



MASSACHUSETTS WATER RESOURCES AUTHORITY

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September 24, 2021

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Catherine Vakalopoulos
Department of Environmental Protection
1 Winter Street
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RE: Massachusetts Water Resources Authority
Permit Number MA 0103284
Contingency Plan Threshold Exceedance: Stellwagen Basin DO percent saturation

Dear Mr. Borci and Ms. Vakalopoulos:

The Massachusetts Water Resources Authority (“MWRA”) monitors percent saturation of bottom water dissolved oxygen (“DO”)¹ in the Stellwagen Basin as part of MWRA’s permit-attached Ambient Monitoring Plan² and Contingency Plan.³ The Contingency Plan states that the DO percent saturation during any survey while the water column is stratified (June through October) is expected to be at least 80% (caution level threshold) or at least 75% (warning level threshold) unless background conditions are lower. Background conditions are computed from monitoring during the baseline period 1992-2000, prior to when operation of the outfall in Massachusetts Bay began. When testing against the caution and warning level thresholds, if background conditions are lower than the thresholds, the DO percent saturation must be above the background conditions.

On September 8th, MWRA conducted a routine water column monitoring survey. After routine data quality checks, the results were compared to thresholds on September 21st. The threshold checks revealed that the warning level had been exceeded for Stellwagen Basin bottom water DO percent saturation. The bottom water DO percent saturation at the Stellwagen Basin location (station F22) was 66.3%. As noted above, the Contingency Plan warning threshold level is 75%. The calculated background condition value is 67.17%. Because dissolved oxygen concentrations remain above both state standards and threshold levels, there is no adverse impact to marine life. This exceedance of the warning level and background condition value for Stellwagen Basin DO percent saturation requires this regulatory and public notification in accordance with Part I.8.b (Contingency Plan) of the Deer Island Treatment Plant NPDES permit.

¹ For an explanation of the DO measurements, see <https://www.mwra.com/harbor/html/thresholds.htm#do>.

² *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>. See pages 24 and 40-41 for specific information on DO monitoring.

³ *Massachusetts Water Resources Authority Contingency Plan Revision 1*. 2001. Report 2001-ms-071. <https://www.mwra.com/harbor/enquad/pdf/2001-ms-71.pdf>. For sections in the Contingency Plan specifically relevant to DO, see pages 23-24 and 26.

Background

Station F22 where the exceedance occurred is in water 79.7 meters (m; 261.5 feet) deep, located 17.5 kilometers (km; 10.9 miles) away from the easternmost riser of the 30 m (100 feet) deep outfall (Figure 1).

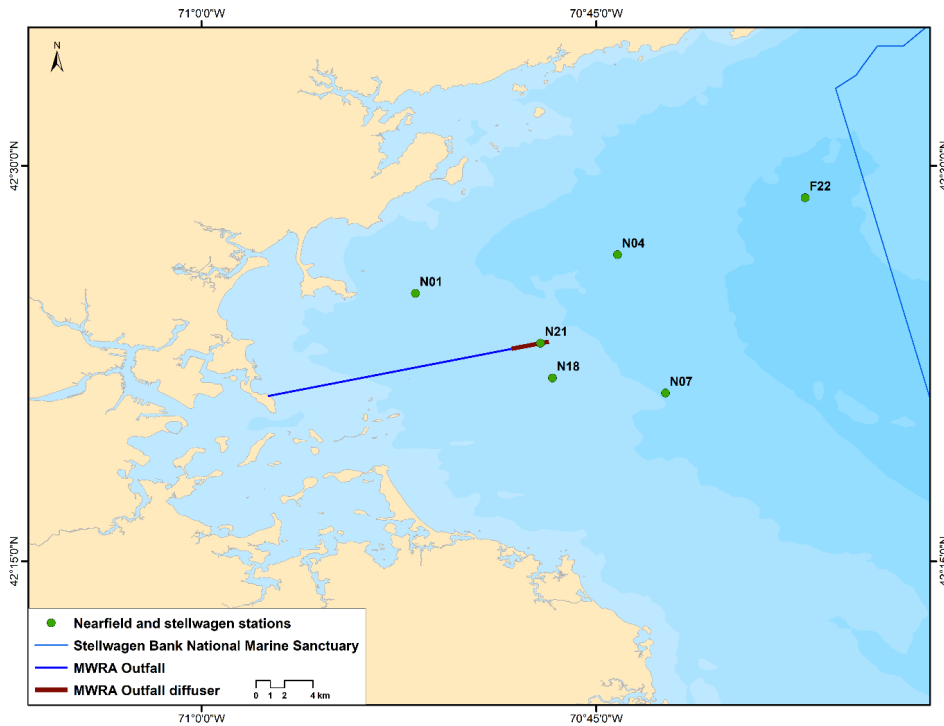


Figure 1. Map of Stellwagen Basin station (F22), nearfield, and the outfall.

In past MWRA studies, regional factors have been identified as having a larger influence on DO levels in Massachusetts Bay than the outfall (emphasis added below):

On a regional scale, circulation in the bays is often affected by the larger pattern of water flow in the Gulf of Maine. The western Maine coastal current usually flows southwestward along the coast of Maine and New Hampshire and depending on prevailing oceanographic and meteorological conditions may enter Massachusetts Bay south of Cape Ann (Geyer et al. 1992). Optimal conditions for inflow usually occur during the spring when winds out of the northeast bring significant freshwater inflow from the gulf into the bays and transport generally follows a counterclockwise path along the coast to Cape Cod Bay. Inflow from the gulf is the major source of nutrients to the bay. ***The inflow also helps to flush the bay, and gives the bay its water quality characteristics including dissolved oxygen levels and plankton communities (including nuisance blooms such as *Alexandrium*)...***

Furthermore, modeling and statistical analyses indicate that bottom water DO levels in Massachusetts Bay are highly correlated with conditions along the bay/Gulf of Maine boundary and that ***regional processes and advection are the primary factors governing bottom water DO concentrations in the bay*** (HydroQual 2001, Geyer et al. 2002, Jiang et al. 2007).⁴

⁴ *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>

For water column parameters other than nitrogen, such as chlorophyll or dissolved oxygen, MWRA monitoring has shown no outfall influence. For nitrogen the outfall influence extends as far as 20 km (12 miles) away on an infrequent basis, and persistently less than 10 km (6 miles) away. There is no evidence that dissolved oxygen conditions at F22, which is 17.5 km (10.9 miles) from the outfall, are influenced by the outfall.

Exceedance

While the DO percent saturation was below the background condition, the bottom water DO concentration value in Stellwagen Basin was 6.32 mg/L, which was higher than the background level of 6.23 mg/L. This background level is itself higher than the Massachusetts water quality standard for DO in Class SA waters, which is 6.0 mg/L.⁵ Table 1 shows bottom water DO data from the September 8th survey and the Contingency Plan thresholds (caution, warning, and background). Results are shown for both the Stellwagen Basin station and the “nearfield,” a spatial average across five stations located within a 10 x 12 km area centered on the outfall.

LOCATION	PARAMETER	TEST LEVEL	THRESHOLD VALUE	BACKGROUND VALUE	UNIT	TEST RESULT	STDEV	N	EXCEEDANCE Y/N
Nearfield	bottom dissolved oxygen	CAUTION	6.5	6.05	mg/L	6.36	0.45	5	N
	bottom dissolved oxygen	WARNING	6	6.05	mg/L	6.36	0.45	5	N
Nearfield	bottom DO % saturation	CAUTION	80	65.28	%	71.3	7.37	5	N
	bottom DO % saturation	WARNING	75	65.28	%	71.3	7.37	5	N
Stellwagen Basin	bottom dissolved oxygen	CAUTION	6.5	6.23	mg/L	6.32	0	1	N
	bottom dissolved oxygen	WARNING	6	6.23	mg/L	6.32	0	1	N
Stellwagen Basin	bottom DO % saturation	CAUTION	80	67.17	%	66.3	0	1	Y
	bottom DO % saturation	WARNING	75	67.17	%	66.3	0	1	Y

Table 1. Bottom water DO results from September 8 survey, with Contingency Plan thresholds

Figure 2 shows the DO percent saturation results from F22 from the September 8th survey. The results from the downcast (as the instrument travels down through the water column) are in green, and the upcast results (as the instrument returns to the surface) are the orange triangles. The dark blue line is the mean of the results from the previous three years during the same time period as the current downcast and upcast results. The shaded blue and gray areas are: (a) the interquartile range of the results from 2000-2020; and (b) the minimum and maximum results from 2000-2020, respectively – both from the same time period as the survey results.

⁵ Massachusetts Surface Water Quality Standards, 314 CMR 4.05(4)(a)(1). <https://www.mass.gov/doc/314-cmr-400-surface-water-quality-standards/download>

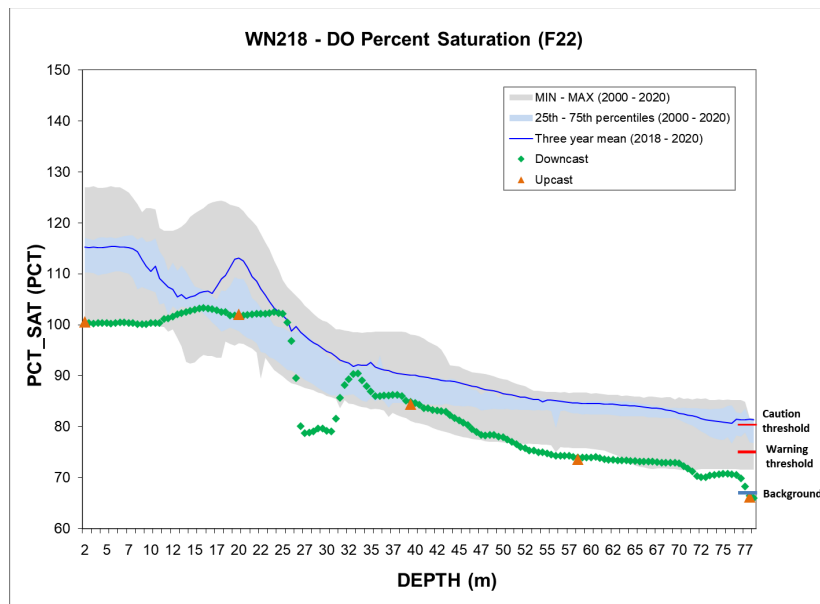


Figure 2. DO percent saturation results from F22 on the September 8th survey.

Figure 3 shows the DO concentration at F22 from the September 8th survey. The plot elements are the same as in Figure 2.

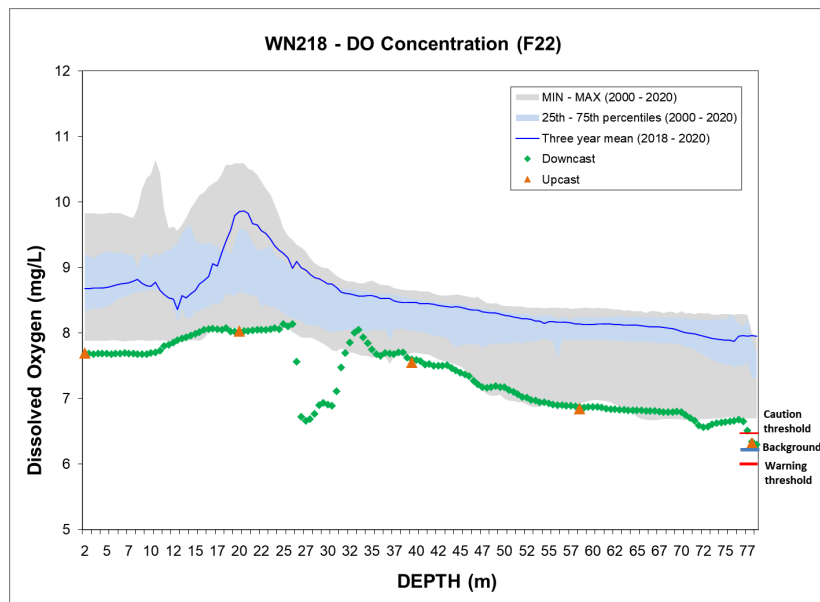


Figure 3. DO concentration results from F22 on the September 8th survey.

Discussion

There is currently no evidence this exceedance is related to the Deer Island Treatment Plant outfall discharge. Both warning level thresholds and background condition values for DO percent saturation and concentration thresholds were met in the nearfield immediately around the outfall. If this DO exceedance was directly attributable to the outfall, one would reasonably expect to see DO depletion in the nearfield as well as in Stellwagen Basin.

Previously, there was a caution level threshold exceedance for bottom water Stellwagen Basin DO percent saturation in early October 2000; there was also an exceedance in the nearfield.

Similar to this current exceedance, the DO concentrations at both locations met the threshold values. Excursions of percent saturation below the caution level were not unusual in the pre-outfall phase of monitoring in both the nearfield and Stellwagen Basin – they occurred in seven of the eight years before the outfall went online.⁶

It should be noted that under stratified water column conditions – as existed for this survey – it is normal for DO concentrations and percent saturation to decrease in the bottom waters (Figure 4). As a result of the stratification, there is no physical mechanism for the water below the thermocline to have any exchange with the atmosphere, and natural biological consumption processes cause DO to decline. Finally, the DO concentration is more important for healthy biological activity than percent saturation, and as noted above, the DO concentration at Stellwagen Basin was both higher than the threshold background value and met state water quality standards.

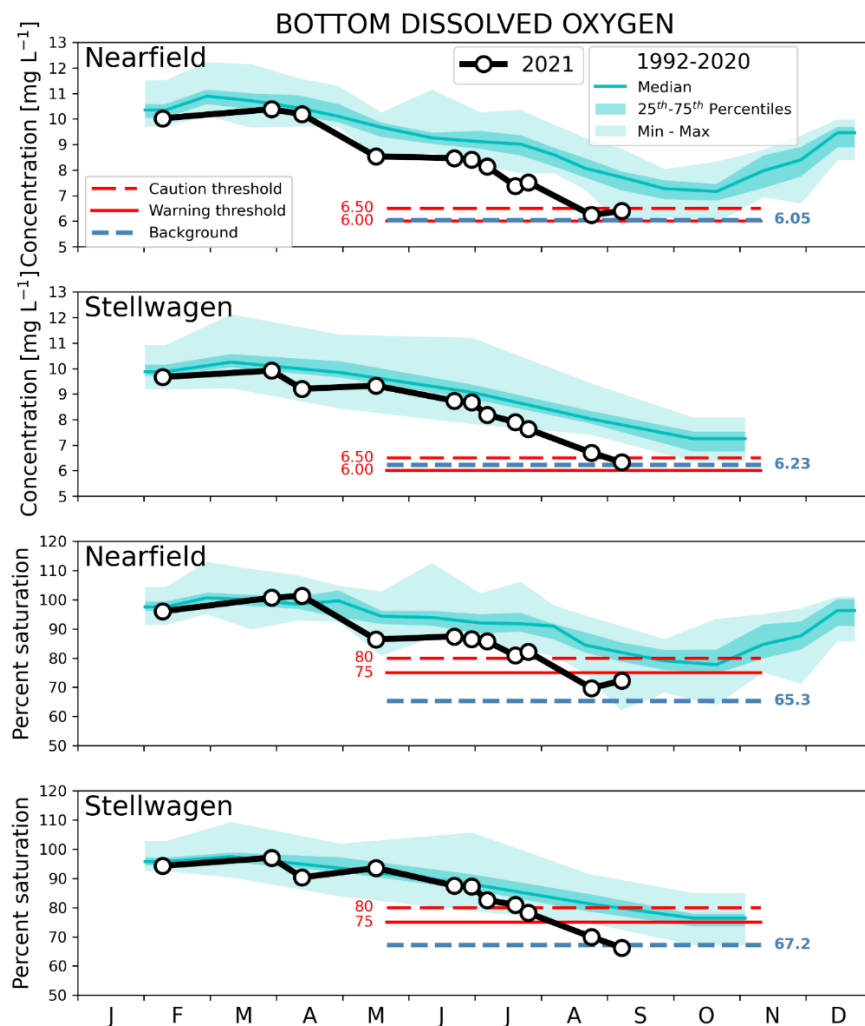


Figure 4. 2021 DO results compared to 1992-2020 historical results in Stellwagen Basin and the nearfield

It is also worth noting that DO percent saturation is not in the current state water quality standards. Percent saturation was removed from EPA’s National Recommended Water Quality

⁶ November 10, 2000 letter to DEP and EPA regarding Contingency Plan exceedances of DO.
<https://www.mwra.com/harbor/pdf/ax111000.pdf>

Criteria in 2002, and from MA DEP Water Quality Standards in 2006. The CP thresholds were implemented in 2000.

Conclusion

The conclusion of our initial evaluation, based on the information presented here, is that the exceedance is not related to the outfall. It may be related to widely recognized regional long-term trends of warming temperatures and declining oxygen concentrations, which are clear from analysis of many independent datasets including MWRA monitoring data. Further evaluations of the exceedance will be presented at the next OMSAP meeting.

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

Sincerely,

Carolyn M. Fiore
Deputy Chief Operating Officer

cc:

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