November 14, 2023

NWWC

How to Get More Out of a Lagoon-based Treatment System

Showcasing recent projects and strategies

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ENGINEERS · ARCHITECTS · PLANNERS

Agenda

01 Casselman Lagoons

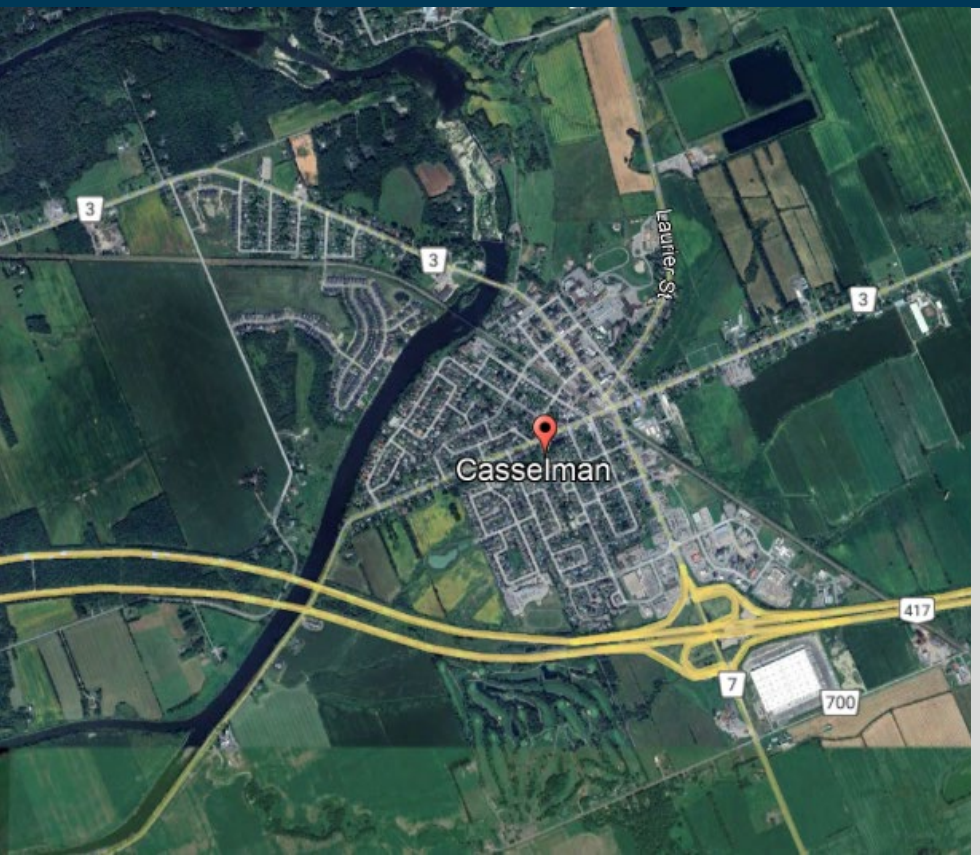
02 Winchester Lagoons

03 Brighton Lagoons

04 Key Takeaways

05 Q&A

Casselman Lagoons



Casselman
Pre-upgrade Conditions

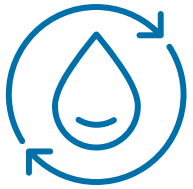
- Rated capacity of 2,110 m^3/d
- Two facultative lagoons + one aerated lagoon
- Seasonal discharge:
  - October 1 to December 19 (fall)
  - March 7 to May 15 (spring)
- Effective storage volume of 260,000 m^3
- Landlocked site

Effluent Parameter	Spring Discharge		Fall Discharge	
	Seasonal Average Concentration (mg/L)	Seasonal Loading (kg/season)	Seasonal Average Concentration (mg/L)	Seasonal Loading (kg/season)
CBOD5	25	12,563	15	4,015
Total Suspended Solids	25	12,563	25	6,691
Total Phosphorous	1.0	503	1.0	268
Total Ammonia Nitrogen	16.0	8,040	5.0	1,338
Hydrogen Sulphide	0.1	50.3	Not Detected	-
pH	6.0 – 9.5	-	6.0 – 9.5	-
Seasonal Flow Volume	502,500 m^3/season (Mar. 7 – May 15)		267,650 m^3/season (Oct. 1 – Dec. 19)	

Drivers

- Growth within the community
- Challenge with TAN during spring discharge
- Elevated effluent TSS
- Discharge limited due to ice-free cover condition

Preferred Solution



Maintain treatment capacity to support 20-year growth.

Implement a polishing specialized treatment system (moving bed biofilm reactor or MBBR c/w disc filter) pilot tested and one of the first municipal installations in Ontario

Extend discharge windows to allow for continuous discharge from October 1 to May 15.

Minimal upgrade existing lagoons.

Site Layout

Casselman Lagoons Upgrades

Existing Lagoons

- Civil works

Moving Bed Biofilm Reactor (MBBR)

- Intermediate pumping
- BOD_5 and TAN removal

Disc Filter and Process Building

- TSS and TP removal
- Process building

Diversion Chamber

- Bypass
- Provision for future

New Environmental Compliance Approval (ECA) Limits

Winter/Spring

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.

Fall

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.

New Monthly Maximum Allowance Discharge

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

Table 13: Effluent Wastewater Quality (2018-2022)

Parameter	Discharge Window	New ECA Compliance Limit [1]	2018	2019	2020	2021 [2]	2022 [2]
$CBOD_5$ (mg/L)	Fall (Oct. 1 to Dec. 31)	15	5.8	3.8	3.0	3.2	6.3
	Winter/Spring (Jan. 1 to May 15)	25	8.2	3.2	5.6	3.0	4.9
Total Suspended Solids (mg/L)	Fall (Oct. 1 to Dec. 31)	25	36 [3]	14.8	3.9	9.7	10.6
	Winter/Spring (Jan. 1 to May 15)	25	15.8	10.0	14.0	3.0	13.3
Total Phosphorous (mg/L)	Fall (Oct. 1 to Dec. 31)	1	0.2	0.2	0.1	0.3	0.4
	Winter/Spring (Jan. 1 to May 15)	1	0.3	0.2	0.2	0.2	0.4
Total Ammonia Nitrogen (mg/L)	Fall (Oct.1 to Nov. 30)	5	0.1	5.3	0.1	1.5	1.2
	Fall (Dec.1 to 31)	12	-	-	1.0	4.9	7.7
	Winter (Jan.1 to Mar. 31)	12	-	-	-	-	9.8
	Spring (Apr.1 to May 15)	6	17 [3]	0.6	17	0.1	2.4
Hydrogen Sulphide (mg/L)	Fall (Oct.1 to Dec.31)	Not Detected	0	0	0	0	-
	Winter/Spring (Jan.1 to May 15)	0.1	0	0	0	0	-
pH	Fall (Oct.1 to Dec.31)	6.0-8.0	8.5 [4]	8.2	7.9	7.6	-
	Winter/Spring (Jan.1 to May 15)	6.0-8.0	7.8	7.8	7.8	7.6	-
E. Coli (CFU/100 mL)	Fall (Oct. 1 to Dec. 31)	200	-	-	1.4	28	60
	Winter/Spring (Jan. 1 to May 15)	200	-	-	36	67	126

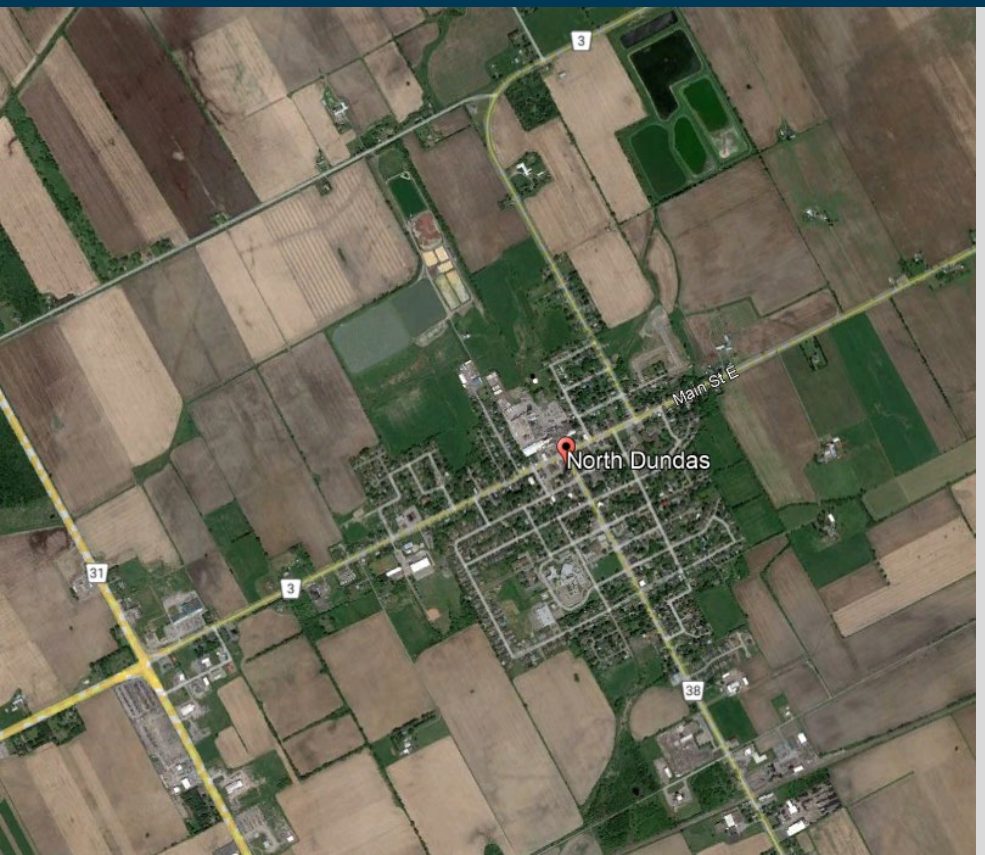
(1) Per ECA No. 8160-BAHPRF (April 19, 2019)
(2) MBBR and disc filter system was installed and began operating in 2021. It was noted that a process upset was experienced in the same year and trouble shooting the system has been taking place up to spring 2022. The information is not reflective of the STS treatment performance with the new MBBR and disc filter system.
(3) Non-Compliant per ECA No. 8225-B3HSD4 (October 3, 2018) / ECA No. 2712-6RVNRB (August 24, 2006): TSS (fall) =25 mg/L and TAN (spring) =16 mg/L.
(4) Compliant per ECA No. 8225-B3HSD4 (October 3, 2018) / ECA No. 2712-6RVNRB (August 24, 2006): pH limit fall and spring 6.0 to 9.5.

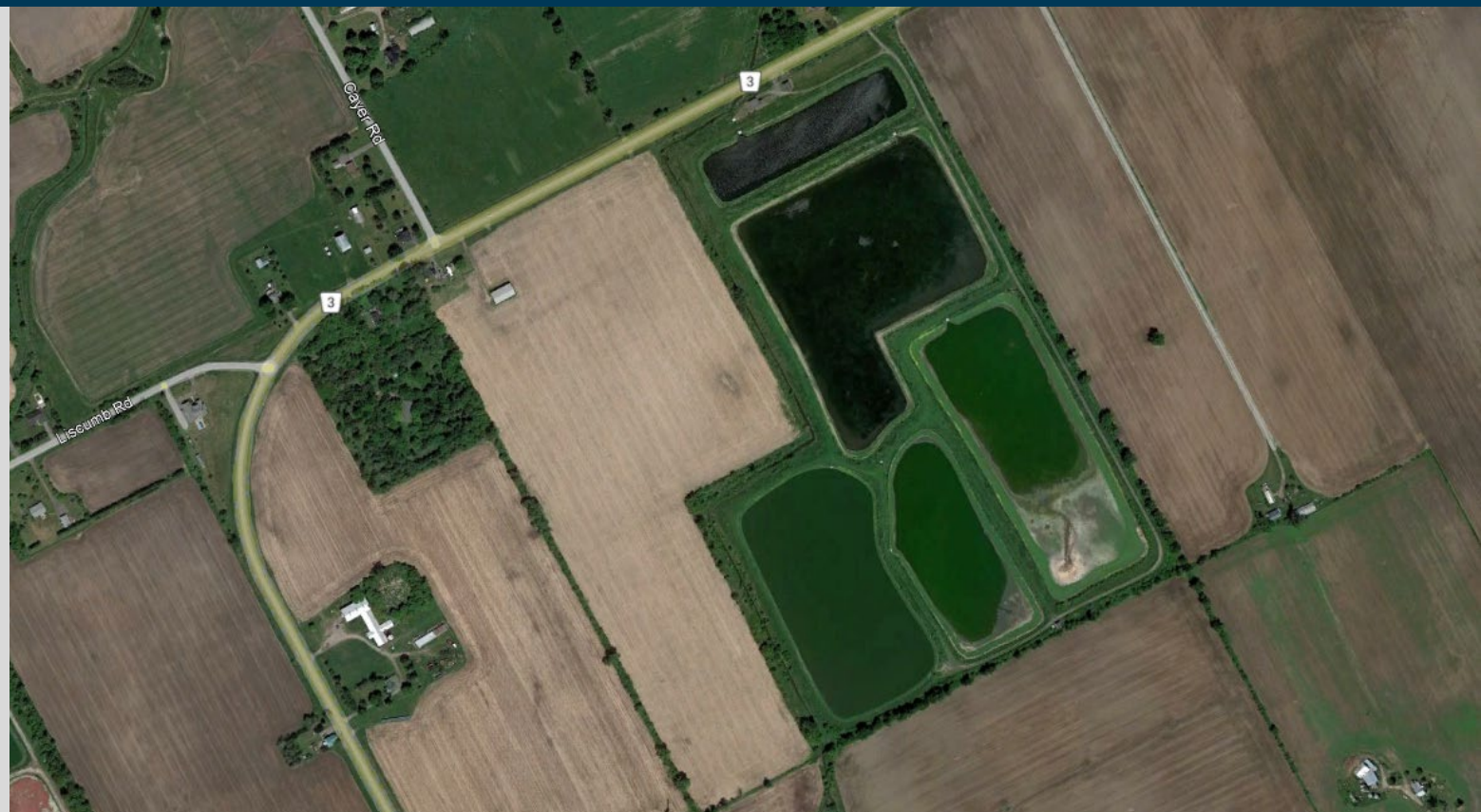
Results

- Effluent concentration limits met since MBBR/disc filter was commissioned and tested.
- Constructed value: $6.8M (2019 dollar)
- Planning for next phased expansion has been initiated.
  - Further expand the discharge window to allow year-round discharge → successful preliminary discussion with MECP

TOWNSHIP OF
North Dundas

Winchester Lagoons





Winchester Pre-upgrade Conditions

- Rated Capacity of 2,220 m^3/d
- Three primary facultative cells, one polishing cell and one post aeration cell
- Seasonal discharge
  - November 1 to December 31 (fall)
  - March 1 to April 30 (spring)
- Effective storage volume of 470,000 m^3
- Landlocked site

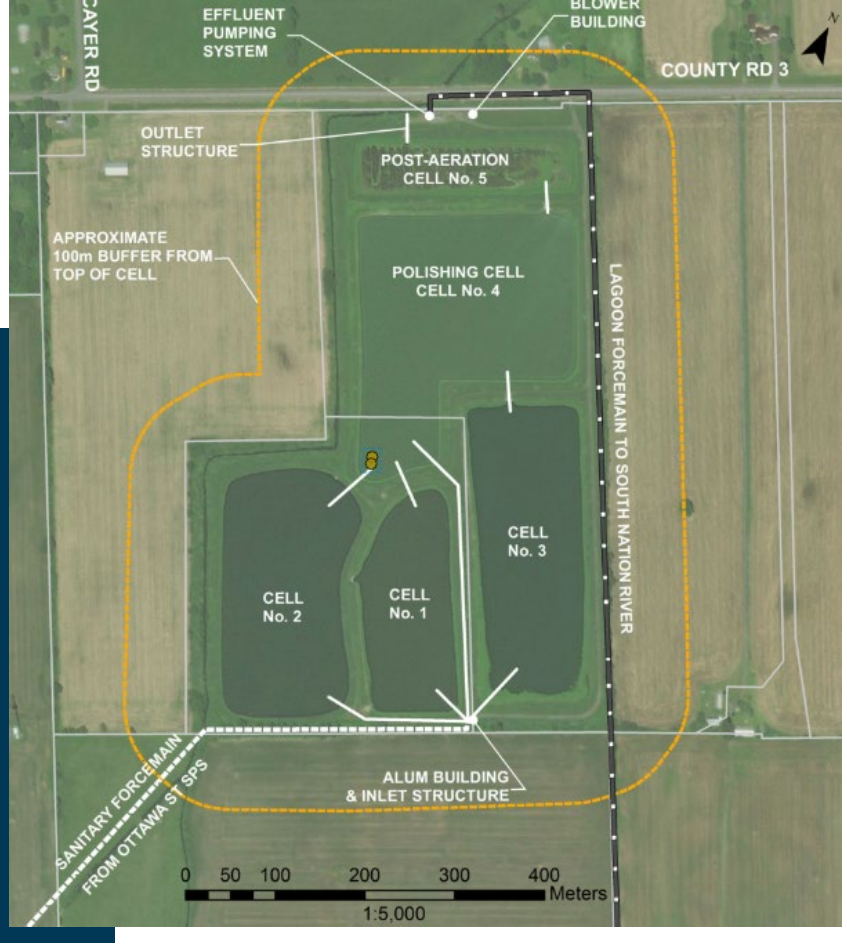
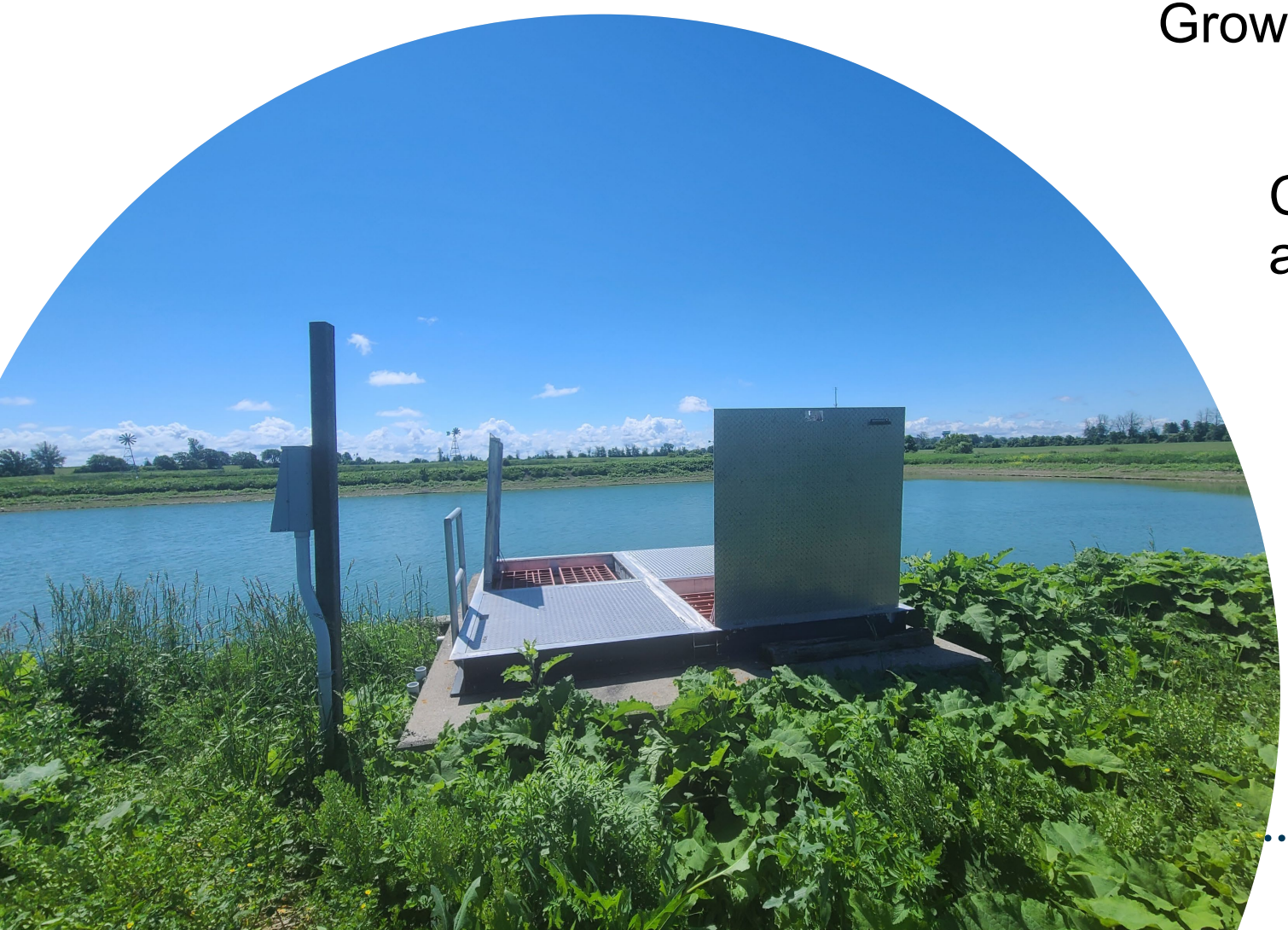


Table 2 - Effluent Limits

Effluent Parameter	**Average Concentration** (milligrams per litre unless otherwise indicated)	**Total Annual Loading** (kilograms per year unless otherwise indicated)
Column 1	Column 2	Column 3
CBOD5	30.0	24,309
Total Suspended Solids	40.0	32,412
Total Phosphorus	1.0	810.3
Total Ammonia Nitrogen	7.0 (Fall discharge) 15.0 (Spring discharge)	- -
Undissociated Hydrogen Sulphide	0.02 (Spring discharge)	-
pH of the effluent maintained between 6.0 to 9.5, inclusive, at all times		

Drivers



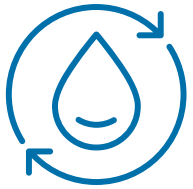
Growth in the community

Challenge with effluent TAN, TSS and undissociated H_2S

Spring discharge delayed due to ice-free cover condition

Challenge to empty lagoons

Preferred Solution



Maintain treatment capacity to support 20-year growth.

Retrofit existing polishing cell and install a specialized polishing treatment system (submerged attached growth reactor or SAGR).

Extend discharge windows to allow for continuous discharge from October 1 to April 30.

Upgrade existing lagoons.

New Environmental Compliance Approval (ECA) Limits

Concentration Limits upon completion of construction of all Proposed Works

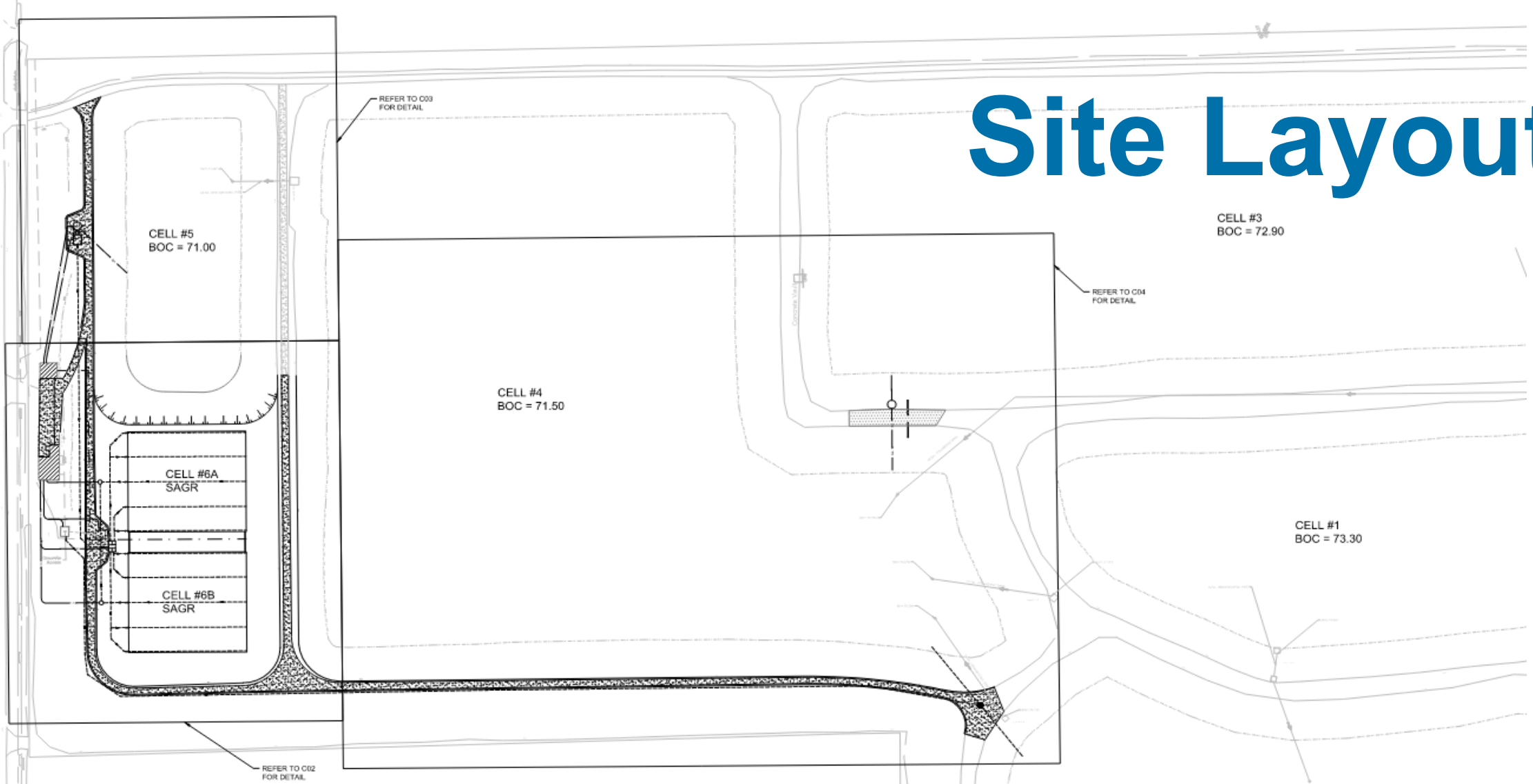
Effluent Parameter	Averaging Calculator	Limit (maximum unless otherwise indicated)
CBOD5	Monthly Average Effluent Concentration	25.0 mg/L
Total Suspended Solids	Monthly Average Effluent Concentration	25.0 mg/L
Total Phosphorus	Monthly Average Effluent Concentration	1.0 mg/L
Total Ammonia Nitrogen	Monthly Average Effluent Concentration	10.7 mg/L (Jan 1 - Feb 28) 8.9 mg/L (Mar 1 - Mar 31) 5.3 mg/L (Apr 1 - Apr 30) 5.9 mg/L (Nov 1 - Dec 31)
pH	Single Sample Result	between 6.0 - 9.0 inclusive

New Monthly Max Allowable Discharge

Minimum Dilution Ratio

Period	Minimum Dilution Ratio ratio volume of river to effluent flow	Maximum Effluent Flow Rate (m3/d)
January	10:1	2,125
February	10 :1	1,780
March	20:1	6,411
April	40:1	6,600
November	10:1	4,709
December	10:1	5,823

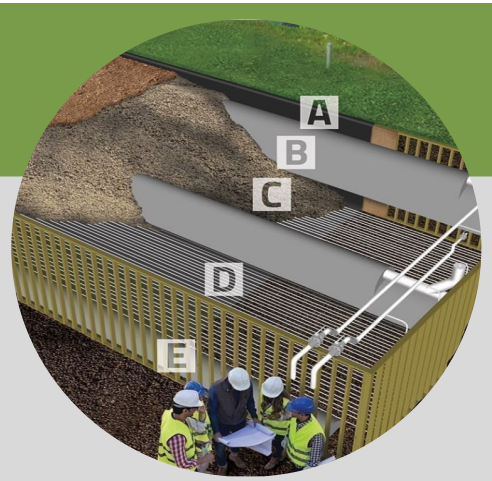
Site Layout


REFER TO C03
FOR DETAIL
CELL #5
BOC = 71.00
CELL #3
BOC = 72.90
REFER TO C04
FOR DETAIL
CELL #4
BOC = 71.50
CELL #6A
SAGR
CELL #6B
SAGR
CELL #1
BOC = 73.30
CELL #2
BOC = 72.55
REFER TO C02
FOR DETAIL

Winchester Lagoon Upgrades

Existing Lagoons

- Cell #3 outlet structure relocation → prevent short circuiting
- Remove aeration piping in polishing cell



Submerged attached growth reactor (SAGR)

- Fit within existing cell
- Intermediate pumping
- Recirculation pumping

New Blowers

- Demolish existing blowers and install new SAGR blowers

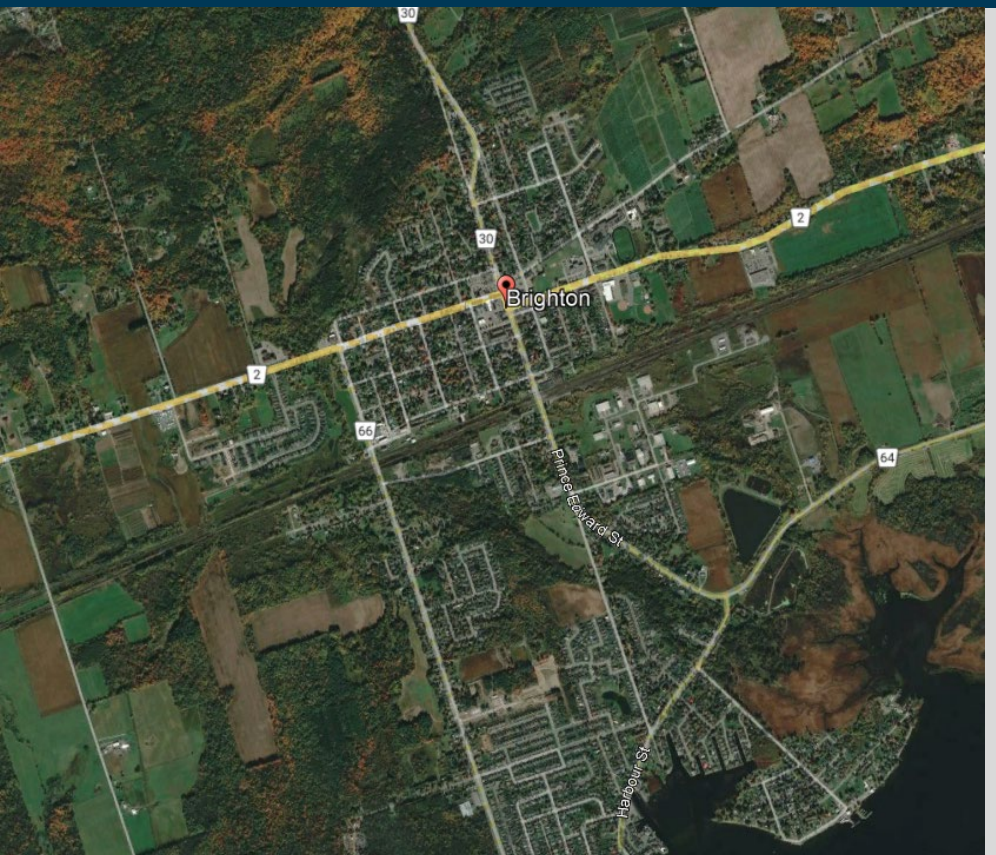
Effluent Pump Station

- Demolish existing effluent pumps and install new pumps

Construction Underway

- Project tendered in 2023
- Tender price: $12.1M (2023 dollar)
- Anticipated substantial completion in 2025

Brighton Lagoons



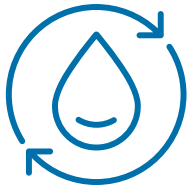
Brighton Pre-upgrade Conditions

- Rated capacity of 4,600 m^3/d
- One aerated lagoon + one facultative lagoon
- Continuous discharge to a wetland that outlets to Presqu'ile Bay / Lake Ontario

Drivers

- Growth in the community
- Insufficient aeration/mixing
- Challenges with effluent TAN and TSS
- Constructed wetland → no significant treatment

Preferred Solution



Maintain treatment capacity to support 20-year growth.

Convert lagoon-based system to an extended aeration mechanical plant.

Provide on-site sludge treatment and management.

Proposed upgrades

- Liquid treatment:
  - Headworks building
  - Influent pumping
  - Aeration lagoon with new blowers and diffusers
  - Secondary clarification
  - Effluent disinfection system
- Solids treatment:
  - WAS stabilization/ storage pond with supplemental aeration

Proposed upgrades

- Class EA Opinion of Probable Costs (OPC): $24.6M (2023 dollar)
- Design currently underway; tender-ready by end of 2024

Key Takeaways

Lagoons continue to provide effective and reliable treatment → maximize the use of existing infrastructure.

Site specific conditions → treatment process, technologies, and preferred solution.

Preconsultations with stakeholder agencies → “lock in” design decisions early and reduce approvals timelines.

Thank you!

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