MEMORANDUM

May 12, 2020

TO: Historical Memo

FM: Peter Carter / Steven Yee

RE: Carnation Wastewater Treatment Plant
April 2020 Process Summary

The Carnation Treatment Plant (CTP) discharged to the Chinook Bend wetlands for all of April. All reclaimed water quality requirements were met. Effluent Biochemical Oxygen Demand (BOD_5) and Total Suspended Solids (TSS) averaged <1.0 mg/L and <2.0 mg/L, respectively, and BOD_5 and TSS removals were >99.6% and >99.2% respectively. All permit-required samples were collected and analyzed.

Effluent flow averaged 0.106-MGD. Influent flow averaged 0.114-MGD; influent flow is usually slightly higher than effluent flow due to internal recycle flows. The max-day effluent flow was 0.120-MGD on April 29 and 30. The permeate temperature increased across the month from about 16.6°C and to 20.0°C.

The plant operated with one of the two aeration basins in service (Basin 2). The MLSS averaged 9160-mg/L. An estimated 9000 dry lbs. of waste sludge and scum were hauled to the South Plant for further treatment. Flow was cycled through all five of the membrane trains for the entire month of April. Both UV trains were in service the entire month.

Total-N removal averaged 86%. Effluent ammonia (NH_3) averaged <0.2-mg/L as N. Effluent nitrite plus nitrate (NO_2+NO_3) averaged 7.6-mg/L as N. Total phosphorus (P) averaged 5.0-mg/L for a total P removal of 41%. N and P analyses were performed every week.

Alkalinity was added to the secondary process to maintain the instantaneous effluent pH above pH 6.9. Caustic Soda (25% solution) was the alkalinity source; a total of 569 gallons was used. Effluent alkalinity averaged 127-mg/L (with a range of 113-139) as $CaCO_3$; influent alkalinity was in the range of 222-260 mg/l as $CaCO_3$. 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.

Tables 1 and 2 present membrane maintenance cleaning information and membrane performance data, respectively. Average TMPs were in the 1.5 to 1.7 psi range. The control system limits flow through the membranes to keep the TMP <8.0-psi; this protects the membranes' integrity. An estimated 68-gallons of sodium hypochlorite were used for maintenance cleans in April. An additional 97 gallons of sodium hypochlorite and 46 gallons of citric acid were used for recovery cleans for membrane trains 1, 2 and 3.

Two operational events are worth noting. The first event, or events, was when the control system prevented the plant from permeating twice this month. It happened for the first time on April 2, which prevented the plant from being able to discharge for 14 hours. The unused aeration basin was used to store flow while an instrument/electrical team attempted to correct the problem. Though they were unable to identify the problem, the plant began to operate on its own and the accumulated flow could then be discharged. On April 8, the control system again stopped communicating and permeating was impossible for 11 hours. Flow was stored during the 11 hours by filling the unused aeration basin. The non-

membrane parts of the plant were able to be run in hand. While checking the fiber optic communication lines and discovering some issues, the plant began running again, so troubleshooting and repairs were suspended while stored flow was pumped down (as only 1/3 of the storage capacity in the aeration basin was left). The fiber-optic lines were later repaired and plans were made to install an ethernet communications system (as a back-up to the fiber optics) since the distances involved did not require fiber optics. The second operational event of note occurred on April 10 when the membrane system shut down on high TMPs on all trains. Troubleshooting revealed that the agitation aeration blowers, while showing normal on the SCADA system, would only run at minimum speed. Thus, there was not enough air being supplied for membrane agitation. A reset of the blowers returned them to normal operation.

Table 1: Membrane Maintenance Cleans Performed April 2020

Week Beginning	Train 1	Train 2	Train 3	Train 4	Train 5
4/1			MC[1]	MC	MC
4/5	MC	MC	MC		MC
4/12	MC RC_{hypo} RC_{citric}	MC	MC		MC
4/19	MC	MC RC_{hypo} RC_{citric}	MC	MC	MC
4/26	MC	MC	MC RC_{hypo} RC_{citric}	MC	

[1] MC refers to a maintenance clean
[2] RC_{hypo} refers to a sodium hypochlorite recovery clean
[3] RC_{citric} refers to a citric acid recovery clean

Table 2: Membrane Performance April 2020

MEMBRANE PARAMETERS	Train 1	Train 2	Train 3	Train 4	Train 5
Permeate Turbidity (NTU)[1]					
Average for Month	0.10	0.11	0.08	0.07	0.12
Design	*< 0.2*	*< 0.2*	*< 0.2*	*< 0.2*	*< 0.2*
Permeate Flow (GPD)[2]					
Average Daily for Month	23,655	24,362	24,664	23,217	22,416
AADF (Annual Average Flow) Design	*97,500*	*97,500*	*97,500*	*97,500*	*97,500*
Maximum Daily for Month	39,985	33,813	44,965	38,767	41,792
PDF (Peak Day) Design	*165,000*	*165,000*	*165,000*	*165,000*	*165,000*
Permeate Flow Rate (GPM)[3]					
Average for Month	20	20	20	18	18
Peak Hour for Month	160	133	128	92	103
PHF (Peak Hour) Design	*180*	*180*	*180*	*180*	*180*
Instantaneous Flux (GFD[4])[5]					
Average for Month	7.8	8.0	7.8	7.5	7.7
Trans-Membrane Pressure (PSI)[6]					
Average for Month	1.6	1.6	1.7	1.5	1.7
Maximum for Month	7.9	8.0	7.8	7.5	7.7
(Average/Maximum) Design	*2.0/10*	*2.0/10*	*2.0/10*	*2.0/10*	*2.0/10*
Permeate Temperature (ºC)[7]					
Minimum for Month	16.0	16.0	16.0	16.0	16.0
Design	*>12*	*> 12*	*> 12*	*> 12*	*> 12*
Permeability at 20ºC (GFD/PSI)[8]					
Average for Month	5.1	5.2	4.8	5.3	4.9
(Recovery Clean Trigger) Design	*< 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/Ft^2". 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 20ºC) – parameter assesses fouled condition of membrane. The trigger value listed is from the GE O&M manual.