

# MEMORANDUM

February 12, 2024

TO: Historical Memo

FM: Matt Macdonald

RE: Carnation Wastewater Treatment Plant  
January 2024 Process Summary

The Carnation Treatment Plant (CTP) discharged to the Chinook Bend wetland for the entire month of January and all water quality requirements were met. Effluent Carbonaceous Biochemical Oxygen Demand (CBOD<sub>5</sub>) and Total Suspended Solids (TSS) averaged <1.0 mg/L and <2.0 mg/L, respectively. CBOD<sub>5</sub> and TSS removals were >99% and >99%, respectively. The max daily total coliform grab for the month was an estimated 1.7-cfu/100-mL. All permit-required samples were collected and analyzed.

Effluent flow averaged 0.113-MGD. Influent flow averaged 0.119-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. On the evening of January 14 and morning of January 15, subfreezing temperatures and issues with heating caused an indoor process water pipe to break. The ensuing leak to the plant drain recycled approximately 90,000 gallons of process water (disinfected effluent) back to the plant influent. This unintended recycle was not included in the daily influent flow.

Effluent total-nitrogen (TN) averaged 9.7-mg/L as N. Ammonia (NH<sub>3</sub>) and nitrite plus nitrate (NO<sub>2</sub>+NO<sub>3</sub>) averaged 1.28-mg/L and 7.3-mg/L, respectively. The max-weekly average effluent TN was 19.8-mg/L as N and the monthly average TN removal rate was 86%<sup>1</sup> in January. Nitrogen removal was unusually low on the third week of January due to several equipment related issues, some of which were related to abnormally cold temperatures and power bumps. The most significant issue was the zone 2 mixer which stopped working on January 13. By January 20 a new mixer was installed and operational. Effluent total phosphorus (P) averaged 2.5-mg/L for the month with a Total P removal of 68%. The 2024 year average effluent Total-P and Total Kjeldahl Nitrogen (TKN) are 2.5-mg/L as P and 2.5-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 6.9. A total of approximately 277<sup>2</sup> gallons of Caustic Soda (25% NaOH solution) was added. Effluent alkalinity averaged 97-mg/L (with a range of 61-124 mg/L) as CaCO<sub>3</sub>; influent alkalinity was in the range of 223-275 mg/l as CaCO<sub>3</sub>. 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 9,400-mg/L with a range of 8,700-mg/L to 10,000-mg/L. An estimated 6500 dry lbs. of

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<sup>1</sup>Calculated using days when both influent and effluent nutrients were sampled.

<sup>2</sup>Calculated by tank level drop and assumed the same rate of use from January 23 to January 30.

waste activated sludge were hauled to the South Plant for further treatment. Of the volume wasted, approximately 63% was from the memDense hydrocyclone.

Four of the five membrane trains were available for service in January; train 4 remains out of service with a permeate pump and VFD issue. UV train 2 operated with both subsystems on for all of January while train 1 remained out of service to install and commission the new UV train. Commissioning is expected to restart in February. On January 31, communication issues with the UV train in service caused a loss of dosage data on multiple occasions, the longest of which was 22 minutes. Other UV process data confirmed that the system continued to operate as usual; the UV dosage before and after the data loss was maintained throughout the event.

Tables 1 and 2 present monthly membrane maintenance cleaning information and membrane performance data, respectively. Trans-membrane pressure (TMP) averaged 0.5-psi and temperature corrected permeability averaged 22.4-gfd/psi. The control system limits flow through the membranes to a TMP value of 8.0-psi; this protects the membranes' integrity.

Approximately 55<sup>1</sup> gallons of sodium hypochlorite was used to perform 22 maintenance cleans in January. Approximately 65 gallons of sodium hypochlorite was used for recovery cleans on trains 1 through 3.

Table 1: Membrane Maintenance Cleans Performed January 2024

Week Beginning	Train 1	Train 2	Train 3	Train 4	Train 5
12/31	MC x 2 <sup>2</sup>	MC	MC x 2		MC
1/7	MC		MC		MC
1/14	MC	MC x 2	MC		MC
1/21	MC	MC x2	MC		MC
1/28	MC	MC	MC		

<sup>1</sup> Calculated by flow meter totalizer

<sup>2</sup> Maintenance Clean

Table 2: Membrane Performance January 2024

MEMBRANE PARAMETERS	Train 1	Train 2	Train 3	Train 4 Out of Service	Train 5
<b>Permeate Turbidity (NTU)<sup>1</sup></b>					
Average for Month	0.07	0.10	0.10		0.10
<i>Design</i>	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
<b>Permeate Flow (GPD)<sup>2</sup></b>					
Average Daily for Month	41,300	38,145	36,463		40,730
<i>AADF (Annual Average Flow) Design</i>	97,500	97,500	97,500	97,500	97,500
Maximum Daily for Month	74,218	75,513	69,127		74,718
<i>PDF (Peak Day) Design</i>	165,000	165,000	165,000	165,000	165,000
<b>Permeate Flow Rate (GPM)<sup>3</sup></b>					
Average for Month	36	34	33		36
Peak Hour for Month	112	127	114		115
<i>PHF (Peak Hour) Design</i>	180	180	180	180	180
<b>Instantaneous Flux (GFD<sup>4</sup>)<sup>5</sup></b>					
Average for Month	8.8	9.0	9.1		8.7
<b>Trans-Membrane Pressure (PSI)<sup>6</sup></b>					
Average for Month		0.6	0.5		0.4
Maximum for Month		2.0	8.2		1.7
<i>(Average/Maximum) Design</i>	2.0/10	2.0/10	2.0/10	2.0/10	2.0/10
<b>Permeate Temperature (°C)<sup>7</sup></b>					
Minimum for Month	12.3	12.3	12.3		12.3
<i>Design</i>	> 12	> 12	> 12	> 12	> 12
<b>Permeability at 20°C (GFD/PSI)<sup>8</sup></b>					
Average for Month		16.8	27.9		22.6
<i>(Recovery Clean Trigger) Design</i>	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0

<sup>1</sup> Permeate turbidity – indication of membrane integrity.

<sup>2</sup> 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.

<sup>3</sup> 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.

<sup>4</sup> “GFD” is shorthand for “GPD/Ft<sup>2</sup>”. 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).

<sup>5</sup> 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.

<sup>6</sup> 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.

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

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