NPDES Compliance Summary Report, Fiscal Year 2023 Clinton Wastewater Treatment Plant

Massachusetts Water Resources Authority
Environmental Quality, Water & Wastewater
Report 2023-10

Citation:
Winkler D. 2023. NPDES compliance summary report, fiscal year 2023, Clinton Wastewater Treatment Plant. Massachusetts Water Resources Authority. Report 2023-10. 23 pp.

NPDES COMPLIANCE SUMMARY REPORT
Fiscal Year 2023
Clinton Wastewater Treatment Plant

Prepared by

Devon Winkler

Environmental Quality, Operations Division
Massachusetts Water Resources Authority
Deer Island Treatment Plant
33 Tafts Avenue
Boston, MA 02128
(617) 242-6000

Table of Contents

Figures

Tables

Executive Summary

The Massachusetts Water Resources Authority (MWRA) assumed formal operational responsibility of the Clinton Wastewater Treatment Plant in 1987 (Acts of 1987, Chapter 307). Major facility upgrades of primary, secondary, and advanced treatment facilities were completed in 1992. The plant provides treatment of wastewater from the town of Clinton and the Lancaster Sewer District using an activated sludge process in combination with advanced nutrient removal. In 2017, MWRA added a Phosphorus Reduction Facility to provide advanced tertiary treatment and reduce phosphorus concentrations. Effluent is chlorinated and dechlorinated before being discharged to the South Branch of the Nashua River, a Class B warm water fishery as defined by Massachusetts Surface Water Quality Standards (314 CMR 4.00).

MWRA had been operating the Clinton Wastewater Treatment Plant (Clinton Plant) under an individual NPDES permit that became effective on March 1, 2017, and was administratively continued since it expired on February 28, 2022. Effective April 1, 2023, the individual permit was replaced with the Medium Wastewater Treatment Facility general permit. The NPDES permit requires MWRA to monitor the Clinton Plant effluent wastewater for specific parameters. These limits are derived from federal regulations, state water quality standards, available dilution in the Nashua River, and watershed-specific concerns.

This report summarizes monitoring and compliance data from July 1, 2022 to June 30, 2023 (fiscal year 23). We examine wastewater influent and effluent quality trends against the limits of MWRA's NPDES permit limits over each fiscal year (FY) and longer historical records. This report also highlights additional NPDES reporting including industrial wastewater, operations and maintenance, and sludge processing.

Permit Compliance

All violations are summarized in Table 1, with further detail for each parameter provided in the following sections. Table 2 lists the limit for each parameter with FY23 monitoring results.

Table 1. Summary of NPDES Permit Violations, FY23

Effluent Characteristics		FY23 Violations
Flow	12-month Rolling Average:	1
Biochemical Oxygen Demand (BOD)	Monthly Average:	0
	Weekly Average:	0
Total Suspended Solids (TSS)	Monthly Average:	0
	Weekly Average:	0
pH		0
Dissolved Oxygen (DO)	Daily Average Minimum:	0
E. coli	Monthly Geometric Mean:	0
	Daily Geometric Mean:	0
Total Chlorine Residual (TCR)	Monthly Average:	0
	Daily Maximum:	0
Copper	Monthly Average:	2
	Daily Maximum:	0
Total Ammonia Nitrogen: June 1st - October 31st	Monthly Average:	0
	Daily Maximum:	0
Total Phosphorus: April 1st - October 31st	Monthly Average:	0
	Daily Maximum:	0
Acute Toxicity[1]	Daily Minimum:	0
Chronic Toxicity[1]	Daily Minimum:	1

[1] Toxicity testing is conducted on a quarterly basis.

Table 2. NPDES Permit Compliance Results, FY23

Parameter	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Flow (MGD, million gallons per day)												
Limit	*3.01*	*3.01*	*3.01*	*3.01*	*3.01*	*3.01*	*3.01*	*3.01*	*3.01*	*3.01*	*3.01*	*3.01*
Monthly Average	1.68	1.54	1.83	1.92	2.01	2.85	3.53	2.72	3.36	2.71	3.10	2.57
12-Month Rolling Average	**3.02**	2.90	2.69	2.51	2.36	2.38	2.46	2.38	2.38	2.35	2.43	2.49
Biochemical Oxygen Demand (BOD)												
Limit (mg/L)	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*
Monthly Average	1.5	1.4	1.3	1.4	1.8	2.0	1.3	2.3	1.3	0.4	1.5	1.3
Weekly Average	1.9	1.6	1.6	1.5	2.8	2.8	1.9	2.3	3.5	1.8	2.3	2.3
Limit (lbs/day)	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*
Monthly Average	20	18	20	23	30	43	35	51	34	12	42	27
Weekly Average	28	21	22	24	46	55	49	50	70	48	63	47
Limit	*85%*	*85%*	*85%*	*85%*	*85%*	*85%*	*85%*	*85%*	*85%*	*85%*	*85%*	*85%*
Percent Removal	99.3	99.3	99.3	99.3	99.1	98.8	99.1	98.6	98.9	99.7	99.1	99.4
Total Suspended Solids (TSS)												
Limit (mg/L)	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*
Monthly Average	1.2	1.5	1.5	1.3	2.2	3.8	2.4	2.6	2.5	1.2	2.5	1.7
Weekly Average	1.8	2.4	1.7	1.5	3.0	5.1	3.1	2.8	3.4	1.8	1.6	6.8
Limit (lbs/day)	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*
Monthly Average	17	20	22	21	37	88	70	57	68	24	62	36
Weekly Average	25	31	28	23	51	132	83	69	110	43	53	159
Limit	*85%*	*85%*	*85%*	*85%*	*85%*	*85%*	*85%*	*85%*	*85%*	*85%*	*85%*	*85%*
Percent Removal	99.6	99.6	99.5	99.6	99.1	98.1	98.7	98.8	98.2	99.2	99.3	99.6
pH (SU)												
Limit	*6.5 -8.3*	*6.5 -8.3*	*6.5 -8.3*	*6.5 -8.3*	*6.5 -8.3*	*6.5 -8.3*	*6.5 -8.3*	*6.5 -8.3*	*6.5 -8.3*	*6.5 -8.3*	*6.5 -8.3*	*6.5 -8.3*
Range	7.3-7.8	7.2-7.8	7.3-7.8	7.3-7.7	7.3-7.8	7.1-7.7	7.0-7.7	7.4-7.7	7.3-7.8	7.4-7.8	6.5-7.6	7.3-7.7
Dissolved Oxygen (mg/L)												
Limit	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*
Minimum Conc.	8.1	8.1	8.3	8.6	8.7	9.7	10.7	10.6	10.6	9.5	9.3	7.8
***E. coli* Bacteria (cfu/100mL)**												
Limit	*126*	*126*	*126*	*126*	*126*	*126*	*126*	*126*	*126*	*126*	*126*	*126*
Monthly Geometric Mean	5	5	5	5	5	5	5	5	5	5	5	6
Limit	*409*	*409*	*409*	*409*	*409*	*409*	*409*	*409*	*409*	*409*	*409*	*409*
Maximum Daily	5	7	23	7	19	17	5	9	11	7	5	11

Parameter	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Total Chlorine Residual (µg/L)												
Limit	*17.6*	*17.6*	*17.6*	*17.6*	*17.6*	*17.6*	*17.6*	*17.6*	*17.6*	*20.0*	*20.0*	*20.0*
Monthly Average	0.13	0.11	0	0.13	0	0	0	0.29	0	<20	0.13	<20
Limit	*30.4*	*30.4*	*30.4*	*30.4*	*30.4*	*30.4*	*30.4*	*30.4*	*30.4*	*30.4*	*30.4*	*30.4*
Maximum Daily	4	3.33	0	4	0	0	0	4	0	<20	4	<20
Total Recoverable Copper (µg/L)												
Limit	*11.6*	*11.6*	*11.6*	*11.6*	*11.6*	*11.6*	*11.6*	*11.6*	*11.6*	*11.6*	*11.6*	*11.6*
Monthly Average	**12.45**	**12.25**	9.82	10.51	7.79	9.27	8.00	6.17	7.32	7.77	6.91	8.70
Limit	*14.0*	*14.0*	*14.0*	*14.0*	*14.0*	*14.0*	*14.0*	*14.0*	*14.0*	*14.0*	*14.0*	*14.0*
Maximum Daily	12.7	12.3	10.7	11.1	7.79	10.0	8.00	6.17	7.94	8.36	6.91	8.70
Total Ammonia, as N (mg/L)												
Limit	*2*	*2*	*2*	*2*	*10*	*10*	*10*	*10*	*10*	*3.9*	*2.1*	*2*
Monthly Average	0	0	0.01	0.01	0	0.02	0	0	0.08	0.02	<0.1	<0.1
Limit	*3*	*3*	*3*	*3*	*35.2*	*35.2*	*35.2*	*35.2*	*35.2*	-	-	*3*
Maximum Daily	0	0	0.07	0.05	0	0.03	0	0	0.15	0.07	<0.1	<0.1
Total Phosphorus												
Limit	*0.15*	*0.15*	*0.15*	*0.15*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*0.15*	*0.15*	*0.15*
Monthly Average Conc. (mg/L)	0.10	0.07	0.05	0.06	0.16	0.20	0.10	0.20	0.13	0.04	0.04	0.08
Limit	*3.8*	*3.8*	*3.8*	*3.8*	*25.1*	*25.1*	*25.1*	*25.1*	*25.1*	*3.8*	*3.8*	*3.8*
Monthly Average Loading (lbs/day)	1.4	0.9	0.7	0.9	2.5	4.2	2.7	4.2	3.4	0.8	1.1	1.7
Whole Effluent Toxicity (%)												
Limit			*>100*			*>100*			*>100*	*>100*		
Acute Toxicity (LC50)			>100			>100			>100	>100		
Limit			*62.5*			*62.5*			*62.5*	*62.5*		
Chronic Toxicity (NOEC)			**12.5**			100			100	100		

Values that are bold and underlined are permit limit violations.

Reporting requirements for both chlorine residual and total ammonia have changed under the April 2023 permit. When either is not detected in the effluent, chlorine residual will be reported as "<20 ug/L" and total ammonia as "<0.1 mg/L".

Flow

The Clinton Plant receives flow from the town of Clinton and the Lancaster Sewer District. Figure 1 shows the average daily flow by month for both communities in FY23. Lancaster flow was 11% of the total flow to the plant on average during the fiscal year.

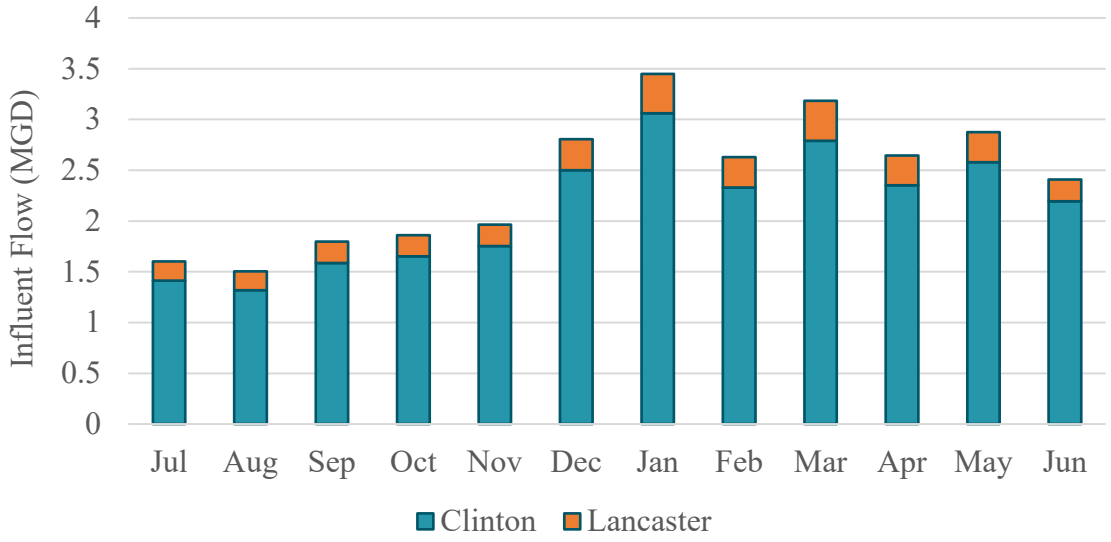


Figure 1. Monthly Average Influent Flow by Town, FY23

Influent flow can be influenced by rainfall, an indirect measure of infiltration and inflow potential to the Clinton and Lancaster collection systems. Figure 2 shows the FY23 monthly influent flow range against monthly rainfall. Average and maximum plant flows were highest in January 2023.

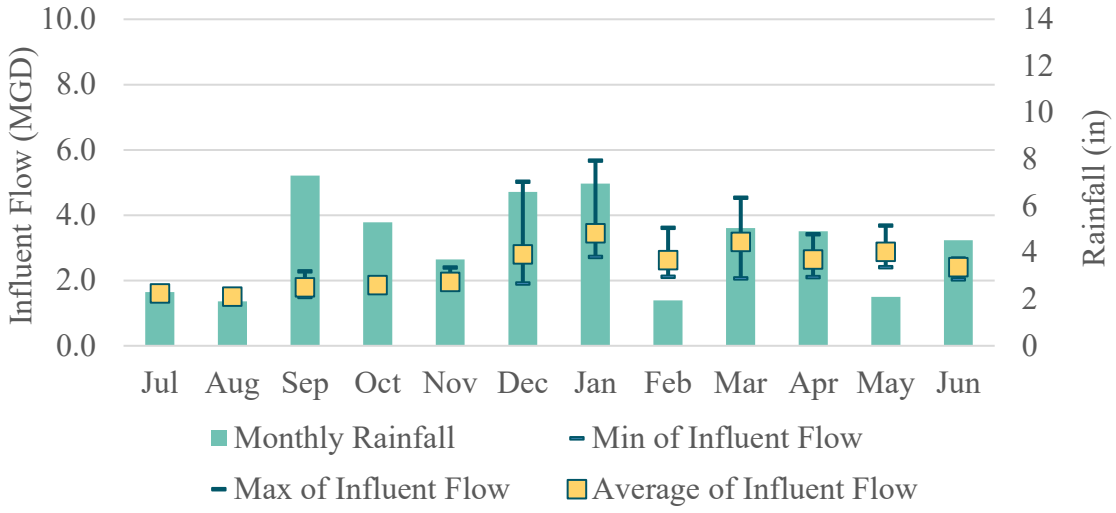


Figure 2. Influent Flow Compared to Precipitation, FY23

Figures 3 and 4 below detail 5-year and 15-year historical plant flows respectively. Figure 3 compares the 12-month rolling average effluent flow against the permit limit of 3.01 million gallons per day (MGD). The daily flow in green shows the variability in plant flow due to rainfall, snowmelt and other factors. As a result of prolonged periods of high flow in FY19 and FY22, the rolling average flow exceeded the permit limit for months at a time. Figure 4 compares annual average flows with annual rainfall. The permit limit was only exceeded in the first month (July) of FY23, a residual effect of the high flows in FY22.

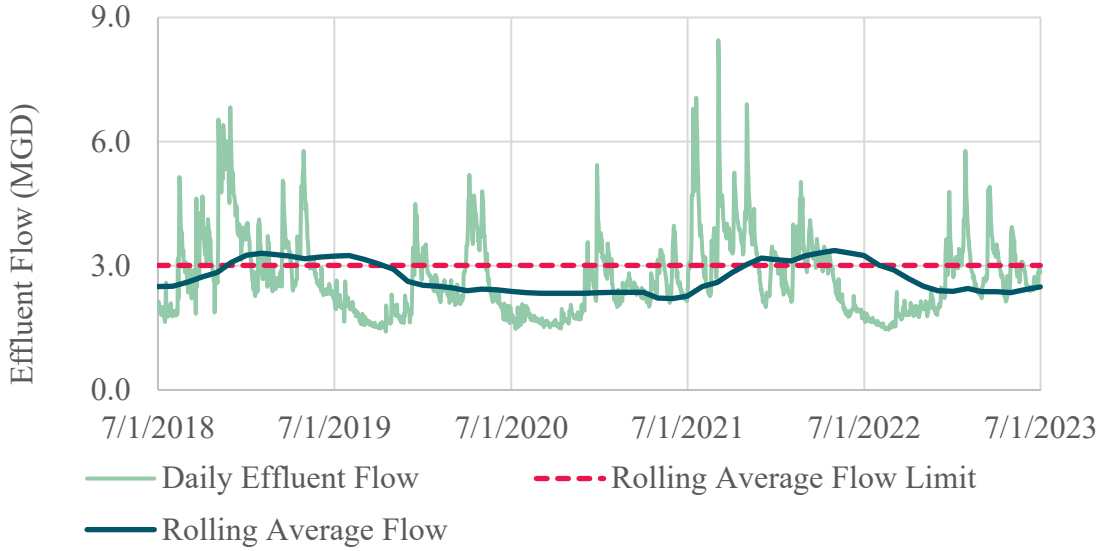


Figure 3. Daily Effluent Flow and 12-month Rolling Average Flow, FY19-FY23

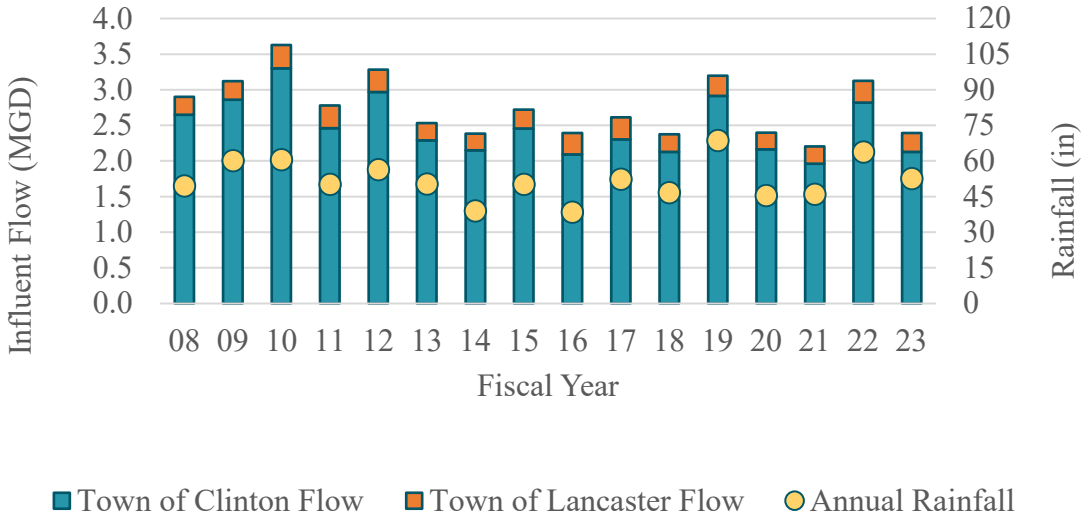


Figure 4. Historical Influent Flow Compared to Precipitation, FY08-FY23

Biochemical Oxygen Demand

Wastewater treatment plants measure Biochemical Oxygen Demand (BOD) as an index for the amount of organic material being discharged to the environment. It is measured as the 5-day oxygen consumption by organisms decomposing organic matter. The Clinton Plant, like other wastewater treatment plants, has a limit of not less than 85% BOD removal and monthly and weekly average concentration limit of 20 mg/L in the effluent.

Figure 5 below is a plot of the influent BOD concentration and loading in FY23. Concentrations were highest in October 2022, while loadings were highest in June 2023.

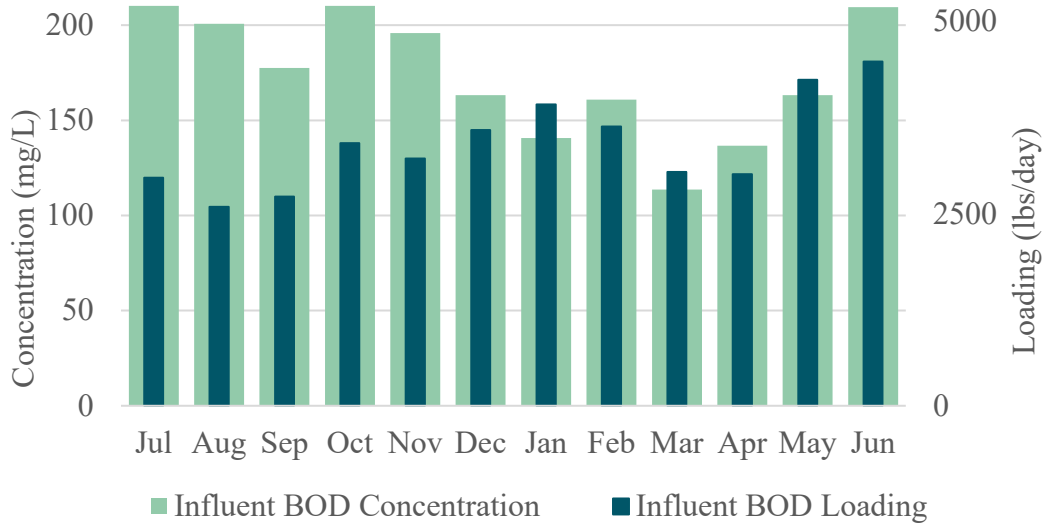


Figure 5. Influent BOD Concentrations and Loadings, FY23

Figure 6 compares BOD monthly average concentration and loading against the permit limits of 20 mg/L and 500 lbs/day respectively. The Clinton Plant effluent was well below permit limits throughout FY23. Figure 7 shows the plant's effectiveness at removing BOD from the influent, with monthly percent removal well above the 85% minimum with an average removal of 99.2%.

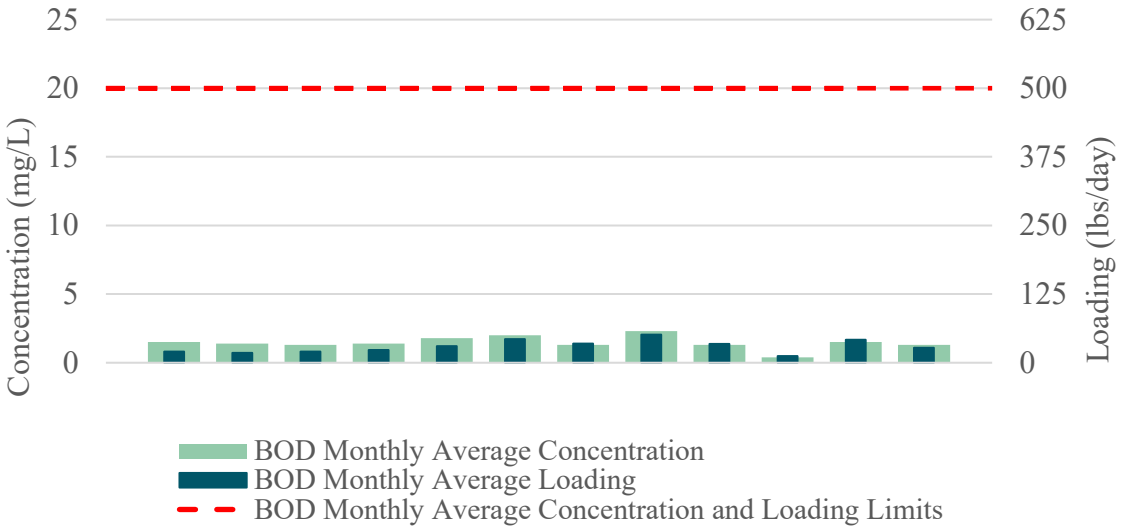


Figure 6. Effluent BOD Concentrations and Loadings, FY23

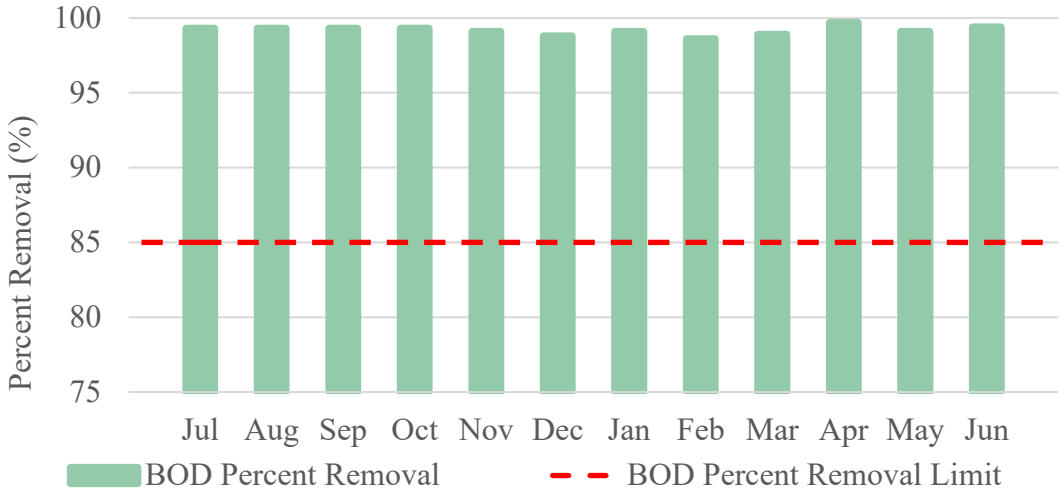


Figure 7. BOD Percent Removal, FY23

Figure 8 below contains individual influent and effluent BOD test results for the last five fiscal years. Effluent BOD concentrations are consistently well below the permit limit despite variable influent concentrations. An exceedance of the weekly average limit in June 2019 was the result of a high-BOD slug of industrial wastewater. This event was isolated to June 11th and caused no additional impacts to plant operations. MWRA's Toxic Reduction and Control Department investigated, found the likely source, and confirmed the event to be exceptional and not expected to occur in the future.

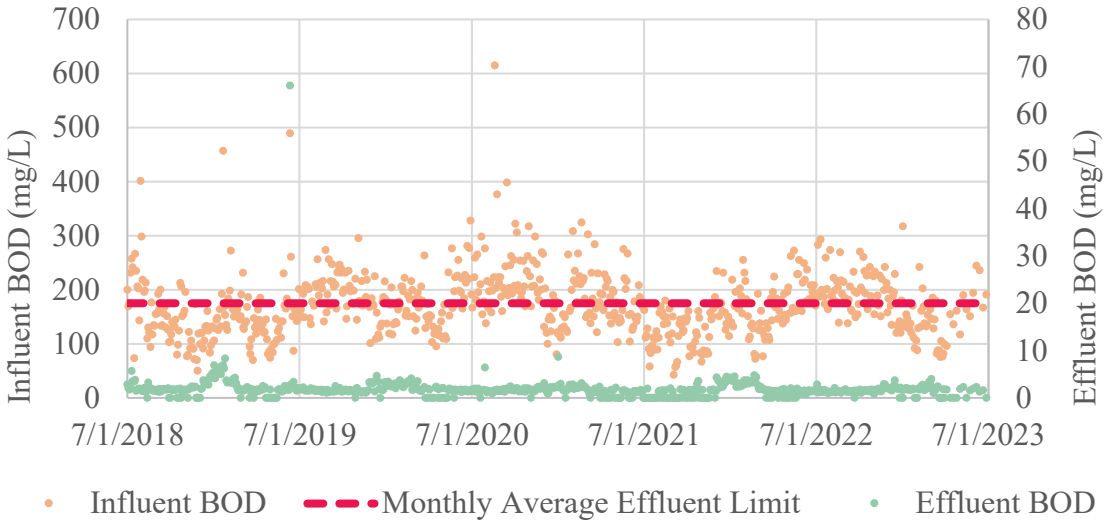


Figure 8. Influent and Effluent BOD Concentration Trends, FY19-FY23

Total Suspended Solids

Total suspended solids (TSS) is another conventional wastewater parameter included in NPDES permits. TSS is measured as the amount of solids that are trapped on a filter. As with BOD, the Clinton Plant has a benchmark of 85% TSS removal and limit of 20 mg/L in the effluent.

Figure 9 below is a plot of the influent TSS concentration and loading in FY23. Concentrations were highest in June 2023, while loadings were highest in May 2023.

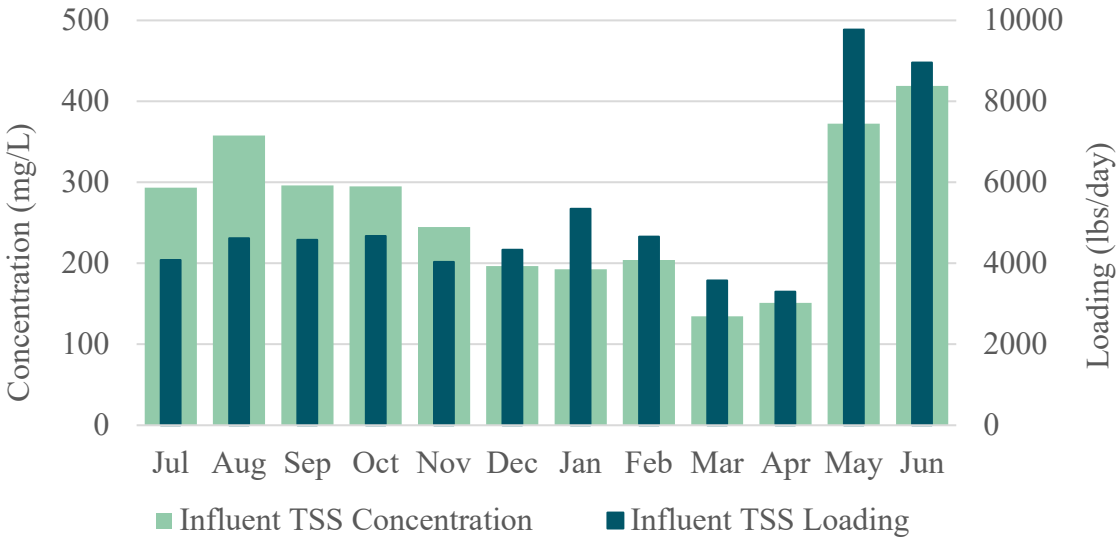


Figure 9. Influent TSS Concentrations and Loadings, FY23

Figure 10 compares TSS monthly average effluent concentration and loading against the permit limits of 20 mg/L and 500 lbs/day, respectively. The Clinton Plant effluent was well below permit limits throughout FY23. Figure 11 shows the plant's effectiveness at removing TSS from the influent, with monthly percent removal well above 85% and an average removal of 99.1%.

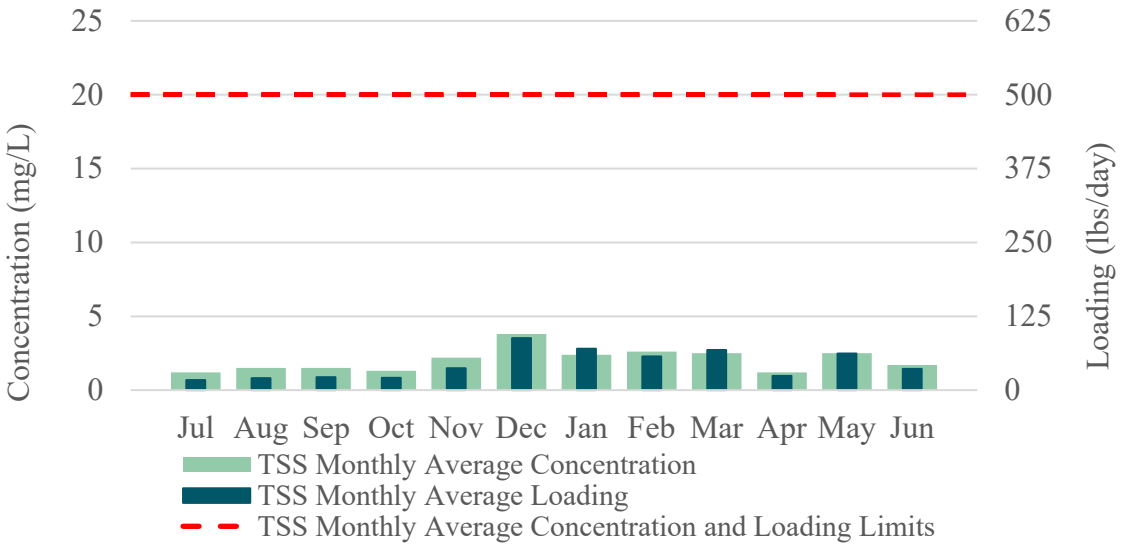


Figure 10. Effluent TSS Concentrations and Loadings, FY23

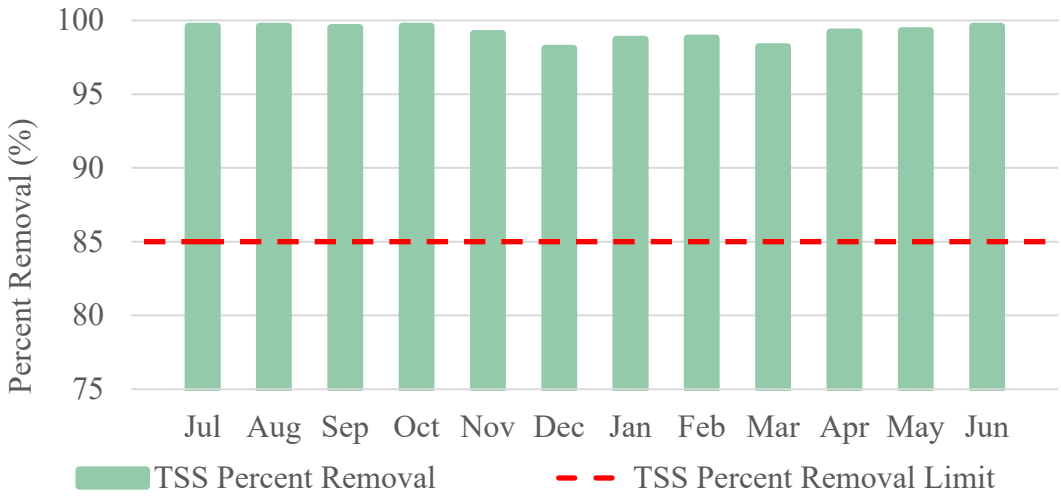


Figure 11. TSS Percent Removal, FY23

Figure 12 contains individual influent and effluent TSS test results for the previous five fiscal years. Effluent TSS concentrations are consistently well below the permit limit despite variable influent concentrations.

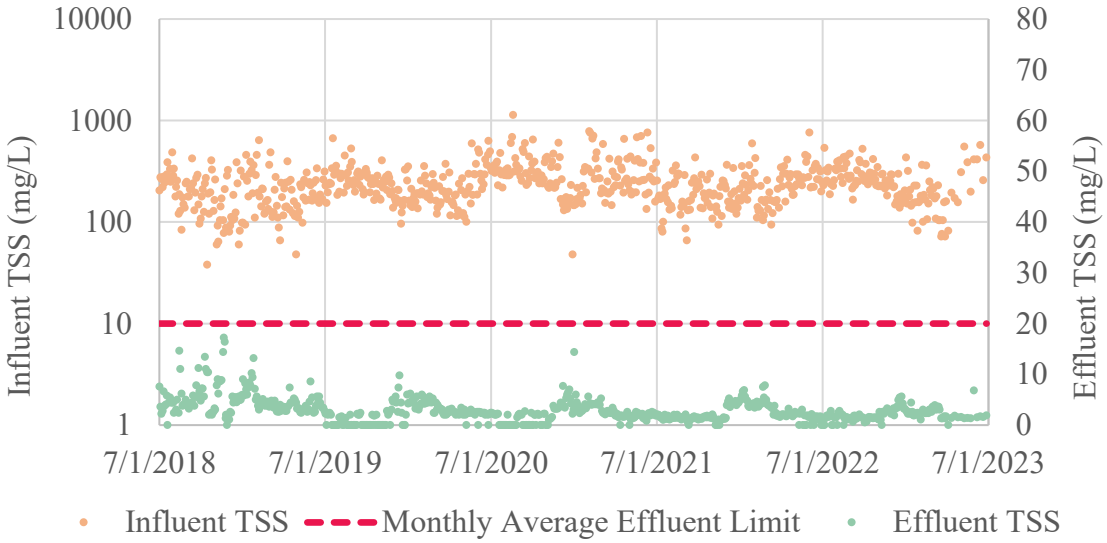


Figure 12. Influent and Effluent TSS Concentration Trends, FY19-FY23

pH

pH is a standard water quality measurement that determines how acidic or basic the water is. In the environment, pH that is too high or low can influence nutrient availability and environmental toxicity. In the Clinton Plant effluent, pH must fall between 6.5 and 8.3 Standard Units (SU) as required by Massachusetts Surface Water Quality Standards. Figure 13 compares the monthly pH range in FY23 with these limits. Results are within the standards.

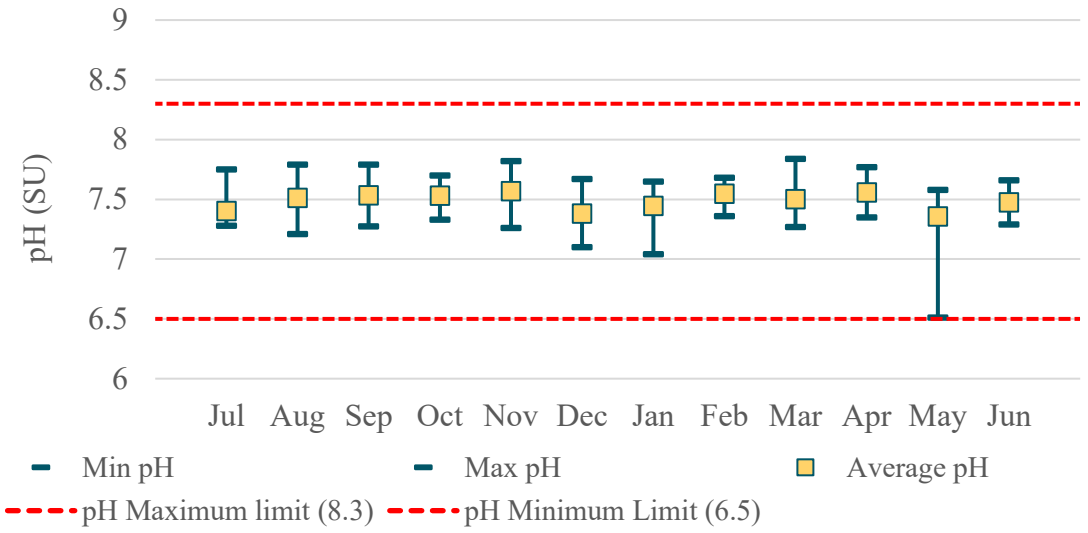


Figure 13. Effluent pH Range, FY23

Figure 14 contains all daily average pH results for FY19-FY23.

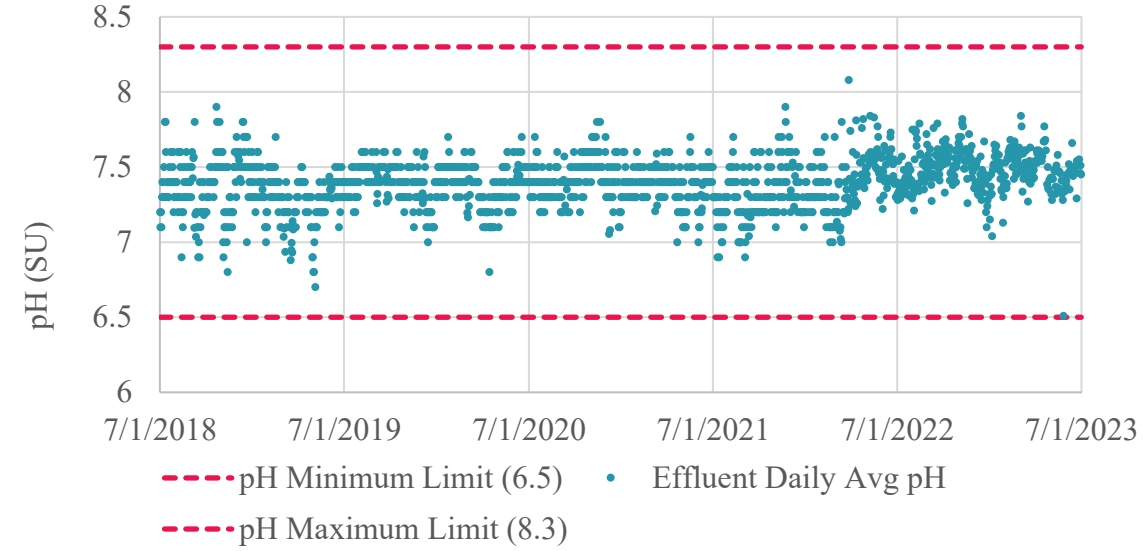


Figure 14. Effluent Daily Average pH, FY19-FY23

Dissolved Oxygen

Dissolved oxygen (DO) is a measure of the oxygen available to aquatic organisms. The Clinton Plant is required to meet a minimum DO criterion of 6.0 mg/L. Figure 15 plots the monthly DO range in FY23 against this minimum standard. Results demonstrate DO levels are higher than the minimum requirements.

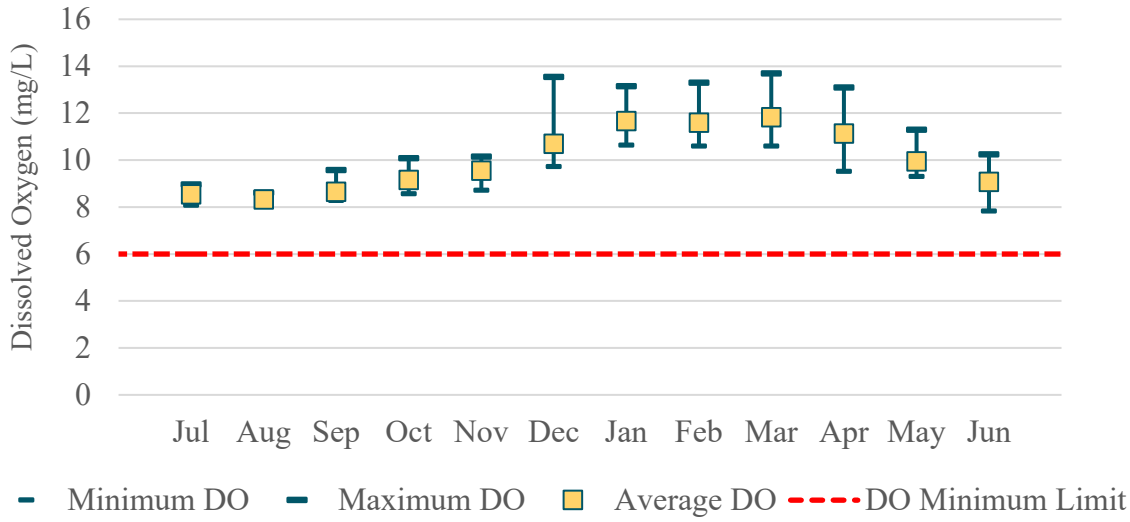


Figure 15. Effluent DO Range, FY23

Figure 16 plots the 5-year daily average DO results against the minimum DO requirement of 6.0 mg/L. There is seasonality to DO in the effluent, as oxygen is more soluble in water at lower temperatures. During all seasons, DO levels are above minimum requirements.

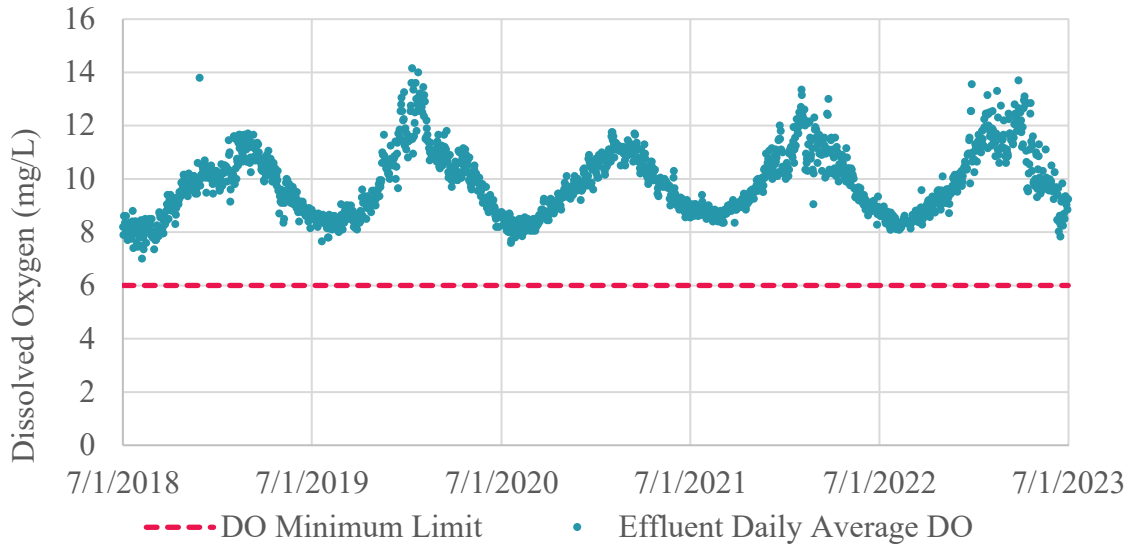


Figure 16. Effluent Daily Average Dissolved Oxygen, FY19-FY23

E. coli

Wastewater treatment plants monitor indicator bacteria to measure the effectiveness of disinfection at the end of the treatment process. As a freshwater discharger in Massachusetts, the Clinton Plant permit requires monitoring of *E. coli*, with a daily maximum limit of 409 colonies per 100mL. The permit further requires a monthly limit of 126 colonies per 100mL calculated as a geometric mean (geomean). Figure 17 below shows the results for FY23, plotted on a logarithmic scale. Results are well below the standards.

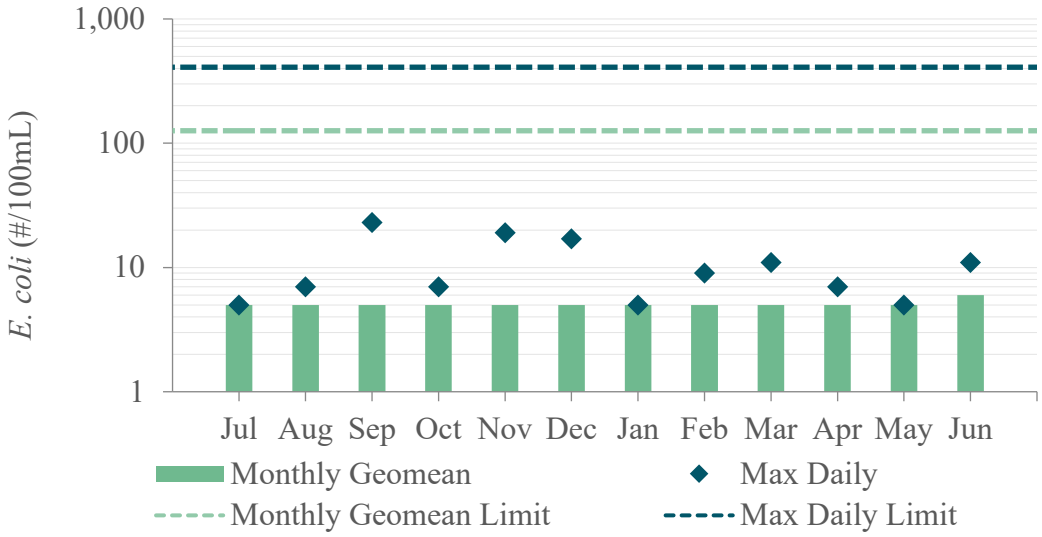


Figure 17. Effluent *E. coli* Monthly Geometric Mean (Geomean) and Daily Maximum Concentrations, FY23

Total Chlorine Residual

Total Chlorine Residual (TCR) is a measure of free chlorine and bound chlorine present in water. Chlorine is the disinfecting agent in the final stages of wastewater treatment at the Clinton Plant. Following disinfection, the plant dechlorinates the wastewater with sodium bisulfite to ensure the disinfecting agents and chlorine compounds do not reach the environment. The NPDES permit contains limits for a daily maximum and monthly average TCR based on Massachusetts Surface Water Quality Standards. As shown in Figure 18, the chlorine residual in FY23 was generally non-detectable. Sampling is performed at least twice per day. Due to a change in reporting requirements, if chlorine residual is not detected it is reported as "< 20 ug/L" rather than zero. Note that only months where there was chlorine detected in any sample are displayed.

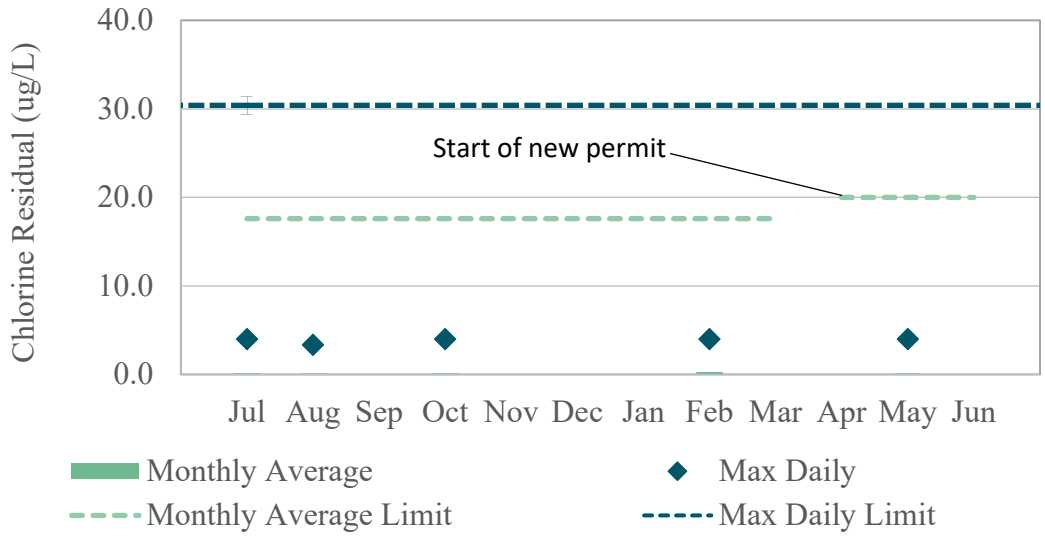


Figure 18. Effluent Total Chlorine Residual Concentrations, FY23

Total Recoverable Copper

Copper, like other metals, can be toxic to aquatic life. The Clinton Plant has monthly average and daily maximum effluent limits of 11.6 and 14.0 µg/L, respectively. Copper is tested more frequently during months with quarterly toxicity sampling. Clinton's monthly average for effluent copper exceeded the limit in July and August 2022 (Figure 19). After investigation, staff found the July exceedance to correlate with levels found in Clinton's municipal water supply. Though lower, levels in August were still high as a result of exceptionally low flows and most of the effluent copper being in a dissolved form. The treatment process at the Clinton Plant removes most of the particulate copper, but is less effective at removing /dissolved copper.

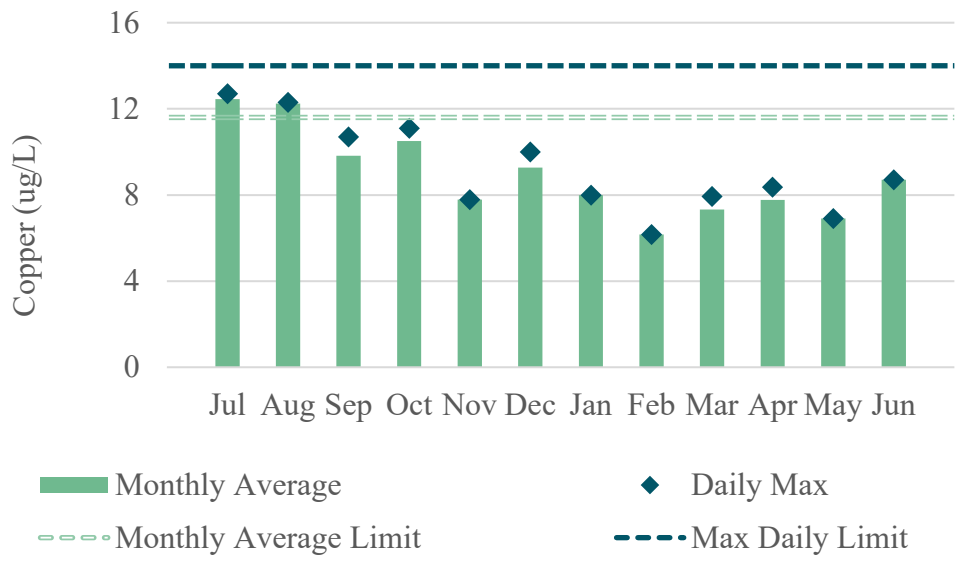


Figure 19. Effluent Copper Monthly Average and Daily Maximum Concentrations, FY23

Figure 20 presents FY19-FY23 copper results.

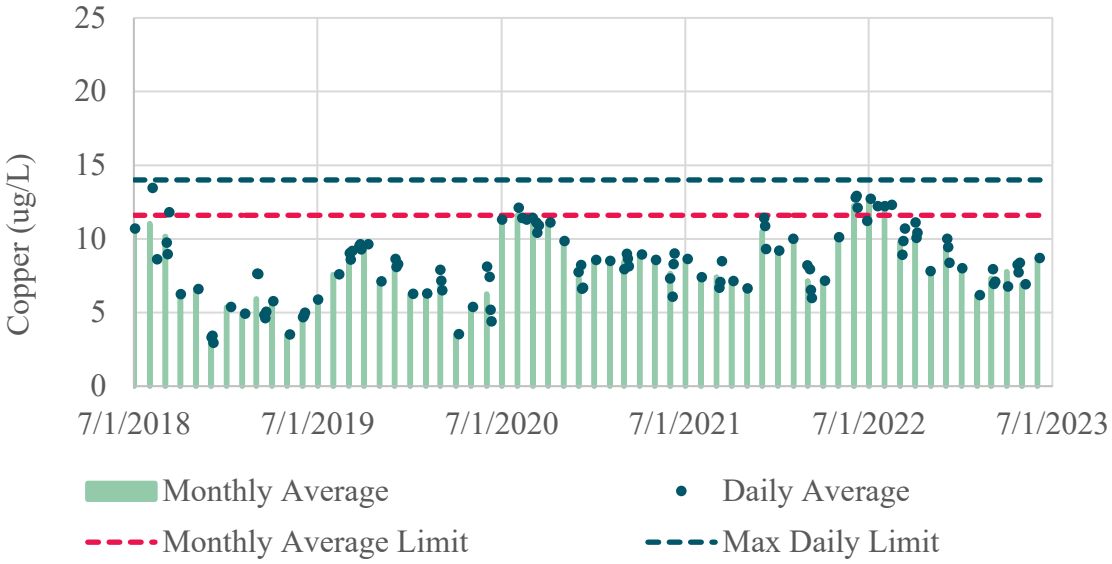


Figure 20. Effluent Copper Monthly Average and Daily Maximum Concentrations, FY19-FY23

Total Ammonia, as N

Ammonia (NH3-N) removal is a critical and challenging process for wastewater treatment plants. It is present in high concentrations in wastewater and potentially toxic in the environment if not removed in later stages of treatment.

The Clinton Plant has seasonal effluent limits for ammonia in its NPDES Permit. The limits are most stringent during the growing season, from June through October. There are no maximum daily limits in April and May; results are to be reported. The plant met both the daily maximum and monthly average concentration limits in FY23 as shown in Figure 21 below. Due to a change in reporting requirements, if ammonia is not detected it is reported as "< 0.1 mg/L" rather than zero. Note that only months where there was ammonia detected in any sample are displayed.

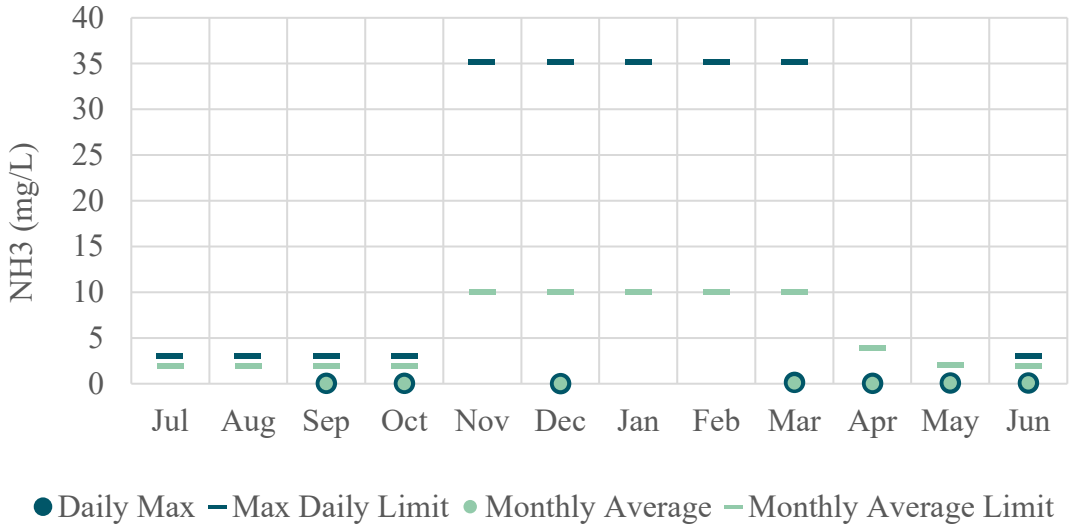


Figure 21. Effluent Ammonia Concentrations, FY23

Total Phosphorus

In a freshwater system, over-enrichment of total phosphorus (TP) can result in eutrophication and subsequent oxygen depletion. Elevated phosphorus and eutrophic conditions have been observed in the Nashua River Watershed well downstream of the Clinton Plant, particularly in the Pepperell Pond Impoundment. The Massachusetts Department of Environmental Protection developed a draft Total Maximum Daily Load (TMDL) for the Nashua River[1] for total phosphorus in 2007.

While the Clinton Plant and the South Branch of the Nashua River represent a small portion of the total phosphorus load to the impoundment, more stringent seasonal phosphorus limits were added to the NPDES permit in 2017, requiring the construction of a Phosphorus Reduction Facility (PRF). The permit included a compliance schedule, with the current phosphorus limits ultimately going into effect on April 1, 2019. The Clinton Plant met its total phosphorus limits in FY23, as shown in Figure 22 below.

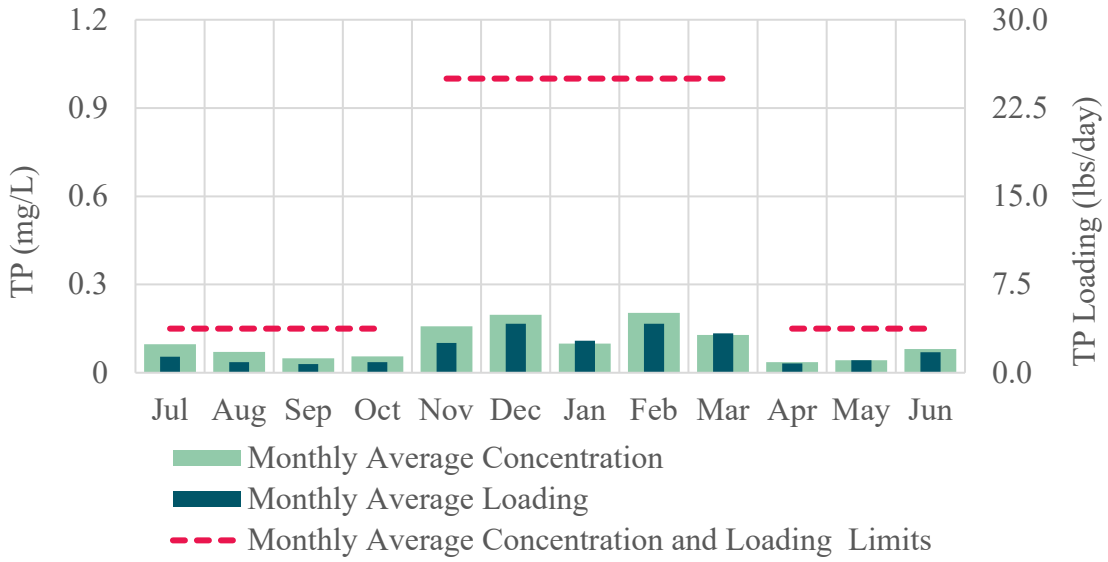


Figure 22. Effluent Total Phosphorus Concentrations and Loadings, FY23

[1] Draft - Nashua River, Massachusetts – Total Maximum Daily Load for the Nutrient Phosphorus https://www.mass.gov/files/documents/2016/08/mx/nashua.pdf

Figure 23 below contains individual influent and effluent TP test results for the last five fiscal years. Effluent TP concentrations are predominately below the seasonal permit limits despite variable influent concentrations. Note that from March 2017-March 2019 the Clinton Plant was operating under a compliance schedule for TP limits with an interim monthly average limit of 1,000 µg/L from April through October and no limit in November-March.

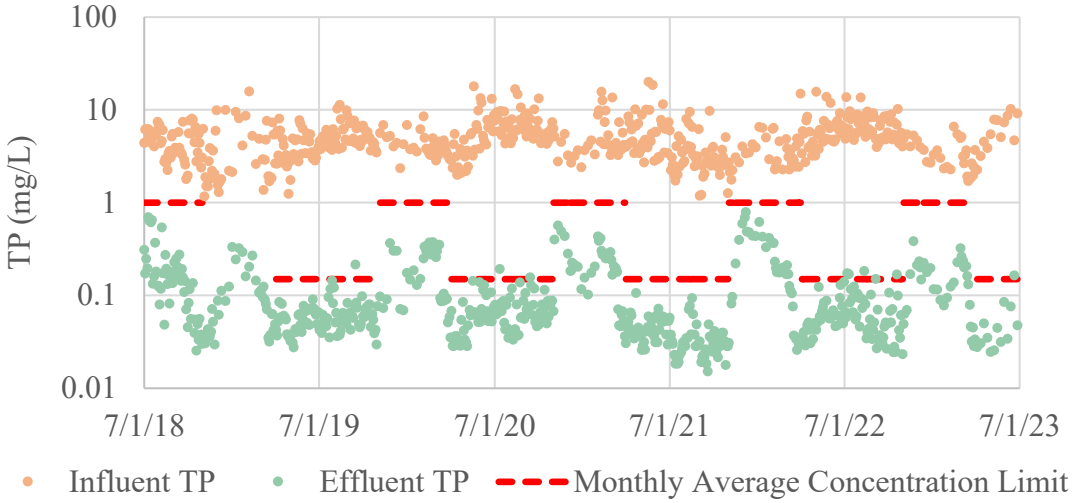


Figure 23. Influent and Effluent Total Phosphorus Concentrations Trends, FY19-FY23. Note logarithmic scale for y-axis.

Whole Effluent Toxicity

Whole Effluent Toxicity (WET) testing measures specific organisms' response to the cumulative effect of all potential pollutants in wastewater effluent. The toxicity limits are minimum values that must be achieved: 50% survival when exposed to 100% effluent (LC50) (acute toxicity) or no observed effect (NOEC) to growth or reproduction in the test organisms exposed to a sample of 62.5% effluent (chronic toxicity). Toxicity limit testing is performed quarterly using freshwater daphnid shrimp (*Ceriodaphnia dubia*). The Clinton Plant met acute toxicity limits in FY23 as shown in Figure 24. Chronic toxicity limits were met in all but the first quarter of FY23 as seen in Figure 25.

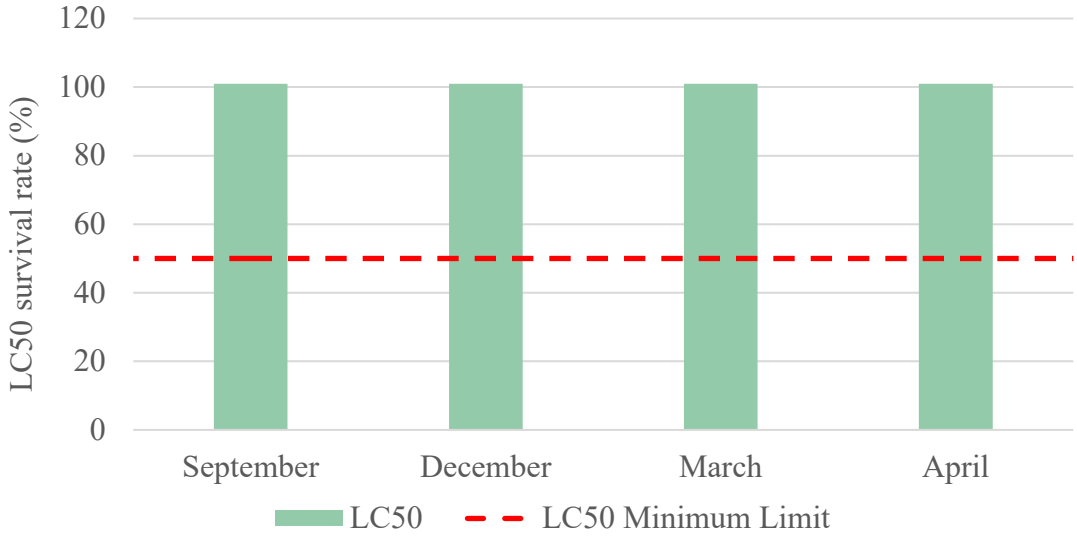


Figure 24. Quarterly Acute Toxicity Results, FY23

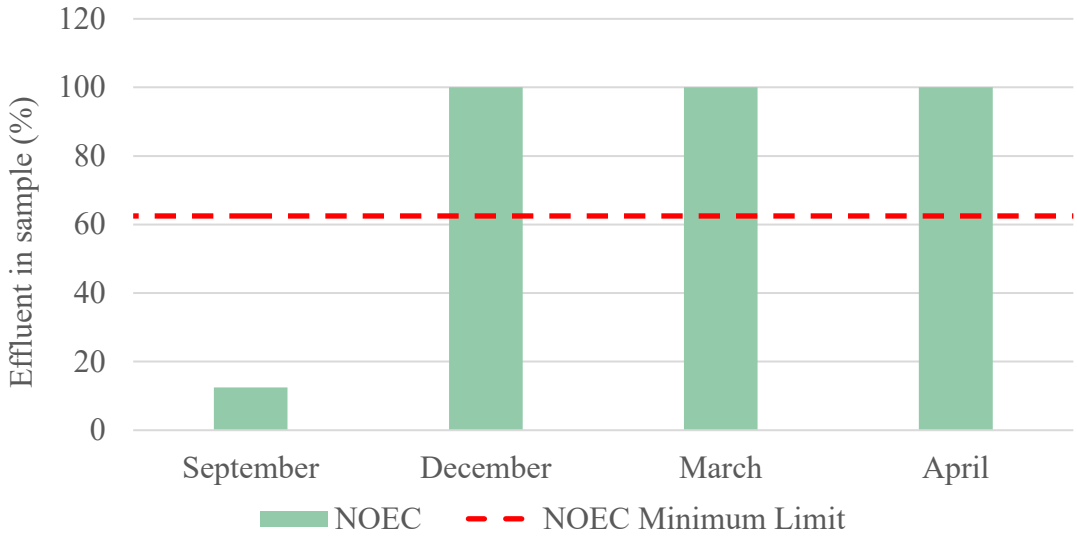


Figure 25. Quarterly Chronic Toxicity Results, FY23

Additional Permit Requirements

Industrial Pretreatment Program

MWRA's Toxic Reduction and Control (TRAC) Department is responsible for developing and enforcing local limits for industrial users in the Clinton Plant collection system. The local limits program is designed to prevent pollutants from entering the treatment system that would interfere with the operation of the treatment plant or pass through untreated to contaminate the receiving water. TRAC also submits an Industrial Waste Annual Report[2] for each fiscal year by October 31st of the following year. The appendices of these reports contain information on concentrations of priority pollutants in the Clinton Plant influent and effluent.

Operation and Maintenance of the Sewer System

MWRA submits an annual report detailing activities related to the operation and maintenance of the MWRA-owned portion of the collection system leading to the Clinton Plant – a single, 5,399-foot long interceptor.

Unauthorized Discharges

Discharge of wastewater from any other point source, including sanitary sewer overflows (SSOs), is not authorized by the Clinton NPDES permit. There were no unauthorized discharges from the Clinton Plant or the MWRA-owned portion of the collection system in FY23.

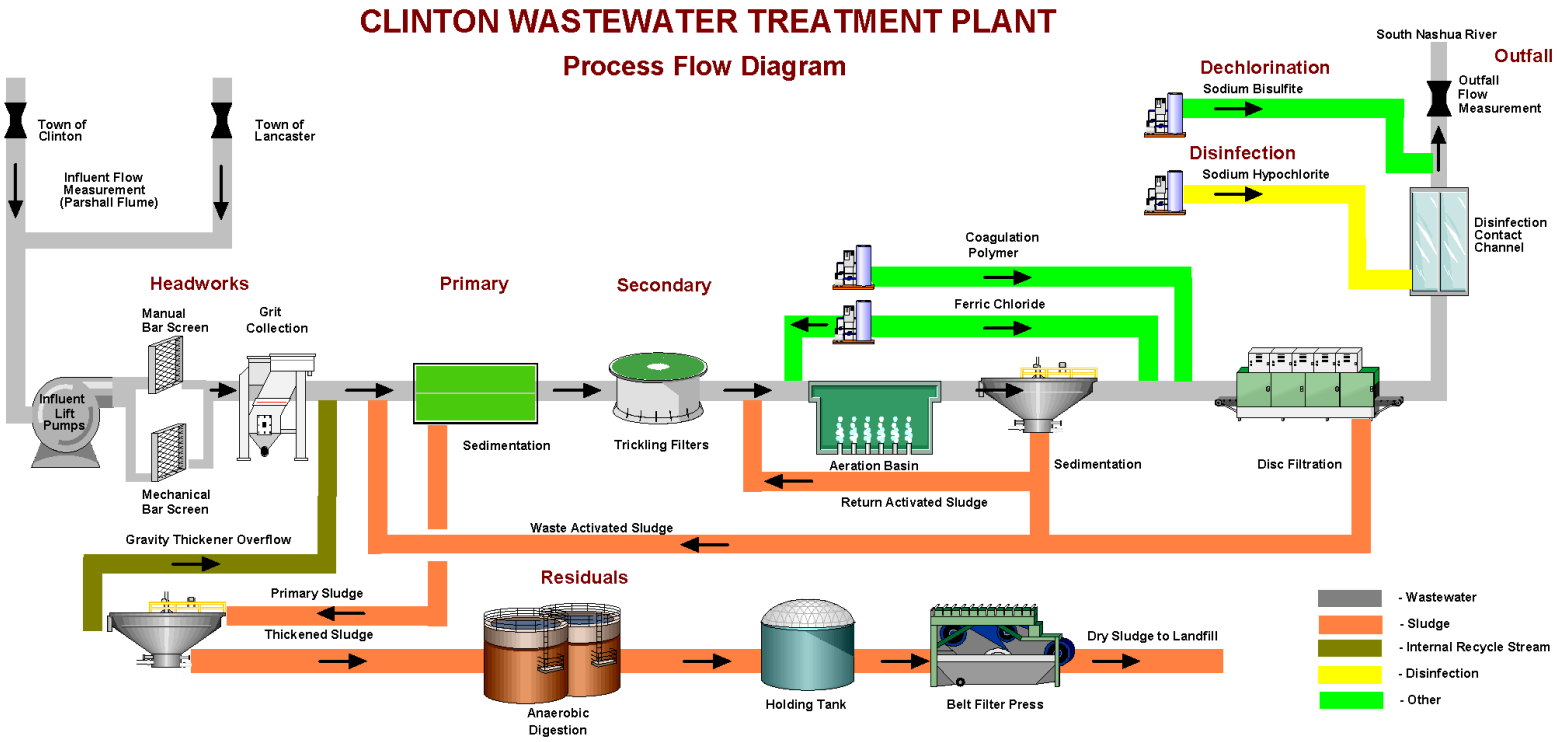
Sludge Processing

MWRA trucks dewatered sludge to a residuals landfill located in the Town of Clinton, owned and operated by MWRA. This sludge landfill is double-lined and includes a leachate collection system that pumps leachate and runoff to the Town of Clinton's sewer system to be treated at the Clinton Plant. Soil cover is applied to the sludge following each delivery to keep the sludge from attracting pests as required by 40 CFR 503.33(b)(11). By February 19th of each year, MWRA must submit to EPA (i) certification that this requirement is being met, and (ii) the number of dry metric tons of sludge disposed of in the landfill. Groundwater around the landfill is monitored to ensure that metals and other pollutants do not pass through the liner.

[2] https://www.mwra.com/annual/tracindustrialwastereport/industrialwastereports.htm

Appendices

Appendix A – Clinton Wastewater Treatment Plant Schematic



Massachusetts Water Resources Authority
Deer Island
33 Tafts Avenue • Boston, MA 02128
www.mwra.com
617-242-6000