

## Elmira Wastewater Treatment Plant, Region of Waterloo, Ontario

The Region of Waterloo retained Engineering and Technology Associates Inc. (ETA) to undertake a feasibility study to optimize the Elmira WWTP using innovative technologies, with respect to concerns of sludge bulking, settleability of mixed liquor and biological overload. The main objective was to consider the biological treatment (bioreactors and secondary clarifiers).

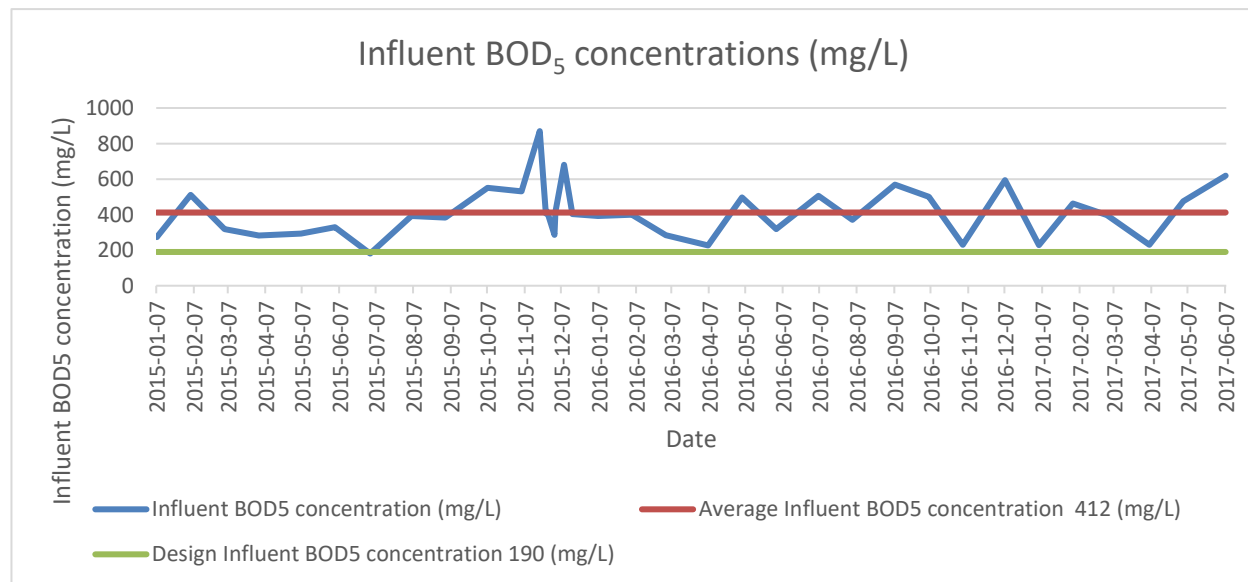
The Elmira WWTP is a Class III facility with a BNR process and tertiary filtration. It was originally constructed in 1967, and expanded in 1983 and then again in 2000. The facility is operated under the CoA No: 6698-8QGJ8E issued on January 27, 2012. The rated capacity of the Elmira WWTP is 7,800 m<sup>3</sup>/d and the peak flow rate is 19,500 m<sup>3</sup>/d, respectively.

The Study involved:

- Reviewing and establishing **flows and loads**
- **Carrying out additional testing**
- Consideration of conventional approaches to improve plant performance
- Consideration of innovative technology to improve plant performance
- Recommendation for optimization the plant

As per the CoA, the plant rated capacity is 7,800 m<sup>3</sup>/d. The projected flow is expected to increase from the current flow of 4,479 m<sup>3</sup>/d in 2016 to 9,455 m<sup>3</sup>/d in 2051. It is anticipated that the projected flow will exceed the rated capacity for the Elmira WWTP by approximately 2039. The maximum day flow was recorded on July 31, 2015 at 13,249 m<sup>3</sup>/day. During the period January 2015 and August 2017, the average day flow was approximately 4,500 m<sup>3</sup>/d. This represents only 58% of the rated capacity of 7,800 m<sup>3</sup>/d.

Both the BOD<sub>5</sub> (412 mg/l) and TSS (374 mg/L) concentrations (between Jan 2015 to June 2017) exceed the design values of 190 mg/L. The Elmira WWTP is heavily loaded with industrial sewer which makes the BOD<sub>5</sub> and TSS concentrations to be considerably higher than the design values.



Even though the Elmira WWTP is operating at only 58% of the rated capacity, the influent loads for BOD<sub>5</sub> and TSS are higher than the design values. The increased BOD<sub>5</sub> requires additional biomass in the aeration tanks. The increased biomass in the aeration tank will increase the area required for clarification (maintaining the same SLR for the clarifier). Also, increased BOD<sub>5</sub> and TSS loads will increase the biosolids produced at the Elmira WWTP.

Filed tests showed (August 2017) that there was no sludge bulking (on the specific day). However, historical data showed that the plant experienced sludge bulking every spring. At the time of the tests in August 2017, the settling velocities were much smaller than those associated with granular activated sludge.

Using conventional methods, the upgrades that will be required at Elmira WWTP to bring the plant in compliance with the MOE Design Guidelines are as follows:

- Modify the bioreactors influent chamber to allow the primary effluent be split to three bioreactors
- Decommission the old bioreactors
- Construct a third bioreactor with similar volumes as the existing two bioreactors
- Modify the bioreactors effluent channel to allow the incorporation of the third bioreactor
- Increase the aeration requirement by 50%
- Provide all required aeration grid within the third bioreactor
- Equip the third bioreactor with mixers and recycle pumps as the other two existing bioreactors
- Retrofit the two small clarifiers



This option will improve the operation of the Elmira WWTP and provide additional capacity that will satisfy the flow projections made in the Master Plan. The upgraded Elmira WWTP will be in compliance with the MOE Design guidelines established for a BNR plant. **The cost of this is estimated to be \$3.84 Million, with an implementation schedule of 12 months.**

Using innovative technology S::Select, consisting of hydrocyclones, will provide the following benefits:

- Increase the settling velocity of the mixed liquor to > 4 m/h resulting in smaller final clarifier
- Increase the capacity of the existing bioreactors as the granular activated sludge is twice as active as the conventional floc based activated sludge. At the same biomass concentration, it will be possible to treat twice as much load to the plant. Accordingly, to satisfy the Master Plan projections a third bioreactor will not need to be constructed.
- Improve the clarified effluent quality.
- Reduce the polymer consumption for the biosolids management facility.
- Eliminate sludge bulking events
- Reduce energy consumption by approximately 15%



- Reduce operation and maintenance costs as there will be less equipment to be operated and maintained

The cost of this is estimated to be \$1.52 Million, with an implementation schedule of 3 months.

It was recommended to implement the S::Select<sup>®</sup> technology for the Elmira WWTP.