

# MEMORANDUM

June 12, 2024

TO: Historical Memo

FM: Matt Macdonald

RE: Carnation Wastewater Treatment Plant  
May 2024 Process Summary

The Carnation Treatment Plant (CTP) continued to discharge to the Snoqualmie river outfall in May to facilitate commissioning the new UV system. Reclaimed water regulations require that the new UV system have a bioassay validation that confirms virus removal performance prior to producing reclaimed water. Sampling for the bioassay validation occurred in April, however the final report has not been issued. Thus, during commissioning and until the final report is issued, the CTP must discharge to the Snoqualmie river outfall. 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. All fecal coliform and *E.coli* grab samples for the month produced no colony forming units.

Effluent flow averaged 0.100-MGD. Influent flow averaged 0.106-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 9.0-mg/L as N. Ammonia (NH<sub>3</sub>) and nitrite plus nitrate (NO<sub>2</sub>+NO<sub>3</sub>) averaged 0.04-mg/L and 7.8-mg/L, respectively. The max-weekly average effluent TN was 10.4-mg/L as N and the monthly average TN removal rate was 84%<sup>1</sup> in May. Effluent total phosphorus (P) averaged 4.9-mg/L for the month with a Total P removal of 44%. Effluent nutrient sampling in May 2024 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 6.7. A total of approximately 465<sup>2</sup> gallons of Caustic Soda (25% NaOH solution) was added. Effluent alkalinity averaged 105-mg/L (with a range of 90-120 mg/L) as CaCO<sub>3</sub>; influent alkalinity was in the range of 205-271 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 9,100-mg/L with a range of 8,400-mg/L to 9,900-mg/L. An estimated 7600 dry lbs. of waste activated sludge were hauled to the South Plant for further treatment. Of the volume wasted, approximately 92% was from the memDense hydrocyclone.

Four of the five membrane trains were available for service in May; train 4 remains out of service with a permeate pump and VFD issue. The UV system was operated with two UV reactors in series for the

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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

whole month of May. UV train 2 (the old UV system) operated from the beginning of May until May 3 when the vendor was onsite and fixed a programming issue that was impacting UV train 1. UV train 1 was in operation from May 3 until May 19 when a new issue began to cause plant shutdowns at night and excessive operator callouts. From May 19 until May 28 UV train 2 was in operation while troubleshooting was performed on UV train 1. On May 28 setpoint changes resolved the issues with UV train 1 and it was in operation for the remainder of the month. Both UV train 1 issues were associated with the wipe cycle which caused a low dosage failure, and both issues have been resolved.

Tables 1 and 2 present monthly membrane maintenance cleaning information and membrane performance data, respectively. Trans-membrane pressure (TMP) averaged 0.47-psi and temperature corrected permeability averaged 19.5-gfd/psi. The control system limits flow through the membranes to a TMP value of 8.0-psi; this protects the membranes' integrity. A total of 18 maintenance cleans were performed in May.

Table 1: Membrane Maintenance Cleans Performed May 2024

Week Beginning	Train 1	Train 2	Train 3	Train 4	Train 5
4/28	MC <sup>1</sup>	MC	MC		
5/5	MC	MC	MC X 2		MC
5/12	MC	MC	MC		MC
5/19	MC	MC			MC
5/26	MC	MC			MC

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<sup>1</sup> Maintenance Clean

Table 2: Membrane Performance May 2024

<b>MEMBRANE PARAMETERS</b>	<b>Train 1</b>	<b>Train 2</b>	<b>Train 3</b>	<b>Train 4 Out of Service</b>	<b>Train 5</b>
<b>Permeate Turbidity (NTU)<sup>1</sup></b>					
Average for Month	0.08	0.10	0.09		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	34,391	40,301	36,171		31,985
<i>AADF (Annual Average Flow) Design</i>	97,500	97,500	97,500	97,500	97,500
Maximum Daily for Month	65,900	83,021	77,965		66,304
<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	32	36	32		29
Peak Hour for Month	136	182	156		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	8.0	9.5	8.2		8.5
<b>Trans-Membrane Pressure (PSI)<sup>6</sup></b>					
Average for Month	0.4	0.6	0.3		0.5
Maximum for Month	2.1	1.9	1.5		1.2
<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	17.5	17.5	17.5		17.5
<i>Design</i>	>12	> 12	> 12	> 12	> 12
<b>Permeability at 20°C (GFD/PSI)<sup>8</sup></b>					
Average for Month	18.8	15.6	25.8		17.8
<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.