

# MEMORANDUM

May 29, 2024

TO: Historical Memo

FM: Matt Macdonald

RE: Carnation Wastewater Treatment Plant  
April 2024 Process Summary

The Carnation Treatment Plant (CTP) continued to discharge to the Snoqualmie river outfall in April 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. Thus, during commissioning and until the bioassay is completed, the CTP must discharge to the Snoqualmie river outfall. The second phase of Bioassay sampling was performed on April 22 and April 23. Results of the validation are expected in May. 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 0.095-MGD. Influent flow averaged 0.101-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 9.3-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 8.1-mg/L, respectively. The max-weekly average effluent TN was 11.9-mg/L as N and the monthly average TN removal rate was 84%<sup>1</sup> in April. Effluent total phosphorus (P) averaged 5.1-mg/L for the month with a Total P removal of 32%. Effluent nutrient sampling in April 2024 was performed twice per week (Monday and Tuesday); influent nutrient sampling was performed once per week (Tuesday) except for April 23 when the sample contained a large fraction of recycled effluent (related to the bioassay testing performed that day).

Alkalinity was added to the secondary process to maintain the instantaneous effluent pH above pH 6.9. A total of approximately 467<sup>2</sup> gallons of Caustic Soda (25% NaOH solution) was added. Effluent alkalinity averaged 110-mg/L (with a range of 96-126 mg/L) as CaCO<sub>3</sub>; influent alkalinity was in the range of 240-268 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 9,300-mg/L with a range of 8,700-mg/L to 9,900-mg/L. An estimated 9100 dry lbs. of waste activated sludge were hauled to the South Plant for further treatment. Of the volume wasted, approximately 100% was from the memDense hydrocyclone.

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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

Four of the five membrane trains were available for service in April; train 4 remains out of service with a permeate pump and VFD issue. UV train 1 operated with both subsystems on from April 1 until April 25. It was taken offline because a programming issue was causing the train to shut down at night, resulting in excessive operator callouts. From April 25 until the end of the month train 2 (the old UV system) was operated.

On April 23 the effluent tower was batch disinfected with sodium hypochlorite, immediately after a no-dose UV bioassay test. Prior to the test, the level of the effluent tower was reduced, to facilitate batch disinfection. A total coliform sample from the tower before batch disinfection yielded <1.0 CFU/100mL. The effluent tower and UV system piping was then brought to 1 mg/L total chlorine residual for 30 minutes. A de-chlorinated sample taken after batch disinfection yielded no colony forming units. The tower was partially dechlorinated with a final total chlorine residual of 0.3 mg/L, prior to being filled again before discharging effluent to the Snoqualmie River outfall. The calculated maximum chlorine residual after the effluent tower was refilled was 0.05 mg/L. This conservative limit was reported as the chlorine residual for the day, though the true value would have been lower due to the effluent having no chlorine residual for the first half of the day.

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 18.2-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 16 maintenance cleans were performed in April.

Table 1: Membrane Maintenance Cleans Performed April 2024

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

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<sup>1</sup> Maintenance Clean

Table 2: Membrane Performance April 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	0.10	0.11	0.10		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	29,317	35,243	32,430		30,921
<i>AADF (Annual Average Flow) Design</i>	97,500	97,500	97,500	97,500	97,500
Maximum Daily for Month	64,051	93,782	61,165		56,415
<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	28	33	31		32
Peak Hour for Month	122	184	129		184
<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	8.6	7.8		8.1
<b>Trans-Membrane Pressure (PSI)<sup>6</sup></b>					
Average for Month	0.4	0.6	0.4		0.5
Maximum for Month	1.9	1.9	1.7		1.9
<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	16.4	16.4	16.4		16.4
<i>Design</i>	> 12	> 12	> 12	> 12	> 12
<b>Permeability at 20°C (GFD/PSI)<sup>8</sup></b>					
Average for Month	19.1	16.1	19.6		17.9
<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.