

MEMORANDUM

January 10, 2019

TO: Historical Memo

FM: Peter Carter / Steven Yee

RE: Carnation Wastewater Treatment Plant
December 2018 Process Summary

The Carnation Treatment Plant (CTP) discharged to the Chinook Bend wetlands for the entire month of December. Effluent Biochemical Oxygen Demand (BOD₅) and Total Suspended Solids (TSS) averaged <1.0 mg/L and <2.0 mg/L, respectively. BOD₅ and TSS removals were both >99%. All permit-required samples were collected and analyzed. Effluent flow averaged 0.106-MGD. Influent flow to the CTP averaged slightly higher (0.111-MGD) due to internal recycle flows. The max-day effluent flow was 0.129-MGD on December 9. Local rainfall (Fall City gage) totaled 6.41-inches for the month. The permeate temperature dropped from 64°F to 61°F across the month. On December 11 the Department of Ecology conducted a scheduled Class II inspection of the Carnation Plant.

The plant operated with one of two aeration basins in service (Basin 1). The MLSS averaged 8300-mg/L. An estimated 3700 dry lbs. of waste sludge and scum were hauled to the South Plant for further treatment. Flow was cycled through all five membrane trains and both UV trains in December. Membrane Train 5 continued to operate with a manually-operated feed valve while we await parts.

Total-N removal averaged 81%. Effluent ammonia (NH₃) averaged <0.1-mg/L as N. Effluent nitrite plus nitrate (NO₂+NO₃) averaged 11.1-mg/L as N. Effluent Total phosphorus (P) averaged 3.8-mg/L for a total P removal of 47%. N and P analyses are performed on a weekly basis.

Alkalinity was added continuously to the secondary process to always maintain the effluent pH above pH 6.7. Magnesium Hydroxide Solution [Mg(OH)₂] was the alkalinity source this month. Effluent alkalinity averaged 140-mg/L (with a range of 107-191) as CaCO₃; influent alkalinity was in the range of 224-255 mg/l as CaCO₃. Alkalinity addition replaces the alkalinity lost during nitrification; the effluent pH would likely fall below the permitted minimum pH 6.0 if alkalinity addition stopped. The Mg(OH)₂ solution was further diluted to order to promote mixing as the tank level got low. (The Mg(OH)₂ trial is ending at the end of the month.) The Equivalent of 282 gallons of 60% Mg(OH)₂ solution was added in December.

Tables 1 and 2 present membrane maintenance cleaning information and membrane performance data, respectively. Average TMPs were in the 1.4 to 1.6 psi range. The control system limits flow through the membranes to keep the TMP <8.0-psi; this protects the membranes' integrity. An estimated 70-gallons of 12.5% sodium hypochlorite were used for maintenance cleans in December.

Table 1: Membrane Maintenance Cleans Performed

Week Beginning	Train 1	Train 2	Train 3	Train 4	Train 5
12/1	MC ¹	MC	MC	MC	MC
12/9	MC	MC	MC	MC	MC
12/16	MC	MC	MC	MC	MC
12/23	MC	MC	MC	MC	MC
12/30	MC				

¹ MC refers to a Maintenance Clean

Table 2: Membrane Performance December 2018

MEMBRANE PARAMETERS	Train 1	Train 2	Train 3	Train 4	Train 5
Permeate Turbidity (NTU)¹					
Average for Month	0.06	0.06	0.05	0.06	0.07
<i>Design</i>	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Permeate Flow (GPD)²					
Average Daily for Month	24,783	25,931	22,008	22,004	21,538
<i>AADF (Annual Average Flow) Design</i>	97,500	97,500	97,500	97,500	97,500
Maximum Daily for Month	44,008	44,752	33,826	34,777	38,718
<i>PDF (Peak Day) Design</i>	165,000	165,000	165,000	165,000	165,000
Permeate Flow Rate (GPM)³					
Average for Month	18	20	17	17	16
Peak Hour for Month	87	111	86	85	92
<i>PHF (Peak Hour) Design</i>	180	180	180	180	180
Instantaneous Flux (GFD⁴)⁵					
Average for Month	7.1	6.8	7.3	7.0	7.5
Trans-Membrane Pressure (PSI)⁶					
Average for Month	1.4	1.4	1.6	1.5	1.5
Maximum for Month	2.2	2.8	4.5	2.4	2.6
<i>(Average/Maximum) Design</i>	2.0/10	2.0/10	2.0/10	2.0/10	2.0/10
Permeate Temperature (°C)⁷					
Minimum for Month	13.3	13.3	13.3	13.3	13.3
<i>Design</i>	> 12	> 12	> 12	> 12	> 12
Permeability at 20°C (GFD/PSI)⁸					
Average for Month	5.4	5.2	4.9	5.1	5.4
<i>(Recovery Clean Trigger) Design</i>	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0

¹ Permeate turbidity – indication of membrane integrity.

² Permeate flow – compares operating to design capacity. The design capacity (AADF and PDF) are both based on entire treatment plant flow with four membrane trains available.

³ Permeate flow rate – check of acute operating conditions to confirm peak hour design condition is not being approached. The design capacity (PHF) is based on entire treatment plant flow with five membrane trains available. The average rate is only for when the membrane is operating.

⁴ “GFD” is shorthand for “GPD/Ft²”. GFD is a flux measurement based on the flow (gallons/day) of permeate that passes through a square foot of membrane surface. Each train has one membrane cassette with 12,920 square feet of surface area.

⁵ Instantaneous flux – check of membrane operating flux. Instantaneous differs from net flux in that it does not account for backpulse and/or relax periods (It is therefore always slightly higher). The design condition is based on net flux and therefore not included. The permeate flow design conditions provide the same information since only a single cassette is operating in each membrane train.

⁶ Trans-membrane pressure – provides information related to fouling and biological process operation (MLSS and filterability). The average and maximum TMP are included for reference.

⁷ Permeate temperature – listed since the hydraulic capacity can be reduced when operating below the minimum design temperature (de-rating of membrane capacity).

⁸ Permeability (temperature corrected to 20°C) – parameter assesses fouled condition of membrane. The trigger value listed is from the GE O&M manual.