



# MASSACHUSETTS WATER RESOURCES AUTHORITY

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September 26, 2022

Todd Borci  
EPA Region 1  
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Boston MA, 02109-3912

Catherine Coniaris  
Department of Environmental Protection  
1 Winter Street  
Boston, MA 02108

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”)<sup>1</sup> in the Stellwagen Basin as part of MWRA’s permit-attached Ambient Monitoring Plan<sup>2</sup> and Contingency Plan.<sup>3</sup> 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 August 23<sup>rd</sup>, MWRA conducted a routine water column monitoring survey. After routine data quality checks, the results were compared to thresholds on September 22<sup>nd</sup>. 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%. As noted above, the Contingency Plan warning threshold level is 75%. The calculated background condition value is 67.17%. Because measured dissolved oxygen concentration of 6.46 mg/L at F22 remained above both state standards (6.0 mg/L) and threshold levels (6.0 mg/L warning level and 6.23 mg/L background value), there is no adverse impact to marine life. 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. DO

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

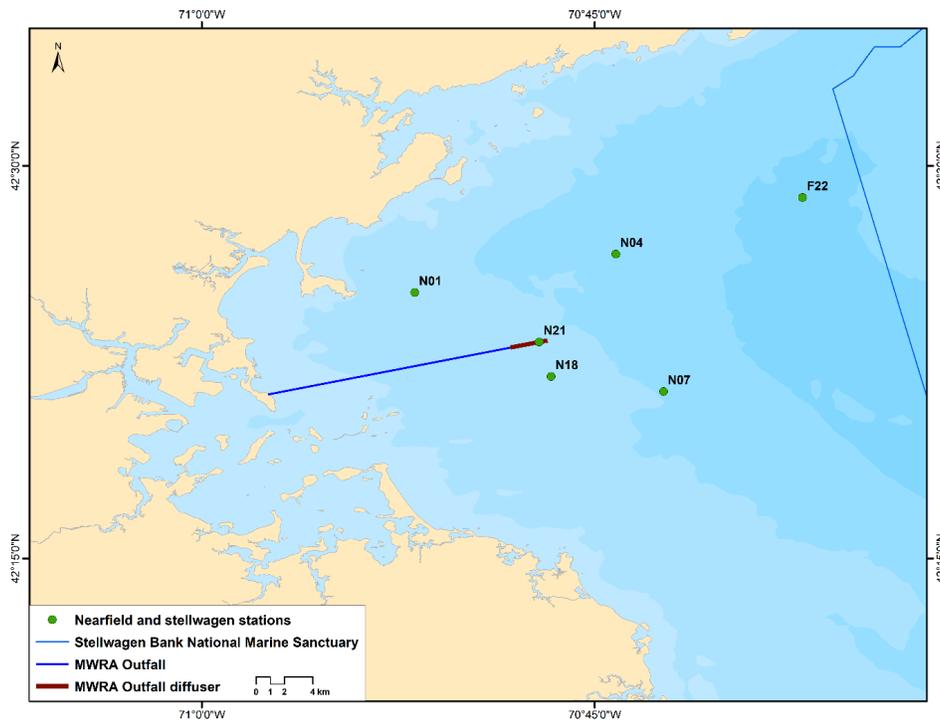
<sup>2</sup> *Ambient Monitoring Plan for the Massachusetts Water Resources Authority Effluent Outfall (Revision 2.1, August 2021)*. Report 2021-08. <https://www.mwra.com/harbor/enquad/pdf/2021-08.pdf>.

<sup>3</sup> *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.

concentration and percent saturation results from the other ten stations on the survey were within expected ranges and there were no other exceedences.

## **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 diffuser (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).<sup>4</sup>

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 bottom water DO percent saturation was below the background condition, the bottom water DO concentration value in Stellwagen Basin was 6.46 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.<sup>5</sup> Table 1 shows bottom water DO data from the August 23<sup>rd</sup> 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.

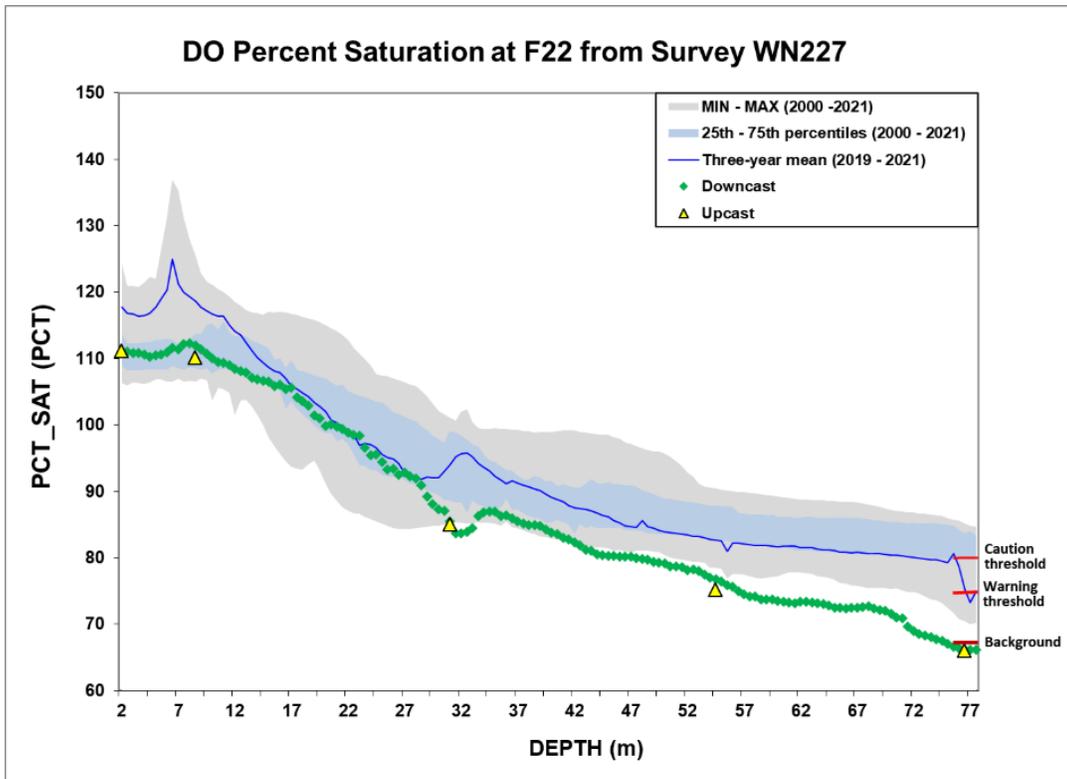
LOCATION	PARAMETER	TEST LEVEL	THRESHOLD VALUE	BACKGROUND VALUE	UNIT	TEST RESULT	EXCEEDANCE Y/N
Nearfield	bottom dissolved oxygen	CAUTION	6.5	6.05	mg/L	6.77	N
	bottom dissolved oxygen	WARNING	6				
Nearfield	bottom DO % saturation	CAUTION	80	65.28	%	73.6	N
	bottom DO % saturation	WARNING	75				
Stellwagen Basin	bottom dissolved oxygen	CAUTION	6.5	6.23	mg/L	6.46	N
	bottom dissolved oxygen	WARNING	6				
Stellwagen Basin	bottom DO % saturation	CAUTION	80	67.17	%	<b>66</b>	<b>Y</b>
	bottom DO % saturation	WARNING	75				

**Table 1.** Bottom water DO results from August 23 survey, with Contingency Plan thresholds

Figure 2 shows the DO percent saturation results from F22 from the August 23<sup>rd</sup> 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 2000-2021; and (b) the minimum and maximum results from 2000-2021, respectively – both from the same time period as the survey results.

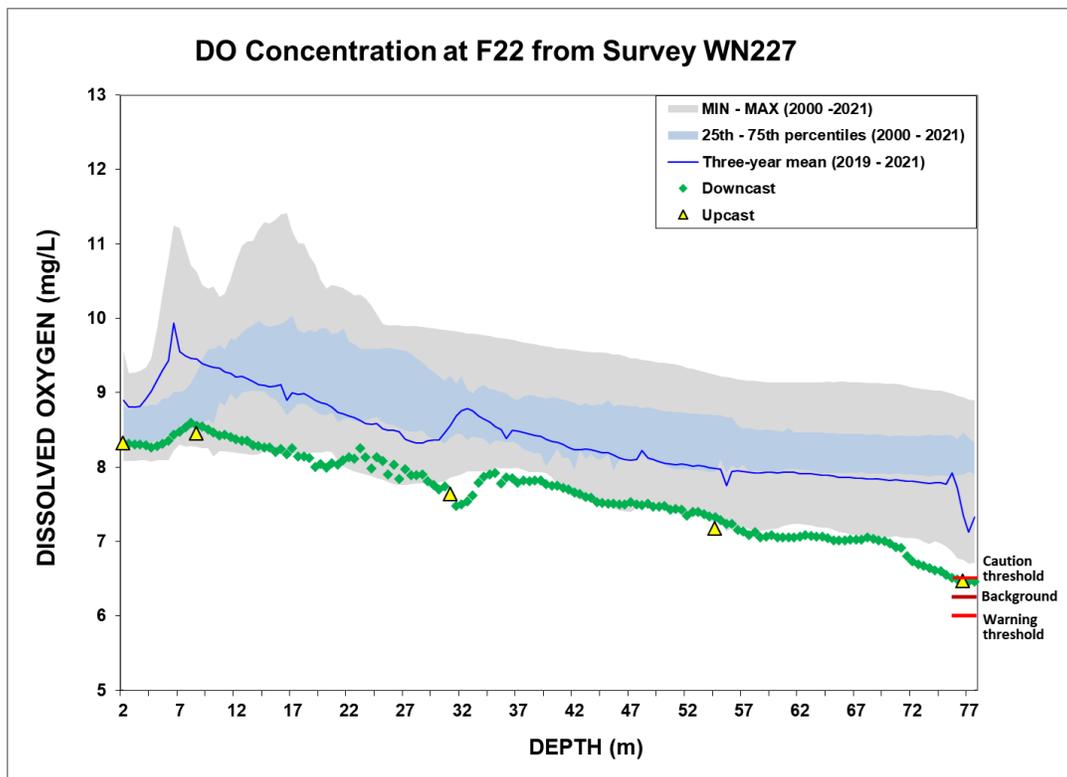
<sup>4</sup> *Ambient Monitoring Plan for the Massachusetts Water Resources Authority Effluent Outfall (Revision 2.1, August 2021)*. Report 2021-08. <https://www.mwra.com/harbor/enquad/pdf/2021-08.pdf>. See pages 24 and 40-41 for specific information on DO monitoring.

<sup>5</sup> 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 August 23<sup>rd</sup> survey.

Figure 3 shows the DO concentration at F22 from the August 23<sup>rd</sup> survey. The plot elements are the same as in Figure 2.



**Figure 3.** DO concentration results from F22 on the August 23<sup>rd</sup> survey.

## **Discussion**

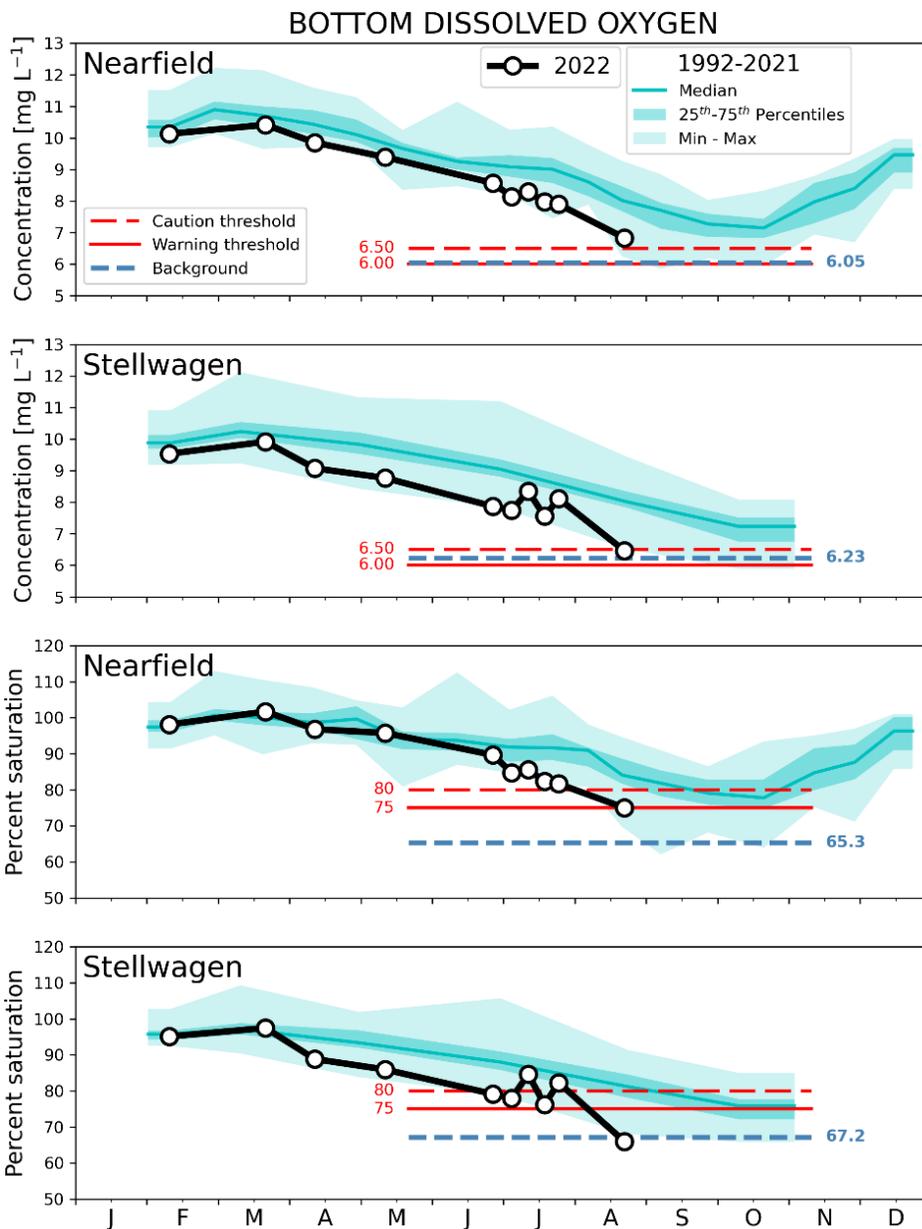
There is currently no evidence this exceedance is related to the Deer Island Treatment Plant outfall discharge. Both warning level thresholds and background condition values for DO percent saturation and concentration thresholds were met in the nearfield immediately around the outfall. If the DO exceedance 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 October 2000 and warning level exceedances in September and November 2021; there was also a caution level exceedance in the nearfield in October 2000. There were no nearfield exceedances in September or November 2021. 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.<sup>6</sup> Similar to this current exceedance, the DO concentrations at both locations in 2000 and September 2021 met the threshold values. Stellwagen Basin DO concentrations in November 2021, however, were below the warning level.

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.

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



**Figure 4.** 2022 DO results compared to 1992-2021 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 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.

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](mailto:betsy.reilley@mwra.com).

Sincerely,

Carolyn M. Fiore  
Deputy Chief Operating Officer

**cc:**

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