Memorandum

Blue Sky ENERGY ENGINEERING & CONSULTING INC.

To:	Matthew Aston, Director of Operations, Township of Wellington North
From:	Melody Johnson, M.A.Sc., P.Eng.
Date:	January 10, 2022
Subject	Review of the 2016 Arthur WWTP Class EA – Summary of the Basis of Development of the Design ADF of 2,300 m^3/d

1. Introduction

The Township of Wellington North (the Township) contacted XCG Consulting Ltd. (XCG) via email on December 8, 2021 to provide an opinion letter summarizing the rationale for the selection of 2,300 m^3/d as the design average day flow (ADF) capacity of an upgraded and expanded Arthur WWTP. This was part of the 2016 Class Environmental Assessment (Class EA) study completed by XCG. Staff members who were involved in the Arthur WWTP Class EA study are no longer with XCG; however, Melody Johnson, now with Blue Sky Energy Engineering & Consulting Inc. (Blue Sky) was involved with the Arthur WWTP Class EA study. Blue Sky was contacted by the Township and XCG, and has since been retained to provide this opinion letter.

The objective of this memorandum is to clarify the basis for the selection of the ADF capacity of 2,300 m^3/d, and to provide a high-level review of the potential for the effluent receiver and/or the WWTP site to accommodate growth beyond 2,300 m^3/d.

The completed 2016 Environmental Study Report (ESR) document, including appendices, was reviewed as part of this assignment. Report appendices that provide supporting information are identified below, as applicable.

2. Development of Future Design ADF of 2,300 m^3/d

2.1 Planning Period and Growth Projections

Class EA studies typically select a planning period for the development of future growth and servicing needs. In the case of the Arthur WWTP Class EA, which was initiated in 2012, the selected planning horizon was 2031, or a design period of approximately 20 years. Details are provided in Appendix B of the ESR. A summary of key items is provided below.

Existing (base) 2012 service population was reported to be 2,596 persons, and residential growth projections were based on 103 lots from the planned Phase 3 Eastridge contribution (284 persons) and other anticipated growth within the service area (714 persons), for a total residential growth of 998 persons to 2031. The residential growth forecast for the Village of Arthur (excluding Eastridge) were taken from the Wellington County Official Plan 1999, revised February 2011 (Part 3, Wellington Growth Strategy, Table 2, p. 10). The total projected residential population to 2031 was, therefore, estimated to be 3,310 persons.

Industrial / commercial / institutional (ICI) flows were also considered. Based on the 2012 Master Plan Study for Water Supply and Sanitary Sewage (Triton Engineering, 2012), a total of 28.7 ha of developable non-residential land would be serviced by 2031, including a vacant designated industrial parcel with 25.1 ha of developable land, and 3.6 ha of developable Highway Commercial parcels. Future growth contribution associated with Golden Valley Farms was based on an equivalent of 9 residential units which was reported to "reflect the remaining unused portion of the Golden Valley Farms allocation" as included in the 2012 Reserve Capacity Calculations for the Arthur WWTP (Triton Engineering, 2012).

2.2 Conversion to a Projected Wastewater Flow Rate

Projected flows associated with residential, ICI and Golden Valley Farms growth were developed using the growth projections (Section 2.1) and unit flow rates.

The design per capita flow rate for residential growth was assumed to be 370 L/cap/d (dry weather) plus I/I of 90 L/cap/d, for an overall value of 460 L/cap/d. These values were consistent with historic reported per capita flows, as well as typical ranges in MOE Design Guidelines (2008). Using these unit rates, the population growth over the design period (998 persons) was estimated to contribute a total of 459 m^3/d to the ADF.

Wastewater flow rates for ICI contributions were based on a dry weather flow of 14 m^3/ha/d (the high end of the typical range for commercial / light industrial developments, and the low end of the range for medium industrial development), plus an I/I allowance of 3 m^3/ha/d (based on estimates of historic I/I contributions to the Arthur WWTP's ADF). Thus, the overall design ICI flow rate was 17 m^3/ha/d. Servicing the available ICI growth lands (total of 28.7 ha) was estimated to contribute a total of 488 m^3/d to the ADF.

The Golden Valley Farms future growth contribution was based on an equivalent of 9 residential units (Section 2.1), which was determined to be equivalent to an ADF of 11 m^3/d.

Table 1 presents a summary of the projected future 2031 ADF capacity 2,300 m^3/d.

Table 1 – Development of the Projected Future ADF Capacity of 2,300 m^3/d

Parameter	Service Population / Area	Design Unit Flow Rate	Wastewater Flow
Base (2012) Residential	2,596 persons	n/a	1,171 m^3/d
Growth (to 2031) Residential	998 persons	460 L/cap/d	459 m^3/d
Total Residential	**3,594 persons**	**n/a**	**1,630 m^3/d**
Base (2012) Golden Valley	n/a	n/a	171 m^3/d
Growth (to 2031) Golden Valley	9 equivalent residential units	2.65 PPU 460 L/cap/d	11 m^3/d
Growth (to 2031) ICI	28.7 ha	17 m3/ha/d	488 m^3/d
Total ICI	**n/a**	**n/a**	**670 m^3/d**
Overall ADF	**n/a**	**n/a**	**2,300 m^3/d**
Notes: PPU = persons per unit			

Finally, a review of existing infrastructure suggested that the implementation of minor improvements could increase the capacity of the Arthur WWTP to 1,860 m^3/d. Therefore, the Class EA considered the potential for a staged approach to the capacity increase:

- Phase 1: Design ADF of 1,860 m^3/d, based on providing additional servicing capacity for the short-term via minor upgrades to the WWTP; and,
- Phase 2: Design ADF of 2,300 m^3/d, based on providing servicing capacity required to the design year of 2031.

3. Assimilative Capacity of the Conestoga River

3.1 Development of Effluent Flow / Concentration Targets

The assimilative capacity study (ACS) of the Conestoga River conducted as part of the Class EA followed a typical approach, and included the items listed below. The ACS report, and associated correspondence with MOE, is included in Appendix D of the ESR.

- Monthly / seasonal assessment of water quality and low flows in the receiver was used to define ambient conditions in the Conestoga River in the vicinity of the outfall. Water quality data were based on monthly sampling conducted by Triton Engineering Services, while flow was assessed using a gauge located just upstream of the existing outfall.
- An evaluation of the "policy status" of the Conestoga River with respect to key parameters was also completed. "Policy 1" applies if the ambient water quality is better than the Provincial Water Quality Objectives (PWQOs), while "Policy 2" applies if ambient water quality does not meet the PWQOs. The Conestoga River was determined to be Policy 2 with respect to total phosphorus (TP), E. coli, and dissolved oxygen (July and August only).
- Effluent concentration targets and maximum effluent discharge flow rates were developed using ambient conditions and the policy status of the receiver. The ACS was completed assuming a future ADF of 2,300 m^3/d (Phase 2, growth to 2031). Subsequently, effluent targets and flow rates were also confirmed for the Phase 1 ADF of 1,860 m^3/d.
- Due to low flows and poor water quality over the summer months, it was determined that year-round discharge to the Conestoga River would not be feasible. Despite this, the effluent discharge period was modified and expanded from September 16 – April 30, to October 1 – May 31.
- There were three main limitations associated with the assimilative capacity of the Conestoga River:
    - Maintaining the downstream fully-mixed unionized ammonia (UIA) concentration at or below the PWQO. To provide the Township with additional discharge flexibility in the event of elevated effluent TAN concentrations, the allowable discharge rate varies with both effluent TAN concentration and measured stream flow.
    - Maintaining minimum dilution ratios. In addition to limiting the facility to seasonal discharge, maintaining minimum dilution ratios also impacted the maximum daily allowable effluent discharge rates, particularly for the months of January to March.

- Conestoga River's Policy 2 status with respect to Total Phosphorus. MOE approved an effluent TP limit of 0.25 mg/L, which is equivalent to an annual TP loading limit of 210 kg/year at and ADF of 2,300 m^3/d.

- Finally, the ACS considered effluent storage volume requirements to facilitate the proposed effluent discharge limitations, including maximum daily discharge rate and seasonal discharge limitations. It was estimated that, when operating at its rated capacity of 2,300 m^3/d, a total storage volume of between 250,000 to 320,000 m^3 would be required, which was less than the maximum available storage capacity of 340,000 m^3 in the existing lagoons.

3.2 Receiver Opportunities / Limitations

As noted above, the ACS was completed assuming a future design ADF of 2,300 m^3/d. As such, the overall maximum ADF capacity that the receiver could accommodate was not defined as it was beyond the scope of the original study. It is therefore possible that this receiver could accommodate a higher design ADF in the future; despite this, there are a number of constraints that limit the overall available assimilative capacity of the Conestoga River as noted in Section 3.1.

An updated evaluation of ambient conditions (background concentrations and low flows) would be necessary to determine if conditions have improved over the past 10 years. Assuming the Conestoga River is still Policy 2 with respect to phosphorus, any future expansion would require the annual TP loading limit remain at or below the currently approved value (210 kg/year). As such, more stringent effluent TP limits would apply. In addition, a high level of nitrification would be required to potentially allow higher effluent flow rates while maintaining downstream UIA concentrations at or below the PWQO. In recent years, the impact of nitrate-nitrogen on effluent receivers has been gaining more attention. This parameter was not considered as part of the 2016 ESR, but might be identified as a potential parameter of concern as part of a future ACS. Any effluent nitrate-nitrogen requirements would add complexity to the overall treatment process.

While improved effluent quality could address concerns with respect to TP and UIA, minimum dilution ratios would still need to be maintained. It is possible that, through negotiations with MECP, revised effluent discharge tables could be developed that increase the maximum daily discharge volume based on real-time stream flow monitoring and updated effluent limits. It is noted that the UIA mass balance calculations completed as part of the ACS were based on the low (7Q20) flows in the Conestoga River. If approved by MECP, it is possible that a more flexible staged discharge approach could be used that considers flows in excess of the monthly 7Q20 flow. This approach could allow an increase of maximum effluent discharge rates while ensuring adequate downstream UIA concentrations and dilution ratios are maintained.

4. Other Considerations

The Arthur WWTP site has sufficient space to accommodate not only the planned expansion to an ADF capacity of 2,300 m^3/d, as presented in the 2016 ESR, but also a future expansion of the mechanical plant.

The effluent storage lagoons have a working storage volume of approximately 340,000 m^3. As noted in Section 2.2, it was estimated that a storage volume of between 250,000 to 320,000 m^3 would be required

to accommodate the expansion to an ADF 2,300 m^3/d. Given the low flows and poor quality in the Conestoga River over the summer months (June to September), seasonal discharge limitation will likely apply to any future expansions to the Arthur WWTP. This would increase the required effluent storage volume, and could exceed the current storage capacity of the effluent storage lagoons. For example, an additional ADF capacity of 100 m^3/d requiring storage over the 122 d non-discharge period would increase the effluent storage requirements by a minimum of 12,200 m^3. Effluent storage requirements would need to be considered in conjunction with an updated ACS of the Conestoga River.

5. Closure

We trust that the above 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.