

# MEMORANDUM

May 12, 2022

TO: Historical Memo

FM: Matt Macdonald

RE: Carnation Wastewater Treatment Plant  
April 2022 Process Summary

The Carnation Treatment Plant (CTP) discharged to the Chinook Bend wetland for the entire month of April. All reclaimed 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, and CBOD<sub>5</sub> and TSS removals were >99% and >99%, respectively. The day-average permeate temperature averaged 17.6°C in April. All permit-required samples were collected and analyzed.

Effluent flow averaged 0.097-MGD. Influent flow averaged 0.103-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 max-daily total coliform grab for the month was an estimated 2.0-cfu/100-mL. While still below effluent quality limits, it is unusual to have any total coliforms in the effluent. Thus, on April 14 the bulbs on Train 1 Subsystem A were replaced. Several total coliform plates had a single colony after the bulb replacement, but ultimately the total coliform results returned to non-detect.

Effluent total-nitrogen (TN) averaged 5.5-mg/L as N with ammonia (NH<sub>3</sub>) and nitrite plus nitrate (NO<sub>2</sub>+NO<sub>3</sub>) accounting for <0.06-mg/L and 4.3-mg/L, respectively. The monthly average TN removal rate was 93%<sup>1</sup> in April. The max-weekly average effluent TN was 6.1mg/L as N. Effluent total phosphorus (P) averaged 3.6-mg/L for the month. Total P removal averaged 59% for the month. The 2022 year-to-date average effluent Total-P and Total Kjeldahl Nitrogen (TKN) are 3.5-mg/L as P and 1.2-mg/L as N, respectively. Effluent nutrient sampling in April 2022 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 6.9. A total of 386<sup>2</sup> gallons of Caustic Soda (25% NaOH solution) was added. Effluent alkalinity averaged 115-mg/L (with a range of 107-134) as CaCO<sub>3</sub>; influent alkalinity was in the range of 237-304 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 1 (AB1) in service the entire month of April. The MLSS averaged 9,700-mg/L. An estimated 8800 dry lbs. of waste sludge and scum were hauled to the South Plant for further treatment.

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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.

Membrane train 3 remained out of service with no membrane cassette for the duration of the month. Membrane trains 2 and 4 were taken out of service on April 7 in preparation for the upcoming membrane tank coating project. On April 19, after operating successfully with just trains 1 and 5 in service for a prolonged time, the membrane cassettes were removed from trains 2, and 4 and stored in a baker tank (located onsite) full of effluent for the duration of the tank coating project. The cassette from train 5 was placed in train 2 so that the plant could operate with the best two cassettes in membrane trains 1 and 2 while membrane tanks 3, 4, and 5 are re-coated. After April 19, membrane trains 1 and 2 were in service.

One of two parallel UV trains was in operation with both subsystems running (in series) while permeating. The 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. Train 1 was taken out of service for troubleshooting from April 1 until April 11. Train 2 was taken out of service for bulb and sleeve replacement on April 14.

Tables 1 and 2 present monthly membrane maintenance cleaning information and membrane performance data, respectively. Trans-membrane pressure (TMP) averaged 2.1-psi and temperature corrected permeability averaged 4.7-gfd/psi. Together, these indicate no significant change in membrane performance in April. The control system limits flow through the membranes at a TMP 8.0-psi; this protects the membranes' integrity.

An estimated 31<sup>1</sup>-gallons of sodium hypochlorite were used in April to perform 11 maintenance cleans and 59-gallons of sodium hypochlorite to perform two recovery cleans (59 gal).

Table 1: Membrane Maintenance Cleans Performed April 2022

Week Beginning	Train 1	Train 2	Train 3	Train 4	Train 5
3/27	MC <sup>2</sup>	MC			MC
4/03	MC	MC			MC x 2
4/10	MC				MC
4/17	MC, RC <sup>3</sup>	MC			RC
4/24	MC				

<sup>1</sup> Calculated using flow totalizer

<sup>2</sup> Maintenance Clean

<sup>3</sup> Recovery Clean

Table 2: Membrane Performance April 2022

MEMBRANE PARAMETERS	Train 1	Train 2 (4/1-7, 4/19-30)	Train 3 (not in service)	Train 4 (4/1-7)	Train 5 (4/1-19)
<b>Permeate Turbidity (NTU)<sup>1</sup></b>					
Average for Month	0.08	0.14		0.11	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	58,798	43,457		10,150	41,772
<i>AADF (Annual Average Flow) Design</i>	97,500	97,500	97,500	97,500	97,500
Maximum Daily for Month	80,997	77,655		45,737	90,606
<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	63	53		35	66
Peak Hour for Month	186	130		117	176
<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	9.0	9.4		9.6	8.8
<b>Trans-Membrane Pressure (PSI)<sup>6</sup></b>					
Average for Month	2.0	2.3		2.0	2.0
Maximum for Month	8.0	6.0		2.8	5.3
<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	16.0	16.6		16.7	16.0
<i>Design</i>	> 12	> 12	> 12	> 12	> 12
<b>Permeability at 20°C (GFD/PSI)<sup>8</sup></b>					
Average for Month	4.9	4.3		5.0	4.6
<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 12,920 square feet of surface area.

<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.

<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.