

Memorandum

June 21, 2024

TO: Historical Memo

FROM: Carol Nelson, Process Analyst
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SUBJECT: Brightwater Treatment Plant
May 2024 Operating Record

All discharge permit requirements were met in May at the Brightwater Treatment Plant (BWTP). All wastewater received Membrane Bioreactor (MBR) secondary treatment. Effluent BOD and TSS averaged <1.2-mg/L and <2.0-mg/L, respectively, and removals were both $\geq 99\%$. All fecal coliform results were less than 1-cfu/100-mL. Effluent pH was maintained between 7.0 and 7.6. Continuous dosing of 59% Magnesium Hydroxide $[\text{Mg}(\text{OH})_2]$ was required to ensure permit compliance for pH. An average flow of 56-gpd of Sodium Hydroxide $[\text{NaOH}]$ added alkalinity on thirteen days to ensure that the NaOH dosing pumps were available in the event of a low inventory of $\text{Mg}(\text{OH})_2$.

Effluent flow to Puget Sound averaged 18.0-MGD. Reclaimed water distributed to customer sites averaged 0.02-MGD this month. Influent flow averaged 18.4-MGD. Approximately 0.4-MGD of treated effluent was used for treatment plant processes and to make reclaimed water (RW) for flushing the RW distribution pipe. RW water sent to South Plant via York Pump station totaled approximately 5.8-MG. 0.1-MG raw sewage was directed to South Plant via the North Creek Pump Station on May 22 to facilitate pumping down the wet well at the Influent Pump Station (IPS). The maximum influent (20.5 MGD) and effluent flows (20.3 MGD) occurred on May 22 following a wet weather event on May 21-22. Membrane capacity ranged between 38-MGD and 48-MGD.

A total of 3.0-inches of rainfall was measured in May based on local rain gauges. The wettest period occurred on May 21-22 (1.4-inches). Precipitation recorded for SeaTac Airport was 1.5-inches of rain, below the normal rainfall of 1.9-inches. Local area air temperatures averaged 55.6°F, which is 1.9°F below normal.

All permit-required samples were collected and analyzed. Final Effluent BOD results for May 18 were rejected due to an error in the sample preparation for the BOD test. 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 6 hours per day. The IPS wet well was “pumped down” on 22 days in May to remove accumulated grease and rags. Influent flow was directed to South Plant via the Brightwater Diversion Structure and North Creek Pump Station (NCPS) on May 22 to facilitate the wet well pump down. Maximum Influent flows was restricted to 26-MGD after May 21 to facilitate taking one Aeration Basin out of service.

Primary Treatment: Three of five primary clarifiers (PC) were in service in May. 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: Three aeration basins (AB's) were in service this month until May 21. AB#2 was taken out of service on May 21 to facilitate repair of the wash-down system, scum gates and upper walls at the north end of the basin damaged in August 2023 fire. As part of the Brightwater Aeration Basin Optimization (BWABO) project, operation of some components of the classifying selector equipment began 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.

Operation of the first selector feed pump and automatic control of the secondary scum gates was enabled this month. The selector pump was tested “wasting mode” to move secondary sludge to the solids area for eight days. Automatic operation of the scum gates worked well to maintain surface wasting. An erroneous flow signal used to control the new selector pump resulted in excessive surface wasting from the basins; as a result, the MLSS and SRT dropped below the targets for spring operation during the last 10 days of the month. This error in the flowmeter signal was discovered later by observing the solids balance changes as well as by comparison with existing flowmeters. The monthly MLSS and SRT averaged 7,343-mg/L and 12 days, respectively. Filamentous growth increased this month. and could possibly be related to rapid decreases in SRT, operating with two of three basins, increased solids return flows, and changes in the surface wasting mode.

Aeration basins continued to operate in “zone-DO” control mode. Aeration air flow averaged 11,095-scfm total to all basins. To inhibit filamentous growth and improve nitrification, DO setpoints increased by 0.2-mg/L on May 29. The new blow-off valve was tested on May 29-30. Operation of the blow-off valve enables a lower minimum air flow to the basins and smoother transitions when the number of blowers decreases or increases as required by the DO control strategy. The improved blower control should improve denitrification once the process stabilizes.

Total Kjeldahl nitrogen (TKN) and TIN concentrations for March, April, and May are summarized below in Table 1. Full nitrification was achieved during the first 21 days this month and then declined after taking AB#2 out of service due to the lower SRT, aeration capacity, and ammonia in the solids return flows. Denitrification was incomplete. Effluent nitrite/nitrate (NO₂+NO₃) and ammonia averaged 35.9-mg/L and 0.9-mg/L as N, respectively. Influent TKN and TIN in May were higher than in April, which is typical for spring when rainfall and dilution of sewage decline. Total nitrogen removal was declined slightly, as compared to April, in part because of incomplete nitrification after May 22.

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

	Days in Month	Influent				Effluent				Total N Removal ¹
		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	
Mar	31	52.7	34.0	20.7	9,099	1.2	34.2	20.5	5,858	33%
Apr	30	55.4	37.0	18.9	8,713	1.2	35.2	18.7	5,510	34.5%
May	31	57.1	38.6	18.4	8,754	2.1	36.9	18.0	5,610	33.4%

¹ Total Nitrogen Removal (TN) is equal to [Influent TKN-(Effluent TKN + Effluent NO₂+NO₃)]/Influent TKN and assumes that the Influent NO₂+NO₃ 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 2,300-gpd or 126-gallons/MG of influent. An additional 731 gallons of 25% NaOH was also used for alkalinity addition in May. The NaOH 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 facilitated availability of the NaOH pumping 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.

Membrane effluent turbidity averaged 0.02 - 0.04 NTU. Membrane Trains were in “relax” mode and LEAP “low” mode this month because filterability was very good. Approximately 2,880-gallons of 12.5% sodium hypochlorite [NaOCl] were used for membrane maintenance cleans. No recovery cleans were done in May.

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 29-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 16.7-gpd and 17.4-gpd per ft² 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 throughout this month. Results from peak flow tests are used to calculate the capacity of the membrane trains. These results help staff anticipate when the need for storage in the influent structure, diverting flow to other treatment plants, or chemically enhanced primary treatment would occur. All peak flow tests were run with trains in backpulse mode.

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

Parameter	Week ending 5/6	Week ending 5/13	Week ending 5/20	Week ending 5/27
TMP before backpulse, average psi ²	-0.9	-0.9	-1.0	-1.0
TMP before backpulse, peak flow test, psi	-1.9	-2.0	-2.0	-2.1
Permeability temperature-corrected ¹ , gfd/psi	9.5	9.1	9.0	8.7
Flow target for peak flow test, gpm ³	4700	4700	4700	4700
Flow hourly average during peak flow test, gpm	3865	3890	3845	3850
MBR Effluent temperature, degrees F	63.1	63.9	64.8	64.5
SRT, days	17	14	15	8
MLSS, mg/L	8521	7984	7320	8092
ML soluble COD, mg/L	28	28	28	33

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 8,420 gallons of 12.5% NaOCl was used in May for final effluent disinfection. The NaOCl effluent disinfection dose averaged 2.1-mg/L as Cl₂. The monthly average and maximum weekly effluent Cl₂ residual at the outfall (aka Point Wells) were 0.05-mg/L and 0.06-mg/L respectively; both met both the monthly and max-weekly permit limits.

Odor Control: All odor control areas had the design-specified number of trains in service; four for Headworks, and three each for Secondary and Solids except when carbon was added to carbon scrubbers. During the first quarter this year, carbon levels in the scrubbers were measured and found to be low in four trains for Headworks and three trains for Solids. On May 15, these carbon scrubbers were topped off with new carbon to ensure no airflow was left untreated. While the carbon was being added, the Headworks and Solids area operated with less than the required number of trains for three to four hours. For Secondary, all four trains were in service starting May 31st to conduct work in Aeration Basin 2 that was taken out of service. Plans to inspect and clean the main odor control ductwork for Headworks and Solids are ongoing.

Thickening: All three of the gravity belt thickeners (GBTs) operated in May. The GBTs thickened approximately 16.4 MG of feed sludge from an average of 1.4% total solids (TS) to 6.0% TS, with an average solids capture of 93.4%. Sludge loading to the thickeners totaled 938 dry tons. The polymer dose for thickening averaged 4.4 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. The temperature in the active digesters averaged 99.0°F and the solids retention time (SRT) averaged 30.2 days, and volatile solids (VS) destruction averaged 58.4%. The total solids concentration in the active digesters averaged 3.0% with a VS fraction of 79.4% VS/TS. Digester 1-Mixer 1 remains out of service following the discovery of a hairline crack on the mixer flange early November 2023. The mixer will remain in place and out of service to reduce potential vibrations that would place additional stress on the crack. Plans to take the digester out of service to repair the crack are scheduled for July 2024. %TS has gradually increased in all three digesters during the later half of the month, likely caused by additional grit and screenings material entering the primary clarifiers and ultimately to the digesters via primary sludge. Monthly average %TS values for Dig-2 (3.16%) were relatively higher compared to Dig-1 (2.91%) and Dig-3 (2.89%).

The average digester VS load was 0.12 lbs-VS/cu-ft./d. Approximately 15.6 million ft³ (MMCF) of digester gas was produced in May, using the gas flow meters to the flares and the boilers. Volatile acid (VA) concentrations in the active digesters and the DSST ranged between 45 to 67 mg/L (concentrations less than 500 mg/L are ideal); and digester gas composition of approximately 59% methane.

Dewatering/Biosolids: Time and temperature requirements for Class B biosolids were met via anaerobic digestion. Dewatering operated 28 days in May, using both centrifuges. Centrifuge feed averaged 2.3% TS and 82.2% VS/TS for the month. Centrifuge biosolids product for Centrifuge 1 averaged 20.3% TS at 84.5% VS/TS and product for Centrifuge 3 averaged 19.8% TS at 84.5% VS/TS. A total of 344 dry tons of solids were processed (according to the feed flow meters and % solids) and 1,647 wet tons (331 dry tons at 20.1% TS) of biosolids cake were produced. A total of 1,664 wet tons (334 dry tons) of biosolids cake were hauled in May. Solids recovery in the dewatering process averaged 95.5%. Polymer dosage averaged 48.9 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.