

# MEMORANDUM

November 9, 2022

TO: Historical Memo

FM: Matt Macdonald

RE: Carnation Wastewater Treatment Plant  
October 2022 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 (CBOD<sub>5</sub>) and Total Suspended Solids (TSS) averaged <1.1 mg/L and <2.0 mg/L, respectively, and CBOD<sub>5</sub> and TSS removals were >99% and >99%, respectively. The max daily total coliform grab for the month was <1.0-cfu/100-mL (there were no colony forming units observed this month). All permit-required samples were collected and analyzed. The permeate temperature decreased from 24.3°C to 20.8°C.

Effluent flow averaged 0.103-MGD. Influent flow averaged 0.109-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 8.0-mg/L as N with ammonia (NH<sub>3</sub>) and nitrite plus nitrate (NO<sub>2</sub>+NO<sub>3</sub>) accounting for 0.02-mg/L and 6.9-mg/L, respectively. The max-weekly average effluent TN was 8.9-mg/L as N and the monthly average TN removal rate was 88%<sup>1</sup> in October. Effluent total phosphorus (P) averaged 5.3-mg/L for the month with a Total P removal of 33%. The 2022 year-to-date average effluent Total-P and Total Kjeldahl Nitrogen (TKN) are 4.5-mg/L as P and 1.2-mg/L as N, respectively. Effluent nutrient sampling in October 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 7.0. A total of 268<sup>2</sup> gallons of Caustic Soda (25% NaOH solution) was added. Effluent alkalinity averaged 88-mg/L (with a range of 71-95) as CaCO<sub>3</sub>; influent alkalinity was in the range of 213-234 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 October. The MLSS averaged 8,200-mg/L. An estimated 3,900 dry lbs. of waste sludge and scum were hauled to the South Plant for further treatment.

All 5 membrane trains were available for service for the duration for the month. However, communication issues with a flow transmitter on train 4 caused it to periodically shut down; Train 4 was run intermittently in October.

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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.

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.

Tables 1 and 2 present monthly membrane maintenance cleaning information and membrane performance data, respectively. Trans-membrane pressure (TMP) averaged 1.1-psi and temperature corrected permeability averaged 6.8-gfd/psi. Both TMP and permeability indicate improved membrane performance which is due to the increase in surface area of the newly installed membrane modules (new modules have increased surface area from 340 sqft to 430 sqft per module, an increase in surface area of approximately 26%). Historically TMP and temperature corrected permeability have varied between 1.3-psi and 5.2-gfd/psi under optimal conditions, to 3.3-psi and 3.4 gfd/psi when mixed liquor has poor filterability. The control system limits flow through the membranes to a TMP value of 8.0-psi; this protects the membranes' integrity.

An estimated 48<sup>1</sup>-gallons of sodium hypochlorite were used in October to perform 22 maintenance cleans. By October 23 the sodium hypochlorite strength had degraded below a useful strength and was wasted to the solids handling basin.

Table 1: Membrane Maintenance Cleans Performed October 2022

Week Beginning	Train 1	Train 2	Train 3	Train 4	Train 5
10/2	MC <sup>2</sup>	MC	MC		MC
10/9	MC	MC	MC x2	MC	MC
10/16	MC	MC	MC	MC	MC
10/23	MC	MC	MC	MC	MC
10/30	MC				

<sup>1</sup> Calculated using tank level drop

<sup>2</sup> Maintenance Clean

<sup>3</sup> no Recovery Cleans performed in September

Table 2: Membrane Performance October 2022

MEMBRANE PARAMETERS	Train 1	Train 2	Train 3	Train 4	Train 5
<b>Permeate Turbidity (NTU)<sup>1</sup></b>					
Average for Month	0.08	0.10	0.10	0.09	0.11
<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	35,383	33,485	34,635	14,636	32,010
<i>AADF (Annual Average Flow) Design</i>	97,500	97,500	97,500	97,500	97,500
Maximum Daily for Month	78,883	69,580	73,171	56,971	71,250
<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	27	30	27	13	25
Peak Hour for Month	103	99	102	100	105
<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	7.9	7.8	8.0	8.5	8.0
<b>Trans-Membrane Pressure (PSI)<sup>6</sup></b>					
Average for Month	1.0	1.1	1.2	1.1	1.1
Maximum for Month	2.0	2.1	2.5	1.4	2.1
<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	19.9	19.9	19.9	19.9	19.9
<i>Design</i>	>12	> 12	> 12	> 12	> 12
<b>Permeability at 20°C (GFD/PSI)<sup>8</sup></b>					
Average for Month	7.4	6.6	6.1	7.5	6.6
<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. 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.