

Appendix C

TM2 - Status of Existing Treatment Facilities and Capacity Assessment



The Regional Municipality of Waterloo

Wastewater Treatment Master Plan Update

**Technical Memorandum No. 2:
Status of Existing Treatment Facilities and
Capacity Assessment**

Final



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1. Introduction

1.1 Background

The Regional Municipality of Waterloo (the Region) is an upper tier municipal government, providing municipal services to seven local area municipalities with a total population of approximately 550,000 people. The Region owns thirteen (13) wastewater treatment plants (WWTPs), one (1) wastewater residuals processing facility, six (6) sewage pumping stations (with a seventh station planned for construction), and two wastewater collection systems (Ayr in the Township of North Dumfries and Wellesley in the Township of Wellesley), treating an approximate average of 66 million cubic meters annually. Wastewater facilities are operated and maintained by the Ontario Clean Water Agency (OCWA) under contract to the Region. Most of the collection systems and pumping station infrastructure that conveys wastewater to the Region's treatment facilities are owned managed and operated by the area municipalities (City of Cambridge, City of Kitchener, City of Waterloo, Township of Wilmot, and Township of Woolwich).

The Region has experienced steady residential and industrial/commercial/institutional (ICI) growth for many years and anticipates this will continue as a result of factors such as a strong local economy, the Province of Ontario's Places to Grow (P2G) Act, and major Regional and Provincial transportation initiatives that are underway. The Region completed a Wastewater Treatment Master Plan (WWTMP) in 2007 (Earth Tech, 2007) to plan for future growth and provision of treatment capacity throughout the Region. Due to changing population growth patterns, wastewater flows, and environmental regulations, the Region is now updating the WWTMP.

CIMA Canada Inc. (CIMA) has been retained by the Region to update the 2007 Master Plan to develop a current, comprehensive, cost-effective and feasible strategy to address the anticipated wastewater treatment and disposal needs of the Region over the next 35 to 40-year planning periods in a manner consistent with the Region's Strategic Plan.

This Technical Memorandum (TM No. 2) has been prepared to review the current status and loadings of the major unit processes, evaluate the treatment capacity and identify current and future needs at each WWTP within the Region. The purpose is

to provide the baseline and identify needs to achieve the Region's goals for each of its wastewater treatment facilities.

1.2 Objectives

The objectives of this Technical Memorandum (TM) are to:

- + Review the existing conditions and historical performance of each WWTP;
- + Establish the existing process capacity of each WWTP;
- + Identify potential constraints and upgrade needs of each of the WWTPs for treatment of future flows and loadings.

2. Approach

To assess the existing facilities in terms of their overall capacity and ability to achieve the effluent quality, the following was completed:

- + Review of available information and literature including:
 - Ontario Ministry of the Environment and Climate Change (MOECC) Environmental Compliance Approvals (ECAs)
 - Design Guidelines for Sewage Works, MOECC, 2008
 - Handbooks for Retrofitting POTWs, United States Environmental Protection Agency (USEPA), EPA/625/6-89/020, July 1989
 - Regional Municipality of Waterloo Wastewater Treatment Master Plan Final Report, Earth Tech Canada Inc., August 2007
 - Kitchener WWTP Phase 3 Upgrades Preliminary Design Draft Final Report, AECOM, August 2012
 - Kitchener Wastewater Treatment Plant Upgrade Project - Site-Wide Facility Plan
 - Final Report, AECOM, July 2011
 - Kitchener Wastewater Treatment Plant Upgrades Municipal Class Environmental Assessment Project File Report, AECOM, September 2012
 - Waterloo WWTP Upgrades Final Design Brief, AECOM, May 2011
 - Galt WWTP Preliminary Design: Facility Plan, TM3, Physical Condition Assessment, CIMA, March 2015
 - Preston WWTP Plant Wide Asset Inventory and Condition Assessment, CIMA, August 2015
 - Preston WWTP Headworks Building Asset Inventory and Condition Assessment Draft Report, CIMA, July 2015
 - Hespeler WWTP Facility Assessment Study, Stantec, June 2015
 - Ayr WWTP Capacity Expansion, Hydromantis/Associate Engineering Joint Venture, 2004.

- Ayr Wastewater Master Plan, XCG Consultants Limited, December 2012
- Ayr Sewage Pumping Station, Forcemain, and Trunk Sewer Routing Municipal Class Environmental Assessment, Stantec, August 2014
- Ayr Wastewater Treatment Plant Expansion Design Brief, Stantec, January 2005
- Baden and New Hamburg Water and Wastewater Master Plan Update -
- Master Plan Report Volume 1: Summary Report (Final), AECOM, June 2011.
- New Hamburg Wastewater Treatment Plant Class Environmental Assessment
- Environmental Study Report, XCG Consultants Limited, January 2015
- New Hamburg Wastewater Treatment Plant Phase 2 Expansion Preliminary Design Report - Final, Hatch Mott Macdonald (HMM), October 2015
- Wellesley WWTP Process and Condition Assessment Final Report, Stantec Consulting Ltd, October 2015
- Wellesley WWTP Operation and Maintenance Manual, Regional Municipality of Waterloo, 1992
- Conestogo and Wellesley WWTPs Filter Upgrades Conceptual Design Report, CH2M HILL, February 2015
- St Jacobs - Elmira Wastewater Treatment Master Plan Final Report, XCG Consultants Limited, February 2013
- Foxboro Green WWTP Upgrades MOECC Design Brief, Stantec, October 2015
- Foxboro Green and Alt-Heidelberg WWTPs Improvement Plan, CIMA, December 2013
- Region of Waterloo Biosolids Management Master Plan, CH2M HILL, September 2011
- Original and upgrade plant drawings and specifications for each WWTP, if any.
- OCWA Operating and Maintenance Reports (2012-2014)

- Water and Wastewater Monitoring Reports from the Region (2012-2015)
 - Plant operation SCADA data provided by the Region
- + Review previous studies on facility physical condition assessment.
- + Review historical wastewater flow and quality data (January 2012 to December 2014) to evaluate the overall performance and process capacity of the WWTPs to date.
- + Discussion with WWTP Operations Staff to document process limitations and specific issues.
- + Perform process capacity assessment based on historical plant operational data (January 2012 to December 2014), plant design criteria, and approved MOECC ECA effluent limits and objectives, capacities, as well as typical design guidelines.
- + Identify constraints and upgrade requirements for process areas based on findings from assessment of process capacity, hydraulic capacity and physical condition.

3. Existing Systems & Capacity Assessment

This section provides a review of the performance and capacity of each WWTP within the Region.

3.1 Kitchener WWTP

3.1.1 Facility Overview

The Kitchener WWTP is a conventional activated sludge (CAS) plant that provides treatment for wastewater generated in the City of Kitchener. Wastewater flows by gravity to the WWTP. The WWTP is comprised of two (2) separate secondary treatment plants (Plants 1 and 2) served by common headworks and primary clarifier facilities. Plant 1 was constructed in the 1960s and Plant 2 was constructed in the 1970s. The Kitchener WWTP is currently operated under Ontario MOECC ECA No. 0102-9RDM5C issued on February 4, 2015. The plant has a rated average day flow (ADF) capacity of 122,745 m³/d and a peak flow capacity of 306,862 m³/d.

The existing treatment processes include screening, grit removal, primary clarification, aeration, secondary clarification and UV disinfection prior to discharge to the Grand River. Ferric chloride is added upstream of the primary clarifiers and ferrous chloride is added downstream of the primary clarifiers, before the flow is split between Plants 1 and 2. Co-thickened waste activated sludge (WAS) and raw sludge is anaerobically digested, dewatered via centrifuges at the off-site Manitou Drive Biosolids Dewatering Facility, with biosolids beneficially used in agriculture. Centrate from Manitou Drive is returned to Plant 2 for treatment.

Currently, the plant is in the process of Phase 3 upgrades to provide reliable and efficient operation and improved effluent quality with full year-round nitrification. The upgrades include new headworks, new secondary treatment plants (Plants 3 and 4; to replace existing Plant 1), tertiary filtration, and anaerobic digestion upgrades. The rated capacity of the plant will remain 122,745 m³/d.

The ECA effluent requirements are summarized in Table 1 for the existing Kitchener WWTP prior to substantial completion of the Secondary Treatment Plants 3 and 4. Following completion of the Plants 3 & 4 and tertiary treatment facility construction, a more stringent effluent limit for phosphorus and year-round nitrification will be implemented, which are also shown in Table 1.

Table 1 Kitchener WWTP Existing ECA Effluent Objectives and Limits (ECA No. 0102-9RDM5C, 2015)

Parameter	Effluent Objectives	Non-Compliance Limits	
	Concentration (mg/L) ⁽¹⁾	Concentration (mg/L) ⁽¹⁾	Loading (kg/d) ⁽²⁾
Current - Prior to Substantial Completion of the Secondary Treatment Plants 3 and 4			
Carbonaceous biochemical oxygen demand (CBOD ₅)	15.0	25.0	3,070
Total suspended solids (TSS)	15.0	25.0	3,070
Total phosphorus (TP)	0.6	1.0	120
<i>E. coli</i> (counts/100 mL) ⁽³⁾	100	200	-
Future - Upon Substantial Completion of the Secondary Treatment Plants 3 and 4			
CBOD ₅	10.0	15.0	1,840
TSS	10.0	15.0	1,840
TP	0.6	1.0	120
<i>E. coli</i> (counts/100 mL) ⁽³⁾	100	200	-
Future - Upon Substantial Completion of the Tertiary Filters			
CBOD ₅	10.0	15.0	1,840
TSS	10.0	15.0	1,840
TP	0.2	0.4	50
Total ammonia nitrogen (TAN)			
May 1 to Nov 30	2.0	4.0	490
Dec 1 to Apr 30	5.0	7.0	860
<i>E. coli</i> (counts/100 mL) ⁽³⁾	100		

Notes:

1. Based on monthly average concentration values.
2. Based on the annual average loading during any calendar year.
3. Based on monthly geometric mean.

3.1.2 Existing Conditions

Historical Flow

A summary of the historical ADF, peak day flow (PDF), peak hourly flow (PHF) and peak instantaneous flow (PIF) of the Kitchener WWTP over the period 2012 to 2014 is presented in Table 2.

The average raw wastewater flow between 2012 and 2014 was 70,970 m³/d, or approximately 60% of the rated capacity of 122,745 m³/d. The average per capita

flow was 300 L/cap·d, which is within a typical range of 225-450 L/cap·d for domestic sewage (MOECC, 2008).

For the capacity assessment in Section 3.1.3 of this TM, the PDF, PHF and PIF factors of 2.1, 2.4 and 3.5, respectively, were applied.

Table 2 Historic Flow to the Kitchener WWTP

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated Capacity (m ³ /d)	122,745	-
Rated Peak Flow Rate (m ³ /d)	306,860	-
ADF (m ³ /d)	70,970 (60%)	-
PDF (m ³ /d)	147,370	2.1 ⁽¹⁾
PHF (99.9 th percentile) (m ³ /d)	170,320	2.4 ⁽²⁾
PIF (m ³ /d)	248,380	3.5 ⁽³⁾
Average Per Capita Flow (L/cap·d)	300 ⁽⁴⁾	-

Notes:

1. Based on historic data (January 2012 to December 2014).
2. Based on historic data (April 2013 to December 2014).
3. Based on the Kitchener WWTP Phase 3 Upgrades Preliminary Design Report (AECOM, August 2012).
4. Based on ADF of 70,970 m³/d and a 2014 population of 234,466 provided in the Region's 2015 Water and Wastewater Monitoring Report

Raw Wastewater Characteristics and Loadings

Historic raw influent wastewater concentrations and loadings from 2012 to 2014 are presented in Table 3. The Kitchener WWTP receives medium strength wastewater (Metcalf & Eddy, 2003).

It should be noted that influent quality data of August to December 2014 were not included in Table 3. The data indicated that influent loadings in 2014 showed an increasing trend over the late summer and fall months. On further analysis, this was determined to be a result of temporary on-site dewatering of the digested sludge storage lagoon, influencing plant influent sampling. Therefore, to be more representative, the influent quality data from January 2012 to July 2014 were used for the raw wastewater characteristic analysis.

Per capita loadings were also calculated based on average loadings in 2012-2014 and service population in 2014 and compared to the typical values expected for

domestic sewage (Metcalf & Eddy, 2003). All of the parameters including CBOD₅, TSS, TP and TKN are lower than the typical per capita loadings.

Table 3 Kitchener WWTP Raw Wastewater Characteristics and Loadings

Parameter	Average Concentration			Average Loading			
	Historic (mg/L) ⁽¹⁾	Design (mg/L) ⁽²⁾	Typical Value (mg/L) ⁽³⁾	Historic (kg/d) (% of Design Loading)	Design (kg/d) ⁽²⁾	Historic Average Per Capita Loading (g/cap.d) ⁽⁴⁾	Typical Per Capita Loading (g/cap.d) ⁽³⁾
CBOD ₅	180	230	190	12,600 (45%)	27,990	55	80
TSS	240	260	210	16,730 (55%)	31,550	70	90
TP	6	6	7	400 (60%)	680	1.7	3.2
TKN	40	43	40	2,830 (55%)	5,280	12	13

Notes:

1. Based on OCWA Operating and Maintenance Annual Report (2012-2014).
2. Based on Kitchener WWTP Upgrades: Preliminary Design Report (AECOM, August 2012)
3. Metcalf & Eddy (2003)
4. Based on average loadings and a 2014 population of 234,466 provided in the Region's 2015 Water and Wastewater Monitoring Report.

Effluent Quality and Performance

The historical effluent quality for the period of 2012 to 2014 is presented in Table 4, along with the existing ECA effluent objectives and compliance limits.

Based on the historical plant effluent quality, the Kitchener WWTP has been able to achieve its effluent compliance limits for the historic review period, with the exception of the TP monthly average concentration in August 2012, and in May, July, October and November 2013. The elevated values of TP concentrations was due to the upset condition during the Plant 2 aeration system upgrade construction and commissioning.

Currently the plant is in the process of Phase 3 upgrades. It is expected that TP removal will be improved with improved settling characteristics in secondary treatment and implementation of tertiary filtration upon the completion of the Phase 3 upgrades.

There is no total ammonia objective or limit in the existing ECA; however, the Region has made a commitment to the Grand River Conservation Authority (GRCA) and Federation of Canadian Municipalities (FCM) to a target concentration of 7 mg/L TAN in the final effluent once Plant 2 upgrades were completed and until Plants 3 and 4 are commissioned. The plant achieved partial nitrification historically, especially after the completion of the Plant 2 upgrades in 2012 with enhanced ammonia removal capability in the aeration facility. The ongoing Phase 3 upgrades at the plant will further enhance the ammonia removal by providing year-round nitrification.

The historical effluent wastewater loadings, with respect to CBOD₅, TSS, TP and TAN are also summarized in Table 4. All annual average loadings are within the existing ECA non-compliance limits.

Table 4 Kitchener WWTP Effluent Quality and Loadings ⁽¹⁾

Parameter	Concentration (mg/L)				Loading (kg/d)		
	Average	Peak Month (2)	Effluent Objective (3)	Non-compliance Limit (3)	Average	Peak Month (2)	Non-compliance Limit (3)
CBOD ₅	6.2	15.5	15.0	25.0	440	990	3,070
TSS	8.5	14.4	15.0	25.0	600	1,360	3,070
TP	0.62	1.01	0.6	1.0	44	63	120
TAN (2012) (4)	19.7	32.5	-	-	1,300	2,100	-
TAN (2013-2014) (5)	6.4	16.9	-	-	480	1,200	-

Notes:

1. Based on OCWA Operating and Maintenance Annual Reports (2012-2014).
2. The highest monthly average value during 31-month period (January 2012-July 2014).
3. Refer to the current effluent objectives and limits (prior to substantial completion of the secondary treatment plants 3 and 4). Effluent objectives are based on monthly average concentration values; Effluent limits are based on annual average loading during any calendar year.
4. Historic effluent TAN data before the completion of Plant 2 upgrades.
5. Historic effluent TAN data after the completion of Plant 2 upgrades with improved ammonia removal ability.

3.1.3 Process Capacity Assessment

A capacity assessment for the major liquids and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The

assessment was based on historical plant operational data, plant design criteria, approved ECA capacities, and typical design guidelines.

Table 5 lists the background data used to estimate the rated capacities for the major processes. It should be noted that the unit process capacity assessment was for the Phase 3 upgraded plant, assuming that the Phase 3 upgrades are complete or near completion when this Master Plan project is completed.

For the purpose of this assessment, both WAS co-thickening and separate WAS thickening were considered.

Table 5 Kitchener WWTP Major Unit Process Summary

Process		Description	Value
Headworks ⁽¹⁾	Perforated Screens	Number	4 (3 duty, 1 standby)
		Capacity (each)	143,000 m ³ /d
	Vortex Type Grit Tanks	Number	2
		Capacity (each)	215,000 m ³ /d
Primary Clarifiers	Rectangular	Number	4
		Surface Area (total)	4,586 m ²
		SWD	3.66 m
Aeration Tanks	Plant 2	Number	1
		Volume (total)	21,071 m ³
		SWD	4.7 m
	Plant 3 ⁽¹⁾	Number	2
		Volume (total)	21,438 m ³
		SWD	5.99 m
	Plant 4 ⁽¹⁾	Number	2
		Volume (total)	21,438 m ³
		SWD	5.99 m
Blowers	Plant 2	Number	5 (4 duty, 1 standby)
		Capacity (per blower)	155.8 m ³ /min of air at 65 kPa
	Plant 3 and Plant 4 ⁽¹⁾	Number	7 (6 duty, 1 standby)
		Capacity (per blower)	5 blowers at 134.2 m ³ /min of air at 73 kPa 2 blowers at 212.5 m ³ /min of air at 48 kPa
	Plant 2	Number	4

Process		Description	Value
Secondary Clarifiers		Surface Area (total)	3,526 m ²
		SWD	3.7 m
	Plant 3 ¹	Number	3
		Surface Area (total)	2,886 m ²
		SWD	4.6 m
	Plant 4 ¹	Number	3
		Surface Area (total)	2,886 m ²
		SWD	4.6 m
Tertiary Filtration ⁽¹⁾	Disk Filters	Number of Filter Units	4 (3 duty, 1 standby)
		Peak Flow Capacity (each)	86,667 m ³ /d
Disinfection	UV Disinfection	Number of channels	3
		Peak flow capacity (total)	400,000 m ³ /d
Effluent Pumping	Submersible Pumps	Number	5
		Capacity (per pump)	3 pumps @ 1,563 L/s 2 pumps @ 810 L/s
Anaerobic Digestion ⁽¹⁾		Number	2 primary
		Volume (total)	16,490 m ³ (primary)
		SWD	10.9 m (primary)

Notes:

1. The unit processes for the Phase 3 upgraded plant (new Plants 3 and 4 to replace Plant 1) (AECOM, August 2012).

The results of the capacity assessment of the Kitchener WWTP are presented in the form of a Performance Potential Graph (PPG) in Figure 1. The length of each bar in Figure 1 shows the theoretical equivalent ADF capacity based on the MOECC design guidelines. The dotted vertical lines show the average current operating conditions (2012-2014) and the ECA approved rated capacity of the WWTP. Where the length of the bar projects beyond the dotted line, the plant has potential reserve capacity. Where the bar stops short of the dotted line, the plant has a potential deficit of operating capacity.

The PPG in Figure 1 shows that all the treatment processes at the Kitchener WWTP are sized sufficiently for the rated capacity of 122,750 m³/d, upon the completion of

the Phase 3 upgrades. It is noted that the capacity of the primary clarifiers and anaerobic digesters will be increased due to separate WAS thickening.

A summary of the equivalent ADF capacity of each unit process and the design criteria on which the capacity assessment was based on is presented in Table 6. Overall, the Kitchener WWTP will have an equivalent ADF capacity of 122,750 m³/d.

It is important to note that as part of the Phase 3 upgrades, the unit processes were strategically oversized or space provided to allow operational flexibility and to accommodate a future expansion (including potential denitrification).

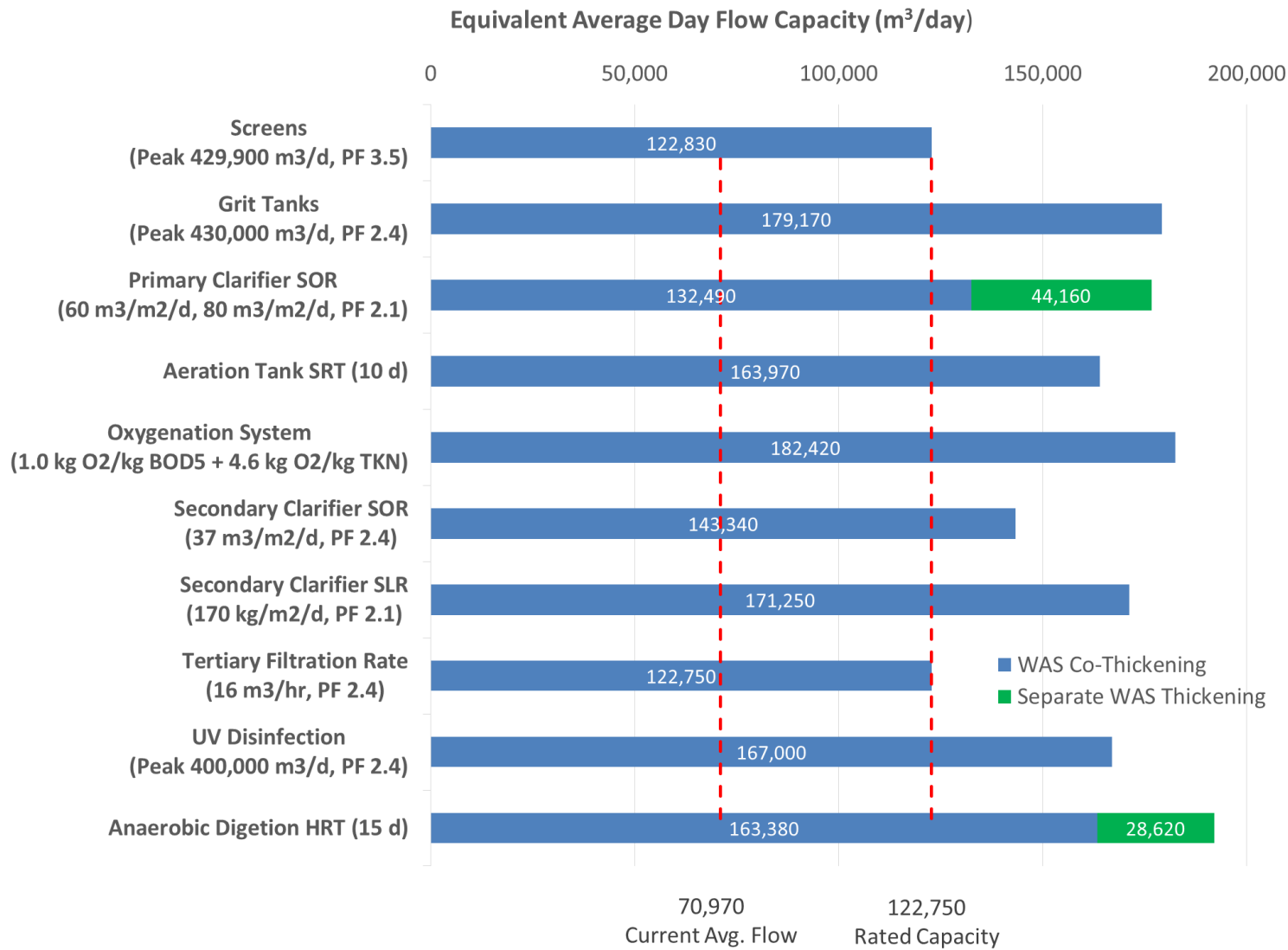


Figure 1 PPG for the Kitchener WWTP

Table 6 Capacity Assessment Summary, Kitchener WWTP

Major Unit Process	Criteria Used	Peak Factor Used	Equivalent ADF Capacity (m ³ /d)			
			Plant 2	Plant 3	Plant 4	Total
Headworks						
Screens	-	PIF = 3.5	-	-	-	122,830
Grit Tanks	-	PHF = 2.4	-	-	-	179,170
Primary Clarifiers						
SOR at PDF (m ³ /m ² /d)	60 ⁽¹⁾	PDF = 2.1	-	-	-	132,490 ⁽¹⁾
	80 ⁽²⁾	PDF = 2.1	-	-	-	176,650 ⁽²⁾
Aeration Tanks						
SRT (days) ⁽³⁾	10	ADF	54,028	54,969	54,969	163,970
Oxygenation System						
Oxygen Demand ⁽⁴⁾	1.0 kg O ₂ /kg BOD ₅ + 4.6 kg O ₂ /kg TKN	ADF	55,614	63,404	63,404	182,420
Secondary Clarifiers						
SOR at PHF (m ³ /m ² /d)	37 ⁽⁵⁾	PHF = 2.4	54,359	44,493	44,493	143,340
SLR at PDF (kg/m ² /d)	170 ⁽⁵⁾	PDF = 2.1	64,943	53,755	53,755	171,250 ⁽⁶⁾
Tertiary Filters						
Filtration Rate (L/m ² ·s)	2.1	PHF = 2.4	-	-	-	122,750
UV Disinfection						
Original Peak Design Flow (m ³ /d)	400,000	PHF = 2.4	-	-	-	167,000
Anaerobic Digester						
HRT (days)	15	ADF	-	-	-	163,380 ⁽¹⁾
	15	ADF	-	-	-	192,000 ⁽²⁾

Notes:

1. With WAS co-thickening in the primary clarifiers.
2. With separate WAS thickening by rotary drum thickeners.
3. Based on a sludge yield of 1.0 kg TSS/kg BOD₅ for conventional activated sludge process with chemical addition for TP removal and 3,000 mg/L MLSS.
4. Peak oxygen demand based on a typical peak factor of 1.5 times the average load to accommodate diurnal loading fluctuations.
5. Based on MOECC Design Guidelines (2008) for conventional activated sludge process with chemical addition for TP removal.
6. Based on assumed MLSS concentration of 3,000 mg/L and return activated sludge (RAS) to ADF ratio of 100%.

3.1.4 Condition Assessment Findings

The Kitchener WWTP has recently completed Phase 1 and Phase 2 upgrades and is in the process of Phase 3 upgrades. These upgrades include:

- + Phase 1: Construction of the Manitou Drive Wastewater Residuals Management Centre (WWRMC) for biosolids dewatering.
- + Phase 2: Upgrades to the Plant 2 aeration tanks to enhance ammonia removal and improve the ability of Plant 2 to treat centrate from Manitou Drive; and construction of a new UV disinfection and effluent pumping station facility to achieve non-acutely toxic effluent discharge.
- + Phase 3: Upgrades to enhance effluent quality with year-round nitrification and tertiary filtration (refer to Section 3.1.5).

Based on the extent of recent and on-going upgrades, the Kitchener WWTP is a newly upgraded plant in good overall condition.

3.1.5 Ongoing and Planned Upgrades

To provide reliable and efficient operation in the long term and address additional Grand River water quality requirements through improved effluent quality, the Region is completing the Phase 3 upgrades to the Kitchener WWTP, which include the following main contracts (AECOM, 2012):

- + Contract 1 – Biosolids Storage Lagoons Decommissioning to prepare space for the new Plants 3 and 4 secondary treatment facilities and Digested Sludge Transfer Pumping Upgrades to pump digested sludge to WWRMC.
- + Contract 2 – Energy Centre and Anaerobic Digestion Upgrade including retrofitting both the existing primary digesters with new fixed steel covers and mixing system, converting the existing secondary digester to a digested sludge storage tank with a flexible membrane gasholder cover, and retaining the existing digested sludge storage tank for standby storage.
- + Contract 3 – Headworks; Plants 3 and 4 Secondary Treatment including new aeration tanks, secondary clarifiers, RAS/WAS pumping stations, blowers and chemical dosing.
- + Contract 4 – Tertiary Treatment and Outfall.

Contract 1 has been completed; Contracts 2, 3 and 4 are ongoing and will be completed in summer 2017.

As part of the Phase 3 upgrades, the plant is in the process of installing a biogas combined heat and power (CHP) unit for energy recovery and greenhouse gas emission reduction (CIMA, 2016).

In addition, the Region is in the process of planning Phase 4 upgrades, which will include the following contract:

- ✦ Contract 5 – New administration building, sludge thickening and miscellaneous works (e.g. Plant 1 decommissioning, Plant 2 secondary clarifier mechanism replacement, primary clarifier mechanism replacement, etc.).

Components of Contract 5 will be prioritized upon completion of the current Phase 3 upgrades.

3.1.6 Summary

The following points summarize the findings from the historical data review and process capacity assessment for the Kitchener WWTP:

- ✦ The Kitchener WWTP historically has produced good quality effluent that has met the MOECC ECA effluent limits for the majority of the historic review period, with the exception of a few occasions where the effluent monthly average TP concentrations exceeded the ECA non-compliance limits due to upset conditions at the plant. The on-going Phase 3 upgrades will address the historic TP problem.
- ✦ All of the treatment units at the Kitchener WWTP have sufficient capacity to meet the design flow of 122,745 m³/d, upon the completion of the Phase 3 upgrades.
- ✦ With the completion of Phase 2 upgrades, there has already been a significant improvement in effluent quality, particularly in terms of NH₃-N. With the completion of the secondary treatment upgrades including year-round nitrification as part of the Phase 3 upgrades, the plant is expected to achieve further improved effluent quality, with an overall available equivalent ADF capacity of 122,745 m³/d.

3.2 Waterloo WWTP

3.2.1 Facility Overview

The Waterloo WWTP is a conventional activated sludge plant that provides treatment for wastewater generated in the City of Waterloo. The plant is currently operated under MOECC ECA No. 9354-8J4PUE issued on January 25, 2012. The plant has

an existing ECA approved hydraulic capacity of 72,730 m³/d, with a rated average day treatment capacity of 57,500 m³/d.

The existing treatment processes include screening, grit removal, primary clarification, aeration, secondary clarification and UV disinfection prior to discharge to the Grand River. Ferric chloride is added prior to the primary clarifiers and/or aeration tanks for phosphorus removal. Raw sludge and mechanically thickened (i.e. via rotary drum thickeners) WAS are anaerobically digested, and dewatered via centrifuges, with biosolids beneficially used in agriculture or in the remediation of mine tailing ponds in northern Ontario.

Currently, the plant is in construction for Contract No. 4 upgrades that will provide the plant with a capacity of 57,500 m³/d with full year-round nitrification, and with a flexibility to increase capacity of all unit processes to 72,730 m³/d (AECOM, May 2011). The upgrades include primary treatment upgrades, improved secondary treatment, new blowers and retrofit of the secondary digester to operate as either a primary or secondary digester.

The ECA effluent requirements for the existing Waterloo WWTP are summarized in Table 7. The ECA provides phased effluent requirements that will require upgrades to achieve a high level of nitrification once the plant flow reaches 54,600 m³/d.

Table 7 Waterloo WWTP Existing ECA Effluent Objectives and Non-Compliance Limits (ECA No. 9354-8J4PUE, 2012)

Parameter	Effluent Objectives	Non-Compliance Limits (>54,600 m ³ /d) ⁽¹⁾	Non-Compliance Limits (≤ 54,600 m ³ /d)
	Concentration (mg/L) ⁽²⁾	Concentration (mg/L) ⁽²⁾	Concentration (mg/L) ⁽²⁾
CBOD ₅	10.0	15.0	15.0
TSS	10.0	15.0	15.0
TP	0.4	0.6	0.8
TAN	1.5	1.8	-
<i>E. coli</i> (counts/100 mL) ⁽³⁾	100	200	-

Notes:

1. Upon the completion of the current Contract No. 4 upgrades at the plant.
2. Based on monthly average concentration values.
3. Based on monthly geometric mean.

In 2013/14, an Assimilative Capacity Study (ACS) was completed for the Waterloo and Hespeler WWTPs. Table 8 provides the future effluent limits recommended by the ACS for the Waterloo WWTP up to the year 2051 (Stantec, April 2014).

Table 8 Waterloo WWTP Proposed Effluent Objectives and Non-Compliance Limits⁽¹⁾

Parameter	Effluent Objectives	Non-Compliance Limits	
	Concentration (mg/L) ⁽²⁾	Concentration (mg/L) ⁽²⁾	Loading (kg/d) ⁽³⁾
CBOD ₅	10.0	15.0	860
TSS	10.0	15.0	860
TP	0.2 (0.4) ⁽⁴⁾	0.4 (0.6) ⁽⁴⁾	23
TAN	1.5	1.8	103
<i>E. coli</i> (counts/100 mL) ⁽⁵⁾	100	200	-

Notes:

1. Based on the ACS for the Hespeler and Waterloo WWTPs (Stantec, April 2014).
2. Based on monthly average concentration values.
3. Based on the annual average loading during any calendar year.
4. The 0.2 mg/L TP effluent objective and the 0.4 mg/L TP effluent non-compliance limit are pending the reconsideration of the ACS to coincide with the ECA amendment for the WWTP upgrading. Numbers in parentheses apply between 2013 and 2024/25 for the interim objectives and non-compliance limits.
5. Based on monthly geometric mean.

3.2.2 Existing Conditions

Historical Flow

A summary of the historical flow data of the Waterloo WWTP over the period 2012 to 2014 is presented in Table 9.

The average raw wastewater flow between 2012 and 2014 was 46,640 m³/d, or approximately 80% of the rated capacity of 57,500 m³/d. The average per capita flow was 340 L/cap·d, which is within a typical range of 225-450 L/cap·d for domestic sewage (MOECC, 2008).

For the capacity assessment in Section 3.2.3 of this TM, the PDF, PHF and PIF factors of 2.5, 2.7 and 3.4, respectively, were applied.

Table 9 Historic Flow to the Waterloo WWTP

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated Capacity (m ³ /d)	57,500	-
ADF (m ³ /d)	46,640 (80%)	-
PDF (m ³ /d)	116,580	2.5 ⁽¹⁾
PHF (m ³ /d)	125,920	2.7 ⁽²⁾
PIF (m ³ /d)	158,560	3.4 ⁽³⁾
Average Per Capita Flow (L/cap·d)	340 ⁽⁴⁾	-

Notes:

1. Based on historic data (January 2012 to December 2014).
2. Assumed based on PDF plus 20% of ADF to account for diurnal conditions.
3. Based on Waterloo Wastewater Treatment Plant Design Brief (AECOM, May 2011).
4. Based on ADF of 46,640 m³/d and a 2014 population of 136,179 provided in the Region's 2015 Water and Wastewater Monitoring Report.

Raw Wastewater Characteristics and Loadings

Historic raw influent wastewater concentrations and loadings from 2012 to 2014 are presented in Table 10. The Waterloo WWTP receives medium to high strength wastewater. The raw wastewater concentrations are representative of a medium strength wastewater with respect to CBOD₅, TP and TKN; and high strength with respect to TSS.

It should be noted that due to the internal WAS recycle from the plant and centrate from the temporary dewatering on site being returned to the plant headworks during 2012 to 2014; the 2012 to 2014 historical influent TSS and BOD₅ concentrations were not considered. To be more representative, the 2009 and 2010 historical TSS and BOD₅ concentrations were used for the raw wastewater characteristics analysis.

Per capita loadings were calculated and compared to the typical values expected for domestic sewage (Metcalf & Eddy, 2003). CBOD₅ and TP parameters are lower than the typical per capita loadings, and TSS and TKN are higher than the typical per capita loadings.

Table 10 Waterloo WWTP Raw Wastewater Characteristics and Loadings⁽¹⁾

Parameter	Average Concentration			Average Loading			
	Historic (mg/L) ⁽²⁾	Design (mg/L) ⁽³⁾	Typical Value (mg/L) ⁽⁴⁾	Historic (kg/d) (% of Design Loading) ⁽⁵⁾	Design (kg/d) ⁽³⁾	Historic Average Per Capita Loading (g/cap.d) ⁽⁶⁾	Typical Per Capita Loading (g/cap.d) ⁽⁴⁾
CBOD ₅	200	200	190	9,230 (80%)	11,500	70	80
TSS	320	230	210	14,670 (110%)	13,130	110	90
TP	6	5	7	290 (95%)	310	2.1	3.2
TKN	50	40	40	2,440 (100%)	2,420	18	13

Notes:

1. Based on OCWA Operating and Maintenance Annual Reports (2012-2014).
2. Based on 2009 and 2010 plant historical data.
3. Based on Waterloo Wastewater Treatment Plant Upgrades Design Brief (AECOM, May 2011).
4. Metcalf & Eddy (2003)
5. Based on average influent concentrations from 2009-2010 and influent flows from 2012-2014.
6. Based on average loadings and a 2014 population of 136,179 provided in the Region's 2015 Water and Wastewater Monitoring Report.

Effluent Quality and Performance

The historical effluent quality for the period of 2012 to 2014 is presented in Table 11, along with the existing ECA effluent objectives and compliance limits. Based on the historical plant effluent, the Waterloo WWTP has been able to achieve its effluent compliance limits for the historic review period.

There is no total ammonia ECA limit in the existing ECA and the plant achieved partial nitrification historically. The ongoing Contract No. 4 upgrades will provide year-round nitrification.

The historical effluent wastewater loadings, with respect to CBOD₅, TSS, and TP are also summarized in Table 11. Currently there are no effluent loading ECA limits at the Waterloo WWTP.

Table 11 Waterloo WWTP Effluent Quality and Loadings ⁽¹⁾

Parameter	Concentration (mg/L)				Loading (kg/d)	
	Average	Peak Month ⁽²⁾	Objective	Non-Compliance Limit ⁽³⁾	Average	Peak Month
CBOD ₅	6.7	13.0	10.0	15.0	310	610
TSS	6.2	13.9	10.0	15.0	290	550
TP	0.3	0.5	0.4	0.8	14	23
TAN	23.8	31.6	1.5	-	1,110	1,450

Notes:

1. Based on OCWA Operating and Maintenance Annual Report (2012-2014).
2. The highest monthly average value during 36-month period (January 2012 - December 2014).
3. Based on monthly average concentration values. Non-compliance limits for plant influent flow <54,600 m³/d.

3.2.3 Process Capacity Assessment

A capacity assessment for the major liquids and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The assessment was based on historical plant operational data, plant design criteria, approved ECA capacities, and typical design guidelines.

The main findings and recommendations are summarized below:

- ✦ All the treatment processes at the Waterloo WWTP are sized sufficiently for the rated capacity of 57,500 m³/d, with the implementation of the Contract No. 4 upgrades. Some treatment processes were strategically oversized during these upgrades to accommodate the next expansion phase to 72,730 m³/d ADF.
- ✦ Anaerobic digesters are sufficient for the plant design flow, with the increased capacity due to separate WAS thickening and the retrofit of the existing secondary digester to operate as either primary or secondary digester as part of the plant Contract No. 3 and No. 4 upgrades.

Table 12 lists the background data used to estimate the rated capacities for the major processes. The unit process capacity assessed for the Waterloo WWTP was based on the completed Contract No. 4 upgrades, which are currently ongoing.

Table 12 Waterloo WWTP Major Unit Process Summary

Process		Description	Value
Raw Sewage Pumping Station	Wet Wells Pumps	Number	2
		Number	5 (4 duty, 1 standby)
		Capacity (per pump)	579 L/s at 12.0 m total dynamic head (TDH)
		Capacity (Firm)	2,316 L/s (200,000 m ³ /d)
Headworks	Mechanical, perforated plate Screen	Number	3 (2 duty, 1 standby)
		Peak Flow Capacity (each)	125,000 m ³ /d
	Vortex Grit Tanks	Number	2
		Peak Flow Capacity (each)	125,000 m ³ /d
Primary Clarifiers	Circular	Number	4
		Surface Area (total)	1,640 m ²
		SWD	3.05 m
Aeration Tanks ⁽¹⁾	Rectangular	Number	2
		Volume (total)	21,345 m ³
		SWD	5.5 m
Blowers ⁽¹⁾	Centrifugal Blowers	Number	7 (6 duty, 1 standby)
		Capacity (each)	155.8 m ³ /min
Secondary Clarifiers	Circular	Number	4
		Surface Area (total)	4,208 m ²
		SWD	3.05 m
UV Disinfection		Number of channels	4
		Number of banks/channel	2
		Peak flow capacity	200,000 m ³ /d
Effluent Pumping Station	Pumps	Number	4 (3 duty, 1 standby)
		Capacity (per pump)	722 L/s
Digesters ⁽¹⁾	Anaerobic	Number	2 (1 primary and 1 secondary) ⁽²⁾
		Volume (total)	13,000 m ³ (primary) ⁽²⁾ 6,500 m ³ (secondary)

Notes:

1. The unit processes based on the Contract No. 4 upgraded plant (AECOM, May 2011). The existing Stage I secondary treatment will be completely demolished with the completion of the Contract No. 4 upgrades.
2. The existing secondary digester has been retrofitted to operate as either primary or secondary digester as part of Contract No. 4 of the plant upgrades and expansion.

The capacity assessment results of the Waterloo WWTP are presented in the PPG in Figure 2.

A summary of the equivalent ADF capacity of each unit process and the design criteria on which the capacity assessment was based is presented in Table 13. Overall, the Waterloo WWTP will have an available equivalent ADF capacity of 57,500 m³/d, upon the completion of Contract No. 4 upgrades.

Table 13 Capacity Assessment Summary, Waterloo WWTP

Major Unit Process	Criteria Used	Peak Factor Used	Equivalent ADF Capacity (m ³ /d)
Raw Sewage Pumping Station Pumps	-	PIF = 3.4	57,500
Headworks Screens	-	PIF = 3.4	72,730
Grit Tanks	-	PHF = 2.7	92,600
Primary Clarifiers SOR at PDF (m ³ /m ² /d)	84 ⁽¹⁾	PDF = 2.4	57,750
Aeration Tanks SRT(days) ⁽²⁾	10	ADF	58,050
Oxygenation System Oxygen Demand ⁽³⁾	1.0 kg O ₂ /kg BOD ₅ + 4.6 kg O ₂ /kg TKN	ADF	77,960
Secondary Clarifier SOR at PHF (m ³ /m ² /d)	37 ⁽⁴⁾	PHF = 2.7	57,670
SLR at PDF (kg/m ² /d)	170 ⁽⁴⁾	PDF = 2.4	60,110 ⁽⁵⁾
UV Disinfection Original Peak Design Flow (m ³ /d)	200,000	PHF = 2.7	74,000
Anaerobic Digester HRT (days)	15	ADF	110,770

Notes:

1. Based on Waterloo Wastewater Treatment Plant Design Brief – Final (AECOM, May 2011)
2. Based on a sludge yield of 1.0 kg TSS/kg BOD₅ for conventional activated sludge process with chemical addition for phosphorus removal and 3,500 mg/L MLSS.
3. Peak oxygen demand with 150% of average oxygen demand to account for diurnal variations.
4. Based on MOECC Design Guidelines (2008) for conventional activated sludge process with chemical addition for phosphorus removal.
5. Based on assumed MLSS concentration of 3,500 mg/L and RAS: ADF ratio of 100%.

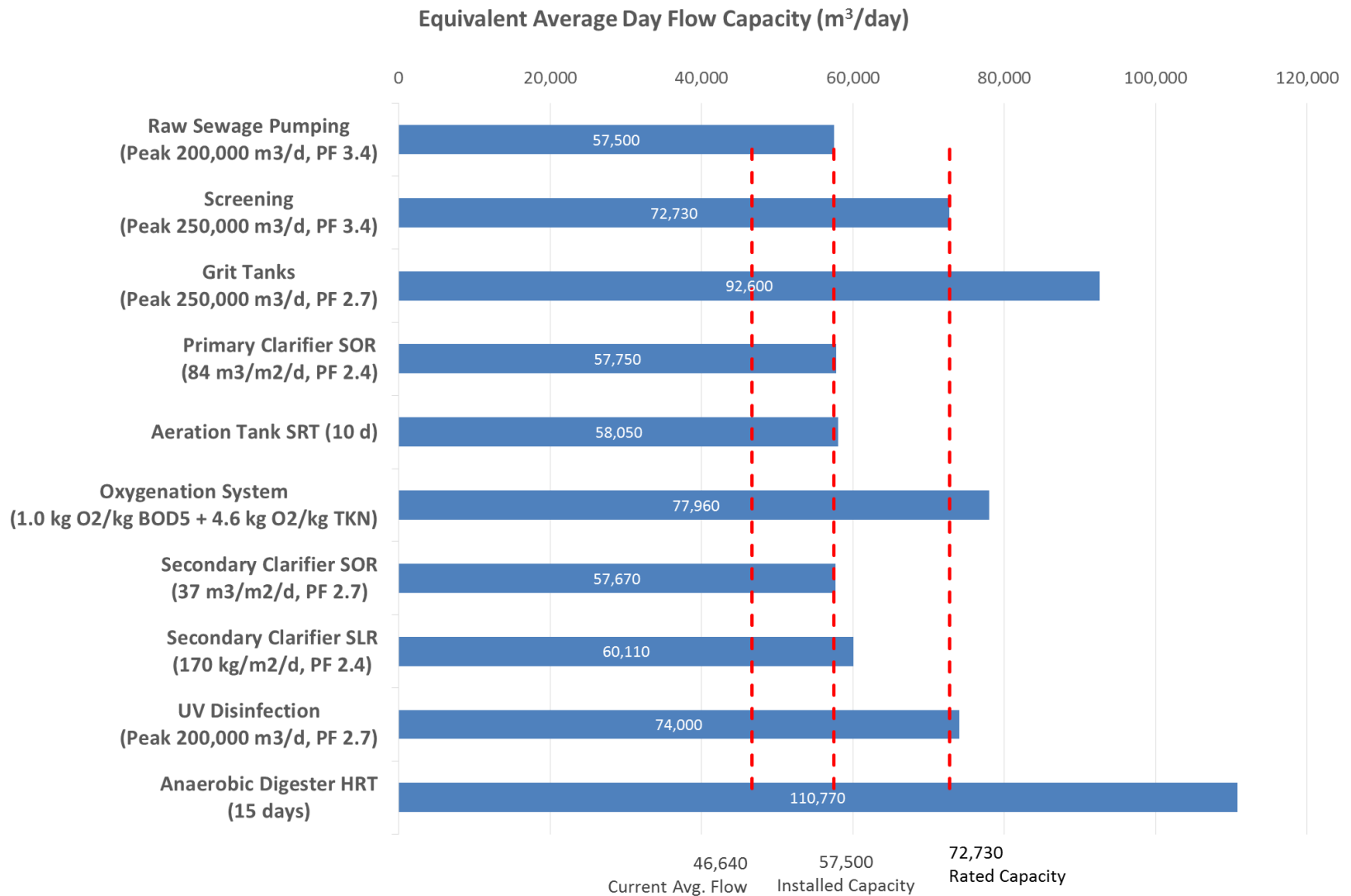


Figure 2 PPG for the Waterloo WWTTP

3.2.4 Condition Assessment Findings

The Waterloo WWTP has recently completed Contracts No. 1 to 3 upgrades and is in the process of completing Contract No. 4 upgrades (refer to Section 3.2.5).

3.2.5 Ongoing and Planned Upgrades

The ongoing Contract No. 4 upgrades will provide a capacity of 57,500 m³/d with year-round nitrification. The upgrades include:

- + Primary treatment upgrades
- + Modification of existing aeration tanks to provide a high level of year-round nitrification
- + Installation of new blowers
- + Retrofit of the secondary digester to operate as either primary or secondary digester

In addition, the plant is in the process of installing a biogas CHP unit for energy recovery and greenhouse gas emission reduction (CIMA, 2016).

To accommodate population growth in the City of Waterloo, the next phase expansion to 72,730 m³/d has been included in the Region's capital budget for construction starting 2020, with an allowance for tertiary treatment to meet lower TP effluent limits. A review will be completed as part of this Master Plan to confirm the timing and need for the capacity expansion based on up-to-date forecasts for growth and flow projections.

3.2.6 Summary

The following points summarize the findings from the historical data review and process capacity assessment for the Waterloo WWTP:

- + The Waterloo WWTP historically has produced good quality effluent that has met the current MOECC ECA effluent limits for the historic review period.
- + All of the treatment units at the Waterloo WWTP have sufficient capacity to meet the design flow of 57,500 m³/d.

- ✦ With the completion of the secondary treatment upgrades including year-round nitrification as part of the Contract No. 4 upgrades, the plant will achieve improved effluent quality, with an overall available equivalent ADF capacity of 57,500 m³/d.
- ✦ The next phase expansion to 72,730 m³/d capacity has been included in the Region's capital budget for construction starting 2020, with an allowance for tertiary treatment to meet lower TP effluent limits. The timing for this capacity expansion will be confirmed as part of this Master Plan based on up-to-date forecasts for growth and flow projections.

3.3 Galt WWTP

3.3.1 Facility Overview

The Galt WWTP, originally constructed in the 1960s, is a conventional activated sludge plant that provides treatment for wastewater generated from a portion of the City of Cambridge. The plant is operated under MOECC ECA No. 2567-8ZEHYF issued on January 14, 2013. The Galt WWTP has a Stage 1 rated ADF capacity of 56,800 m³/d and a peak flow capacity of 171,100 m³/d. The ECA also allows for a future Stage 2 rated ADF capacity of 76,000 m³/d.

The existing treatment processes include screening, aerated grit removal, primary clarification, aeration, secondary clarification, tertiary filtration and UV disinfection prior to discharge to the Grand River. Alum is added to aeration tank effluent channels and/or the filter inlet for phosphorus removal. Raw sludge and mechanically thickened WAS (i.e. via rotary drum thickeners) are anaerobically digested, and dewatered via centrifuges, with biosolids beneficially used in agriculture or in the remediation of mine tailing ponds in northern Ontario. Centrate from the dewatering centrifuges is returned to the liquid treatment train. The plant also receives anaerobically digested biosolids from the Preston WWTP for dewatering and aerated sludge from the Hespeler WWTP for processing through the liquid treatment train.

In 2016, a Facility Plan (CIMA, 2016) was completed for the upgrades at the Galt WWTP to address key issues/deficiencies that have been identified at the facility. The upgrades program is focused on achieving Stage 1 rated capacity, with provisions for future upgrades to Stage 2 rated capacity. A phased approach has been developed for the short and medium term upgrades at the plant.

The ECA effluent requirements for the Galt WWTP current Stage 1 and future Stage 2 are summarized in Table 14. It is noted that effluent requirements become more stringent with an increase in flow.

Table 14 Galt WWTP ECA Effluent Objectives and Limits (ECA No. 2567-8ZEHYF, 2013)

Parameter	Effluent Objectives		Non-Compliance Limits	
	Concentration (mg/L) ⁽¹⁾	Loading (kg/d) ⁽²⁾	Concentration (mg/L) ⁽¹⁾	Loading (kg/d) ⁽²⁾
Stage 1				
CBOD ₅	15.0	850	25.0	1,400
TSS	15.0	850	25.0	1,400
TP	0.6	34	1.0	56
TAN	2.0	114	3.5	196
<i>E. coli</i> (counts/100 mL) ⁽³⁾	200	-	200	-
Stage 2				
CBOD ₅	10.0	760	15.0	1,140
TSS	10.0	760	15.0	1,140
TP	0.5	38	0.5	38
TAN	2.0	152	3.5	266
<i>E. coli</i> (counts/100 mL) ⁽³⁾	200	-	200	-

Notes:

1. Based on monthly average concentration values.
2. Based on the annual average loading during any calendar year.
3. Based on monthly geometric mean.

3.3.2 Existing Conditions

Historical Flow

A summary of the historical flow data of the Galt WWTP over the period 2012 to 2014 is presented in Table 15.

The average raw wastewater flow between 2012 and 2014 was 35,230 m³/d, or approximately 60% of the rated capacity of 56,800 m³/d. The average per capita flow was 415 L/cap-d, which is at the higher end of the typical range of 225-450 L/cap-d for domestic sewage (MOECC, 2008). This may be attributed to the significant industrial contributions from the Industrial Road Service Area (IRSA) flow, which was diverted from the Preston WWTP to the Galt WWTP in 2012 in order to release the treatment capacity at the Preston WWTP.

For the capacity assessment in Section 3.3.3, the PDF, PHF and PIF factors of 1.6, 2.0 and 3.0, respectively, were applied.

Raw Wastewater Characteristics and Loadings

Historic raw influent wastewater concentrations and loadings from 2012 to 2014 are presented in Table 16. The Galt WWTP receives medium strength wastewater, with the industrial loading contributions from the IRSA.

Per capita loadings were calculated and compared to typical values expected for domestic sewage (Metcalf & Eddy, 2003). All of the parameters with the exception of TP are higher than the typical per capita loadings, due to the industrial loading contributions from the IRSA.

Historic average monthly influent concentrations and loadings were used in the unit process capacity assessment in Section 3.3.3.

Table 15 Historic Flow to the Galt WWTP

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated Capacity (m ³ /d)	56,800	-
ADF (m ³ /d)	35,230 (60%)	-
PDF (m ³ /d)	57,600	1.6 ⁽¹⁾
PHF (m ³ /d) (99.9 th Percentile)	70,460	2.0 ⁽²⁾
PIF (m ³ /d)	105,680	3.0 ⁽³⁾
Average Per Capita Flow (L/cap·d)	415 ⁽⁴⁾	-

Notes:

1. Based on historic data (January 2012 to December 2014).
2. Based on historic data (January 2012 to December 2014).
3. Based on the Galt WWTP Facility Plan (CIMA, October 2016).
4. Based on ADF of 35,230 m³/d and a 2014 population of 85,088 provided in the Region's 2015 Water and Wastewater Monitoring Report.

Table 16 Galt WWTP Raw Wastewater Characteristics and Loadings ⁽¹⁾

Parameter	Average Concentration			Average Loading			
	Historic (mg/L) ⁽¹⁾	Design (mg/L) ⁽²⁾	Typical Value (mg/L) ⁽³⁾	Historic (kg/d) (% of Design Loading)	Design (kg/d) ⁽²⁾	Historic Average Per Capita Loading (g/cap.d) ⁽⁴⁾	Typical Per Capita Loading (g/cap.d) ⁽³⁾
CBOD ₅	210	210	190	6,900 (60%)	11,990	80	80
TSS	260	260	210	8,900 (60%)	14,710	110	90
TP	6.0	6.0	7	190 (60%)	320	2.3	3.2
TKN	40	40	40	1,280 (60%)	2,050	15	13

Notes:

1. Based on OCWA Operating and Maintenance Annual Reports (2012-2014).
2. Based on Galt WWTP Conceptual Design Facility Plan Report (CIMA, 2016).
3. Based on Metcalf & Eddy (2003).
4. Based on average loadings and a 2014 population of 85,088 provided in the Region's 2015 Water and Wastewater Monitoring Report.

Effluent Quality and Performance

The historical effluent quality for the period of 2012 to 2014 is presented in Table 17, along with ECA effluent objectives and compliance limits.

Based on the historical plant effluent, the Galt WWTP has been able to achieve its effluent compliance limits for the historic review period.

The historical effluent wastewater loadings, with respect to CBOD₅, TSS, and TP are also summarized in Table 17. All annual average loadings are within the ECA objectives and non-compliance limits.

It should be noted that the existing tertiary filters are overloaded at current flows and bypass routinely during peak flows. Although effluent requirements as per the current plant ECA are achieved through secondary treatment, tertiary filtration provides additional improvements in effluent quality and provides benefits for the Grand River. The existing tertiary filters will be replaced as part of the planned plant upgrades according to the Galt WWTP Facility Plan (CIMA, 2016).

Table 17 Galt WWTP Effluent Quality and Loadings ⁽¹⁾

Parameter	Concentration (mg/L)				Loading (kg/d)			
	Average	Peak Month (2)	Objective	Non-Compliance Limit ⁽³⁾	Average	Peak Month (2)	Objective	Non-Compliance Limit ⁽⁴⁾
CBOD ₅	2.6	5.6	15.0	25.0	90	210	850	1,400
TSS	6.4	16.3	15.0	25.0	230	600	850	1,400
TP	0.32	0.51	0.6	1.0	11	16	34	56
TAN	0.3	1.6	2.0	3.5	11	69	114	196

Notes:

1. Based on OCWA Operating and Maintenance Annual Report (2012-2014).
2. The highest monthly average value during 36-month period (January 2012 - December 2014)
3. Based on monthly average concentration values.
4. Based on annual average loading during any calendar year.

3.3.3 Process Capacity Assessment

A capacity assessment for the major liquids and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The assessment was based on historical plant operational data, plant design criteria, approved ECA capacities, and typical design guidelines.

For the capacity assessment, the following recommendations in the Facility Plan Report (CIMA, November 2015) and the Expert Panel Report (Husband et al., March 2016, refer to Section 3.3.5) were applied:

- ✦ Dual-point alum addition for phosphorus removal (i.e. alum can be added to both primary clarifiers and aeration tank effluent channels), which can provide additional aeration tank capacity through the reduction of WAS generation rate and reduce the amount of chemicals used. Meanwhile with dual point chemical injection, there might be more raw sludge generation, which may impact downstream digestion capacity.
- ✦ Centrate, which is high in nitrogen and ammonia loadings, will be equalized in an equalization tank and returned to the liquid train during low flow periods. This will allow the activated sludge system to operate at a reduced SRT (i.e. 8 days) due to reduced peak ammonia loading, resulting in an increase in overall aeration tank capacity without adding additional tankage.

- ✦ Replacement of the existing tertiary filters and UV system within the existing tertiary filter building footprint.

Table 18 lists the background data used to estimate the rated capacities for the major processes. The capacity assessment results of the Galt WWTP are presented in the PPG in Figure 3.

Overall, all of the treatment processes at the Galt WWTP are sized sufficiently for Stage 1 capacity. Digester capacity is borderline for Stage 1 capacity. More details are summarized below:

- ✦ Mechanical bar screens are sufficient for Stage 1 capacity; however, there is no firm capacity or plant bypass. Grit tanks are sized appropriately for Stage 2 capacity. An emergency bypass will be provided as part of the planned upgrades.
- ✦ Overall, the primary clarifier capacity of the existing plant is sufficient for Stage 1 Capacity, however, based on the current flow split of approximately 50:50, the Plant B primary Clarifier is overloaded at Stage 1 capacity. This could be addressed by adding an additional Plant B primary clarifier (CIMA, 2015).
- ✦ The aeration tank capacity is close to that required for Stage 1 capacity at 8.0 days SRT and 3,500 mg/L MLSS, with the increased capacity due to implementation of centrate equalization coupled with the dual point alum dosing for phosphorus removal. This increased capacity has been taken into consideration in the PPG as shown in Figure 3.
- ✦ The oxygenation system is sized sufficiently for Stage 1 capacity.
- ✦ Overall, the secondary clarifier capacity is sufficient for Stage 1 capacity.
- ✦ Tertiary filters will have sufficient capacity to handle the Stage 1 capacity, upon the completion of the currently planned upgrades.
- ✦ The existing anaerobic digester capacity is slightly lower than the Stage 1 rated capacity of 56,800 m³/d, due to higher raw sludge generation with the implementation of dual point chemical addition.

Table 18 Galt WWTP Major Unit Process Summary

Process		Description	Value
Raw Sewage Pumping Station	Wet Wells	Live Volume	74.6 m ³
	Pumps	Number	6 (5 duty, 1 standby)
		Capacity (per pump)	396.1 L/s at 11.9 m TDH and 885 RPM
		Capacity (Firm)	1,981 L/s (171,115 m ³ /d)
Headworks	Bar Screen	Number	2
		Width	1,500 mm
		Bar Spacing	19 mm
	Aerated Grit Tanks	Number	2
		Volume (total)	395 m ³
		Peak flow capacity	171,100 m ³ /d
Primary Clarifiers	Plant A	Number	4
		Surface Area (total)	1,051 m ²
		SWD	2.74 m
	Plant B	Number	1
		Surface Area (total)	982 m ²
		SWD	3.95 m
Aeration Tanks	Plant A	Number	4
		Volume (total)	6,814 m ³
		SWD	4.19 m
	Plant B	Number	2
		Volume (total)	7,678 m ³
		SWD	4.25 m
Blowers	Centrifugal Blowers	Number	4 (3 duty, 1 standby)
		Capacity (per blower)	212.4 m ³ /min of air at 51.7 kPa
Secondary Clarifiers	Plant A	Number	4
		Surface Area (total)	1,648 m ²
		SWD	3.1 m
	Plant B	Number	2
		Surface Area (total)	1,510 m ²
		SWD	3.9 m

Process		Description	Value
Tertiary Filters ⁽¹⁾	Cloth Media Filters	Filter Hydraulic Capacity (Peak Hourly Flow)	125,000 m ³ /d
UV Disinfection ⁽¹⁾		Number of channels	4
		Peak Hourly Flow Capacity (total)	125,000 m ³ /d
Digestion	Anaerobic digesters	Number	2 (primary)
		Volume (total)	6,490 m ³
		SWD	8.5 m (Digester No.1) 7.0 m (Digester No. 2)
Biosolids Storage	Digested Sludge Storage Tank	Number	1
		Volume (total)	1,090 m ³
		SWD	6.0 m

Notes:

1. The unit processes are for the upgraded plant as recommended in the Galt Facility Plan (CIMA, 2016).

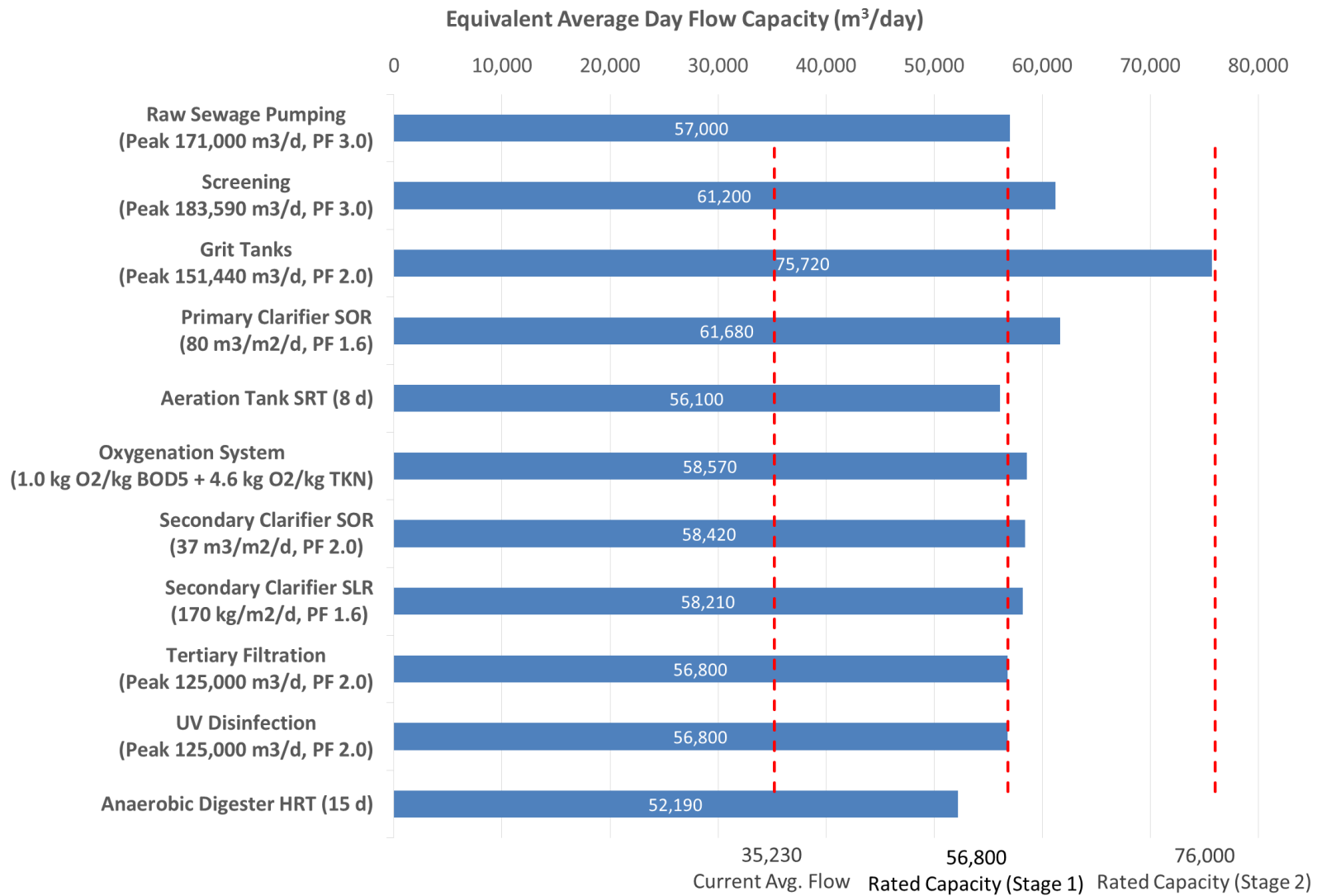


Figure 3 PPG for the Galt WWTP

A summary of the equivalent ADF capacity of each unit process is presented in Table 19. Overall, the Galt WWTP has an available equivalent capacity similar to the Stage 1 rated capacity of 56,800 m³/d, not including the tertiary filters.

Table 19 Preliminary Capacity Assessment Summary, Galt WWTP

Major Unit Process	Criteria Used	Peak Factor Used	Equivalent ADF Capacity (m ³ /d) ⁽¹⁾		
			Plant A	Plant B	Total
Raw Sewage Pumping Pumps	-	PIF = 3.0	-	-	57,000
Headworks Screens	-	PIF = 3.0	-	-	61,200
Grit Tanks	-	PHF = 2.0	-	-	75,720
Primary Clarifiers SOR at PDF (m ³ /m ² /d)	80	PDF = 1.6	42,040	19,640	61,680
Aeration Tanks SRT (days)	8.0 ⁽²⁾	ADF	26,359 ⁽³⁾	29,702 ⁽³⁾	56,060 ⁽³⁾
Oxygenation System Oxygen Demand ⁽⁴⁾	1.0 kg O ₂ /kg BOD ₅ + 4.6 kg O ₂ /kg TKN	ADF	-	-	58,570
Secondary Clarifier SOR at PHF (m ³ /m ² /d)	37 ⁽⁵⁾	PHF = 2.0	30,488	27,935	58,420
SLR at PDF (kg/m ² /d)	170 ⁽⁵⁾	PDF = 1.6	30,375 ⁽⁶⁾	27,832 ⁽⁶⁾	58,210 ⁽⁶⁾
Tertiary Filtration Peak Design Flow (m ³ /d)	125,000	PHF = 2.0	-	-	56,800
UV Disinfection Peak Design Flow (m ³ /d)	125,000	PHF = 2.0	-	-	56,800
Anaerobic Digester HRT (day)	15	ADF	-	-	52,190

Notes:

1. Based on the flow distribution to primary and secondary treatment of 50:50 to Plant A and Plant B, which is consistent with current practice.
2. Based on the assumption that centrate from dewatering process will be equalized, which will allow the activated sludge system to be operated at reduced SRT due to reduced peak ammonia loading.
3. Based on a sludge yield of 0.80 kg TSS/kg BOD₅ for conventional activated sludge process with dual-point chemical addition for phosphorus removal and MLSS of 3,500 mg/L.
4. Based on peak oxygen demand with 150% factor of average oxygen demand to account for diurnal fluctuation.
5. Based on MOECC Design Guidelines (2008) for conventional activated sludge process with nitrification and with chemical addition for phosphorus removal.
6. Based on assumed MLSS concentration of 3,500 mg/L and RAS:ADF ratio of 100%.

3.3.4 Condition Assessment Findings

The Galt WWTP was originally constructed in the 1960s. The plant has undergone a number of upgrades through the years including construction of a sludge thickening and dewatering facility and backup power system, and anaerobic digestion system upgrades.

In 2015, a facility-wide condition assessment was completed for the Galt WWTP (CIMA, 2015). The findings from the above assessment, along with the process capacity assessment results were used to confirm and identify process areas requiring upgrades or rehabilitation. A summary of the key findings is presented in Table 20.

Table 20 Summary of Galt WWTP Condition Assessment

Process	Physical Condition
Raw Sewage Pumping Station	✖ Equipment near the end of its service life
Headworks	✖ Equipment near the end of its service life ✖ No firm screen capacity or plant bypass
Primary Treatment	✖ Near the end of its service life. Needs refurbishment and/or replacement. ✖ Plant B primary treatment is hydraulically restricted based on current flow split
Secondary Treatment	✖ Equipment near the end of its service life. Needs refurbishment
Tertiary Filtration	✖ Tertiary filters exceeded service life. Need refurbishment
UV Disinfection	✖ Spare part availability limited
Centrate Management	✓ No issues identified

3.3.5 Ongoing and Planned Upgrades

The Region has recently completed a Facility Plan and Conceptual Design for upgrades at the Galt WWTP (CIMA, 2016). The primary goal is to deliver the conceptual design for a program of upgrades that best addresses deficiencies,

provides for reliable long-term operation of the facility, and is compatible with the future expansion of the Galt WWTP.

An Expert Panel (EP) was retained by the Region to review the Facility Plan to provide technical comments and alternative approaches to the completion of the Facility Plan (Husband et al., 2016). A summary of the proposed Stage 1 and Stage 2 upgrade works based on the Facility Plan Report and EP recommendations is presented below:

Stage 1 Upgrades

- + Raw Sewage Pumping Station: Refurbish existing raw sewage pumping station, and include raw sewage peak flow buffering storage using a Plant A Primary Clarifier.
- + Headworks: Construct a new screen bypass channel.
- + Primary Treatment: Construct a new Plant B primary clarifier.
- + Secondary Treatment: Implement dual point alum dosing for phosphorus removal and replace aeration blowers.
- + Tertiary Treatment and UV Disinfection: New tertiary filtration and UV disinfection equipment in the existing Tertiary Treatment Facility.
- + Anaerobic Digestion: Optimization of the existing anaerobic digesters to handle Stage 1 rated capacity.
- + Centrate Management: Construct an addition to the existing centrate holding tank.

Stage 2 Upgrades

- + Raw Sewage Pumping Station and Headworks: Construct a new integrated raw sewage pumping station and headworks with wet well equalization storage.
- + Primary Treatment: No additional upgrades required.
- + Secondary Treatment: Convert Plant B aeration tanks to single pass tanks, construct additional aeration tanks, and construct two new Plant B secondary clarifiers.

- + Tertiary Filtration and UV Disinfection: Add additional capacity to treat Stage 2 flows in existing building footprint.
- + Anaerobic Digestion: Construct an additional anaerobic digester to treat Stage 2 flows.
- + Centrate Management: No additional upgrades required.

In addition, similar to the Kitchener and Waterloo WWTPs, the Galt WWTP is currently in the process of installing a biogas CHP unit for energy recovery and greenhouse gas emission reduction (CIMA, 2016).

3.3.6 Summary

The following points summarize the findings from the historical data review and process capacity assessment for the Galt WWTP:

- + The Galt WWTP historically has produced good quality effluent that has met the MOECC ECA effluent limits during the historic review period.
- + The Galt WWTP has sufficient capacity for the Stage 1 capacity of 56,800 m³/d.
- + Overall, the Galt WWTP has an available equivalent ADF capacity similar to the Stage 1 rated capacity of 56,800 m³/d.

3.4 Preston WWTP

3.4.1 Facility Overview

The Preston WWTP, originally constructed prior to 1960, is a conventional activated sludge plant that provides treatment for wastewater generated from a portion of the City of Cambridge. The Preston WWTP is currently operated under MOECC ECA No. 2526-96VJBA issued on June 27, 2013. The plant has a rated ADF capacity of 16,860 m³/d and a peak flow capacity of 43,300 m³/d.

The existing unit treatment processes include screening, vortex grit removal, primary clarification, aeration, secondary clarification and UV disinfection prior to discharge to the Grand River. Alum is added at the outlet of the aeration tanks for phosphorus removal. Co-thickened WAS and raw sludge is anaerobically digested and hauled for dewatering at the Galt WWTP.

The ECA effluent requirements for the Preston WWTP are summarized in Table 21.

Table 21 Preston WWTP Existing ECA Effluent Objectives and Limits (ECA No. 2526-96VJBA 2013)

Parameter	Effluent Objectives		Non-Compliance Limits	
	Concentration (mg/L) ⁽¹⁾	Loading (kg/d) ⁽²⁾	Concentration (mg/L) ⁽¹⁾	Loading (kg/d) ⁽²⁾
CBOD ₅	10.0	168.6	15.0	252.9
TSS	10.0	168.6	15.0	252.9
TP	0.6	10.1	0.7	11.8
TAN (May 1-Sep 30)	3.0	50.6	8.0	134.9
TAN (Oct 1- Apr 30)	5.0	84.3	10.0	168.6
<i>E. coli</i> (counts/100 mL) ⁽³⁾	200	-	200	-

Notes:

1. Based on monthly average concentration values.
2. Based on the annual average loading during any calendar year.
3. Based on monthly geometric mean.

3.4.2 Existing Conditions

Historical Flow

A summary of the historical flow data of the Preston WWTP over the period 2012 to 2014 is presented in Table 22.

The average raw wastewater flow between 2012 and 2014 was 9,000 m³/d, or approximately 50% of the rated capacity of 16,860 m³/d. The average per capita flow was 440 L/cap·d, which is at the upper limit of the typical range of 225-450 L/cap·d for domestic sewage (MOECC, 2008). For the capacity assessment in Section 3.4.3 of this TM, the PDF, PHF and PIF factors of 1.6, 2.1 and 2.9, respectively, were applied.

It is important to note that flow from the IRSA, which is high in organic loading, had previously been directed to the Preston WWTP and limited the plant capacity. To release the capacity at the Preston WWTP, flow from the IRSA was diverted from the Preston WWTP to the Galt WWTP by the end of 2011. With the diversion of these flows, the rated capacity of the Preston WWTP is no longer restricted by the organic loadings in the industrial discharges.

Table 22 Historic Flow to the Preston WWTP

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated Capacity (m ³ /d)	16,860	-
ADF (m ³ /d)	9,000 (50%)	-
PDF (m ³ /d)	15,000	1.6 ⁽¹⁾
PHF (m ³ /d) (99.9 th Percentile)	19,000	2.1 ⁽²⁾
PIF (m ³ /d)	26,890	2.9 ⁽³⁾
Average Per Capita Flow (L/cap·d)	440 ⁽⁴⁾	-

Notes:

1. Based on historic data (January 2012 to December 2014).
2. Based on historic data (January 2012 to December 2014).
3. Assumed based on ECA peaking factor.
4. Based on ADF of 9,000 m³/d and a 2014 population of 20,656 provided in the Region's 2015 Water and Wastewater Monitoring Report.

Raw Wastewater Characteristics and Loadings

Historic raw influent wastewater concentrations and loadings from 2012 to 2014 are presented in Table 23. The Preston WWTP receives medium strength wastewater. Per capita loadings were calculated and compared to the typical values expected for domestic sewage (Metcalf & Eddy, 2003). TSS and TKN per capita loadings are slightly higher than the typical per capita loadings.

Table 23 Preston WWTP Raw Wastewater Characteristics and Loadings ⁽¹⁾

Parameter	Average Concentration			Average Loading			
	Historic (mg/L) ⁽¹⁾	Design (mg/L) ⁽²⁾	Typical Value (mg/L) ⁽³⁾	Historic (kg/d) (% of Design Loading)	Design (kg/d) ⁽²⁾	Historic Average Per Capita Loading (g/cap.d) ⁽⁴⁾	Typical Per Capita Loading (g/cap.d) ⁽³⁾
CBOD ₅	190	310	190	1,660 (30%)	5,250	80	80
TSS	230	290	210	2,050 (40%)	4,920	99	90
TP	5.0	6.5	7	50 (40%)	110	2.3	3.2
TKN	40	37	40	370 (60%)	620	18	13

Notes:

1. Based on OCWA Operating and Maintenance Annual Reports (2012-2014).
2. Based on Preston Wastewater Treatment Plant Pre-Design Report (Acres & Associated, 1997).
3. Based on Metcalf & Eddy (2003).
4. Based on average loadings and a 2014 population of 20,656 provided in the Region's 2015 Water and Wastewater Monitoring Report.

Effluent Quality and Performance

The historical effluent quality for the period of 2012 to 2014 is presented in Table 24, along with ECA effluent objectives and compliance limits. Based on the historical plant effluent quality, the Preston WWTP has been able to achieve its effluent compliance limits.

Table 24 Preston WWTP Effluent Quality and Loadings ⁽¹⁾

Parameter	Concentration (mg/L)				Loading (kg/d)			
	Avg.	Peak Month ⁽²⁾	Object.	Limit ⁽³⁾	Avg.	Peak Month ⁽²⁾	Object.	Limit ⁽⁴⁾
CBOD ₅	2.0	2.1	10.0	15.0	18	23.2	168.6	252.9
TSS	6.6	22.9	10.0	15.0	57	190.5	168.6	252.9
TP	0.23	0.42	0.6	0.7	2.1	3.3	10.1	11.8
TAN (May 1-Sep 30)	0.11	0.12	3.0	8.0	0.9	1.1	50.6	134.9
TAN (Oct 1- Apr 30)	0.11	0.20	5.0	10.0	1.0	2.3	84.3	168.6

Notes:

1. Based on OCWA Operating and Maintenance Annual Reports (2012-2014).
2. The highest monthly average value during 36 month period (January 2012 - December 2014).
3. Based on monthly average concentration values.
4. Based on annual average loading during any calendar year.

3.4.3 Process Capacity Assessment

A capacity assessment for the major liquids and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The assessment was based on historical plant operational data, plant design criteria, approved ECA capacities, and typical design guidelines. Table 25 lists the background data used to estimate the rated capacities for the major processes.

The capacity assessment results of the Preston WWTP are presented in the PPG in Figure 4.

Table 25 Preston WWTP Major Unit Process Summary ⁽¹⁾

Process		Description	Value
Headworks	Coarse Bar Screen	Number	2 duty (1 mechanical, 1 manual)
		Width	750 mm
		Bar Spacing	19 mm (mechanical); 40 mm (manual)
		Peak Flow Capacity (total)	49,440 m ³ /d
	Aerated Grit Tanks	Number	2
		Peak Flow Capacity (total)	49,440 m ³ /d
Primary Clarifiers	Circular	Number	4
		Surface Area (total)	726 m ²
		SWD	4.6 m
Aeration Tanks	Rectangular	Number	4
		Volume (total)	6,650 m ³
Blowers		Number	3 (2 duty, 1 standby)
		Capacity (per blower)	90 m ³ /min of air
Secondary Clarifiers	Circular and Rectangular	Number	6 (4 circular and 2 rectangular)
		Surface Area (total)	1,091 m ²
UV Disinfection		Channels	2
		Capacity	43,300 m ³ /d
Anaerobic Digesters		Number	2 (1 primary and 1 secondary)
		Volume (total)	2,188 m ³ (primary) 2,188 m ³ (secondary)
		SWD	11.9 m

Notes:

1. There is no on-site raw sewage pumping station for the Preston WWTP. The plant is fed by the City of Cambridge's raw sewage pumping station.

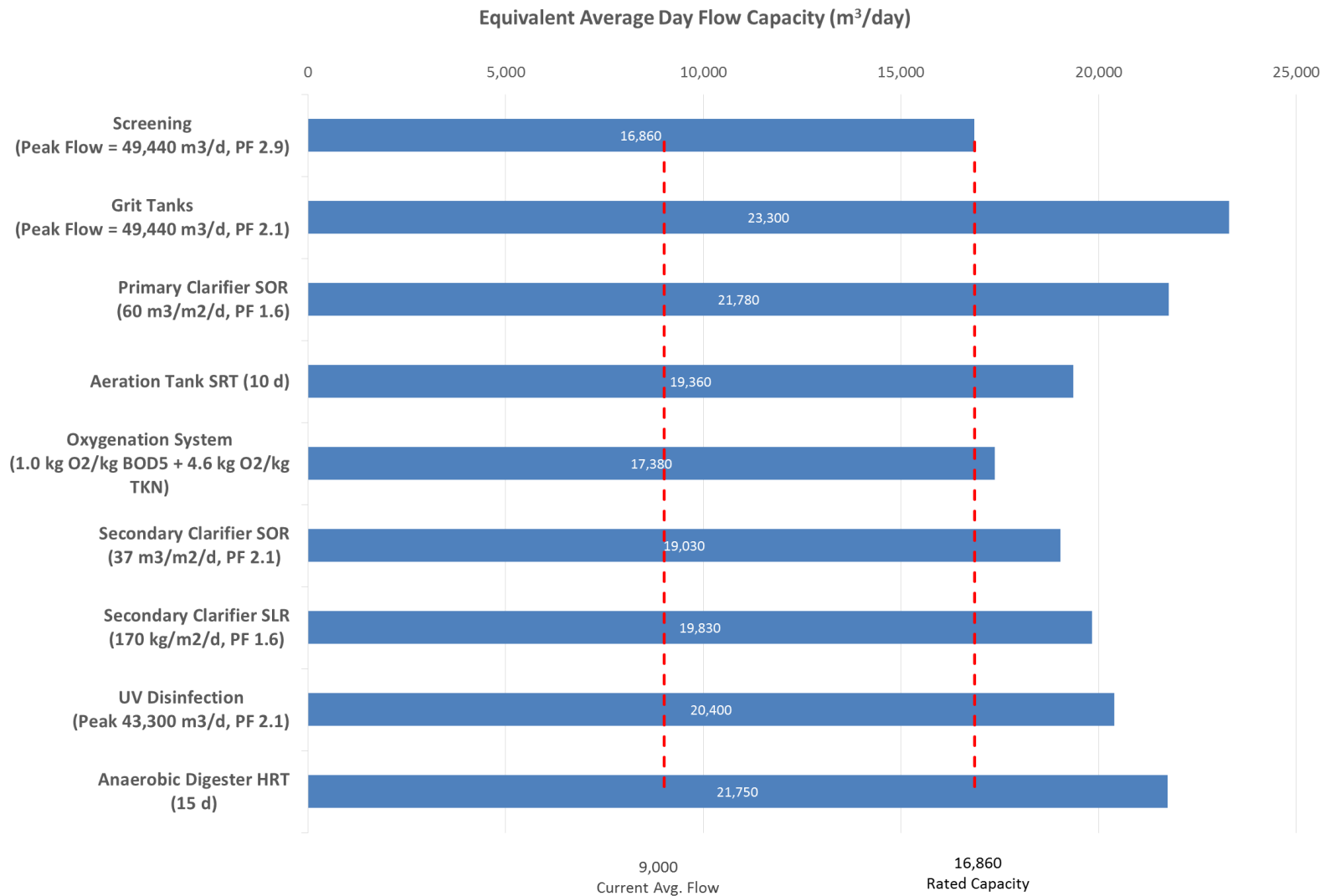


Figure 4 PPG for the Preston WWTP

All treatment processes at the Preston WWTP are sized sufficiently for the current flows and plant rated capacity of 16,860 m³/d. A summary of the equivalent ADF capacity of each unit process is presented in Table 26. Overall, the Preston WWTP has an available equivalent ADF capacity of 16,860 m³/d.

Table 26 Capacity Assessment Summary for Preston WWTP

Major Unit Process	Criteria Used	Peak Factor Used	Equivalent ADF Capacity (m ³ /d)
Headworks			
Screens	-	PIF = 2.9	16,860
Grit Tanks	-	PHF = 2.1	23,300
Primary Clarifiers			
SOR at PDF (m ³ /m ² /d)	60 ⁽¹⁾	PDF = 1.7	21,780
Aeration Tanks			
Solids Retention Time (days) ⁽²⁾	10	ADF	19,380
Oxygenation System			
Oxygen Demand ⁽³⁾	1.0 kg O ₂ /kg BOD ₅ + 4.6 kg O ₂ /kg TKN	ADF	17,130
Secondary Clarifier			
SOR at PHF (m ³ /m ² /d)	37 ⁽⁴⁾	PHF = 2.1	19,030
SLR at PDF (kg/m ² /d)	170 ⁽⁴⁾	PDF = 1.7	19,830
UV Disinfection			
Original Peak Design Flow (m ³ /d)	43,300	PHF = 2.1	20,600
Anaerobic Digester			
Hydraulic Retention Time (days)	15	ADF	21,750

Notes:

1. Based on MOE Design Guidelines for primary clarifiers with WAS co-thickening.
2. Based on a sludge yield of 1.0 kg TSS/kg BOD₅ for conventional activated sludge process with chemical addition for phosphorus removal and 3,500 mg/L MLSS.
3. Peak oxygen demand with 150% factor of average oxygen demand to account for diurnal variations.
4. Based on MOECC Design Guidelines (2008) for conventional activated sludge process with chemical addition for phosphorus removal.
5. Based on assumed MLSS concentration of 3,500 mg/L and RAS: ADF ratio of 100%.

3.4.4 Condition Assessment Findings

The Preston WWTP was constructed prior to 1960 and consisted predominantly of sludge drying beds. The plant has undergone a number of upgrades and expansions through the years with the most recent being plant-wide SCADA upgrades completed in 2010 and digester upgrades completed in 2013.

In October 2015, a facility-wide condition assessment was completed for the Preston WWTP (CIMA, 2015). The findings from this assessment along with the process capacity assessment results were used to confirm and identify process areas requiring upgrades or rehabilitation. A summary of key findings is presented in Table 27.

Table 27 Summary of Preston WWTP Condition Assessment

Process	Physical Condition
Headworks	✗ Mechanical bar screen nearing the end of service life. Needs replacement. ✗ Insufficient hydraulic capacity at the headworks building overflow chamber.
Primary Clarification	✗ Past the service life. Needs refurbishment.
Aeration Tanks	✗ Original tanks. Need significant rehabilitation. ✗ The anoxic zone is no longer functional. ✗ Air diffusers past the service life. Need replacement.
Secondary Clarification	✗ Process equipment needs refurbishment.
UV Disinfection	✓ Near the end of its useful life but in good condition.
Anaerobic Digestion	✓ Upgraded in 2013 and in good condition.

3.4.5 Ongoing and Planned Upgrades

The Preston WWTP is in the process of construction of:

- ✚ A new mechanical screening channel and installation of new mechanical screen.
- ✚ A new odour control system for headworks and primary treatment facility. This includes refurbishment of key primary clarifier structures.

3.4.6 Summary

The following points summarize the findings from the historical data review and process capacity assessment for the Preston WWTP:

- + The Preston WWTP has been able to achieve the current MOECC ECA effluent compliance limits for the historic review period.
- + All of the treatment units have sufficient capacity to meet the design flow of 16,860 m³/d.
- + Overall, the plant has an available equivalent ADF capacity of 16,860 m³/d.
- + The on-going and planned upgrades at the plant include:
 - Construction of a new mechanical screening channel and installation of new mechanical screen (on-going)
 - Refurbishment of primary clarifiers (on-going)
 - Refurbishment of aeration tanks and secondary clarifiers (planned)

3.5 Hespeler WWTP

3.5.1 Facility Overview

The Hespeler WWTP is an extended aeration plant that provides treatment for wastewater generated from a portion of the City of Cambridge. The Hespeler WWTP was originally constructed in 1973 and upgraded in 1988 and 1992. The plant is currently operated under MOECC ECA No. 5631-7YZMCQ issued on January 22, 2010, with a rated ADF capacity of 9,320 m³/d and a peak flow capacity of 19,850 m³/d.

The existing unit treatment processes include aerated grit removal, aeration, secondary clarification, sodium hypochlorite disinfection and dechlorination prior to discharge to the Speed River. Alum is added prior to the secondary clarifiers for phosphorus removal. Waste activated sludge is sent to an aerated sludge holding tank where it is gravity thickened and trucked to the Kitchener WWTP or Galt WWTP for further treatment.

A Facility Assessment has recently been completed for the plant to identify facilities that require improvements before the next planned expansion in 2025 (Stantec, 2015). The recommended upgrades include the construction of a new fine screening

and grit removal facility, new air blowers, addition of a third secondary clarifier, and a new WAS thickening facility. The plant rated capacity will remain 9,320 m³/d.

The existing ECA effluent requirements for the Hespeler WWTP are summarized in Table 28, along with the effluent limits recommended by the 2013/14 ACS for the future expansion up to 2051 (Stantec, April 2014).

Table 28 Hespeler WWTP Existing ECA and Proposed Effluent Objectives and Limits (ECA No. 5631-7YZMCQ, 2010)

Parameter	Effluent Objectives	Non-Compliance Limits	
	Concentration (mg/L) ⁽¹⁾	Concentration (mg/L) ⁽¹⁾	Loading (kg/d) ⁽²⁾
Current			
CBOD ₅	15.0	25.0	233
TSS	15.0	25.0	233
TP	0.75	1.0	9.3
<i>E. coli</i> (counts/100 mL) ⁽³⁾	150	200	-
Future (up to 2051) ⁽⁴⁾			
CBOD ₅	10	15	200
TSS	10	15	200
TP	0.4	0.6	8
TAN			
May 1 to November 30	2	4	53
December 1 to April 30	5	7	94
<i>E. coli</i> (counts/100 mL) ⁽³⁾	150	200	-

Notes:

1. Based on monthly average concentration values.
2. Based on the annual average loading during any calendar year.
3. Based on monthly geometric mean.
4. Based on ACS for the Hespeler and Waterloo WWTPs (Stantec, April 2014).

3.5.2 Existing Conditions

Historical Flow

A summary of the historical flow data for the Hespeler WWTP over the period 2012 to 2014 is presented in Table 29.

The average raw wastewater flow between 2012 and 2014 was 6,940 m³/d, or approximately 75% of the rated capacity of 9,320 m³/d. The average per capita flow was 270 L/cap·d, which is within a typical range of 225-450 L/cap·d for domestic sewage (MOECC, 2008).

For the capacity assessment, the PDF, PHF and PIF factors of 1.8, 3.0 and 3.4, respectively, were applied.

Table 29 Historic Flow to the Hespeler WWTP

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated Capacity (m ³ /d)	9,320	-
ADF (m ³ /d)	6,940 (75%)	
PDF (m ³ /d)	12,300	1.8 ⁽¹⁾
PHF (m ³ /d)	20,810	3.0 ⁽²⁾
PIF (m ³ /d)	23,590	3.4 ⁽²⁾
Average Per Capita Flow (L/cap·d)	270 ⁽³⁾	-

Notes:

1. Based on historic data (January 2012 to December 2014).
2. Based on Facility Assessment Study report (Stantec, June 2015).
3. Based on ADF of 6,940 m³/d and 2014 population of 25,737 provided in the Region's 2015 Water and Wastewater Monitoring Report.

Raw Wastewater Characteristics and Loadings

Historic raw influent wastewater concentrations and loadings from 2012 to 2014 are presented in Table 30. The raw wastewater to the Hespeler WWTP is primarily of domestic origin, with the exception of a few commercial and industrial sources. The raw wastewater characteristics are typical of low to medium strength domestic wastewater quality (Metcalf & Eddy, 2003).

Per capita loadings were calculated and compared to the typical values expected for domestic sewage. All of the parameters including CBOD₅, TSS, TP and TKN are lower than the typical per capita loadings.

Historic average monthly influent concentrations and loadings were used in the unit process capacity assessment in Section 3.5.3.

Table 30 Hespeler WWTP Raw Wastewater Characteristics and Loadings ⁽¹⁾

Parameter	Average Concentration			Average Loading			
	Historic (mg/L) ⁽¹⁾	Design (mg/L) ⁽²⁾	Typical Value (mg/L) ⁽³⁾	Historic (kg/d) (%) of Design Loading)	Design (kg/d) ⁽²⁾	Historic Per Capita Loading (g/cap.d) ⁽⁴⁾	Typical Per Capita Loading (g/cap.d) ⁽³⁾
CBOD ₅	150	150	190	1,100 (75%)	1,400	40	80
TSS	170	180	210	1,190 (70%)	1,680	50	90
TP	5.0	5.0	7	40 (70%)	50	1.4	3.2
TKN	40	40	40	290 (80%)	370	11	13

Notes:

1. Based on OCWA Operating and Maintenance Annual Reports (2012-2014).
2. Based on Facility Assessment Study (Stantec, 2015). The design values are 50th percentile values.
3. Based on Metcalf & Eddy (2003).
4. Based on average loadings and a 2014 population of 25,737 provided in the Region's 2015 Water and Wastewater Monitoring Report.

Effluent Quality and Performance

The historical effluent quality for the period of 2012 to 2014 is presented in Table 31, along with ECA effluent objectives and compliance limits.

Based on the historical plant effluent quality, the Hespeler WWTP has been able to achieve its effluent compliance limits for the historic review period, with the exception of the TP monthly average concentration in November 2013, which exceeded the 1.0 mg/L ECA compliance limit by 0.09 mg/L due to an upset condition experienced at the plant. This upset was rectified by the operational staff by adjusting MLSS, chemical dosage rates, and re-seeding the plant with mixed liquor from a well-established facility.

There are no total ammonia objectives or limits in the existing ECA, and the plant achieved partial nitrification historically.

The historical effluent wastewater loadings, with respect to CBOD₅, TSS, and TP are also summarized in Table 31. All annual average loadings are within the ECA non-compliance limits.

Table 31 Hespeler WWTP Effluent Quality and Loadings ⁽¹⁾

Parameter	Concentration (mg/L)				Loading (kg/d)			
	Avg.	Peak Month ⁽²⁾	Object.	Limit ⁽³⁾	Avg.	Peak Month ⁽²⁾	Object.	Limit ⁽⁴⁾
CBOD ₅	5.9	11.2	15.0	25.0	40	80	140	233
TSS	11.0	24.2	15.0	25.0	80	190	140	233
TP	0.5	1.1	0.75	1.0	3.7	7.8	7.0	9.3
TAN	7.6	23.3	-	-	-	-	-	-

Notes:

1. Based on OCWA Operating and Maintenance Annual Reports (2012-2014).
2. The highest monthly average value during 36-month period (January 2012 - December 2014).
3. Based on monthly average concentration values.
4. Based on annual average loading during any calendar year.

3.5.3 Process Capacity Assessment

A capacity assessment for the major liquids and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The assessment was based on historical plant operational data, plant design criteria, approved ECA capacities, and typical design guidelines. For the purpose of this assessment, it is assumed that the existing ECA requirements will be in place and nitrification will not be required until the plant requires expansion.

Table 32 lists the background data used to estimate the rated capacities for the major unit processes. It should be noted the capacity assessment was carried out for the upgraded Hespeler WWTP, assuming that the current planned upgrades as identified in the Facility Assessment Study (Stantec, 2015) are completed or near completion when this Master Plan Update project is completed (refer to Section 3.5.5).

The capacity assessment results of the Hespeler WWTP are presented in the PPG in Figure 5. All the treatment processes have sufficient capacity for the design flow, upon the completion of the currently planned upgrades. It should be noted that the aeration tank capacity was based on a hydraulic retention time (HRT) of 6 hours, assuming no nitrification requirements consistent with the existing ECA. If nitrification were required in the future, additional aeration tankage will be required, or innovative technologies could be implemented so that there may not be a need to expand aeration tanks.

A summary of the equivalent ADF capacity of each unit process and the design criteria on which the capacity assessment was based is presented in Table 33. Overall, the plant will have an available equivalent ADF capacity of 9,470 m³/d, upon the completion of the planned upgrades.

Table 32 Hespeler WWTP Major Unit Process Summary ⁽¹⁾

Process		Description	Value
Raw Sewage Pumping Station	Pumps	Number	4 submersible pumps (3 duty, 1 standby) 1 jockey pump
		Capacity (each)	155 L/s at 11.6 m TDH (Submersible Pumps) 80 L/s at 10.8 m TDH (Jockey Pump)
		Capacity (Firm)	465 L/s (40,180 m ³ /d)
Headworks	Fine Bar Screen (mechanically cleaned) ⁽²⁾	Number	2 (duty)
		Bar spacing	6 mm
		Capacity (each)	22,360 m ³ /d
	Fine Bar Screen (manually cleaned) ⁽²⁾	Number	1 (standby)
		Capacity (each)	44,720 m ³ /d
	Aerated Grit Tanks ⁽²⁾	Number	1
		Volume (total)	52 m ³
		Peak Flow Capacity (total)	28,400 m ³ /d
Aeration Tanks	Rectangular	Number	2
		Volume (total)	2,385 m ³
		SWD	4.2 m
Blowers ⁽²⁾	Positive Displacement	Number	2 (1 duty, 1 standby)
		Capacity (per blower)	117.8 m ³ /min of air ⁽³⁾
Secondary Clarifiers ⁽²⁾	Circular	Number	3 (2 existing, 1 new)
		Surface Area (total)	616 m ²
		SWD	3.96 m
Disinfection	Chlorination/ Dechlorination	Number of Chlorine Contact Chambers	1
		Volume (total)	316 m ³

Process		Description	Value
Aerobic Digestion	Aerobic Digesters	Number	4
		Volume (total)	1,920 m ³
		SWD	4.7 m

Notes:

1. The unit processes are for the upgraded plant as recommended in the Hespeler WWTP Facility Assessment Study (Stantec, 2015).
2. Based on the current planned upgrades as identified in the Facility Assessment Study (Stantec, 2015).
3. The existing blowers are to be upgraded in the near future and the size is to be confirmed during the upcoming detailed design.

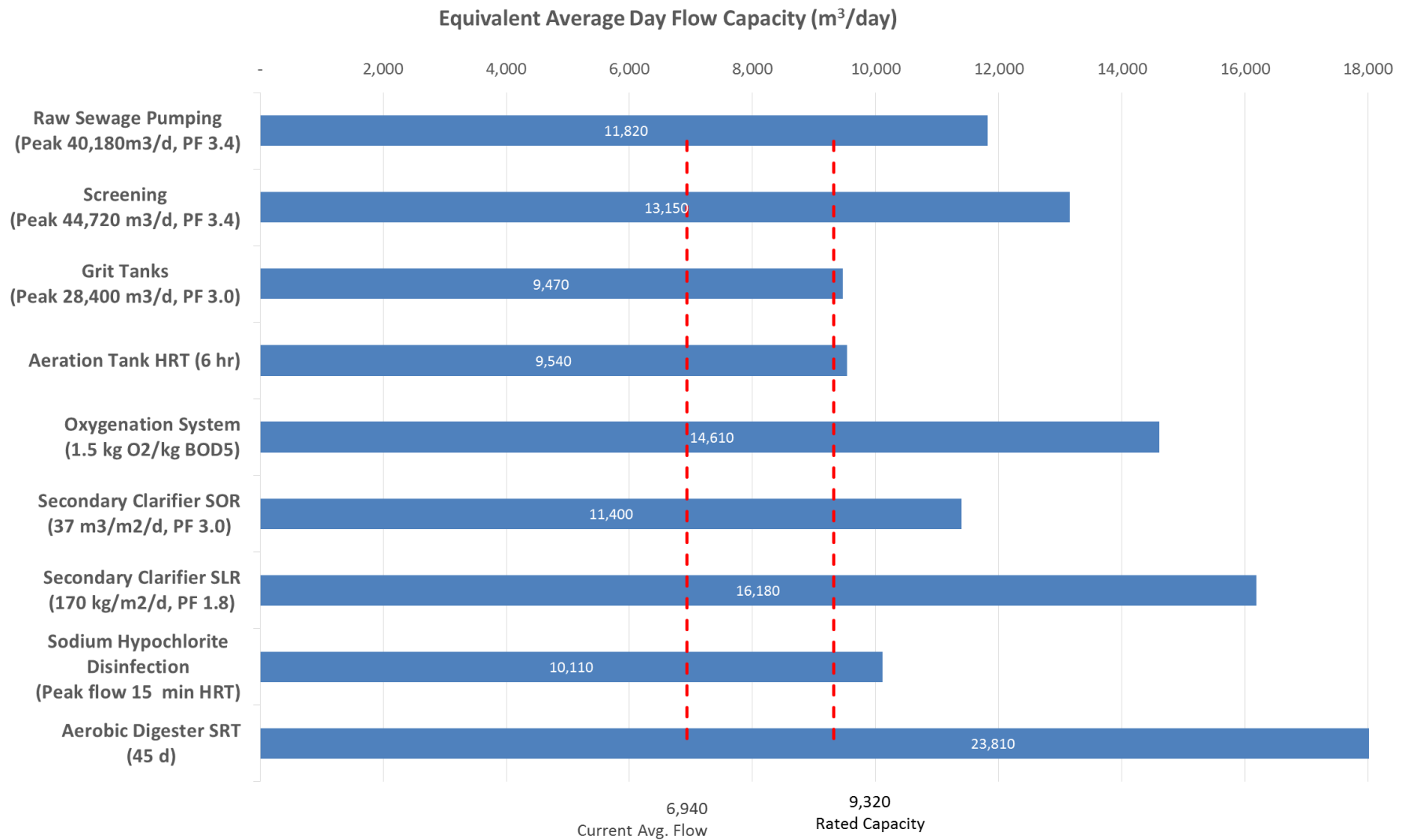


Figure 5 PPG for the Hespeler WWTP

Table 33 Capacity Assessment Summary, Hespeler WWTP

Major Unit Process	Criteria Used	Peak Factor Used	Equivalent ADF Capacity (m ³ /d)
Raw Sewage Pumping Pumps	-	PIF = 3.4	13,850
Headworks Screens Grit Tanks	- -	PIF = 3.4 PHF = 3.0	13,150 9,470
Aeration Tanks Hydraulic Retention Time (hours) ⁽¹⁾	6	ADF	9,540
Oxygenation System Oxygen Demand ⁽²⁾	1.5 kg O ₂ /kg BOD ₅	ADF	14,610 ⁽³⁾
Secondary Clarifier Surface Overflow Rate at PHF (m ³ /m ² /d)	37 ⁽⁴⁾	PHF = 3.0	11,400
Surface Loading Rate at PDF (kg/m ² /d)	170 ⁽⁴⁾	PDF = 1.8	16,180 ⁽⁵⁾
Chlorine Disinfection Contact Time at PHF (min)	15	PHF = 3.0	10,110
Aerobic Digestion SRT (days)	45 ⁽⁶⁾	ADF	23,810

Notes:

1. Based on the assumption that the existing ECA requirements will be in place and nitrification will not be required until the plant next expansion.
2. Peak oxygen demand with 150% factor of average oxygen demand to account for diurnal fluctuation.
3. Estimated based on the existing blower capacity. The existing blowers are to be upgraded in the near future.
4. Based on MOECC Design Guidelines (2008) for extended aeration activated sludge process with chemical addition for phosphorus removal.
5. Based on assumed MLSS concentration of 3,500 mg/L and RAS: ADF ratio of 100% for extended aeration process.
6. Based on MOECC Design Guidelines (2008) of 45 days of SRT including both in digestion and aeration tanks.

3.5.4 Condition Assessment Findings

The Hespeler WWTP has been in service for over 40 years and has undergone several upgrades since the original construction.

A Facility Assessment Study was conducted for the Hespeler WWTP in 2015 (Stantec, 2015) to identify processes and facilities that require improvements before the planned expansion. A summary of the main deficiencies identified is provided in Table 34. The plant is currently being upgraded to address these deficiencies.

Table 34 Summary of Hespeler WWTP Facility Assessment (Stantec, 2015)

Process	Physical Condition
Raw Sewage Pumping Station	✓ No issues identified.
Headworks	✗ Communitor near the end of its service life
Secondary Treatment	✓ Sufficient capacity for aeration tanks. Additional aeration tanks would be required if nitrification required in the future.
	✗ Existing aeration blowers are fixed speed blowers and have a lack of aeration control.
	✗ Need an additional secondary clarifier to meet hydraulic and process capacity requirements
Disinfection and Dechlorination Facility	✓ No issues identified.
Sludge Hauling	✗ Higher than expected sludge hauling. WAS thickening could be considered.
Ancillary Process/Facility	✗ Additional washing and changing facilities are required in the administration building.

3.5.5 Ongoing and Planned Upgrades

Based on the Hespeler WWTP Facility Assessment Study completed in 2015 (Stantec, 2015), the Region is currently completing the design and construction for the following improvements:

- ✚ New fine screening facility
- ✚ New grit classifier and hydrocyclone for automatic grit removal

- + New aeration blowers with variable frequency drive (VFD) and dissolved oxygen (DO) control
- + A third secondary clarifier
- + WAS thickening facility
- + Aerobic digester upgrades (diffuser replacement)

These upgrades have been included in the Region's capital budget for the 2018-2020 construction.

An expansion of capacity to 12,100 m³/d was included in the 2007 WWTMP (Earth Tech, 2007), however it has been deferred beyond the 10-year capital budget, based on the reduced flow forecasts. Through I/I reduction efforts, flow conservation and a decision to service the future East Side Lands by the Kitchener WWTP, actual wastewater flows to the Hespeler WWTP have been less than projected in the 2007 WWTMP. It is now anticipated that a capacity expansion will not be required for the Hespeler WWTP until 2025 (Stantec, 2015).

Based on the expected timing for a capacity expansion, it is expected that upgrades will also be required to nitrify as per the assimilative capacity conducted in 2011-2014, with a proposed ECA objective of 2 and 5 mg/L for NH₃-N (summer and winter, respectively). Optimization of chemical precipitation to achieve a proposed effluent objective of 0.4 m/L will also be required.

3.5.6 Summary

The following points summarize the findings from the historical data review and process capacity assessment for the Hespeler WWTP

- + The Hespeler WWTP has met the MOECC ECA effluent limits for the historic review period, with the exception of the TP monthly average concentration that exceeded the ECA compliance limit in November 2013 due to an upset condition at the plant.
- + All the treatment units have sufficient capacity to meet the design flow of 9,320 m³/d.
- + Overall, the plant will have an available equivalent ADF capacity of 9,470 m³/d.

3.6 Ayr WWTP

3.6.1 Facility Overview

The Ayr WWTP is an extended aeration (EA) package plant that provides treatment for wastewater generated in the Village of Ayr in the Township of North Dumfries. The Ayr WWTP is comprised of two treatment trains (No. 1 and No. 2), with the first treatment train constructed in 1978 and the second treatment train constructed in 2006. The plant is currently operated under MOECC ECA No. 4800-6GMFXG issued on October 20, 2005, with a rated ADF capacity of 3,000 m³/d and a peak flow capacity of 8,100 m³/d. Raw wastewater is conveyed to the plant via a remote sewage pumping station (SPS), the Rose Street SPS.

The existing unit treatment processes include screening, aerated grit removal, aeration, secondary clarification, tertiary filtration and UV disinfection prior to discharge to the Nith River. Ferric chloride is added to the mixed liquor prior to the secondary clarifiers for phosphorus removal. Waste activated sludge is aerobically digested, with liquid digested sludge stored on-site in the biosolids lagoons prior to land application.

The ECA effluent requirements for the Ayr WWTP are summarized in Table 35.

Table 35 Ayr WWTP Effluent Objectives and Limits (ECA No. 4800-6GMFXG, 2005)

Parameter	Effluent Objectives		Non-Compliance Limits	
	Concentration ⁽¹⁾ (mg/L)	Loading ⁽²⁾ (kg/d)	Concentration ⁽¹⁾ (mg/L)	Loading ⁽²⁾ (kg/d)
CBOD ₅	5.0	15.0	10.0	30.0
TSS	5.0	15.0	10.0	30.0
TP	0.15	0.45	0.25	0.75
TAN (May 1 to Sep. 30)	1.0	3.0	1.5	4.5
TAN (Oct. 1 to Apr. 30)	2.0	6.0	3.0	9.0
<i>E. coli</i> (counts/100 mL) ⁽³⁾	200	-	200	-

Notes:

1. Based on monthly average concentration values.
2. Based on monthly average loading values.
3. Based on monthly geometric mean.

3.6.2 Existing Conditions

Historical Flow

A summary of the historical flow data for the Ayr WWTP over the period 2012 to 2014 is presented in Table 36.

The average raw wastewater flow between 2012 and 2014 was 1,298 m³/d, or approximately 45% of the rated capacity of 3,000 m³/d. The average per capita flow was 270 L/cap·d, which is within a typical range of 225-450 L/cap·d for domestic sewage (MOECC, 2008).

For the capacity assessment presented in Section 3.6.3 of this report, the PDF, PHF and PIF factors of 1.4, 1.9 and 2.7, respectively, were applied.

Table 36 Historic Flow to the Ayr WWTP

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated Capacity (m ³ /d)	3,000	-
ADF (m ³ /d)	1,300 (45%)	-
PDF (m ³ /d)	1,750	1.4 ⁽¹⁾
PHF (m ³ /d)	2,400	1.9 ⁽²⁾
PIF (m ³ /d)	3,500	2.7 ⁽³⁾
Average Per Capita Flow (L/cap·d)	270 ⁽⁴⁾	-

Notes:

1. Based on historic data (January 2012 to December 2014).
2. Assumed based on PDF plus 50% of ADF to allow for diurnal fluctuation.
3. Assumed based on ECA peaking factor.
4. Based on ADF of 1,300 m³/d and a 2014 population of 4,879 provided in the Region's Water and Wastewater Monitoring Report.

Raw Wastewater Characteristics and Loadings

Historic raw influent wastewater concentrations and loadings from 2012 to 2014 are presented in Table 37. The Ayr WWTP receives medium strength wastewater.

Per capita loadings were calculated and compared to the typical values expected for domestic sewage (Metcalf & Eddy, 2003). All of the parameters including CBOD₅, TSS, TP and TKN are lower than the typical per capita loadings.

Historic average monthly influent concentrations and loadings were used in the unit process capacity assessment in Section 3.6.3.

Table 37 Ayr WWTP Raw Wastewater Characteristics and Loadings ⁽¹⁾

Parameter	Average Concentration			Average Loading			
	Historic (mg/L) ⁽¹⁾	Design (mg/L) ⁽²⁾	Typical Value (mg/L) ⁽³⁾	Historic (kg/d) (% of Design Loading)	Design (kg/d) ⁽²⁾	Historic Average Per Capita Loading (g/cap.d) ⁽⁴⁾	Typical Per Capita Loading (g/cap.d) ⁽³⁾
CBOD ₅	190	180	190	250 (45%)	540	50	80
TSS	310	150	210	400 (85%)	460	80	90
TP	6	6	7	7 (35%)	20	1.5	3.2
TKN	40	45	40	50 (40%)	130	10	13

Notes:

1. Based on OCWA Operating and Maintenance Annual Reports (2012-2014).
2. Based on Ayr WWTP Expansion Design Brief (Stantec, 2005).
3. Based on Metcalf & Eddy (2003).
4. Based on average loadings and a 2014 population of 4,879 provided in the Region's 2015 Water and Wastewater Monitoring Report.

Effluent Quality and Performance

The historical effluent quality for the period of 2012 to 2014 is presented in Table 38, along with ECA effluent objectives and compliance limits.

Based on the historical plant effluent quality, the Ayr WWTP has been able to achieve its effluent compliance limits for the historic review period.

The historical effluent wastewater loadings, with respect to CBOD₅, TSS, TP and TAN are also summarized in Table 38. All annual average loadings are within the ECA effluent objectives and non-compliance limits.

Table 38 Ayr WWTP Effluent Quality and Loadings ⁽¹⁾

Parameter	Concentration (mg/L)				Loading (kg/d)			
	Avg.	Peak Month ⁽²⁾	Object.	Limit ⁽³⁾	Avg.	Peak Month ⁽²⁾	Object.	Limit ⁽⁴⁾
CBOD ₅	2.0	2.6	5.0	10.0	2.7	4.1	15.0	30.0
TSS	1.4	2.4	5.0	10.0	1.8	3.0	15.0	30.0
TP	0.09	0.15	0.15	0.25	0.11	0.18	0.45	0.75
TAN (May 1 to Sep. 30)	0.10	0.10	1.0	1.5	0.12	0.14	3.0	4.5
TAN (Oct. 1 to Apr. 30)	0.14	0.40	2.0	3.0	0.19	0.57	6.0	9.0

Notes:

1. Based on OCWA Operating and Maintenance Annual Reports (2012-2014).
2. The highest monthly average value during 36-month period (January 2012 - December 2014).
3. Based on monthly average concentration values.
4. Based on annual average loading during any calendar year.

3.6.3 Process Capacity Assessment

A capacity assessment for the major liquids and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The assessment was based on historical plant operational data, plant design criteria, approved ECA capacities, and typical design guidelines.

Table 39 lists the background data used to estimate the rated capacities for the major processes. Details on the remote Rose Street SPS are provided in Section 3.14.5.

Table 39 Ayr WWTP Major Unit Process Summary

Process		Description	Value
Headworks	Manual Bar Screen	Number	1 duty
		Bar Spacing	38 mm
		Capacity	8,100 m ³ /d
	Vortex Grit Tanks	Number	1
		Capacity	8,100 m ³ /d
Aeration Tanks	Annular Ring Type	Number	2
		Volume (total)	1,372 m ³
		SWD	4.6 m
Blowers (Serving aeration tanks and digesters)	Positive Displacement Blowers	Number	6 (4 duty, 2 standby)
		Capacity (each)	10.3 m ³ /min (Treatment Train No. 1) 20.0 m ³ /min (Treatment Train No. 2)
Secondary Clarifiers	Circular	Number	2
		Surface Area (total)	234 m ²
		SWD	3 m (Treatment Train No. 1) 4 m (Treatment Train No. 2).
Tertiary Filters	Shallow bed	Number	2
		Surface Area (total)	63 m ²
UV Disinfection		Channels	1
		Capacity	8,100 m ³ /d
Digestion	Aerobic Digestion	Number	2 primary
		Volume (total)	1,400 m ³
		SDW	4.5 m

The capacity assessment results of the Ayr WWTP are presented in the PPG in Figure 6.

All unit treatment processes have sufficient capacity for the plant design flow of 3,000 m³/d. A summary of the equivalent ADF capacity of each unit process is presented in Table 40. Based on the preliminary assessment shown in Table 40, overall the Ayr WWTP has an available equivalent ADF capacity of 3,000 m³/d.

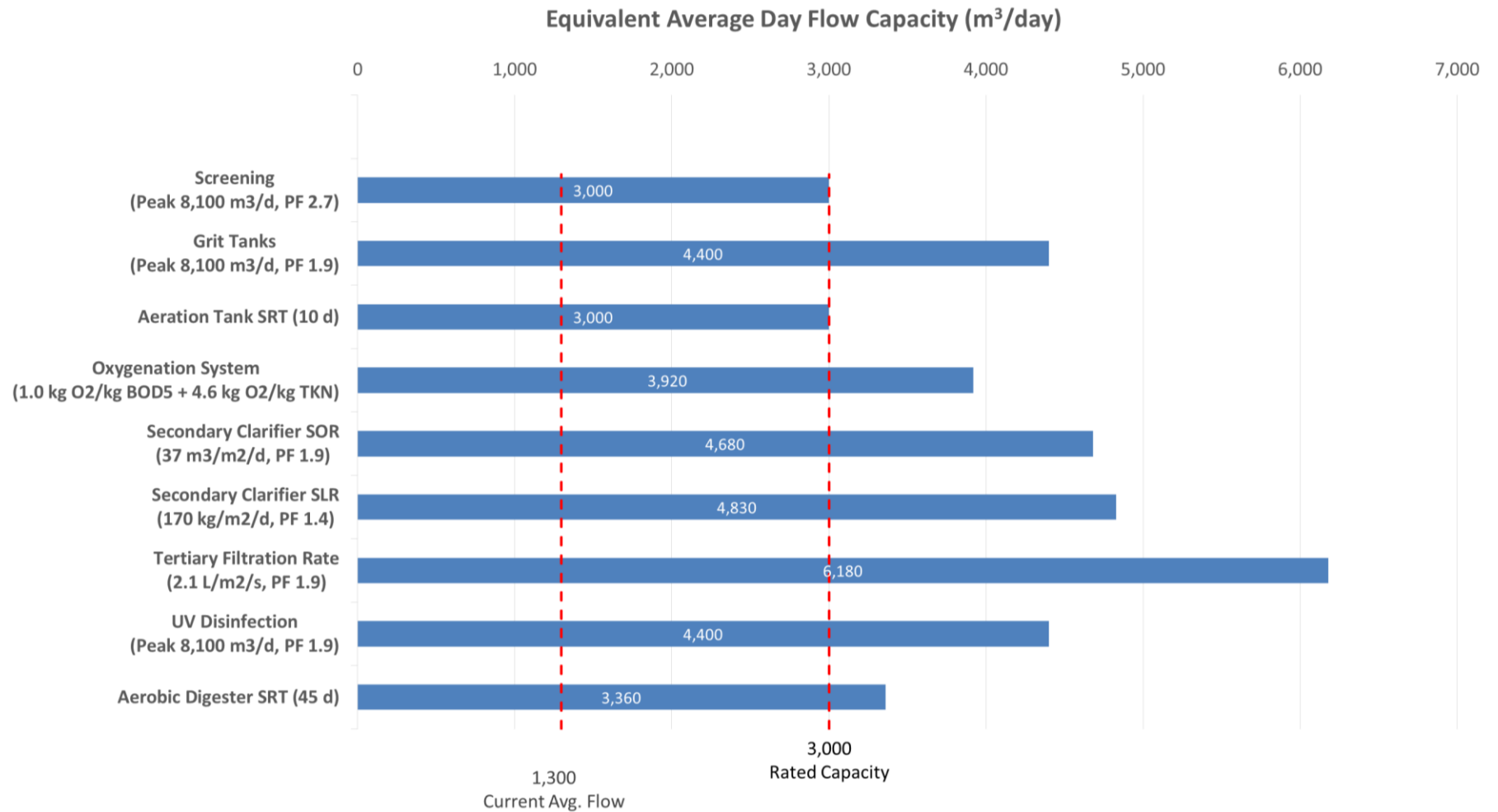


Figure 6 PPG for the Ayr WWTP

Table 40 Preliminary Capacity Assessment Summary, Ayr WWTP

Major Unit Process	Criteria Used	Peak Factor Used	Equivalent ADF Capacity (m ³ /d)
Headworks			
Screens	-	PIF = 2.7	3,000
Grit Tanks	-	PHF = 2.1	4,400
Aeration Tanks			
SRT (days)	10 ⁽¹⁾	ADF	3,000 ⁽²⁾
Oxygenation System			
Oxygen Demand	1.5 kg O ₂ / kg BOD ₅ + 4.6 kg O ₂ /kg TKN	ADF	3,920 ⁽³⁾
Secondary Clarifier			
SOR at PHF (m ³ /m ² /d)	37 ⁽⁴⁾	PHF = 1.9	4,680
SLR at PDF (kg/m ² /d)	170 ⁽⁴⁾	PDF = 1.4	4,830 ⁽⁵⁾
Tertiary Filtration			
Filtration Rate at PHF (L/m ² ·s)	2.1	PHF = 1.9	6,180
UV Disinfection			
Original Peak Design Flow (m ³ /d)	8,100	PHF = 1.9	4,400
Aerobic Digester			
SRT (days)	45 ⁽⁶⁾	ADF	3,360

Notes:

1. Based on the Ayr WWTP Capacity Upgrade Pre-Design Report (Hydromantis/Associated Engineering Joint Venture, 2004).
2. Based on a sludge yield of 0.85 kg TSS/kg BOD₅ for extended aeration activated sludge process with chemical addition for phosphorus removal.
3. Peak oxygen demand with 150% factor of average oxygen demand to account for diurnal fluctuation.
4. Based on MOECC Design Guidelines (2008) for extended aeration activated sludge process with chemical addition to secondary clarifiers.
5. Based on assumed MLSS concentration of 3,500 mg/L and RAS: ADF ratio of 100%.
6. Based on MOECC Design Guidelines (2008) of 45 days of SRT (including both digestion and aeration tanks)

3.6.4 Ongoing and Planned Upgrades

There are currently no ongoing or planned upgrades at the Ayr WWTP.

It should be noted that the Ayr collection system currently is in the design phase for construction of a new raw sewage pumping station (Ayr SPS), to convey wastewater from the new development in the Village of Ayr to the Ayr WWTP. As such, the Ayr

WWTP will have two SPSs that convey all flows to the plant. Therefore, the future capacity requirements of the plant will need to consider not only the population projections but also the SPS operation and capacity with respect to the plant peak flow capacity. The requirements/timing for the capacity expansion of the plant will be based on recommendations from this Master Plan Update project.

3.6.5 Summary

The following points summarize the findings from the historical data review and process capacity assessment for the Ayr WWTP:

- + The Ayr WWTP historically has produced good quality effluent that has met the MOECC effluent limits for the historic review period.
- + There is sufficient capacity at the plant to treat the design flow of 3,000 m³/d.
- + Overall the plant has an available equivalent ADF capacity of 3,000 m³/d.

3.7 New Hamburg WWTP

3.7.1 Facility Overview

The New Hamburg WWTP, originally constructed in 2000, is a sequencing batch reactor (SBR) activated sludge facility that provides treatment for wastewater generated in the communities of Baden and New Hamburg in the Township of Wilmot. The plant is operated under MOECC ECA No. 9330-6G9K5B issued on November 22, 2005, and has a rated ADF capacity of 5,200 m³/d. Raw wastewater is conveyed to the plant via a remote SPS, the Morningside SPS.

The existing unit treatment processes consist of screening, vortex grit removal, SBR secondary treatment, tertiary sand filtration and UV disinfection prior to discharge to the Nith River. Alum is added to the SBR feed channel and/or upstream of the sand filters for phosphorus removal. Waste activated sludge from the SBRs is pumped to the aerobic digesters for stabilization. Biosolids are transferred to a storage lagoon and subsequently beneficially used in agriculture. An on-site emergency storage lagoon is used for temporary storage of plant overflows during wet weather conditions.

Currently, the WWTP is in the process of detailed design for the Phase 2 expansion, which will increase the existing rated ADF capacity from 5,200 m³/d to 6,900 m³/d to

accommodate future community growth (HMM, 2015). The expansion includes replacement of the manual bar screen with an automatic bar screen, construction of a fourth SBR tank, upgrades to aeration blowers, and installation of one additional filter and UV unit.

For the purpose of this TM, the capacity assessment is provided for the Phase 2 upgraded plant, as these upgrades will be constructed within the next three (3) years.

The ECA effluent requirements for the existing New Hamburg WWTP are summarized in Table 41.

Table 41 New Hamburg WWTP Effluent Objectives and Limits (ECA No. 9330-6G9K5B, 2005)

Parameter	Effluent Objectives	Non-Compliance Limits	
	Concentration (mg/L) ⁽¹⁾	Concentration (mg/L) ⁽¹⁾	Loading (kg/d) ⁽²⁾
CBOD ₅	5.0	10.0	52
TSS	5.0	10.0	52
TP	0.2	0.30	1.56
TAN (May 1 to Nov. 30)	0.4	1.0	5.2
TAN (Dec. 1 to Apr. 30)	1.0	2.0	10.4
<i>E. coli</i> (counts/100 mL) ⁽³⁾	-	200	-

Notes:

1. Based on monthly average concentration values.
2. Based on the annual average loading during any calendar year.
3. Based on monthly geometric mean.

3.7.2 Existing Conditions

Historical Flow

A summary of the historical flow data of the New Hamburg WWTP over the period 2012 to 2014 is presented in Table 42.

The average raw wastewater flow between 2012 and 2014 was 3,700 m³/d, or approximately 70% of the existing rated capacity of 5,200 m³/d. The average per capita flow was 290 L/cap·d, which is within a typical range of 225-450 L/cap·d for domestic sewage (MOECC, 2008).

For the capacity assessment for the expanded New Hamburg WWTP in Section 3.7.3, the PDF, PHF and PIF factors of 2.15, 2.78 and 4.4, derived from the Preliminary Design Report (HMM, 2015), were applied. It should be noted that in

HMM's estimates, the peak flows to the WWTP were assumed to be the actual flows to the WWTP, and do not include the flows that may be bypassed to the lagoon.

Table 42 Historic Flow to the New Hamburg WWTP

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor ⁽¹⁾
Rated Capacity (m ³ /d)	6,900 ⁽¹⁾	-
ADF (m ³ /d)	3,700 (55%)	-
PDF (m ³ /d)	8,000	2.15 ⁽²⁾
PHF (m ³ /d)	10,300	2.78 ⁽²⁾
PIF (m ³ /d) to Raw Sewage Pumping Station	16,330	4.40 ⁽³⁾
PIF (m ³ /d) to Screening	15,470	4.17 ⁽⁴⁾
Average Per Capita Flow (L/cap·d)	290 ⁽⁵⁾	-

Notes:

1. Rated capacity of the Phase 2 expanded New Hamburg WWTP (HMM, 2015).
2. Based on the peaking factors in the New Hamburg WWTP Preliminary Design Report (HMM, 2015).
3. The PIFs are based on the Morningside SPS operation/capacity, as all flows are conveyed to the plant via the Morningside SPS.
4. Based on the peaking factor in the New Hamburg WWTP Preliminary Design Report. Peak flows in excess of screening capacity will be diverted to the Emergency Storage Basin (HMM, 2015).
5. Based on a historic ADF of 3,700 m³/d and a 2014 population of 12,787 provided in the Region's 2015 Water and Wastewater Monitoring Report.

Raw Wastewater Characteristics and Loadings

Historic influent wastewater concentrations and loadings are presented in Table 43. It appears that the New Hamburg WWTP receives medium strength wastewater.

Per capita loadings were calculated and compared to the typical values expected for domestic sewage. All of the parameters including CBOD₅, TSS, TP and TKN are lower than the typical per capita loadings. This is probably due to the location of the wastewater autosampler and the impact of the emergency storage lagoon return. It is likely that the wastewater directed to the emergency storage lagoon undergoes some settling within the lagoon and may dilute the influent wastewater.

It is important to note that the above historic raw wastewater quality includes contributions from domestic wastewater and hauled wastewater received at the New

Hamburg WWTP. Currently the Region is conducting a Hauled Wastewater Feasibility Study Update to review management options for hauled wastewater generated within the Region. Based on discussion with the Region, the New Hamburg WWTP is unlikely to receive and treat hauled wastewater after 2018.

Table 43 New Hamburg WWTP Raw Wastewater Characteristics and Loadings⁽¹⁾

Parameter	Average Concentration			Average Loading			
	Historic (mg/L) (1)	Design (mg/L) (2)	Typical Value (mg/L) (3)	Historic (kg/d) (% of Design Loading)	Design (kg/d) (2)	Historic Average Per Capita Loading (g/cap.d) (4)	Typical Per Capita Loading (g/cap.d) (3)
CBOD ₅	160	200	190	590 (40%)	1,350	50	80
TSS	220	220	210	790 (50%)	1,550	60	90
TP	6.0	5.0	7	22 (60%)	35	1.7	3.2
TKN	45	40	40	120 (50%)	220	10	13

Notes:

1. Based on OCWA Operating and Maintenance Annual Reports (2012-2014).
2. Based on New Hamburg WWTP Phase 2 Expansion Preliminary Design Report (HMM, 2015).
3. Based on Metcalf & Eddy (2003)
4. Based on average loadings and a 2014 population of 12,787 provided in the Region's 2015 Water and Wastewater Monitoring Report.

Effluent Quality and Performance

The historical effluent quality for the period of 2012 to 2014 is presented in Table 44, along with ECA effluent objectives and compliance limits.

Based on the historical plant effluent quality, the New Hamburg WWTP achieved its effluent compliance limits, with the exception of the following:

- ✦ The TSS monthly average concentration exceeded the ECA compliance limit in February 2014, due to an upset condition experienced at the plant.
- ✦ The TAN monthly average concentration exceeded the ECA compliance limit in August 2014, due to a bypass event, which occurred over the weekend resulting from a control failure and blower malfunction of SBR No. 3. Action taken in response included temporarily removing SBR No. 3 from service to allow replacement of blown control line.

The historical effluent wastewater loadings, with respect to CBOD₅, TSS, and TP are also summarized in Table 44. All annual average loadings are within the ECA effluent objectives and non-compliance limits.

Table 44 New Hamburg WWTP Effluent Quality and Loadings ⁽¹⁾

Parameter	Concentration (mg/L)				Loading (kg/d)			
	Avg.	Peak Month (2)	Object.	Limit (3)	Avg.	Peak Month (2)	Object.	Limit (4)
CBOD ₅	2.15	4.25	5.0	10.0	7.8	12.9	26	52
TSS	2.77	11.80	5.0	10.0	10.1	35.7	26	52
TP	0.11	0.25	0.2	0.30	0.40	0.79	1.04	1.56
TAN (May 1 to Nov. 30)	0.21	1.94	0.4	1.0	0.69	5.89	2.08	5.2
TAN (Dec. 1 to Apr. 30)	0.14	0.50	1.0	2.0	0.63	2.80	5.2	10.4

Notes:

1. Based on OCWA Operating and Maintenance Annual Reports (2012-2014).
2. The highest monthly average value during 36 month period (January 2012 - December 2014).
3. Based on monthly average concentration values.
4. Based on annual average loading during any calendar year.

3.7.3 Process Capacity Assessment

A capacity assessment for the major liquids and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The assessment was based on historical plant operational data, plant design criteria, approved ECA capacities, and typical design guidelines.

Table 45 lists the background data used to estimate the rated capacities for the major processes. The unit process capacity assessment is for the Phase 2 expanded New Hamburg WWTP, which is currently in the detailed design phase and will be constructed within the next three (3) years.

Flow to the plant is from a remote SPS (the Morningside SPS). Details on the Morningside SPS are provided in Section 3.14.4.

Table 45 New Hamburg WWTP Major Unit Process Summary

Process		Description	Value
Headworks	Fine Bar Screen (mechanically cleaned) ⁽¹⁾	Number	2
		Bar Spacing	10 mm
		Capacity (total)	28,800 m ³ /d
	Aerated Grit Tanks	Number	2 (duty)
		Capacity (total)	19,200 m ³ /d
Bioreactors ⁽¹⁾	Sequencing batch reactors	Number	4 (3 existing, 1 new)
		Volume (total)	10,125 m ³ (at top water level) 7,594 m ³ (at bottom water level)
		SWD	5 m (top water level) 3.75 m (bottom water level)
Blowers ⁽¹⁾	Positive displacement blowers	Number	4 (3 existing, 1 new)
		Capacity (per blower)	34 m ³ /d
Tertiary Filter ⁽¹⁾	Deep bed	Number	4 (3 existing ,1 new)
		Surface area (total)	74.4 m ²
		Peak Flow Capacity (total)	21,213 m ³ /d
Disinfection ⁽¹⁾	UV disinfection	Number of channels	3
		Peak Flow Capacity (total)	21,600 m ³ /d
Digestion	Aerobic Digesters	Number	2
		Volume (total)	6,530 m ³

Notes:

1. The unit processes of the Phase 2 expanded plant with a design ADF of 6,900 m³/d (HMM, 2015).

The capacity assessment results of the New Hamburg WWTP are presented in the PPG in Figure 7.

Upon the completion of the Phase 2 expansion, all unit treatment processes provide sufficient capacity for the Phase 2 design flow of 6,900 m³/d.

The aerobic digesters are sufficient for the design capacity of the plant. However, it should be noted that under the current strategy of the dual use of the existing digesters for both digestion and storage, the capacity of the digester is insufficient for future load, even with no outside biosolids (AECOM, June 2011). Sludge management following digestion at the New Hamburg WWTP is currently being reviewed as part of the Region's parallel Biosolids Strategy development.

A summary of the equivalent ADF capacity of each unit process is presented in Table 46. Overall the New Hamburg WWTP will have an available equivalent capacity of 6,900 m³/d, upon the completion of the Phase 2 expansion.

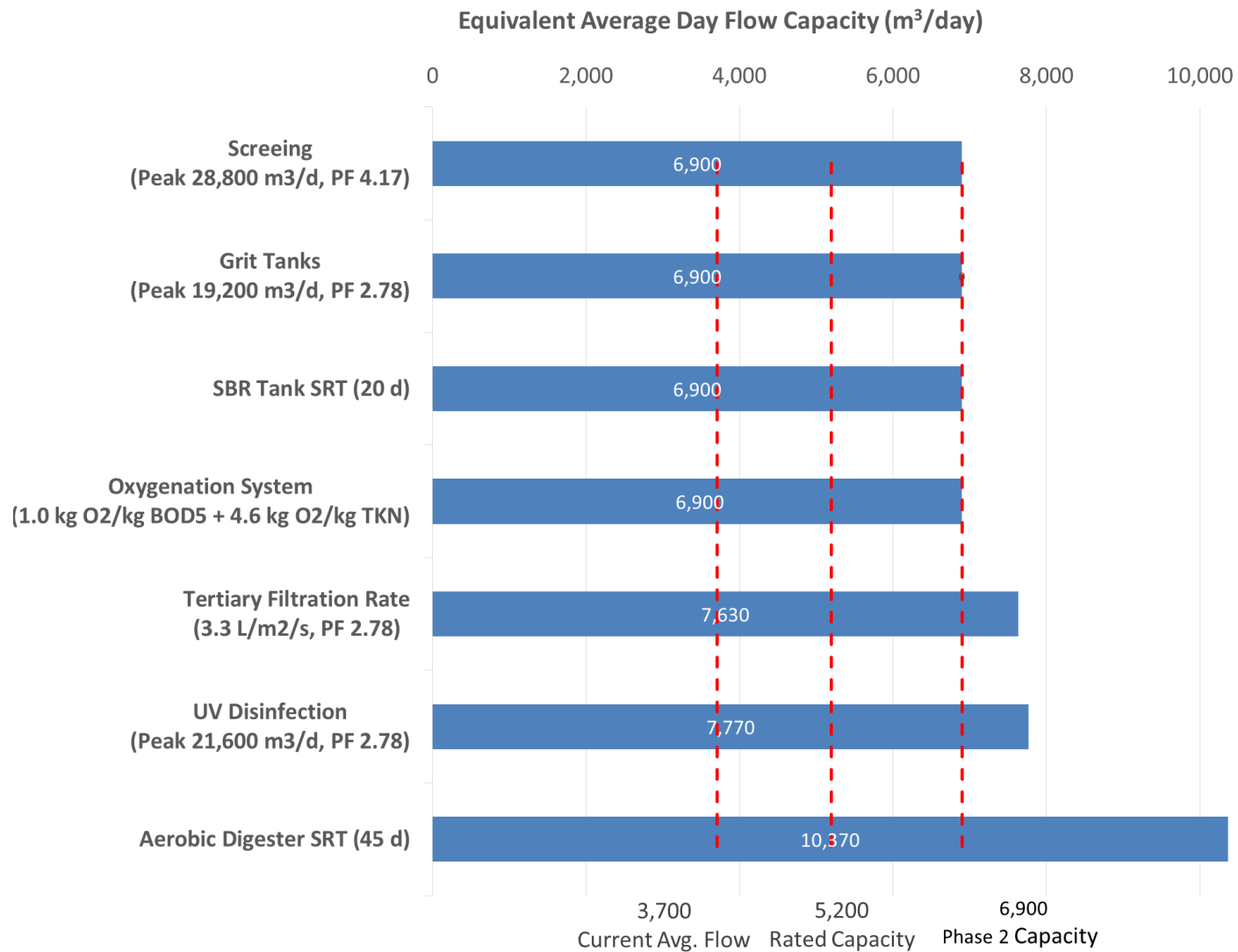


Figure 7 PPG for the New Hamburg WWTP

Table 46 Capacity Assessment Summary, New Hamburg WWTP

Major Unit Process	Criteria Used	Peak Factor Used	Equivalent ADF Capacity (m ³ /d)
Headworks Screens Grit Tanks	- -	PIF = 4.17 PHF = 2.78	6,900 7,520
SBR Tanks SRT (days)	20 ⁽¹⁾	ADF	6,900 ⁽³⁾
Oxygenation System Oxygen Demand	1.5 kg O ₂ /kg BOD ₅ + 4.6 kg O ₂ / kg TKN	ADF	6,900 ⁽³⁾
Tertiary Filtration Filtration Rate at PHF (L/m ² .s)	3.3	PHF = 2.78	7,630
UV Disinfection Original Peak Design Flow (m ³ /d)	21,600 ⁽²⁾	PHF = 2.78	7,770
Aerobic Digester SRT (days)	45 ⁽³⁾	ADF	10,370

Notes:

1. Based on Metcalf & Eddy (2003). The SRT is typical for a nitrifying SBR facility.
2. Based on the New Hamburg WWTP Phase 2 Expansion Final Preliminary Design Report (HMM, 2015).
3. Based on MOECC Design Guidelines (2008). 45 days of SRT including both in digestion and aeration tanks.

3.7.4 Ongoing and Planned Upgrades

The Region has recently completed a Schedule C Class Environmental Assessment (EA) (XCG, January 2015) and Preliminary Design (HMM, 2015) for the Phase 2 expansion of the New Hamburg WWTP that built upon the Baden and New Hamburg WWTP Master Plan Update completed in 2011 (AECOM, June 2011).

The Phase 2 expansion will increase the plant rated capacity to 6,900 m³/d from 5,200 m³/d and is currently in the detailed design phase. The expansion includes (HMM, 2015):

- + Headworks: replace manual bar screen with automated one;
- + Secondary treatment: construct one additional SBR tank;
- + Oxygenation system: expansion of SBR and aerobic digester blower capacity;

- + Tertiary sand filters: install one additional filter;
- + UV disinfection system: install one additional UV unit.

These upgrades will be constructed within the next three (3) years.

3.7.5 Summary

The following points summarize the findings from the historical data review and process capacity assessment for the New Hamburg WWTP:

- + The New Hamburg WWTP has been able to achieve its effluent compliance limits for the historic review period, with the exception of the TAN monthly average concentration in August 2014 due to an equipment failure.
- + All the treatment units at the plant will have sufficient capacity to handle the Phase 2 design flow of 6,900 m³/d, upon the completion of the Phase 2 expansion. The overall available equivalent ADF capacity will be 6,900 m³/d.
- + The dual use of the aerobic digesters for digestion and storage has resulted in a bottleneck at the plant. With the current plan to locate a hauled waste receiving station elsewhere in the Region, this bottleneck may be alleviated.
- + The expansion of the plant to 6,900 m³/d is currently in the detailed design phase and the upgrades will be constructed within the next three (3) years.

3.8 Wellesley WWTP

3.8.1 Facility Overview

The Wellesley WWTP is an extended aeration (EA) package plant that provides treatment for wastewater generated in the Township of Wellesley. The Wellesley WWTP is comprised of two package plants (Plant No. 1 and No. 2), with the first package plant constructed in 1973 and the second package plant constructed in 1993. The WWTP is currently operated under MOECC ECA No. 3-0048-91-006 issued on May 15, 1991, with a rated ADF capacity of 1,100 m³/d.

The existing unit treatment processes include screening, aeration, secondary clarification, tertiary filtration and ozone disinfection prior to discharge to the Nith River. Alum is added to aeration tank effluent for phosphorus removal. WAS is stored

in an aerated sludge holding tank prior to being hauled to the Waterloo WWTP for further processing.

The ECA effluent requirements for the Wellesley WWTP are summarized in Table 47. The plant is required to meet stringent effluent ammonia nitrogen (TAN of 0.75 mg/L) and phosphorus (TP of 0.5 mg/L) limits.

Table 47 Wellesley WWTP Existing ECA Effluent Objectives and Limits (ECA No. 3-0048-91-006, 1991)

Parameter	Effluent Objectives		Non-Compliance Limits	
	Concentration (mg/L)	Loading (kg/d)	Concentration (mg/L)	Loading (kg/d)
CBOD ₅	10 ⁽²⁾	11.0 ⁽²⁾	15 ⁽¹⁾	16.5 ⁽¹⁾
TSS	10 ⁽²⁾	11.0 ⁽²⁾	15 ⁽¹⁾	16.5 ⁽¹⁾
TP	0.5 ⁽¹⁾	0.55 ⁽¹⁾	0.5 ⁽¹⁾	0.55 ⁽¹⁾
TAN	0.5 ⁽²⁾	0.55 ⁽²⁾	0.75 ⁽¹⁾	0.82 ⁽¹⁾
<i>E. coli</i> (counts/100 mL) ⁽³⁾	200	-	200	-

Notes:

1. Based on monthly average concentration and/or loading.
2. Based on annual average concentration and/or loading during any calendar year.
3. Based on monthly geometric mean.

3.8.2 Existing Conditions

Historical Flow

A summary of the historical flow data for the Wellesley WWTP over the period 2012 to 2014 is presented in Table 48.

The average raw wastewater flow between 2012 and 2014 was 870 m³/d, or approximately 80% of the rated capacity of 1,100 m³/d. The average per capita flow was 266 L/cap·d, which is within the typical range of 225-450 L/cap·d for domestic sewage (MOECC, 2008).

For the capacity assessment in Section 3.8.3 of this report, the PDF, PHF and PIF factors of 3.5, 4.0 and 4.0, respectively, were applied.

Table 48 Historic Flow to the Wellesley WWTP

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated Capacity (m ³ /d)	1,100	-
ADF (m ³ /d)	870 (80%)	1.0
PDF (m ³ /d)	3,100	3.5 ⁽¹⁾
PHF (m ³ /d)	3,500	4.0 ⁽²⁾
PIF (m ³ /d)	3,500	4.0 ⁽²⁾
Average Per Capita Flow (L/cap·d)	270 ⁽³⁾	-

Notes:

1. Based on historic data (January 2012 – December 2014).
2. Assumed based on ECA peaking factor and Operation and Maintenance Manual of the Wellesley WWTP (1992).
3. Based on ADF of 870 m³/d and a 2014 population of 3,270 provided in the Region's 2015 Water and Wastewater Monitoring Report.

Raw Wastewater Characteristics and Loadings

Historic raw influent wastewater concentrations and loadings from 2012 to 2014 are presented in Table 49. The Wellesley WWTP receives medium strength wastewater. Per capita loadings were calculated and compared to the typical values expected for domestic sewage. All of the parameters including CBOD₅, TSS, TP and TKN are lower than the typical per capita loadings.

Historic average monthly influent concentrations and loadings were used in the unit process capacity assessment in Section 3.8.3.

Effluent Quality and Performance

The historical effluent quality for the period of 2012 to 2014 is presented in Table 50, along with ECA effluent objectives and compliance limits.

Based on the historical plant effluent quality, the Wellesley WWTP has been able to achieve its effluent compliance limits, except one elevated value for TAN in March 2012 due to an air supply line failure in Plant No. 1. Repair was made to the air supply line and compliance had been restored in April 2012.

The historical effluent wastewater loadings, with respect to CBOD₅, TSS, TP and TAN are also summarized in Table 50. All annual average loadings are within the ECA non-compliance limits.

Table 49 Wellesley WWTP Raw Wastewater Characteristics and Loadings ⁽¹⁾

Parameter	Average Concentration			Average Loading			
	Historic (mg/L) ⁽¹⁾	Design (mg/L) ⁽²⁾	Typical Value (mg/L) ⁽³⁾	Historic (kg/d) (% of Design Loading)	Design (kg/d) ⁽²⁾	Historic Average Per Capita Loading (g/cap.d) ⁽⁴⁾	Typical Per Capita Loading (g/cap.d) ⁽³⁾
CBOD ₅	160	140	190	130 (85%)	150	40	80
TSS	220	170	210	180 (95%)	190	60	90
TP	6	5	7	5 (90%)	6	1.5	3.2
TKN	30	28	40	28 (85%)	33	10	13

Notes:

1. Based on OCWA Operating and Maintenance Annual Reports (2012-2014).
2. Based on Wellesley Wastewater Treatment Plant - Process and Condition Assessment (Stantec, 2015). The design values are 50th percentile values.
3. Based on Metcalf & Eddy (2003).
4. Based on average loadings and a 2014 population of 3,270 provided in the Region's 2015 Water and Wastewater Monitoring Report.

Table 50 Wellesley WWTP Effluent Quality and Loadings ⁽¹⁾

Parameter	Concentration (mg/L)				Loading (kg/d)			
	Avg.	Peak Month ⁽²⁾	Object.	Limit	Avg.	Peak Month ⁽²⁾	Object.	Limit
CBOD ₅	3.1	6.3	10 ⁽⁴⁾	15 ⁽³⁾	2.8	9.7	11.0 ⁽⁴⁾	16.5 ⁽³⁾
TSS	3.7	11.8	10 ⁽⁴⁾	15 ⁽³⁾	3.4	13.7	11.0 ⁽⁴⁾	16.5 ⁽³⁾
TP	0.1	0.4	0.5 ⁽³⁾	0.5 ⁽³⁾	0.12	0.36	0.55 ⁽³⁾	0.55 ⁽³⁾
TAN	0.2	1.02	0.5 ⁽⁴⁾	0.75 ⁽³⁾	0.18	0.80	0.55 ⁽⁴⁾	0.82 ⁽³⁾

Notes:

1. Based on OCWA Operating and Maintenance Annual Reports (2012-2014).
2. The highest monthly average value during 36-month period (January 2012 - December 2014).
3. Based on monthly average concentration values.
4. Based on annual average loading during any calendar year.

3.8.3 Process Capacity Assessment

A capacity assessment for the major liquids and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The assessment was based on historical plant operational data, plant design criteria,

approved ECA capacities, and typical design guidelines. Table 51 lists the background data used to estimate the rated capacities for the major processes.

Table 51 Wellesley WWTP Major Unit Process Summary

Process		Description	Value
Raw Sewage Pumping Station	Wet Well	Dimension	1.83 m in diameter and 8.6 m in depth
		Live Volume	18 m ³
		Number	2 (1 duty, 1 standby)
		Capacity (per pump)	52 L/s at 12.5 m TDH
		Capacity (Firm)	52 L/s (4,400 m ³ /d)
Headworks	Coarse Bar Screen (Manual)	Number	1
		Bar Spacing	12 mm
		Peak flow capacity (total)	6,400 m ³ /d
Aeration Tanks	Plant No. 1 (Annular Ring)	Number	1
		Volume (total)	490 m ³
		SWD	4.5 m
	Plant No. 2 (Annular Ring)	Number	1
		Volume (total)	509 m ³
		SWD	4.5 m
Blowers		Number	3 (2 duty, 1 standby)
		Capacity (each)	9.6 m ³ /min of air at 150 kPa
Secondary Clarifiers	Plant No. 1 (Circular)	Number	1
		Surface Area (total)	38.5 m ²
		SWD	4.5 m
	Plant No. 2 (Circular)	Number	1
		Surface Area (total)	64 m ²
		SWD	4.5 m
Tertiary Filters	Deep bed sand filters	Number	4
		Surface Area (total)	18.6 m ³
Disinfection	Ozonation	Number of Ozone Generator	2
		Capacity (each)	22.7 kg ozone/day
Sludge Handling	Aerated Sludge Storage Tank	Number	1
		Volume (total)	72 m ³
		SDW	4 m

The capacity assessment results of the Wellesley WWTP are presented in the PPG in Figure 8.

All the unit treatment processes have sufficient capacity for the current flows and the plant design flow, with the exception of secondary clarification capacity which is slightly less than the plant design flow. This is due to the high infiltration/inflow (I/I) experienced at the plant, which results in high wet weather flows and higher peak factors (i.e. a PHF of 4.0) than typical design values. It should be noted that capacity assessment was based on the observed actual peak flows and peak factors.

If I/I is reduced, additional secondary clarification capacity would be available. However, I/I reductions can be difficult to achieve and challenging to quantify the impacts on treatment capacity improvements in advance. Contingency recommendations on I/I reduction will be provided in later memos within the WWTMP.

A summary of the equivalent ADF capacity of each unit process is presented in Table 52. Overall the Wellesley WWTP has an available equivalent ADF capacity slightly less than the design flow of 1,100 m³/d, limited by secondary clarification.

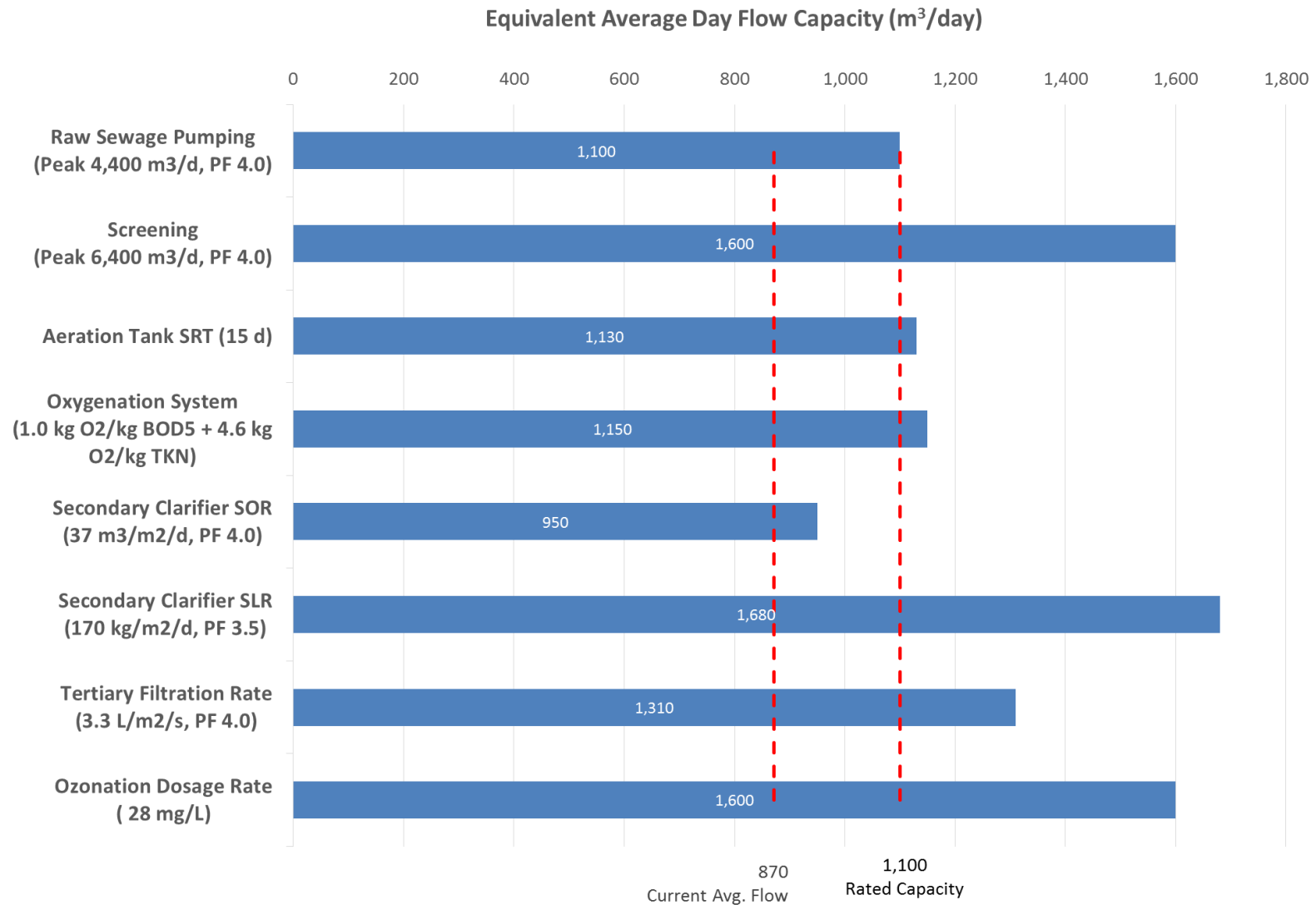


Figure 8 PPG for the Wellesley WWTP

Table 52 Capacity Assessment Summary, Wellesley WWTP

Major Unit Process	Criteria Used	Peak Factor Used	Equivalent ADF Capacity (m ³ /d)		
			Plant A	Plant B	Total
Raw Sewage Pumping Pumps	-	PIF = 4.0	-	-	1,100
Headworks Screens	-	PIF = 4.0	-	-	1,600
Aeration Tanks Solids Retention Time (days) ⁽¹⁾	15	ADF	548	569	1,120
Oxygenation System Oxygen Demand ⁽²⁾	1.5 kg O ₂ /kg BOD ₅ + 4.6 kg O ₂ /kg TKN - 2.86 kg O ₂ /kg NO ₃	ADF	568	568	1,140
Secondary Clarifier Surface Overflow Rate at PHF (m ³ /m ² /d) Surface Loading Rate at PDF (kg/m ² /d)	37 ⁽³⁾	PHF = 4.0	385	640	950
	170 ⁽³⁾	PDF = 3.5	633 ⁽⁴⁾	1051 ⁽⁴⁾	1,680
Tertiary Filtration Filtration Rate at PHF (L/m ² ·s)	3.3	PHF = 4.0	-	-	1,310
Ozone Disinfection Ozone Dosage (mg/L) at ADF	28 ⁽⁵⁾	ADF	-	-	1,600
Sludge Holding Tank Liquid Sludge Storage Time (days)	5	ADF	-	-	1,100

Notes:

1. Based on a sludge yield of 0.85 kg TSS/kg BOD₅ for extended aeration activated sludge process with chemical addition for phosphorus removal.
2. Peak oxygen demand with 150% factor of average oxygen demand to account for diurnal fluctuation. An oxygen credit of 2.86 kg O₂/kg NO₃ (Metcalf & Eddy, 2003) was applied for the denitrification process at the plant.
3. Based on MOECC Design Guidelines (2008) for extended aeration activated sludge process with chemical addition for phosphorus removal.
4. Based on assumed MLSS concentration of 2,300 mg/L and RAS: ADF ratio of 100%.
5. Based on the Wellesley WWTP Operation and Maintenance Manual 1992 and Wellesley WWTP Expansion: Phase 1 Pre-Design Report (Stanley, 1990).

3.8.4 Condition Assessment Findings

The Wellesley WWTP was constructed in approximately in 1973 as a single unit extended aeration package plant, and was duplicated in 1993. The 1993 upgrades also included a headworks building, process operations building (chemical storage, tertiary filters and disinfection) and sludge holding tank. The plant has undergone a number of upgrades through the years including construction of standby power system and SCADA upgrades in 2013/2014.

An inventory and condition assessment of all existing assets for the Wellesley WWTP have recently been completed, as part of the Region's Asset Management Implementation Project (Stantec, 2015/2016). The results of this study are summarized in Table 53, which provided the Region with an up-to-date asset inventory of the Wellesley WWTP, including a 25-year forecast for replacement and repair for all major assets.

Table 53 Summary of Wellesley WWTP Condition Assessment ⁽¹⁾

Process	Physical Condition
Raw Sewage Pumping Station	✖ Equipment near the end of its service life
Headworks	✖ Equipment near the end of its service life ✖ Limited hydraulic capacity at the manual bar screen and within the v-notch weir flow splitter box.
Secondary Treatment	✖ Equipment near the end of its service life. Needs refurbishment or replacement ✖ Aeration diffusers are coarse bubble diffusers. Could be replaced with fine bubble diffusers to improve efficiency.
Tertiary Filtration	✖ Tertiary filters near the end of their service life and lack of redundancy. To be replaced with cloth media filter system ⁽²⁾
Ozone	✖ Equipment near the end of its service life.
WAS and Sludge Storage	✖ Equipment near the end of its service life. Needs replacement

Notes:

1. Based on the Wellesley WWTP Condition Assessment Report (Stantec, 2016).
2. Based on Conestogo and Wellesley WWTPs Filter Upgrades Conceptual Design Report (CH2M, 2015).

3.8.5 Ongoing and Planned Upgrades

The Wellesley WWTP is currently in the design phase for tertiary filter upgrades to improve operability and maintain the WWTP effluent quality in accordance with the ECA. The existing filters will be replaced with cloth media filters with a design ADF of 1,100 m³/d and a peak flow of 4,400 m³/d (CH2M Hill, 2015).

3.8.6 Summary

The following points summarize the findings from the historical data review and process capacity assessment for the Wellesley WWTP:

- + The Wellesley WWTP historically has produced good quality effluent that has met the compliance limits for the historic review period, except one elevated value for TAN in March 2012 due to an air supply line failure at the plant.
- + The plant is limited to slightly less than the design flow of 1,100 m³/d, due to limited secondary clarification capacity. The reduced secondary clarifier capacity is a result of high I/I experienced at the plant. If I/I is reduced, the capacity may be gained.
- + Ongoing upgrades for the plant include:
 - Tertiary filter upgrades

3.9 St Jacobs WWTP

3.9.1 Facility Overview

The St Jacobs WWTP is an oxidation ditch extended aeration plant that provides treatment for wastewater generated in the Town of St Jacobs located in the Township of Woolwich. The St Jacobs WWTP was originally constructed in 1971, and was expanded in 2000. The plant is operated under MOECC ECA No. 1047-94FHWA issued on March 22, 2013, and has a rated ADF capacity of 1,450 m³/d.

The existing unit treatment processes include screening, vortex grit removal, aeration, secondary clarification, tertiary filtration and UV disinfection prior to discharge to the Conestogo River. Alum is added both upstream and downstream of the secondary clarifiers for phosphorus removal. WAS is stored in the aerated sludge holding tank prior to being hauled to the Waterloo WWTP for further processing.

The ECA effluent requirements for the St Jacobs WWTP are summarized in Table 54.

Table 54 St Jacobs WWTP Existing ECA Effluent Objectives and Limits (ECA No. 1047-94FHWA, 2013)

Parameter	Effluent Objectives	Non-Compliance Limits	
	Concentration (mg/L) ⁽¹⁾	Concentration (mg/L) ⁽¹⁾	Loading (kg/d) ⁽²⁾
CBOD ₅	5.0	10.0	14.5
TSS	5.0	10.0	14.5
TP	0.2	0.30	0.44
TAN (May 1 to Oct. 30)	0.7	1.0	1.5
TAN (Nov. 1 to Apr. 30)	1.0	2.0	2.9
<i>E. coli</i> (counts/100 mL) ⁽³⁾	100	200	-
Notes: 1. Based on monthly average concentration values. 2. Based on the annual average loading during any calendar year. 3. Based on monthly geometric mean.			

Notes:

1. Based on monthly average concentration values.
2. Based on the annual average loading during any calendar year.
3. Based on monthly geometric mean.

3.9.2 Existing Conditions

Historical Flow

A summary of the historical flow data of the St Jacobs WWTP over the period 2012 to 2014 is presented in Table 55.

The average raw wastewater flow between 2012 and 2014 was 920 m³/d, or approximately 65% of the rated capacity of 1,450 m³/d. The average per capita flow was 496 L/cap·d, which is higher than a typical range of 225-450 L/cap·d for domestic sewage. This is attributed to the historical I/I issues at the plant. A joint program was undertaken by the Region and the Township from 1997 to 2007 to target reductions in extraneous flows (St Jacob's I/I Reduction Program). Although some upgrades were completed in the collection system, I/I contributions are still present and likely related to extraneous flows from private services. If the I/I issues are addressed and extraneous flows are reduced, per capita flows would be reduced and capacity may be gained at the plant.

For the capacity assessment in Section 3.9.3 of this TM, the PDF, PHF and PIF factors of 2.8, 3.3 and 3.6, respectively, were applied.

Table 55 Historic Flow to the St Jacobs WWTP

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated Capacity (m ³ /d)	1,450	-
ADF (m ³ /d)	920 (65%)	-
PDF (m ³ /d)	2,600	2.8 ⁽¹⁾
PHF (m ³ /d)	3,100	3.3 ⁽²⁾
PIF (m ³ /d)	3,300	3.6 ⁽³⁾
Average Per Capita Flow (L/cap·d)	500 ⁽⁴⁾	-

Notes:

1. Based on historic data (January 2012 to December 2014).
2. Assumed based on PDF plus 50% of ADF to allow for diurnal variations.
3. Estimated based on on-site pumping station rated capacity and plant rated capacity.
4. Based on ADF of 920 m³/d and a 2014 population of 1,858 provided in the Region's 2015 Water and Wastewater Monitoring Report.

Raw Wastewater Characteristics and Loadings

Historic raw influent wastewater concentrations and loadings from 2012 to 2014 are presented in Table 56. The raw wastewater entering the St Jacobs WWTP includes wastewater primarily from domestic and commercial sources. There are no large industrial contributors located in St Jacobs. The raw wastewater concentrations are representative of a low to medium strength wastewater (Metcalf & Eddy, 2003). This may be attributed to the significant I/I issues experienced at the plant, resulting in the dilution of the raw wastewater.

Per capita loadings were calculated and compared to the typical values expected for domestic sewage (Metcalf & Eddy, 2015). It shows that the CBOD₅ and TP per capita loadings were lower than the typical values, and TSS and TKN per capita loadings were higher than the typical values.

Table 56 St. Jacob WWTP Raw Wastewater Characteristics and Loadings ⁽¹⁾

Parameter	Average Concentration			Average Loading			
	Historic (mg/L) ⁽¹⁾	Design (mg/L) ⁽²⁾	Typical Value (mg/L) ⁽³⁾	Historic (kg/d) (% of Design Loading)	Design (kg/d) ⁽²⁾	Historic Average Per Capita Loading (g/cap.d) ⁽⁴⁾	Typical Per Capita Loading (g/cap.d) ⁽³⁾
CBOD ₅	120	160	190	110 (45%)	230	60	80
TSS	220	220	210	200 (60%)	320	110	90
TP	5.0	5.0	7	5 (60%)	8	2.6	3.2
TKN	35 (34)	35 (36)	40	30 (60%)	50	16	13

Notes:

1. Based on OCWA Operating and Maintenance Annual Reports (2012-2014).
2. Based on St Jacobs Wastewater Treatment Plant: Preliminary Design Report (Stanley Consulting, 1998)
3. Based on Metcalf & Eddy (2003).
4. Based on average loadings and a 2014 population of 1,858 provided in the Region's 2015 Water and Wastewater Monitoring Report.

Effluent Quality and Performance

The historical effluent quality for the period of 2012 to 2014 is presented in Table 57, along with ECA effluent objectives and compliance limits. Based on the historical plant effluent quality, the St Jacobs WWTP has consistently met its effluent compliance limits except one elevated value in January 2014 for TAN. This was due to extreme cold temperature experienced in January, which negatively affected the nitrification performance of the oxidation ditch. A process adjustment has been made to improve treatment in maintaining a higher concentration of solids to promote biomass activity, which along with the increasing seasonal temperature enabled the facility to return to compliance.

The historical effluent wastewater loadings, with respect to CBOD₅, TSS, TP and TAN are also summarized in Table 57. All annual average loadings are within the ECA effluent objectives and non-compliance limits.

Table 57 St Jacobs WWTP Effluent Quality and Loadings ⁽¹⁾

Parameter	Concentration (mg/L)				Loading (kg/d)			
	Avg.	Peak Month (2)	Objective	Limit (3)	Avg.	Peak Month (2)	Objective	Limit (4)
CBOD ₅	1.7	2.0	5.0	10.0	1.5	3.5	7.3	14.5
TSS	1.6	3.0	5.0	10.0	1.4	3.8	7.3	14.5
TP	0.07	0.13	0.2	0.30	0.06	0.14	0.29	0.44
TAN (May 1 to Oct. 30)	0.14	0.32	0.7	1.0	0.11	0.28	1.0	1.5
TAN (Nov. 1 to Apr. 30)	0.42	2.31	1.0	2.0	0.41	2.02	1.5	2.9

Notes:

1. Based on OCWA Operating and Maintenance Annual Report (2012-2014).
2. The highest monthly average value during 36-month period (January 2012 - December 2014).
3. Based on monthly average concentration values.
4. Based on annual average loading during any calendar year.

3.9.3 Process Capacity Assessment

A capacity assessment for the major liquids and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The assessment was based on historical plant operational data, plant design criteria, approved ECA capacities, and typical design guidelines.

Table 58 lists the background data used to estimate the rated capacities for the major processes.

The capacity assessment results of the St Jacobs WWTP are presented in the PPG in Figure 9. Overall, all the treatment processes provide sufficient capacity for the current and design flow, with the exception of the tertiary filtration and UV disinfection.

The reduced tertiary filtration and UV disinfection capacity compared to the design flow is due to the significant I/I issue experienced at the plant, which results in high wet weather flows and high hydraulic loadings to the filters and UV disinfection system. A higher historic peak factor (i.e. a PHF of 3.3) than original design value was applied when determining the equivalent ADF capacity of these processes.

Table 58 St Jacobs WWTP Major Unit Process Summary

Process		Description	Value
Raw Sewage Pumping Station	Pumps	Number	3 (2 duty, 1 standby)
		Capacity (per pump)	42.0 L/s at 11 m TDH
		Capacity (Firm)	60 L/s (5,180 m ³ /d) ⁽¹⁾
Headworks	Grinder/Auger Screen	Number	2 (1 duty, 1 standby)
		Capacity	5,676 m ³ /d
	Vortex Grit Tanks	Number	1
		Capacity	5,184 m ³ /d
Bioreactor	Oxidation Ditch	Number	1
		Volume (total)	904 m ³
Mechanical Aerator	Rotor	Number	2
		Oxygen Transfer Capacity (total)	1,286 kg O ₂ /d ⁽¹⁾
Secondary Clarifiers	Circular	Number	2
		Surface Area (total)	208 m ²
Tertiary Filters	Deep bed	Number	3
		Surface Area (total)	13.9 m ³
Disinfection	UV disinfection	Number of channels	1
		Capacity	3,625 m ³ /d
Sludge Handling	Aerated Sludge Holding Tank	Number	1
		Volume (total)	195 m ³
		SDW	1.96

Notes:

1. Based on St Jacobs – Elmira Wastewater Treatment Master Plan (XCG, 2013).

A joint program was undertaken by the Region and the Township from 1997 to 2007 to target reductions in extraneous flows (St Jacobs I/I Reduction Program). Although some upgrades were completed in the collection system, I/I contributions are still present and likely related to extraneous flows from private services. If the I/I issues are addressed in the future and extraneous flows are reduced, capacity of tertiary filtration and UV disinfection may be gained at the plant.

It should be noted that I/I reductions can be difficult to achieve and challenging to quantify the impacts on treatment capacity improvements in advance. Contingency recommendations on I/I reduction will be provided in later memos within the WWTMP.

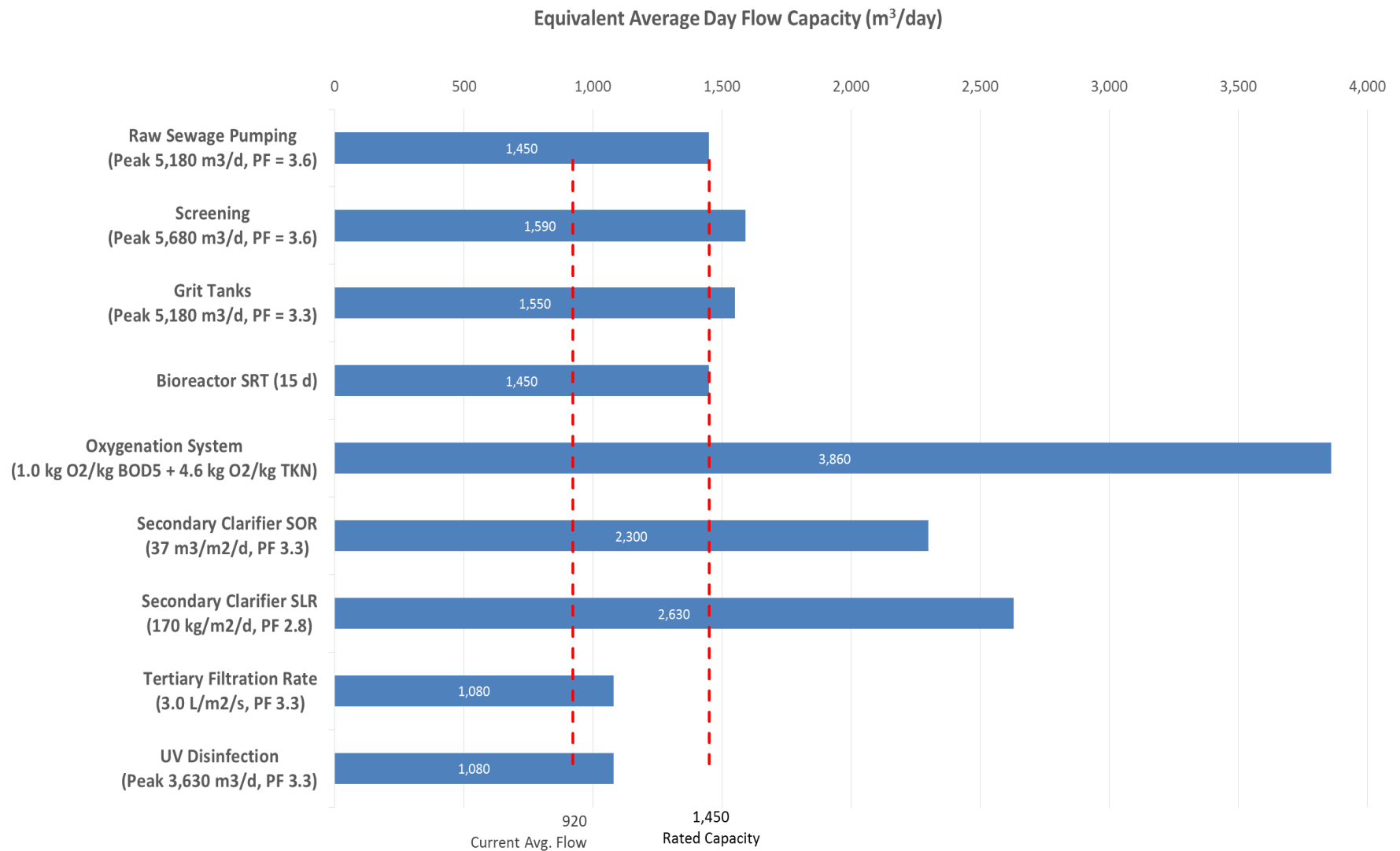


Figure 9 PPG for the St Jacobs WWTP

A summary of the estimated equivalent ADF capacity of each unit process is presented in Table 59. Overall the St Jacobs WWTP has an available ADF capacity of 1,080 m³/d, limited by the tertiary filters.

It is important to note that the ADF capacity of the bioreactor at the St Jacobs WWTP may actually be lower than the data suggested in Table 59 due to the impacts of very low temperatures (<3°C) experienced in the oxidation ditch in winter which can reduce nitrification performance (XCG, 2013).

Table 59 Capacity Assessment Summary, St Jacobs WWTP

Major Unit Process	Criteria Used	Peak Factor Used	Equivalent ADF Capacity (m ³ /d)
Raw Sewage Pumping Station Pumps	-	PIF = 3.6	1,450
Headworks Screens	-	PIF = 3.6	1,620
Grit Tanks	-	PHF = 3.3	1,550
Bioreactor HRT (h)	15		1,450
SRT (days) ⁽¹⁾	15		2120
Oxygenation System Oxygen Demand ⁽²⁾	1.5 kg O ₂ /kg BOD ₅ + 4.6 kg O ₂ /kg TKN		3,870
Secondary Clarifier SRT at PHF (m ³ /m ² /d)	37 ⁽³⁾	PHF = 3.3	2,300
SLR at PDF (kg/m ² /d)	170 ⁽³⁾	PDF = 2.8	2,630 ⁽⁴⁾
Tertiary Filtration Filtration Rate at PHF (L/m ² ·s)	3.0 ⁽⁵⁾	PHF = 3.3	1,080
UV Disinfection Original Peak Design Flow (m ³ /d)	3,630	PHF = 3.3	1,080

Notes:

1. Based on a sludge yield of 0.85 kg TSS/kg BOD₅ with chemical addition for phosphorus removal.
2. Peak oxygen demand with 150% factor of average oxygen demand to account for diurnal fluctuation.
3. Based on MOECC Design Guidelines (2008) for extended aeration activated sludge process with chemical addition for phosphorus removal.
4. Based on assumed MLSS concentration of 3,500 mg/L and RAS: ADF ratio of 100%.
5. Based on St Jacobs WWTP Preliminary Design Report (Stanley, 1998).

3.9.4 Condition Assessment Findings

The St Jacobs WWTP was constructed in 1971 and underwent upgrades in 2000.

An inventory and condition assessment of all existing assets for the St Jacobs WWTP have recently been completed, as part of the Region's Asset Management Implementation Project (CH2M HILL, 2015). The results of this study are summarized in Table 60, which provided the Region with an up-to-date asset inventory of the St Jacobs WWTP, including a 25-year forecast for replacement and repair for all major assets. Since the WWTP underwent major upgrades in 2000, assets are generally in good physical condition with no noted operational issues.

Table 60 Summary of St Jacobs WWTP Condition Assessment ⁽¹⁾

Process	Physical Condition
Raw Sewage Pumping Station	✓ Equipment near the end of its service life but in good condition
Headworks	✓ Equipment in good physical condition
Secondary Treatment	✓ Equipment in good physical condition in general. Needs minor repair (e.g. oxidation ditch brush aerator motor gear drives and secondary clarifier enclosure need repairs).
Tertiary Treatment	✓ Equipment in good physical condition in general
UV Disinfection	✓ Equipment in good physical condition in general
Sludge Handling	✗ Equipment past its service life. Needs replacement
SCADA Workstation	✗ Near the end of its useful life. Needs replacement

Notes:

1. Based on the St Jacobs WWTP Asset Inventory & Condition Assessment Report (CH2M HILL, 2015).

3.9.5 Summary

The following points summarize the findings from the historical data review and process capacity assessment for the St Jacobs WWTP:

- ✚ The St Jacobs WWTP historically has produced good quality effluent that has met the MOECC ECA effluent limits for the historic review period, with the exception of one elevated value in January 2014 for TAN due to extreme cold temperature affecting nitrification performance.

- ✦ There is sufficient capacity at the plant to treat the design flow, with the exception of the tertiary filters and the UV disinfection system due to the I/I issue experienced at the plant. A joint program was undertaken by the Region and the Township from 1997 to 2007 to target reductions in extraneous flows (St Jacob's I/I Reduction Program). Although some upgrades were completed in the collection system, I/I contributions are still present and likely related to extraneous flows from private services. If the I/I issues are addressed in the future and extraneous flows are reduced, per capita flows would be reduced and capacity may be gained at the plant. Overall the plant has an available ADF capacity of 1,080 m³/d, limited by the tertiary filters.

3.10 Elmira WWTP

3.10.1 Facility Overview

The Elmira WWTP is a biological nutrient removal (BNR) plant that provides treatment for wastewater generated in the town of Elmira located in the Township of Woolwich. The Elmira WWTP was originally constructed in 1967 and expanded in 1983 and again in 2000. The plant is operated under MOECC ECA No. 6698-8QGJ8E issued on January 27, 2012 with a rated ADF capacity of 7,800 m³/d and a peak flow capacity of 19,500 m³/d.

The existing unit treatment processes include flow equalization, screening, vortex grit removal, primary clarification, BNR bioreactors (consisting of anaerobic cells, anoxic cells, aerobic cells and a swing zone), secondary clarification, tertiary filtration and UV disinfection prior to discharge to the Canagagigue Creek. The addition of ferric chloride upstream of the secondary clarifiers for phosphorus removal is provided to improve the performance of the BNR system. Primary sludge is transferred to a fermenter tank for volatile fatty acid (VFA) production. The supernatant from the fermenter tank is returned to the anaerobic zone of the bioreactors to facilitate biological phosphorus removal. WAS is transferred to a sludge blend tank for blending and storage. The fermented sludge and WAS are then dewatered in a centrifuge, with haulage off-site for disposal.

The ECA effluent requirements for the Elmira WWTP are summarized in Table 61.

Table 61 Elmira WWTP Existing ECA Effluent Objectives and Limits (ECA No. 6698-8QGJ8E, 2012)

Parameter	Effluent Objectives	Non-Compliance Limits	
	Concentration (mg/L) ⁽¹⁾	Concentration (mg/L) ⁽¹⁾	Loading (kg/d) ⁽²⁾
CBOD ₅	5.0	10.0	78.0
TSS	5.0	10.0	78.0
TP	0.2	0.50	3.9
TAN (May 1 to Oct. 30)	0.4	0.7	5.5
TAN (Nov. 1 to Apr. 30)	1.0	2.0	15.6
<i>E. coli</i> (counts/100 mL) ⁽³⁾	-	200	-

Notes:

1. Based on monthly average concentration values.
2. Based on the annual average loading during any calendar year.
3. Based on monthly geometric mean.

3.10.2 Existing System

Historical Flow

A summary of the historical flow data of the Elmira WWTP over the period 2012 to 2014 is presented in Table 62.

The average raw wastewater flow between 2012 and 2014 was 4,400 m³/d, or approximately 55% of the rated capacity of 7,800 m³/d. The average per capita flow was 450 L/cap·d, which is in the higher end of a typical range of 225-450 L/cap·d for domestic sewage (MOECC, 2008). The high average per capita flow may be attributed to additional contribution from industrial areas and historical I&I issues experienced at the plant.

For the capacity assessment in Section 3.10.3 of this report, the PDF factor was limited to the historic average of 3.2. The PHF and PIF factors were limited to 3.2, equivalent to the PDF factor with available on-site flow equalization.

Table 62 Historic Flow to the Elmira WWTP

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated Capacity (m ³ /d)	7,800	-
ADF (m ³ /d)	4,400 (55%)	1.0
PDF (m ³ /d)	13,890	3.2 ⁽¹⁾
Average Per Capita Flow (L/cap·d)	450 ⁽²⁾	-

Notes:

1. Based on historic data (January 2012 to December 2014).
2. Based on ADF of 4,400 m³/d and a 2014 population of 9,896 provided in the Region's 2015 Water and Wastewater Monitoring Report.

Raw Wastewater Characteristics and Loadings

Historic raw influent concentrations and loadings from 2012 to 2014 are presented in Table 63. The Elmira WWTP service area has a large industrial and commercial area and therefore the plant receives medium to high strength wastewater. The raw wastewater concentrations are representative of a medium strength wastewater with respect to CBOD₅, TP and TKN; and high strength with respect to TSS.

Per capita loadings were calculated and compared to the typical values expected for domestic sewage. All of the parameters, with the exception of total phosphorus, are higher than the typical values, due to industrial contributions being high relative to a typical community.

Table 63 Elmira WWTP Raw Wastewater Characteristics and Loadings ⁽¹⁾

Parameter	Average Concentration			Average Loading			
	Historic (mg/L) ⁽¹⁾	Design (mg/L) ⁽²⁾	Typical Value (mg/L) ⁽³⁾	Historic (kg/d) (% of Design Loading)	Design (kg/d) ⁽²⁾	Historic Average Per Capita Loading (g/cap.d) ⁽⁴⁾	Typical Per Capita Loading (g/cap.d) ⁽³⁾
CBOD ₅	260	190	190	1,070 (70%)	1,480	110	80
TSS	350	190	210	1,480 (100%)	1,480	150	90
TP	7.0 (6.7)	5.3	7	28 (70%)	40	2.8	3.2
TKN	45	40	40	190 (60%)	310	20	13

Notes:

1. Based on OCWA Operating and Maintenance Annual Reports (2012-2014).
2. Based on Elmira WWTP Preliminary Design Report (Stanley, 1998).
3. Based on Metcalf & Eddy (2003).
4. Based on average loadings and a 2014 population of 9,896 provided in the Region's 2015 Water and Wastewater Monitoring Report.

Effluent Quality and Performance

The historical effluent quality for the period of 2012 to 2014 is presented in Table 64, along with ECA effluent objectives and compliance limits.

Based on the historical plant effluent quality, the Elmira WWTP has been able to achieve its effluent compliance limits for the historic review period, with the exception of the TAN monthly average concentrations in February to April, 2012. This was due to the increased influent hydraulic loading causing a decrease in retention time in the aeration tanks and/or inhibitory influent loading affecting the nitrification process. Process adjustments were made to ensure a more consistent hydraulic and organic loading to the secondary treatment system by improved utilization of the equalization tanks.

The historical effluent wastewater loadings, with respect to CBOD₅, TSS, TP and TAN are also summarized in Table 64. All annual average loadings are within the ECA effluent objectives and non-compliance limits.

Table 64 Elmira WWTP Effluent Quality and Loadings ⁽¹⁾

Parameter	Concentration (mg/L)				Loading (kg/d)			
	Avg.	Peak Month ⁽²⁾	Object.	Limit ⁽³⁾	Avg.	Peak Month ⁽²⁾	Object.	Limit ⁽⁴⁾
CBOD ₅	2.6	3.1	5.0	10.0	9.1	15.8	39.0	78.0
TSS	1.9	8.5	5.0	10.0	8.6	43.2	39.0	78.0
TP	0.10	0.21	0.2	0.50	0.42	1.07	1.6	3.9
TAN (May 1 to Oct. 30)	0.13	0.44	0.4	0.7	0.48	1.4	3.1	5.5
TAN (Nov. 1 to Apr. 30)	0.57	3.06	1.0	2.0	2.46	15.6	7.8	15.6

Notes:

1. Based on OCWA Operating and Maintenance Annual Reports (2012-2014).
2. The highest monthly average value during 36-month period (January 2012 - December 2014).
3. Based on monthly average concentration values.
4. Based on annual average loading during any calendar year.

3.10.3 Process Capacity Assessment

A capacity assessment for the major liquids and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The

assessment was based on historical plant operational data, plant design criteria, approved ECA capacities, and typical design guidelines.

Table 65 lists the background data used to estimate the rated capacities for the major processes. The capacity assessment results of the Elmira WWTP are presented in the PPG in Figure 10.

Table 65 Elmira WWTP Major Unit Process Summary

Process		Description	Value
Equalization (EQ) Tanks	Rectangular	Number	6 (2 on-site at the plant and 4 off-site at SPS)
		Capacity (Total)	6,290 m ³
Raw Sewage Pumping Station (off-site)	Pumps	Number	3 submersible pumps (2 duty, 1 standby) 1 Jockey pump
		Capacity (each)	200 L/s (submersible pumps), 100 L/s (Jockey pump)
		Capacity (Firm)	500 L/s (43,200 m ³ /d) ⁽¹⁾
Headworks	Coarse Bar Screen	Number	2
		Bar Spacing	32 mm
		Capacity (each)	19,500 m ³ /d
	Vortex Grit Tanks	Number	2
		Capacity (total)	39,000 m ³ /d
Primary Clarifiers	Circular	Number	2
		Surface Area (total)	234 m ²
		SWD	2.43 m
Bioreactors	Pre-anoxic Cell	Number	2
		Volume (total)	320 m ³
		SWD	4.5 m
	Anaerobic Cell	Number	2
		Volume (total)	320 m ³
		SWD	4.5 m
	Swing Zone (Anoxic/Aerobic) ⁽²⁾	Number	2
		Volume (total)	278 m ³
		SWD	4.5 m
	Aerobic Cell	Number	4
		Volume (total)	1,756 m ³
		SWD	4.5 m
Blowers	Centrifugal	Number	3 (2 duty, 1 standby)

Process		Description	Value
		Capacity (each)	27.3 m ³ /min of air
Secondary Clarifiers	Circular	Number	3
		Surface Area (total)	884 m ²
		SWD	3.65 m
Tertiary Filters	Shallow bed Travelling Bridges	Number	2
		Surface area (total)	136.8 m ²
Disinfection	UV Disinfection	Number of channels	2
		Capacity (total)	19,500 m ³ /d
Fermenter		Number	1
		Tank Volume (total)	377 m ³
Sludge Blending Tank		Number	1
		Tank Volume	377 m ³

Notes:

1. Based on St Jacobs – Elmira WWTP Master Plan (XCG, 2012).
2. The swing zone is operated as an anoxic zone in summer and an aerobic zone during the remaining part of the year.

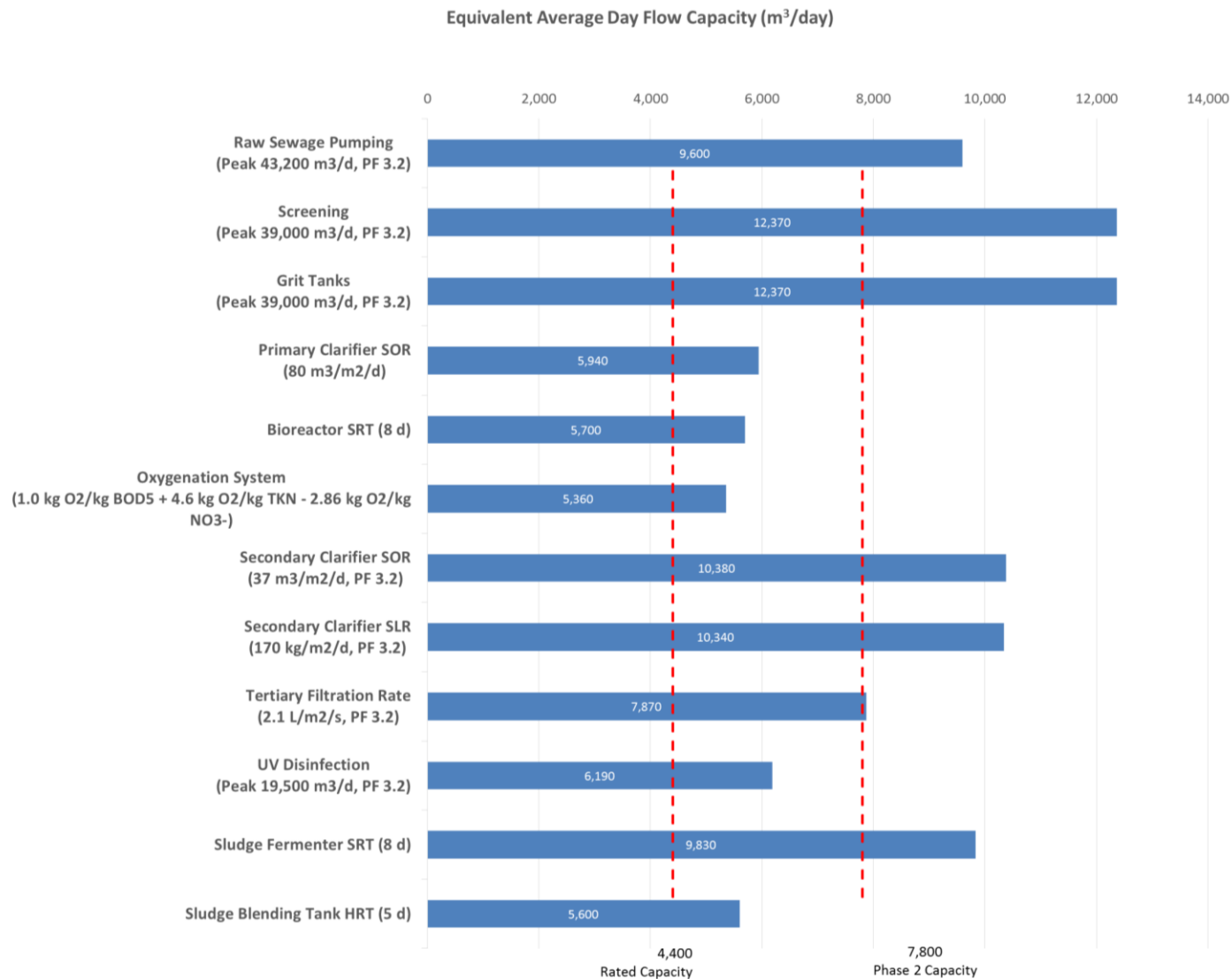


Figure 10 PPG for the Elmira WWTP

Several treatment processes at the Elmira WWTP do not have sufficient capacity for the plant design flow, including the primary clarifiers, bioreactors, oxygenation system and UV disinfection system.

The aerobic zone SRT and oxygen availability are the most limiting factors of the plant. This is due to the greater BOD₅ loadings used in the capacity assessment calculation as compared to the BOD₅ loadings originally used to design the Elmira WWTP. In the Preliminary Design Report prepared by Stanley Consulting (Stanley, 1998), the design was based on an annual average raw wastewater BOD₅ concentration of 190 mg/L; this is lower than the current BOD₅ concentration of 260 mg/L as presented in Table 63. If the influent BOD₅ loadings were similar to the original design basis, additional capacity of the bioreactors and oxygenation system would be available.

The primary clarifiers and UV disinfection system have sufficient capacity for the current flow but not for the plant design flow. This is due to the significant I/I issue experienced at the plant, which results in higher sustained wet weather flows and higher peak factors (i.e. 3.2) used in the capacity assessment than original design values.

A joint program was undertaken by the Region and the Township from 1997 to 2007 to target reductions in extraneous flows. Although some upgrades were completed in the collection system, I/I contributions are still present and likely related to extraneous flows from private services. If the I/I issues are addressed in the future and extraneous flows are reduced, the capacity of the primary clarifiers and UV disinfection system would increase.

It should be noted that BOD₅ loading and I/I reductions can be difficult to achieve and challenging to quantify the impacts on treatment capacity improvements in advance. Contingency recommendations will be provided in later memos within the WWTMP.

A summary of the equivalent ADF capacity of each unit process is presented in Table 66. Overall the Elmira WWTP has an available equivalent ADF capacity of 5,360 m³/d, limited by the bioreactors and the oxygenation system.

Table 66 Capacity Assessment Summary, Elmira WWTP

Major Unit Process	Criteria Used	Peak Factor Used	Equivalent ADF Capacity (m ³ /d)
Raw Sewage Pumping Station Pumps	-	PIF = 3.2	9,600
Headworks Screens	-	PIF = 3.2	12,370
Grit Tanks	-	PHF = 3.2	12,370
Primary Clarifiers Surface Overflow Rate at PDF (m ³ /m ² /d)	80	PDF = 3.2	5,940
BNR Bioreactors Solids Retention Time (days) in Aerobic Zone	8 ⁽¹⁾	ADF	5,700 ⁽²⁾
Oxygenation System Oxygen Demand ⁽²⁾	1.0 kg O ₂ /kg BOD ₅ + 4.6 kg O ₂ /kg TKN - 2.86 kg O ₂ /kg NO ₃	ADF	5,360
Secondary Clarifier Surface Overflow Rate at PHF (m ³ /m ² /d) Surface Loading Rate at PDF (kg/m ² /d)	37 ⁽³⁾ 170 ⁽³⁾	PHF = 3.2 PDF = 3.2	10,380 10,340 ⁽⁴⁾
Tertiary Filtration Filtration Rate at PHF (L/m ² ·s)	2.1 ⁽⁵⁾	PHF = 3.2	7,870
UV Disinfection Original Peak Design Flow (m ³ /d)	19,500	PHF = 3.2	6,190
Fermenter SRT (days)	8	ADF	9,830
Sludge Blending Tank Sludge Retention Time (days)	5	ADF	5,600

Notes:

1. Based on a typical yield of 0.80 kg TSS/kg BOD₅ for the BNR plant with small amount of chemical addition for phosphorus removal improvements and MLSS of 3,500 mg/L.
2. The capacity assessment for the bioreactors was based on the current actual BOD₅ loading (BOD₅ = 260 mg/L) rather than the reduced loading.
3. Peak oxygen demand with 150% factor of average oxygen demand to account for diurnal fluctuation. An oxygen credit of 2.86 kg O₂/kg NO₃ (Metcalf & Eddy, 2003) was applied for the denitrification process at the plant.
4. Based on MOECC Design Guidelines (2008) for activated sludge process with nitrification and with chemical addition for phosphorus removal.
5. Based on assumed MLSS concentration of 3,500 mg/L and RAS:ADF ratio of 100%.
6. Based on MOECC Design Guidelines for shallow bed filters.

3.10.4 Condition Assessment Findings

The Elmira WWTP was constructed in 1967, expanded in 1983 and again in 2000. An inventory and condition assessment of all existing assets for the Elmira WWTP have recently been completed, as part of the Region's Asset Management Implementation Project (AECOM, 2016). The results of this study are summarized in Table 67, which provided the Region with an up-to-date asset inventory of the Elmira WWTP, including a 25-year forecast for replacement and repair for all major assets.

Table 67 Summary of Elmira WWTP Condition Assessment ⁽¹⁾

Process	Physical Condition
Raw Sewage Pumping Station (off-site)	✓ Equipment in very good to good conditions
Equalization Tanks	✓ Equipment in good to fair condition
Headworks	✓ Equipment in good condition
Primary Clarification	✗ Near the end of service life, but performing very well. Replacement may be delayed with only minor repairs.
Bioreactors	✓ Equipment in good condition. No issues identified
Secondary Clarification	✗ Equipment near the end of service life. Needs replacement.
Tertiary Filtration	✓ Tertiary filter No. 1 in fair condition; and tertiary filter No. 2 in good condition
UV Disinfection	✓ Equipment near the end of its useful life but in fair condition.
Sludge Fermenter	✓ Process equipment in good condition
Building HVAC Issues	✗ Near or past the service life. Needs repairing and/or replacement

3.10.5 Summary

The following points summarize the findings from the historical data review and process capacity assessment for the Elmira WWTP:

- + The Elmira WWTP has historically produced good quality effluent that has met the ECA compliance limit, with the exception of the TAN monthly average concentration due to increased hydraulic loading and/or inhibitory influent loading.
- + Overall, the Elmira WWTP has an available equivalent ADF capacity of 5,360 m³/d, limited by the bioreactors and the oxygenation system due to elevated influent BOD₅ loading as compared to the original design criteria.
- + Primary clarifiers and UV disinfection system are insufficient to handle the plant design capacity due to significant I/I issue at the plant. A joint program was undertaken by the Region and the Township from 1997 to 2007 to target reductions in extraneous flows. Although some upgrades were completed in the collection system, I/I contributions are still present and likely related to extraneous flows from private services. If the I/I issues are addressed in the future and extraneous flows are reduced, per capita flows would be reduced and capacity may be gained at the plant.

3.11 Alt-Heidelberg WWTP

3.11.1 Facility Overview

The Alt-Heidelberg WWTP, originally constructed in 1999, is a biological nutrient removal (BNR) plant that provides treatment for wastewater from approximately 90 homes within the Community of Heidelberg in the Township of Woolwich. The Alt-Heidelberg WWTP is operated under MOECC ECA No. 9893-97RR3P issued on June 19, 2013. The plant has a rated ADF capacity of 130 m³/d and a peak flow capacity of 276 m³/d (3.2 L/s).

The existing unit treatment processes include equalization, BNR bioreactors (consisting of anaerobic, anoxic and aerobic cells), secondary clarification, tertiary filtration and UV disinfection prior to discharge to the Heidelberg Creek. Ferric chloride is added to the aeration tanks for phosphorus removal. Sludge generated from the BNR process is aerobically digested and hauled to the Waterloo WWTP for further conditioning.

The ECA effluent requirements for the Alt-Heidelberg WWTP are summarized in Table 68.

Table 68 Alt-Heidelberg WWTP Effluent Objectives and Limits (ECA No. 9893-97RR3P, 2013)

Parameter	Effluent Objectives		Non-Compliance Limits	
	Average Conc. (mg/L) ⁽¹⁾	Daily Conc. (mg/L)	Average Conc. (mg/L) ⁽¹⁾	Average Loading (kg/d) ⁽²⁾
CBOD ₅	5.0	20.0	7.5	0.58
TSS	5.0	20.0	10.0	0.78
TP	0.3	1.2	0.4	0.03
TAN (May 1 to Oct. 30)	1.5	6.0	2.0	0.16
TAN (Nov. 1 to Apr. 30)	3.0	12.0	4.0	0.31
Nitrate Nitrogen	7.5	30.0	10.0	0.78
<i>E. coli</i> (counts/100 mL) ⁽³⁾	150	-	200	-

Notes:

1. Based on monthly average concentration values.
2. Based on monthly average loading values.
3. Based on monthly geometric mean.

3.11.2 Existing Conditions

Historical Flow

A summary of the historical flow data of the Alt-Heidelberg WWTP over the period 2012 to 2014 is presented in Table 69. The average raw wastewater flow between 2012 and 2014 was 60 m³/d, or approximately 50% of the rated capacity of 130 m³/d. The average per capita flow was 240 L/cap·d, which is within the typical range of 225-450 L/cap·d for domestic sewage (MOECC, 2008).

For the capacity assessment in Section 3.11.3 of this TM, the PDF, PHF and PIF factors of 2.7, 3.2 and 4.1, respectively, were applied.

Table 69 Historic Flow to the Alt-Heidelberg WWTP (2012-2014)

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated Capacity (m ³ /d)	130	-
ADF (m ³ /d)	60 (50%)	-
PDF (m ³ /d)	170	2.7 ⁽¹⁾
PHF (m ³ /d)	200	3.2 ⁽²⁾
PIF (m ³ /d)	250	4.1 ⁽³⁾
Average Per Capita Flow (L/cap·d)	240 ⁽⁴⁾	-

Notes:

1. Based on historic data (January 2012 to December 2014).
2. Assumed based on PDF plus 50% of ADF to allow for diurnal variations
3. Estimated based on on-site raw sewage pumping station rated capacity and plant ECA rated capacity.
4. Based on an ADF of 60 m³/d and a 2014 population of 263 provided in the Water and Wastewater Monitoring Report.

Raw Wastewater Characteristics and Loadings

Historic influent concentrations and loadings from 2012 to 2014 are presented in Table 70. The Alt-Heidelberg WWTP receives medium strength wastewater. Per capita loadings were calculated and compared to the typical values expected for domestic sewage. All of the parameters including CBOD₅, TSS, TP and TKN are lower than the typical per capita loadings.

Historic average monthly influent concentrations and loadings were used in the unit process capacity assessment in Section 3.11.3.

Table 70 Alt-Heidelberg WWTP Raw Wastewater Characteristics and Loadings⁽¹⁾

Parameter	Average Concentration			Average Loading			
	Historic (mg/L) (1)	Design (mg/L) (2)	Typical Value (mg/L) (3)	Historic (kg/d) (% of Design Loading)	Design (kg/d) (2)	Historic Average Per Capita Loading (g/cap.d) (4)	Typical Per Capita Loading (g/cap.d) (3)
CBOD ₅	220	200-300	190	14 (35-50%)	30 - 40	50	80
TSS	230	200-300	210	15 (37-50%)	30 - 40	30	90
TP	7.0 (7.3)	4 - 12	7	0.5 (30-100%)	0.5 - 1.6	1.8	3.2
TKN	50	30 - 60	40	3 (40-85%)	4 - 8	12.8	13

Notes:

1. Based on OCWA Operating and Maintenance Annual Report (2012-2014).
2. Based on Design Basis/Pre-design Report: Communal Wastewater Treatment System (CWTS) Alt Heidelberg Estates (CRA, 1997)
3. Based on Metcalf & Eddy (2003).
4. Based on average loadings and a 2014 population of 263 provided in the Region's 2015 Water and Wastewater Monitoring Report.

Effluent Quality and Performance

The historical effluent quality for the period of 2012 to 2014 is presented in Table 71, along with ECA effluent objectives and compliance limits. Based on the historical plant effluent quality, the Alt-Heidelberg WWTP achieved its effluent compliance limits. The historical effluent wastewater loadings, with respect to CBOD₅, TSS, and TP are also summarized in Table 71. All annual average loadings are within the ECA compliance limits.

Table 71 Alt-Heidelberg Effluent Quality and Loadings ⁽¹⁾

Parameter	Concentration (mg/L)				Loading (kg/d)		
	Avg.	Peak Month ⁽²⁾	Object.	Non-Compliance Limit ⁽³⁾	Avg.	Peak Month ⁽²⁾	Non-Compliance Limit ⁽⁴⁾
CBOD ₅	2.0	2.7	5.0	7.5	0.13	0.18	0.58
TSS	1.4	3.1	5.0	10.0	0.09	0.17	0.78
TP	0.07	0.35	0.3	0.4	0.004	0.023	0.03
TAN (May 1 to Oct. 30)	0.12	0.51	1.5	2.0	0.007	0.028	0.16
TAN (Nov. 1 to Apr. 30)	0.23	1.30	3.0	4.0	0.015	0.081	0.31
Nitrate Nitrogen ⁽⁵⁾	-	-	7.5	10.0	-	-	0.78

Notes:

1. Based on OCWA Operating and Maintenance Annual Reports (2012-2014).
2. The highest monthly average value during 36-month period (January 2012 - December 2014).
3. Based on monthly average concentration values.
4. Based on annual average loading during any calendar year.
5. Nitrate nitrogen data is not available.

3.11.3 Process Capacity Assessment

A capacity assessment for the major liquids and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The assessment was based on historical plant operational data, plant design criteria, approved ECA capacities, and typical design guidelines.

Table 72 lists the background data used to estimate the rated capacities for the major processes.

Table 72 Alt-Heidelberg WWTP Major Unit Process Summary

Process		Description	Value
Raw Sewage Pumping Station	Pumps	Number	2 (1 duty, 1 standby)
		Capacity (per pump)	6.25 L/s at 3.8 m TDH
		Capacity (Firm)	6.25 L/s (540 m ³ /d)
Equalization Tank	Rectangular	Number	2
		Volume (total)	122 m ³
Bioreactors	Anaerobic Tank	Number	2
		Volume (total)	29 m ³
		SWD	4.62 m
	Anoxic Tank	Number	2
		Volume (total)	28 m ³
		SWD	4.57 m
	Aerobic Tank	Number	2
		Volume (total)	51 m ³
		SWD	4.47 m
Blowers	Rotary positive displacement blowers	Number	2 (1 duty, 1 standby)
		Capacity (each)	5 m ³ /min of air ⁽¹⁾
Secondary Clarifiers	Square	Number	1
		Surface Area (total)	11 m ²
		SWD	5.42 m
Tertiary Filters	Shallow bed	Number	2
		Surface area (total)	2.2 m ²
Disinfection	UV disinfection	Number of channels	1
		Number of banks/channel	3
		Number of lamps (total)	6
Digestion	Aerobic digestion	Number	1
		Tank Volume (total)	32.4 m ³
		SWD	4.0 m

Notes:

1. Two blowers (one duty, one standby), each having a capacity of 5 m³/min to supply process air to equalization tanks, aeration tanks and aerobic digesters.

The results of the capacity assessment of the Alt-Heidelberg WWTP are presented in the PPG in Figure 11.

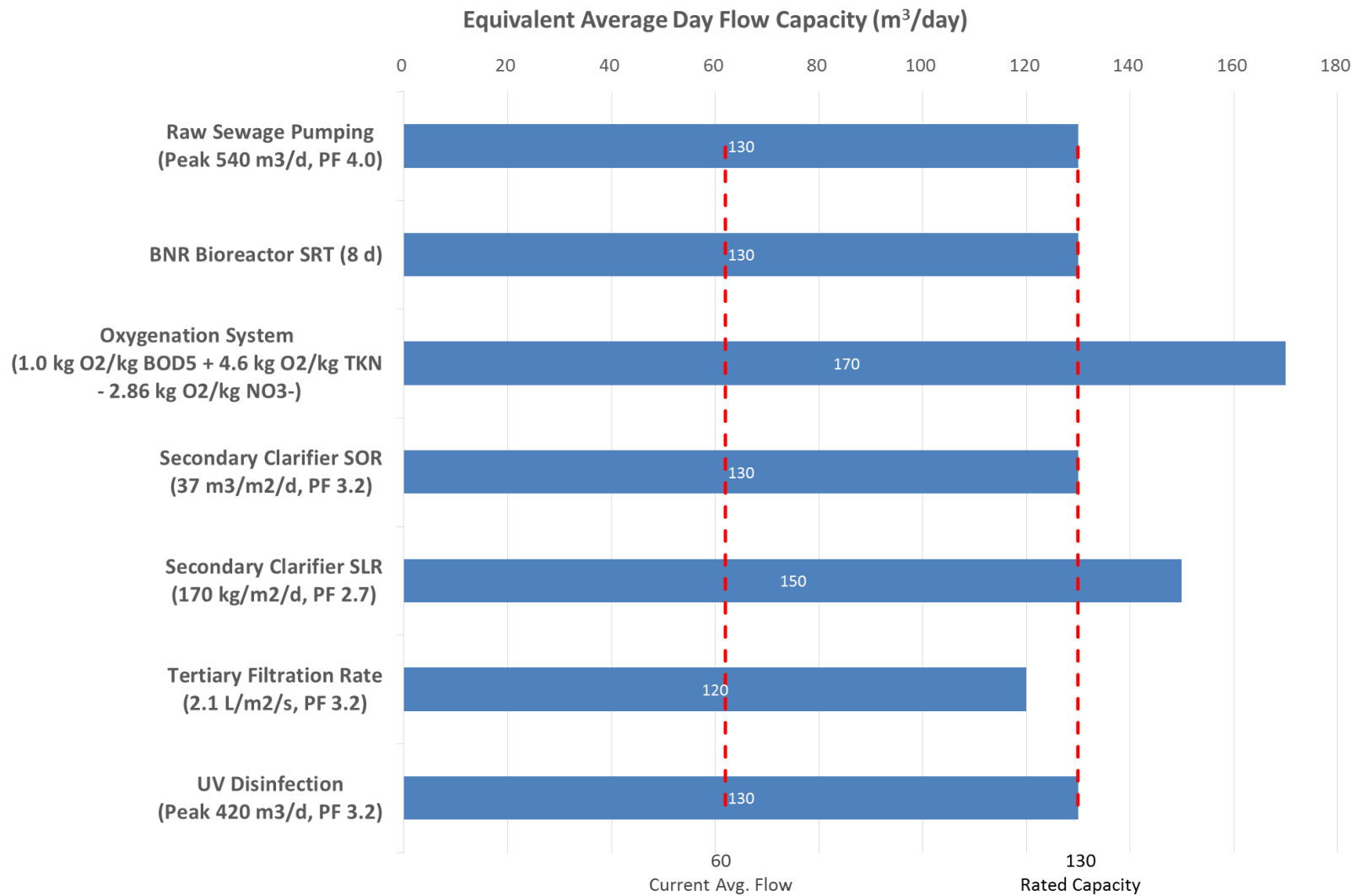


Figure 11 PPG for the Alt-Heidelberg WWTP

A summary of the equivalent ADF capacity of each unit process is presented in Table 73.

The treatment processes all appear to have sufficient capacity for the current and rated design flows with the exception of tertiary filtration, which is limited to slightly less than the plant design flow of 130 m³/d based on MOECC Design Guidelines. Due to the short duration of PHF, it is expected the plant design flow can be handled hydraulically by the tertiary filters with minimal impact on performance of the filters.

Table 73 Capacity Assessment Summary, Alt-Heidelberg WWTP

Major Unit Process	Criteria Used	Peak Factor Used	Equivalent ADF Capacity (m ³ /d)
Raw Sewage Pumping Station Pumps	-	PIF = 4.1	135
BNR Bioreactors SRT (days) ⁽¹⁾	8	ADF	130
Oxygenation System Oxygen Demand ⁽²⁾	1.0 kg O ₂ /kg BOD ₅ + 4.6 kg O ₂ /kg TKN – 2.86 kg O ₂ /kg NO ₃	ADF	170
Secondary Clarifier SOR at PHF (m ³ /m ² /d) SLR at PDF (kg/m ² /d)	37 ⁽³⁾ 170 ⁽³⁾	PHF = 3.2 PDF = 2.7	130 150 ⁽⁴⁾
Tertiary Filtration Filtration Rate (L/m ² ·s)	2.1	PHF = 3.2	120
UV Disinfection Original Peak Design Flow (m ³ /d)	420	PHF = 3.2	130

Notes:

1. Based on a sludge yield of 0.85 kg TSS/kg BOD₅ with chemical addition for phosphorus removal and MLSS of 3,500 mg/L.
2. Peak oxygen demand with 150% factor of average oxygen demand to account for diurnal fluctuation. An oxygen credit of 2.86 kg O₂/kg NO₃ (Metcalf & Eddy, 2003) was applied for the denitrification process at the plant.
3. Based on MOECC Design Guidelines (2008) for activated sludge process with chemical addition for phosphorus removal.
4. Based on assumed MLSS concentration of 3,500 mg/L and RAS: ADF ratio of 100%.

3.11.4 Condition Assessment

A condition assessment has recently been completed for the Alt-Heidelberg WWTP in 2013 (CIMA, December 2013). Several minor deficiencies were identified and are being addressed as part of on-going upgrades.

3.11.5 Ongoing and Planned Upgrades

Several minor upgrades were identified and are currently being implemented at the plant based on previously completed capacity and condition assessment (CIMA, 2015), including:

- + Replace the raw sewage pumps with submersible chopper pumps to reduce ragging issues.
- + Replace the oxidation reduction potential (ORP) transmitters and dissolved oxygen (DO) meters in the bioreactors.
- + Provide containment for chemical tanks.
- + Minor electrical upgrades for equalization pumps and aeration blowers.
- + Minor structural and architectural upgrades for equalization tank, sludge holding tank and aeration room.

3.11.6 Summary

The following points summarize the findings from the historical data review and process capacity assessment for the Alt-Heidelberg WWTP:

- + The Alt-Heidelberg WWTP historically has produced good quality effluent that has met the MOECC ECA effluent limits for the historic review period.
- + All the treatment processes have sufficient capacity to handle the plant design flow, with the exception of tertiary filtration. Due to the short duration of PHF, it is expected that the tertiary filters can handle the plant design flow hydraulically with minimal impact to performance.
- + Overall the Alt-Heidelberg WWTP has an available equivalent ADF capacity of 130 m³/d.
- + Several minor upgrades have been identified and are currently being implemented at the plant.

3.12 Foxboro Green WWTP

3.12.1 Facility Overview

The Foxboro Green WWTP, originally constructed in 1999, is a rotating biological contactor (RBC) plant that provides BOD removal and nitrogen removal (nitrification and denitrification) for wastewater generated in the Foxboro Green Retirement Community in the Township of Wilmot. The Foxboro Green WWTP is operated under MOECC ECA No. 7201-8ZMQGA issued on March 20, 2013. The treatment facility consists of three packaged RBC plants (Plants No. 1, 2 and 3). Each plant has a rated ADF capacity of 50 m³/d, with a total rated ADF capacity of 150 m³/d.

The existing unit treatment processes include primary clarification, rotating contactors, intermediate clarification, denitrification, and final clarification prior to discharge to seven subsurface disposal leaching beds (Leaching Beds A, B, C, D, E, F and G). There is no chemical used in the RBC process and disinfection is not required for the leaching bed system. WAS is returned to the primary settling tanks for co-thickening. Co-thickened primary sludge and WAS are hauled to the Waterloo WWTP for further treatment.

The ECA effluent requirements for the Foxboro Green WWTP are summarized in Table 74.

Table 74 Foxboro Green WWTP Effluent Objectives (ECA No. 7201-8ZMQGA, 2013) ⁽¹⁾

Parameter	Effluent Objectives
	Concentration (mg/L)
CBOD ₅	20
TSS	20
TN	19

Notes:

1. There are no effluent limits in this ECA.

3.12.2 Existing Conditions

Historical Flow

A summary of the historical flow data for the Foxboro Green WWTP over the period 2012 to 2014 is presented in Table 75.

The average raw wastewater flow between 2012 and 2014 was 110 m³/d, or approximately 75% of the rated capacity of 150 m³/d. The average per capita flow

was 273 L/cap·d, which is within a typical range of 225-450 L/cap·d for domestic sewage (MOECC, 2008).

For the capacity assessment in Section 3.12.3 of this TM, the PDF, PHF and PIF factors of 2.1, 2.6 and 3.9, respectively, were applied.

Table 75 Historic Flow to the Foxboro Green WWTP

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated Capacity (m ³ /d)	150	-
ADF (m ³ /d)	110 (75%)	-
PDF (m ³ /d)	240	2.1 ⁽¹⁾
PIF (m ³ /d)	290	2.6 ⁽²⁾
PHF (m ³ /d)	440	4.0 ⁽³⁾
Average Per Capita Flow (L/cap·d)	270 ⁽⁴⁾	-

Notes:

1. Based on historic data (January 2012 to December 2014).
2. Assumed based on PDF plus 50% of ADF to allow for diurnal variations.
3. Based on Harmon formula.
4. Based on ADF of 110 m³/d and a 2014 population of 417 provided in the Region's 2015 Water and Wastewater Monitoring Report.

Raw Wastewater Characteristics and Loadings

Historic raw influent wastewater concentrations and loadings from 2012 to 2014 are presented in Table 76. The Foxboro Green WWTP receives low to medium strength wastewater. The raw wastewater concentrations are representative of a medium strength wastewater with respect to CBOD₅, TP and TKN; and low strength with respect to TSS.

Per capita loadings were calculated and compared to the typical values expected for domestic sewage. All of the parameters including CBOD₅, TSS, TP and TKN are lower than the typical per capita loadings.

Historic average monthly influent concentrations and loadings were used in the unit process capacity assessment in Section 3.12.3.

Table 76 Foxboro Green WWTP Raw Wastewater Characteristics and Loadings⁽¹⁾

Parameter	Average Concentration			Average Loading			
	Historic (mg/L) (1)	Design (mg/L) (2)	Typical Value (mg/L) (3)	Historic (kg/d) (% of Design Loading)	Design (kg/d) (2)	Historic Average Per Capita Loading (g/cap.d) (4)	Typical Per Capita Loading (g/cap.d) (3)
CBOD ₅	150	110	190	18 (100%)	17	40	80
TSS	100	230	210	12 (35%)	34	30	90
TP	6.0		7	1		1.8	3.2
TKN	45 (43)	40	40	5 (85%)	6	12	13

Notes:

1. Based on OCWA Operating and Maintenance Annual Reports (2012-2014).
2. Based on TM1: Foxboro Green WWTP Existing Conditions and Long-Term Options (Stantec, 2014). The design values are 50th percentile values. Using these parameters assumes upgrades are completed.
3. Based on Metcalf & Eddy (2003).
4. Based on average loadings and a 2014 population of 417 provided in the Region's 2015 Water and Wastewater Monitoring Report.

Effluent Quality and Performance

The historical effluent quality for the period of 2012 to 2014 is presented in Table 77, along with ECA effluent objectives (there are no limits for this ECA).

Based on the historical plant effluent quality, the Foxboro Green WWTP achieved its effluent objectives, with the exception of the following:

- ✦ The CBOD₅ monthly average concentration exceeded the ECA effluent objective in February and May 2012 and April 2013.
- ✦ The TSS monthly average concentration exceeded the ECA objective in May 2012.
- ✦ The TN monthly average concentration exceeded the ECA effluent objective in March, April and December 2012 and February 2014.

All the above events were caused due to maintenance issues arising throughout the year affecting the performance of the individual RBC's (OCWA, 2012-2014). A number of upgrades are currently ongoing to improve reliability and performance of the plant.

Table 77 Foxboro Green WWTP Effluent Quality and Loadings (1)

Parameter	Concentration (mg/L)			Loading (kg/d) ⁽⁴⁾	
	Average	Peak Month ⁽²⁾	Objectives ⁽³⁾	Average	Peak Month ⁽²⁾
CBOD ₅	9.5	43.0	20	1.06	4.04
TSS	8.8	22.1	20	1.00	2.38
TP	4.5	6.0	-	0.53	0.80
TN ⁽⁵⁾	-	-	19	0.23	0.85

Notes:

1. Based on OCWA Operating and Maintenance Annual Reports (2012-2014).
2. The highest monthly average value during 36-month period (January 2012 - December 2014).
3. Based on monthly average concentration values.
4. There are no effluent loading objectives and limits in the Foxboro ECA.
5. TN concentration measured data is not available.

3.12.3 Process Capacity Assessment

A capacity assessment for the major liquids and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The assessment was based on historical plant operational data, plant design criteria, approved ECA capacities, and typical design guidelines. Table 78 lists the background data used to estimate the rated capacities for the major processes.

The results of the capacity assessment of the Foxboro Green WWTP are presented in the PPG in Figure 12. It appears that there is sufficient capacity at the Foxboro Green WWTP to handle the plant design capacity and achieve the current ECA limits.

Table 78 Foxboro Green WWTP Major Unit Process Summary

Process		Description	Value
Raw Sewage Pumping Station	Pumps	Number	2 (for RBC No. 3)
		Capacity (per pump)	2.61 L/s at 2.52 m TDH
		Capacity (Firm)	2.61 L/s (226 m ³ /d)
Primary Settling Tank	RBC No.1	Number	1
		Surface Area (total)	7.0 m ²
		SWD	2.7 m
	RBC No.2	Number	1
		Surface Area (total)	6.1 m ²
		SWD	2.7 m
	RBC No.3	Number	1
		Surface Area (total)	6.3 m ²
		SWD	2.7 m
Rotating Biological Contactors (RBC)	RBC No.1	Number of RBC tank	1
		Bio Media Area	2,999 m ²
		Denitrification Chamber Surface Area	1,887 m ²
	RBC No. 2	Number of RBC tank	1
		Bio Media Area	2,787 m ²
		Denitrification Chamber Surface Area	1,115 m ²
	RBC No. 3	Number of RBC tank	1
		Bio Media Area	3,000 m ²
		Denitrification Chamber Surface Area	1,887 m ²
Final Clarifiers	RBC No.1	Number	1
		Surface Area (total)	6.6 m ²
		SWD	2.5 m
	RBC No. 2	Number	1
		Surface Area (total)	6.6 m ²
		SWD	2.5 m
	RBC No. 3	Number	1
		Surface Area (total)	6.6 m ²
		SWD	2.5 m

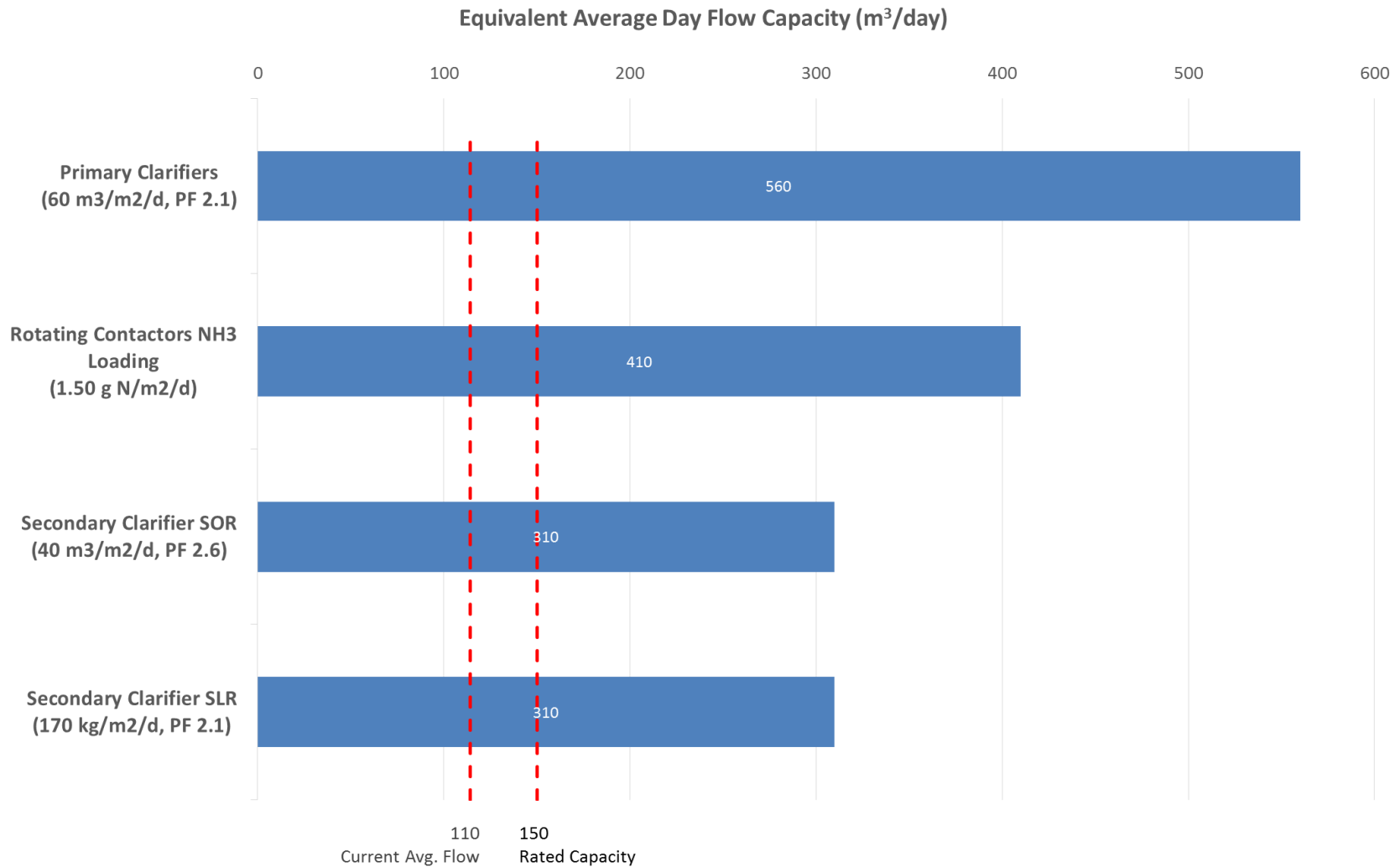


Figure 12 PPG for the Foxboro Green WWTP

A summary of the equivalent ADF capacity of each unit process is presented in Table 79. Overall the Foxboro Green WWTP has an available equivalent ADF capacity of 306 m³/d.

Table 79 Capacity Assessment Summary, Foxboro Green WWTP

Major Unit Process	Criteria Used	Peak Factor Used	Equivalent ADF Capacity (m ³ /d)			
			RBC No. 1	RBC No. 2	RBC No. 3	Total
Primary Clarifiers Surface Overflow Rate at PDF (m ³ /m ² /d)	60 ⁽¹⁾	PDF = 2.1	203	175	182	560
Rotating Biological Contactors Hydraulic Loading Rate (L/m ² ·d) NH ₃ Loading (g N/m ² ·d)	50 ⁽²⁾ 1.5 ⁽²⁾	ADF ADF	150 139	139 130	150 140	440 410
Final Clarifiers SOR at PHF (m ³ /m ² /d) SLR at PDF (kg/m ² /d)	40 ⁽³⁾ 170 ⁽³⁾	PHF = 2.6 PDF = 2.1	102 104 ⁽⁴⁾	102 104 ⁽⁴⁾	102 104 ⁽⁴⁾	310 310 ⁽⁴⁾

Notes:

1. Based on MOECC Design Guideline (2008) for WAS co-thickening in primary clarifiers.
2. Based on MOECC Design Guideline (2008) for RBC with nitrification.
3. Based on Metcalf & Eddy (2003) for RBC with nitrification.
4. Based on assumed MLSS concentration of 3,500 mg/L and RAS: ADF ratio of 100%.

3.12.4 Condition Assessment

The Foxboro Green WWTP has been in service for over 20 years. A condition assessment has recently been completed for the Foxboro Green WWTP in 2013 (CIMA, December 2013). Several upgrades were identified and are currently being implemented as part of an on-going project.

Despite an overall improvement to system performance, the plant experiences frequent equipment failures, resulting in maintenance issues arising throughout the year affecting the performance of the individual RBC's.

In 2014, due to operational problems with Leaching Bed C, a preliminary site inspection of Leaching Bed C was completed by Stantec to inspect the four

distribution cells/chambers (C1-C4) and the manifold chamber (Stantec, December 2014). It was found that:

- + One of the distribution valves to Leaching Bed C was closed and one was partially open, resulting in the remaining leaching bed cells were being overloaded.
- + Some of the levellers had fallen off and the pipes appeared to have shifted in distribution chambers. Distribution Chamber C1 appeared to have the most pipe settling and disconnected levelers.
- + Distribution Chamber C1 also had a broken irrigation pipe directly on top of the distribution box and 100 mm pipe within the distribution box. Stantec does not know what the purpose of the 100 mm pipes, nor is it shown on the recorded drawings.
- + In Distribution Chamber C3, the as recorded drawings showed 11 pipes urns but only 10 were found in the distribution box.
- + Some sediment was also observed in each of the distribution chambers.

Based on the site inspections, the following is recommended for Leaching Bed C (Stantec, December 2014):

- + Repair and relocate the irrigation pipe located above distribution chamber C1.
- + Determine the purpose of the 100 mm pipe in Distribution Chamber C1.
- + Performance four test pits in Leaching Bed C to confirm working condition.

3.12.5 On-going and Planned Upgrades

The Foxboro WWTP is currently in the design phase of the upgrades to address infrastructure deficiencies. The upgrades primarily consist of the following items (Stantec, October 2015):

- + New instrumentation (i.e. flow meters and ORP in anoxic zone) for better process control
- + Replacement of all RAS/recirculation pumps (rated for Class 1 Division 1 areas)
- + Replacement of existing anoxic media to improve de-nitrification performance
- + Construction of a new odour control building

- ✦ Replacement of electrical distribution equipment; HVAC equipment; and grating, stairs, guardrails, and steel supports for RBCs

3.12.6 Summary

The following points summarize the findings from the historical data review and process capacity assessment for the Foxboro WWTP

- ✦ The Foxboro WWTP has been able to achieve its effluent objectives for the historic review period, with the exception of a few occasions where the effluent monthly average CBOD₅, TSS and TN exceeded the ECA non-compliance limits. Several minor upgrades have been identified and are currently implemented to improve reliability and performance of the plant.
- ✦ There is excess capacity at the plant for the design loadings. Overall the plant has an available equivalent ADF capacity of 306 m³/d.

3.13 Conestogo WWTP

3.13.1 Facility Overview

The Conestogo WWTP is a sequencing batch reactor (SBR) plant that provides BOD removal, nitrification and phosphorus removal for wastewater generated from the approximately 70 to 80 homes in the Golf Course Development Area in the Township of Woolwich. The Conestogo WWTP was commissioned in 2005 and was designed for an ADF of 148 m³/d. The plant is currently operated under MOECC ECA No. 8637-5L7MVC issued on April 10, 2003.

The existing unit treatment processes include sequencing batch reactor secondary treatment, tertiary filtration and UV disinfection prior to discharge to Grand River. Alum is added to the SBR tanks for phosphorus removal. Sludge generated is hauled to the Waterloo WWTP for further treatment.

The ECA effluent requirements for the Conestogo WWTP are summarized in Table 80.

Table 80 Conestogo WWTP Effluent Objectives and Limits (ECA No. 8637-5L7MVC, 2003)

Parameter	Effluent Objectives	Non-Compliance Limits	
	Concentration (mg/L) ⁽¹⁾	Concentration (mg/L) ⁽¹⁾	Loading (kg/d) ⁽²⁾
CBOD ₅	5.0	10.0	1.5
TSS	7.0	14.0	2.1
TP	0.2	0.3	0.05
TAN (May 1 to Oct. 31)	1.0	2.0	0.3
TAN (Nov. 1 to Apr. 30)	4.0	8.0	1.2
<i>E. coli</i> (counts/100 mL) ⁽³⁾	200	200	-

Notes:

1. Based on monthly average concentration values.
2. Based on annual average loading values in any calendar year.
3. Based on monthly geometric mean.

3.13.2 Existing Conditions

Historical Flow

A summary of the historical flow data of the Conestogo WWTP over the period 2012 to 2014 is presented in Table 81.

The average raw wastewater flow between 2012 and 2014 was 40 m³/d, or approximately 30% of the rated capacity of 148 m³/d. The average per capita flow was 169 L/cap·d, which is below a typical range of 225-450 L/cap·d for domestic sewage (MOECC, 2008).

For the capacity assessment in Section 3.13.3 of this TM, the PDF, PHF and PIF factors of 3.5, 4.0 and 4.4, respectively, were applied.

Table 81 Historic Flow to the Conestogo WWTP

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated Capacity (m ³ /d)	148	-
ADF (m ³ /d)	40 (30%)	-
PDF (m ³ /d)	150	3.5 ⁽¹⁾
PHF (m ³ /d)	170	4.0 ⁽²⁾
PIF (m ³ /d)	190	4.4 ⁽³⁾
Average Per Capita Flow (L/cap·d)	169 ⁽⁴⁾	-

Notes:

1. Based on historic data (January 2012 to December 2014).
2. Assumed based on PDF plus 50% of ADF to allow for diurnal variations.
3. Estimated based on on-site pumping station rated capacity and plant rated capacity.
4. Based on an ADF of 43 m³/d and a 2014 population of 252 provided by the Region's 2015 Water and Wastewater Monitoring Report.

Raw Wastewater Characteristics and Loadings

Historic raw influent concentrations and loadings from 2012 to 2014 are presented in Table 82. The Conestogo WWTP receives low to medium strength wastewater. Per capita loadings were calculated and compared to the typical values expected for domestic sewage. All of the parameters including CBOD₅, TSS, TP and TKN are lower than the typical per capita loadings.

Historic average monthly influent concentrations and loadings were used in the unit process capacity assessment in Section 3.13.3.

Effluent Quality and Performance

The historical effluent quality for the period of 2012 to 2014 is presented in Table 83, along with ECA effluent objectives and compliance limits. Based on the historical plant effluent quality, the Conestogo WWTP has consistently achieved its effluent compliance limits, with the exception of the TP monthly average concentration exceeding the ECA effluent limit in April 2012. Filter upgrades are ongoing to improve the phosphorus removal performance (CH2M Hill, 2015).

Table 82 Conestogo WWTP Raw Wastewater Characteristics and Loadings ⁽¹⁾

Parameter	Average Concentration			Average Loading			
	Historic (mg/L) (1)	Design (mg/L) (2)	Typical Value (mg/L) (3)	Historic (kg/d) (% of Design Loading)	Design (kg/d) (2)	Historic Average Per Capita Loading (g/cap.d) (4)	Typical Per Capita Loading (g/cap.d) (3)
CBOD ₅	180	180	190	7.6 (30%)	30	30	80
TSS	200	210	210	8.7 (30%)	30	35	90
TP	7	8	7	0.3 (30%)	1	1.2	3.2
TKN	55 (56)	35	40	2.4 (60%)	4	9	13

Notes:

1. Based on OCWA Operating and Maintenance Annual Report (2012-2014).
2. Based on Conestogo WWTP Final Preliminary Design Report (Acres and Associated, 2002).
3. Based on Metcalf & Eddy (2003).
4. Based on average loadings and a 2014 population of 252 provided in the Region's 2015 Water and Wastewater Monitoring Report.

Table 83 Conestogo WWTP Effluent Quality and Loadings ⁽¹⁾

Parameter	Concentration (mg/L)				Loading (kg/d)		
	Average	Peak Month (2)	Objective	Limit (3)	Average	Peak Month (2)	Limit (4)
CBOD ₅	2.0	2.2	5.0	10.0	0.09	0.15	1.5
TSS	1.7	3.0	7.0	14.0	0.07	0.20	2.1
TP	0.09	0.35	0.2	0.3	0.004	0.017	0.05
TAN (May 1 to Oct. 31)	0.18	0.83	1.0	2.0	0.01	0.02	0.3
TAN (Nov. 1 to Apr. 30)	0.26	0.55	4.0	8.0	0.01	0.04	1.2

Notes:

1. Based on OCWA Operating and Maintenance Annual Report (2012-2014).
2. The highest monthly average value during 36-month period (January 2012 - December 2014).
3. Based on monthly average concentration values.
4. Based on annual average loading during any calendar year.

3.13.3 Process Capacity Assessment

A capacity assessment for the major liquids and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The assessment was based on historical plant operational data, plant design criteria, approved ECA capacities, and typical design guidelines. Table 84 lists the background data used to estimate the rated capacities for the major processes.

Table 84 Conestogo WWTP Major Unit Process Summary

Process		Description	Value
Raw Sewage Pumping Station	Pumps	Number	2 (1 duty, 1 standby)
		Capacity (per pump)	7.6 L/s at 7.1 m TDH
		Capacity (Firm)	7.6 L/s (657 m ³ /d)
SBR Tanks	Rectangular	Number	2
		Design Capacity (each)	99 m ³ /d ADF
Blowers		Number	3 (2 duty, 1 standby)
		Capacity (per blower)	2.6 m ³ /min of air
Tertiary Filter	Shallow bed	Number	2
		Surface area (total)	2.4 m ²
Disinfection	UV Disinfection	Maximum UV dose	36 mW. s/cm ²
		Transmittance	65%
		Peak flow capacity	591 m ³ /d

All the treatment unit processes at the Conestogo WWTP have sufficient capacity for the current flows and rated capacity. A summary of the equivalent ADF capacity of each unit process is presented in Table 85.

Table 85 Capacity Assessment Summary, Conestogo WWTP

Major Unit Process	Criteria Used	Peak Factor Used	Equivalent ADF Capacity (m ³ /d)
Raw Sewage Pumping Station Raw Sewage Pumps	-	PIF = 4.4	150
SBR Tanks SRT (days)	30 ⁽¹⁾	ADF	200 ⁽²⁾
Oxygenation System Oxygen Demand ⁽³⁾	1.5 kg O ₂ /kg BOD ₅ + 4.6 kg O ₂ /kg TKN	ADF	260
Tertiary Filtration Filtration Rate at PHF (L/m ² ·s)	3.3	PHF = 4.0	170
UV Disinfection Original Peak Design Flow (m ³ /d)	590	PHF = 4.0	150

Notes:

1. Based on Metcalf and Eddy (2003).
2. Based on Conestogo WWTP ECA 2003.
3. Peak oxygen demand with 150% factor of average oxygen demand to account for diurnal fluctuation.

The results of the capacity assessment of the Conestogo WWTP are presented in the PPG in Figure 13.

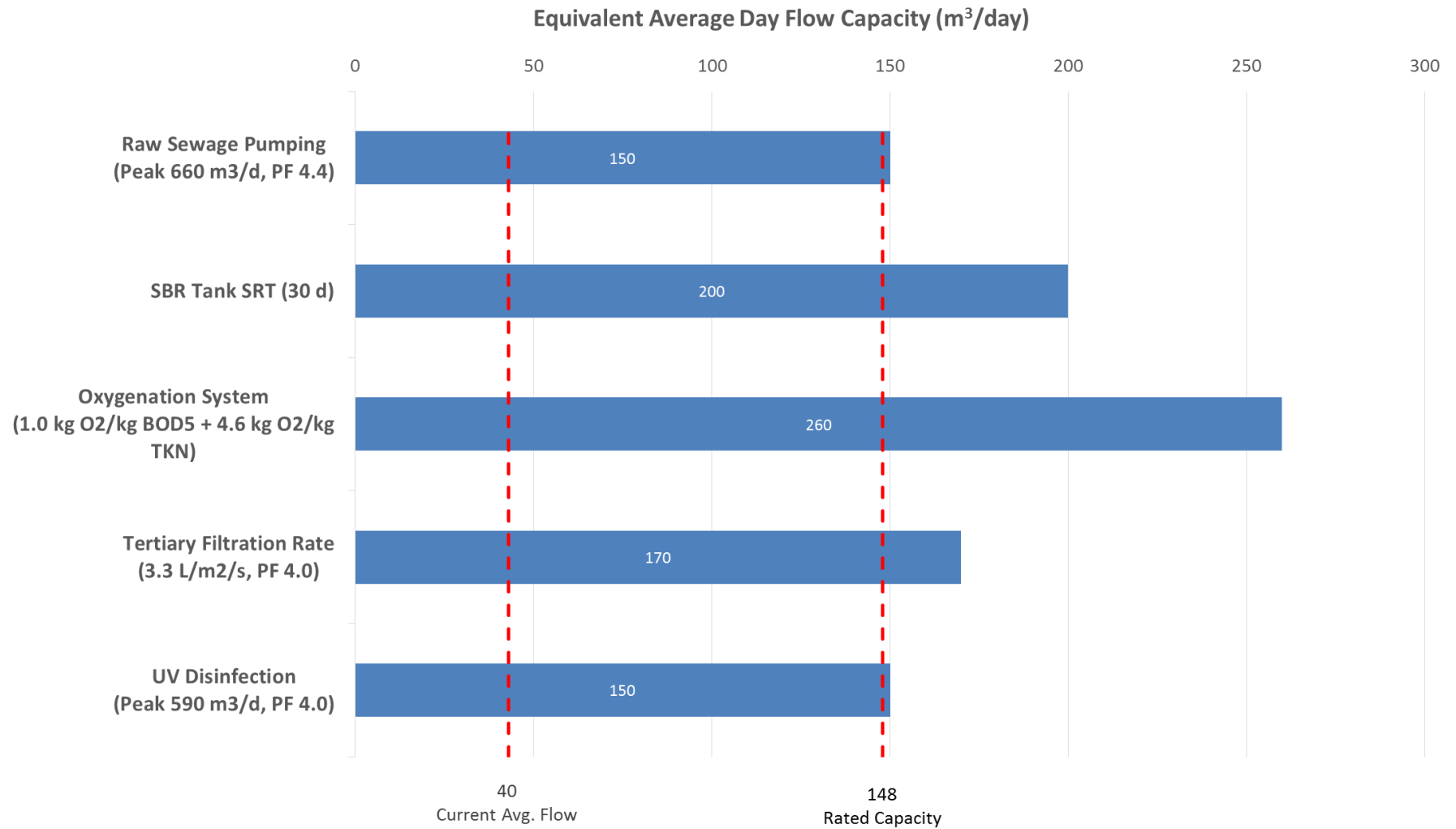


Figure 13 PPG for the Conestogo WWTP

3.13.4 Condition Assessment Findings

The Conestogo WWTP was constructed in 2005. There have been no major upgrades to the WWTP since its construction, but some pieces of equipment have been added and/or replaced since initial construction.

An inventory and condition assessment of all existing assets for the Conestogo WWTP have recently been completed, as part of the Region's Asset Management Implementation Project (CH2M, Hill, 2015^a). The results of the study provided the Region with an up-to-date asset inventory of the Conestogo WWTP, including a 25-year forecast for replacement and repair for all major assets. Since the WWTP was commissioned in 2005, assets are generally in good physical condition. Several minor upgrades were identified as follows:

- + Install permanent, energy efficient and safer heating system to prevent SBR decant motors from freezing during winter
- + Replace the equalization tank pump check valves
- + Find suitable storage location for chemical drums which incorporates secondary containment
- + Replace the boiler and associated piping in the Blower Room
- + Replace SCADA workstation with a more current operating system.

3.13.5 Ongoing and Planned Upgrades

The Conestogo WWTP is currently in the design phase for the tertiary filter upgrades to improve operability and maintain the WWTP effluent quality in accordance with the ECA. The existing filter will be replaced with cloth media filters with a design ADF of 148 m³/d and a peak flow of 592 m³/d (CH2M Hill, 2015^b).

3.13.6 Summary

The following points summarize the findings from the historical data review and process capacity assessment for the Conestogo WWTP:

- + The Conestogo WWTP historically has produced good quality effluent that has met the MOECC ECA effluent limits.

- + There is excess capacity at the plant for the design loadings. Overall the plant has an available equivalent ADF capacity of 148 m³/d.
- + Ongoing upgrades for the plant include:
 - Tertiary filter upgrades.

3.14 Sewage Pumping Stations

As part of this Master Plan Update project, the following Region-owned Sewage pumping stations (SPSs) were also evaluated to identify if the existing SPSs have sufficient capacity to handle the current flow and if there are any upgrade requirements.

- + Bridgeport SPS
- + Spring Valley SPS
- + Baden SPS
- + Morningside SPS
- + Rose Street SPS
- + Ayr SPS
- + Nith River Way SPS

The capacity assessment of the sewage pumping stations was based on comparing the observed current peak wet weather flows (PWWFs) to the station against the existing station firm capacity (i.e., capacity with the largest pump out of service). For the stations where influent flow monitoring data was available (Spring Valley and Bridgeport SPSs), the PWWF was determined using the station historic influent flow monitoring data (i.e. SCADA data at five-minute intervals) during 2013 to 2016.

For the stations where influent flow monitoring data is unavailable (Baden, Morningside and Rose Street SPSs), the current peak wet weather flows were based on the station discharge flow monitoring data. The capacity assessment results for these stations could be refined, if any current influent flow monitoring data is available.

For the Ayr SPS (also referred to as the Swan Street SPS), it is a proposed pumping station and is currently in the detailed design stage. Therefore, there is no flow

monitoring data available for this station, and the capacity assessment was not conducted for this station.

3.14.1 Bridgeport Sewage Pumping Station

The Bridgeport SPS, originally built in 1978, is owned by the Region of Waterloo, and is situated within the City of Kitchener. The Bridgeport SPS receives wastewater from the City of Kitchener and the City of Waterloo and pumps to the Waterloo WWTP for treatment. The pumping station is operated under MOECC ECA No. 7007-8CUJZV, issued on January 24, 2011.

The Bridgeport SPS is currently equipped with two (one duty, one standby) 136 L/s variable speed pumps and one 68 L/s fixed speed jockey pump. The firm capacity of the station is estimated to be 136 L/s, as the jockey pump cannot operate at the same time as the larger variable speed pumps based on the operating head (RVA, July 2016).

The current PWWF into the station is 85 L/s observed on March 31, 2015, which is approximately 60% of the station's firm capacity. Therefore, the existing station has sufficient capacity to handle the current peak wet weather flow. It also has sufficient capacity to handle the projected 2051 PWWF of 114 L/s.

The capacity assessment results of the Bridgeport SPS are summarized in Table 86.

Table 86 Capacity Assessment of the Bridgeport Sewage Pumping Station

Parameter	Value
Number of Pumps	3 (2 variable speed pumps and 1 fixed speed pump)
Pump Capacity (Each) ⁽¹⁾	136 L/s (variable speed) 68 L/s (fixed speed)
Existing SPS Firm Capacity ⁽²⁾	136 L/s (sufficient for current PWWF)
Monitored Current PWWF ⁽³⁾	85 L/s (60% of rated capacity)

Notes:

1. Based on Bridgeport SPS ECA No. 7007-8CUJZV (January, 2011).
2. Based on Bridgeport SPS Flow Diversion TM1 (R.V.A., July 2016).
3. Based on Bridgeport SPS historic influent flow monitoring data (July 2015 to Jun 2016).

3.14.2 Spring Valley Sewage Pumping Station

The Spring Valley SPS, originally built in 1960, is owned by the Region of Waterloo, and is situated within the City of Kitchener. The Spring Valley SPS receives wastewater from the City of Kitchener and pumps it to the Kitchener WWTP for treatment. The pumping station was upgraded in 1992 and is currently operated under MOECC ECA No. 3-0871-92-006, issued on August 4, 1992.

The existing Spring Valley SPS is equipped with three (2 duty, 1 standby) 195 L/s pumps at a total dynamic head (TDH) of 34.8 m. The firm capacity of the station is 245 L/s based on the existing pumps and system curves (RVA, 2015).

The current PWWF into the station is 207 L/s observed on July 14, 2015, which is approximately 85% of the station's firm capacity. Therefore, the existing station has sufficient capacity to handle the current peak wet weather flow. The 2051 projected PWWF of 252 L/s will slightly exceed the existing firm capacity.

The capacity assessment results of the existing Spring Valley SPS are summarized Table 87.

Table 87 Capacity Assessment of the Spring Valley Sewage Pumping Station

Parameter	Value
Number of Pumps	3 (2 duty, 1 standby)
Pump Capacity (Each) ⁽¹⁾	195 L/s at 34.8 m TDH
Existing SPS Firm Capacity ⁽²⁾	245 L/s (sufficient for current PWWF)
Monitored Current PWWF ⁽³⁾	207 L/s (85% of rated capacity)

Notes:

1. Based on Spring Valley SPS ECA No. 3-0871-92-006 (August 4, 1992).
2. Based on Spring Valley Sewage Pumping Station Preliminary Design Report (R.V. A., July 2015).
3. Based on Spring Valley SPS historic influent flow monitoring data (Apr 2015 to June 2016).

Currently, the Spring Valley SPS is in the process of upgrades to replace the existing raw sewage pumps with new units sized to meet the current station firm capacity of 245 L/s (R.V.A., July 2015). Construction is anticipated to take place in 2016/2017, over a twelve (12) month duration.

In addition, the Region has recently completed a Feasibility Study investigating the potential diversion of the Bridgeport SPS flows from the Waterloo WWTP to the

Kitchener WWTP by utilizing the Spring Valley SPS. The diversion of these flows would provide additional capacity at the Waterloo WWTP for future growth. In order for this diversion to be possible, the Feasibility Study recommended that the capacity of the Spring Valley SPS and downstream conveyance infrastructure (i.e. forcemain) would need to be increased from 245 L/s to 381 L/s (R.V. Anderson, July 2016). This potential diversion will be explored as part of this WWTMP Update.

3.14.3 Baden Sewage Pumping Station

The Baden SPS, originally built in 2000, is located on Foundry Street, Baden, between Gingerich Rd and Highway 7/8. The pumping station collects wastewater from the Community of Baden and conveys it to the Morningside SPS via a 200 mm forcemain, where it is pumped to the New Hamburg WWTP for treatment. The pumping station is operated under MOECC ECA No. 4162-4LKPG5, issued on June 28, 2000.

The Baden SPS is equipped with three dry pit pumps (two rated at 49 L/s and one rated at 25 L/s) and three submersible equalization pumps (each rated at 46.7 L/s). The station has a firm capacity of 187 L/s based on the pump and system curves, with 47 L/s to the Morningside SPS and 140 L/s to an equalization tank (EQ, 1,400 m³/d) for storage during peak wet weather flow events (HMM, 2012). The original preliminary design completed at the time of constructing the station estimated that the firm capacity can be increased to 200 L/s with replacement of the two larger dry pit pumps (Stanley, 1998).

The current peak wet weather discharge flow for the station is 185 L/s, observed on September 10, 2014, which is approximately 99% of the station's firm capacity. Therefore, the existing station has sufficient capacity to handle the current peak wet weather flow. However, it does not have sufficient capacity to handle the projected 2051 PWWF of 226 L/s.

The capacity assessment results of the existing Baden SPS are summarized in Table 88.

Table 88 Capacity Assessment of the Baden Sewage Pumping Station

Parameter	Value
Number of Pumps	2 large dry pit pumps (1 duty, 1 standby) 1 dry pit jockey pump 3 submersible equalization pumps
Pump Capacity (Each) ⁽¹⁾	49 L/s (large dry pit pumps) 25 L/s (Jockey pump) 47 L/s (submersible equalization pumps)
Existing SPS Firm Capacity ⁽²⁾	187 L/s (sufficient for current PWWF)
Monitored Current PWWF ⁽³⁾	185 L/s (99% of rated capacity)

Notes:

1. Based on Baden SPS ECA No. 4162-4LKPG5 (June 2000).
2. Based on Baden SPS Investigation Report (HMM, June 2012).
3. Based on Baden SPS historic discharge flow monitoring data (Jun 2013 to Jun 2016).

The existing station has limited pumping and equalization storage capacity to handle the current I/I, as indicated in the 2011 Baden/New Hamburg Waste and Waster Master Plan (AECOM, 2011). Excess flows have been directly trucked to the New Hamburg WWTP on occasion. The 2011 Master Plan recommended that I/I flow be reduced or additional equalization storage capacity be provided at the Baden SPS in order to continue to discharge peak dry weather flow to the Morningside SPS.

In 2012, an investigation was completed for the Baden SPS to determine the constraints of the station and provide recommendations for upgrading the pumping station (HMM, June 2012). The study identified that the preferred option is to continue hauling of excess flow during the very high flow events up to 2041, due to the lowest cost of this option.

To handle the 2051 peak wet weather flows, it is recommended that options to increase the capacity of the Baden SPS be reviewed, which may include continuing hauling of excess flows, installation of an additional pump or equalization storage tank. Requirements/timing for upgrades of the Baden SPS are to be confirmed in the later memos through this Master Plan.

3.14.4 Morningside Sewage Pumping Station

The Morningside SPS is situated within the Morningside Retirement Community located southeast of Morningside Circle West. The pumping station collects all the wastewater from the communities of Baden and New Hamburg and pumps it directly via twin 300 mm forcemains into the New Hamburg WWTP for treatment. The Morningside pumping station is the sole collection point for all wastewater flows to the WWTP.

The Morningside SPS is currently equipped with four 87.5 L/s submersible pumps (3 duty and 1 standby). Three of the existing pumps are the original Flygt CP 3300 model and the fourth pump was replaced with the Flygt NP 3301 model in 2015 (Stantec, 2017). The Morningside station has a firm capacity of 248 L/s based on the pump and system curves (Stantec, 2017).

The current peak wet weather discharge flow for the station is 206 L/s observed on June 9, 2010, which is approximately 80% of the station's firm capacity. Therefore the existing station has sufficient capacity to handle the current peak wet weather flow. However, it does not have sufficient capacity to handle the projected 2051 PWWF of 272 L/s.

The capacity assessment results of the existing Morningside SPS are summarized in Table 89.

Table 89 Capacity Assessment of the Morningside Sewage Pumping Station

Parameter	Value
Number of Pumps	4 (3 duty, 1 standby)
Pump Capacity (Each) ⁽¹⁾	87.5 L/s
Existing SPS Firm Capacity ⁽¹⁾	248 L/s (sufficient for current PWWF)
Monitored Current PWWF ⁽²⁾	206 L/s (80% of rated capacity)

Notes:

1. Based on the Morningside Sewage Pumping Station Capacity Assessment Report (Stantec, 2017).
2. Based on Morningside SPS historic discharge flow monitoring data (June 2008 to October 2012).

A capacity assessment was completed to evaluate the potential capacity upgrade options at the Morningside SPS to meet future growth needs (Stantec, 2017). The assessment identified that an expansion to 290 L/s could be provided with the replacement of all the existing four pumps.

3.14.5 Rose Street Sewage Pumping Station

The Rose Street SPS is located at the intersection of Rose Street and Water Street in the Village of Ayr. The Rose Street SPS receives all of the wastewater from the Village of Ayr and pumps it directly into the Ayr WWTP for treatment.

The Rose Street SPS is currently equipped with three 47 L/s raw sewage pumps. The firm capacity of the pumping station is estimated to be 80 L/s, according to the 2012 Ayr Wastewater Master Plan (XCG, 2012).

The current peak wet weather discharge flow for the station is 38 L/s observed on June 14, 2013, which is approximately 50% of the station's firm capacity, suggesting that the existing station has sufficient capacity to handle the current peak wet weather flow. The existing station also has sufficient capacity to handle the projected 2051 PWWF of 56 L/s.

The capacity assessment results of the Rose Street SPS are summarized in Table 90.

Table 90 Capacity Assessment of the Rose Street Sewage Pumping Station

Parameter	Value
Number of Pumps	3 (2 duty, 1 standby)
Pump Capacity (Each) ⁽¹⁾	47 L/s
Exting SPS Firm Capacity ⁽¹⁾	80 L/s (sufficient for current PWWF)
Monitored Current PWWF ⁽²⁾	38 L/s (50% of rated capacity)

Notes:

1. Based on Ayr Wastewater Master Plan Report (XCG, 2012).
2. Based on Rose Street SPS historic discharge flow monitoring data (January 2013 to December 2015).

3.14.6 Ayr Sewage Pumping Station

The Ayr SPS (also referred to as the Swan Street SPS) is a proposed Sewage Pumping Station to service the new development in the south end of the Village of Ayr, Township of North Dumfries. The station will be located near the northeast corner of Swan Street and Brant-Waterloo Road to convey sewage to the Ayr WWTP, along with the Rose Street SPS, according to the Ayr SPS, Forcemain, and Trunk Sewer Class EA (Stantec, 2014).

The Ayr SPS will be constructed in two phases (Phase 1 and Phase 2), with a firm capacity of 46 L/s for Phase 1 and 84 L/s for Phase 2 (Blue Plan, 2016). The station

shall be initially constructed with two pumps (one duty, one standby, each rated 46 L/s) to meet the Phase 1 flow requirements, with provision to accommodate future Phase 2 flows. Once the population has grown to the point that Phase 1 flow projections are exceeded, upgrades to the station will be required, including one additional pump and a second forcemain (Blue Plan, 2016). The Phase 1 capacity is sufficient to handle the projected 2051 PWWF of 41 L/s.

As discussed in Section 3.6.4, with the construction of the proposed Ayr SPS, the Ayr WWTP will have two SPSs (i.e. Rose St. and Ayr SPSs) that convey all flows to the plant. Therefore, the future capacity requirements of the plant will need to consider not only the population projections but also the SPS operation and capacity with respect to the downstream plant peak flow capacity requirements.

3.14.7 Nith River Way Sewage Pumping Station

The Nith River Way SPS is located on Nith River Way, Ayr and services a relatively small area. It receives wastewater from Seyler Street, Nith River Way, Robson Street, Simone Place, Douglas Street and Broom Street, Ayr.

The Nith River Way SPS is equipped with two 3.9 L/s pumps that pump into a 150 mm diameter forcemain that discharges into the Broom Street sanitary sewer. The firm capacity of the Nith River Way SPS was estimated to be 3.9 L/s based on the largest pump out of service and a pump efficiency of 75%, according to the 2014 Ayr Wastewater System Class EA (Stantec, 2014), which is sufficient to convey flows from this small service area.

The capacity assessment results of the Nith River Way SPS are summarized in Table 91. It should be noted that Nith River Way SPS is a dedicated development SPS and there is minimal projected growth, and no population and flow projections were estimated for this station.

Table 91 Capacity Assessment of the Nith River Way Sewage Pumping Station

Parameter	Value
Number of Pumps	2 (1 duty, 1 standby)
Pump Capacity (Each) ⁽¹⁾	3.9 L/s
Existing SPS Firm Capacity ⁽¹⁾	3.9 L/s (sufficient for current PWWF)
Current PWWF	<3.9 L/s

Notes:

1. Based on Ayr Sewage pumping station, Forcemain, and Trunk Sewer Routing Municipal Class Environmental Assessment (Stantec, 2014).

4. Summary and Recommendations

The current status and capacity of all the thirteen WWTPs and seven SPSs within the Region were evaluated. The main findings and recommendations are summarized as follows:

- ✦ All the WWTPs historically have produced good quality effluent that has met the MOECC ECA effluent limits, with the exception of the total ammonia nitrogen (TAN) and/or total phosphorus (TP) concentration on occasions at a few plants.
- ✦ All the WWTPs have sufficient capacity to handle the plant design flows, with the exception of some unit processes at the Wellesley, St Jacobs and Elmira WWTPs due to I/I issues experienced at the plants and/or higher influent organic loadings than original design values.
- ✦ All the Region-owned SPSs have sufficient capacity to convey the current PIFs.

A summary of the preliminary capacity assessment results for all the WWTPs and SPSs within the Region is provided in Table 92 and Table 93, respectively.

Table 92 Capacity Assessment of WWTPs, Region of Waterloo

Facility	Rated Capacity (m ³ /d)	Current Flow (2012-2014) (m ³ /d) (% of Rated Capacity)	Equivalent ADF Capacity (m ³ /d)	Most Limiting Factor	Recommendations to improve Plant Capacity
Kitchener WWTP	122,745	70,970 (60%)	122,750	N/A	N/A
Waterloo WWTP	57,500	46,640 (80%)	57,500	N/A	N/A
Galt WWTP	56,800	35,230 (60%)	52,190	N/A	N/A
Preston WWTP	16,860	9,000 (55%)	16,860	N/A	N/A
Hespeler WWTP ⁽¹⁾	9,320	6,940 (75%)	9,470	N/A	N/A
Ayr WWTP	3,000	1,300 (45%)	3,000	N/A	N/A
New Hamburg WWTP ⁽²⁾	6,900	3,700 (55%)	6,900	N/A	N/A
Wellesley WWTP	1,100	870 (80%)	950	Secondary Clarifiers	Reduce I/I ⁽³⁾
St Jacobs WWTP	1,450	920 (65%)	1,080	Tertiary Filters	Reduce I/I ⁽³⁾
Elmira WWTP	7,800	4,450 (55%)	5,700	Bioreactors	Reduce I/I; and reduce influent BOD ₅ loadings ⁽³⁾
Alt-Heidelberg WWTP	130	60 (50%)	130	N/A	N/A
Foxboro Green WWTP	150	110 (75%)	310	N/A	N/A
Conestogo WWTP	148	43 (30%)	150	N/A	N/A

Notes:

1. Capacity assessment is for the upgraded Hespeler WWTP with an addition of third secondary clarifier and fine screens (Stantec, 2015).
2. Capacity assessment is for the Phase 2 expanded New Hamburg WWTP with a design ADF of 6,900 m³/d (HMM, 2015).
3. Contingency recommendations on I/I and BOD₅ loading reduction will be addressed in later memos within this WWTMP.

Table 93 Capacity Assessment of SPSs, Region of Waterloo

Sewage Pumping Station	Firm Capacity (L/s)	Current PWWF (L/s) (% of Firm Capacity)	2051 PWWF (L/s)	Recommendations
Bridgeport SPS	136	85 (60%) ⁽¹⁾	114	N/A
Spring Valley SPS	245	207 (85%) ⁽¹⁾	252	N/A
Baden SPS	187	185 (98%) ⁽²⁾	226	Review options to increase the SPS capacity to handle the 2051 PWWF.
Morningside SPS	248	206 (80%) ⁽²⁾	272	Pump upgrades to provide additional capacity to handle the 2051 PWWF ⁽⁵⁾ .
Rose Street SPS	80	38 (50%) ⁽²⁾	56	N/A
Ayr SPS	46	N/A ⁽³⁾	41	N/A
Nith River Way SPS	N/A	<3.9 (<100%)	N/A ⁽⁴⁾	N/A

Notes:

1. Peak wet weather flow into the station based on historic influent flow monitoring data.
2. Peak wet weather discharge flow for the station based on historic discharge flow monitoring data.
3. The Ayr SPS is currently under construction and there is no current flow data available.
4. Nith River Way SPS is a dedicated development SPS, and there is no projected growth.
5. Based on Morningside Sewage pumping station Capacity Assessment (Stantec, February 2017).

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