MEMORANDUM

December 13, 2021

TO: Historical Memo

FM: Matt Macdonald

RE: Carnation Wastewater Treatment Plant
November 2021 Process Summary

November 2021 is the first Discharge Monitoring Report covered by the new (Version 3) Carnation Treatment Plant NPDES Individual Permit WA0032182, issued September 24, 2021.

The Carnation Treatment Plant (CTP) discharged to the Chinook Bend wetland for the entire month of November. All reclaimed water quality requirements were met. Effluent Carbonaceous Biochemical Oxygen Demand ($CBOD_5$) and Total Suspended Solids (TSS) averaged <1.0 mg/L and <2.0 mg/L, respectively, and $CBOD_5$ and TSS removals were >99.5% and >99.4%, respectively. The max-daily total coliform grab for the month was an estimated 0.3-cfu/100-mL on November 8. The day-average permeate temperature ranged from 18.3°C to 20.2°C. All permit-required samples were collected and analyzed.

Effluent flow averaged 0.104-MGD. Influent flow averaged 0.110-MGD; influent flow is slightly higher than effluent flow due to internal recycle flows. The influent flow meter continued to report artificially high flow totals for the duration of the month. In response, daily influent flow totals were estimated by summing the measured effluent flow and an estimate of the internal recycle and wasted activated sludge. The monthly average flow of 0.104-MGD was similar to October's average flow despite the heavy rainfall received in November: 10.26-inches at Seatac Airport.

Effluent total-nitrogen (TN) averaged 6.9-mg/L as N and resulted in a removal rate of 90% in November[1]; the max weekly average TN was 8.2-mg/L as N. Effluent ammonia (NH_3) averaged 0.3-mg/L as N. Effluent nitrite plus nitrate (NO_2+NO_3) averaged 5.6-mg/L as N. Effluent total phosphorus (P) averaged 3.3-mg/L for a total P removal of 63%. Year-to-date annual average effluent P is 3.9-mg/L and the year-to-date effluent Total Kjeldahl Nitrogen (TKN) is 1.4-mg/L as N. Effluent nutrient sampling was performed twice per week (Monday and Tuesday); influent nutrient sampling was performed once per week (Tuesday).

Alkalinity was continuously added to the secondary process to maintain the instantaneous effluent pH above pH 6.8. A total of 263[2] gallons of Caustic Soda (25% NaOH solution) was used for alkalinity adjustment. Effluent alkalinity averaged 97-mg/L (with a range of 88-109) as $CaCO_3$; influent alkalinity was in the range of 243-284 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.

The plant operated with Aeration Basin 1 (AB1) in service the entire month of November. The MLSS averaged 9,800-mg/L. An estimated 7600 dry lbs. of waste sludge and scum were hauled to the South Plant for further treatment.

[1]Calculated using days when both influent and effluent nutrients were sampled.
[2]Calculated by tank level drop.

Membrane trains 1, 2, and 4 were in service for the duration of November. Train 3 began the month out of service and was put in service November 10. Train 5 was taken out of service on November 17 and remained out of service for the rest of the month due to turbidities frequently rising above 0.2-NTU (the control systems will shut down the train prior to sustaining 0.5-NTU or greater for 5 minutes).

While permeating, one of two parallel UV trains is in operation with both subsystems running (in series). The decision to operate both UV subsystems was based on recent issues with the UV system. A single UV train with one subsystem running provides sufficient dosage; the second subsystem is operated for redundancy.

On November 3, the CTP effluent was disinfected with a UV dosage below 80-mJ/cm2 for a duration of approximately 15 minutes. During the event, the minimum recorded UV dosage was 9-mJ/cm2. A sample from the effluent storage tank taken a few hours after the event yielded no total coliforms. The storage tank provides a hydraulic retention time of approximately half a day so the sample should include the under-disinfected permeate (mixed with the rest of the stored effluent). The event occurred during a routine generator test. Before the generator test, UV Train 2 was operated with both of its subsystems operated in-series. The switch from utility power to generator power went as usual and UV Train 1 came online with both subsystems in service. However, upon switching from generator to utility power, just one of the two UV subsystems in UV train 1 came online. The one UV subsystem that came online failed to produce sufficient UV intensity to exceed an 80-mJ/cm^2 dose. The low dosage alarm also failed to shut down the membrane system due to an incorrect setting on the UV control system. The plant produced effluent at the low UV dosage for 15 minutes until the operator intervened. As a corrective action, the alarm settings were changed to cause a plant shutdown when the UV dosage is below 85-mJ/cm^2. A recreation of the event resulted in both UV subsystems coming online and exceeding 80-mJ/cm^2 as designed. The single UV subsystem coming online with insufficient UV intensity could not be replicated.

Tables 1 and 2 present membrane maintenance cleaning information and membrane performance data, respectively. Average TMPs were in the 1.9 to 2.3 psi range. The control system limits flow through the membranes at a TMP 8.0-psi; this protects the membranes' integrity.

An estimated 33[1]-gallons of sodium hypochlorite were used in November to perform 19 maintenance cleans.

Table 1: Membrane Maintenance Cleans Performed November 2021

Week Beginning	Train 1	Train 2	Train 3	Train 4	Train 5
10/31		MC[2]		MC	MC
11/07	MC		MC	MC	MC
11/14	MC	MC	MC	MC	
11/21	MC	MC	MC	MC	
11/28	MC	MC	MC	MC	

[1] Calculated using flow totalizer

Table 2: Membrane Performance November 2021

MEMBRANE PARAMETERS	Train 1	Train 2	Train 3	Train 4	Train 5
Permeate Turbidity (NTU)[1]					
Average for Month	0.11	0.12	0.18	0.09	
Design	*< 0.2*	*< 0.2*	*< 0.2*	*< 0.2*	*< 0.2*
Permeate Flow (GPD)[2]					
Average Daily for Month	40,662	37,821	19,778	34,175	
AADF (Annual Average Flow) Design	*97,500*	*97,500*	*97,500*	*97,500*	*97,500*
Maximum Daily for Month	91,474	77,352	51,995	69,809	
PDF (Peak Day) Design	*165,000*	*165,000*	*165,000*	*165,000*	*165,000*
Permeate Flow Rate (GPM)[3]					
Average for Month	28	32	18	25	
Peak Hour for Month	118	104	98	99	
PHF (Peak Hour) Design	*180*	*180*	*180*	*180*	*180*
Instantaneous Flux (GFD[4])[5]					
Average for Month	8.9	8.4	8.3	8.7	
Trans-Membrane Pressure (PSI)[6]					
Average for Month	2.3	2.1	2.2	1.9	
Maximum for Month	6.8	4.6	7.9	7.9	
(Average/Maximum) Design	*2.0/10*	*2.0/10*	*2.0/10*	*2.0/10*	*2.0/10*
Permeate Temperature (°C)[7]					
Minimum for Month	17.4	17.4	17.4	17.4	
Design	*>12*	*> 12*	*> 12*	*> 12*	*> 12*
Permeability at 20°C (GFD/PSI)[8]					
Average for Month	4.4	4.1	4.2	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 20°C) – parameter assesses fouled condition of membrane. The trigger value listed is from the GE O&M manual.