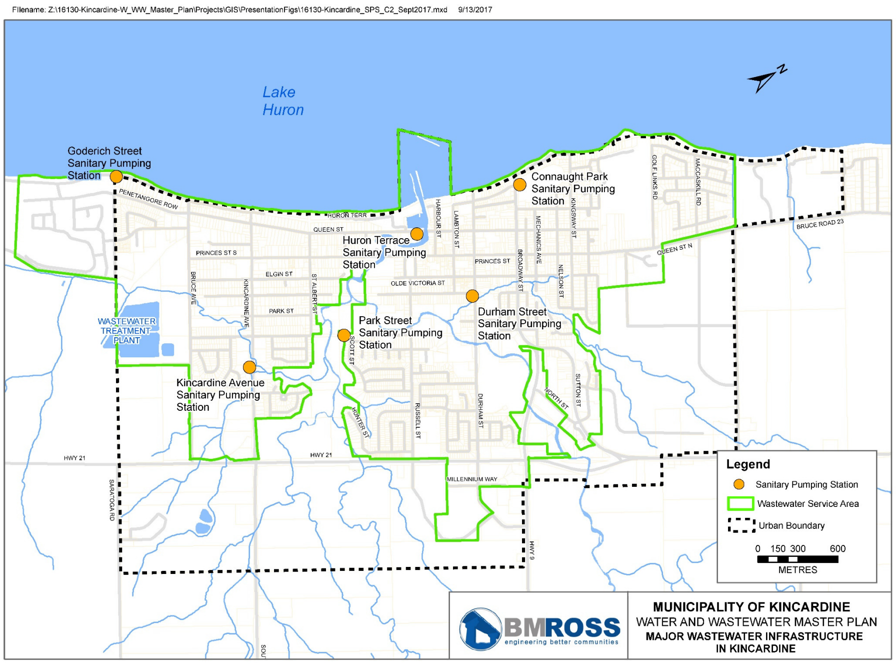
METERS
MUNICIPALITY OF KINCARDINE
WATER AND WASTEWATER MASTER PLAN
MAJOR WATER INFRASTRUCTURE
IN TIVERTON
BMROSS
engineering better communities

Tiverton Water

- Groundwater supply with elevated water storage
  - Existing max. day use: 659 m^3/d
  - PTTW capacity: 774.66 m^3/d
- For fastest growth forecast + commitments an expansion could be required in approximately 5 years
  - Potential to address via standby well
- Need to rehabilitate the existing standpipe BPS to gain some storage. Once done, sufficient storage for 50+ years.

Wastewater Considerations

- Outlet for treated wastewater
- Treatment plant capacity
- Collection system
  - Sewage pumping stations (SPSs) and forcemains
  - Sewers
- 2 WWTPs
  - Kincardine WWTP
  - BEC WWTP



Kincardine WWTP

- Capacity is 5,910 m^3/d as annual average day
  - 6,093 ERUs
- Current reserve capacity is 2,099 m^3/d
  - 2,163 ERUs
- Uncommitted reserve capacity is 993 m^3/d
  - 1,024 ERUs

Kincardine WWTP – Projected Expansion Considerations

- Consider two extrapolated growth forecasts:
  - Official Plan High Growth + Commitments – Expand by 2028
  - Development Charges + Commitments – Expand by 2049
- Actual timing will depend on rate of development
- Expansion possible at existing site, would result in mechanical plant

Kincardine Wastewater – Collection

- Look at SPS and forcemain, trunk sewer capacities
- Analysis is ongoing. Currently identified needs include:
  - Trunk sewer upgrades on Russell Street, and on Gary & Sutton Streets to southwest
  - Park St. SPS – increase capacity for Business Park
  - Durham St. SPS – increase capacity for development north of Gary
  - Huron Terrace SPS – recommend begin process to initiate increase in capacity (i.e. Class EA)

SPS Summary

SPS	2014-2016 Max.	Ex. Rated Capacity Per ECA
	L/s	
Goderich St.	25	46
Kincardine Ave.	14	49
Park St.	56	99
Durham St.	20	27
Huron Terrace	114	115
Connaught	39	89[1]

Notes:

1. Pending replacement planned for 2018.

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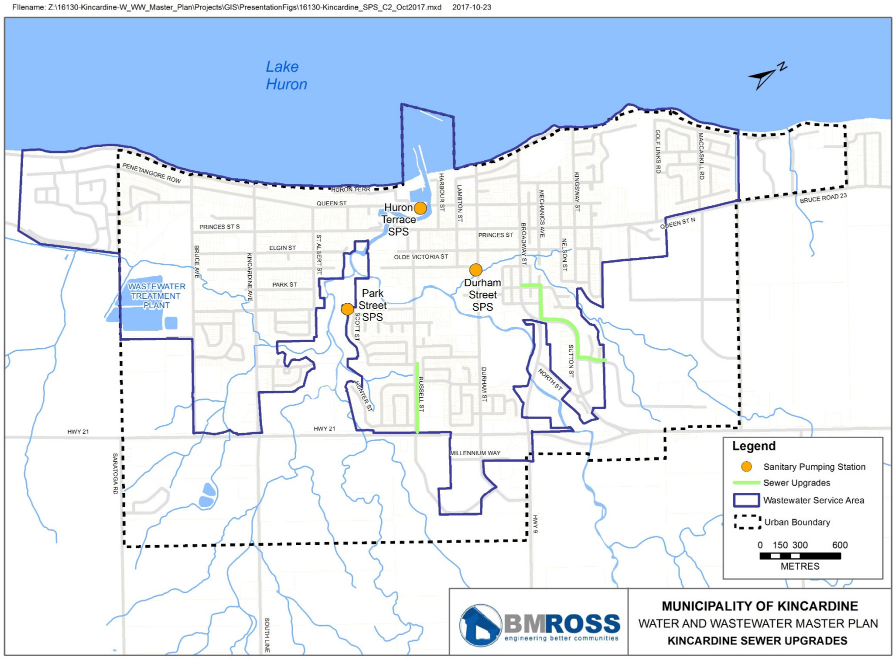

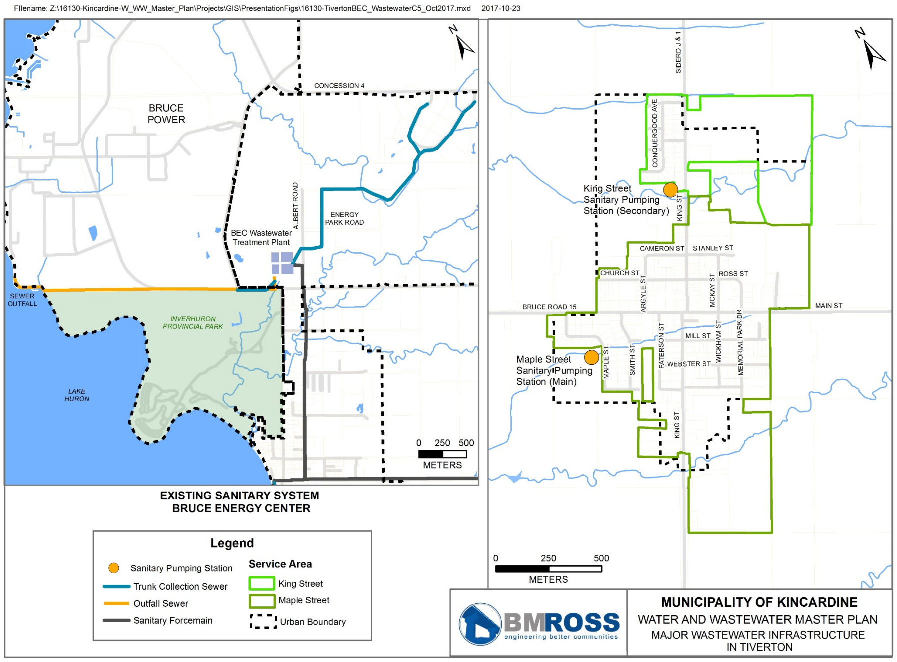

BEC WWTP

- Services: Tiverton, Inverhuron, Bruce Energy Centre industrial park
- Capacity is 2,200 m^3/d
  - Need to consider both ERUs and ICI flows
- Current reserve capacity is 1,395 m^3/d
- Commitments for Bruce Power reserve, Inverhuron Class EA, Tiverton
- Uncommitted reserve capacity is 667m^3/d
  - 926 ERUs or equivalent ICI

Expansion Timing

- Actual timing for water & wastewater infrastructure upgrades/expansion related to development status (i.e. growth), rather than calendar year
- Need to consider maintaining a reserve for development (i.e. include development commitments in reserve capacity analysis)

Bruce Power Servicing

- Based on work completed for Master Plan to date, providing Bruce Power with water and wastewater services will require new/expanded infrastructure
- September 2017 – Municipality and Bruce Power came to an agreement to initiate Class EAs for a new water treatment plant and BEC wastewater treatment plant expansion
- Anticipate 2.5 to 4 years from start of Class EA to approval

Next Steps

- Continue work on water distribution and wastewater collection system evaluations
- Review Public and Agency comments
- Identify and evaluate servicing alternatives
- Identify the preferred servicing strategies
- Present servicing strategy to Council
- Finalize Master Plan report
  (includes a 30-day public review period)
- Master Plan approved by Council

Questions/Comments

B. M. ROSS AND ASSOCIATES LIMITED
Engineers and Planners
62 North Street, Goderich, ON N7A 2T4
p. (519) 524-2641 • f. (519) 524-4403
www.bmross.net

File No. 16130

Municipality of Kincardine
Water and Wastewater Servicing Master Plan

Public Information Centre – October 24, 2017
Meeting Notes

A Public Information Centre (PIC) was held on Tuesday, October 24, 2017 at the Municipal Administration Office for the Municipality of Kincardine Water and Wastewater Servicing Master Plan. The PIC included display panels and a presentation by BMROSS staff. There were approximately one dozen people in attendance. The presentation started at 7:15 pm and the following questions and comments were received from attendees:

Question and/or Comment	Response
What is the current population of the Town of Kincardine? Has the population increased from the last census?	Current population is 8,315, which is an increase from the 2011 census. Population data for the Town is available on the Census website.
Does the problem/opportunity statement include consideration of existing users?	Noted. Will revise to it clear that existing development is also being considered as part of the Master Plan.
How are existing, unserviced residential lots considered in terms of commitments for water and wastewater?	Existing, unserviced residential lots are considered existing commitments 1. where previous study work has identified an intent to provide service, and are factored into the demands for water and wastewater
Any consideration of connecting Tiverton to the Kincardine water supply?	Future provision of water to Tiverton via connection to a 2nd water treatment plant at the north end of the Municipality will be considered as part of the Class EA related to that potential plant. At this time, there is no identified need to expedite such a connection to a new supply.
Raised concern about cost of infrastructure. Will cost be on taxpayers (i.e, build it and hope development comes)?	Noted. Generally, development contributes to infrastructure costs through the collection of

	development charges and agreements negotiated with the Municipality.
If nothing is done, development will go other places.	Noted.
What's the timeline for completion of the Master Plan?	Hope to have a draft of the Master Plan prepared by the end of 2017.
Is there any opportunity to include triggers to require underserviced areas to connect to municipal systems? Requested that the Master Plan address risks associated with existing underserviced areas.	Noted – can look at including risks associated with existing underserviced areas
Has substantial lands north of Kincardine with intention to develop. Noted that lands were not included in the Master Plan.	Noted. The Master Plan includes developments that have at least initiated discussions with the Municipality and Bruce County Planning. Advised to contact the Municipality and Bruce County Planning.
Municipality should not pay to service Bruce Power with water.	Noted.
Municipality should not accept wastewater flows from Bruce Power because it will contain chemicals.	The Municipality currently has sewer connection by-law that regulates what can be discharged into the sanitary sewers. The EA for the wastewater project will assess the risk associated with sewage form the Bruce Power site.
Suggested installing a sewer line along Bruce Road 23 to Bruce Road 20 and extended the water line along Bruce Road 23 to Bruce Road 20.	Noted.

The meeting adjourned at 8:30 P.M.

Meeting Notes prepared by:
B.M. ROSS AND ASSOCIATES LIMITED
Lisa J. Courtney, M.Sc., R.P.P, MCIP

File: 16130

MUNICIPALITY OF KINCARDINE

WATER AND WASTEWATER SERVICING MASTER PLAN

PUBLIC MEETING

October 24, 2017

ATTENDANCE LIST

(PLEASE PRINT)

Name	Address

File: 16130

MUNICIPALITY OF KINCARDINE

WASTER AND WASTEWATER SERVICING MASTER PLAN

PUBLIC MEETING

October 24, 2017

COMMENTS

Name: ____

Address: ____

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PLEASE HAND IN, MAIL, EMAIL, OR FAX TO:

B. M. ROSS AND ASSOCIATES LIMITED
Consulting Engineers
62 North Street
Goderich, Ontario
N7A 2T4

Phone: (519) 524-2641 Fax: (519) 524-4403
E-mail: lcourtney@bmross.net
Attention: Lisa Courtney, Environmental Planner

Comments and Information collected by B.M. Ross & Associates Limited on behalf of the Municipality of Kincardine will assist in decision making pertaining to the Master Plan study. Comments and opinions will be kept on file but will not be included in study documentation made available for public review. Under the Freedom of Information and Protection of Privacy Act (1990) personal information provided to the Municipality of Kincardine will remain confidential unless prior consent is obtained.

Lisa Courtney

From: Paul Elston <p.elston@SVCA.ON.CA>
Sent: November 13, 2017 2:56 PM
To: lcourtney@bmross.net
Subject: Municipality of Kincardine - Water and Wastewater Servicing Master Plan Study

Follow Up Flag: Follow up
Flag Status: Flagged

Hi Lisa,

My apologies for the tardy response to you regarding the project noted above. SVCA staff would like to be part of the review parties inasmuch as some of the infrastructure works, when determined may require permits pursuant to our Regulation 169/06, as amended. Accordingly, we would like to receive information regarding the status of the EA and any information that may be related to wetlands, watercourses, and other areas that may fall under our Regulation.

Thank you for your correspondence. If you have any questions, regarding our involvement, please contact our office.

Sincerely,

SAUGEEN CONSERVATION

Paul Elston, Regulations Officer
1078 Bruce Rd. 12, Box 150 Formosa ON N0G 1W0
519-367-3040 Ext. 225 Fax 519-367-3041
p.elston@svca.on.ca
www.svca.on.ca

Lisa Courtney

From: Lisa Courtney <lcourtney@bmross.net>
Sent: February 5, 2018 4:39 PM
To: Carl Seider
Subject: RE: 16130 - Kincardine Water and Wastewater Master Plan

Hi Carl,

Thanks for the speedy response. Always appreciated. The Water and Wastewater Servicing Master Plan is not addressing stormwater infrastructure, but in the Source Protection part of the report I can certainly add some text explaining transport pathways, stormwater infrastructure and EBA modelling, and that if there are any major changes to stormwater infrastructure it may impact modelling results.

For the recommended review of the PTTW and MDWL for Tiverton, I will add text explaining that Source Protection needs to be informed during the study and that if there are any changes in the pumping rates the groundwater model for delineating the WHPAs will need updated.

I expect we will be issuing the draft Master Plan for public and review agency comment soon, so when that happens I'll be sure to let you know.

Lisa J. Courtney, MSc., MCIP, RPP
B. M. Ross and Associates Limited
Engineers and Planners
62 North Street
Goderich, ON N7A 2T4

Ph: (519) 524-2641
Fax: (519) 524-4403
lcourtney@bmross.net
www.bmross.net

From: Carl Seider [mailto:c.seider@waterprotection.ca]
Sent: February 5, 2018 1:53 PM
To: Lisa Courtney <lcourtney@bmross.net>
Cc: RMO Mailbox <rmo@greysauble.on.ca>; Erik Downing <E.Downing@SVCA.ON.CA>
Subject: RE: 16130 - Kincardine Water and Wastewater Master Plan

Hi Lisa,

Thanks for providing a copy of the materials related to drinking water source protection under the Kincardine Water & Wastewater Master Plan review process. The two items that we would be interested in would be potential changes to the stormwater upgrades in Kincardine and review of the PTTW in Tiverton.

Under the Events-Based modelling conducted for Kincardine related to fuel threats, the modelling looked at potential pathways where a spill of fuel could reach the Lake. If there are significant changes to the stormwater system in Kincardine, this could impact the modelling results.

With respect to the PTTW review in Tiverton, if there were to be a change in the upper limit of water that can be drawn from the aquifer, then we would need to update the groundwater model assumptions that were used to delineate the Wellhead Protection Area in Tiverton.

Please keep us informed on updates to the Master Plan as it relates to these two areas.

Thanks again.

Carl Seider, Project Manager

Drinking Water Source Protection
237897 Inglis Falls Road, RR 4
Owen Sound, Ontario, N4K 5N6
Phone: 519-470-3000 Ext. 201
Toll Free: 877-470-3001
Fax: 519-470-3005
c.seider@waterprotection.ca

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
www.waterprotection.ca

From: Lisa Courtney [mailto:lcourtney@bmross.net]
Sent: Monday, February 05, 2018 11:20 AM
To: Carl Seider <c.seider@waterprotection.ca>
Subject: 16130 - Kincardine Water and Wastewater Master Plan

Hello Carl,

Hope you had a nice weekend. We are working on Water and Wastewater Servicing Master Plan for the Municipality of Kincardine and I'm reaching out to see if there are any comments about threats/policies/vulnerable areas from the source water side of things. The intent of the Servicing Master Plan is to identify water and wastewater infrastructure needs for the existing Kincardine, Tiverton and Lakeshore areas, as well as what might be needed to service future development. I have attached two pdfs – the first is the section of the draft report that identifies the recommended works. Most of the recommended works are upgrades to existing facilities. For water, outside of the already initiated EA for providing Bruce Power with water which is investigating a new WTP at the north end of the Municipality, the identified water projects are:

- Kincardine – modify the disinfection process, rehabilitate the standpipe booster pump, and trunk watermain improvements
- Tiverton – review PTTW and MDWL for potential rerating, rehabilitate standpipe booster pump, and watermain improvements for fireflow

I have also attached the section of the report that summarizes the vulnerable areas in the Master Plan study area, and threats that may apply to water/wastewater infrastructure works. If you'd like to see the entire document, let me know and I will send you the FTP link.

If you have any comments or suggestions, I'd be happy to incorporate them into the Master Plan. Thanks kindly,

Lisa J. Courtney, MSc., MCIP, RPP
B. M. Ross and Associates Limited
Engineers and Planners
62 North Street
Goderich, ON N7A 2T4

Ph: (519) 524-2641
Fax: (519) 524-4403
lcourtney@bmross.net
www.bmross.net

MUNICPALITY OF KINCARDINE

WATER AND WASTEWATER MASTER PLAN

NOTICE OF STUDY COMPLETION

THE PROJECT:
The Municipality of Kincardine initiated a Water and Wastewater Master Plan study for Kincardine, Tiverton, the Bruce Energy Centre, Concession 2 Industrial Park and the lakeshore area, to identify infrastructure needs for existing development and future growth. The Master Plan establishes potential needs associated with growth and development, assesses current infrastructure capacities compared to current and projected needs, and identifies recommended works to address constraints. The works recommended in the Master Plan, as well as project timing and Municipal Class Environmental Assessment schedule are as follows:

Project	Class EA Schedule	Timing
Kincardine Drinking Water System		
Modify Disinfection Process	A	Within 5 years
Rehabilitate Standpipe Booster Pumping Station	A	Within 5 years
Trunk Watermain Upgrades, Russell St., Sutton St., Kincardine Ave.	A+	2018
Gary St. Booster Pumping Station	A	2018
Tiverton Drinking Water System		
Review permits and licenses for rerating	N/A	Within 3 years
Rehabilitate Standpipe Booster Pumping Station	A	Within 5 years
King St. Watermain (Replace or Upgrade)	A+	In response to development
Kincardine Wastewater System		
Durham St. Sewage Pumping Station (SPS) Upgrades – Design and Approvals	A+	2018
Huron Terrace SPS Upgrades – Design and Approvals	A+	2018
Park St. SPS Upgrades – Design and Approvals	A+	2018
SPS and Wastewater Treatment Plant Control Upgrades	A	At discretion of Municipality
Durham St. Sewer Upgrades	A+	In response to development
Queen St. & Kingsway St. Sewer Upgrades	A+	In response to development
Russel St. Sewer Upgrades	A+	In response to development
Gary St. area Sewer Upgrades	A+	2018
BEC and Service Area Wastewater System		
Maple St. SPS Upgrades – Design and Approvals	A+	Within 5 years
SPS and Wastewater Treatment Plant Control Upgrades	A	At discretion of Municipality

PUBLIC INVOLVEMENT:
The Master Plan study process was completed in accordance with Phases 1 and 2 of the Municipal Class Environmental Assessment (Class EA) process. Public consultation is a key component of that process. The Master Plan is being placed on public record for 30 calendar days for review. The Master Plan will be available for public review at the following locations during their regular business hours:

- Municipality of Kincardine Administration Centre (1485 Concession 5, Kincardine) and the Municipal website (www.kincardine.net)
- Bruce County Library – Kincardine Branch (727 Queen St, Kincardine)
- Bruce County Library – Tiverton Branch (56 King Street, Tiverton)

Any comments or questions regarding the Master Plan should be directed by **March 23, 2018** to B. M. Ross and Associates, 62 North Street, Goderich Ontario, N7A 2T4. Telephone (519) 524-2641. Fax (519) 524-4403. Attention: Lisa Courtney, Environmental Planner. E-mail: lcourtney@bmross.net. Subject to comments received, the Municipality of Kincardine intends to adopt the Water and Wastewater Master Plan.

APPEAL PROCESS:
A Master Plan does not require approval under the EA Act, however, specific projects identified within a Master Plan must fulfil the applicable requirements under the Class EA process. If concerns regarding the projects identified in the Master Plan cannot be resolved in discussion with the Municipality, a person may request a Part II Order under the EA Act, which addresses individual EAs. Written requests must be submitted within 30 calendar days of this notice and sent to the Municipality and: Minister, Ministry of the Environment and Climate Change, Floor 11, 77 Wellesley St. W, Toronto ON M7A 2T5 Fax: (416) 314-8452 and Director, Environmental Assessment and Permissions Branch, Ministry of Environment and Climate Change, 135 St. Clair Ave West, 1st Floor, Toronto ON M4V 1P5.

Adam Weishar, Director of Public Works
Municipality of Kincardine

This Notice issued February 21, 2018

SAUGEEN CONSERVATION
1078 Bruce Road 12, P.O. Box 150, Formosa ON Canada N0G 1W0
Tel 519-367-3040, Fax 519-367-3041, publicinfo@svca.on.ca, www.svca.on.ca

SENT ELECTRONICALLY (lcourtney@bmross.net)

March 22, 2018

B. M. Ross and Associates Limited
62 North Street
Goderich, ON
N7A 2T4

Attention: Lisa J. Courtney, M. Sc., RPP, MCIP
Registered Professional Planner

Dear Ms. Courtney:

RE: Notice of Study Completion
Water and Wastewater Servicing Master Plan
Municipality of Kincardine

The Saugeen Valley Conservation Authority (SVCA) has received the Notice of Study Completion for the Water and Wastewater Master Plan for the Municipality of Kincardine. The Master Plan has been prepared to identify current and future needs for various infrastructure facilities and projects in the municipality.

SVCA staff have identified several areas in the Master Plan where SVCA input will be required. Of more immediate interest are those projects identified for 2018. It is these projects where additional details will be required for our further detailed review. The details would include preliminary design plans as they become available and where the works may require SVCA permit(s) pursuant to our Ontario Regulation 169/06, as amended. We have outlined the following 2018 projects that will require more detailed SVCA staff review:

a. Trunk Watermain upgrades for Russell St., Sutton Street and Kincardine Avenue;

b. Durham Street Sewage Pumping Station (SPS) upgrades (if details related to proposed infrastructure works are part of the scenario)

c. Huron Terrace SPS upgrades (if details related to proposed infrastructure works are part of the scenario);

d. Park Street SPS upgrades (if details related to proposed infrastructure works are part of the scenario); and it is noted that

e. Connaught Park Sewage Pumping Station (SPS) Trunk Sewer Replacement
    - SVCA staff reviewed details for this portion of the overall project. SVCA Permit No. 17-162 was issued for the portions of the proposed works within the SVCA Regulated Area;

SVCA staff have identified other works within the Master Plan proposed for the future at the discretion of the Municipality or in response to development. In these areas, SVCA staff request to be provided with preliminary design and construction drawings for further review of these proposed upgrades as information becomes available. We have identified these projects as follows:

a. Durham Street SPS - Future Sanitary Sewer System Upgrades for Gary St., Sutton St., Mechanics Ave. and James St.;

b. Huron Terrace SPS - Forcemain Replacement and Sanitary Sewer Upgrades on Durham, Queen and Kingsway Streets;

c. Park Street SPS -Related Sanitary Sewer Upgrades on Russell Street;

d. Goderich Street SPS;

e. Kincardine Avenue SPS;

f. Kincardine WWTP;

g. Tiverton Drinking Water System – King Street watermain;

h. Kincardine Drinking Water System – Trunk Watermain Upgrades – Sutton Street, Russell Street and Kincardine Avenue; and

i. Bruce Energy Centre WWTP – Expansion.

The SVCA staff thank you for the opportunity to provide our comments and will appreciate the opportunities to review the details of the various projects as they continue. Accordingly, we request that you continue to notify our Authority as subsequent steps arrive. If you have any questions, do not hesitate to contact our office.

We trust this information will be of assistance to you.

Sincerely,

Paul Elston
Regulations Officer
Saugeen Conservation

PE/pe
cc: Adam Weishar, Director of Public Works, Municipality of Kincardine (via email)
Maureen Couture, Director, SVCA (via email)
Andrew White, Director, SVCA (via email)

Ministry of Tourism, Culture and Sport

Heritage Program Unit
Programs and Services Branch
401 Bay Street, Suite 1700
Toronto ON M7A 0A7
Tel: 416 314 7133
Fax: 416 212 1802

Ministère du Tourisme, de la Culture et du Sport

Unité des programmes patrimoine
Direction des programmes et des services
401, rue Bay, Bureau 1700
Toronto ON M7A 0A7
Tél: 416 314 7133
Téléc: 416 212 1802

March 23, 2018 (EMAIL ONLY)

Lisa Courtney
B.M. Ross & Associates
62 North Street,
Goderich, ON N7A2T4
E: lcourtney@bmross.net

RE:	**MTCS file #:**	**0007295**
	Proponent:	**Municipality of Kincardine**
	Subject:	**Notice of Completion** **Water and Wastewater Master Plan study for Kincardine, Tiverton, the Bruce Energy Centre, Concession 2 Industrial Park and the Lakeshore area**
	Location:	**Municipality of Kincardine, Ontario**

Dear Ms. Courtney:

Thank you for providing the Ministry of Tourism, Culture and Sport (MTCS) with the Notice of Commencement for your project. MTCS's interest in this Master Plan project relates to its mandate of conserving Ontario's cultural heritage, which includes:

- Archaeological resources, including land-based and marine;
- Built heritage resources, including bridges and monuments; and,
- Cultural heritage landscapes.

Under the Municipal Class Environmental Assessment (EA) process, the proponent is required to determine a project's potential impact on cultural heritage resources. A Master Plan project at minimum will address Phases 1 and 2 of the Municipal Class EA process. Developing and reviewing inventories of known and potential cultural heritage resources within the study area can identify specific resources that may play a significant role in guiding the evaluation of alternatives for subsequent project-driven EAs.

While some cultural heritage resources may have already been formally identified, others may be identified through screening and evaluation. Indigenous communities may have knowledge that can contribute to the identification of cultural heritage resources, and we suggest that any engagement with Indigenous communities includes a discussion about known or potential cultural heritage resources that are of value to these communities. Municipal Heritage Committees, historical societies and other local heritage organizations may also have knowledge that contributes to the identification of cultural heritage resources.

MTCS recommends that any additional work associated with this Master Plan considers cultural heritage resources. MTCS reminds the proponent that consideration of cultural heritage resources is a commitment of an Environmental Assessment. As seen in section 3.4 of this report, MTCS recommends that appropriate screening is done for any projects identified as part of the servicing strategy. This includes screening for archaeological resources as well as Built Heritage and Cultural Heritage Landscapes.

Archaeological Resources

Your Master Plan project may impact archaeological resources and you should screen the project with the MTCS *Criteria for Evaluating Archaeological Potential* and *Criteria for Evaluating Marine Archaeological Potential* to determine if archaeological assessments will be needed for subsequent project-driven Municipal Class EAs. MTCS archaeological sites data are available at *archaeology@ontario.ca*, and if your Master Plan project area exhibits archaeological potential or encompasses archaeological sites of high cultural heritage value or interest, these data should be used in the evaluation of alternatives.

Built Heritage and Cultural Heritage Landscapes
The MTCS *Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes* should be completed to help determine whether your Master Plan project may impact cultural heritage resources. The Clerk/s for the municipality encompassing the EA project can provide information on property registered or designated under the *Ontario Heritage Act* and municipal Heritage Planners can also provide information that will assist you in completing the checklist. A determination of whether the Master Plan project area impacts potential or known heritage resources of cultural heritage value or interest should be used in the evaluation of alternatives.

If subsequent project-driven Municipal Class EAs may impact potential or known heritage resources MTCS recommends that a Heritage Impact Assessment (HIA), prepared by a qualified consultant, should be completed to assess potential project impacts. Our Ministry's *Info Sheet #5: Heritage Impact Assessments and Conservation Plans* outlines the scope of HIAs. Please send the HIA to MTCS for review, and make it available to local organizations or individuals who have expressed interest in review.

Environmental Assessment Reporting
All technical heritage studies and their recommendations are to be addressed and incorporated into Master Plan projects. Please advise MTCS whether any technical heritage studies will be completed for your Master Plan project, and provide them to MTCS before issuing a Notice of Completion. If your screening has identified no known or potential cultural heritage resources, or no impacts to these resources, please include the completed checklists and supporting documentation in the Master Plan report or file.

Thank-you for consulting MTCS on this project if you have any questions please contact the undersigned.

Sincerely,

Brooke Herczeg
Heritage Planner
Brooke.Herczeg@Ontario.ca

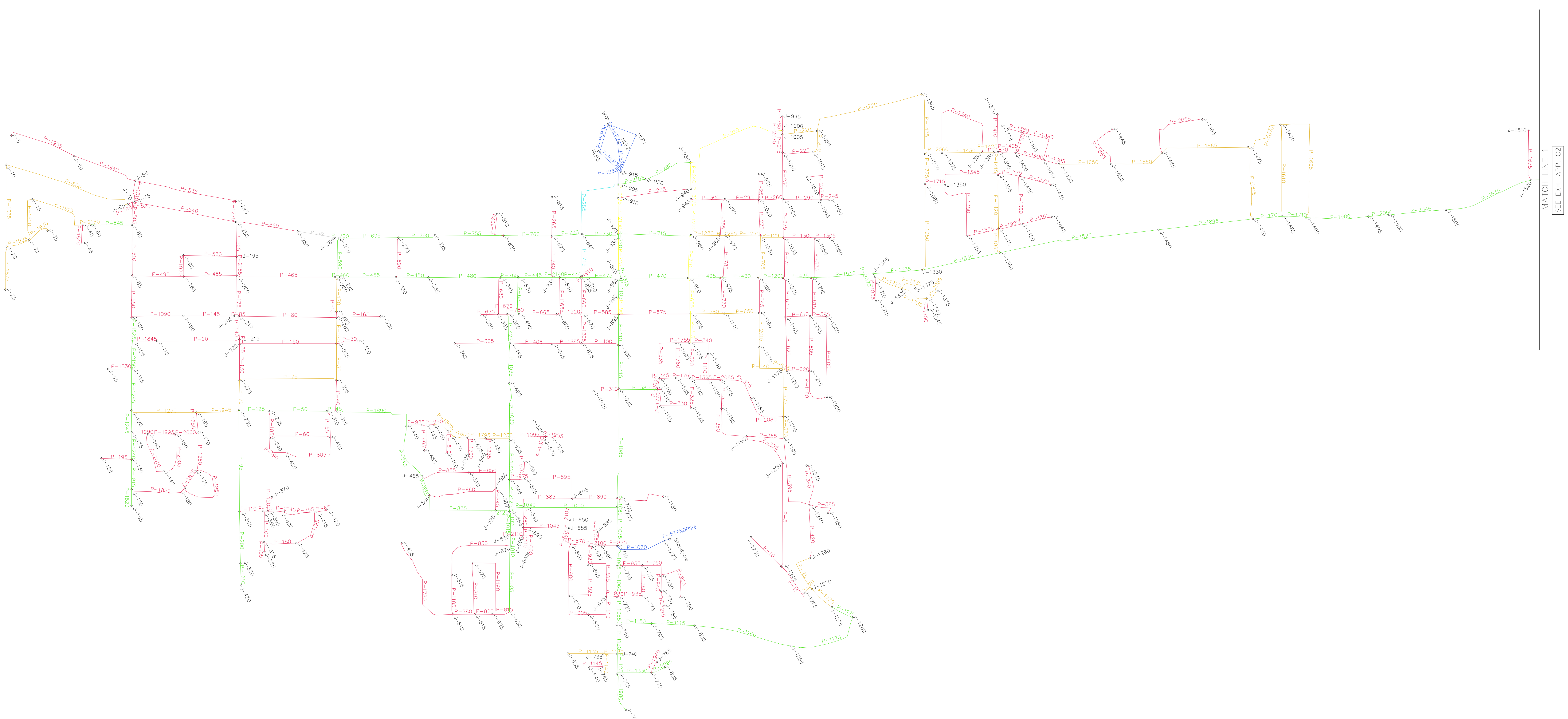
It is the sole responsibility of proponents to ensure that any information and documentation submitted as part of their EA report or file is accurate. MTCS makes no representation or warranty as to the completeness, accuracy or quality of the any checklists, reports or supporting documentation submitted as part of the EA process, and in no way shall MTCS be liable for any harm, damages, costs, expenses, losses, claims or actions that may result if any checklists, reports or supporting documents are discovered to be inaccurate, incomplete, misleading or fraudulent.

Please notify MTCS if archaeological resources are impacted by EA project work. All activities impacting archaeological resources must cease immediately, and a licensed archaeologist is required to carry out an archaeological assessment in accordance with the Ontario Heritage Act and the Standards and Guidelines for Consultant Archaeologists.

If human remains are encountered, all activities must cease immediately and the local police as well as the Registrar, Burials of the Ministry of Government and Consumer Services (416-326-8800) must be contacted. In situations where human remains are associated with archaeological resources, MTCS should also be notified to ensure that the site is not subject to unlicensed alterations which would be a contravention of the Ontario Heritage Act.

LEGEND

- 100 mm DIA. WATERMAIN
- 150 mm DIA. WATERMAIN
- 200 mm DIA. WATERMAIN
- 250 mm DIA. WATERMAIN
- 300 mm DIA. WATERMAIN
- 350 mm DIA. WATERMAIN
- 400 mm DIA. WATERMAIN



No.	DATE	REVISION
1	Feb. 14, 2018	ISSUED FOR MASTER PLAN

BMROSS
engineering better communities

Goderich | Mount Forest | Sarnia

Municipality of Kincardine

Water & Wastewater Master Plan

Kincardine Water Distribution System WaterCAD Schematic

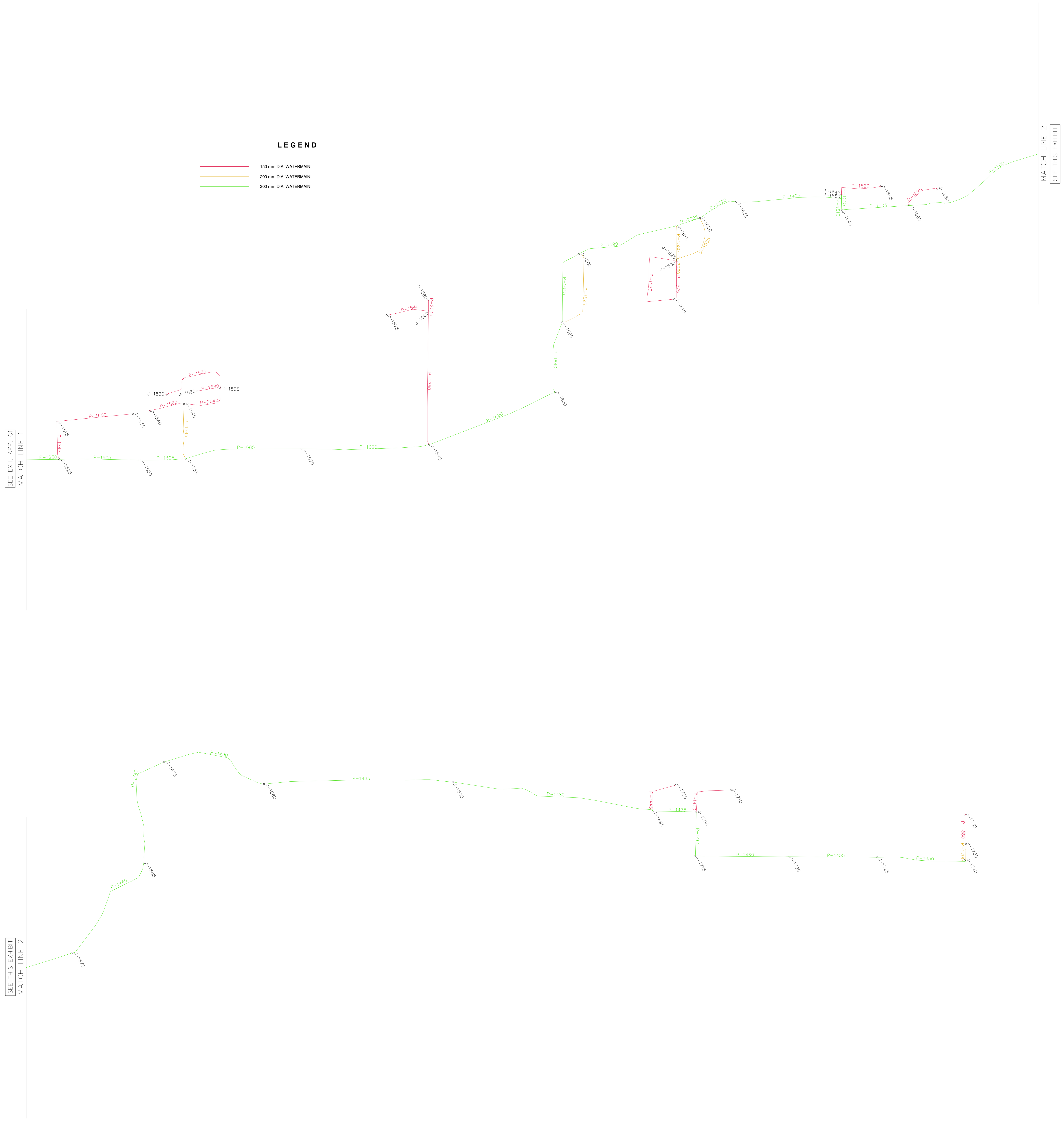
Project No. 16130

Scale N.T.S.

Exhibit App. C1

LEGEND

150 mm DIA. WATERMAIN
200 mm DIA. WATERMAIN
300 mm DIA. WATERMAIN



No.	DATE	REVISION
1	Feb. 14, 2018	ISSUED FOR MASTER PLAN

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Municipality of Kincardine

Water & Wastewater Master Plan

Kincardine Water Distribution System WaterCAD Schematic

Project No. 16130

Scale N.T.S.

Exhibit App. C2

No.	DATE	REVISION
1	Feb. 14, 2018	ISSUED FOR MASTER PLAN

BMROSS engineering better communities

Goderich | Mount Forest | Sarnia

Municipality of Kincardine

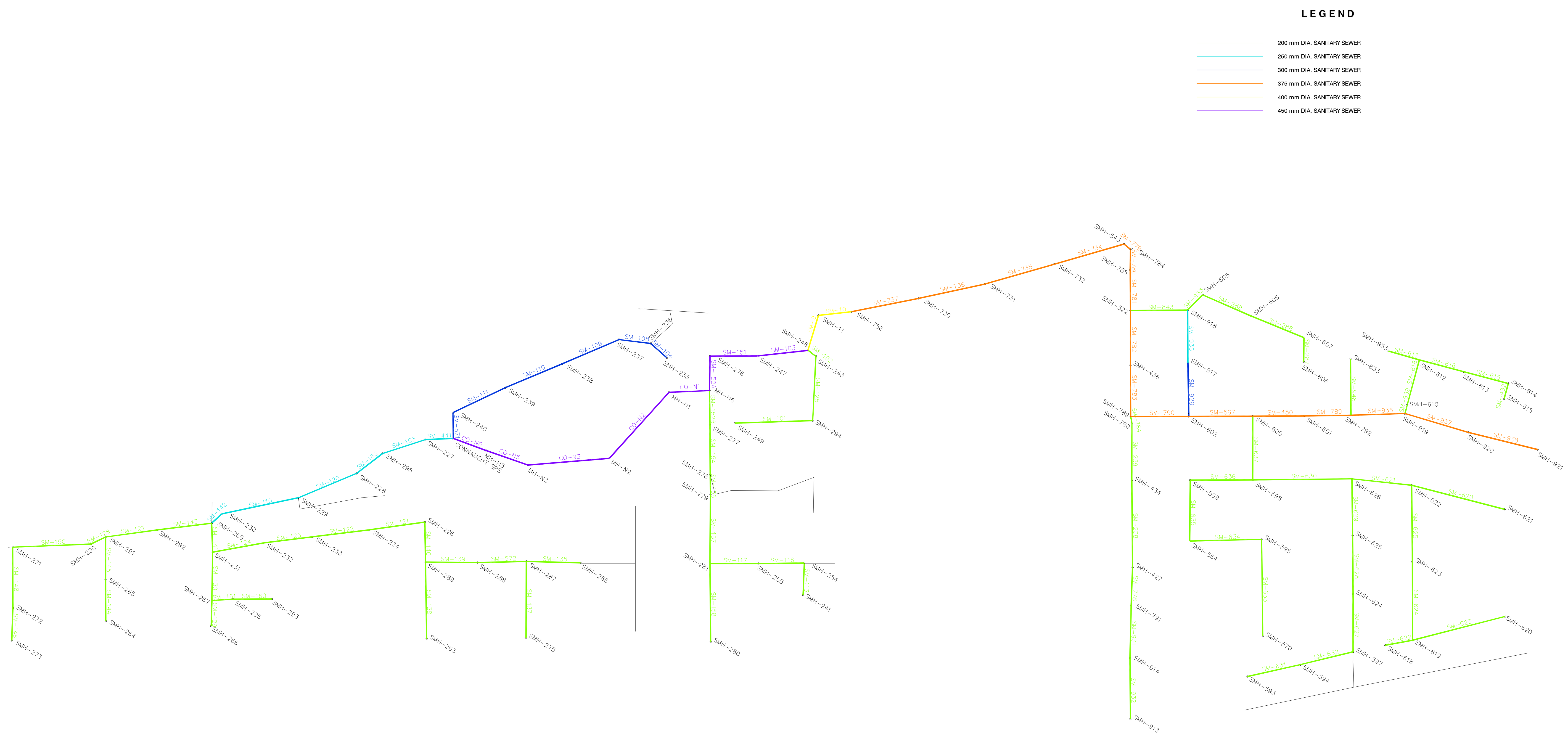
Water & Wastewater Master Plan

Tiverton Water Distribution System WaterCAD Schematic

Project No. 16130

Scale N.T.S.

Exhibit App. D1



No.	DATE	REVISION
1	Feb. 14, 2018	ISSUED FOR MASTER PLAN

BMROSS engineering better communities

Goderich | Mount Forest | Sarnia

Municipality of Kincardine

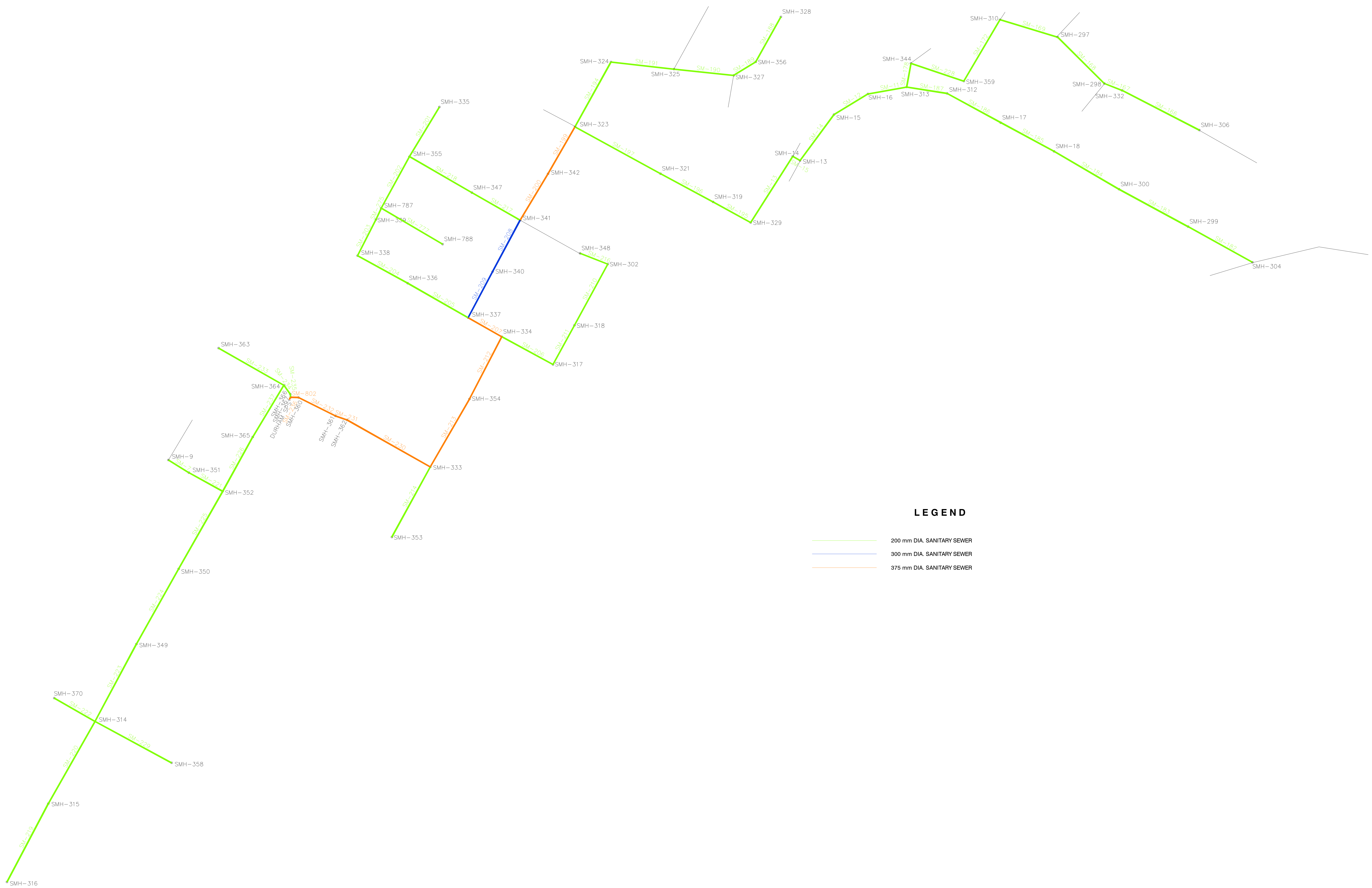
Water & Wastewater Master Plan

Kincardine Connaught Park SPS Catchment Area SewerCAD Schematic

Project No. 16130

Scale N.T.S.

Exhibit App. E1



LEGEND

200 mm DIA. SANITARY SEWER

300 mm DIA. SANITARY SEWER

375 mm DIA. SANITARY SEWER

N

No.	DATE	REVISION
1	Feb. 14, 2018	ISSUED FOR MASTER PLAN

BMROSS
engineering better communities

Goderich	Mount Forest	Sarnia

Municipality of Kincardine

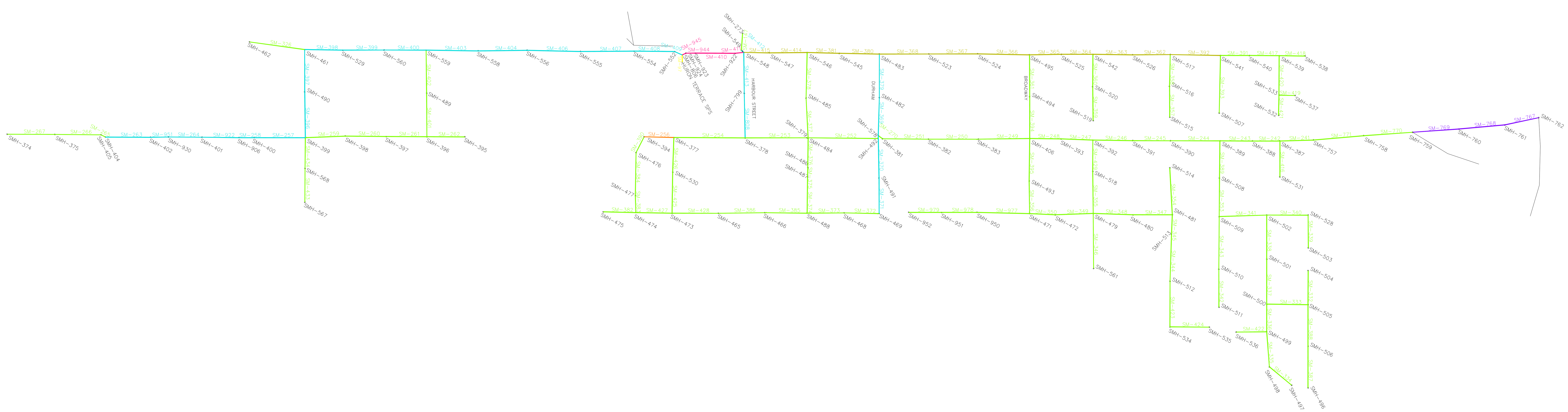
Water & Wastewater Master Plan

Kincardine Durham St. SPS Catchment Area SewerCAD Schematic

Project No. 16130

Scale
N.T.S.

Exhibit App. E2



LEGEND

200 mm DIA. SANITARY SEWER
250 mm DIA. SANITARY SEWER
375 mm DIA. SANITARY SEWER
400 mm DIA. SANITARY SEWER
450 mm DIA. SANITARY SEWER
525 mm DIA. SANITARY SEWER
600 mm DIA. SANITARY SEWER

No.	DATE	REVISION
1	Feb. 14, 2018	ISSUED FOR MASTER PLAN

BMROSS engineering better communities

Goderich | Mount Forest | Sarnia

Municipality of Kincardine

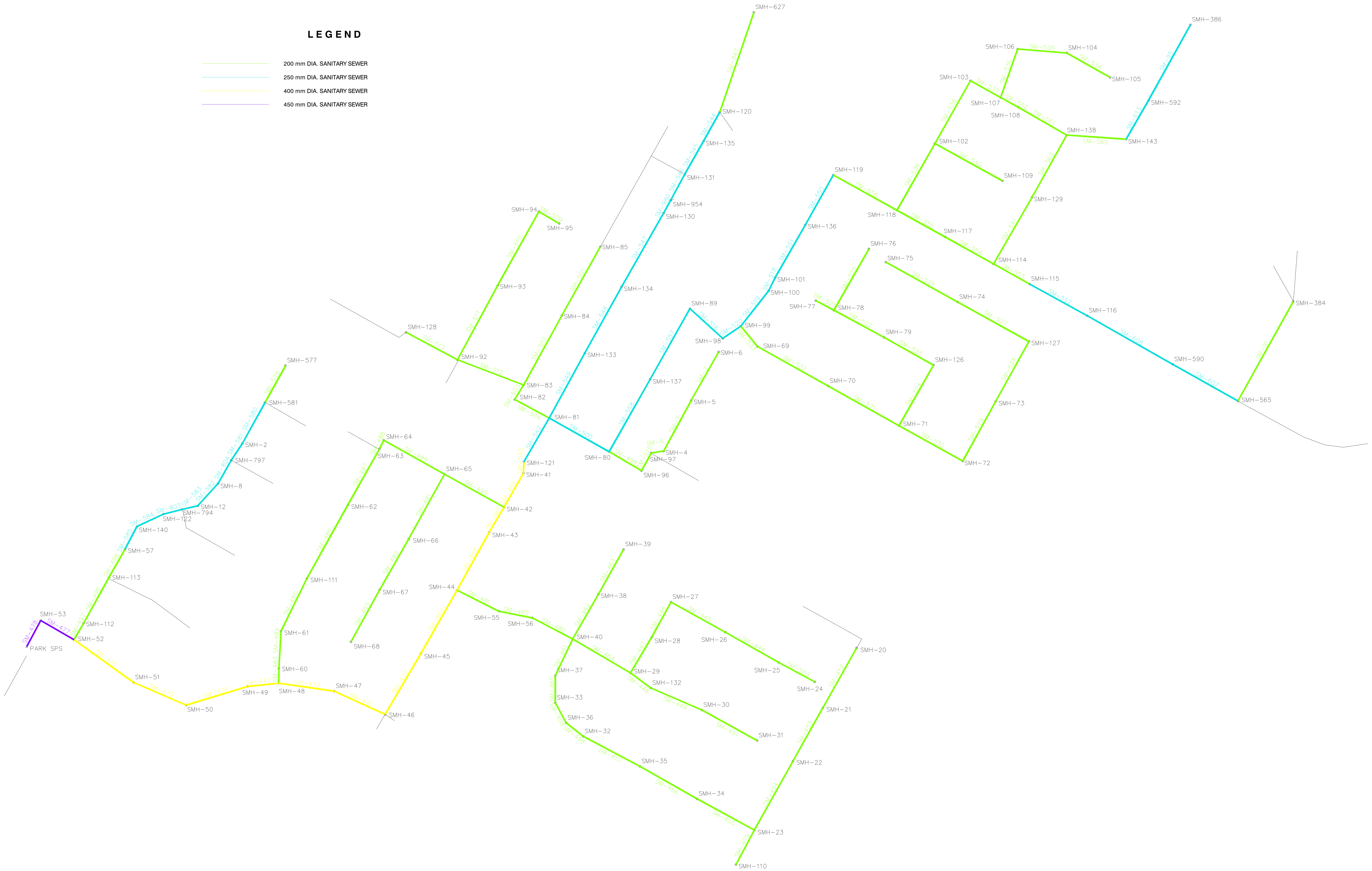
Water & Wastewater Master Plan

Kincardine Huron Terrace SPS Catchment Area SewerCAD Schematic

Project No. 16130

Scale N.T.S.

Exhibit App. E3



No.	DATE	REVISION
1	Feb. 14, 2018	ISSUED FOR MASTER PLAN

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Municipality of Kincardine

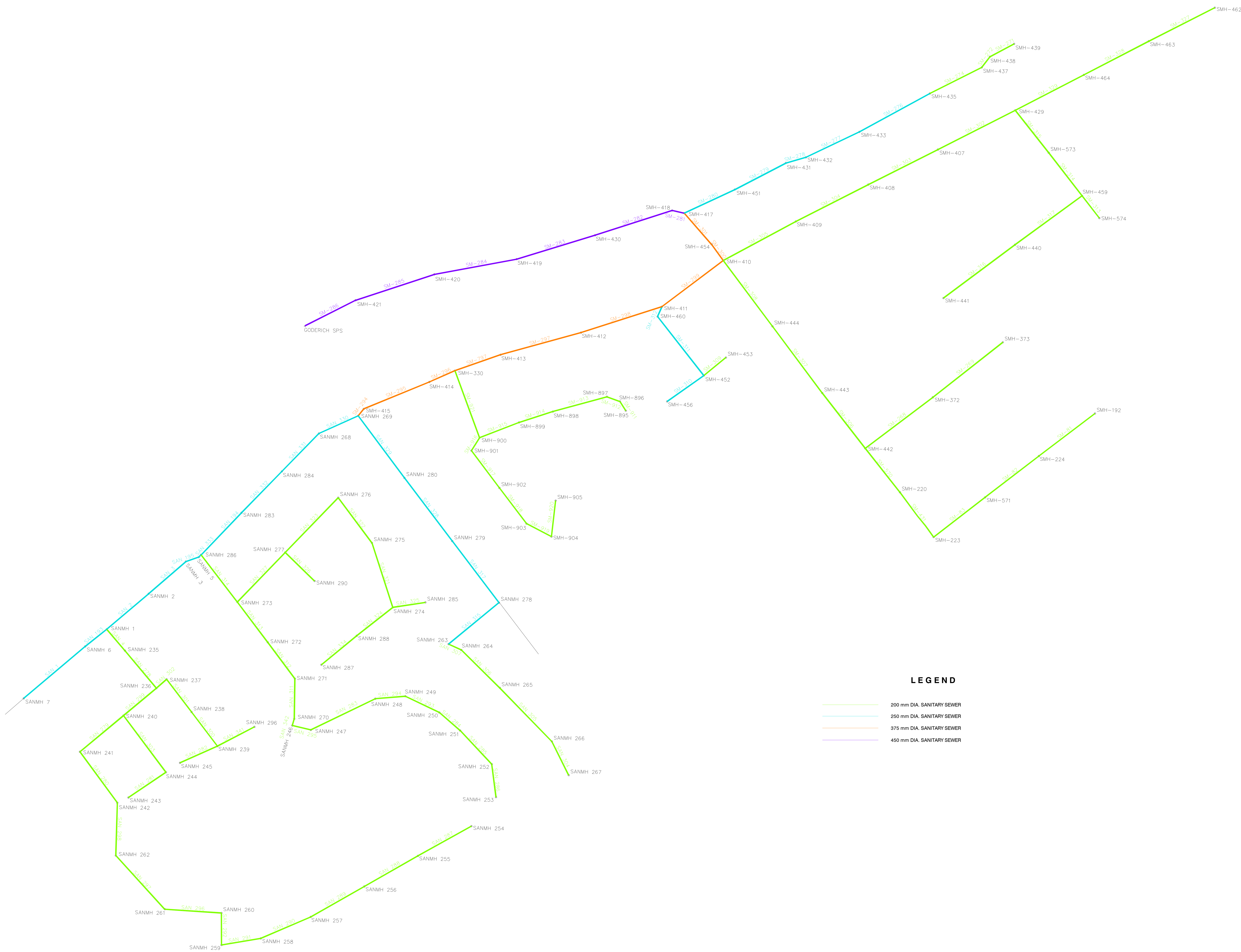
Water & Wastewater Master Plan

Kincardine Park St. SPS Catchment Area SewerCAD Schematic

Project No. 16130

Scale N.T.S.

Exhibit App. E4



No.	DATE	REVISION
1	Feb. 14, 2018	ISSUED FOR MASTER PLAN

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Municipality of Kincardine

Water & Wastewater Master Plan

Kincardine Goderich St. SPS Catchment Area SewerCAD Schematic

Project No. 16130

Scale
N.T.S.

Exhibit App. E5

N

No.	DATE	REVISION
1	Feb. 14, 2018	ISSUED FOR MASTER PLAN

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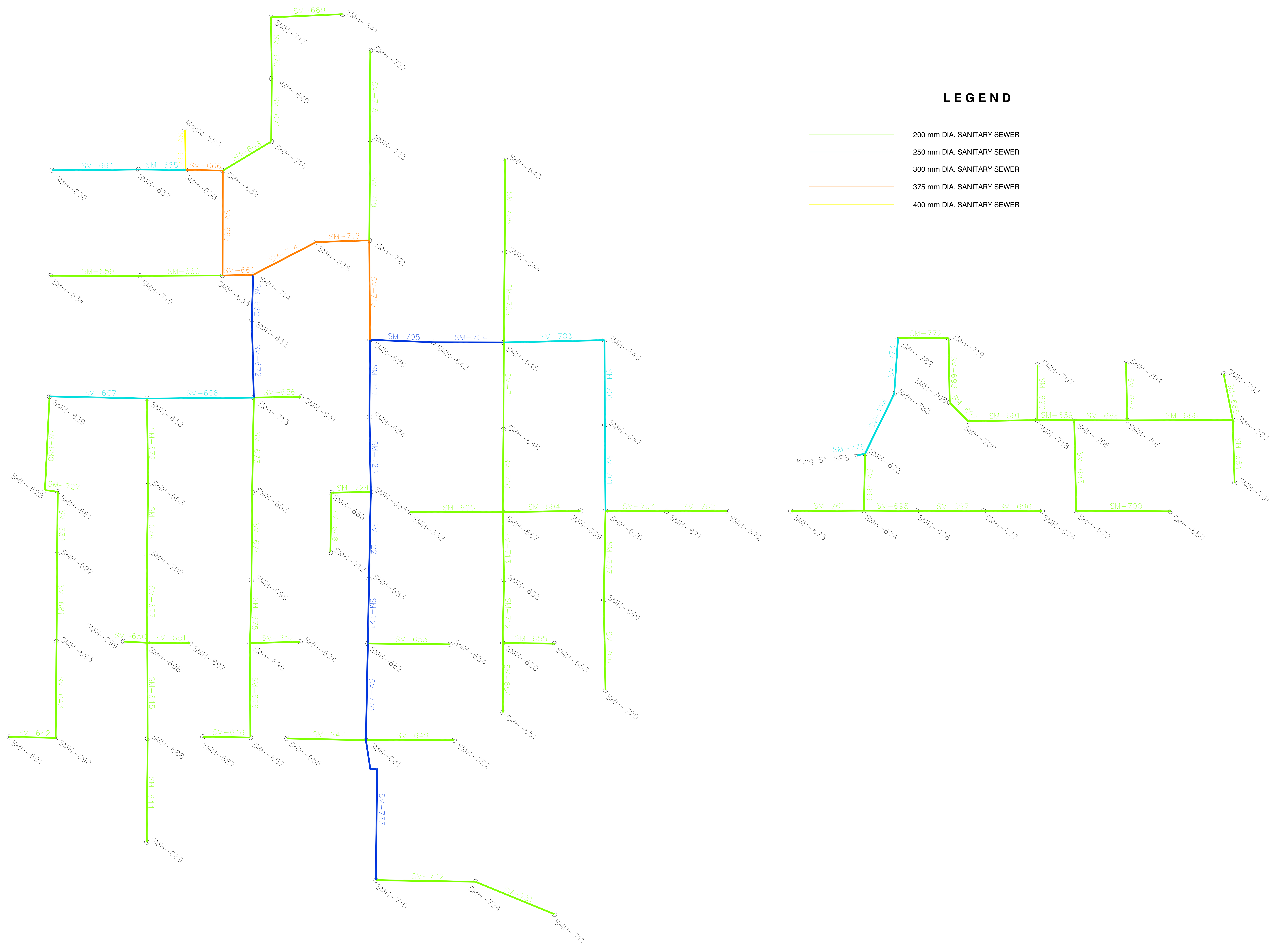
Water & Wastewater Master Plan

Kincardine Kincardine Ave. SPS Catchment Area SewerCAD Schematic

Project No. 16130

Scale N.T.S.

Exhibit App. E6



No.	DATE	REVISION
1	Feb. 14, 2018	ISSUED FOR MASTER PLAN

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Water & Wastewater Master Plan

Tiverton Sanitary Collection System SewerCAD Schematic

Project No. 16130

Scale
N.T.S.

Exhibit App. G1