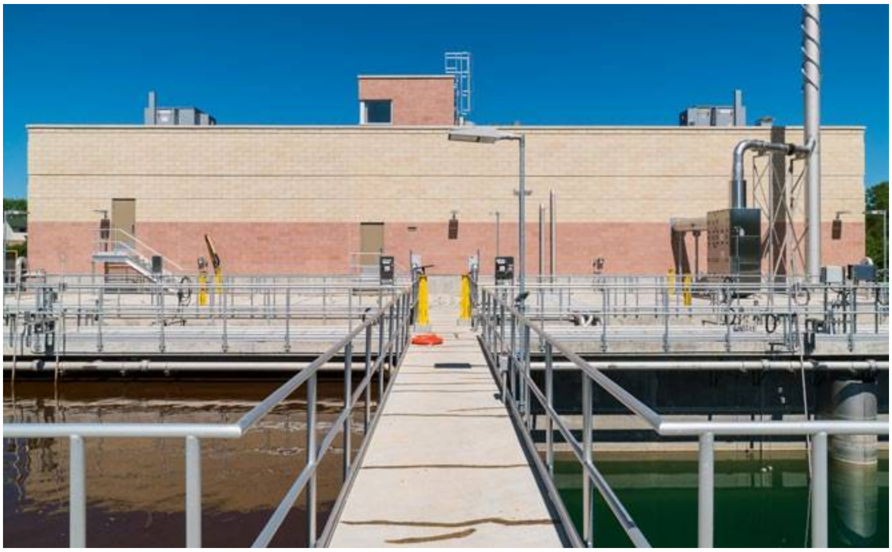
UPGRADING MILLBROOK'S WWTP TO MEET NEW DISCHARGE LIMITS

By **James Des Cotes**, **Valera Saknenko**, **Vincent Nazareth**, **Wayne Hancock** and **Kyle Phillips**



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The Millbrook Wastewater Treatment Plant (WWTP) is located in the Village of Millbrook, Ontario, which is part of the Township of Cavan Monaghan. The plant was originally constructed in 1975 and had a rated capacity of 1,326 m^3/day. As a result of growth outlined in the Official Plans, plant capacity needed to expand to 2,521 m^3/day.

The Township retained R.V. Anderson Associates Limited to complete a Municipal Class Environmental Assessment study (following the Schedule C process), provide detailed design services, and administer the construction contract for the expanded plant.

This project was funded by both provincial and federal governments under the Building Canada Fund, which stipulated that any improvements made under it must be substantially performed by March 2016.

Effluent from the Millbrook plant is discharged into Baxter Creek, which ultimately joins the Otonabee River that flows into the Bay of Quinte, located on the northern shore of Lake Ontario. The Bay of Quinte is a designated Remedial Action Plan area. Recognizing that the Ministry of Environment and Climate Change (MOECC) would seek to control pollutant loads, a strategy was developed to provide a design that reduces pollutant loads even at higher future flows. This hastened the MOECC approval of discharge criteria, allowing the project to meet the funding deadline.

Table 1 shows the effluent limits under

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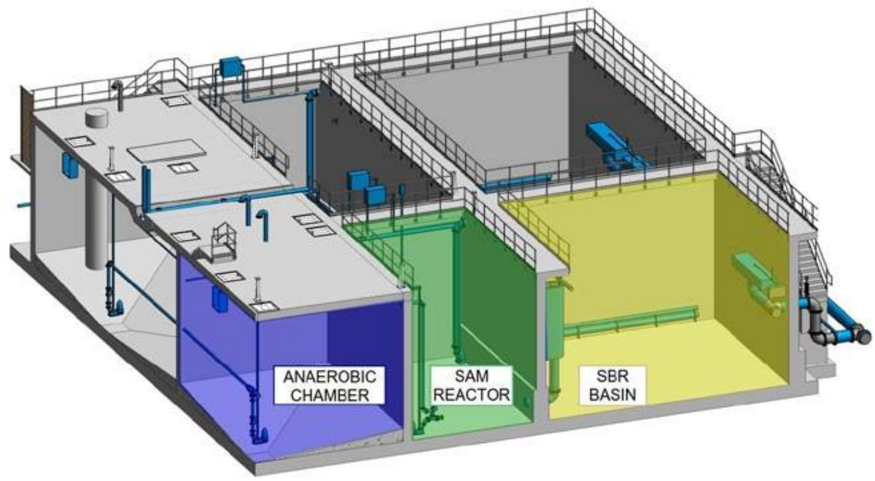
Table 1. Former and updated effluent limits.

Effluent Parameter	Former C of A		New ECA		
	Limit (mg/L except E-Coli)	Waste Loading (kg/day)	Objective (mg/L)	Limit (mg/L except E-Coli)	Waste Loading (kg/day)
$CBOD_5$	15	19.9	5	7	17.7
TSS	15	19.9	5	6	15.1
TP	0.43	0.57	0.10	0.15	0.38
TAN (<15°C)	7	9.3	2	3	7.6
TAN (>15°C)	3.5	4.6	1	2	5.0
E-Coli	200 org/100mL	-	-	100 org/100mL	-



Schematic of the ISAM ™ sequencing batch reactor.

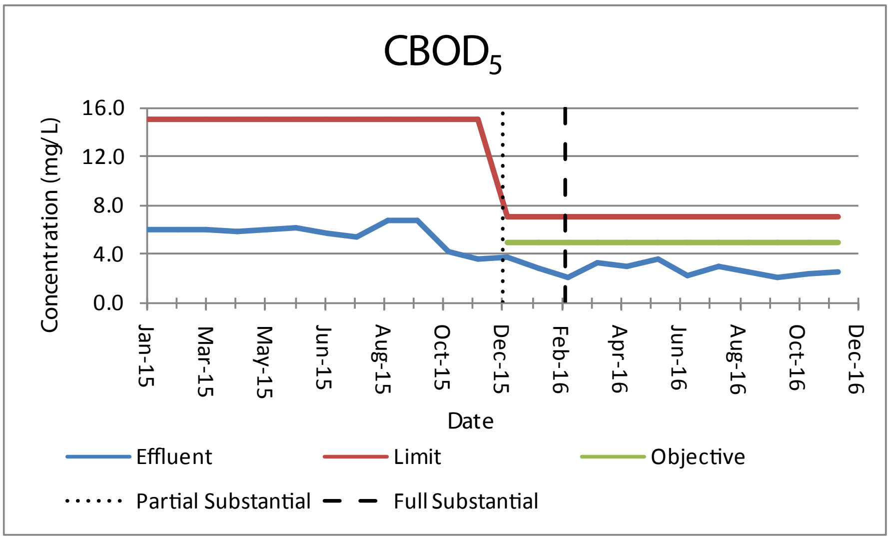


Figure 1. $CBOD_5$ effluent data.

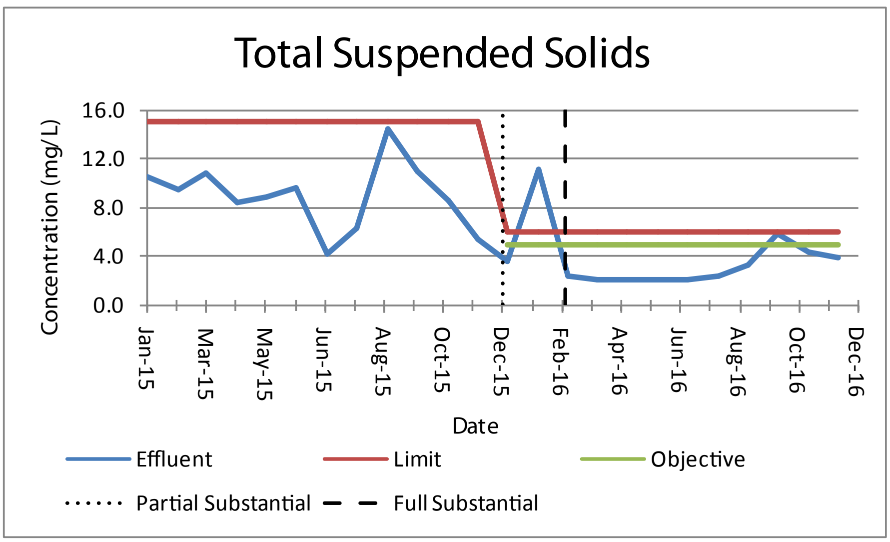


Figure 2. Total suspended solids effluent data.

the old Certificate of Approval (C of A) and the new limits and objectives under the updated Environmental Compliance Approval (ECA).

Effluent limits for the plant were reduced by approximately 50%. To meet non-toxic effluent requirements, total ammonia nitrogen (TAN) was limited to 3 mg/L in the winter and 2 mg/L in the summer. Total phosphorus (TP) was reduced by the largest percent, with a limit of 0.15 mg/L and objective of 0.10 mg/L, reflecting reduced pollutant loading to Baxter Creek even at the higher design flows of 33%. This was a concession offered by the Township that expedited the setting of limits without the need for an extended assimilative capacity study. This would have delayed the process by 8 – 12 months.

The expanded Millbrook WWTP was then designed to meet these stringent effluent discharge requirements. In addition to maintaining plant operation during construction, a significant design challenge was a very limited footprint available for the new facility. Available space was restricted by marshlands on two sides and by existing facilities on another side.

To expand the plant in such a limited area, a decision was made to build a completely new secondary and tertiary treatment facility on the available footprint, and then retrofit the existing aeration tank and the secondary clarifier into equalization tanks. This approach had several benefits:

- The Township received a completely new facility;
- It allowed a two-stage commissioning;
- The existing plant was kept in operation at all times;
- Existing tankage was repurposed as equalization tanks;
- The number of tertiary filters and the operational cost of the UV disinfection system were reduced with the use of the equalization tanks;
- The Building Canada Fund deadline was met.

To meet stringent effluent limits and to overcome project constraints, new treatment processes were required. A new process building was designed to incorporate a raw sewage lift station, screening and grit removal, aeration equipment, chemical system, continuous backwash tertiary sand filtration, and UV disinfection.

For this project, the ISAM™ Integrated Surge Anoxic Mix Sequencing Batch Reactor (SBR) system by Fluidyne Corp. was selected for the secondary process. This SBR system features three tanks in series.

The first is the anaerobic chamber, which receives raw sewage and allows solids and waste activated sludge to be co-settled and stored. Sludge stored in this chamber undergoes digestion and is thickened over time, before being sent to the plant's existing sludge storage system. The volume of this tank was designed for 180 days of sludge digestion/storage to complement the existing sludge storage tank on-site, for a total of 240 days of storage.

The second basin is the Surge Anoxic Mix (SAM™) reactor, where flow is equalized and the nitrification/denitrification process begins. Since raw sewage continuously flows into this basin, the denitrification process is accelerated here.

When the liquid level in the reactor reaches a pre-set level, pumps within convey the liquid to the SBR basin. Here, the process follows a series of stages: mixing without aeration, mixing with aeration, settling, and decanting. During the decant period, clarified secondary effluent flows out while the remaining sludge is used to seed the next batch.

Through the SBR process and the following continuous backwash filter system with ferric sulfate dosing and final UV disinfection, the plant can produce effluent that meets the stringent MOECC ECA requirements.

By constructing these facilities as a single structure, the overall footprint was minimized, eliminating the need to acquire more land.

Construction of the Millbrook WWTP expansion commenced in August 2014. To ensure continuous operation of the plant and that the former C of A effluent discharge limits were met all the time, a decision was made to commission the plant in two stages: preliminary and secondary treatment first, and then tertiary treatment.

Following a commissioning period

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for the new secondary treatment process, this part of the project was substantially performed in December 2015. At this time, the new screening and degritting facilities, SBR, and UV disinfection were put into full operation, meeting the former C of A limits. Once this was achieved the old plant was taken out of service.

In the following months, the existing aeration tank and secondary clarifier were converted to equalization tanks and the tertiary filtration system was put into operation. This remaining part of the project was considered substantially performed in March 2016, meeting the deadline stipulated by the Building Canada Fund.

The upgraded process has been in continuous operation since the end of December 2015. In Figures 1 to 4, the effluent quality parameters are presented for a two-year period (from January 2015 through to December 2016). This covers one year before and one year after the new SBR system was put into operation.

Figure 1 shows the $CBOD_5$ concentration of the plant effluent. Even though the former plant was meeting the new $CBOD_5$ limit, it was not able to continuously meet new effluent objectives for $CBOD_5$. Since the new process started, the plant has been consistently meeting the more stringent effluent objectives, with a significant safety factor.

As can be seen in Figure 2, total suspended solids (TSS) in the plant effluent used to be high, occasionally approaching the former limit of 15 mg/L. After the tertiary filters were put into operation, TSS numbers dropped to below the new effluent limit level and, in most cases, below the new effluent objective.

Figure 3 shows that the former plant exceeded its TP limit of 0.43 mg/L on one occasion in 2015, but maintained an average TP concentration in a range between 0.2 to 0.35 mg/L. After the switch to the new treatment system, the plant has been consistently meeting the new TP effluent objective of 0.1 mg/L.

With respect to the total ammonia nitrogen (TAN), historically, the plant rarely had a problem meeting this limit. Figure 4 shows this parameter is well below the effluent objective, both before and after the new plant was put into operation.

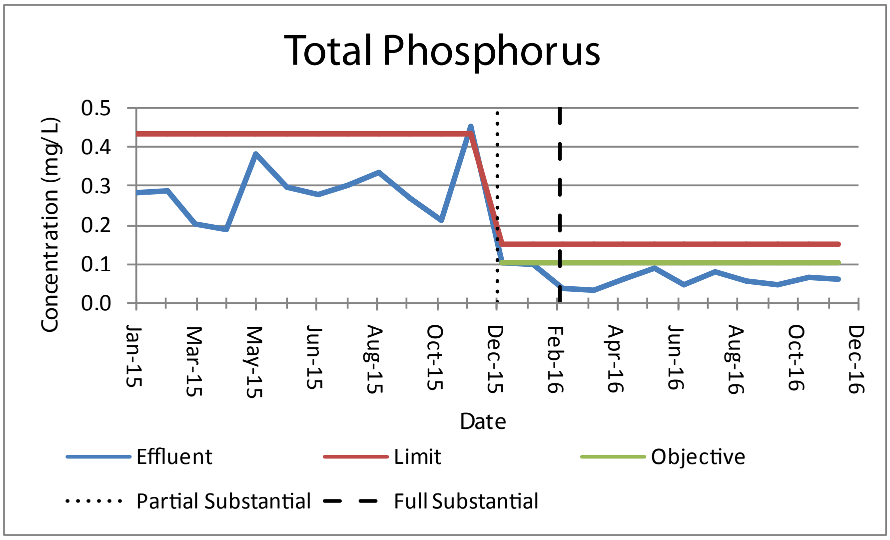

Figure 3. Total phosphorus effluent data.

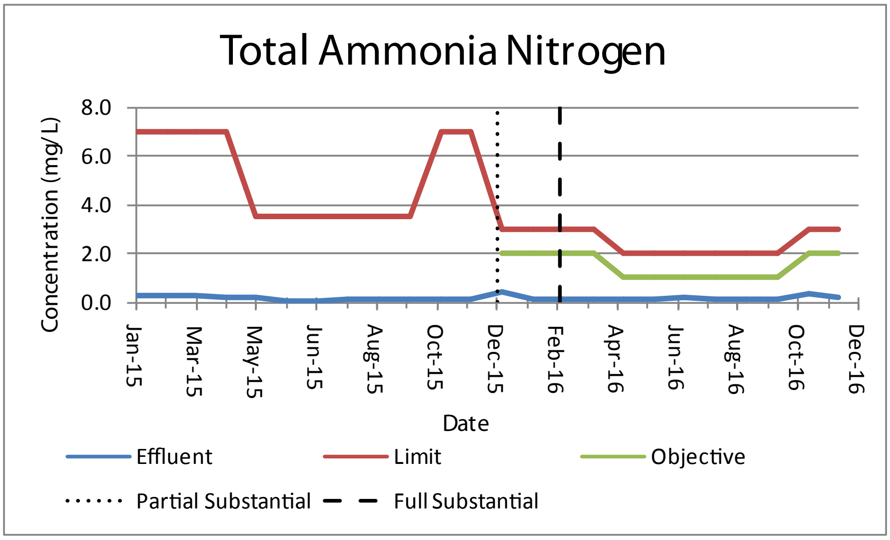

Figure 4. Total ammonia nitrogen effluent data.

CONCLUSION

With the upgrades completed, the Millbrook Wastewater Treatment Plant has been continuously meeting the new stringent effluent limits, consistently surpassing the effluent objectives stipulated in its ECA. The plant now provides tertiary level treatment for sewage from the Township of Cavan Monaghan.

Effluent from the plant is cleaner than ever before and total effluent load to the receiving body of water, even at higher flows, will be lower than before. This means that for the design life of the plant, despite increasing flows, Baxter Creek will assimilate less pollutant load, ultimately contributing to improved environmental protection of the Bay of Quinte and Lake Ontario.

Based on the success of this project, it was recognized by the Ontario Public Works Association with a Project of the Year Award for Small Municipalities in 2016. ■

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