MASSACHUSETTS WATER RESOURCES AUTHORITY
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February 16, 2024

Todd Borci
EPA Region 1
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Boston MA, 02109-3912

Catherine Coniaris
Department of Environmental Protection
100 Cambridge St., 9th Floor
Boston, MA 02114

RE: Massachusetts Water Resources Authority
Permit Number MA 0103284
Contingency Plan Threshold Exceedance: Annual nearfield chlorophyll

Dear Mr. Borci and Ms. Coniaris:

The Massachusetts Water Resources Authority ("MWRA") monitors chlorophyll in the nearfield as part of its permit-attached Ambient Monitoring Plan[1] and Contingency Plan.[2] This letter is a regulatory and public notification that the results exceeded the Contingency Plan caution threshold for nearfield annual chlorophyll in accordance with Part I.8.b (Contingency Plan) of the Deer Island Treatment Plant NPDES permit.

The Contingency Plan caution threshold for annual nearfield chlorophyll is 108 mg/m^2, and the warning threshold is 144 mg/m^2. MWRA has received and checked all 2023 chlorophyll results and calculated that the nearfield average for 2023 was 116 mg/m^2, over the caution threshold of 108 mg/m^2.

MWRA believes an extraordinary bloom of the dinoflagellate *Tripos muelleri* drove the annual average chlorophyll levels above the threshold. The bloom of *T. muelleri* was not exclusive to the MWRA monitoring area; observers saw high abundances throughout the Gulf of Maine, south to Martha's Vineyard, MA, and continuing along the Rhode Island and Connecticut coasts.[3]

[1] *Ambient Monitoring Plan for the Massachusetts Water Resources Authority Effluent Outfall (Revision 2.1, August 2021)*. Report 2021-08. https://www.mwra.com/harbor/enquad/pdf/2021-08.pdf.
[2] *Massachusetts Water Resources Authority Contingency Plan Revision 1*. 2001. Report 2001-ms-071. https://www.mwra.com/harbor/enquad/pdf/2001-ms-71.pdf.

[3] Presentation to OMSAP by Dr. David Borkman, Rhode Island Department of Environmental Management, February 9, 2024, as well as the December 8, 2023 letter on the summer 2023 chlorophyll threshold exceedance, https://www.mwra.com/harbor/pdf/20231208_amx.pdf

Background

Figure 1 shows MWRA monitoring locations in Massachusetts Bay. The outfall nearfield is a group of five stations (N01, N04, N07, N18, and N21) covering a 6 by 7.5 mile (10 by 12 kilometer) area centered on the outfall diffuser.

The farfield stations (F06, F10, F13, and F15) south of the nearfield and the Stellwagen Basin station (F22) are farther from the outfall and not part of Contingency Plan threshold. However, they often provide useful context for nearfield conditions. Station F23 is at the mouth of Boston Harbor. While this station is physically quite different from the others, it can also give useful context.

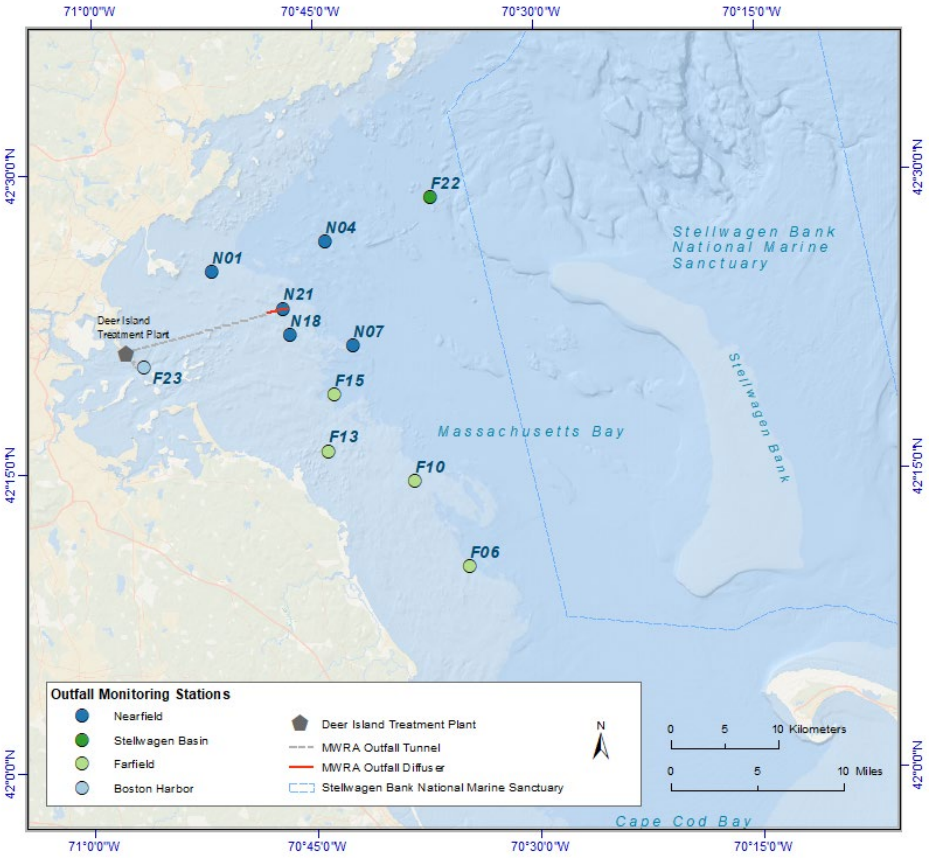

Figure 1. Map of outfall, nearfield, Stellwagen Basin, farfield, and harbor monitoring stations.

Exceedance

MWRA calculates the annual chlorophyll average by first calculating a depth-averaged chlorophyll for each nearfield station visit using the calibrated fluorescence probe data measured every 0.5 m from the surface to the bottom. Then, a survey average is calculated by averaging the depth-averaged chlorophyll values for each station. Finally, to calculate the annual average, the nine survey averages are averaged together.

The annual thresholds are based on a similar calculation done for surveys prior to the diversion of the wastewater discharge to Massachusetts Bay; the caution threshold is based on 1.5 times

the pre-diversion annual average, and the warning threshold is two times the pre-diversion annual average. The seasonal thresholds in Table 3 are based on the 95th percentile of the pre-diversion seasonal averages. The seasonal thresholds are only caution level thresholds; there are no warning level seasonal thresholds.

Table 1 shows the "survey average" nearfield chlorophyll from each of the surveys in 2023. Table 2 shows the overall annual nearfield chlorophyll average compared to the Contingency Plan threshold.

SURVEY ID	SURVEY DATE	AVERAGE NEARFIELD CHLOROPHYLL (MG/M^2)	STANDARD DEVIATION	NUMBER OF NEARFIELD STATIONS IN AVERAGE
WN231	February 9, 2023	82.13	27.56	5
WN232	March 21, 2023	21.46	11.89	5
WN233	April 18, 2023	183.14	100.47	5
WN234	May 16, 2023	348.54	132.5	5
WN235	June 21, 2023	181.11	45.04	5
WN236	July 25, 2023	55.27	9.69	5
WN237	August 29, 2023	66.97	11.25	5
WN238	September 12, 2023	47.68	4.31	5
WN239	October 18, 2023	60.03	10.71	5

Table 1. 2023 nearfield chlorophyll results, by survey date.

AVERAGE NEARFIELD CHLOROPHYLL (MG/M^2)	STANDARD DEVIATION	CAUTION THRESHOLD (MG/M^2)	WARNING THRESHOLD (MG/M^2)	EXCEEDANCE (YES/NO)
116	104.2	108	144	**Yes, Caution**

Table 2. 2023 annual nearfield summer chlorophyll results compared to the thresholds.

Discussion

An unprecedented bloom of the dinoflagellate *Tripos muelleri* (previously known as *Ceratium tripos*) likely drove the high summer chlorophyll levels, which in turn elevated the annual average. *T. muelleri* is a dinoflagellate that is not considered a harmful or nuisance algae species. Before 2023, the most recent exceedance of a chlorophyll threshold was in 2006. That summer, chlorophyll levels were high due to a bloom of the chain-forming diatom *Dactyliosolen fragilissimus*.[4] There was not an annual chlorophyll threshold exceedance that year. Figure 2 shows the historical record of annual nearfield chlorophyll measurements from 1992 to 2023.

[4] October 25, 2006 letter to EPA and DEP. https://www.mwra.com/harbor/pdf/20061025amx.pdf

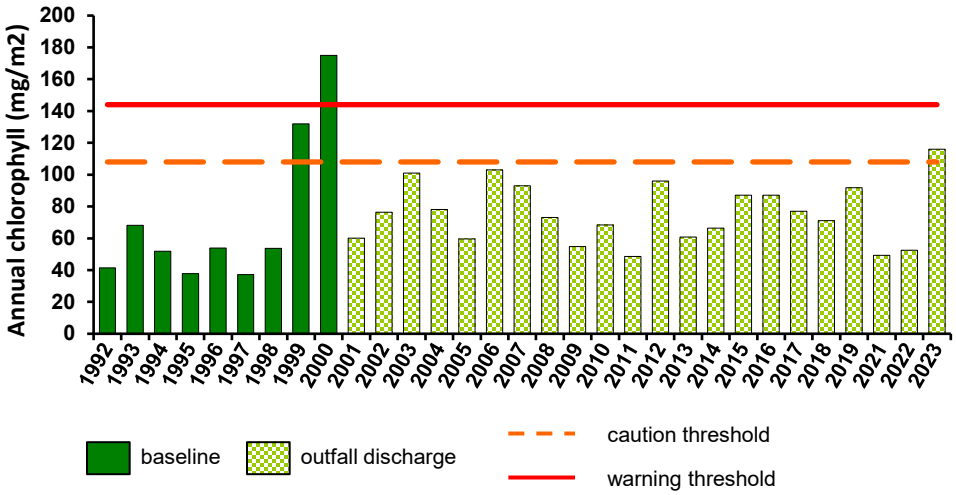

Figure 2. Annual nearfield chlorophyll, 1992-2023. The orange dashed line is the Contingency Plan caution threshold, and the solid red line is the warning threshold.

Table 3 shows the 2023 nearfield chlorophyll results compared to the various seasonal and annual thresholds in the Contingency Plan. Note that the high chlorophyll levels from the *Tripos* bloom are quite noticeable in the April to June survey results. However, it is obvious that the bloom, from a Contingency Plan threshold perspective, is quite temporally constrained. The winter/spring and fall chlorophyll results were quite a bit lower than the thresholds for those seasons. For context, the seasonal and annual averages for the previous five years (2018-2022) are also included.

SEASON	SURVEY DATE	AVERAGE NEARFIELD CHLOROPHYLL	2023 SEASONAL AVERAGE	2018-2022 SEASONAL AVERAGE	SEASONAL THRESHOLD	2023 ANNUAL AVERAGE	2018-2022 ANNUAL AVERAGE	ANNUAL THRESHOLD
Winter/Spring	2/9/23	82.13	95.6	84.3	199	116	65.1	108 (caution) 144 (warning)
Winter/Spring	3/21/23	21.46						
Winter/Spring	4/18/23	183.14						
Summer	5/16/23	348.54	163	51.2	89			
Summer	6/21/23	181.11						
Summer	7/25/23	55.27						
Summer	8/29/23	66.97						
Fall	9/12/23	47.68	53.9	74	239			
Fall	10/18/23	60.03						

Table 3. Nearfield chlorophyll results from 2023 and 2018-2022 compared to all the Contingency Plan seasonal thresholds and the annual thresholds. Seasonal thresholds only have a caution level. All values in mg/m^2.

Additional data on the *T. muelleri* bloom is included in the MWRA's December 8, 2023 letter on the Contingency Plan exceedance of the summer chlorophyll threshold.[5] As mentioned in that letter, the bloom of *T. muelleri* was not exclusive to the MWRA monitoring area, and high chlorophyll levels were seen at the farfield monitoring stations and the stations in Cape Cod Bay sampled by the Center for Coastal Studies.

On January 18, the Northeastern Regional Association of Ocean Observing Systems and the University of New Hampshire hosted a workshop on the bloom. MWRA staff attended that meeting and the consensus from the attendees was that the bloom was likely due to specific physical oceanographic processes seen in the Gulf of Maine in 2023. Attendees did not discuss the MWRA outfall as a cause.

Conclusion

The conclusion of our preliminary evaluation, based on the fact this bloom of *T. muelleri* was a region-wide event seen throughout the Gulf of Maine and continuing south to Martha's Vineyard, MA, and the Rhode Island and Connecticut coasts, is that the exceedance is not related to the outfall. The extremely high chlorophyll measurements from April to June due to the bloom heavily influenced the annual average. Active research by a number of parties on the bloom's contributing factors is ongoing, and MWRA is committed to providing its monitoring data to any interested parties.

MWRA will provide raw monitoring data upon request. If you have any questions regarding this matter, please email Dr. Betsy Reilley at betsy.reilley@mwra.com.

Sincerely,

Rebecca Weidman
Deputy Chief Operating Officer

[5] December 8, 2023 letter on the summer 2023 chlorophyll threshold exceedance, https://www.mwra.com/harbor/pdf/20231208_amx.pdf

cc:

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