

MEMORANDUM

November 13, 2023

TO: Historical Memo

FM: Matt Macdonald

RE: Carnation Wastewater Treatment Plant
October 2023 Process Summary

The Carnation Treatment Plant (CTP) discharged to the Chinook Bend wetland for the entire month of October and all water quality requirements were met. Effluent Carbonaceous Biochemical Oxygen Demand (CBOD₅) and Total Suspended Solids (TSS) averaged <1.0 mg/L and <2.0 mg/L, respectively. CBOD₅ and TSS removals were >99% and >99%, respectively. The max daily total coliform grab for the month was an estimated <1.0-cfu/100-mL (there were no observed coliforms colonies this month). All permit-required samples were collected and analyzed. All permit-required samples were collected and analyzed. The permeate temperature averaged 21.8°C.

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.

Effluent total-nitrogen (TN) averaged 7.0-mg/L as N. Ammonia (NH₃) and nitrite plus nitrate (NO₂+NO₃) averaged 0.07-mg/L and 6.0-mg/L, respectively. The max-weekly average effluent TN was 8.9-mg/L as N and the monthly average TN removal rate was 89%¹ in October. Effluent total phosphorus (P) averaged 4.4-mg/L for the month with a Total P removal of 45%. The 2023 year-to-date average effluent Total-P and Total Kjeldahl Nitrogen (TKN) are 4.7-mg/L as P and 1.2-mg/L as N, respectively. Effluent nutrient sampling was performed twice per week (Monday and Tuesday); influent nutrient sampling was performed once per week (Tuesday).

Alkalinity was added to the secondary process to maintain the instantaneous effluent pH above pH 7.0. A total of 313² gallons of Caustic Soda (25% NaOH solution) was added. Effluent alkalinity averaged 100-mg/L (with a range of 87-114) as CaCO₃; influent alkalinity was in the range of 234-262 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 plant operated with Aeration Basin 2 (AB2) in service. The mixed liquor total suspended solids (MLSS) averaged 9,300-mg/L with a range of 8,500-mg/L to 10,000-mg/L. An estimated 5,900 dry lbs. of waste activated sludge were hauled to the South Plant for further treatment. Of the volume wasted, approximately 75% was from the memDense hydrocyclone.

All 5 membrane trains were available for service for the duration for the month, apart from train 4 which was out of service October 21-25 and October 31 due to a false alarm causing it to shut down. One of two parallel UV trains was in operation with both subsystems running (in series) while permeating. The

¹Calculated using days when both influent and effluent nutrients were sampled.

²Calculated by tank level drop.

decision to operate both UV subsystems was based on earlier issues with the UV system. A single UV train with one subsystem in operation provides sufficient dosage; the second subsystem is operated for redundancy. On October 18, UV train 1 was taken offline to begin construction of the UV train replacement. Commissioning of the first train is expected in November.

Tables 1 and 2 present monthly membrane maintenance cleaning information and membrane performance data, respectively. Trans-membrane pressure (TMP) averaged 0.4-psi and temperature corrected permeability averaged 19.8-gfd/psi. The control system limits flow through the membranes to a TMP value of 8.0-psi; this protects the membranes' integrity.

Approximately 80¹ gallons of sodium hypochlorite was used to perform 19 maintenance cleans in October.

The memDense hydrocyclone skid was commissioned in mid-September and routine wasting using the device began on September 19. In October, 62,000 gal of the hydrocyclone overflow fraction and 20,500 gal of mixed liquor were wasted to South Plant. During operation, approximately 32% of the mass fraction and 25% of the volume fraction exited in the underflow stream. The remainder of the mass and volume exited in the overflow stream. The TSS concentration of hydrocyclone overflow was approximately 7% less than the mixed liquor, resulting in a need to waste additional volume to maintain the same mixed liquor concentration.

Table 1: Membrane Maintenance Cleans Performed October 2023

Week Beginning	Train 1	Train 2	Train 3	Train 4	Train 5
11/1	MC ²	MC	MC	MC	MC
11/8	MC	MC	MC	MC	MC
11/15	MC	MC	MC	MC	MC
11/22	MC	MC	MC	MC	MC
11/29	MC x 2	MC			

¹ Calculated by flow meter totalizer

² Maintenance Clean

Table 2: Membrane Performance October 2023

MEMBRANE PARAMETERS	Train 1	Train 2	Train 3	Train 4	Train 5
Permeate Turbidity (NTU)¹					
Average for Month	0.08	0.11	0.11	0.11	0.10
<i>Design</i>	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Permeate Flow (GPD)²					
Average Daily for Month	31,155	32,132	31,533	18,237	30,512
<i>AADF (Annual Average Flow) Design</i>	97,500	97,500	97,500	97,500	97,500
Maximum Daily for Month	59,123	64,261	63,107	43,258	67,710
<i>PDF (Peak Day) Design</i>	165,000	165,000	165,000	165,000	165,000
Permeate Flow Rate (GPM)³					
Average for Month	29	30	30	16	29
Peak Hour for Month	116	136	147	165	115
<i>PHF (Peak Hour) Design</i>	180	180	180	180	180
Instantaneous Flux (GFD⁴)⁵					
Average for Month	8.3	8.4	8.4	8.6	8.3
Trans-Membrane Pressure (PSI)⁶					
Average for Month	0.4	0.4	0.4	0.4	0.4
Maximum for Month	1.0	2.0	2.6	1.5	0.8
<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	17.6	17.6	17.6	17.6	17.6
<i>Design</i>	> 12	> 12	> 12	> 12	> 12
Permeability at 20°C (GFD/PSI)⁸					
Average for Month	20.8	18.4	19.6	21.1	19.2
<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 16,340 square feet of surface area (formerly 12,920 square feet).

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. Control system limits TMP to 8 psi.

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.