

MEMORANDUM

October 12, 2018

TO: Historical Memo

FM: Peter Carter / Steven Yee

RE: Carnation Wastewater Treatment Plant
September 2018 Process Summary

The Carnation Treatment Plant (CTP) discharged to the Snoqualmie River for the first half of the month and flowed to the Chinook Bend wetlands for the second half of the month (starting September 17). Effluent was sent to the Snoqualmie River because of issues with high effluent total coliforms (TC); effluent was initially sent to the river on July 26. After considerable and arduous troubleshooting of operational, sampling and analytical issues, flow was finally returned to the Chinook Bend wetland after fully disinfecting the outfall line, after seven consecutive days of TC results within reclaimed water (RW) limits, and after the chlorine residual at the outfall had dropped to zero.

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 0.104-MGD. Influent flow to the CTP averaged slightly higher (0.112-MGD) due to internal recycle flows. The max-day effluent flow was 0.122-MGD on September 23. Local rainfall (Fall City gage) totaled 2.35-inches for the month. The permeate temperature dropped from 76°F to 73°F across the month.

The plant operated with one of two aeration basins in service (Basin 1). The MLSS averaged 8300-mg/L. An estimated 4100 dry lbs. of waste sludge and scum were hauled to the South Plant for further treatment.

Total-N removal averaged 77%. Effluent ammonia (NH₃) averaged <0.1-mg/L as N. Effluent nitrite plus nitrate (NO₂+NO₃) averaged 6.4-mg/L as N. Effluent Total phosphorus (P) averaged 4.5-mg/L. N and P analyses were performed on a weekly basis.

Alkalinity was added continuously to Basin 1 in order to maintain the effluent pH above pH 7.0 at all times. 60% Magnesium Hydroxide Solution [Mg(OH)₂] was used as the alkalinity source this month rather than 25% sodium hydroxide solution (NaOH). Mg(OH)₂ is much safer than NaOH to handle, it will reduce the effluent sodium content, and it may improve the filterability of the mixed liquor. 285-gallons of 60% Mg(OH)₂ was added in September. Effluent alkalinity averaged 207-mg/L as CaCO₃; influent alkalinity was in the range of 230-263 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.)

Flow was cycled through all five membrane trains and both UV trains in September. Membrane Train 5 was taken out of service on September 14 due to the failure of the membrane feed valve. However, it was returned to service Sept. 25, with a manually operated feed valve, while we awaited parts. Tables 1 and 2 present membrane maintenance cleaning information and membrane performance data, respectively.

Slack adjustment was performed on Membrane Cassettes 1 and 2 in September. Slack adjustment is necessary every 5-10 years of service. If the membrane “noodle” does not have sufficient slack, the air scour does not keep them sufficiently clean and permeability is reduced as a result. A number of leaks in Cassette 1 and a few leaks in Cassette 2 were also repaired. A shard, of what appeared to be epoxy coating with sharp edges, was recovered from a module in Cassette 1. This shard was the apparent cause of the damage to the membranes in that train. Slack adjustment will be performed on the other three cassettes in October.

An estimated 50-gallons of 12.5% sodium hypochlorite were used for maintenance cleans, with an additional 73-gallons used for recovery cleans of Membrane Cassettes 1 and 2. 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.

Table 1: Membrane Maintenance and Recovery Cleans Performed

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

¹ MC refers to a Maintenance Clean

² RCHypo refers to a Sodium Hypochlorite Recovery Clean

Table 2: Membrane Performance September 2018

MEMBRANE PARAMETERS	Train 1	Train 2	Train 3	Train 4	Train 5
Permeate Turbidity (NTU)¹					
Average for Month	0.07	0.08	0.05	0.06	0.21
<i>Design</i>	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Permeate Flow (GPD)²					
Average Daily for Month	23,215	26,158	23,119	28,026	15,799
<i>AADF (Annual Average Flow) Design</i>	97,500	97,500	97,500	97,500	97,500
Maximum Daily for Month	41,565	41,710	40,351	54,028	39,127
<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	19	16	21	12
Peak Hour for Month	141	114	94	136	107
<i>PHF (Peak Hour) Design</i>	180	180	180	180	180
Instantaneous Flux (GFD⁴)⁵					
Average for Month	7.4	7.9	7.3	7.4	7.1
Trans-Membrane Pressure (PSI)⁶					
Average for Month	1.4	1.4	1.6	1.5	1.4
Maximum for Month	8.0	3.8	3.7	3.3	2.5
<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	22.8	22.8	22.8	22.8	22.8
<i>Design</i>	> 12	> 12	> 12	> 12	> 12
Permeability at 20°C (GFD/PSI)⁸					
Average for Month	4.7	5.1	4.1	4.5	4.5
<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.