Memorandum

April 12, 2024

TO: Historical Memo

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

All discharge permit requirements were met in March 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 ≥ 99%. All fecal coliform results were less than 1-cfu/100-mL. Effluent pH was maintained between 7.0 and 7.5. Continuous dosing of 59% Magnesium Hydroxide [$Mg(OH)_2$] was required to ensure permit compliance for pH. An average flow of 150gpd of Sodium Hydroxide [NaOH] added alkalinity on 22 days to insure that the NaOH dosing pumps were available in the event of a low inventory of $Mg(OH)_2$.

Effluent flow to Puget Sound averaged 20.5-MGD. No reclaimed water was distributed offsite this month. Influent flow averaged 20.7-MGD. Approximately 0.2-MGD of effluent was used for flushing and filling the reclaimed water line to the Influent Pump Station (IPS) and other plant processes. The maximum influent and effluent flows, which were both 24.0-MGD, occurred after a wet weather event on Feb.28 – Mar.1. Influent flows were directed to South Plant via the York Diversion Gate at Hollywood Pump Station on two days in March; the York diversion gate at Hollywood Pump Station was opened for several hours on both Mar. 19 & 20 by Offsite Operations. The monthly total influent sewage directed to South Plant was approximately 0.4-MG. Membrane capacity ranged between 43-MGD and 46-MGD.

March rainfall totaled 3.4-inches based on local rain gauges. The wettest period occurred on Mar. 27-28 (0.9-inches). Precipitation recorded for SeaTac Airport was 2.4-inches of rain, which is 1.8-inches below normal. Local area air temperatures averaged 47.1°F, which is the same as normal. Membrane effluent temperatures increased from 58.8°F to 60.9°F.

All permit-required samples were collected and analyzed. Membrane effluent TSS values were substituted for Final Effluent (FE) TSS values for Mar. 31 due to problems with the lab results for FE. No blending events occurred this month.

Influent Pumping: Influent flow was pumped using the small raw sewage pump sets (RSP) every day this month. Two pump sets were required for an average of 11 hours per day. The IPS wet well was "pumped down" on 20 days in March to remove accumulated grease and rags. Influent flow was not directed to South Plant via the Brightwater Diversion Structure and North Creek Pump Station (NCPS) during pump downs this month. As mentioned above, influent flow was directed to South Plant via the Hollywood Pump station on Mar. 19 and Mar. 20.

Primary Treatment: Three of five primary clarifiers (PC), PC-1, PC-2, and PC-3, were in service in March. Repair of the leaking concrete joint of PC-5 was completed in March and the tank will be refilled and

checked for leaks next month. Solids return flows were directed to PC-1. Regular cleaning of the primary effluent screens continued.

Secondary Treatment: Three aeration basins (AB's) were in service this month. Aeration basins continued to operate in the "zone-DO" control mode this month. Aeration air flow for the month averaged 10,280-scfm total to the three basins. Filamentous growth was present this month but was not abundant. The MLSS and SRT averaged 8,608-mg/L and 21 days, respectively. Secondary foam was present and did not cause any operational problems. The MLSS was maintained primarily by surface wasting.

Full nitrification was achieved most of this month and denitrification was incomplete. Effluent nitrite/nitrate (NO_2+NO_3) and ammonia averaged 34.1-mg/L and 0.1-mg/L as N, respectively. Influent concentrations for total Kjeldahl nitrogen (TKN) and TIN in March were higher than in February, which is typical for the early spring when rainfall and dilution of sewage decline. Results for January, February and March are summarized in Table 1. March's total nitrogen removal was slightly higher than February and January's. This was not unexpected as total nitrogen removal typically increases as flows decrease.

Denitrification was limited by the inability to maintain lower DO concentrations with the current aeration system. In contrast with the afternoon and evening hours, during the morning hours, the air demand was lower than the minimum air flow for the current blower configuration. Plans for tuning the system include installation of a blow-off valve, which will improve DO control by allowing a lower minimum air flow to the basins. No DO setpoint changes were made this month due to the current limitations in maintaining low DO throughout the day. Any changes to DO setpoints are done slowly to support process stability.

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]
Jan	31	41.8	30.4	23.9	8,343	1.6	30.7	23.9	6,104	23%
Feb	29	47.4	31.7	21.5	8,491	1.8	32.7	21.4	5,950	27%
Mar	31	52.7	34.0	20.7	9,099	1.2	34.2	20.5	5,858	33%

[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 2,465-gpd or 119-gallons/MG of influent. An additional 3,243 gallons of 25% NaOH was also used for alkalinity addition in March. 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 - 0.03 NTU. Membrane Trains were in "relax" mode and LEAP "low" mode this month because filterability was very good. Approximately 3,900-gallons of 12.5% sodium hypochlorite [NaOCl] were used for membrane maintenance cleans. An additional 742 gallons of NaOCl were used for recovery clean on Train 8.

Membrane capacity ranged between 43-MGD and 46-MGD this month. This range 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 35-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 16.8-gpd and 17.3-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 normally adjusted up/down 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 facilitate discerning when a blending event could occur (requiring 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 3/4	Week ending 3/11	Week ending 3/18	Week ending 3/25
TMP before backpulse, average psi[2]	-1.3	-1.2	-1.2	-1.1
TMP before backpulse, peak flow test, psi	-2.1	-2.0	-2.1	-2.1
Permeability temperature-corrected[1], gfd/psi	9.3	9.5	9.1	9.0
Flow target for peak flow test, gpm[3]	4700	4700	4700	4700
Flow hourly average during peak flow test, gpm	3890	3845	3840	3860
MBR Effluent temperature, degrees F	59.2	59.5	60.3	61.1
SRT, days	18	18	28	23
MLSS, mg/L	8655	8355	8475	9175
ML soluble COD, mg/L	32	33	41	29

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 6,875 gallons of 12.5% NaOCl was used in March for final effluent disinfection. The NaOCl effluent disinfection dose averaged 1.5-mg/L as Cl_2. The monthly average and maximum weekly effluent Cl_2 residual at the outfall (aka Point Wells) were 0.04-mg/L and 0.05-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 for roughly 5 hours on Mar. 24 and 10 hours on Mar. 26 when pressure sensor alarms caused the Headworks area OC fan 4 to trip offline. Air balancing work continued this month on Mar. 1, Mar. 8, Mar.12, and Mar.18. Pressure setpoints for the fans at Headworks and Solids were increased to 3.2" and 2.7", respectively. A work plan to inspect and clean the main odor control ductwork is being developed.

Thickening: Two of the three gravity belt thickeners (GBTs) operated in March. GBT 1 was taken out of service in February due to a leak found on the feed piping. The GBTs thickened approximately 14.0 MG of feed sludge from an average of 1.4% total solids (TS) to 5.4% TS, with an average solids capture of 93.7%. Sludge loading to the thickeners totaled 824 dry tons. The polymer dose for thickening averaged 4.3 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 33.6 days, and volatile solids (VS) destruction averaged 59.8%. The total solids concentration in the active digesters averaged 2.8% with a VS fraction of 79.2% VS/TS.

Draft tube mixers in Digester 2 (mixer 2) and Digester 3 (mixer 2) were removed in September for repair. A hairline crack was discovered on the Digester 1 Mixer 1 flange, where it was previously welded in 2018. The mixer will remain in place and out of service to reduce potential vibrations that would place additional stress on the crack. Safety staff have determined the likelihood of crack propagation is minimal and that the hazardous emissions emanating from the fissure are minimal. The area has been roped off to limit traffic and staff are periodically checking the crack for expansion. Plans to take the digester out of service to repair the crack are scheduled for April 2024.

The average digester VS load was 0.09 lbs-VS/cu-ft./d. Approximately 14.9 million ft^3 (MMCF) of digester gas was produced in March, using the gas flow meters to the flares and the boilers. Volatile acid (VA) concentrations in the active digesters and the DSST ranged between 47 to 57 mg/L (concentrations less than 500 mg/L are ideal); and digester gas composition of approximately 59% methane.

Dewatering/Biosolids: All biosolids met the requirements for Class B. Dewatering operated 29 days in March, using both centrifuges. Centrifuge feed averaged 2.3% TS and 81.6% VS/TS for the month. Centrifuge biosolids product for Centrifuge 1 averaged 21.3% TS at 84.1% VS/TS and product for Centrifuge 3 averaged 20.8% TS at 84.0% VS/TS. A total of 326 dry tons of solids were processed (according to the feed flow meters and % solids) and 1,484 wet tons (312.2 dry tons at 21.0% TS) of biosolids cake were produced. A total of 1,534 wet tons (322 dry tons) of biosolids cake were hauled in March. Solids recovery in the dewatering process averaged 95.3%. Polymer dosage averaged 52.6 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.