Appendix E

Assimilative Capacity Study of the South Nation River (February 2024)

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

MEMO

Date:	February 23, 2024
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Subject:	Technical Memorandum – Assimilative Capacity Study of the South Nation River R1
JLR No.:	16953-133

Introduction

J.L Richards & Associates Limited (JLR) in association with Blue Sky Energy Engineering & Consulting Inc. (Blue Sky) acting as the sub-consultant, were retained by the Municipality of Casselman (the Municipality) to conduct an Assimilative Capacity Study (ACS) of the South Nation River. The findings obtained from this study will be used as a key input for the ongoing Water and Wastewater Infrastructure Master Plan, to inform the comparison of alternatives to expand the Casselman Wastewater Treatment System (WWTS) to accommodate future growth.

Background and Objectives

The Casselman WWTS operates under Amended Environmental Compliance Approval (ECA) No. 8160-BAHPRF, with a rated capacity of 2,110 m^3/day and allowable seasonal discharge to the South Nation River between October 1 and May 15. In 2022, JLR was retained by Casselman to complete a Water and Wastewater Infrastructure Master Plan in accordance with the Municipal Class Environmental Assessment requirements. Through the Master Plan process, it was determined that the anticipated future design average daily flow (ADF) of the WWTS is approximately 4,050 m^3/day.

Through preliminary consultation with the Ministry of Environment, Consultation and Parks (MECP), it was identified that to expand the discharge flow rate and/or timing of discharge from the WWTS, the Municipality must undertake an ACS, which demonstrates the impact of the proposed changes on the South Nation River.

The objectives of this Technical Memorandum are to:

- Present project background including existing conditions and stakeholder consultation activities.
- Summarize the methodology and results of the ACS.
- Comment on the impact of discharge scenarios on storage and treatment technologies.

Existing Conditions

Description of the Existing System

The Casselman WWTS is a seasonal-discharge facultative lagoon system with post-lagoon polishing treatment. The treatment train consists of:

- Two (2) facultative lagoons (Cells A and B), each with an effective storage volume of 115,000 m^3
- One (1) aerated lagoon (Cell C), with an effective storage volume of 100,000 m^3
- An alum dosing system for phosphorus precipitation.
- One Moving Bed Biofilm Reactor (MBBR) to provide post-lagoon nitrification (ammonia removal), with a rated capacity of 3,500 m^3/d and peak flow rate of 5,000 m^3/d, and
- One disk filter to provide polishing removal of suspended solids and phosphorus, with a peak flow rate of 10,000 m^3/d.

Currently, the system is operating at 65% of its total rated capacity with an ADF of 1,381 m^3/d, and a maximum day flow (MDF) of 3,206 m^3/d. Based on the wastewater demands and growth development timelines, the WWTS is projected to reach 100% of its rated capacity in 2026.

Existing ECA Discharge Regime

Under the existing ECA, effluent discharge to the South Nation River is permitted during two seasonal periods, Winter/Spring and Fall. The Winter/Spring season permits a total allowable effluent discharge volume of 502,500 m^3 between January 1 and May 15. The Fall season permits a total allowable effluent discharge volume of 267,650 m^3 between October 1 and December 31. In addition to the total allowable seasonal effluent discharge volumes, the ECA defines maximum daily discharge rates for each calendar month within the permitted period, see Table 1 below.

Table 1: Maximum Monthly Effluent Discharge Rates

DISCHARGE PERIOD	MAXIMUM DISCHARGE RATE (m^3/d)
Jan 1 – 31	5,000
Feb 1 – 28/29	5,000
Mar 1 – 31	5,000
Apr 1 – 30	7,000
May 1 – 15	7,000
Oct 1 – 31	4,000
Nov 1 – 30	4,000
Dec 1 – 31	5,000

The ECA also defines effluent concentration objectives and limits as well as seasonal loading limits for carbonaceous biochemical oxygen demand ($cBOD_5$), total suspended solids (TSS), total phosphorus (TP), hydrogen sulfide, and total ammonia nitrogen (TAN). Effluent concentration objectives and limits and seasonal loading limits are summarized in Table 2 below.

Table 2: Final Effluent Compliance Objectives and Limits

Parameter	Concentration Objective	Concentration Limit	Loading Limit
Winter/Spring (Jan 1 – May 15)			
$CBOD_5$	15 mg/L	25 mg/L	93.06 kg/d
TSS	15 mg/L	25 mg/L	93.06 kg/d
TP	0.8 mg/L	1.0 mg/L	3.73 kg/d
TAN Jan 1 – Mar 31 Apr 1 – May 15	 12.0 mg/L 6.0 mg/L	 12.0 mg/L 6.0 mg/L	 44.67 kg/d 22.33 kg/d
E. coli [1]	100 CFU/100 mL	200 CFU/100 mL	-
Hydrogen Sulfide	0.1 mg/L	0.1 mg/L	0.37 kg/d
pH	Maintained between 6.8 to 7.8, inclusive, at all times	Maintained between 6.0 to 8.0, inclusive, at all times	-
Fall (Oct 1 – Dec 31)			
$CBOD_5$	10 mg/L	15 mg/L	43.64 kg/d
TSS	10 mg/L	25 mg/L	72.73 kg/d
TP	0.8 mg/L	1.0 mg/L	2.91 kg/d
TAN Oct 1 – Nov 30 Dec 1 – Dec 31	 5.0 mg/L 12.0 mg/L	 5.0 mg/L 12.0 mg/L	 14.55 kg/d 34.89 kg/d
E. coli [1]	100 CFU/100 mL	200 CFU/100 mL	-
Hydrogen Sulfide	Not Detected	Not Detected	-
pH	Maintained between 6.8 to 7.8, inclusive, at all times	Maintained between 6.0 to 8.0, inclusive, at all times	-
1. In our understanding, *E. coli* was added in error during the previous ECA amendment, as there is no disinfection treatment at the facility and no discharge during summer months. Therefore, although this water quality parameter is measured, compliance is not enforced.			

Stakeholder Pre-Consultation and Identification of Preferred Approach

MECP Pre-Consultation

On November 2nd, 2023, a consultation meeting was held with the MECP. JLR and BlueSky presented two scenarios for increasing the total discharge flow to 4,050 m^3/day. Scenario 1 proposed to increase flow during the existing discharge window, while Scenario 2 proposed to expand the discharge window to be year-round.

An analysis of Scenario 1 estimated a maximum effluent storage volume requirement of 460,000 m^3, which would require additional storage of 130,000 m^3 from the existing capacity. Maximum annual TP loading was limited to 770 kg/year as per the existing loading limits. A summary of the TP and TAN objectives and limits outlined for Scenario 1 is provided in Table 3 below.

Table 3: Scenario 1 – Seasonal Discharge TP and TAN Objectives and Limits

Parameter	Objective		Limit	
TP	Monthly	0.36 mg/L	Monthly	0.45 mg/L
TAN Winter (Dec 1 to Mar 31) Spring (Apr 1 to May 15) Fall (Oct 1 to Nov 30)	 Monthly Monthly Monthly	 8.0 mg/L 4.8 mg/L 3.6 mg/L	 Monthly Monthly Monthly	 10.0 mg/L 6.0 mg/L 4.5 mg/L

An analysis of Scenario 2 estimated a maximum effluent storage volume requirement of 315,000 m^3, which is 15,000 m^3 less than the existing capacity. Maximum annual TP loading was reduced from the existing loading limits of 770 kg/year to 476 kg/year; however a new summer TP loading of 45.7 kg would be introduced. A summary of the TP and TAN objectives and limits outlined for Scenario 2 is provided in Table 4 below.

Table 4: Scenario 2 – Year-round Discharge TP and TAN Objectives and Limits

Parameter	Objective		Limit	
TP	Monthly	0.20 mg/L	Monthly	0.30 mg/L
TAN Winter (Dec 1 to Mar 31) Spring (Apr 1 to May 31) Summer (Jun 1 to Sep 30) Fall (Oct 1 to Nov 30)	 Monthly Monthly Monthly Monthly	 9.2 mg/L 4.8 mg/L 1.0 mg/L 4.0 mg/L	 Monthly Monthly Monthly Monthly	 11.5 mg/L 6.0 mg/L 1.3 mg/L 5.0 mg/L

Given the existing property limitations for expanding the storage capacity at the wastewater treatment facility, the additional buffer provided from reduced storage volume requirements, and the overall reduction in annual TP loadings, Scenario 2 was deemed the favorable option. Refer to Appendix A for meeting minutes.

SNCA Consultation

The South Nation Conservation Authority (SNCA) was contacted to discuss the ongoing Class EA study and proposed ACS approach to expand the discharge window to be year-round. From email correspondence dated November 29, 2023, SNCA confirmed that they had no concerns with respect to expanding the discharge period to year-round provided total TP loading does not exceed the current ECA limit.

Based on the consultation with the governing authorities, the ACS was completed to correspond with Scenario 2, to increase the effluent discharge window to be year-round.

Desktop Assimilative Capacity Study

A desktop assimilative capacity study of the South Nation River was undertaken by Blue Sky to develop reasonable effluent targets and discharge rates for an upgraded WWTS and assess the potential to expand the existing discharge window and increase the allowable rate of discharge based on anticipated effluent criteria. The ACS Report dated January 11, 2024 has been included in Appendix A. The study included the following components:

- Review of available data in the upstream vicinity of the effluent discharge location to establish ambient conditions and SNR flow conditions. A nearby Provincial Water Quality Monitoring Network (PWQMN) station was identified to be located approximately 1km upstream of the outfall. The station's data contained information on water quality parameters between 1970 to 2020 including BOD_5, DO, ammonia, temperature, pH, TP, TSS, Nitrate, *E. Coli* (1970 to 2020). A Water Survey of Canada (WSC) gauge was identified to be located approximately 1km upstream of the outfall; the gauge contained river flow data from 1950 to 2021.

- Establishment of water quality ambient conditions for the South Nation River as defined by MECP and Provincial Water Quality Objectives (PWQO).
- Assessment of the effluent discharge period to be expanded to year-round discharge which eliminates the need for additional storage lagoon volume.
- Assessment of mixing zone characteristics using CORMIX.
- Recommendation of loading and water quality parameters.

Ambient Conditions

For establishing the South Nation River ambient water quality parameters, the 75th percentile is applied when characterizing ambient conditions. For dissolved oxygen (DO), low concentrations are indicators of degraded water quality; therefore 25th percentiles are typically used rather than 75th percentiles to characterize ambient conditions.

The receiving water quality is assigned Policy 1 if the ambient concentrations is less than the PWQO and Policy 2 if the ambient concentrations exceed the PWQO. The following water quality parameters were assigned Policy 1: unionized ammonia (with limited capacity between June to August), DO, and E. coli. TP was assigned Policy 2.

Given that there are no PWQO values for TSS, the Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQG) were used. For TSS the CWQG recommends a maximum increase of 5 mg/L from background levels for long-term exposures.

The 7Q20 river flow (minimum average 7-day low flow with a return period of 20 years) was also calculated on a monthly basis to represent low-flow conditions.

Results

The ACS considered an expanded yearly discharge window for its analysis. Assessment of seasonal impact from the effluent assumed the following seasonal periods:

- Winter: December 1 to March 31
- Spring: April 1 to May 31
- Summer: June 1 to September 30
- Fall: October 1 to November 30

The ACS considered the impact of stored precipitation in the lagoons on total discharge volume requirements. Using an analysis of monthly precipitation/evaporation rates, the existing lagoon cells were determined to contribute the equivalent of 297 m^3/d of stored precipitation. As a result, effluent limits were developed assuming a total equivalent effluent discharge rate of 4,347 m^3/d. Monthly discharge volumes were considered to maintain adequate dilution ratios, with a minimum value of 10:1, ensuring reasonable downstream fully mixed water quality, and providing allowances for WWTS operational flexibility.

Maximum Effluent Discharge Rates

Based on the analysis, maximum effluent discharge rates were developed for each month and are presented below in Table 5. Assuming the upgraded WWTS discharges effluent at the maximum proposed discharge rates throughout the year, a total annual volume of 1,674,050 m^3 would be discharged (equivalent to average day flow of 4,586 m^3/d). This average day flow provides sufficient flexibility to discharge the design influent ADF (4,050 m^3/d) plus the anticipated stored precipitation volume (297 m^3/d).

Table 5: Monthly Maximum Effluent Discharge Rates and Minimum Dilution Ratio

MONTH	MAXIMUM DAILY DISCHARGE RATE	MINIMUM DILUTION RATIO
January	5,750 m^3/d	12.4
February	5,600 m^3/d	12.4
March	7,250 m^3/d	12.3
April	10,000 m^3/d	72.9
May	4,500 m^3/d	40.5
June	2,150 m^3/d	26.2
July	1,050 m^3/d	26.2
August	900 m^3/d	26.3
September	910 m^3/d	26.2
October	2,250 m^3/d	13.1
November	6,050 m^3/d	13.1
December	8,750 m^3/d	12.4

CORMIX Modelling

To determine the required distance downstream of the effluent discharge to attain fully mixed conditions, a CORMIX model was performed. The results of the model are summarized in Table 6 below. Excluding the month of April, the results represent relatively small mixing zones which would result in minimal impact on the South Nation River. Despite the larger distance to attain fully mixed conditions in April (375 m), the impact on downstream total phosphorus and unionized ammonia is expected to be low due to the high dilution ratio (72.9:1) and the proposed effluent limits maintaining total phosphorus concentrations close to ambient values and unionized ammonia below the PWQO.

Table 6: Summary of Distance Required Downstream to Achieve Fully Mixed Conditions

MONTH	EFFLUENT FLOW (m^3/d)	RIVER FLOW (m^3/s)	DILUTION RATIO	DISTANCE-DOWNSTREAM TO ACHIEVE FULLY-MIXED CONDITIONS (m)
January	5,750	0.826	12.4	100
February	5,600	0.802	12.4	100
March	7,250	1.035	12.3	130
April	10,000	8.442	72.9	375
May	4,500	2.108	40.5	175
June	2,150	0.652	26.2	80
July	1,050	0.319	26.2	75
August	900	0.274	26.3	80
September	910	0.276	26.2	80
October	2,250	0.340	13.1	80
November	6,050	0.918	13.1	125

MONTH	EFFLUENT FLOW (m^3/d)	RIVER FLOW (m^3/s)	DILUTION RATIO	DISTANCE-DOWNSTREAM TO ACHIEVE FULLY-MIXED CONDITIONS (m)
December	8,750	1.251	12.4	125

Proposed Effluent Objectives and Limits

The proposed effluent objectives and limits were conducted using a mass-balance approach to ensure downstream, fully-mixed season concentrations remain at or below the PWQO at ambient (75th percentile) concentrations and low (7Q20) flows. The analysis also considered limiting the future effluent total phosphorus loadings to 770 kg/year (existing ECA limit) or less, while also considering minimizing total phosphorus loading during the critical summer period to reduce impacts on downstream, fully mixed total phosphorus concentrations. Effluent pH targets are equal to those under the existing ECA. The recommended seasonal E. coli objective and limit are consistent with targets for similar municipal WWTS's in Ontario and, in particular, facilities discharging to the South Nation River. The proposed water quality objectives and limits are summarized in Table 7 below.

Table 7: Proposed Effluent Water Quality Objectives and Limits

PARAMETER	AVERAGING PERIOD	OBJECTIVE	LIMIT
$cBOD_5$	Monthly	10 mg/L	12 mg/L
TSS	Monthly	10 mg/L	12 mg/L
TP	Monthly	0.20 mg/L	0.30 mg/L
TAN			
Dec 1 to Mar 31	Monthly	9.2 mg/L	11.5 mg/L
Apr 1 to May 31	Monthly	4.8 mg/L	6.0 mg/L
Jun 1 to Sep 30	Monthly	1.0 mg/L	1.3 mg/L
Oct 1 to Nov 30	Monthly	4.0 mg/L	5.0 mg/L
E.coli			
May 1 to Oct 31	Monthly	150 CFU/100 mL	200 CFU/100 mL
pH	Single Grab	6.8 to 7.8	6.0 to 8.0

MECP Comments and Response

Comments on the ACS Report were provided by Sarah Baxter, Surface Water Specialist, in a memorandum dated February 1, 2024, and a response was provided by Blue Sky in a memorandum dated February 16, 2024. This correspondence has been included in Appendix B. Based on MECP's comments, revised proposed effluent water quality objectives and limits were prepared as presented in Table 8, as well as proposed effluent loading limits as presented in Table 9. Following formal acceptance by MECP, these values can be used as the basis of design for comparison of design alternatives for a future Schedule C MCEA as well as future application for ECA amendment for increased treatment capacity of the lagoon system.

Table 8: Revised Proposed Effluent Water Quality Objectives and Limits

PARAMETER	AVERAGING PERIOD	OBJECTIVE	LIMIT
$cBOD_5$	Monthly	10 mg/L	12 mg/L
TSS	Monthly	10 mg/L	12 mg/L
TP	Monthly	0.20 mg/L	0.30 mg/L
TAN			
Dec 1 to Mar 31	Monthly	9.2 mg/L	11.5 mg/L
Apr 1 to May 31	Monthly	4.8 mg/L	6.0 mg/L
Jun 1 to Sep 30	Monthly	1.0 mg/L	1.3 mg/L
Oct 1 to Nov 30	Monthly	4.0 mg/L	5.0 mg/L
E.coli			
May 1 to Oct 31	Monthly	150 CFU/100 mL	200 CFU/100 mL
pH	Single Grab	6.8 to 7.8	6.0 to 8.0

Table 9: Proposed Effluent Loading Limits

PARAMETER	AVERAGING PERIOD	LIMIT (kg/d)
$cBOD_5$	Annual	52.5
TSS	Annual	52.5
TP	Annual	1.31
TAN		
January	Monthly	66.1
February	Monthly	64.4
March	Monthly	83.4
April	Monthly	60.0
May	Monthly	27.0
June	Monthly	2.80
July	Monthly	1.37
August	Monthly	1.17
September	Monthly	1.18
October	Monthly	11.3
November	Monthly	30.3
December	Monthly	100.6

Description of Required Upgrades

As noted above, the existing facultative lagoon system is anticipated to have sufficient storage capacity to accomplish the required flow balancing between months without expansion.

JLR consulted with the supplier of the MBBR and disk filter system, Veolia, to discuss whether the new effluent objectives and limits could be achieved at the new monthly flow rates, with the discussion focusing on TAN and TP. Veolia provided the following preliminary comments:

- The proposed maximum flow rate through the MBBR and disk filter is equal to their peak design flow rates; therefore, the units can hydraulically handle the new monthly flow rates.
- The proposed TAN objectives appear to be achievable with the existing system, to be confirmed using process modelling by Veolia. The stricter TAN objectives during the summer were not a concern given the expected warm temperatures during this period.

- The proposed TP objective is reasonable for a disk filter; however, Veolia recommended that the following upgrades be considered:
  - Provision of a second disk filter to provide redundancy. Given the difference between allowable discharge in April (10,000 m^3/d) and the following six months (900 – 4,500 m^3/d), any prolonged system failure during April could result in excess wastewater accumulating in the lagoons which could not be discharged, resulting in an emergency overflow.
  - Provision of a coagulation chamber to provide a secondary point of coagulant dosing, to ensure that all reactive phosphorus is precipitated into particulate form prior to filtration.

It was also acknowledged that a new disinfection system (e.g. UV or chlorination/de-chlorination) would need to be provided in order to ensure that the E.coli objective is met.

Veolia then prepared a proposal with technical recommendations related to achieving the more stringent effluent criteria, dated January 26, 2024; this proposal has been included in Appendix C. In addition to the above preliminary comments, the proposal includes recommendations to improve the flow path within the existing lagoon cells to improve pre-treatment, and to increase MBBR aeration blower capacity.

The preferred approach to upgrading the treatment system, including any phasing of upgrades, will be confirmed during the future Schedule C MCEA for expansion of the WWTS.

Conclusion

The ACS of the South Nation River was completed following recommendations outlined from consultation with the MECP and the SNCA for the increasing the effluent discharge window to be year-round. The effluent quality objectives and limits outlined within this technical memorandum were developed using a future design influent ADF of 4,050 m^3/d, and an equivalent average effluent discharge rate of 4,347 m^3/d, are anticipated to have minimal effect on the South Nation River.

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Appendix A

ACS Report

Final Report
Assimilative Capacity Study to Support the Expansion of the Casselman WWTS

January 11, 2024

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1. Introduction

1.1 Overview

A Class Environmental Assessment (Class EA) study is underway to determine the most cost effective and environmentally sustainable approach to increasing wastewater servicing capacity to meet future growth needs in Casselman. An assimilative capacity assessment of the South Nation River is required to develop reasonable effluent targets and discharge rates for an upgraded Casselman WWTS.

Blue Sky Energy Engineering & Consulting Inc. (Blue Sky), in association with J.L. Richards & Associates Limited (JLR), has been retained to conduct a desk-top assimilative capacity study (ACS) of the South Nation River to support the Casselman WWTS Class EA study. This report summarizes the results of the ACS.

1.2 Objectives

The specific objectives of the ACS are to:

- Document data sources and assumptions used;
- Define ambient water quality and verify low flow conditions in the South Nation River;
- Complete CORMIX modelling of the mixing zone; and,
- Develop recommendations for future effluent requirements for an upgraded Casselman WWTS a future annual discharge average daily flow (ADF) value of 4,050 m^3/d.

2. Background

2.1 Current Effluent Requirements

The existing Casselman WWTS is a lagoon-based treatment system operated under amended Environmental Compliance Approval (ECA) No. 8160-BAHPRF and has a rated capacity of 2,110 m^3/d. The facility discharges directly to the South Nation River.

Effluent discharge is currently permitted during two seasonal periods, namely:

- Winter/Spring (Jan 1 to May 15): Total allowable discharge volume of 502,500 m^3; and,
- Fall (Oct 1 to Dec 31): Total allowable discharge volume of 267,650 m^3.

In addition to the total seasonal discharge volumes permitted, maximum effluent discharge rates have been defined for each calendar month, as shown in Table 2.1. Effluent concentration objectives and limits are shown in Table 2.2.

In addition to the above, the ECA specifies seasonal loading limits for $cBOD_5$, TSS TP, and hydrogen sulfide, as well as semi-seasonal loading limits for TAN. These are summarized in Table 2.3, and are based on the concentration limit (Table 2.2) and total allowable discharge volumes during each discharge period.

Table 2.1 – Existing Maximum Monthly Effluent Discharge Rates – Casselman WWTS (2,110 m^3/d)

Discharge Period	Maximum Discharge Rate	Maximum Discharge Rate Based on Dilution Ratio [(1)]
Jan 1 – 31	5,000 m^3/d	SNR Flow/10
Feb 1 – 28/29	5,000 m^3/d	SNR Flow/10
Mar 1 – 31	5,000 m^3/d	SNR Flow/40
Apr 1 – 30	7,000 m^3/d	SNR Flow/60
May 1 – 15	7,000 m^3/d	SNR Flow/60
Oct 1 – 31	4,000 m^3/d	SNR Flow/15
Nov 1 – 30	4,000 m^3/d	SNR Flow/10
Dec 1 – 31	5,000 m^3/d	SNR Flow/15
Notes: 1. SNR Flow = South Nation River Flow		

Table 2.2 – Existing Effluent Objectives and Limits – Casselman WWTS (2,110 m^3/d)

Parameter	Objective		Limit	
	Averaging Period	Value	Averaging Period	Value
$cBOD_5$				
Jan 1 to May 15	Monthly	15 mg/L	Monthly	25 mg/L
Oct 1 to Dec 31	Monthly	10 mg/L	Monthly	15 mg/L
TSS				
Jan 1 to May 15	Monthly	15 mg/L	Monthly	25 mg/L
Oct 1 to Dec 31	Monthly	10 mg/L	Monthly	25 mg/L
TP	Monthly	0.8 mg/L	Monthly	1.0 mg/L
TAN				
Jan 1 to Mar 31	Monthly	12.0 mg/L	Monthly	12.0 mg/L
Apr 1 to May 15	Monthly	6.0 mg/L	Monthly	6.0 mg/L
Oct 1 to Nov 30	Monthly	5.0 mg/L	Monthly	5.0 mg/L
Dec 1 to Dec 31	Monthly	12.0 mg/L	Monthly	12.0 mg/L
E. coli	Monthly (1)	100 CFU/100 mL	Monthly (1)	200 CFU/100 mL
Hydrogen Sulfide				
Jan 1 to May 15	Monthly	0.1 mg/L	Monthly	0.1 mg/L
Oct 1 to Dec 31	Monthly	Not Detected	Monthly	Not Detected
pH	Single Sample	6.8 to 7.8	Single Sample	6.0 to 8.0

Notes:

$cBOD_5$ – 5-day biochemical oxygen demand

TSS – total suspended solids

TP – total phosphorus

1. Monthly geometric mean

Table 2.3 – Existing Effluent Loading Limits – Casselman WWTS (2,110 m^3/d)

Parameter	Averaging Period	Limit
$cBOD_5$		
Jan 1 to May 15	Seasonal	93.06 kg/d
Oct 1 to Dec 31	Seasonal	43.64 kg/d
TSS		
Jan 1 to May 15	Seasonal	93.06 kg/d
Oct 1 to Dec 31	Seasonal	72.73 kg/d
TP		
Jan 1 to May 15	Seasonal	3.73 kg/d
Oct 1 to Dec 31	Seasonal	2.91 kg/d
TAN		
Jan 1 to Mar 31	Seasonal	44.67 kg/d
Apr 1 to May 15	Seasonal	22.33 kg/d
Oct 1 to Nov 30	Seasonal	14.55 kg/d
Dec 1 to Dec 31	Seasonal	34.89 kg/d
Hydrogen Sulfide		
Jan 1 to May 15	Seasonal	0.37 kg/d
Oct 1 to Dec 31	Seasonal	-

2.2 Existing Outfall Configuration

The existing outfall is a 500 to 525 mm diameter pipe discharging approximately 75 m off the east bank of the South Nation River via a two-port diffuser. An as-built drawing of the outfall (dated 1978) is shown in Figure 2.1.

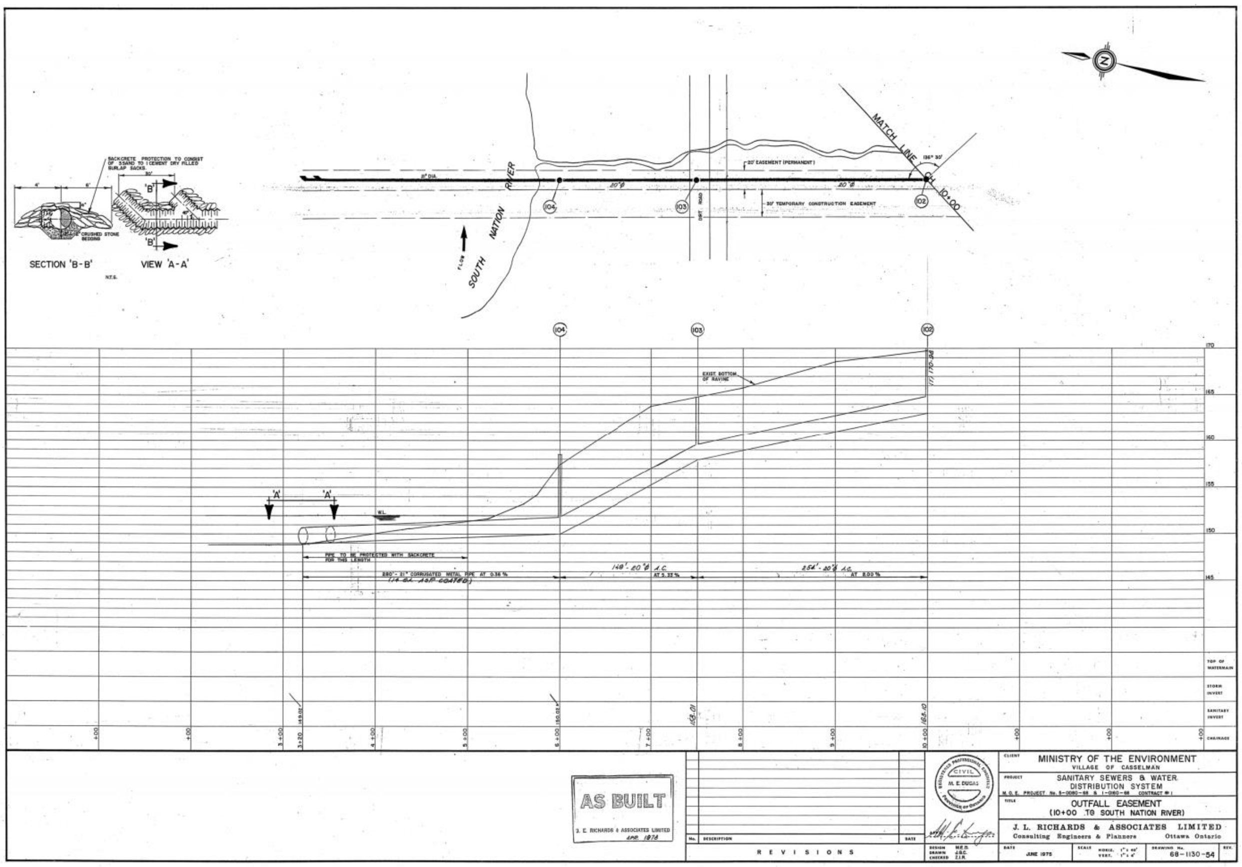

Figure 2.1 – As-Built Drawing of Existing Outfall

2.3 Available Data

In establishing ambient water quality and flow for a receiver, recent data available in the upstream vicinity of the effluent discharge location is reviewed to establish ambient conditions. In the case of the Casselman WWTS assimilative capacity assessment, a nearby Provincial Water Quality Monitoring Network (PWQMN) station is located approximately 1 km upstream of the outfall, while a Water Survey of Canada (WSC) gauge is located approximately 1 km upstream of the outfall. Information regarding the PWQMN and WSC stations is presented in Table 2.2, while their locations are presented in Figure 2.2.

Table 2.2 – Summary of Key Data Sources to Assess Ambient Conditions

Key Location Along South Nation River	Distance Relative to Plantagenet WWTS Outfall	Parameters of Interest	Period of Record Used in this Study
PWQMN Station 18207010002	1 km upstream	BOD_5, DO, ammonia, temperature, pH, TP, TSS, nitrate, E. coli	1970 – 2020
WSC Gauge 02LB013	1 km upstream	Flow	1950 – 2021

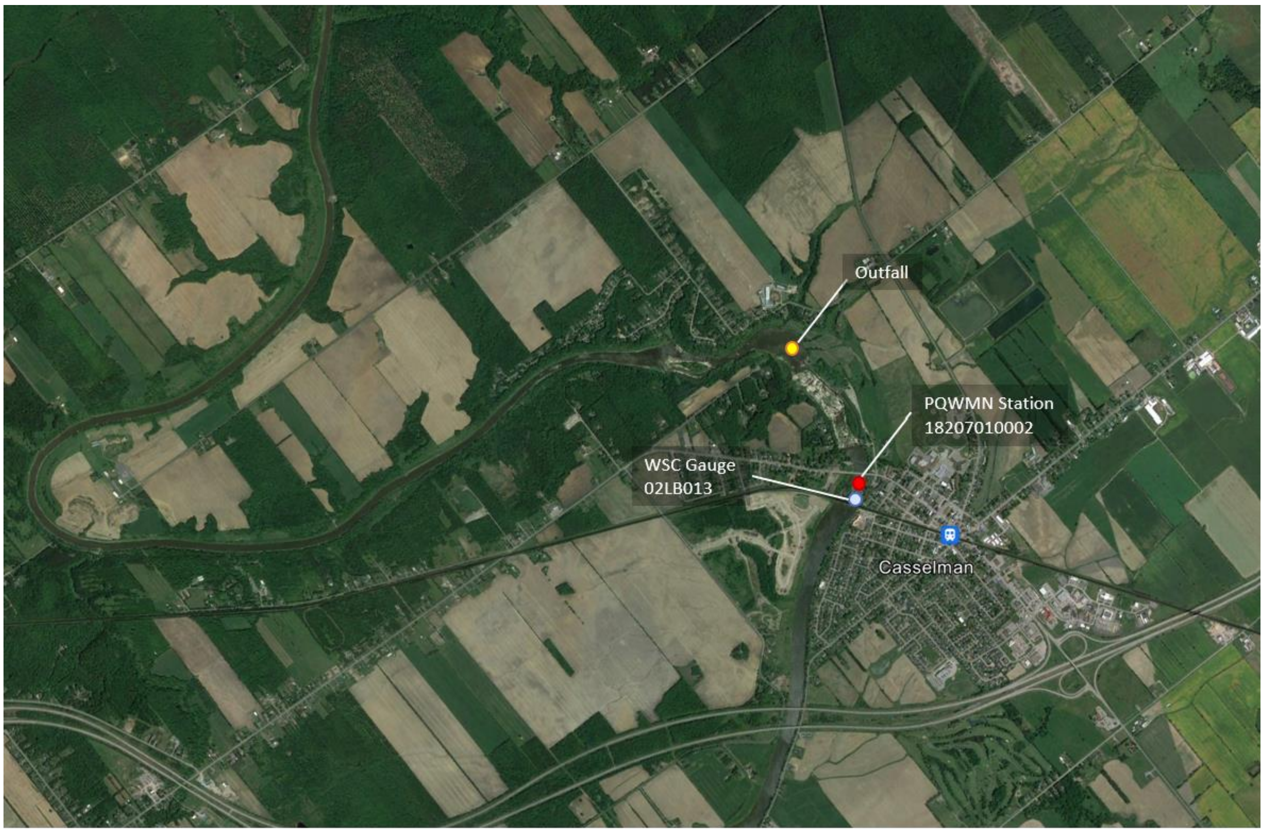

Figure 2.2 – Locations of the Outfall, WSC Gauge and PWQMN Station

3. Ambient Conditions

3.1 Water Quality

Representative background water quality can be defined by examining South Nation River water quality in the vicinity of the Plantagenet WWTP outfall. For analysis purposes, the 75th percentile threshold is applied to characterize ambient conditions, as recommended by the Ministry of the Environment (MOE), now Ministry of the Environment, Conservation and Parks (MOECP). The MOE states, "Normally the 75th percentile is used to determine background quality…".[1] The receiving water quality is assigned Policy 1 if the ambient concentration is less than the Provincial Water Quality Objective (PWQO) and Policy 2 if the ambient concentration exceeds the PWQO. The implication of being a Policy 1 or Policy 2 receiver is described briefly below.

- **Policy 1:** In areas which have water quality better than the Provincial Water Quality Objectives, water quality shall be maintained at or above the Objectives.
- **Policy 2:** Water quality which presently does not meet the Provincial Water Quality Objectives shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the Objectives.

For the purposes of this analysis, PWQMN data collected over the period 1970 to 2020 were used. The findings for each parameter of interest are summarized in the sections below.

3.1.1 Total Phosphorus

The MOE PWQO state that, as an interim guideline for streams and rivers, total phosphorus (TP) should not exceed 0.03 mg/L, to prevent excessive plant growth. The statistical summary for total phosphorus concentration is shown in Table 3.1. The monthly and annual 75th percentile concentrations exceed the PWQO. Therefore, the receiver is MOE Policy 2 in the vicinity of Casselman with respect to TP.

[1] Ministry of Environment and Energy, *Water Management: Policies, Guidelines, Provincial Water Quality Objectives.* July 1994 (MOE Blue Book).

Table 3.1 – Total Phosphorous Concentrations in the South Nation River in the Vicinity of Casselman

Month	Average (mg/L)	Median (mg/L)	75^{th} Percentile (mg/L)	Number of Observations
January	0.133	0.110	0.180	9
February	0.210	0.150	0.255	11
March	0.154	0.110	0.135	15
April	0.107	0.070	0.099	22
May	0.069	0.060	0.080	38
June	0.067	0.059	0.090	46
July	0.091	0.080	0.120	42
August	0.181	0.090	0.140	43
September	0.141	0.091	0.158	38
October	0.160	0.088	0.116	40
November	0.099	0.051	0.096	38
December	0.083	0.080	0.120	11
Overall	**0.146**	**0.110**	**0.175**	**353**
PWQO	–	–	0.030	–

3.1.2 Unionized Ammonia

The percentage of unionized ammonia in aqueous solution varies depending on the temperature and pH of the water. Ambient total ammonia, pH, and temperature are summarized in Table 3.2, Table 3.3, and Table 3.4, respectively. Synoptic pH and temperature data were used to determine daily dissociation ratios; using the daily dissociation ratios and associated daily total ammonia concentrations, it was possible to calculate daily unionized ammonia (UIA) concentrations in the South Nation River. The average, median and 75^{th} Percentile unionized ammonia concentrations are presented in Table 3.5.

Ambient total ammonia concentrations showed limited seasonal variation. While also showing limited seasonal trends, pH in the South Nation River is elevated, which increases the ammonia dissociation ratio for this receiver. As expected, temperature varies seasonally and is quite high (>24°C) over the period June to August, also increasing the dissociation ratios for those months. Ambient UIA concentrations were, therefore, elevated over these warm months, with little to no assimilative capacity over that period; conversely, ambient (75^{th}) percentile UIA concentrations were well below the PWQO during all other months. Therefore, the receiver can be characterized as Policy 1 for UIA, with limited assimilative capacity over the period June to August.

Table 3.2 – Total Ammonia Concentrations in the South Nation River in the Vicinity of Casselman

Month	Average (mg/L)	Median (mg/L)	75th Percentile (mg/L)	Number of Observations
January	0.31	0.31	0.32	6
February	0.35	0.33	0.51	6
March	0.15	0.11	0.15	10
April	0.12	0.09	0.13	21
May	0.07	0.07	0.10	33
June	0.08	0.07	0.10	41
July	0.08	0.07	0.09	40
August	0.13	0.11	0.15	40
September	0.10	0.08	0.13	37
October	0.08	0.05	0.09	37
November	0.06	0.05	0.08	34
December	0.05	0.05	0.07	8
Overall	**0.19**	**0.12**	**0.30**	**313**

Notes:

Ammonia concentrations as reported as mg/L as NH_3.

Table 3.3 – pH in the South Nation River in the Vicinity of Casselman

Month	Average (mg/L)	Median (mg/L)	75th Percentile (mg/L)	Number of Observations
January	7.84	7.70	8.03	5
February	7.59	7.55	7.65	7
March	7.92	7.90	8.09	11
April	8.12	8.10	8.18	19
May	8.30	8.32	8.43	31
June	8.29	8.30	8.48	39
July	8.41	8.36	8.50	34
August	8.23	8.24	8.38	37
September	8.11	8.20	8.34	31
October	8.09	8.16	8.34	33
November	8.21	8.21	8.32	32
December	8.13	8.20	8.31	10
Overall	**7.90**	**7.83**	**8.19**	**289**

Table 3.4 – Temperature in the South Nation River in the Vicinity of Casselman

Month	Average (mg/L)	Median (mg/L)	75th Percentile (mg/L)	Number of Observations
January	0.9	0.5	1.0	9
February	1.0	1.0	1.5	11
March	2.6	2.0	3.0	15
April	8.3	8.8	11.4	23
May	15.6	15.9	17.7	36
June	22.1	22.5	24.0	43
July	23.7	24.2	25.9	41
August	22.5	23.1	24.3	44
September	17.8	18.4	19.0	36
October	10.1	10.1	12.4	39
November	5.2	4.8	6.4	37
December	2.4	2.0	3.7	11
Overall	**1.8**	**1.0**	**2.5**	**345**

Table 3.5 – Unionized Ammonia Concentrations in the South Nation River in the Vicinity of Casselman

Month	Average (µg/L)	Median (µg/L)	75th Percentile (µg/L)	Number of Observations
January	1.3	1.3	1.5	2
February	1.4	1.4	1.9	2
March	2.1	0.8	2.1	6
April	2.8	2.5	3.6	17
May	5.5	4.9	8.1	25
June	9.5	8.0	13.0	34
July	22.8	8.0	17.2	30
August	20.3	9.3	16.0	32
September	4.8	4.4	6.6	27
October	2.2	1.9	3.2	28
November	1.9	1.1	2.2	26
December	0.7	0.6	0.9	7
Overall	**1.3**	**0.7**	**1.7**	**236**
PWQO	–	–	20	–

Notes:

Unionized ammonia concentrations as reported as mg/L as NH_3. As a conservative measure, the dataset includes two elevated, single-sample UIA results in July and August 2021 that impacted the calculated average concentrations for those months.

3.1.3 Dissolved Oxygen and BOD_5

For dissolved oxygen (DO), low concentrations are indications of degraded water quality; therefore 25th percentiles are typically used, rather than 75th percentiles, to characterize ambient conditions. Assuming the South Nation River is a warm water fishery, the PWQO for DO ranges from 4 to 7 mg/L from month-to-month based on temperature: cooler temperatures have a higher PWQO for DO than warmer temperatures.

Average and 25th percentile DO concentrations are presented in Table 3.6 along with the monthly PWQO (based on ambient temperature data shown in Table 3.4). In addition to DO data, 178 samples were analyzed over the review period for BOD_5, with an average concentration of 3.0 mg/L and 75th percentile value of 4.0 mg/L, suggesting low background concentrations of oxygen depleting constituents.

Based on the available data, the South Nation River is Policy 1 with respect to DO in the vicinity of Casselman. This demonstrates that there is adequate assimilative capacity available for future BOD_5 loads from an upgraded and expanded WWTP.

Table 3.6 – Dissolved Oxygen Concentrations in the South Nation River in the Vicinity of Casselman

Month	Average (mg/L)	25th Percentile (mg/L)	PWQO (1)	Number of Observations
January	9.8	8.4	7	8
February	10.1	8.7	7	9
March	10.5	10.0	7	14
April	10.8	10.2	5	19
May	9.5	9.0	5	30
June	9.3	8.0	4	37
July	8.3	7.3	4	35
August	7.7	6.5	4	38
September	7.5	7.2	5	31
October	9.2	7.9	5	31
November	11.8	11.4	6	32
December	11.7	11.0	7	7

Notes:

1. The PWQO values applied were based on the 75th percentile monthly temperatures shown in Table 3.4 assuming a warm water fishery.

3.1.4 Total Suspended Solids

There are no PWQO values for total suspended solids (TSS), however the Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQG) recommend a maximum average increase of 5 mg/L from background levels for long-term exposures. Reported PWQMN TSS concentrations are elevated throughout all months for which data are available. A statistical summary of TSS concentrations is provided in Table 3.7.

Since there is no PWQO, it is not possible to define a Policy status for the South Nation River in relation to TSS. However, to be consistent with the objectives of the CWQG, the discharge of effluent from the WWTP should not increase downstream fully-mixed concentrations by more than 5 mg/L.

Table 3.7 – Total Suspended Solids Concentrations in the South Nation River in the Vicinity of Casselman

Month	Average (mg/L)	Median (mg/L)	75^{th} Percentile (mg/L)	Number of Observations
January	15.0	–	–	1
February	15.0	–	–	1
March	9.1	9.1	11.1	2
April	18.7	13.8	21.5	16
May	12.9	9.0	12.0	21
June	8.9	7.1	10.0	29
July	11.1	7.0	9.1	23
August	8.4	6.9	10.9	29
September	7.8	7.0	9.3	23
October	14.8	11.7	16.4	22
November	7.8	6.7	8.7	21
December	8.4	8.2	10.3	6
Overall	**9.8**	**9.7**	**14.5**	**194**

3.1.5 Nitrate

There is no PWQO for nitrate, however the CWQG recommends a long-term exposure limit of 3.0 mg/L as N, and a short-term (acute) exposure limit of 124 mg/L as N. A statistical summary of reported PWQMN nitrate concentrations is provided in Table 3.8.

During most calendar months, the ambient (75^{th} percentile) nitrate concentration is below the CWQG long-term exposure limit. Monthly ambient (75^{th} percentile) nitrate concentrations occasionally exceeded the long-term exposure limit (June, November and December), but were significantly below the short-term exposure limit. In addition, monthly median nitrate concentrations were below the short-term exposure limit with the exception of December. Such seasonal variability in ambient concentrations, with higher values during colder periods, is typical of surface waters such as the South Nation River.

Table 3.8 – Nitrate Concentrations in the South Nation River in the Vicinity of Casselman

Month	Average (mg/L)	Median (mg/L)	75th Percentile (mg/L)	Number of Observations
January	–	–	–	–
February	1.1	–	–	1
March	1.8	1.4	2.3	5
April	2.3	2.2	3.0	16
May	1.5	1.5	2.2	25
June	2.5	2.0	4.1	33
July	1.6	1.1	2.2	32
August	0.9	0.5	1.5	31
September	0.6	0.2	0.7	28
October	1.9	1.2	2.9	28
November	2.9	2.4	4.1	27
December	2.9	3.1	3.8	6
Overall	**2.3**	**1.9**	**3.6**	**232**

3.1.6 E. coli

A total of 15 samples were analyzed for E. coli over the review period. Individual sample results ranged from 8 to 1,800 CFU/100 mL with an overall geometric mean of 38 CFU/100 mL, which is below the PWQO of 100 CFU/100 mL. As a result, the South Nation River can be characterized as Policy 1 with respect to E. coli.

3.2 Flow

Typically for assimilative capacity analyses, the 7Q20 river flow (minimum average 7-day low flow with a return period of 20 years) represents an appropriate design condition. As described in Section 2.3, the closest stream flow gauge with relevant data is Water Survey of Canada (WSC) hydrometric station 02LB013 which is located on South Nation River approximately 1 km upstream of the Casselman outfall.

A statistical analysis of recorded flows in the South Nation River was used to determine monthly low (7Q20) flows in the receiver. The results of the low flow analysis are presented in Table 3.9, while details can be found in Appendix A. Flows in the South Nation River vary seasonally, with the lowest flows through the Summer into early Fall (June to September). The highest 7Q20 flow occurs in April, coinciding with the Spring freshet.

Table 3.9 – Results of Low Flow Analysis – South Nation River in the Vicinity of Casselman

Month	WSC Station 02LB013 Mean Flow (m^3/s)	WSC Station 02LB013 7Q20 Flow (m^3/s)
January	16.1	0.826
February	13.9	0.802
March	61.8	1.035
April	106.6	8.442
May	21.7	2.108
June	10.8	0.652
July	6.7	0.319
August	4.6	0.274
September	4.5	0.276
October	11.6	0.340
November	20.3	0.918
December	21.6	1.251

4. Determination of Effluent Limits

4.1 Methodology

A conference call was held between MECP and Blue Sky staff on October 5, 2023 to discuss a preliminary approach to completing the ACS study, with a follow-up virtual meeting on November 2, 2023. During the November 2023 meeting, alternative discharge windows were discussed (namely, retaining the existing discharge period (October 1 to May 15) or expanding to year-round discharge), and additional details presented regarding the proposed approach to defining effluent limits for a number of parameters.

Subsequently, the South Nation Conservation (SNC) was contacted to discuss the ongoing Class EA Study and proposed ACS approach. In email correspondence dated November 29, 2023, SNC confirmed that they have no concerns with respect to expanding the discharge period to year-round provided total TP loading does not exceed the current ECA limit.

Copies of correspondence and meeting notes from these consultation activities are included in Appendix C. Based on the outcome of these consultation activities with MECP and SNC, the approved ACS approach consists of the following:

- Allow the effluent discharge period to be expanded to year-round discharge. This approach eliminates the need for additional effluent storage lagoon volume.
- Consider the impact of stored precipitation in the lagoons on total discharge volume requirements. Based on an analysis of monthly precipitation / evaporation rates, the existing lagoon cells would contribute the equivalent of 297 m^3/d of stored precipitation. As a result, effluent limits were developed assuming a total equivalent annual average effluent discharge rate of 4,347 m^3/d.
- Monthly discharge volumes to consider maintaining adequate dilution ratios (minimum value of 10 : 1), ensuring reasonable downstream fully-mixed water quality, and providing allowances for WWTS operational flexibility.
- Utilize a mass-balance approach to ensure downstream, fully-mixed seasonal UIA concentrations remain at or below the PWQO at ambient (75^{th} percentile) concentrations and low (7Q20) flows. Proposed effluent TAN targets will also ensure non-toxicity at end-of-pipe.
- Limit future effluent TP loadings to 770 kg/yr (current ECA limit). Consideration will also be given to minimizing TP loadings during the critical Summer period, decreasing the annual TP loading limit if possible, as well as the impact on downstream, fully-mixed TP concentrations.
- An assessment of mixing zone characteristics using the expert system CORMIX.
- Nitrate is not currently a parameter of concern for the South Nation River. As a result, no effluent nitrate targets will be proposed.
- Effluent pH and *E. coli* targets will be consistent with targets for other municipal WWTSs in Ontario and, in particular, facilities discharging to the South Nation River.

In addition to the above, the seasonal impact of effluent on the South Nation River was assessed assuming the following seasonal periods:

- Winter: December 1 to March 31
- Spring: April 1 to May 31
- Summer: June 1 to September 30
- Fall: October 1 to November 30

4.2 Maximum Effluent Discharge Rates

Maximum effluent discharge rates were developed for each calendar month, and are presented in Table 4.1. Associated monthly minimum dilution ratios are also shown.

The proposed effluent discharge rates result in dilution ratios consistent with the required minimum design value of 10 : 1. Assuming that the upgraded Casselman WWTS discharges effluent at the maximum proposed discharge rates for all days each calendar month, a total annual volume of 1,674,050 m^3 could be discharged (equivalent to an average day flow of 4,586 m^3/d). This provides sufficient flexibility to discharge the design influent ADF (4,050 m^3/d) plus the anticipated stored precipitation volume (297 m^3/d).

Table 4.1 – Proposed Maximum Monthly Effluent Discharge Rates

Month	Maximum Daily Discharge Rate	Minimum Dilution Ratio
January	5,750 m^3/d	12.4
February	5,600 m^3/d	12.4
March	7,250 m^3/d	12.3
April	10,000 m^3/d	72.9
May	4,500 m^3/d	40.5
June	2,150 m^3/d	26.2
July	1,050 m^3/d	26.2
August	900 m^3/d	26.3
September	910 m^3/d	26.2
October	2,250 m^3/d	13.1
November	6,050 m^3/d	13.1
December	8,750 m^3/d	12.4

4.3 Effluent $cBOD_5$

There are no PWQO or CWQG targets specified for $cBOD_5$. However, the presence of carbonaceous and nitrogenous biochemical oxygen demand (cBOD and nBOD, respectively) can affect downstream DO concentrations.

An assessment of ambient water quality (see Section 3) concluded that the South Nation River is Policy 1 for DO, with historic 25th percentile concentrations at least 2.2 mg/L greater than the PWQO for all months. Furthermore, the available ambient BOD_5 concentration (ambient 75th percentile of 4.0 mg/L) suggest low background concentrations of oxygen depleting constituents.

Proposed $cBOD_5$ requirements of 10 mg/L (design objective) and 12 mg/L (design limit) are being proposed in conjunction with year-round nitrification (see Section 5.6). At the design limit, low flow conditions and ambient background concentrations, the fully mixed $cBOD_5$ concentration would increase by up to 0.59 mg/L (Winter). During the critical Summer period (June to September), the fully mixed $cBOD_5$ concentration would only increase by up to 0.29 mg/L. These increases would have minimal impact on the downstream DO concentrations.

4.4 Effluent Total Suspended Solids

There is no PWQO target specified for TSS. The CWQG recommends a maximum short-term (< 24 h period) increase of 25 mg/L above background, and a maximum increase of 5 mg/L over long-term exposures (up to 30 days).

Effluent TSS requirements of 10 mg/L (design objective) and 12 mg/L (design limit) are proposed. These are consistent with the proposed cBOD5 limits (see Section 5.3). At the design limit, low flow conditions and ambient background concentrations, the fully mixed TSS concentration would only increase by up to 0.13 mg/L, which meets the CWQG recommendation.

4.5 Effluent Total Phosphorus

The South Nation River was determined to be Policy 2 for TP (see Appendix A) and, therefore, ambient (75th percentile) concentrations exceed the PWQO of 0.030 mg/L. During the November 2023 consultation meeting with MECP, a future TP concentration limit of 0.30 mg/L was proposed (see Appendix C). This is equivalent to a total annual TP loading limit of 476 kg/year (based on a total average annual discharge volume of 4,347 m3/d), which is consistent with the target of maintaining effluent TP at or below the current ECA limit (770 kg/year). In addition to the TP limit of 0.30 mg/L, a TP objective of 0.20 mg/L is also proposed. The ambient TP concentrations and resulting downstream fully-mixed TP concentrations are shown in Table 4.2.

To minimize the environmental impact associated the effluent discharge, the combined daily maximum effluent discharge rate and TP concentration limit ensure that downstream, fully-mixed TP concentration would increase by no more than 5.2% above ambient conditions during the critical Summer (June to September) period.

Table 4.2 – Fully Mixed TP Concentration Under Proposed Effluent TP Limits and Effluent Discharge Rates

Month	Seasonal Ambient TP [(1)] (mg/L)	Fully-Mixed TP (mg/L)	Increase Above Ambient TP (%)
January	0.185	0.194	4.4
February	0.185	0.194	4.4
March	0.185	0.194	4.5
April	0.110	0.113	2.3
May	0.110	0.115	4.0
June	0.120	0.127	5.2
July	0.120	0.127	5.2
August	0.120	0.127	5.2
September	0.120	0.127	5.2
October	0.110	0.124	10.9
November	0.110	0.123	10.9
December	0.185	0.194	4.4
January	0.185	0.194	4.4

Notes:

1. For the purposes of assessing ambient TP concentrations, seasonal 75th percentile concentrations were utilized (Winter = Dec to Mar; Spring = Apr to May; Summer = Jun to Sep; Fall = Oct to Nov).

4.6 Effluent Total Ammonia Nitrogen

In developing TAN limits, two factors were considered: ensuring non-toxic effluent at end-of-pipe, and ensuring downstream conditions within the South Nation River meet the PWQO un-ionized ammonia (UIA) limit of 20 µg/L as NH_3 (16 µg/L as N).

Extensive research by the US EPA and others has demonstrated that a non-toxic limit for UIA ranges between 0.1 mg/L and 0.5 mg/L as NH_3, depending on the aquatic species present in the receiver. The federal Wastewater Systems Effluent Regulations (WSER) under the Fisheries Act set effluent UIA toxicity to 1.25 mg/L (at 15°C). Therefore, selecting a value of 0.2 mg/L as NH_3 at end-of-pipe, which is near the low end of the US EPA range, is more conservative than, and consistent with, the requirements of WSER.

The percentage of UIA in aqueous solution varies depending on the temperature and pH of the water. In order to determine the in-stream UIA concentration, it is necessary to specify anticipated ambient temperature and pH values that can be used to estimate the ammonia dissociation ratio. To account for the seasonal variability in stream temperatures, four seasonal periods were defined: Winter (Dec to Mar); Spring (Apr to May); Summer (Jun to Sep); Fall (Oct to Nov). For each season, ambient conditions were taken to be the 75th percentile UIA concentration, and 75th percentile dissociation ratio over that period.

To confirm non-toxicity at end-of-pipe, it was necessary to define effluent temperature and pH values. Effluent pH and temperature data were available over the existing discharge window (Oct 1 to May 15). It was noted that effluent pH stabilized after the Casselman WWTS was upgraded in 2020. Analyzing single sample effluent pH over the period 2020 to 2023, it was determined that the 75th percentile pH values were 7.8 for Winter and Fall, and 7.6 for Spring. As a conservative measure, it was assumed that future

75th percentile effluent pH would be 7.8 for all seasons. Effluent is expected to continue to be stored in the lagoon prior to discharge. Using effluent temperature data over the period 2017 to 2023, 75th percentile effluent temperatures were determined to be 6.1°C in both April and November. Ambient temperatures in the South Nation River were higher in those months (6.4°C in Nov and 11.4°C in Apr, see Table 3.4). As a conservative measure, ambient seasonal South Nation River temperatures of 17.0°C, 24.2°C and 10.6°C were used to assess non-toxicity at end-of-pipe for Spring, Summer and Fall, respectively. The 75th percentile November temperature of 6.1°C in the South Nation River was used to represent worst-case Winter effluent temperatures, since it is possible that effluent temperatures of ~6°C could be possible in early December (the start of the Winter discharge period).

For the proposed effluent TAN limits to be acceptable, the downstream UIA concentration must be less than or equal to the PWQO of 20 µg/L (as NH_3), while also meeting the non-toxicity threshold of 0.2 mg/L (as NH_3) at end of pipe. Using the proposed effluent flows (see Table 5.1), it was determined that the effluent TAN limit was limited by downstream fully-mixed UIA less than the PWQO. As a result, the end-of-pipe UIA concentration would be below 0.20 mg/L for all months.

The recommended compliance limits for TAN are: 11.5 mg/L for Winter (Dec to Mar); 6.0 mg/L for Spring (Apr to May); 1.3 mg/L for Summer (Jun to Sep); and, 5.0 mg/L for Fall (Oct to Nov). These are consistent with, or more stringent than, the existing ECA discharge limits over the period Oct 1 to May 15. The proposed Summer TAN limit represents a high level of nitrification, and ensures downstream fully-mixed UIA concentrations remain under the PWQO during this critical, warm weather period. The proposed effluent ammonia limits and resulting downstream UIA concentrations at the minimum effluent dilution ratio are shown in Table 4.3.

Table 4.3 – Fully Mixed Un-ionized Ammonia Under Proposed Effluent TAN Limits and Effluent Discharge Rates

Month	Effluent TAN Limit (mg/L as N)	Seasonal Ambient UIA (1) (µg/L as NH_3)	Seasonal Dissociation Ratio (1) (%)	Fully-Mixed UIA (µg/L as NH_3)
January	11.5	1.74	1.8	19.2
February	11.5	1.74	1.8	19.3
March	11.5	1.74	1.8	19.4
April	6.0	6.19	8.0	13.4
May	6.0	6.19	8.0	19.4
June	1.3	12.74	14.3	19.4
July	1.3	12.74	14.3	19.4
August	1.3	12.74	14.3	19.3
September	1.3	12.74	14.3	19.4
October	5.0	2.73	4.1	19.3
November	5.0	2.73	4.1	19.3
December	11.5	1.74	1.8	19.3

Notes:

1. For the purposes of assessing ambient TP concentrations, seasonal 75th percentile concentrations were utilized (Winter = Dec to Mar; Spring = Apr to May; Summer = Jun to Sep; Fall = Oct to Nov).

4.7 Effluent E. coli

The current ECA specifies an E. coli compliance limit of 200 CFU/100 mL and a design objective of 150 CFU/100 mL (based on geometric mean). Despite this, other similarly sized facilities discharging to the South Nation River do not have E. coli specified over the cold-weather discharge period (e.g. November to April for Winchester WWTS).

Therefore, an E. coli compliance limit of 200 CFU/100 mL and a design objective of 150 CFU/100 mL (based on geometric mean) are proposed for the warm-weather discharge period (e.g. May to October) for an upgraded Casselman WWTS. This is consistent with the current ECA objective and limit, as well as seasonal disinfection requirements for similarly-sized municipal wastewater treatment discharging to the South Nation River.

4.8 Effluent pH

A compliance limit pH range of 6.0 to 8.0 is proposed as a single-sample limit, with a corresponding design objective of 6.8 to 7.8. This is consistent with the pH requirements stipulated in the current ECA.

5. Mixing Zone Modelling

5.1 Model Configuration

The model was developed based on the current configuration of the outfall, which consists of two 21" corrugated discharge pipes, approximately oriented along the main flow direction in the South Nation River. The discharge pipes are approximately center channel and are separated by approximately 9 m. The channel is highly irregular, with discharge located in a ponded area immediately upstream of a riffle section. CORMIX allows for either a single port outlet, or a diffuser having three or more outlets, but not a double pipe discharge. As recommended by CORMIX documentation, a double port discharge can be approximated by either modelling each port independently, or by modeling an equivalent single discharge pipe. Modeling each discharge port independently requires that the corresponding plumes do not overlap, and in this particular case, the mixing zones associated with each discharge pipe are too close to avoid interaction. Therefore, an equivalent single discharge pipe was applied for modelling purposes.

The shallow discharge location, combined with high discharge velocity relative to ambient conditions contributed uncertainty to near-field model predictions. Far-field model results are more reliable; however, the South nation River channel is highly irregular, with the discharge located in a ponded area, immediately upstream of a riffle section. Furthermore, CORMIX assumes that the river cross-section and ambient conditions are uniform down-stream of the discharge. Since the actual river cross-section, velocity, and depth is variable, additional mixing would take place and the far-field mixing results generated by CORMIX may be interpreted as conservative estimates. Definitive delineation of the mixing zone would require either field-dye studies under low-flow conditions are the development and application of a comprehensive numerical model.

The modelled location of the outfall outlet is shown in Figure 5.1.

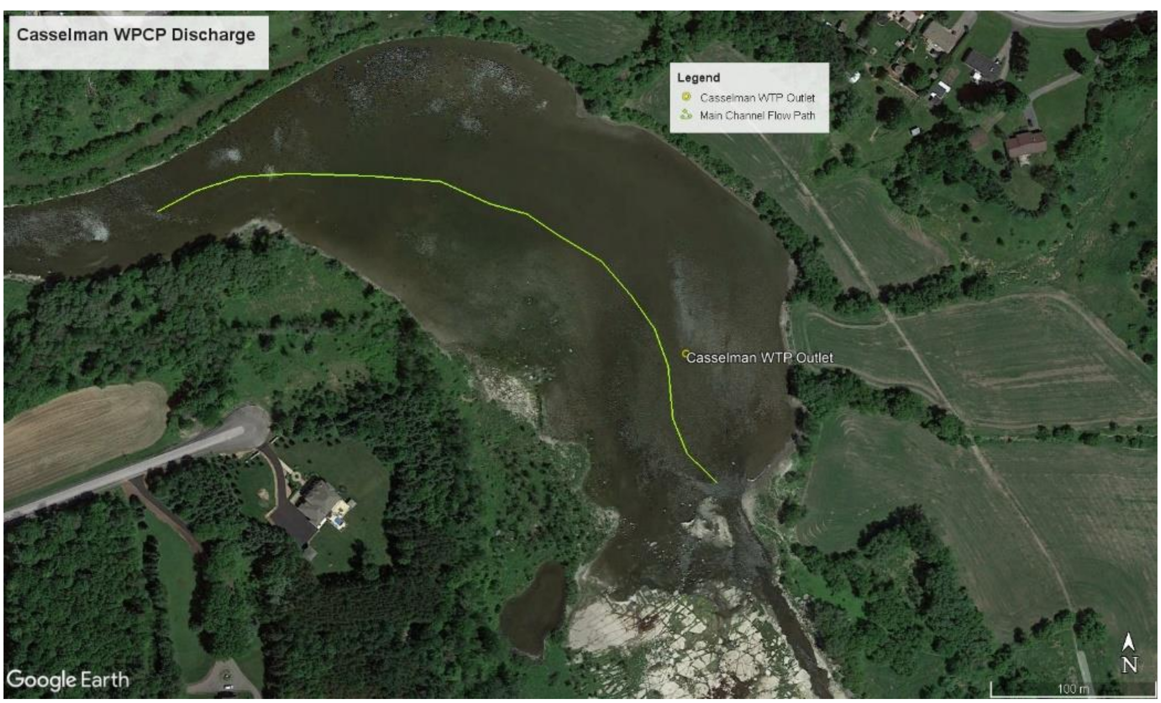

Figure 5.1 – Modelled Outfall Location

5.2 Modelling Results

Monthly modelling runs were completed using the calculated monthly 7Q20 flow (see Table 3.9) and proposed monthly maximum discharge rates (see Section 4.2, Table 4.1). The results are presented in tabular format below, with details provided in Appendix B.

Excluding April, the modelling suggests that fully-mixed conditions are achieved within 175 m or less for all months. During the critical summer discharge period (June to September), fully-mixed conditions are achieved in 80 m or less. These represent relatively small mixing zones, and would result in minimal impact on the South Nation River.

The distance to fully-mixed conditions in April is 375 m, which is significantly higher than that predicted for the other months. Despite this, the impact on downstream TP and UIA concentrations are anticipated to be low in April due to the high dilution ratio (72.9 : 1) and proposed effluent limits maintaining TP concentrations close to ambient values and UIA well below the PWQO (see Sections 4.6 and Table 4.3). Furthermore, the near-field region is modelled to be < 10 m, and the concentration excess in the plume reaches 5% by approximately 20 m (see Appendix B).

Table 5.1 – CORMIX Modelling Summary

Month	Effluent Flow (m^3/d)	River Flow (m^3/d)	Dilution Ratio	Distance Downstream to Achieve Fully-Mixed Conditions (m)
January	5,570	0.826	12.4 : 1	100
February	5,600	0.802	12.4 : 1	100
March	7,250	1.035	12.3 : 1	130
April	10,000	8.442	72.9 : 1	375
May	4,500	2.108	40.2 : 1	175
June	2,150	0.652	26.2 : 1	80
July	1,050	0.319	26.2 : 1	75
August	900	0.274	26.3 : 1	80
September	910	0.276	26.2 : 1	80
October	2,250	0.340	13.1 : 1	80
November	6,050	0.918	13.1 : 1	125
December	8,750	1.251	12.4 : 1	125

6. Summary

Proposed seasonal effluent discharge rates and associated effluent objectives and limits were developed for an upgraded Casselman WWTS and are summarized in Tables 5.1 and 5.2. These were developed for a future design influent ADF capacity of 4,050 m^3/d, and equivalent average effluent discharge rate (inclusive of stored precipitation) of 4,347 m^3/d.

Table 5.1 – Proposed Maximum Daily Effluent Discharge Rates

Date Range	Maximum Daily Discharge Rate
January	5,750 m^3/d
February	5,600 m^3/d
March	7,250 m^3/d
April	10,000 m^3/d
May	4,500 m^3/d
June	2,150 m^3/d
July	1,050 m^3/d
August	900 m^3/d
September	910 m^3/d
October	2,250 m^3/d
November	6,050 m^3/d
December	8,750 m^3/d

Table 5.2 – Proposed Effluent Objectives and Limits

Parameter	Averaging Period	Objective (mg/L unless noted otherwise)	Limit (mg/L unless noted otherwise)
$cBOD_5$	Monthly	10	12
TSS	Monthly	10	12
TP	Monthly	0.20	0.30
TAN			
Dec 1 to Mar 31	Monthly	9.2	11.5
Apr 1 to May 31	Monthly	4.8	6.0
Jun 1 to Sep 30	Monthly	1.0	1.3
Oct 1 to Nov 30	Monthly	4.0	5.0
E. coli			
May 1 to Oct 31	Monthly	150 CFU/100 mL	200 CFU/100 mL
pH	Single Grab	6.8 to 7.8	6.0 to 8.0

7. References

MOEE (1994). Policy B-1-5 – Deriving Receiving Water Based Point Source Effluent Requirements for Ontario Waters.

Appendix A
Low Flow Analysis Details

A.1. Summary of Low Flow Assessment Results

Although the period of record for the Water Survey Canada gauging station at Casselman (02LB013) spanned over 50 years, from 1972 through 2023, continuous daily flow measurements were limited. Complete seasonal daily flow information for Casselman was available for only 13 years. A complete seasonal period of record was deemed to be 90% or greater daily flow measurements. Fewer flow measurements prevented reliable estimation of most seasonal 7-day low flows. Furthermore, 13 years of record is too short to apply for estimation of seasonal 7Q20 low-flow estimates. In order to increase the available 7-day low flow data series for Casselman, and generate seasonal 7Q20 low-flows, the Water Survey Canada flow gauging station at Plantagenet (02LB005) was applied, Flow monitoring at Plantagenet spanned over 100 years from 1915 through 2023. A plot of the available seasonal 7-day low flows for both Casselman and Plantagenet is provided in Figure A.1

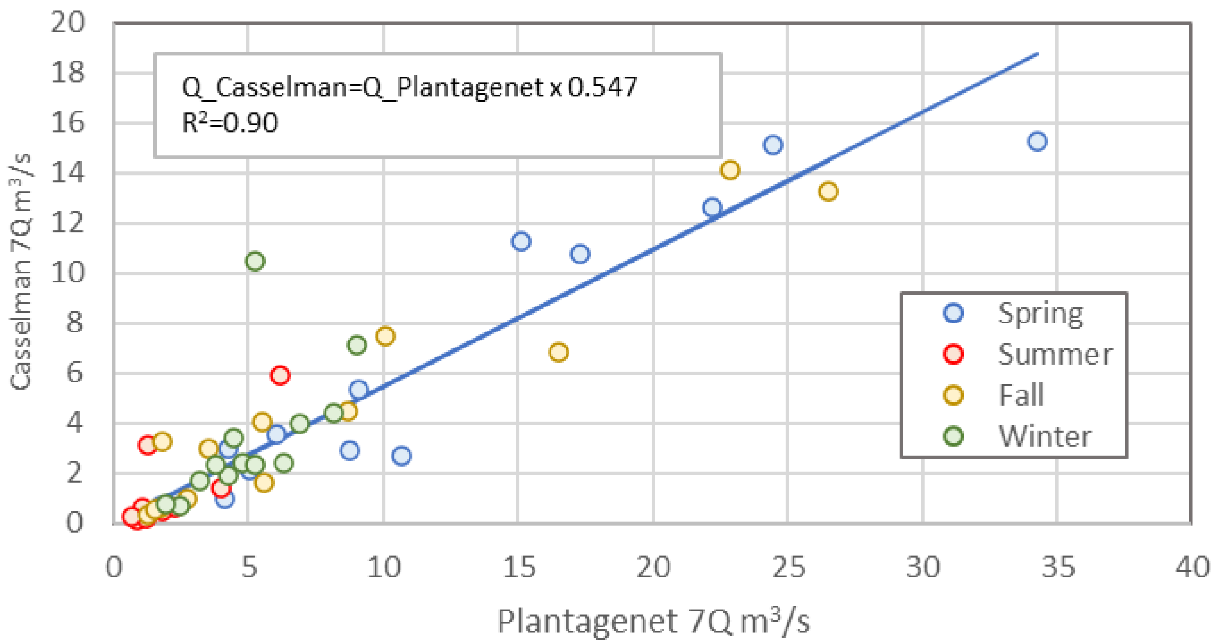

Figure A.1. Annual 7-day Low Flow for Plantagenet (02LB005) and Casselman (02LB013)

The correlation between 7-day seasonal low-flow for Plantagenet and Casselman was approximately 90%. Furthermore, the regression slope is 0.547 which is consistent with the drainage are ratio. The drainage area at Plantagenet is 3,810 km^2, while the drainage area at Casselman is 2,410 km^2, a ratio of about 63%. The regression relation illustrated on Figure 1 was applied to generate a 75 year composite low-flow series for each month for Casselman. The composite series incudes all available seasonal 7-day low-flow, and where not available, includes the low flow estimate generated using the regression relation discussed above. This composite seasonal low flow series was used to generate monthly 7Q20 low-flows and are summarized in Table A.1. The best-fit frequency distribution used for each month are also shown.

Table A.1 – Monthly 7Q20 Low Flow Estimates for the South Nation River in the Vicinity of Casselman

Month	Best-Fit Frequency Distribution	7Q20 Flow (m^3/s)
January	Log Normal	0.826
February	Log Normal	0.802
March	EVIII Method of Lowest Observed Drought	1.035
April	EVIII Method of Lowest Observed Drought	8.442
May	Log normal	2.108
June	Log normal	0.652
July	EVIII Method of Lowest Observed Drought	0.319
August	Log normal	0.274
September	EVIII Method of Lowest Observed Drought	0.276
October	EVIII Method of Lowest Observed Drought	0.340
November	EVIII Method of Lowest Observed Drought	0.918
December	Log Normal	1.251

C.2. Monthly Fitted Distribution Plots

Fitted distribution plots for each month are provided in Figures A.1 to A.12 below.

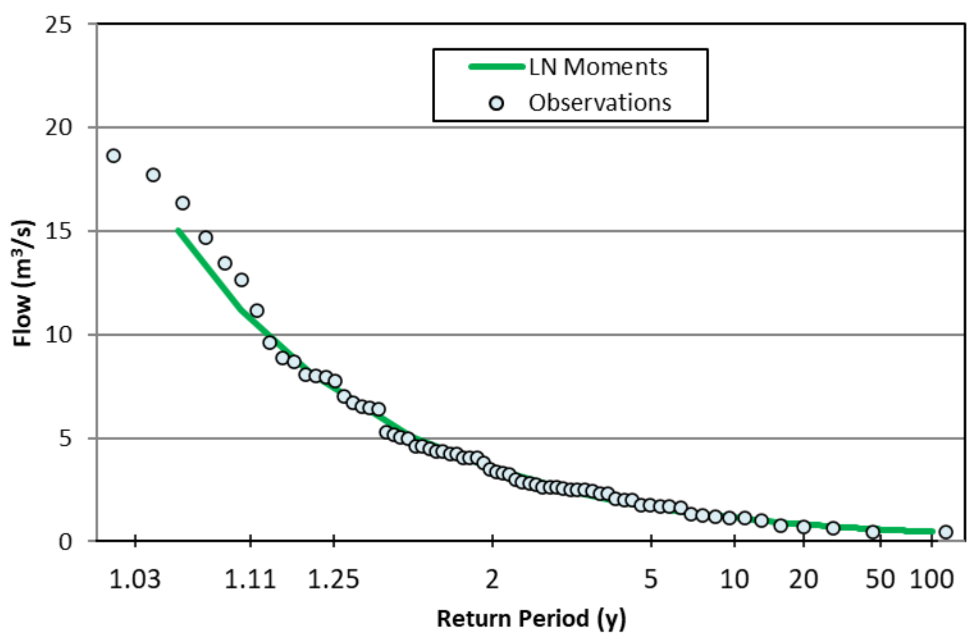

Figure A.1 January Low Flow Frequency Plot

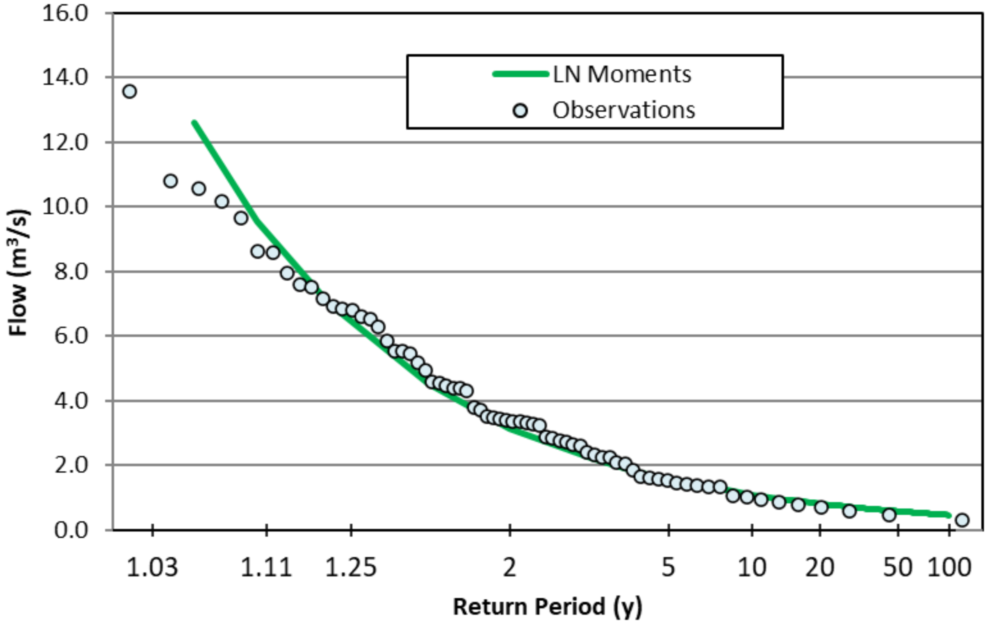

Figure A.2 February Low Flow Frequency Plot

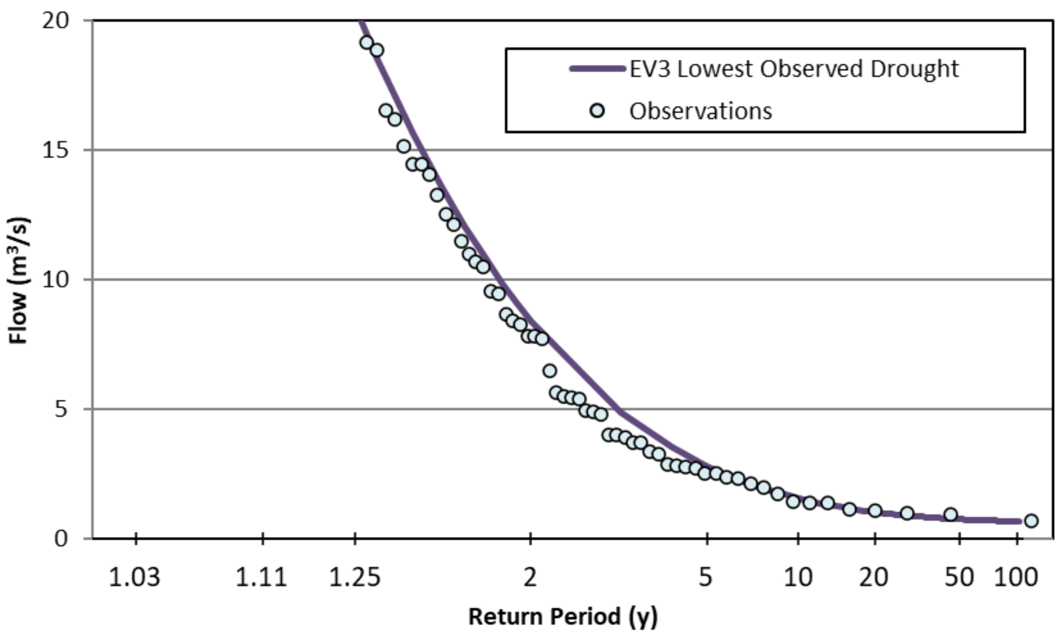

Figure A.3 March Low Flow Frequency Plot

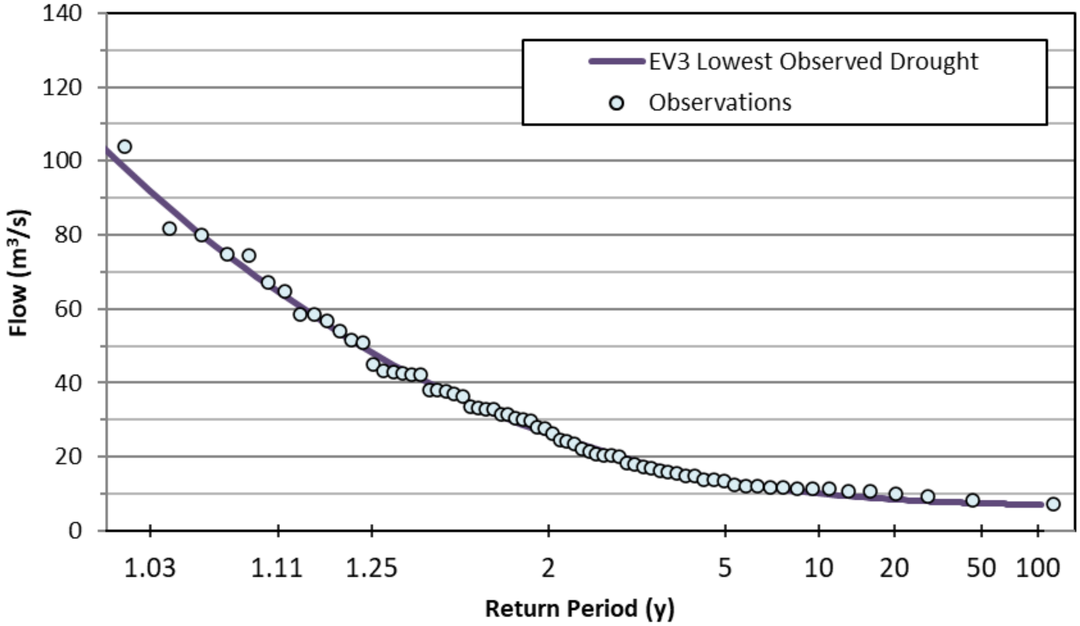

Figure A.4 April Low Flow Frequency Plot

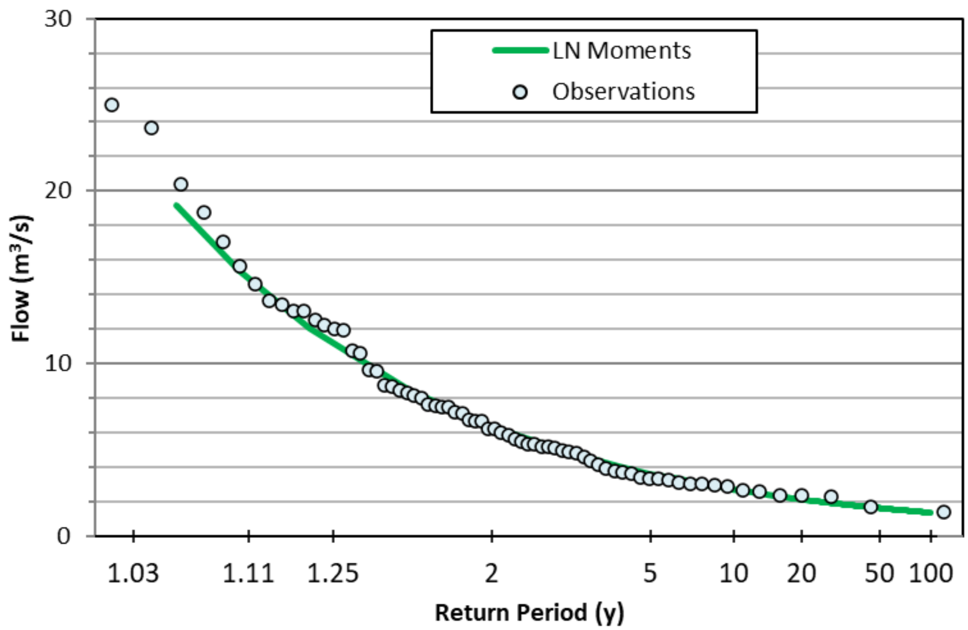

Figure A.5 May Low Flow Frequency Plot

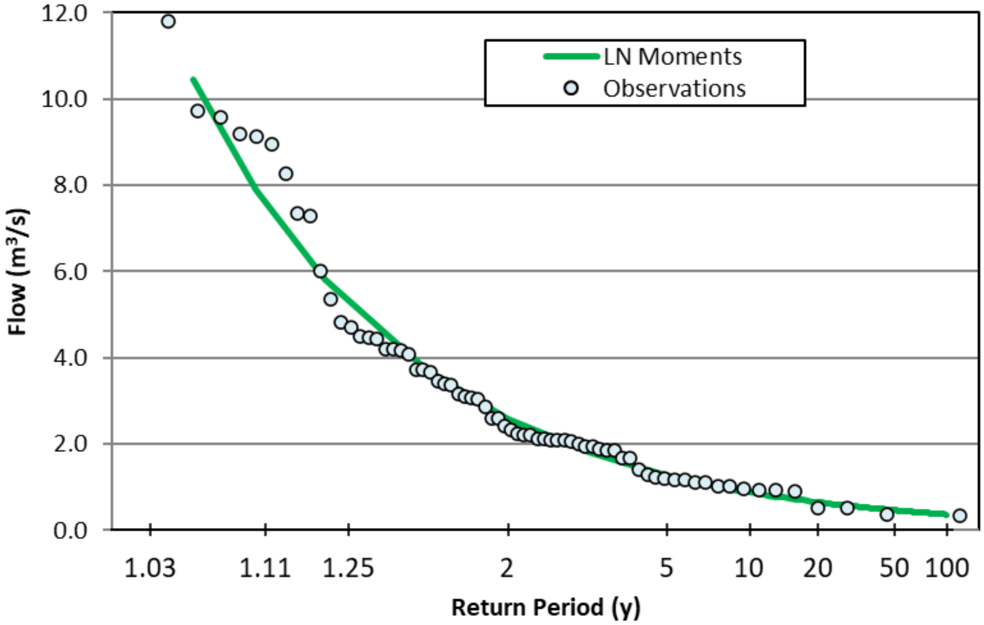

Figure A.6 June Low Flow Frequency Plot

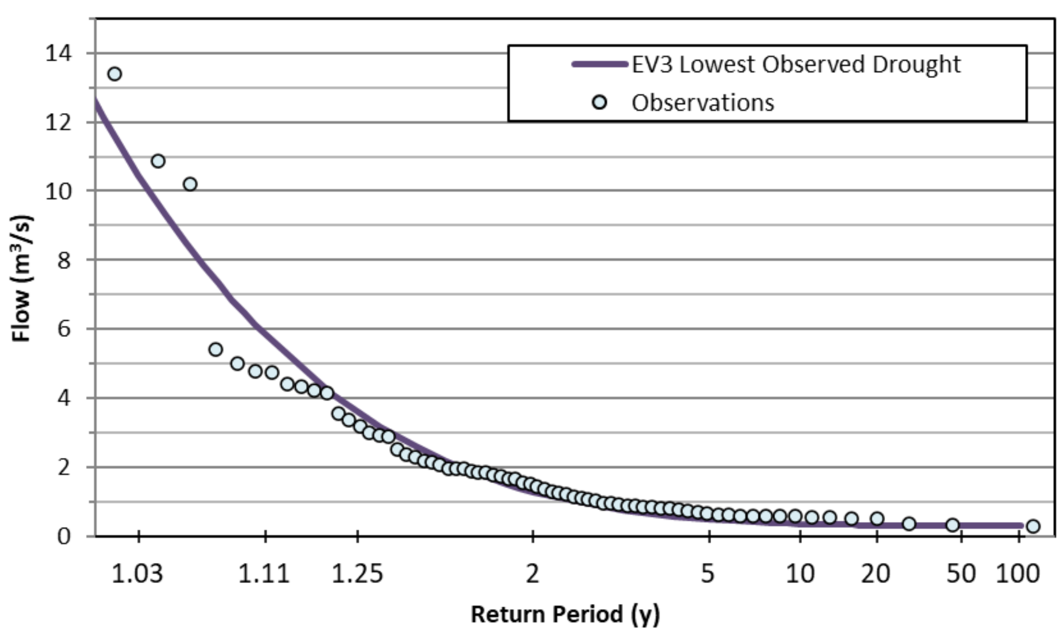

Figure A.7 July Low Flow Frequency Plot

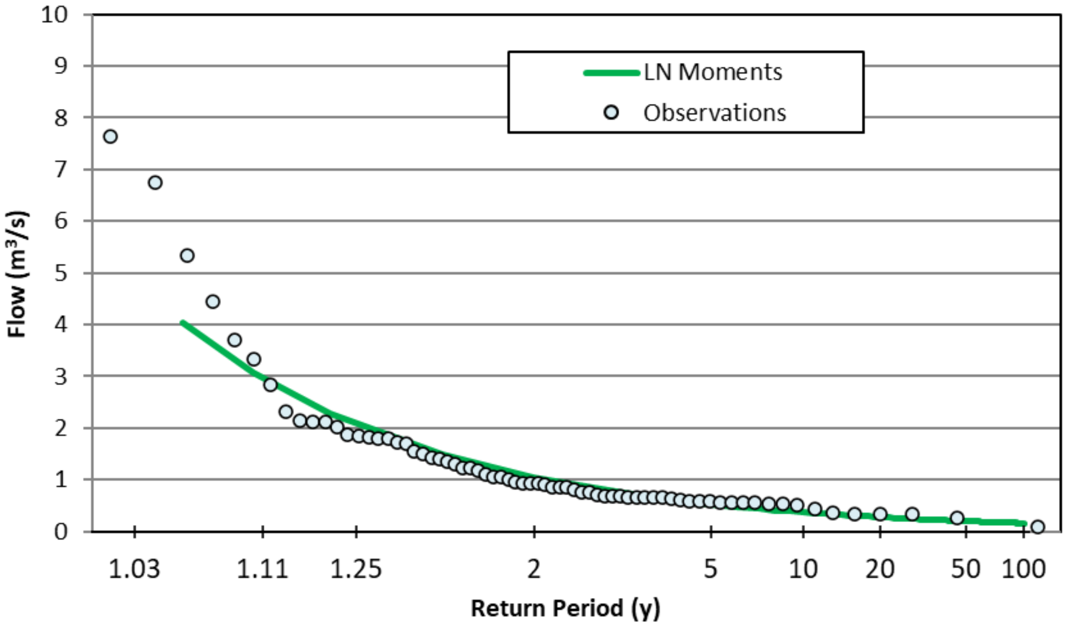

Figure A.8 August Low Flow Frequency Plot

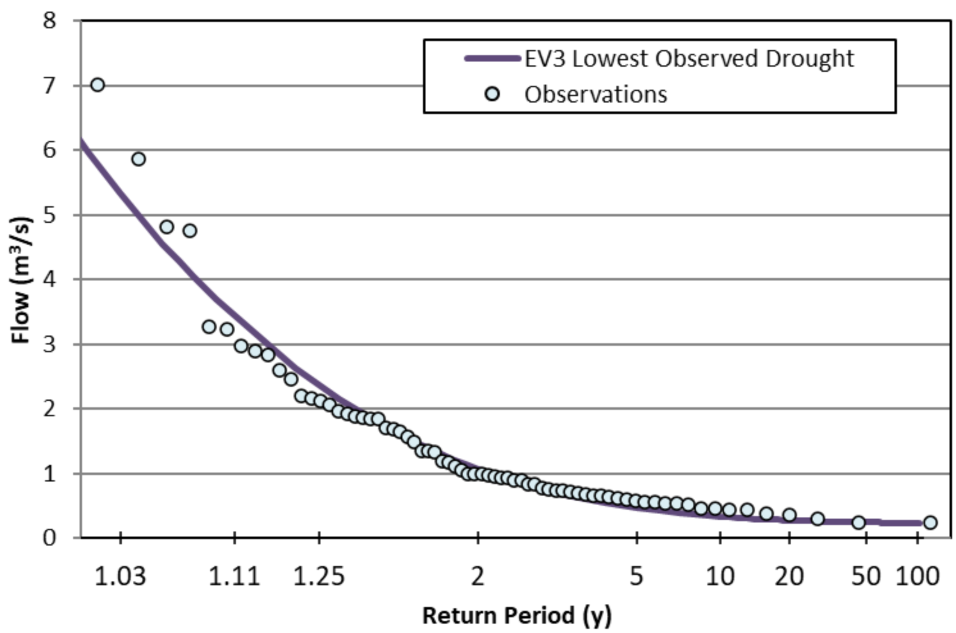

Figure A.9 September Low Flow Frequency Plot

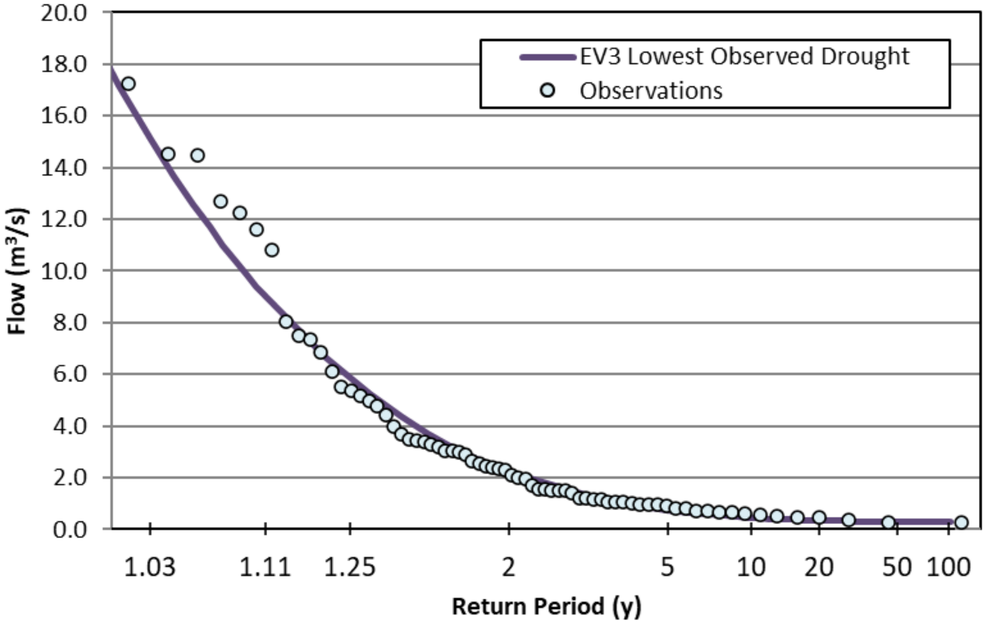

Figure A.10 October Low Flow Frequency Plot

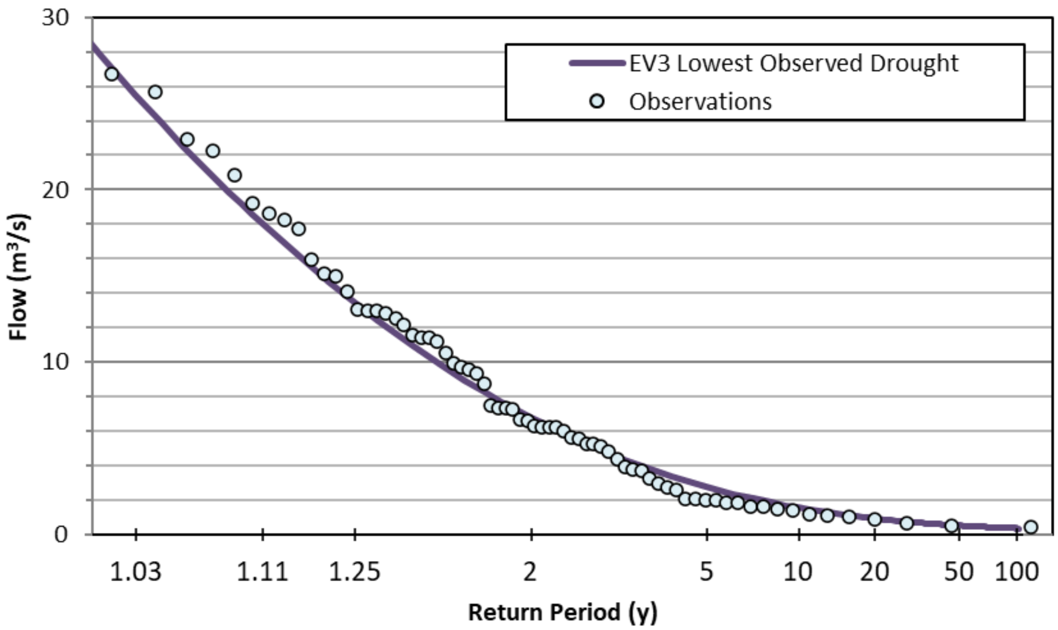

Figure A.11 November Low Flow Frequency Plot

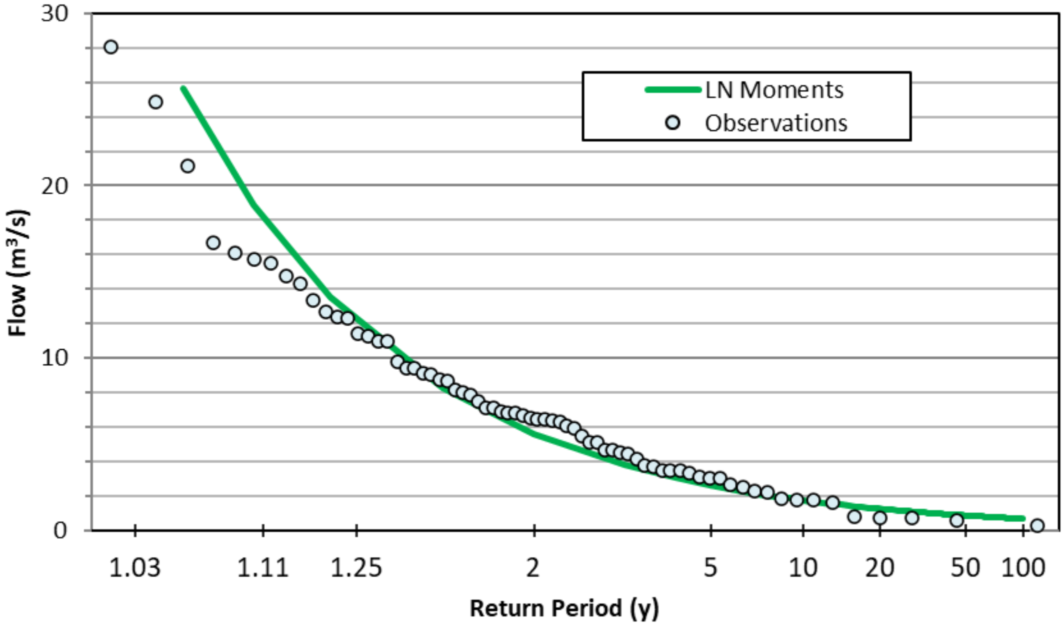

Figure A.12 December Low Flow Frequency Plot

Appendix B
CORMIX Modelling Details

B.1. January

- 7Q20 flow = 0.826 m^3/s, Effluent flow = 5,600 m^3/d (0.0648 m^3/s).
- Assumed channel depth = 1 m, and width = 20m.
- Assumed neutrally buoyant plume.
- CORMIX addresses multi-port diffusers with 3 or more ports, or submerged single port discharges. In this assessment, the two discharge pipes were replaced with three ports of equivalent total area.
- There is a significant difference between the effluent discharge velocity (~0.17 m/s) and the ambient stream velocity (0.03 m/s) resulting in potentially unreliable near-field CORMIX results. Replacing the three-port discharge approximation with an equivalent single port yielded similar results.
- Typical mixing results for January provided below. Completely mixed conditions achieved within the first 100 m.

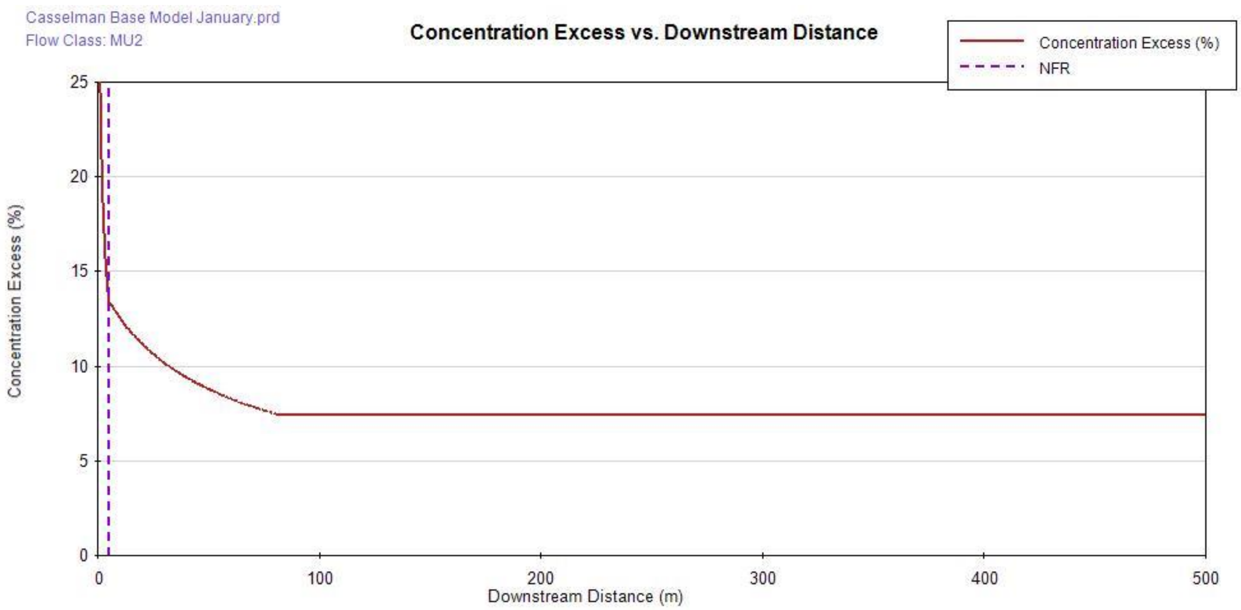

Figure B.1 – CORMIX Results for January

B.2. February

- 7Q20 flow = 0.802 m^3/s, Effluent flow = 5,750 m^3/d (0.0665 m^3/s).
- Assumed channel depth = 1 m, and width = 20m.
- Assumed neutrally buoyant plume.
- In this assessment, the two discharge pipes were replaced with three ports of equivalent total area.
- As with January results, near-field predictions are potentially unreliable, however, far-field predictions acceptable.
- Typical mixing results for February provided below. Completely mixed conditions achieved within the first 100 m.

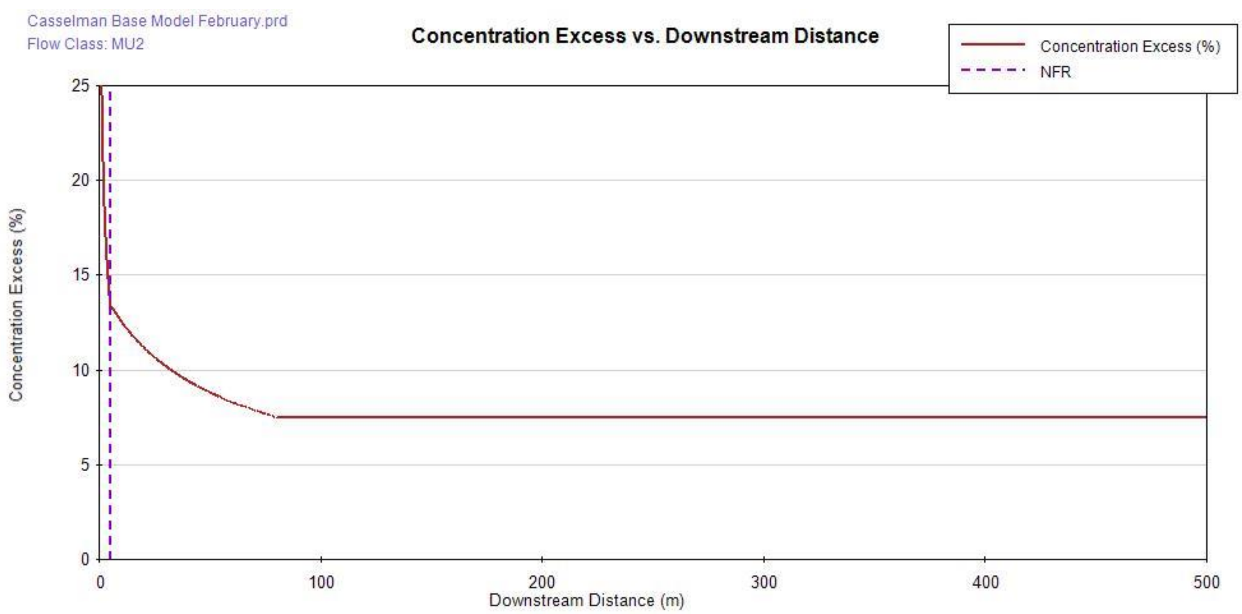

Figure B.1 – CORMIX Results for February

B.3. March

- 7Q20 flow = 1.035 m3/s, Effluent flow = 7,250 m3/d (0.0839 m3/s).
- Assumed channel depth = 1.2 m, and width = 25 m.
- Assumed neutrally buoyant plume.
- In this assessment, the two discharge pipes were replaced with three ports of equivalent total area.
- As with January results, near-field predictions are potentially unreliable, however, far-field predictions acceptable.
- Typical mixing results for March provided below. Completely mixed conditions achieved within the first 130 m.

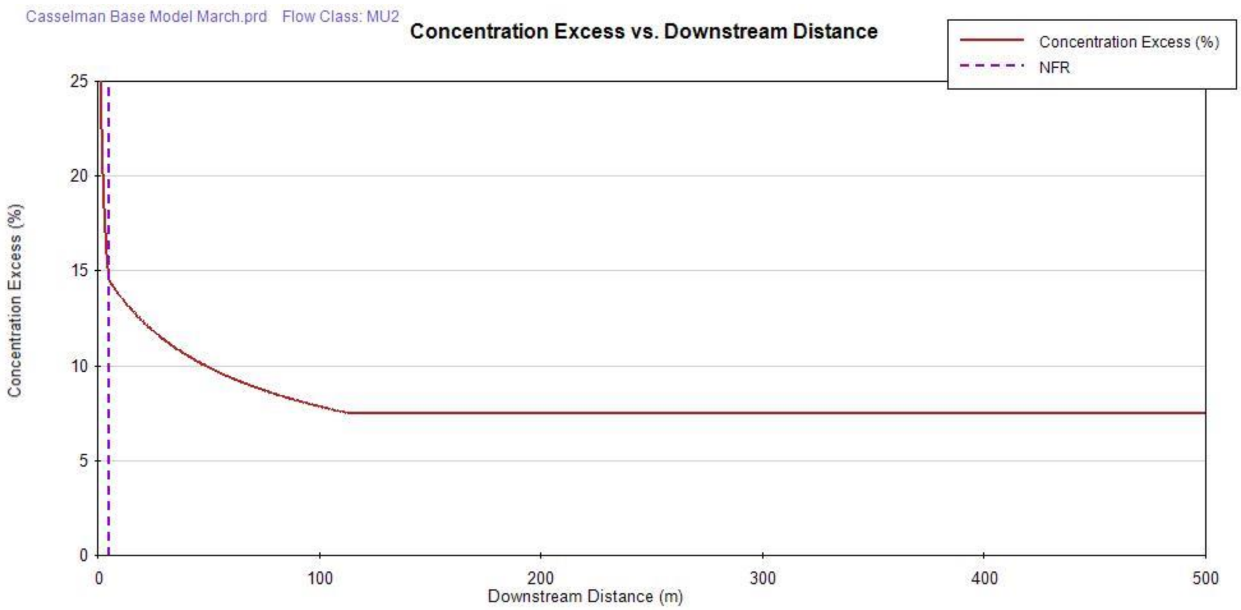

Figure B.3 – CORMIX Results for March

B.4. April

- 7Q20 flow = 8.442 m^3/s, Effluent flow = 10,000 m^3/d (0.116 m^3/s).
- Assumed channel depth = 2 m, and width = 60m.
- Assumed neutrally buoyant plume.
- Typical mixing results for April provided below. Completely mixed conditions achieved within the first 375 m.

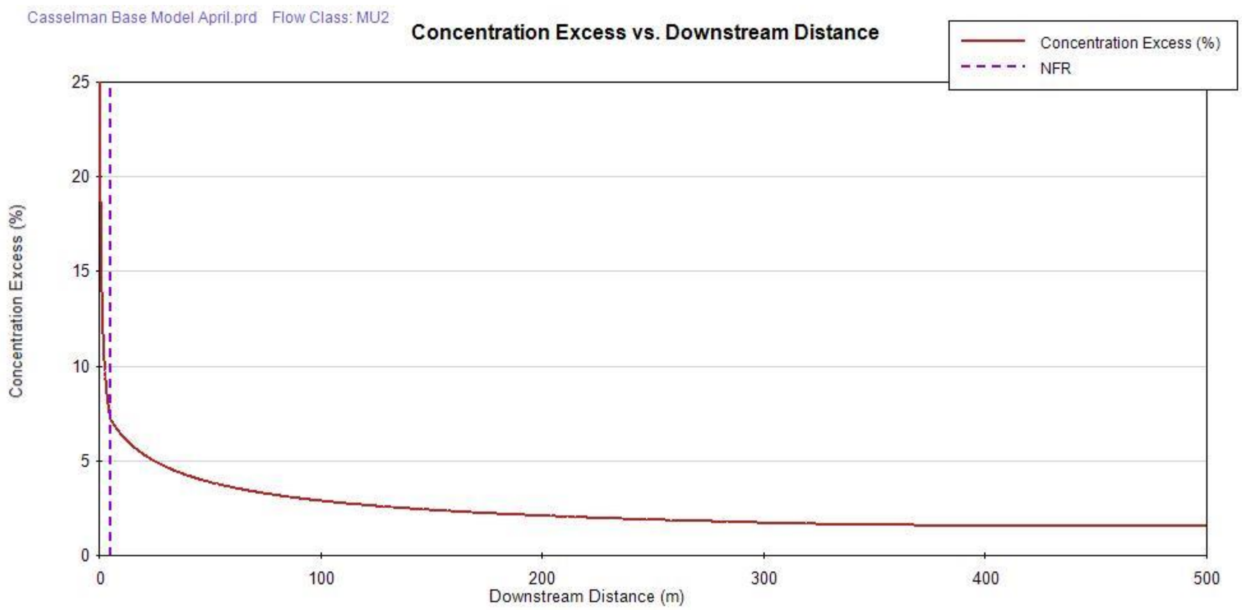

Figure B.4 – CORMIX Results for April

B.5. May

- 7Q20 flow = 2.108 m3/s, Effluent flow = 4,500 m3/d (0.0521 m3/s).
- Assumed channel depth = 1.8 m, and width = 35m.
- Assumed neutrally buoyant plume.
- In this assessment, the two discharge pipes were replaced with three ports of equivalent total area.
- As with January results, near-field predictions are potentially unreliable, however, far-field predictions acceptable.
- Typical mixing results for May provided below. Completely mixed conditions achieved within the first 175 m.

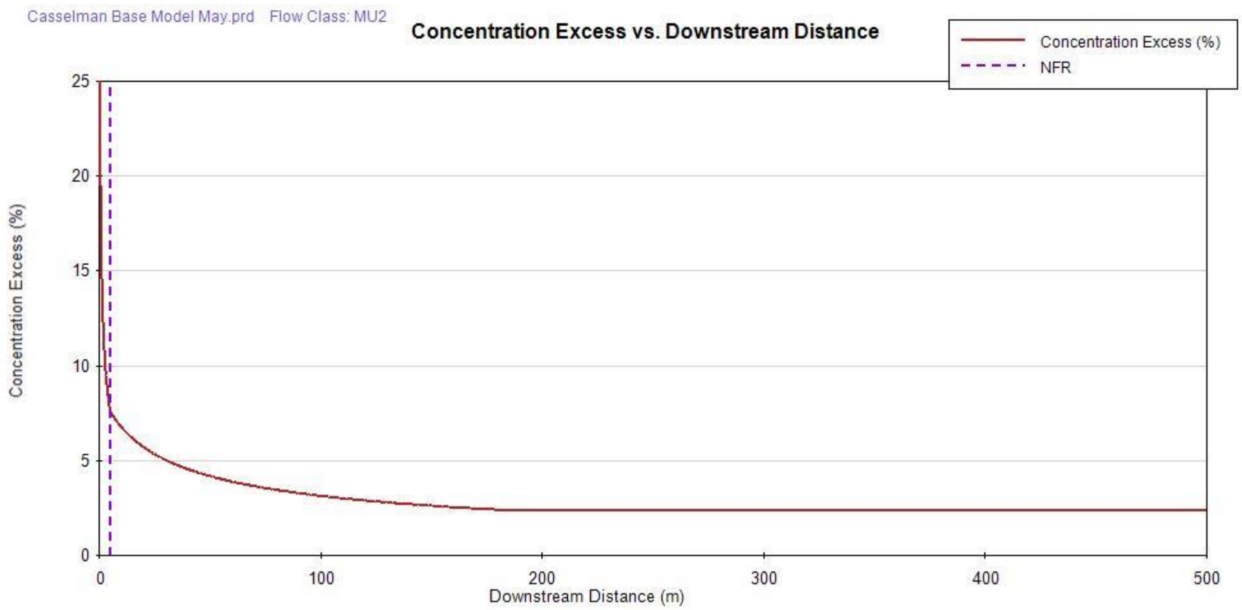

Figure B.5 – CORMIX Results for May

B.6. June

- 7Q20 flow = 0.652 m^3/s, Effluent flow = 2,150 m^3/d (0.0249 m^3/s).
- Assumed channel depth = 1.0 m, and width = 20 m.
- Assumed neutrally buoyant plume.
- In this assessment, the two discharge pipes were replaced with three ports of equivalent total area.
- As with January results, near-field predictions are potentially unreliable, however, far-field predictions acceptable.
- Typical mixing results for June provided below. Completely mixed conditions achieved within the first 80 m.

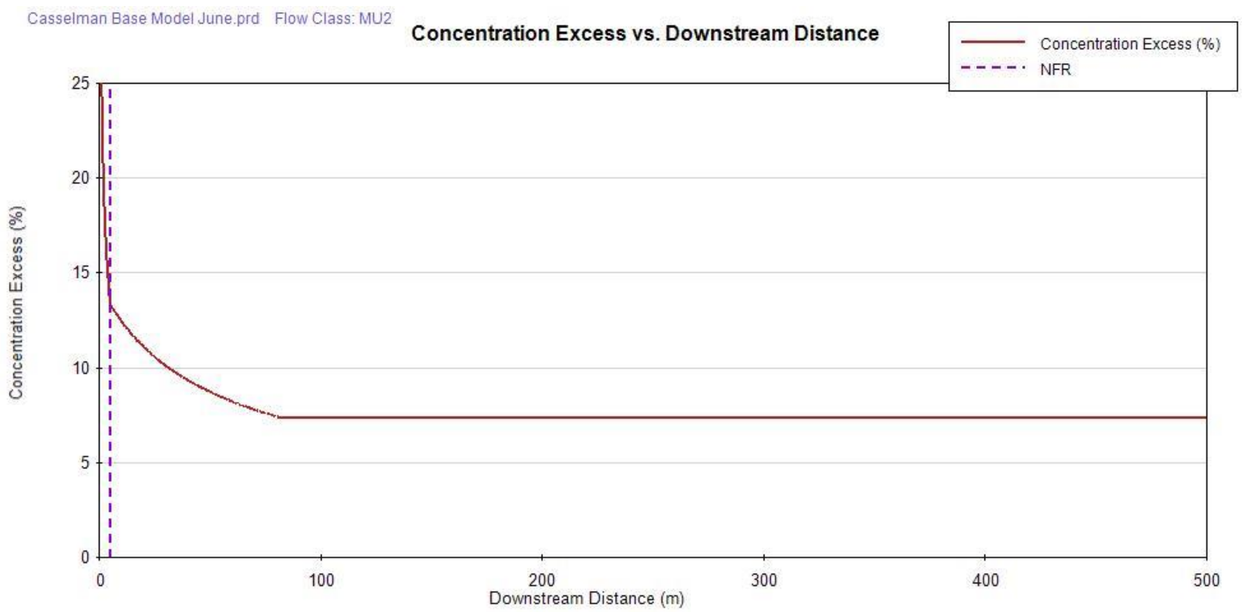

Figure B.6 – CORMIX Results for June

B.7. July

- 7Q20 flow = 0.319 m^3/s, Effluent flow = 1,050 m^3/d (0.0122 m^3/s).
- Assumed channel depth = 1.0 m, and width = 20 m.
- Assumed neutrally buoyant plume.
- In this assessment, the two discharge pipes were replaced with three ports of equivalent total area.
- As with January results, near-field predictions are potentially unreliable, however, far-field predictions acceptable.
- Typical mixing results for July provided below. Completely mixed conditions achieved within the first 75 m.

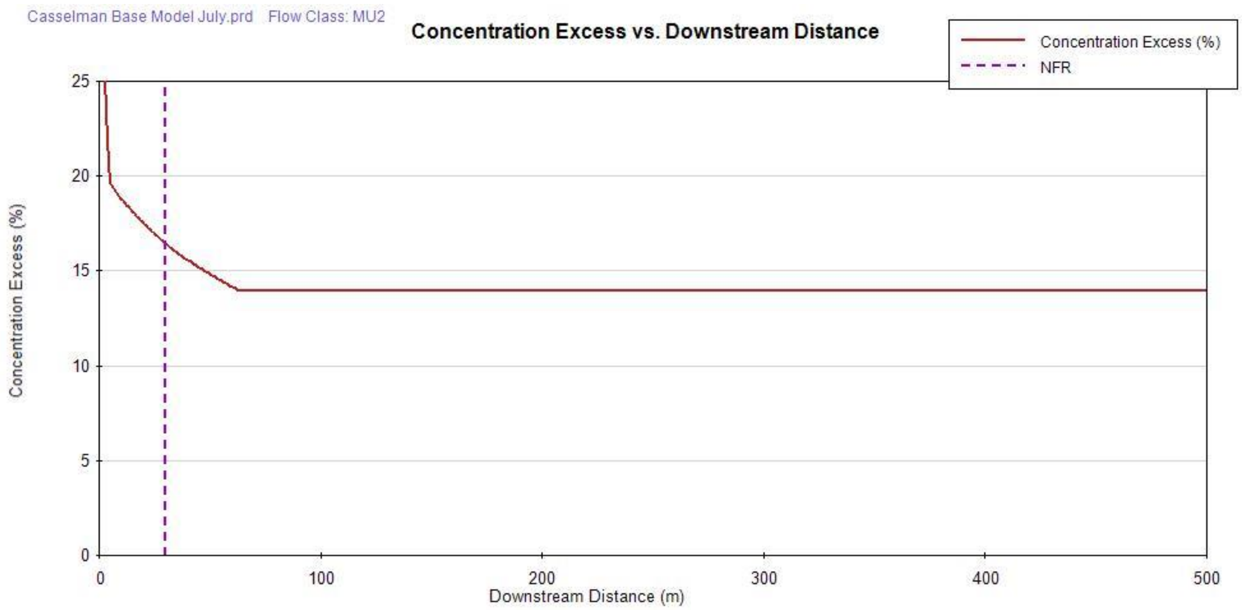

Figure B.7 – CORMIX Results for July

B.8. August

- 7Q20 flow = 0.274 m^3/s, Effluent flow = 900 m^3/d (0.0104 m^3/s).
- Assumed channel depth = 1.0 m, and width = 20 m.
- Assumed neutrally buoyant plume.
- In this assessment, the two discharge pipes were replaced with three ports of equivalent total area.
- As with January results, near-field predictions are potentially unreliable, however, far-field predictions acceptable.
- Typical mixing results for August provided below. Completely mixed conditions achieved within the first 80 m.

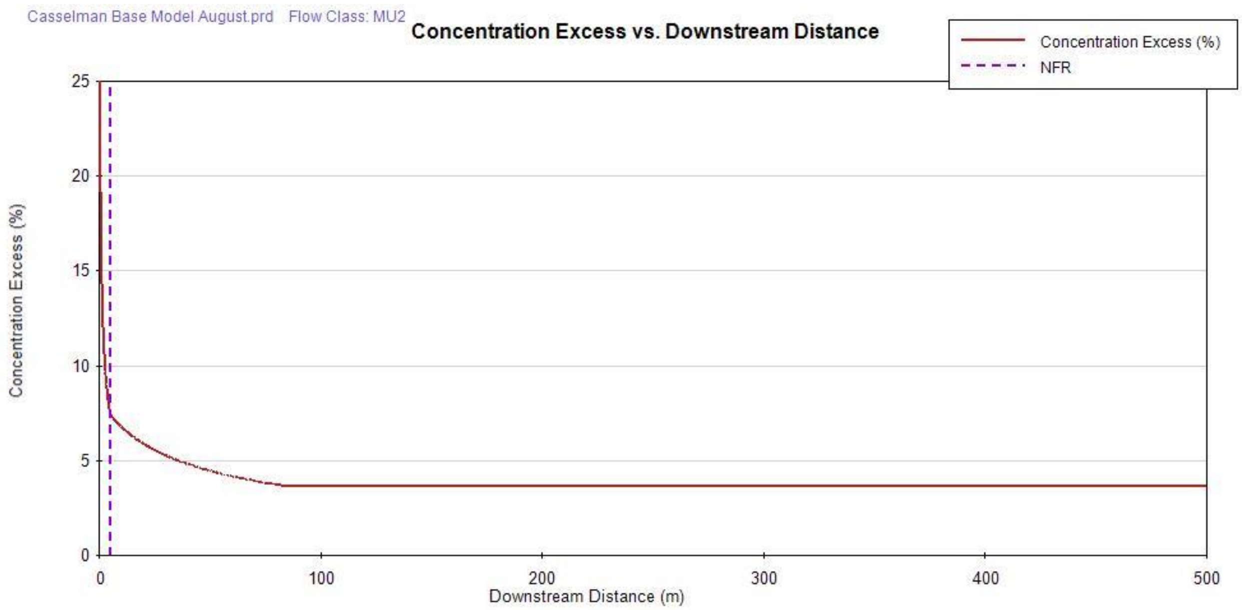

Figure B.8 – CORMIX Results for August

B.9. September

- 7Q20 flow = 0.276 m^3/s, Effluent flow = 910 m^3/d (0.0105 m^3/s).
- Assumed channel depth = 1.0 m, and width = 20 m.
- Assumed neutrally buoyant plume.
- In this assessment, the two discharge pipes were replaced with three ports of equivalent total area.
- As with January results, near-field predictions are potentially unreliable, however, far-field predictions acceptable.
- Typical mixing results for September provided below. Completely mixed conditions achieved within the first 80 m.

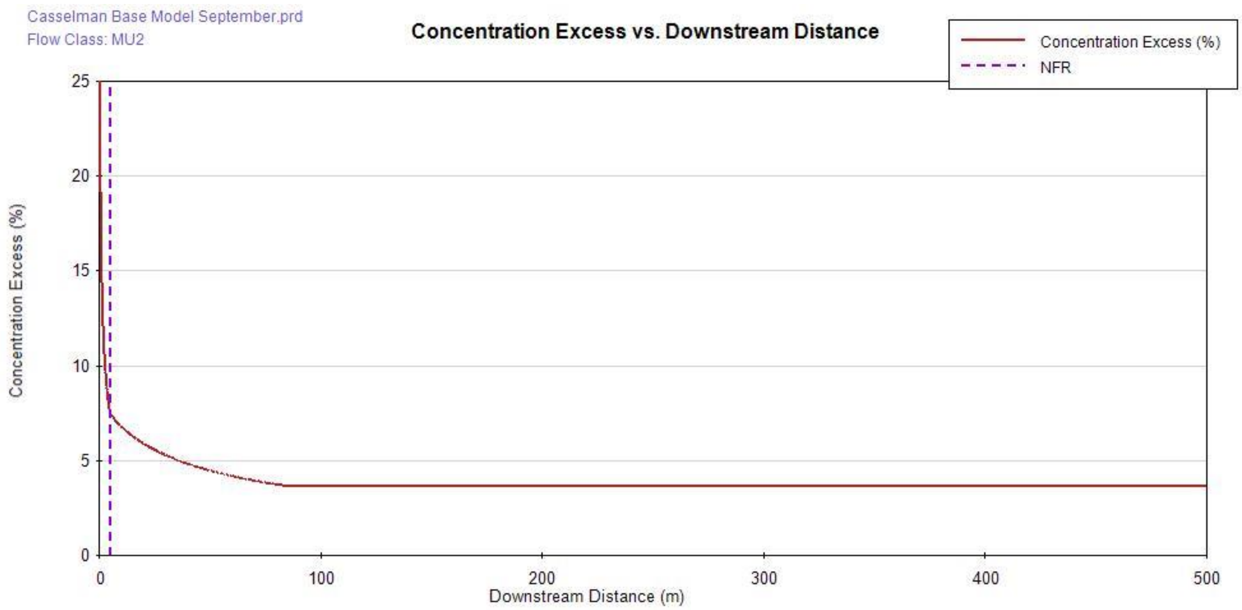

Figure B.9 – CORMIX Results for September

B.10. October

- 7Q20 flow = 0.340 m^3/s, Effluent flow = 2,250 m^3/d (0.0260 m^3/s).
- Assumed channel depth = 1.0 m, and width = 20 m.
- Assumed neutrally buoyant plume.
- In this assessment, the two discharge pipes were replaced with three ports of equivalent total area.
- As with January results, near-field predictions are potentially unreliable, however, far-field predictions acceptable.
- Typical mixing results for October provided below. Completely mixed conditions achieved within the first 80 m.

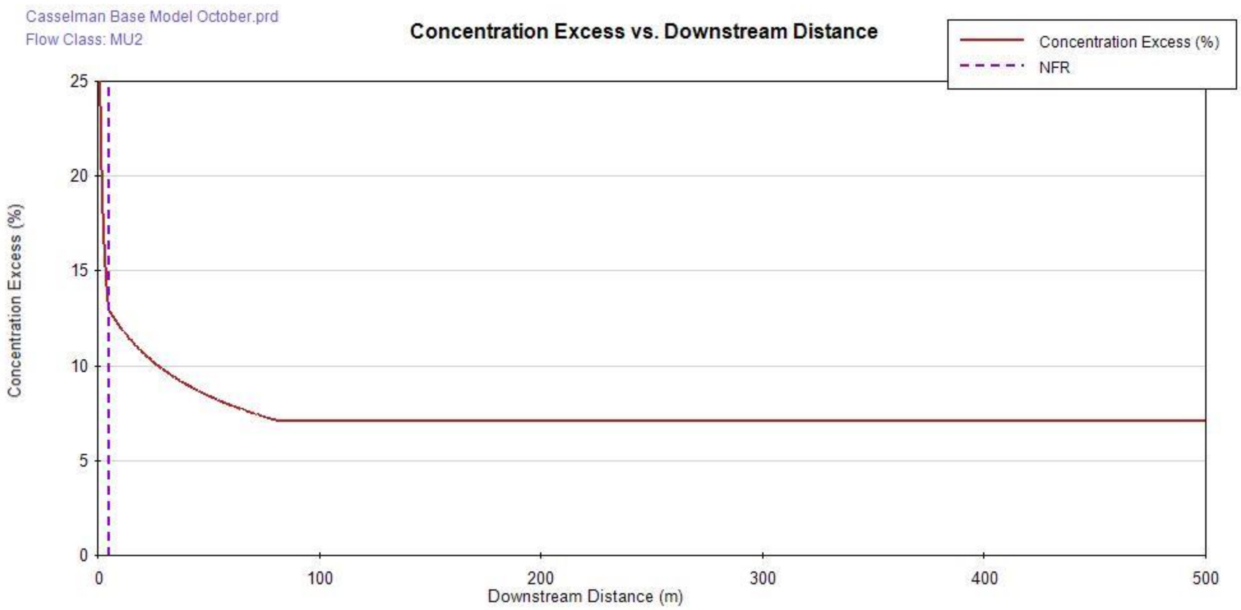

Figure B.10 – CORMIX Results for October

B.11. November

- 7Q20 flow = 0.918 m^3/s, Effluent flow = 6,050 m^3/d (0.0700 m^3/s).
- Assumed channel depth = 1.2 m, and width = 25 m.
- Assumed neutrally buoyant plume.
- In this assessment, the two discharge pipes were replaced with three ports of equivalent total area.
- As with January results, near-field predictions are potentially unreliable, however, far-field predictions acceptable.
- Typical mixing results for October provided below. Completely mixed conditions achieved within the first 125 m.

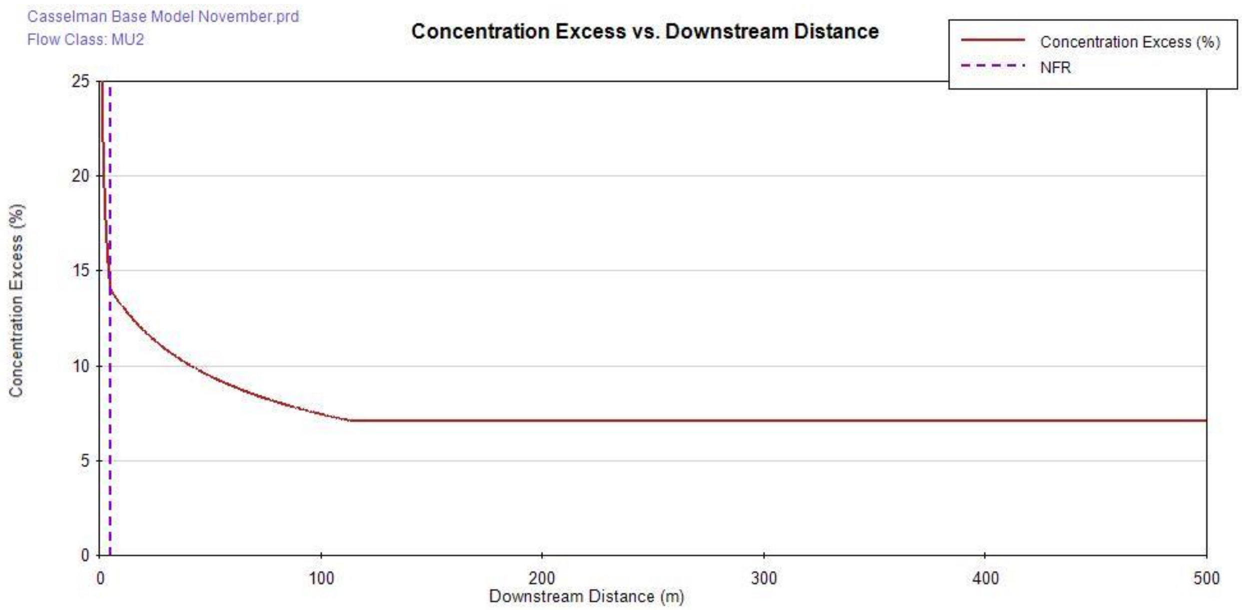

Figure B.11 – CORMIX Results for November

B.12. December

- 7Q20 flow = 1.251 m^3/s, Effluent flow = 8,750 m^3/d (0.101 m^3/s).
- Assumed channel depth = 1.2 m, and width = 25 m.
- Assumed neutrally buoyant plume.
- In this assessment, the two discharge pipes were replaced with three ports of equivalent total area.
- As with January results, near-field predictions are potentially unreliable, however, far-field predictions acceptable.
- Typical mixing results for October provided below. Completely mixed conditions achieved within the first 125 m.

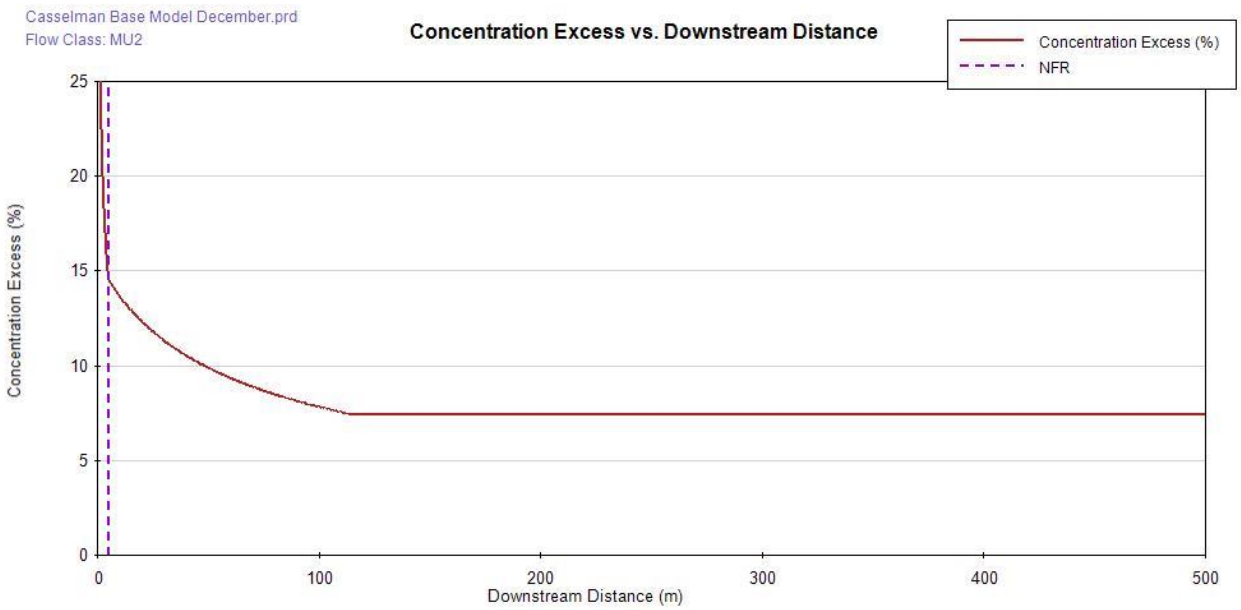

Figure B.12 – CORMIX Results for December

Appendix C

Correspondence Meeting Notes, Meeting Minutes and Presentation Materials from Consultation with MECP and SNC

Melody Johnson

From:	Baxter, Sarah (She/Her) (MECP) <Sarah.Baxter@ontario.ca>
Sent:	October 10, 2023 1:15 PM
To:	Melody Johnson; Castro, Victor (MECP)
Cc:	Carolyn Chan; Michael Hulley
Subject:	RE: Casselman ACS - Notes from Conversation held Oct 5/23

Hey Melody,

Just wanted to confirm that your notes below accurately reflect our discussion last week.

I look forward to hearing about the ACS results on November 2.

Sarah Baxter
Surface Water Specialist
Technical Support Section – Eastern Region
Ministry of the Environment, Conservation and Parks
1259 Gardiners Road, Unit 3, Kingston ON, K7P 3J6
E: sarah.baxter@ontario.ca

From: Melody Johnson <melody@bskyeng.com>
Sent: October 6, 2023 1:02 PM
To: Baxter, Sarah (She/Her) (MECP) <Sarah.Baxter@ontario.ca>; Castro, Victor (MECP) <Victor.Castro@ontario.ca>
Cc: Carolyn Chan <cchan@jlrichards.ca>; Michael Hulley <Michael.Hulley@bskyeng.com>
Subject: Casselman ACS - Notes from Conversation held Oct 5/23

Hi Sarah / Victor,

Thank you for taking the time to speak with me yesterday regarding the ongoing Casselman ACS. I think it was a productive discussion and will help guide us in our subsequent analyses.

I've put together a summary of our conversation below, and attached a copy of the two high-level slides I presented during our call. Please let me know if you have any comments / changes / additions you'd like to make to the summary.

- Blue Sky presented a high-level overview of a proposed approach, which includes:
  - Extending the discharge period from the current Fall/Winter/Spring (Oct 1-May 15) period to year-round
  - Maintaining a minimum dilution ratio of 10:1 for all months (7Q20 : max discharge rate)
  - Ensure UIA PWQO is met at downstream, fully-mixed conditions
  - Ensure UIA non-toxicity at end-of-pipe (using an approach consistent with that used for Winchester)
  - Allow for the discharge of accumulated precipitation in lagoon cells
- Blue Sky also presented an initial low flow analysis (by calendar month) for the SNR in the vicinity of Casselman
- Victor noted that MECP is open to discussions re: extending the discharge period to year-round, however there are concerns related to Summer effluent discharges:
  - Nutrients, particularly phosphorus, are a significant concern in the SNR during the Summer months

    - Upstream agricultural impacts, low flows and elevated temperatures contribute to limited assimilative capacity
    - Current seasonal discharge facilities to this watershed can take advantage of a “trade off”: less stringent nutrient limits by avoiding discharge during the critical Summer period
    - Extending the discharge period for the Casselman facility to the Summer months would require higher level treatment and more stringent effluent limits for P (and N)
- Melody noted that a recent ACS completed by Blue Sky for a constrained receiver in the Nottawasaga Valley watershed utilized an innovative approach to setting discharge flow rates
    - Effluent flows are a function of actual receiver flow, making it possible to discharge effluent during more critical seasonal periods (Summer) while minimizing impact on the receiver
    - Victor and Sarah noted that MECP could be open to considering an approach such as this for the SNR, but that details and supporting analyses would be required
    - Victor also noted that the expectation for stringent effluent requirements over the Summer period would remain
- MECP would like to see the following during the planned November 2, 2023 meeting:
    - An option that maintains the current discharge period (Oct 1-May 15) to determine the impact on effluent storage requirements and overall feasibility
    - That any options that incorporate extending discharge to the Summer period (May 16-Sep 30) take into consideration the receiver’s seasonal sensitivity to nutrient loadings

Thanks, and have a lovely long weekend!

Melody Johnson, PhD, P.Eng., Senior Consultant
melody@bskyeng.com | www.bskyeng.com | M. 647.721.7644

BLUE SKY Energy Engineering & Consulting Inc.
EXPERTISE | BEST PRACTICES | CREATIVE THINKING

Casselman WWTS – ACS of the South Nation River

Current ECA Rated Capacity: 2,110 m^3/d (770,150 m^3/year)

Future Design Rated Capacity: 4,050 m^3/d (1,478,250 m^3/year)

Schedule B (cont.)

Spring - Final Effluent Compliance Limits

Winter/Spring (January 1 to May 15) - Seasonal Flow Volume = 502,500 m^3

Concentration Limits of Works (upon completion of construction of all Proposed Works)

Final Effluent Parameter	Averaging Calculator	Limit (maximum unless otherwise indicated)
CBOD5	Monthly Average Effluent Concentration	25
Total Suspended Solids	Monthly Average Effluent Concentration	25
Total Phosphorus	Monthly Average Effluent Concentration	1.0
Total Ammonia Nitrogen	Monthly Average Effluent Concentration	
January 1 to March 31		12.0 mg/L
April 1 to May 15		6.0 mg/L
E. coli	Monthly Geometric Mean Density	*200 CFU/100 mL
Hydrogen Sulphide	Monthly Average Effluent Concentration	0.1 mg/L
pH of the effluent maintained between 6.0 to 8.0, inclusive, at all times		

*If the MPN method is utilized for *E. coli* analysis the objective shall be 200 MPN/100 mL.

Schedule B (cont.)

Fall - Final Effluent Compliance Limits

Fall (October 1 to December 31) - Seasonal Flow Volume = 267,650 m^3

oncentration Limits of Works (upon completion of construction of all Proposed Works)

luent Parameter	Averaging Calculator	Limit (maximum unless otherwise indicated)
	Monthly Average Effluent Concentration	15
spended Solids	Monthly Average Effluent Concentration	25
osphorus	Monthly Average Effluent Concentration	1.0
nmonia Nitrogen	Monthly Average Effluent Concentration	
October 1 to November 30		5.0 mg/L
December 1 to December 31		12.0 mg/L
E. coli	Monthly Geometric Mean Density	*200 CFU/100 mL
Hydrogen Sulphide	Monthly Average Effluent Concentration	Not Detected
pH of the effluent maintained between 6.0 to 8.0, inclusive, at all times		

*If the MPN method is utilized for *E. coli* analysis the objective shall be 200 MPN/100 mL.

October 5, 2023

Casselman WWTS – ACS of the South Nation River

Schedule B (cont.)

Maximum Monthly Effluent Discharge Rates

Discharge Period	Maximum Discharge Rate	Maximum Discharge Rate Based on Dilution Ratio
January 1 - 31	5,000 m^3/d	SNR Flow/10
February 1 - 28/29	5,000 m^3/d	SNR Flow/10
March 1 - 31	5,000 m^3/d	SNR Flow/40
April 1 -30	7,000 m^3/d	SNR Flow/60
May 1 -15	7,000 m^3/d	SNR Flow/60
October 1 -31	4,000 m^3/d	SNR Flow/15
November 1 - 30	4,000 m^3/d	SNR Flow/10
December 1 - 31	5,000 m^3/d	SNR Flow/15

Low Flow Analysis Results – South Nation River in the Vicinity of Casselman

Month	7Q20 Flow (m^3/s)
January	0.826
February	0.802
March	1.035
April	8.442
May	2.108
June	0.652
July	0.319
August	0.274
September	0.276
October	0.340
November	0.918
December	1.251

Proposed Approach:

- Extend discharge period from Oct 1 – May 15 to year-round
- Maintain minimum dilution ratio of 10:1 for all months (7Q20 : max discharge rate)
- Ensure UIA PWQO met at fully-mixed conditions
- Ensure UIA non-toxicity at end-of-pipe (consistent with Winchester)
- Allow for discharge of accumulated precipitation in lagoon cells

October 5, 2023

J.L.Richards
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Casselman Lagoon Assimilative Capacity Study
MECP Pre-Consultation Meeting 1 **Minutes of Meeting No. 1**

Attendance:	Name	Company	Email
	Pierre-Paul Beauchamp (PB)	Village of Casselman (Casselman)	ppbeauchamp@casselman.ca
	Yves Morrissette (YM)	Casselman	ymorrissette@casselman.ca
	Dawn Crump (DC)	Ontario Clean Water Agency (OCWA)	dcrump@ocwa.com
	Victor Castro (VC)	Ministry of the Environment, Conservation and Parks (MECP)	victor.castro@ontario.ca
	Sarah Baxter (SB)	MECP	sarah.baxter@ontario.ca
	Jon Orpana (JO)	MECP	jon.orpana@ontario.ca
	Melody Johnson (MJ)	Blue Sky Energy Engineering and Consulting Inc. (Blue Sky)	melody@bskyeng.com
	Jordan Morrissette (JM)	J.L. Richards & Associates Limited (JLR)	jmorrissette@jlrichards.ca
	Carolyn Chan (CC)	JLR	cchan@jlrichards.ca
	Kevin Cortez (KC)	JLR	kcortez@jlrichards.ca

The meeting commenced at 10:00 a.m. on Thursday, November 2, 2023 at Microsoft Teams.

The following summary of the discussions of this meeting has been prepared to record decisions reached and actions required for the project. Please advise the undersigned of any errors or omissions within the next three business days.

ITEM **ACTION BY** **DUE BY**

1.1 INTRODUCTION
- JLR introduced the project and the team members.
- The Assimilative Capacity Study is being performed during the ongoing Master Plan Update project, prior to the commencement of a dedicated Environmental Assessment (EA) for the Casselman Lagoon system; results from the study will form a key input in the EA process.
- Blue Sky brought in as sub-consultant to perform the capacity assessment of the South Nation River.

1.2 OVERVIEW OF EXISTING SYSTEM
- The existing system consists of 3-Cell lagoon system with LagoonGuard MBBR and Disk Filter with a rated capacity of 2,110 m^3/d.
- Casselman Master Plan identified future facility rated capacity at 4,050m^3/d.
- Under existing ECA No. 8160-BAHPRF dated April 29, 2019, discharge to the South Nation River is permitted Seasonally (Spring and Fall).
- There are different maximum discharge values and effluent criteria for the different time periods; refer to attached slides.

1.3 ASSIMILATIVE CAPACITY OF SOUTH NATION RIVER
- All calculations are based on 7Q20 flows from the South Nation River.

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Casselman Lagoon Assimilative Capacity Study

MECP Pre-Consultation Meeting 1
Minutes of Meeting No. 1

ITEM	ACTION BY	DUE BY

- MJ noted that for the month of May, 7Q20 flows can be increased if considering the first half of May as Summer flow conditions occur in the later half of May.
- Proposed approach looked at two different scenarios:
  - Scenario 1 - Maintain the current effluent discharge window
  - Scenario 2 – Increase to year-round effluent discharge
- Approach maintained minimum dilution ratio of 10:1 for all months and did not exceed annual total phosphorus loading of 770 kg/year outlined in the existing ECA.
- SCENARIO 1 (refer to attached slides)
  - Updated maximum discharge rate is increased except for October.
  - MJ is proposing a reduced TP monthly limit of 0.45 mg/L, which results in annual TP loading of 770 kg/year.
  - TAN limit is reduced during the Fall and Winter to 4.5 mg/L and 10.0 mg/L, respectively, and maintained at 6.0 mg/L during the Spring
  - Estimated maximum effluent storage volume of 460,000m^3 (end of October). Given the storage requirement exceeds the existing storage capacity of 330,000m^3, new lagoon cells would be required.
  - Mixing calculations showed that TAN in fully mixed condition was below Provincial Water Quality Objective (PWQO) value for all months
  - TP percent increase above ambient conditions range between 4.0% in April and 19.6% in November
  - SB asked whether CORMIX modelling of the mixing zone had been performed. MJ noted that this was planned but not yet completed and confirmed that the fully mixed values presented were based on mass loading approach.
  - VC inquired about space availability and if the municipality would be required to purchase land for the construction of the additional lagoon cells. YM stated that all the surrounding land is owned by The Nation, purchasing additional land would be very difficult and expensive
- SCENARIO 2 (refer to attached slides)
  - For the new summer discharge, considered over 25:1 dilution ratio.
  - Proposed TP monthly limit of 0.3 mg/L results in TP total annual loading reduced to 476 kg/year, with 45.7 kg occurring during the summer
  - TAN monthly limit of 11.5 mg/L during the winter (Dec 1 – Mar 31), 6.0 mg/L during Spring (Apr 1 – May 31), 1.3 mg/L during Summer (June 1 – Sep 30), and 5.0 mg/L during Fall (Oct. 1 – Nov 30).
  - Total storage requirements of 310,000 m^3, no new lagoon cells necessary
  - Approximately 5% increase in TP concentration from the ambient concentration in the summer months
  - MECP inquired if the existing treatment system could consistently achieve the proposed effluent criteria. JLR noted that this would be investigated during the EA process; planning to discuss with Veolia regarding MBBR and disk filter capacity. Reviewing historical performance, warm weather TAN values look promising, TP to be further explored. JLR noted that the — **Action by: JLR**

Casselman Lagoon Assimilative Capacity Study
MECP Pre-Consultation Meeting 1 **Minutes of Meeting No. 1**

ITEM		ACTION BY	DUE BY
	EA could include stress testing to demonstrate feasibility of meeting the proposed compliance limits.		
	- MECP inquired if the plant currently monitors for effluent E.coli. OCWA confirmed that monitoring occurs, noting that the current ECA erroneously provides a limit for E.coli despite lack of disinfection. Reviewing recent results, DC reported a range of 2,700 cfu in January 2023 and 2 cfu in May 2023. A similar trend was observed for the year 2022.		
	- MECP requested that ACS include review of E.coli criteria, especially if effluent is discharged during the summer months.	JLR/ Blue Sky	
	- MJ commented that the purpose of the discussion is to determine if the MECP generally agrees with the approach and proposed limits presented, or whether they have initial concerns or see any red flags that must be addressed.		
	- MECP commented that the approach was generally acceptable. Although new summer discharge into the SNR is a concern, and although the approach presents a 0.3 mg/L TP effluent limit which is not considered equivalent to “Best Available Technology” (i.e. as achieved by mechanical plants with advanced filtration), VC noted that there is recognition that the existing facility is not a new point source. SB commented that the overall reduction in total annual TP loading was favourable.		
	- VC inquired if there were any additional scenarios considered, such as a mechanical plant. YM noted Casselman’s concerns as to cost. JM commented that the future EA would consider all options, but a mechanical plant is likely to be screened out given the availability of storage and the relative costs.		
	- MECP would like project team to contact SNCA to discuss converting to year-round discharge, and incorporate SNCA’s comments into draft ACS report. JLR to initiate discussion with SNCA.	JLR	
	- YM stated that Casselman is a small municipality whose borders are bounded by The Nation giving a cap to ultimate population. Given that the municipality has recently invested in the MBBR treatment system, YM considers that upgrading to a mechanical plant would be too expensive and have minimal benefit.		
1.4	NEXT STEPS AND FINAL COMMENTS		
	• SB expressed interest in CORMIX modelling results regarding mixing zone length. Blue Sky to complete for inclusion in Draft ACS report.	Blue Sky	
	• MECP inquired if there had been odour complaints. OCWA stated that no complaints were received except for foaming from the MBBR.		
	• MECP inquired about the closest neighbouring property. JLR stated that the closest neighbour was a residential property approximately 150 m north.		
	• JO requested to be copied in all future correspondence regarding the ACS for tracking purposes.	JLR	

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Casselman Lagoon Assimilative Capacity Study
MECP Pre-Consultation Meeting 1 **Minutes of Meeting No. 1**

ITEM	**ACTION BY**	**DUE BY**
Meeting adjourned at 10:52 a.m.		

Prepared by:

Issued on: November 9, 2023

Kevin Cortez, M.Eng., EIT
Environmental Engineering Intern

Reviewed by:

Carolyn Chan, M.A.Sc., P.Eng.
Environmental Engineer

Distribution: All attendees

Project No. 16953-133

November 2, 2023

Casselman Lagoons - Assimilative Capacity Review of South Nation River

CANADA BEST MANAGED COMPANIES Platinum member

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

Agenda

- Project Contacts
- Overview of Existing System
- Assimilative Capacity of South Nation River
- Approach
- Preliminary Results
- Next Steps/Comments

Project Contacts

Village of Casselman (Owner)

- Pierre-Paul Beauchamp, Director of Public Works – ppbeauchamp@casselman.ca
- Yves Morrissette, Chief Administrative Office – ymorrissette@casselman.ca

Ontario Clean Water Agency (OCWA)

- Dawn Crump, Process & Compliance – dcrump@ocwa.com

Project Contacts

J.L. Richards and Associates Limited

- Jordan Morrissette, M.Eng., P.Eng., Senior Environmental Engineer – jmorrissette@jlrichards.ca
- Carolyn Chan, M.A.sc. P.Eng., Environmental Engineer – cchan@jlrichards.ca
- Kevin Cortez, Intern Environmental Engineer – kcortez@jlrichards.ca

Blue Sky Energy Engineering and Consulting Inc. (Assimilative Capacity Assessment)

- Melody Johnson, M.A.Sc., PhD, P.Eng., Senior Consultant – melody@bskyeng.com

Overview of Existing System

ECA No. 8160-BAHPRF dated April 29, 2019

Existing Rated Capacity = 2,110 m^3/d

3-Cell Lagoon System with LagoonGuard MBBR and Disk Filter

Seasonal Discharge to South Nation River

Future Rated Capacity = 4,050 m^3/d

Existing ECA

Schedule B (cont.)

Spring - Final Effluent Compliance Limits

Winter/Spring (January 1 to May 15) - Seasonal Flow Volume = 502,500 m^3

Concentration Limits of Works (upon completion of construction of all Proposed Works)

Final Effluent Parameter	Averaging Calculator	Limit (maximum unless otherwise indicated)
CBOD5	Monthly Average Effluent Concentration	25
Total Suspended Solids	Monthly Average Effluent Concentration	25
Total Phosphorus	Monthly Average Effluent Concentration	1.0
Total Ammonia Nitrogen January 1 to March 31 April 1 to May 15	Monthly Average Effluent Concentration	 12.0 mg/L 6.0 mg/L
E. coli	Monthly Geometric Mean Density	*200 CFU/100 mL
Hydrogen Sulphide	Monthly Average Effluent Concentration	0.1 mg/L
pH of the effluent maintained between 6.0 to 8.0, inclusive, at all times		

*If the MPN method is utilized for *E. coli* analysis the objective shall be 200 MPN/100 mL.

Schedule B (cont.)

Maximum Monthly Effluent Discharge Rates

Discharge Period	Maximum Discharge Rate	Maximum Discharge Rate Based on Dilution Ratio
January 1 - 31	5,000 m^3/d	SNR Flow/10
February 1 - 28/29	5,000 m^3/d	SNR Flow/10
March 1 - 31	5,000 m^3/d	SNR Flow/40
April 1 -30	7,000 m^3/d	SNR Flow/60
May 1 -15	7,000 m^3/d	SNR Flow/60
October 1 -31	4,000 m^3/d	SNR Flow/15
November 1 - 30	4,000 m^3/d	SNR Flow/10
December 1 - 31	5,000 m^3/d	SNR Flow/15

Schedule B (cont.)

Fall - Final Effluent Compliance Limits

Fall (October 1 to December 31) - Seasonal Flow Volume = 267,650 m^3

Concentration Limits of Works (upon completion of construction of all Proposed Works)

Final Effluent Parameter	Averaging Calculator	Limit (maximum unless otherwise indicated)
CBOD5	Monthly Average Effluent Concentration	15
Total Suspended Solids	Monthly Average Effluent Concentration	25
Total Phosphorus	Monthly Average Effluent Concentration	1.0
Total Ammonia Nitrogen October 1 to November 30 December 1 to December 31	Monthly Average Effluent Concentration	 5.0 mg/L 12.0 mg/L
E. coli	Monthly Geometric Mean Density	*200 CFU/100 mL
Hydrogen Sulphide	Monthly Average Effluent Concentration	Not Detected
pH of the effluent maintained between 6.0 to 8.0, inclusive, at all times		

*If the MPN method is utilized for *E. coli* analysis the objective shall be 200 MPN/100 mL.

Assimilative Capacity of South Nation River

Preliminary Analysis

Low Flow Analysis Results – South Nation River in the Vicinity of Casselman

Month	7Q20 Flow (m^3/s)
January	0.826
February	0.802
March	1.035
April	8.442
May	2.108
June	0.652
July	0.319
August	0.274
September	0.276
October	0.340
November	0.918
December	1.251

Ambient Water Quality:

- Policy 2 for TP
- Policy 1 for UIA

Proposed Approach

Schedule B (cont.)

Maximum Monthly Effluent Discharge Rates

Discharge Period	Maximum Discharge Rate	Maximum Discharge Rate Based on Dilution Ratio
January 1 - 31	5,000 m^3/d	SNR Flow/10
February 1 - 28/29	5,000 m^3/d	SNR Flow/10
March 1 - 31	5,000 m^3/d	SNR Flow/40
April 1 -30	7,000 m^3/d	SNR Flow/60
May 1 -15	7,000 m^3/d	SNR Flow/60
October 1 -31	4,000 m^3/d	SNR Flow/15
November 1 - 30	4,000 m^3/d	SNR Flow/10
December 1 - 31	5,000 m^3/d	SNR Flow/15

- Two scenarios:
  - Seasonal (maintain current discharge period of Oct 1 – May 15)
  - Year-round (extend discharge period from)
- Maintain minimum dilution ratio of 10:1 for all months (7Q20 : max discharge rate)
- The maximum annual TP loading to the SNR will not exceed the current equivalent ECA limit of 770 kg/year
- Ensure UIA PWQO met at fully-mixed conditions
- Ensure UIA non-toxicity at end-of-pipe (consistent with Winchester)
- Allow for discharge of accumulated precipitation in lagoon cells

Scenarios

1. Seasonal: Maintain current discharge window (Oct 1 to May 15)
2. Year-round: Extend discharge window

1. Seasonal Discharge

Discharge Period	Maximum Discharge Rate	Minimum Dilution Ratio Acheived [1]
Jan 1 – 31	6,750 m^3/d	10.6 : 1
Feb 1 – 28/29	6,550 m^3/d	10.6 : 1
Mar 1 – 31	8,450 m^3/d	10.6 : 1
Apr 1 – 30	10,000 m^3/d	72.9 : 1
May 1 – 15	9,000 m^3/d	39.4 : 1
May 16 – 31	-	-
Jun 1 – 30	-	-
July 1 – 31	-	-
Aug 1 – 31	-	-
Sep 1 – 30	-	-
Oct 1 – 31	2,500 m^3/d	11.8 : 1
Nov 1 – 30	6,800 m^3/d	11.7 : 1
Dec 1 – 31	10,200 m^3/d	10.6 : 1

Notes:

1. SNR 7Q20 flow : Effluent Flow

1. Seasonal Discharge

Parameter	Objective		Limit	
TP	Monthly	0.36 mg/L	Monthly	0.45 mg/L
TAN				
Winter (Dec 1 to Mar 31)	Monthly	8.0 mg/L	Monthly	10.0 mg/L
Spring (Apr 1 to May 15)	Monthly	4.8 mg/L	Monthly	6.0 mg/L
Fall (Oct 1 to Nov 30)	Monthly	3.6 mg/L	Monthly	4.5 mg/L

Excess Discharge Capacity: **0 to 6%** (depends on new storage lagoon area requirements)

Estimated Maximum Effluent Storage Volume Requirement: **460,000 m^3** (end of October) > 330,000 m^3

Maximum Summer TP Loading: **0 kg** (no summer discharge)

Maximum Annual TP Loading: **770 kg/year**

1. Seasonal Discharge

Discharge Period	Fully-Mixed UIA (ug/L as NH3)	Fully-Mixed TP (mg/L)	% Increase Above Ambient TP
Jan 1 – 31	19.4	0.208	11.0
Feb 1 – 28/29	19.4	0.208	11.0
Mar 1 – 31	19.4	0.208	11.0
Apr 1 – 30	13.4	0.115	4.0
May 1 – 15	19.7	0.118	7.1
May 16 – 31	-	-	-
Jun 1 – 30	-	-	-
July 1 – 31	-	-	-
Aug 1 – 31	-	-	-
Sep 1 – 30	-	-	-
Oct 1 – 31	19.2	0.137	19.5
Nov 1 – 30	19.3	0.137	19.6
Dec 1 – 31	19.3	0.208	11.0
PWQO	**20 ug/L as NH3**	**0.030 mg/L**	**n/a**

2. Year-Round Discharge

Discharge Period	Maximum Discharge Rate	Minimum Dilution Ratio Acheived (1)
Jan 1 – 31	5,750 m^3/d	12.4 : 1
Feb 1 – 28/29	5,600 m^3/d	12.4 : 1
Mar 1 – 31	7,250 m^3/d	12.3 : 1
Apr 1 – 30	10,000 m^3/d	72.9 : 1
May 1 – 31	4,500 m^3/d	40.5 : 1
Jun 1 – 30	2,150 m^3/d	26.2 : 1
July 1 – 31	1,050 m^3/d	26.2 : 1
Aug 1 – 31	900 m^3/d	26.3 : 1
Sep 1 – 30	910 m^3/d	26.2 : 1
Oct 1 – 31	2,250 m^3/d	13.1 : 1
Nov 1 – 30	6,050 m^3/d	13.1 : 1
Dec 1 – 31	8,750 m^3/d	12.4 : 1

Notes:

1. SNR 7Q20 flow : Effluent Flow

2. Year-Round Discharge

Parameter	Objective		Limit	
TP	Monthly	0.20 mg/L	Monthly	0.30 mg/L
TAN				
Winter (Dec 1 to Mar 31)	Monthly	9.2 mg/L	Monthly	11.5 mg/L
Spring (Apr 1 to May 31)	Monthly	4.8 mg/L	Monthly	6.0 mg/L
Summer (June 1 to Sep 30)	Monthly	1.0 mg/L	Monthly	1.3 mg/L
Fall (Oct 1 to Nov 30)	Monthly	4.0 mg/L	Monthly	5.0 mg/L

Excess Discharge Capacity: **5.5%** (assumes no new lagoons required)

Estimated Maximum Effluent Storage Volume Requirement: **315,000 m^3** (end of October) < 330,000 m^3

Maximum Summer TP Loading: **45.7 kg** (average of 0.37 kg/d over the Summer)

Maximum Annual TP Loading: **476 kg/year**

2. Year-Round Discharge

Discharge Period	Fully-Mixed UIA (ug/L as NH3)	Fully-Mixed TP (mg/L)	% Increase Above Ambient TP
Jan 1 – 31	19.2	0.194	4.4
Feb 1 – 28/29	19.3	0.194	4.4
Mar 1 – 31	19.4	0.194	4.5
Apr 1 – 30	13.4	0.113	2.3
May 1 – 31	19.4	0.115	4.0
Jun 1 – 30	19.4	0.127	5.2
July 1 – 31	19.4	0.127	5.2
Aug 1 – 31	19.3	0.127	5.2
Sep 1 – 30	19.4	0.127	5.2
Oct 1 – 31	19.3	0.124	10.9
Nov 1 – 30	19.3	0.123	10.9
Dec 1 – 31	19.3	0.194	4.4
PWQO	**20 ug/L as NH3**	**0.030 mg/L**	**n/a**

Next Steps and Final Comments

- Maintaining seasonal discharge:
  - Expansion to effluent storage volume required
  - Project impacts (site, schedule, cost)
- Expanding discharge to year-round:
  - Minimum summer dilution ratio (~25 : 1)?
  - Summer TP concentration limit (0.30 mg/L)?
  - New TP loading to SNR over the summer (45.7 kg over June – Sep)?
- Next steps:
  - Update discharge alternatives (as required)
  - Evaluate and select preferred discharge alternative
  - Document in ACS report

Thank you!

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Environmental Engineering Intern
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Email: kcortez@jlrichards.ca

www.jlrichards.ca

Melody Johnson

From: Melody Johnson
Sent: November 30, 2023 11:10 AM
To: Melody Johnson
Subject: FW: 16953-133 Casselman Lagoon ACS

From: Claire Lemay <clemay@nation.on.ca>
Sent: Wednesday, November 29, 2023 3:27 PM
To: Carolyn Chan <cchan@jlrichards.ca>
Cc: Kevin Cortez <kcortez@jlrichards.ca>
Subject: Re: 16953-133 Casselman Lagoon ACS

Hi Carolyn,

SNC has no concerns with the proposal to extend the discharge period from seasonal to year-round as long as the proposal remains to maintain the total phosphorus loading to the South Nation River within the allowable limits of the existing ECA.

Thank you,
Claire Lemay

From: Carolyn Chan <cchan@jlrichards.ca>
Sent: Wednesday, November 29, 2023 10:07 AM
To: Claire Lemay <clemay@nation.on.ca>
Cc: Kevin Cortez <kcortez@jlrichards.ca>
Subject: RE: 16953-133 Casselman Lagoon ACS

Hi Claire,

Can you provide an update? Happy to schedule a meeting if that's quicker.

Best,
Carolyn

Carolyn Chan, P.Eng., M.A.Sc.
Environmental Engineer

J.L. Richards & Associates Limited
107 - 450 Speedvale Ave. West, Guelph, ON N1H 7Y6
Direct: 226-780-7367

J.L. Richards & Associates Limited
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From: Claire Lemay <clemay@nation.on.ca>
Sent: Tuesday, November 21, 2023 12:06 PM
To: Carolyn Chan <cchan@jlrichards.ca>

Cc: Info Mailbox <info@nation.on.ca>
Subject: RE: 16953-133 Casselman Lagoon ACS

Hi Carolyn,
Thank you for your inquiry. I'm consulting my colleagues and I'll get back to you within the next few days.
Regards,
Claire

From: Carolyn Chan <cchan@jlrichards.ca>
Sent: Monday, November 20, 2023 8:14 AM
To: Claire Lemay <clemay@nation.on.ca>
Cc: Info Mailbox <info@nation.on.ca>
Subject: RE: 16953-133 Casselman Lagoon ACS

Hi Claire,

Just following up on my previous email – did you get a chance to look at the attached?

Copying the general email inbox in case Claire is not the correct contact.

Thank you,
Carolyn

Carolyn Chan, P.Eng., M.A.Sc.
Environmental Engineer

J.L. Richards & Associates Limited
107 - 450 Speedvale Ave. West, Guelph, ON N1H 7Y6
Direct: 226-780-7367

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From: Carolyn Chan
Sent: Thursday, November 9, 2023 3:05 PM
To: clemay@nation.on.ca
Cc: Melody Johnson <melody@bskyeng.com>; Jordan Morrissette <jmorrissette@jlrichards.ca>; Kevin Cortez <kcortez@jlrichards.ca>
Subject: 16953-133 Casselman Lagoon ACS

Hi Claire,

We're completing an Assimilative Capacity Study to support the ongoing Master Plan Update for the Municipality of Casselman, to plan for growth in the community. One of the scenarios under consideration is expanding the discharge window of the plant. See attached slides recently presented to the MECP showing proposed quantity and effluent quality on a monthly basis; with year-round discharge, there is an increase in TP loading to the river during summer months, but an overall reduction in approved TP loading on an annual basis.

We are interested in hearing the SNCA's opinion of this scenario and incorporating any comments into our draft ACS report. Could you take a look, or pass this to the appropriate contact? Happy to set up a virtual meeting to discuss.

Best,

Carolyn

Claire Lemay | RPP, Senior Planner
38 Victoria Street, Box 29, Finch, ON K0C 1K0
Tel: 613-984-2948 or 1-877-984-2948 | Fax: 613-984-2872
nation.on.ca | make a donation

South Nation Conservation de la Nation Sud

Our local environment, we're in it together.
Notre environnement local, protégeons-le ensemble.

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Appendix B

MECP Correspondence

Memorandum

To:	Sarah Baxter, Surface Water Specialist, Eastern Region, MECP
CC:	Jon Orpana, Environmental Assessment Coordinator, MECP Carolyn Chan, P.Eng., J.L. Richards & Associates Limited
From:	Melody Johnson, PhD, P.Eng.
Date:	February 16, 2024
Subject:	Casselman WWTS Assimilative Capacity Study – Response to MECP Comments

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"Final Report – Assimilative Capacity Study to Support the Expansion of the Casselman WWTS" dated January 11, 2024 was prepared by Blue Sky Energy Engineering & Consulting Inc. (Blue Sky) and submitted to the Ministry of the Environment, Conservation and Parks (MECP) for review. Comments were provided by Sarah Baxter, Surface Water Specialist, in a memorandum dated February 1, 2024 (see Attachment A).

MECP have agreed to both the maximum effluent discharge rates and proposed effluent objectives and limits as presented in the Assimilative Capacity Study report, with the following exceptions:

> "a. If disinfection equipment is to be installed it should be operated all year and E. Coli limits should be in place for all months; and,
>
> b. There should also be effluent loading limits established for $cBOD_5$, TSS, TAN, and TP."

Our responses to these two comments are provided below.

Comment: "a. If disinfection equipment is to be installed it should be operated all year and E. Coli limits should be in place for all months."

Response: We propose to update the E. coli effluent objectives and limits to apply year-round, rather than the previously proposed seasonal discharge period of May 1 to October 31.

Comment: "b. There should also be effluent loading limits established for $cBOD_5$, TSS, TAN, and TP."

Response: Due to the variable nature of permitted effluent discharge rates, and the fact that the proposed effluent objectives and limits for $cBOD_5$, TSS and TP remain constant year-round, we are proposing annual effluent limits for these parameters calculated as follows:

Average total annual discharge rate (4,374 m^3/d) * Effluent concentration limit

This results in proposed effluent $cBOD_5$, TSS and TP loading limits of 52.5 kg/d, 52.5 kg/d and 1.31 kg/d, respectively, calculated on an annual average basis.

Because effluent TAN limits vary seasonally, and effluent discharge rates vary monthly, we are proposing monthly TAN loading limits calculated as follows:

Maximum monthly discharge rate (m^3/d) * Seasonal TAN concentration limit

This results in monthly effluent TAN loading limits. These have been calculated and are presented in Table 3 below.

Given the above, the proposed effluent requirements have been updated and are presented below in Table 1 (discharge rate), Table 2 (concentration targets) and Table 3 (loading limits). Items in **bold font** represent new and/or modified values.

Table 1 – Maximum Monthly Effluent Discharge Rates

Month	Discharge Rate (m^3/d)	Minimum Dilution Ratio
January	5,750 m^3/d	12.4
February	5,600 m^3/d	12.4
March	7,250 m^3/d	12.3
April	10,000 m^3/d	72.9
May	4,500 m^3/d	40.5
June	2,150 m^3/d	26.2
July	1,050 m^3/d	26.2
August	900 m^3/d	26.3
September	910 m^3/d	26.2
October	2,250 m^3/d	13.1
November	6,050 m^3/d	13.1
December	8,750 m^3/d	12.4

Table 2 – Proposed Effluent Objectives and Limits

Parameter	Averaging Period	Objective (mg/L unless noted otherwise)	Limit (mg/L unless noted otherwise)
$cBOD_5$	Monthly	10	12
TSS	Monthly	10	12
TP	Monthly	0.20	0.30
TAN			
Dec 1 to Mar 31	Monthly	9.2	11.5
Apr 1 to May 31	Monthly	4.8	6.0
Jun 1 to Sep 30	Monthly	1.0	1.3
Oct 1 to Nov 30	Monthly	4.0	5.0
E. coli	**Monthly**	**150 CFU/100 mL**	**200 CFU/100 mL**
pH	Single Grab	6.8 to 7.8	6.0 to 8.0

Table 3 – Proposed Effluent Loading Limits

Parameter	Averaging Period	Limit (kg/d)
cBOD5	**Annual**	**52.5**
TSS	**Annual**	**52.5**
TP	**Annual**	**1.31**
TAN		
January	**Monthly**	**66.1**
February	**Monthly**	**64.4**
March	**Monthly**	**83.4**
April	**Monthly**	**60.0**
May	**Monthly**	**27.0**
June	**Monthly**	**2.80**
July	**Monthly**	**1.37**
August	**Monthly**	**1.17**
September	**Monthly**	**1.18**
October	**Monthly**	**11.3**
November	**Monthly**	**30.3**
December	**Monthly**	**100.6**

We trust that the above adequately addresses your comments and provides you with the information you require at this time. Should you have any questions or concerns, please do not hesitate to contact Melody Johnson at melody@bskyeng.com or 647-721-7644.

Attachment A

MECP Memorandum dated February 1, 2024

Ministry of the Environment, Conservation and Parks
Eastern Region
1259 Gardiners Road, Unit 3
Kingston ON K7P 3J6
Phone: 613.549.4000
or 1.800.267.0974

Ministère de l'Environnement, de la Protection de la nature et des Parcs
Région de l'Est
1259, rue Gardiners, unité 3
Kingston (Ontario) K7P 3J6
Tél: 613 549-4000
ou 1 800 267-0974

Ontario

M E M O R A N D U M

February 1, 2024

TO: Jon Orpana
Environmental Assessment Coordinator
Environmental Assessment and Permissions Division
Eastern Region

FROM: Sarah Baxter
Surface Water Specialist
Technical Support Section
Eastern Region

RE: Casselman Wastewater Treatment System
Assimilative Capacity Study
Municipality of Casselman; United Counties of Prescott and Russell
Environmental Compliance Approval #8160-BAHPRF
ECHO #1-278240452

I have reviewed the "*Final Report, Assimilative Capacity Study to Support the Expansion of the Casselman WWTS*" dated January 11, 2024 and prepared by Blue Sky Energy Engineering & Consulting Inc. The following comments, relative to surface water impact concerns, are provided for your consideration.

Background

The Casselman Wastewater Treatment System (WWTS) is a municipal facultative lagoon system that services the Village of Casselman. The system has a rated capacity of 2,110 m^3/day and is regulated by Environmental Compliance Approval (ECA) #8160-BAHPRF. The system includes 3 facultative lagoon cells (A, B, C), an aeration system, a phosphorus removal system, and a flow measurement system. Effluent is discharged to the South Nation River via an outfall sewer equipped with two diffuser ports.

Effluent discharge is permitted between October 1 to May 15 each year. Schedule B of the ECA lists the monthly maximum effluent discharge rate. The Village is permitted to release a total of 502,500 m^3 of effluent during the winter/spring discharge period (January 1 to May 15) and 267,650 m^3 of effluent during the fall discharge period (October 1 to December 31).

The effluent objectives and limits for carbonaceous biochemical oxygen demand ($CBOD_5$), total suspended solids (TSS), total phosphorous (TP), total ammonia nitrogen (TAN), E. Coli, hydrogen sulphide (H_2S), and pH are presented in **Table 1** and **Table 2**.

Table 1: Effluent Objectives and Limits for the Spring/Winter Discharge Period

Parameter	Timeframe	Concentration Objective	Concentration Limit	Loading Limit
$CBOD_5$	Jan 1 – May 15	15 mg/L	25 mg/L	93.06 kg/d
TSS	Jan 1 – May 15	15 mg/L	25 mg/L	93.06 kg/d
TP	Jan 1 – May 15	0.8 mg/L	1 mg/L	3.73 kg/d
TAN	Jan 1 – Mar 31	12 mg/L	12 mg/L	44.67 kg/d
	Apr 1 – May 15	6 mg/L	6 mg/L	22.34 kg/d
E.Coli	Jan 1 – May 15	100 CFU/100 mL	200 CFU/100 mL	
H_2S	Jan 1 – May 15	0.1 mg/L	0.1 mg/L	0.37 kg/d
pH		6.8 – 7.8	6.0 – 8.0	

Table 2: Effluent Objectives and Limits for the Fall Discharge Period

Parameter	Timeframe	Concentration Objective	Concentration Limit	Loading Limit
$CBOD_5$	Oct 1 – Dec 31	10 mg/L	15 mg/L	43.64 kg/d
TSS	Oct 1 – Dec 31	10 mg/L	25 mg/L	72.73 kg/d
TP	Oct 1 – Dec 31	0.8 mg/L	1 mg/L	2.91 kg/d
TAN	Oct 1 – Nov 30	5 mg/L	5 mg/L	14.55 kg/d
	Dec 1 – Dec 31	12 mg/L	12 mg/L	34.89 kg/d
E.Coli	Oct 1 – Dec 31	100 CFU/100 mL	200 CFU/100 mL	
H_2S	Oct 1 – Dec 31	Non-detect	Non-detect	
pH	Oct 1 – Dec 31	6.8 – 7.8	6.0 – 8.0	

The Village is completing a Class Environmental Assessment (EA) to increase wastewater servicing capacity to meet the needs of future growth projections. An increase in wastewater volume to 4,050 m^3/day is proposed. Completion of an Assimilative Capacity Study (ACS) serves the EA by determining the site-specific effluent criteria so appropriate upgrades and technology can be explored. The reviewed document has been provided as a result.

Assimilative Capacity Study

Blue Sky have completed the ACS on the basis that the effluent discharge window will be extended to a year-round discharge. In previous pre-submission consultation (PSC) meetings, consideration was given to maintaining the existing discharge window. However, maintaining the existing discharge period would require the construction of another lagoon and it is my understanding that there is no property available to do so.

Background flow data was obtained from Water Survey of Canada (WSC) gauge #02LB013, which is located approximately 1 kilometer upstream of the WWTS. Data was available for 1950-2021. Background water quality data for BOD_5, dissolved oxygen (DO), TAN, temperature, pH, TP, TSS, nitrate, and E. Coli was obtained from Provincial Water Quality Monitoring Network (PWQMN) station #18207010002. This station is also approximately 1 kilometer upstream of the sewage system with data available from 1950-2020.

The ACS approach also:

- Assumed that the lagoon system would receive 297 m^3/d of precipitation, so the discharge capacity was increased to 4,347 m^3/d;
- Maintained a minimum dilution ratio of 10:1;
- Limited future TP loadings to 770 kg/yr (the current ECA limit);
- Used a mass-balance approach to ensure downstream un-ionized ammonia (UIA) concentrations were below the PWQO;
- Proposed TAN effluent limits that would be non-toxic at end-of-pipe;
- Suggested effluent limits for pH and E.Coli based on those approved for other similar WWTS; and,
- Assessed the proposed effluent limits using CORMIX.

Flows

Blue Sky developed maximum effluent discharge rates for each month, using monthly average 7Q20 flows in the South Nation River and a minimum dilution ratio of 10:1. The proposed rates are provided in Table 3 below.

Table 3: Proposed Maximum Monthly Effluent Discharge Rates

Month	Discharge Rate (m3/d)	Minimum Dilution Ratio
January	5,750	12.4
February	5,600	12.4
March	7,250	12.3
April	10,000	72.9
May	4,500	40.5
June	2,150	26.2
July	1,050	26.2
August	900	26.3
September	910	26.2
October	2,250	13.1
November	6,050	13.1
December	8,750	12.4

The proposed maximum discharge rates would permit an annual discharge volume of 1,674,050 m^3 or an average daily flow of 4,586 m^3. Blue Sky notes this volume will provide some flexibility in discharging the design flow plus the anticipated precipitation.

Total Phosphorus

The South Nation River is a Policy 2 receiver with respect to total phosphorus, so the existing discharge load of 770 kg/yr must be maintained or reduced. The South Nation Conservation Authority were contacted regarding the proposed effluent discharge during the summer months and there were no objections provided that the annual phosphorus loading be maintained or reduced.

Blue Sky has proposed an effluent design objective of 0.2 mg/L, a compliance limit of 0.3 mg/L, and a loading limit of 446 mg/L (**Table 4**). This loading limit is 57% less than the value currently approved. Blue Sky indicates that phosphorus concentrations downstream of the discharge are not anticipated to increase more than 5.2% above ambient during the summer months.

Carbonaceous Biochemical Oxygen Demand

The South Nation River is a Policy 1 receiver with respect to dissolved oxygen. The long-term annual 75th percentile for BOD is 4 mg/L, indicating background concentrations are low.

Blue Sky has proposed a design objective of 10 mg/L and a compliance limit of 12 mg/L (**Table 4**). At these values, $CBOD_5$ concentrations in the mixing zone could increase from 0.29 mg/L (June-September) to 0.59 mg/L (winter). Blue Sky suggests these minor concentration increases would not have a significant impact on dissolved oxygen concentrations.

Total Suspended Solids

South Nation River background TSS concentrations are elevated compared to many receiving streams of a similar size, having a long-term annual 75th percentile of 14.5 mg/L. Since there is no Provincial Water Quality Objective (PWQO) for TSS, Blue Sky recommends not exceeding the long-term Canadian Water Quality Guideline (CWQG) of a 5 mg/L increase above ambient.

Blue Sky has proposed a design objective of 10 mg/L and a compliance limit of 12 mg/L (**Table 4**). The proposed limit is significantly less than that currently approved (25 mg/L). Blue Sky indicates that downstream concentrations should not increase more than 0.13 mg/L, which meets the long-term CWQG.

Total Ammonia Nitrogen

Ambient TAN concentrations in the South Nation River are relatively low. However, the receiver has a naturally elevated pH (long-term annual 75th percentile of 8.19) and water temperatures are elevated in the summer months, so there is limited assimilative capacity available for UIA in June, July, and August.

When developing monthly TAN limits, Blue Sky used conservative effluent and/or receiver pH and temperature values to ensure the un-ionized ammonia concentration did not exceed 0.2 mg/L at the end-of-pipe. They also ensured that the downstream UIA concentrations met the PWQO of 0.02 mg/L.

The proposed TAN limits are 11.5 mg/L (December to March), 6 mg/L (April to May), 1.3 mg/L (June to September), and 5 mg/L (October to November) (**Table 4**). Blue Sky notes that these values are consistent with, or more stringent, than existing TAN limits.

pH

Blue Sky has proposed a pH design objective of 6.8-7.8 and a compliance limit of 6.0-8.0 (**Table 4**). These values are consistent with those approved by the existing ECA.

E. Coli

Blue Sky has proposed an E.Coli design objective of 150 CFU/100 mL and a compliance limit of 200 CFU/100 mL during the warm weather discharge period of May to October (**Table 4**). They suggest these values are consistent with the current ECA and other municipal WWTS discharging to the South Nation River.

Table 4: Proposed Effluent Design Objectives and Compliance Limits

Parameter	Timeframe	Objective	Limit
$CBOD_5$	All months	10 mg/L	12 mg/L
TSS	All months	10 mg/L	12 mg/L
TP	All months	0.2 mg/L	0.3 mg/L
TAN	Dec 1 – Mar 31	9.2 mg/L	11.5 mg/L
	Apr 1 – May 31	4.8 mg/L	6.0 mg/L
	Jun 1 – Sep 30	1.0 mg/L	1.3 mg/L
	Oct 1 – Nov 30	4.0 mg/L	5.0 mg/L
E. Coli	May 1 – Oct 31	150 CFU/100 mL	200 CFU/100 mL
pH	All months	6.8 – 7.8	6.0 – 8.0

CORMIX Modelling

Blue Sky completed CORMIX modelling using the monthly 7Q20 flows and the maximum monthly discharge rates. With the exception of April, fully mixed conditions are achieved within 175 meters of the diffuser. In the critical summer months, the mixing zone is only 80 meters in length.

In April, the estimated mixing zone size is 375 meters. Blue Sky acknowledges that this value is considerably larger than the other months, but notes there should be limited impact on downstream water quality because of the high dilution ratio in April (72.9:1). They also indicate that the concentration excess in the plume should reach 5% by 20 meters downstream of the diffuser.

Conclusions and Recommendations

1. The Village of Casselman are completing a Class EA to increase wastewater servicing capacity. The reviewed ACS has been completed to develop appropriate site-specific effluent criteria and aid in selection of appropriate sewage works upgrades/treatment options.

2. I have no objections to the proposed maximum effluent discharge rates listed in **Table 3** as all dilution ratios are greater than 10:1 and additional dilution capacity was allocated in the more critical summer months.

3. I have no objections to the proposed effluent objectives and limits outlined in **Table 4** except that:
    a. If disinfection equipment is to be installed it should be operated all year and E.Coli limits should be in place for all months; and,
    b. There should also be effluent loading limits established for $CBOD_5$, TSS, TAN, and TP.

If you have any questions regarding the above comments, I would be pleased to discuss them with you.

Sarah Baxter, B.Sc.H.

ec: V. Castro
C. Klein

c: File SW PR CA 03 07 (Casselman WWTS)

Appendix C

Veolia Technical Proposal

JL Richards

Attention: Carolyn Chan, P.Eng.

Environmental Engineer

CASSELMAN WWTP

COLD WEATHER SPECIALIZED TREATMENT SYSTEM

LAGOONGUARD™ - NIT MBBR + DISCFILTER

CONTINUOUS DISCHARGE

January 26th, 2024

Proposal Number: TM-123502

Prepared By:

Robert Lafond, P. Eng., Senior Process Engineer

Jason Boomhour, Municipal Business Development ON & MB

VEOLIA Water Technologies Canada
ISO 9001: 2008
4105 Sartelon, St-Laurent (QC) H4S 2B3
Tél: 514 334-7230 ● Fax: 514 334-5070
www.VEOLIAwatertechnologies.ca

WATER TECHNOLOGIES

January 26th, 2024

J.L. Richards & Associates Limited

Attention: **Carolyn Chan**, P.Eng., Environmental Engineer
Re: **Casselman WWTP**
LAGOONGUARD™ - NIT using MBBR™ Media + DISCFILTER
CONTINUOUS DISCHARGE ALL YEAR LONG
Our Project No: TM-123502

Carolyn,

Please find here our Proposal with technical information for the increasing of capacity of the **VEOLIA** LAGOONGUARD - NIT system and DISCFILTER processes in operation at Casselman WWTP.

The objective of this proposal is to present a scenario to respond to the increasing the capacity of the Casselman WWTP in the near future. VEOLIA proposes to upgrade the existing installations by adding some equipment to achieve the new effluent requirement more stringent mainly for TSS and phosphorus.

The existing MBBR reactor will not have to be modified and will not require any upgrade because the capacity of the MBBR or LagoonGuard-NIT have enough capacity to process the wastewater mainly during winter time.

The adder of the existing installation will be mainly on the filtration process and also on the increasing of the blowers' capacity.

We appreciate the opportunity to provide you with this proposal. We look forward to a meeting to further discuss the project with you. We believe there is still some room for design optimization, and would be happy to discuss them with you at your earliest convenience.

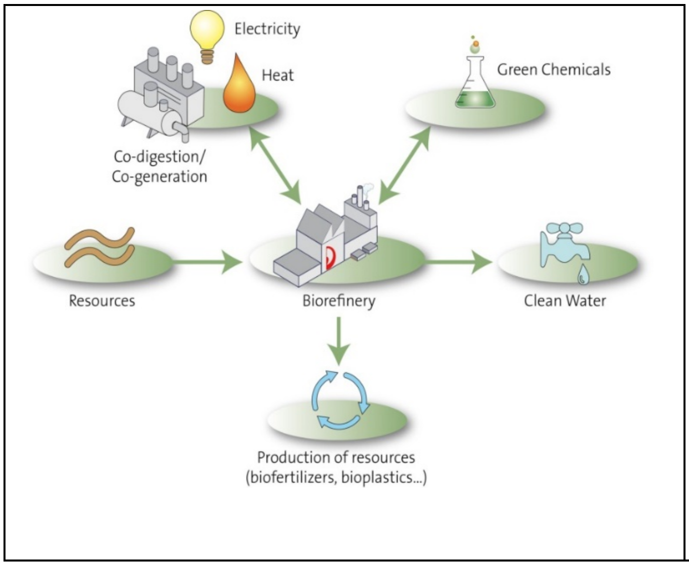
Best Regards,

Jason Boomhour
Municipal Business Development ON & MB
Direct: 519.274.3416
jason.boomhour@veolia.com

Table of Contents

1. INTRODUCTION

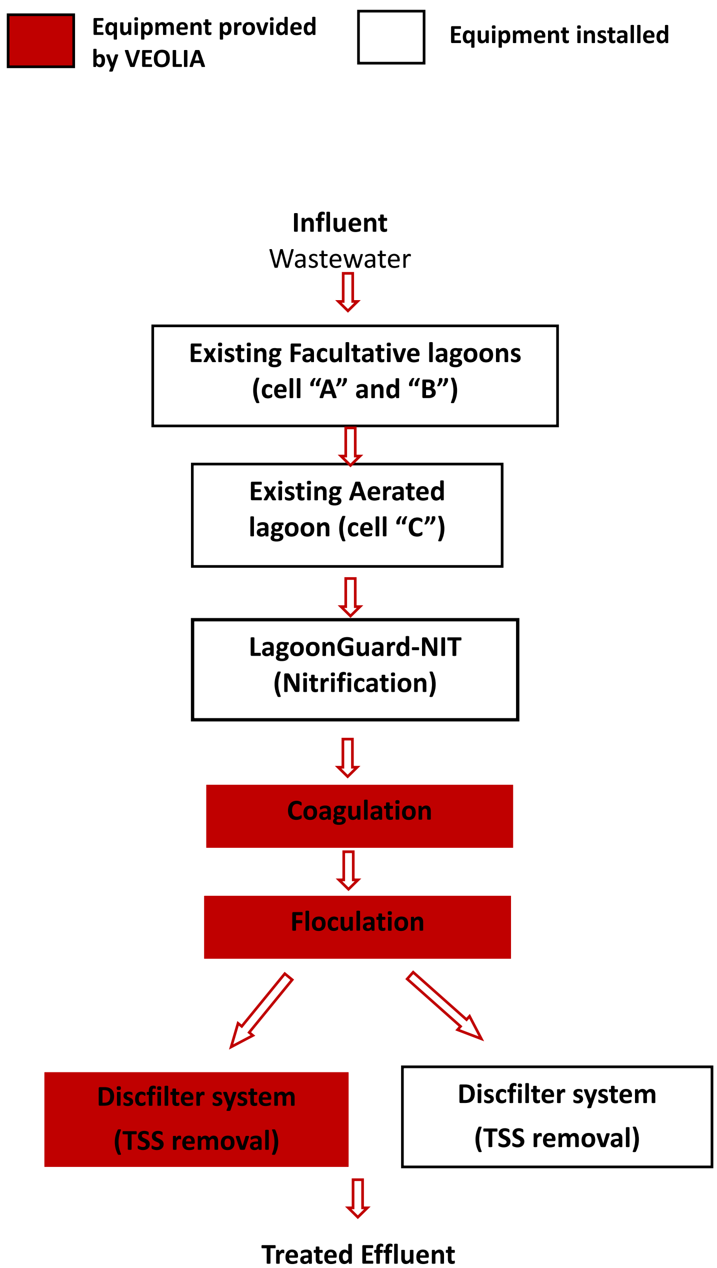
VEOLIA provides unique water and wastewater solutions to both industrial and municipal clients. VEOLIA draws upon more than 500 technologies and over 3,000 patents to find the best solution for each specific application. These resources, combined with VEOLIA's experience gained over the last 160 years in the water treatment industry, ensure that treatment needs are met through cost-effective, environmentally sound solutions implemented through projects focused on safety, quality and customer satisfaction.



VEOLIA is a trustful partner that will help to develop sustainable projects. More and more, when municipalities and industries have the opportunities to work with VEOLIA, wastewater treatment plants are not only considered as treatment stations, but as an opportunity to valorise resources. This change is now possible thanks to VEOLIA's expertise.

VEOLIA has been contacted to offer a solution for the upgrade of the existing LagoonGuard-NIT lagoon-based Casselman WWTP for a continuous discharge all year long with stringent effluent requirements. VEOLIA's proposed solution must therefore allow it to address these issues, while keeping the existing lagoon system and LagoonGuard-NIT.

VEOLIA's proposed solution is relatively simple, and consists in adding to the existing LagoonGuard-NIT an additional DISCFILTER cloth filtration system and a common coagulation and flocculation tank to achieve the low TSS and phosphorus effluent all year long. The following figure shows schematically the proposed Block flow Diagram.


Equipment provided by VEOLIA
Equipment installed
Influent
Wastewater
Existing Facultative lagoons (cell "A" and "B")
Existing Aerated lagoon (cell "C")
LagoonGuard-NIT (Nitrification)
Coagulation
Floculation
Discfilter system (TSS removal)
Discfilter system (TSS removal)
Treated Effluent

2. Data and assumptions

The new design flow per month for a continuous discharge was determined by JLRichards.

Discharge Period	Maximum Discharge Rate	Minimum Dilution Ratio Acheived [1]
Jan 1 – 31	5,750 m^3/d	12.4 : 1
Feb 1 – 28/29	5,600 m^3/d	12.4 : 1
Mar 1 – 31	7,250 m^3/d	12.3 : 1
Apr 1 – 30	10,000 m^3/d	72.9 : 1
May 1 – 31	4,500 m^3/d	40.5 : 1
Jun 1 – 30	2,150 m^3/d	26.2 : 1
July 1 – 31	1,050 m^3/d	26.2 : 1
Aug 1 – 31	900 m^3/d	26.3 : 1
Sep 1 – 30	910 m^3/d	26.2 : 1
Oct 1 – 31	2,250 m^3/d	13.1 : 1
Nov 1 – 30	6,050 m^3/d	13.1 : 1
Dec 1 – 31	8,750 m^3/d	12.4 : 1
Notes: 1. SNR 7Q20 flow : Effluent Flow		

Without more information on the effluent produced by the existing storage lagoons in the future we took the same value of the initial design. If more accurate value are available we will be able to update our design

Parameter	Raw Wastewater	Treated Effluent (Post-Aeration Cell)
CBOD5	160 mg/L[1]	Up to 60 mg/L[4]
Total Suspended Solids	210 mg/L[1]	Up to 60 mg/L[4]
Total Ammonium Nitrogen	32 mg/L[3]	Up to 23 mg/L
Total Phosphorus	7.0 mg/L[1]	0.420
Hydrogen Sulphide	-	Not detected
Temperature	0.5 – 25 °C	0.5 – 25 °C
pH	-	7.8 – 9.1
Alkalinity	350 mg/L[2]	-

The new effluent requirement would be:

Parameter	Objective		Limit	
TP	Monthly	0.20 mg/L	Monthly	0.30 mg/L
TAN				
Winter (Dec 1 to Mar 31)	Monthly	9.2 mg/L	Monthly	11.5 mg/L
Spring (Apr 1 to May 31)	Monthly	4.8 mg/L	Monthly	6.0 mg/L
Summer (June 1 to Sep 30)	Monthly	1.0 mg/L	Monthly	1.3 mg/L
Fall (Oct 1 to Nov 30)	Monthly	4.0 mg/L	Monthly	5.0 mg/L

3. BIOLOGICAL TREATMENT AND FILTRATION

3.1. Screening pre-treatment (not included)

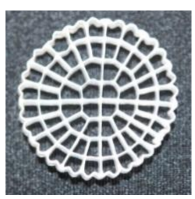
No pre-treatment is required because the lagoons will remove the small and dense particles.

3.2. LAGOONGUARD™ Reactors

The proposed biological treatment is composed of LAGOONGUARD™ MOVING BED™ Biofilm Reactors (MBBR) reactors with ANOXKALDNES™ MBBR media. The process design is based on over 20 years of experience in developing the ANOXKALDNES™ Moving Bed™ Biofilm Technology. It is supported by pilot scale and full scale data from existing municipal treatment facilities using the ANOXKALDNES™ MOVING BED™ Biofilm Technology for organic removal and nitrification. Over 600 ANOXKALDNES™ installations are in operation worldwide.

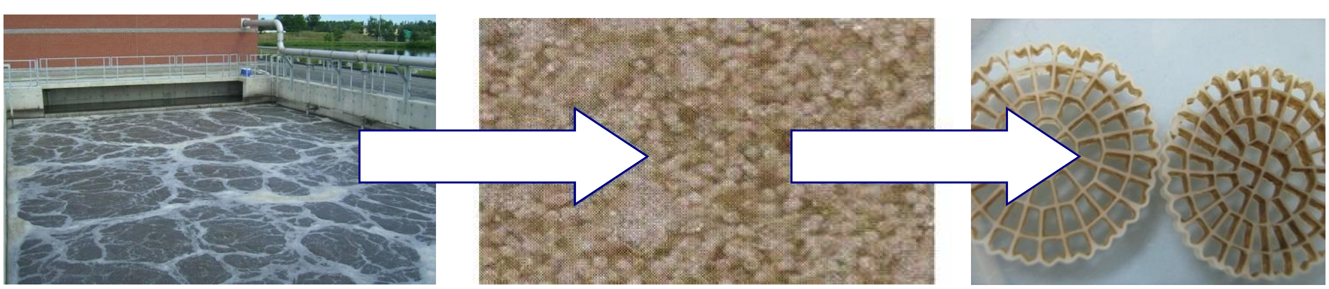
The flexibility of this patented technology allows the design of very compact and efficient stand-alone MBBR solutions as well as optimal upgrades of other, existing, biological processes, often without the need for new basins.

The microorganisms treating the wastewater grow on the surfaces of the ANOXKALDNES™ Media (or carrier) in the treatment reactor. The MOVING BED™ Biofilm Reactors (MBBR) process utilizes a cylindrical plastic carrier about 25 mm in diameter, as seen in Figure , to provide an environment in which bacterial populations and protozoa can grow very effectively.



Media K5

- Effective protected area = 800 m^2/m^3
- Diameter = 25 mm
- Thickness = 4 mm



The carriers are retained in the tanks by sieves which allow the treated water to pass to downstream units for further processing. Stainless steel laterals and diffusers provided oxygen to the system for bacterial growth but also mixing energy.

One of the important features of the process is that biofilm thickness is controlled by the movement of the media so that oxygen diffusion through the biofilm is encouraged. Detached biofilm is suspended within the reactor and leaves the reactor with the treated wastewater. The sloughed biofilm will be captured in a separation device downstream.

It is important to note that the Moving Bed Biofilm Reactor is a stand-alone biological treatment system with no need for backwashing of the media. The wastewater treatment plant will operate as a fixed-film process with no return activated sludge being pumped back from the clarification unit to the bioreactor. In a suspended sludge based treatment system, the sludge has to continuously be separated from the treated water and returned to the treatment basin

LagoonGuard : Existing system

The most stringent condition (which is then the design condition) is the spring season, where water temperature is low (around 2 to 5°C), along with maximum flow condition up to 10 000 m3/day. The slight difference in effluent discharge requirement has a minimal influence on reactor sizing, between spring and fall conditions.
Summer conditions with potential treatment in the existing storage cell due to warmer wastewater temperature will not be in issue for the TAN, even if more stringent in terms of effluent requirement.

The existing MBBR reactor will be able to perform considering the new inlet flow condition compared to the initial one for the design of the plant.
It could be possible that the future April influent flow of 10 000 m3/d would reduce depending of the influent water temperature of the MBBR process during April.
If it’s the case it will be possible to increase the flow during May, June and July.
We will need more information on the flow limit and wastewater temperature for those months.
Ideally readings of 2024 during those months would be helpful for the future design.

Blowers: Increase of capacity
The existing blowers of 25 HP would have to be upgraded to supply more air. We are in communication with the blower manufacturer to verify if we have residual capacity of the existing bowers to do it.
Another option would be to add one more blower to increase the capacity of aeration for both MBBR reactors.

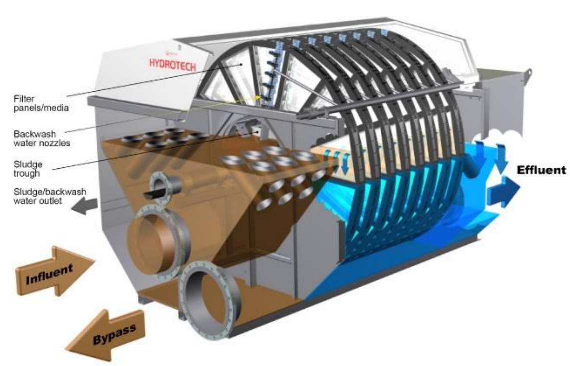
No more modification or adhering to the MBBR process will be required.

3.3.HYDROTECH DISCFILTER Filtration

Downstream FROM THE LAGOONGUARD™, a filtration unit is required for TSS removal. The proposed HYDROTECH DISCFILTER uses a mesh filter cloth mounted on filter panels. These panels stem from a central drum where inlet water is admitted into the unit for treatment. Water is filtered in inside-out mode, flowing from the centre tube to the open base of the filter discs, through the polyester cloth before reaching the filtered water collection tank integral to the packaged unit. Solids and particles present in the inlet water are retained by the filter media on the inside of the filter panels, eventually leading to a build-up of captured solids on the filter media. Consequently, headloss across the HYDROTECH DISCFILTER increases, resulting in increased water level at the inlet of the unit.

At a predetermined water level, the high level switch initiates a backwash cycle, which rotates the filter discs in order to expose clean filter media to the water flow path, while subjecting the dirty filter media to the cleaning action of the backwash spray tips. Filtered water stored in the tank is pumped to feed the series of spray tips strategically installed on the moving arms of the backwash system. This serves to clean the entire surface of the filter media while limiting the use of filtered water in the process. An outlet weir integral to the filtered water collection tank is used to maintain the water level according to the volume of filtered water needed to carry out the backwash cycle. Filtered water flows over the weir of the tank and out of the unit.

Schematic of HYDROTECH DISCFILTER – Tank Version



Discfilter: Additional unit

The new effluent requirement for TSS and phosphorus, plus the increasing of the flow and the nature of the wastewater during summer season discharge will require an additional discfilter system.

The second unit will be most of the time a backup of the first one but during high flow and/or algae event (mainly in summer) this additional unit could be in operation at the same time or in operation one at a time during event of high solids content at low flow in the effluent depending of the duration.

The second unit of discfilter will be the same as the existing one, simplifying the spare parts and maintenance operation. The final positioning of the second unit should be close to the first one, ideally side by side to facilitate the operator's operation between the two units.

Flocculation and coagulation mixers tanks:

Due to low phosphorus objective and to assure low TSS all year, a coagulation tank and flocculation tank will have to be added to the existing installation.

Both tanks (probably in concrete pour in place) will be downstream of the MBBR effluent and upstream of the two discfilter. These two mixing tanks should be in the same extension of the existing mechanical building for the second discfilter. The volume of both tanks should be around 15 m3 (to be validated).
Mixers and supports for both tanks will be supplied by VEOLIA.

Chemical skids

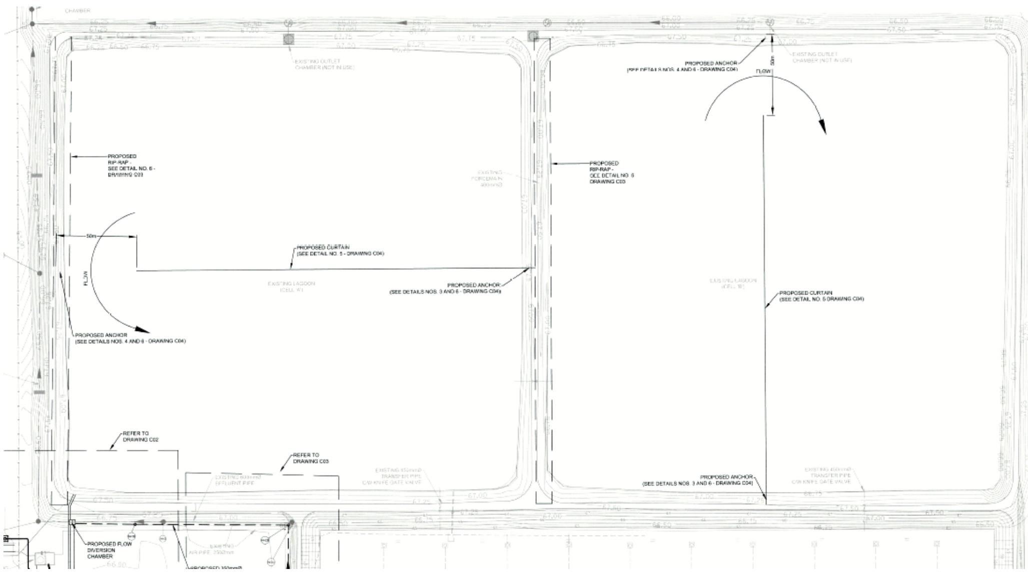
The coagulant and polymer system preparation will be supplied by VEOLIA .

Coagulant system: The coagulant skids will include two (2) metering pumps (1+1) and all the valves and accessories for the operation of the skids.

Polymer system: The polymer system will include an automatic polymer preparation system HYDRAPOL from dry polymer . Two metering pumps (1+1) will complete the polymer dosing system.

3.4.Modification of CELL A

The Cell A configuration is not optimal for the future operation and also for the actual operation.
The influent flow of Cell A has a preferential flow pattern to go to Cell B.
This configuration will not allow the use of the complete retention volume of the Cell A mainly during summer time.
Initially it was proposed on drawings of JLR to install a floating baffle on Cell A and Cell B to use the total volume of the lagoons and at the same time increase the retention time of both lagoons.

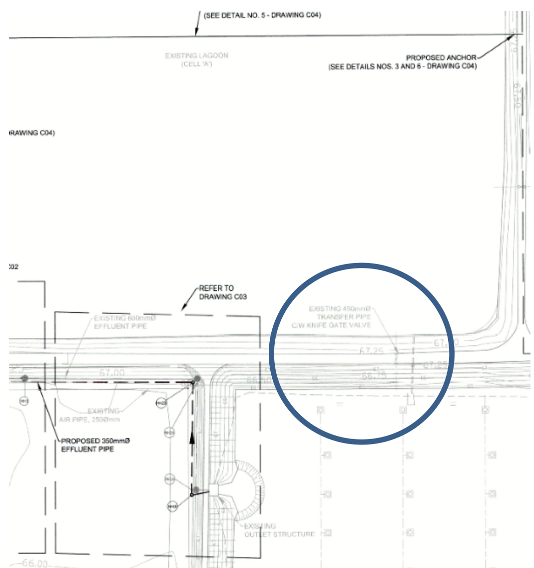


Those floating baffles or curtains will be required to the "***Continuous Discharge***" especially for Cell A.

During summertime the ammonia content is partially or completely nitrified naturally in the three cells.

With curtain and the existing connection between Cell A and Cell C (*Existing 450 mm diam. Transfer pipe with a knife gate valve*) it will be possible to feed the MBBR system and maintain the biomass active with ammonia and BOD concentration of Cell A.

At the end of the summer, gradually the flow coming from Cell A will be reduced to finally feed the MBBR only with the Cell C.



3.5.Control Panel

The LAGOONGUARD™ , DISCFILTER and dosing system processes will be controlled by the same single control panel.

4. Scope of Supply

HYDROTECH DISCFILTER

- **One (1) HYDROTECH DISCFILTERs, model HSF2222/21-1F, including:**
    - 304 SS Filter frame
    - Filtration discs with woven polyester filter media (10 µm openings)
    - 304 SS centre drum
    - ABS plastic disc segment
    - Filter panel frames
    - One (1) motor and gearbox
    - One (1) backwash pump
    - Aluminium covers
    - Instrumentation, lot of level floats
    - Factory pre-assembled

Coagulation Tank

- Pendulum mixer with supports
- Coagulant skid with two metering pumps,
  (one in operation + 1 in standby

Flocculation Tank

- Pendulum mixer with supports
- Flocculant skid with two metering pumps,
  one in operation + 1 in standby
- HYDRAPOL Automatic polymer preparation from dry polymer.

Panel Control (existing one)

- Adder to control chemical dosing system , mixers and additional discfilter
-

These elements are included in the proposal:

- Process engineering and drawings showing outline tank requirements and equipment location
- Operation & Maintenance manuals.

These elements are not included in this proposal and will be addressed by the client:

- Permits, including certificate of authorization, necessary construction permits and licences.
- Equipment installation in the mechanical building.
- Unloading, storage, maintenance preservation and protection of all equipment and materials on-site.
- All site preparation, grading, finding foundation placement and excavation for foundation, underground piping, conduits and drains.
- Foundations, buildings, sumps, trenches and similar concrete works, site interferences, fencing and landscaping (including asphalt or paving).
- Supply and installation of interconnecting piping between the client's installations and the treatment system, and between the various skids that are part of the treatment system.
- All labor, material and utilities required to install the supplied equipment.
- Supply and installation of all electrical power and conduit to the treatment system main control panel plus interconnection between the treatment system main control panel and ancillary equipment as required, including wire, cable, junction boxes, fittings, conduit, etc.
- Start-up, Commissioning, performance testing
- Motor starters and/or VFDs
- SCADA
- Equipment freight to site

5. Budget Price and Terms of Payment

Estimated cost

Estimated budget price for the items described in section 4 above is: **$CDN**

This budget is non-binding and is presented for project planning and evaluation purposes only and is not a firm offer.

Terms of payment

Typical terms of payment are:

- 10% on receipt of PO
- 25% on submittal of shop drawings
- 50% on equipment ready to ship
- 5% after commissioning
- All payment terms are 100% net 30 days from the date of invoice.

Suggested schedule

A projected schedule typical for this type of project is presented in the following table:

Table 5 Schedule

ITEM	TIMELINE	CONDITIONS
Shop drawings	6-8 weeks	Submission within designated timeline following receipt of a contract accepted by all parties
Complete Equipment Delivery	14-18 weeks	After receipt of written approval of shop drawings

This schedule is indicative and open for discussion.

Carolyn Chan

From:	Boomhour, Jason <jason.boomhour@veolia.com>
Sent:	February 13, 2024 12:13 PM
To:	Carolyn Chan
Cc:	Kevin Cortez
Subject:	Re: 16953-133 - Casselman Lagoon MBBR & Disk Filter optimization

Carolyn,

We have finally completed the budget price for the phase upgrades at Casselman.

If we want to phase the upgrade , it will depend on the requirement of the city (flow increasing for the next years: gradually or rapidly) and also effluent requirements of the ministry considering the new permit of discharge all year long. Please see below the identified phases and budget price for equipment supply within Veolia's scope.

First phase:
Put the floating curtain will be required to optimise the nitrification all year long mainly during a 12 months discharge objective - **provided by others**.

Second phase:
Upgrade to 30 HP blower new unit ***$55,000.00 est.***
Upgrade existing blower to 30 HP ***$????? pending***
- more information pending on blowers, rough price on the new unit, we will confirm more accurately when possible

If the new Pt requirement of < 0,3 is requested rapidly and the influent flow is not increasing, the coagulation tank and flocculation tank will be required immediately.
- mixers, supports, instrumentation and dosing pumps for coagulation and flocculation. **$235,000.00**
- adder to include CRX tanks for coagulation and flocculation **$90,000.00**

Third phase:
- discfilter HSF-2221 with all the options of the first one + pressure cleaning system **$600,000.00**

Jason Boomhour
Municipal Business Development ON & MB
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ISO 9001:2015

#Veolia on Social Media

On Thu, Nov 2, 2023 at 1:46 PM Carolyn Chan <cchan@jlrichards.ca> wrote:

Hi Jason,

JLR is currently completing a Master Plan Update for the Village of Casselman's sewage system and I'm leading the Assimilative Capacity Study component. Due to recent growth pressures, the future rated capacity is now 4,050 m3/d and we have been pre-consulting with the MECP regarding two scenarios, one keeping the seasonal discharge (adding additional storage) and the other introducing year-round discharge.

Both scenarios involve increased average flow through the system and some level of tightening of discharge criteria; focus so far has been on Total Ammonia-N and Total Phosphorus.

A key question at this point is to what extent the existing MBBR and Disk Filter could be optimized to meet the new criteria and new loading. The attached presentation includes proposed monthly discharge values and effluent criteria. For now let's assume the incoming sewage from Cell C has the same quality as the original MBBR design basis.

Do you think we could meet sometime next week for a preliminary discussion? Do you have any initial questions or concerns we should look into prior to the discussion?

Thanks,

Carolyn

Carolyn Chan, P.Eng., M.A.Sc.
Environmental Engineer

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