Memorandum

September 13, 2024

TO: Historical Memo

FROM: Carol Nelson, Process Analyst
Samayyah Williams, Process Engineer

SUBJECT: Brightwater Treatment Plant
August 2024 Operating Record

All discharge permit requirements were met in August at the Brightwater Treatment Plant (BWTP). All wastewater received Membrane Bioreactor (MBR) secondary treatment. Effluent BOD and TSS averaged <1.5-mg/L and <2.0-mg/L, respectively, and removals were both ≥ 99%. All fecal coliform results were less than 1-cfu/100-mL except for 2 days, Aug 16 and 17. Effluent pH was maintained between 7.0 and 7.6. Continuous dosing of 59% Magnesium Hydroxide [$Mg(OH)_2$] was required to ensure permit compliance for pH. Sodium Hydroxide [NaOH] was added on 8 days to ensure that the NaOH dosing pumps were available and for 3 days when the $Mg(OH)_2$ pumps were out of service to facilitate maintenance and construction activities.

Effluent flow to Puget Sound averaged 14.8-MGD. Reclaimed water distributed to customer sites averaged 0.4-MGD this month. Influent flow averaged 15.3-MGD. Approximately 0.1-MGD of treated effluent was used for treatment plant and Influent Pump Station (IPS) processes. RW drain water sent to South Plant via York Pump station totaled approximately 2.2-MG. The maximum effluent flow, 17.4-MGD, occurred on Aug.18, a day after the maximum daily rainfall. To reduce the solids loading to Brightwater, approximately of 36.4-MG of raw sewage was directed to West Point. The influent flow reduction helped maintain digester health while one digester remains out of service for maintenance. No bypass or overflows resulted from the redirected influent. No raw sewage was directed to South Plant this month due to a major maintenance project occurring there.

A total of 3.1-inches of rainfall was measured in August based on local rain gauges. The wettest periods occurred on Aug.17-18, (1.5-inches) and Aug 23-24 (1.3-inches). Precipitation recorded for SeaTac Airport was 1.7-inches of rain, above the normal rainfall of 1.0-inches. Local area air temperatures averaged 66.7 °F, which is 0.7 °F below normal.

All permit-required samples were collected and analyzed. Results for the influent BOD for Aug. 21 were rejected due to a laboratory error in the preparing the sample. No blending events occurred this month.

Influent Pumping: Influent was pumped using the small raw sewage pump sets (RSP) every day this month. Two pump sets were required for an average of 4 hour per day on five days. The IPS wet well was "pumped down" on 21 days in August to remove accumulated grease and rags. Maximum influent flow was restricted to 26-MGD this month to accommodate having one aeration basin (AB) out of service.

Primary Treatment: Three of five primary clarifiers (PC) were in service in June. PC-2, PC-3, and PC-4 were in service the entire month. Solids return flows were directed to PC-2. Regular cleaning of the primary effluent screens continued.

Secondary Treatment: Two aeration basins were in service this month. AB#2 remained out of service to facilitate contractor repair of items at the north end of the basin damaged in the August 2023 fire: wash-down

system, scum gates, upper walls, and underside of the deck. As part of the Brightwater Aeration Basin Optimization (BWABO) project, testing of some components of the classifying selector equipment continued this month. Operation of the selector will facilitate improved control of the solids retention time (SRT) and removal of foaming sludge as the secondary process moves towards a low DO and simultaneous nitrification/denitrification (SND) processes.

The new selector feed pumps, new wasting pumps, secondary scum gates, and selector scum gates were operated and tested this month. Surface wasting was accomplished using the selector feed pumps in "wasting mode" on Aug. 1. For the rest of the month, the classifying selector was in service and the new selector wasting pumps were used for surface wasting. Tuning of the control of the scum gates, selector feed pumps and selector scum gate continued this month. Filamentous growth was present but did not result in problems with wasting or maintaining flow through the basins. The monthly MLSS and SRT averaged 7511-mg/L and 15 days, respectively.

Aeration basins continued to operate in "zone-DO" control mode. Aeration air flow averaged 12,160-scfm total to all basins. The blow-off valve installed in May continued to work well in August. The improved blower control should improve denitrification once the process stabilizes. DO setpoints were not changed this month; lowering setpoints will be tried after the side stream selector operation is fully operational and foam is reduced.

Total Kjeldahl nitrogen (TKN) and total inorganic nitrogen (TIN) concentrations for June, July, and August are summarized below in Table 1. Full nitrification was achieved during most days this month, while denitrification was incomplete, in part because of higher sustained DO concentrations. Effluent nitrite/nitrate (NO_2+NO_3) and ammonia averaged 38.3-mg/L and 0.3-mg/L as N, respectively. Influent TKN and TIN in August were similar to July's, which is typical for dry weather conditions when the sewage is not diluted by infiltration. Total nitrogen removal improved, relative to July's. Total effluent TIN loading was higher than in July because of increased flows to the plant; less sewage was directed to West Point, rainfall increased, and there was a slight reduction in reclaimed water distribution.

Table 1. Influent and Effluent TKN and TIN concentrations and loading.

		Influent				Effluent				
	Days in Month	Influent TKN, mg/L	Influent TIN, mg/L	Influent Flow, (MGD)	Influent TKN, lbs per day	Effluent TKN, mg/L	Effluent TIN, mg/L	Effluent Flow, (MGD)	Effluent TIN, lbs per day	Total N Removal[1]
June	30	59.3	38.5	18.5	9,140	2.7	39.3	17.9	5,927	30.8%
July	31	64.8	41.6	13.3	7,213	2.1	42.6	12.6	4,454	31.4%
Aug	31	63.1	39.9	15.3	8,056	2.6	38.6	14.8	4,765	35.3%

[1] Total Nitrogen Removal (TN) is equal to [Influent TKN-(Effluent TKN + Effluent NO_2+NO_3)]/Influent TKN and assumes that the Influent NO_2+NO_3 is very low. TKN is Organic Nitrogen + Ammonia.

Alkalinity in the form of a 59% $Mg(OH)_2$ solution was added to the secondary process to ensure minimum effluent pH limits were met and to achieve complete nitrification. The 59% $Mg(OH)_2$ solution dose averaged approximately 1,865-gpd or 122-gallons/MG of influent. An additional 3,600 gallons of 25% NaOH was also used for alkalinity addition in August. 990 gallons of this addition occurred by gravity flow with the suction and discharge of the NaOH pumps left open and the dosing pumps off. Leaving the pumps valved in keeps them available to pump NaOH from the control room, in the event that the demand quickly increases due to low influent alkalinity, higher ammonia loading from the solids area, or low $Mg(OH)_2$ inventory. An additional 615 gallons of NaOH was used to facilitate taking the east RAS channel out of service on July 30 – Aug. 1 for contractor work on the classifying selector equipment. The remaining usage of NaOH facilitated maintenance on a control system power supply and the $Mg(OH)_2$ dosing pump and plumbing.

In August, all membrane fiber and most hardware for cassettes in Trains 4 and 6 were replaced by the membrane vendor. The decision to replace the membranes in these two trains was based on data from bubble tests and online turbidity meters which indicated that Trains 4 and 6 were the poorest performing trains. Membrane replacement is being performed over several years. Trains 3 and 5 were refurbished in 2023, Trains 4 & 6 in 2024; the remaining 4 trains will be refurbished by 2026. The new membrane modules have approximately 13% more capacity than the existing ones; as a result, Trains 3,4,5 and 6 now have 17.5 cassettes per train instead of 20, while maintaining the same capacity as before the replacement. This will facilitate increasing the train capacity in the future by adding membranes to fill the existing cassettes. While rebuilding the cassettes for Train 4, the coating on Train 4 was found to be defective. Because the loose coating poses a hazard to membranes, the refurbished cassettes are being stored, submerged in effluent, in a spare membrane train (Train 10). They will remain in this basin until the coating can be repaired in Train 4.

Membrane effluent turbidity averaged 0.02 - 0.05 NTU. Membrane Trains were in "relax" mode and LEAP "low" mode this month because filterability was very good. Approximately 3,460-gallons of 12.5% NaOCl were used for membrane maintenance cleans. An additional 400-gallons were used for flushing and cleaning Trains 4, 6, and 10 as part of the membrane replacement process.

Membrane capacity was above the range needed to process the average influent flow. Plans are in place to rebuild the effluent check valves for all trains in the coming year to prevent the effluent pumps from shutting down. Soluble COD (sCOD) in the mixed liquor averaged 28-mg/L; this parameter has been well correlated with permeability (lower sCOD is correlated with higher permeability). The maximum hourly flux during peak flow tests was between 13.0-gpd and 17.6-gpd per ft^2 of membrane surface.

Table 2 shows the weekly average trans-membrane pressure (TMP), membrane permeability, and SRT. Flow setpoints for the peak flow tests are increased or decreased depending on the TMP before backpulse and anticipated influent flow. The rated instantaneous peak hourly flow for one membrane train is 4,950-gpm. The peak flow setpoint was 4,700-gpm for all but 5 days of the month. On Aug. 8, the setpoint was inadvertently changed to 3500-gpm due to an interruption of the control system (when the new uninterruptable power supply (UPS) was brought online). The setpoint change was discovered on Aug. 13 and returned to 4700-gpm. Results from peak flow tests are used to calculate the capacity of the membrane trains. These results help staff anticipate the need for storage in the influent structure, diverting flow to other treatment plants, or chemically enhanced primary treatment. All peak flow tests were run with trains in backpulse mode.

Table 2. Trans-membrane pressure, membrane permeability, and SRT.

Parameter	Week ending 8/5	Week ending 8/12	Week ending 8/19	Week ending 8/26
TMP before backpulse, average psi[2]	-1.0	-0.9	-0.9	-0.8
TMP before backpulse, peak flow test, psi	-1.8	-1.4	-1.8	-1.8
Permeability temperature-corrected[1], gfd/psi	8.8	10.1	8.7	9.0
Flow target for peak flow test, gpm[3]	4700	3840	4700	4700
Flow hourly average during peak flow test, gpm	3830	3310	3840	3900
MBR Effluent temperature, degrees F	71.3	71.7	71.8	71.5
SRT, days	15	16	15	14
MLSS, mg/L	7865	7980	7835	7395
ML soluble COD, mg/L	30	30	29	28

1 Temperature-corrected Permeability based on Peak Flow Test.
2 TMPs during the moderate flow period of the day
3 Flow target is the instantaneous flow, the hourly flow takes into account time the train is not in production.

Disinfection: Approximately 7,205 gallons of 12.5% NaOCl was used in August for final effluent disinfection. The NaOCl effluent disinfection dose averaged 2.2-mg/L as Cl_2. The monthly average and maximum weekly effluent Cl_2 residual at the outfall (aka Point Wells) were both less than 0.03-mg/L; both met both the monthly and max-weekly permit limits. On Aug. 16 and 17, fecal coliform results were estimated as 190-cfu/100-mL and 9.1-cfu/100-mL, respectively. All other results were <1-cfu/100 mL. Possible causes for the unusually high results include contamination near the sample tap, low levels in the Membrane effluent box, and returning membrane train #6 to service after its membrane modules were replaced on Aug. 15. Low levels in the effluent box could cause material to slough off of the sides. When the Train 6 hardware was replaced, sludge could enter effluent piping downstream of the membranes. In the morning of Aug. 15, turbidity reached 0.25-NTU for less than 2 minutes. No turbidity spikes above 0.2-NTU were observed in the effluent box after Aug. 15. The grab sample area was cleaned thoroughly on Aug. 18. The dose setpoint was gradually increased from 1.7-mg/L to 3.0-mg/L between Aug. 13 and Aug. 20 to increase the chlorine residual concentration at the IPS sample point for fecal coliforms.

Odor Control: All odor control areas except for Secondary had the design-specified number of trains in service; four for Headworks and three for Solids. For Secondary, all four trains were in service starting May 31st to provide maintenance air and facilitate repair work in Aeration Basin 2. Two primary sump pumps and a metering pump were repaired this month. Calibration and repairs of ORP and pH probes are ongoing.

Thickening: All three gravity belt thickeners (GBTs) operated in August. The GBTs thickened approximately 11.5 MG of feed sludge from an average of 1.6% total solids (TS) to 6.4% TS, with an average solids capture of 91.9%. Sludge loading to the thickeners totaled 785 dry tons. The polymer dose for thickening averaged 4.8 pounds active polymer per dry tons solids processed. The thickening and swing polymer blending units operated normally during the month.

Anaerobic Digestion: The digestion process met time and temperature requirements for Class B biosolids for the month and operated with two active digesters. Digester 1 remained out of service in August; Mixer 1 flange was repaired on July 25th, and staff began draining the tank shortly thereafter. Inspection of the empty digester revealed a mechanical failure of one draft tube mixer and it was removed for repairs at the end of August. Additional preventive maintenance repairs and inspections were performed on Digester-1 during August. The plan for Digester-1 is to put it back into service in September.

The temperature and solids retention time (SRT) for the two digesters averaged 98°F and 27.2 days respectively. Volatile solids (VS) destruction averaged 57.9% for the month. Total solids (%TS) continued to remain elevated in Digester 2, resulting in an average TS in the two active digesters of 3.8% and a VS fraction of 74.0% VS/TS.

The average digester VS load for the two active digesters was 0.13 lbs-VS/cu-ft./d. Approximately 12.4 million ft^3 (MMCF) of digester gas was produced in August, using the gas flow meters to the flares and the boilers. Volatile acid (VA) concentrations in the two active digesters and the DSST remained below 100-mg/L (concentrations less than 500-mg/L are ideal); and digester gas was composed of approximately 59% methane and 41% carbon dioxide.

Dewatering/Biosolids: Dewatering operated 25 days in August, using both centrifuges. Centrifuge feed averaged 2.5% TS and 81.5% VS/TS for the month. Centrifuge biosolids product for Centrifuge 1 averaged 21.4% TS at 82.9% VS/TS and product for Centrifuge 3 averaged 20.4% TS at 83.2% VS/TS. A total of 286 dry tons of solids were processed (according to the feed flow meters and % solids) and 1,254 wet tons (260 dry tons at 20.8% TS) of biosolids cake were produced. A total of 1,130 wet tons (235 dry tons) of biosolids cake were hauled in August. Solids recovery in the dewatering process averaged 94.8%. Polymer dosage averaged 43.6 lbs-active per dry ton produced. The dewatering polymer unit operated normally during the month. Plans to replace all three skid units (thickening, dewatering, and the swing unit) are ongoing.