Environmental Quality Department
Massachusetts Water Resources Authority
1/5/2021

Contingency Plan Quarterly Report
on Ambient Monitoring Results
Fourth Quarter 2020

MWRA gathers data near the outfall discharge location in Massachusetts Bay. These data are used to calculate results on various thresholds in the Contingency Plan that is attached to its Deer Island Treatment Plant (DITP) NPDES discharge permit. This report shows ambient monitoring results for Contingency Plan thresholds that became available October through December 2020. Previous Contingency Plan reports are available at http://www.mwra.state.ma.us/harbor/html/archive.htm#cpq.

Results in this report include 2020 seasonal nuisance algae abundances, water column seasonal areal chlorophyll and dissolved oxygen, and benthic infauna diversity results. There are no Contingency Plan threshold exceedances for any of these results.

COVID-19 impacts on Ambient Monitoring in 2020. The COVID-19 pandemic resulted in some impacts to MWRA's ambient monitoring activities in 2020. The March water column survey was cancelled, due to pandemic related restrictions, as well as weather issues preventing safe boating. The April survey was postponed to early May. MWRA and its monitoring team worked to adapt the monitoring to the health and safety and social distancing guidance required by the pandemic. With the exception of the March and April water column data, all scheduled 2020 water column, sediment, and winter flounder monitoring samples related to Contingency Plan Thresholds were successfully collected.

NUISANCE ALGAE

ALEXANDRIUM - autumn (September – October) 2020

The nuisance algae *Alexandrium catenella* can cause paralytic shellfish poisoning (PSP, "red tide") in Massachusetts Bay. MWRA measures *Alexandrium* abundance in its monitoring program, and checks observations of shellfish PSP toxicity from state fisheries agencies from Maine to Massachusetts and other regional monitoring programs to keep track of the course of Gulf of Maine *Alexandrium* blooms.

In September and October 2020, *Alexandrium* samples were collected from two routine water column surveys. All sample results were well below the threshold value of 100 cells per liter.

In the figures below, we compare *Alexandrium* data for each sample collected at nearfield (within about 7 kilometers of the outfall) stations to the threshold value. The first figure includes data since the start of the monitoring program in 1992 (Figure 1). To better display recent values, the second figure shows 2020 data only, which were collected during nine routine water column surveys and two special *Alexandrium* surveys from February through October in 2020 (Figure 2). Note that a logarithmic scale is used in both graphs.

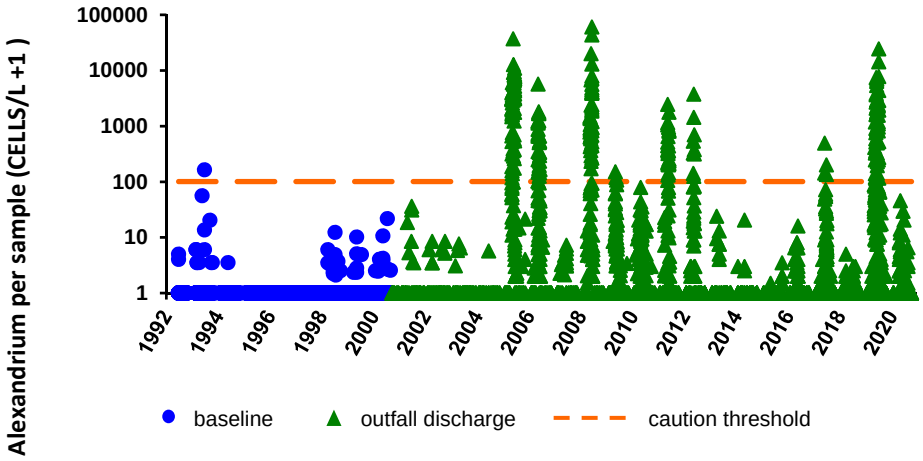

Figure 1. *Alexandrium* cell concentrations in Nearfield (1992-2020)

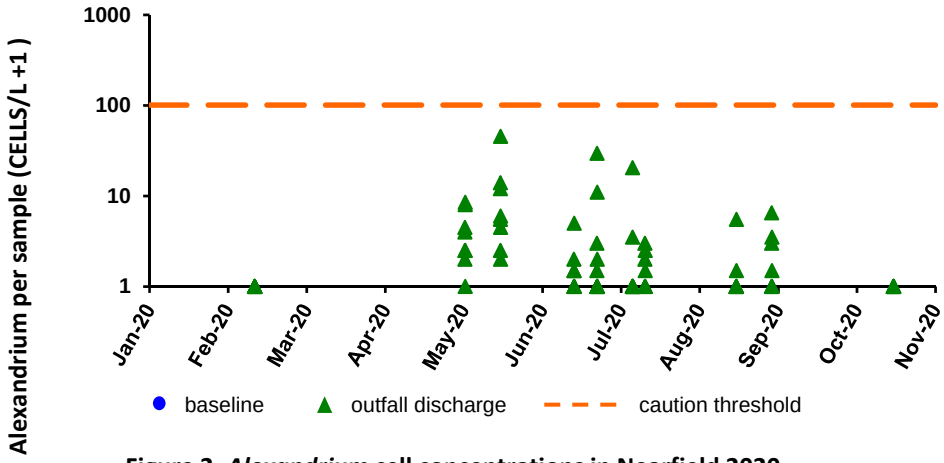

Figure 2. *Alexandrium* cell concentrations in Nearfield 2020

***Alexandrium* per-sample abundance (cells/liter)**

Caution threshold	100
September-October 2020	5.5*
* maximum of all nearfield samples collected September – October 2020	

***PSEUDO-NITZSCHIA* – Summer (May-August) and autumn (September-October) 2020**

There were no *Pseudo-nitzschia* threshold exceedances for summer and autumn 2020. For *Pseudo-nitzschia* nuisance algae species, the Caution Level threshold values were derived from the 95th percentile of seasonal baseline means, and seasonal mean abundances at nearfield stations are compared against threshold values.

During summer 2020, *Pseudo-nitzschia* was observed with low abundance in three samples from nearfield stations. The summer mean abundance of 366 cells per liter was well below the Caution Level threshold of 43,100 cells per liter. In autumn, *Pseudo-nitzschia* was observed in multiple samples from nearfield stations, with mean abundance of 1,150 cells per liter, also well below the Caution Level threshold of 27,500 cells per liter for the season.

In the figures below, we display the *Pseudo-nitzschia* Caution Level thresholds for summer (Figure 3) and autumn (Figure 4), and the mean abundance data for the two seasons from since the start of the monitoring program in 1992.

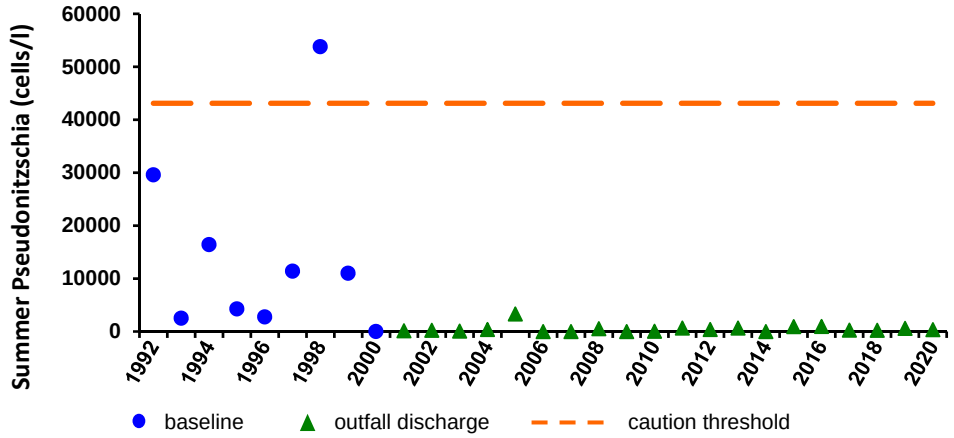

Figure 3. Seasonal mean *Pseudo-nitzschia* abundance in nearfield Summer (1992 - 2020)

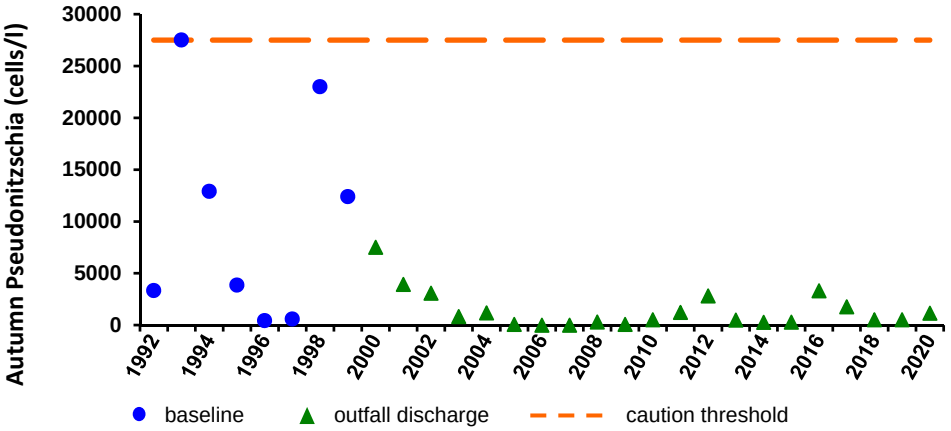

Figure 4. Seasonal mean *Pseudo-nitzschia* abundance in nearfield Autumn (1992 - 2020)

PHAEOCYSTIS – August – October 2020

In February 2017, EPA approved changes in the Contingency Plan to remove the seasonal threshold for the abundance of the nuisance alga *Phaeocystis pouchetii* in the nearfield water column. During bloom conditions, *Phaeocystis* can form large, gelatinous colonies, which may accumulate as foam as they disintegrate on beaches. Evaluations of prior threshold exceedances for this species have indicated that they resulted from natural fluctuations in Massachusetts Bay, do not represent degradation, were not a result of MWRA's discharge, and have not occurred in concentrations that would pose problems for recreation. MWRA agreed to continue to report each quarter on nearfield survey mean abundances of *Phaeocystis pouchetii* compared to its historical seasonal pattern. This quarter, results from August through October 2020 became available.

The figure below (Figure 5) shows the 2020 survey mean *Phaeocystis* results against the seasonal background from prior years since 1992. Due to reductions in the number of surveys conducted each year, the historical seasonal pattern encompasses more time-points than shown for the current year.

There were no *Phaeocystis* cells observed in samples collected during surveys from August through October 2020, which was consistent with the historical pattern.

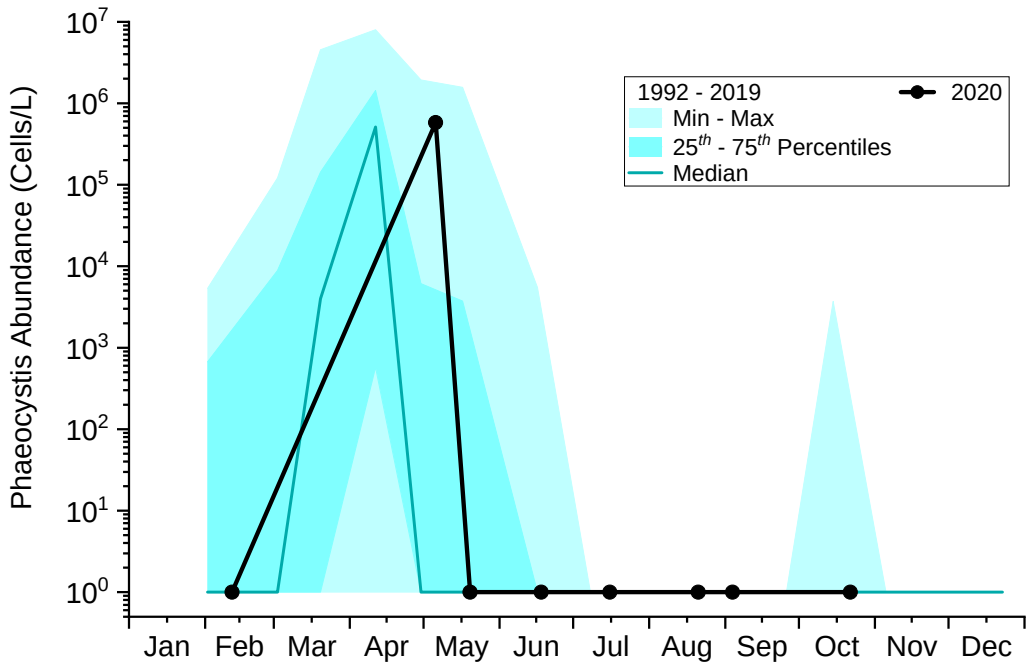

Figure 5. Mean *Phaeocystis* abundance per survey in Nearfield (1992 – 2020)

CHLOROPHYLL – Summer (May-August) and autumn (September – October) 2020

There were no chlorophyll threshold exceedances for either the summer or autumn thresholds for 2020. The nearfield mean areal chlorophyll was 53.7 mg/ m^2 for summer 2020, and 102 mg/m^2 for autumn, well below their respective seasonal Caution Level thresholds of 89 mg/ m2 and 239 mg/m^2. Both seasonal results were within the ranges of the baseline (pre-discharge) and previous post-discharge years.

Due to the impact of COVID-19 pandemic, water samples were not collected in March and April for the spring season this year. Because of this, the annual mean chlorophyll Contingency Plan threshold test could not be performed.

The figures below compares seasonal chlorophyll results for summer (Figure 6) and autumn (Figure 7), and for survey mean results (Figure 8) in 2020 with those historical results since the start of the monitoring program in 1992. Figure 8 shows that even though the annual threshold could not be tested, the chlorophyll results that are available were all within ranges observed during previous years.

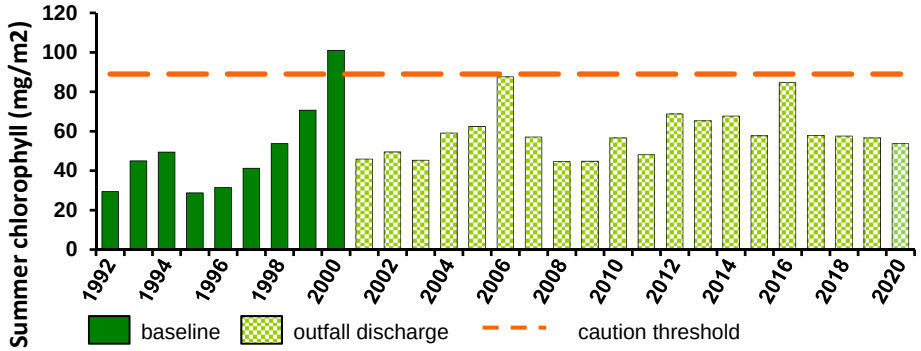

Figure 6. Summer mean areal chlorophyll concentrations in Nearfield (1992-2020)

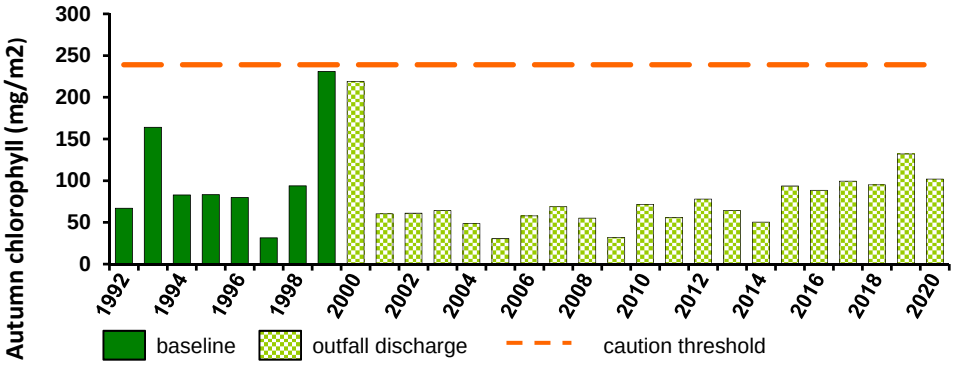

Figure 7. Autumn mean areal chlorophyll concentrations in Nearfield (1992-2020)

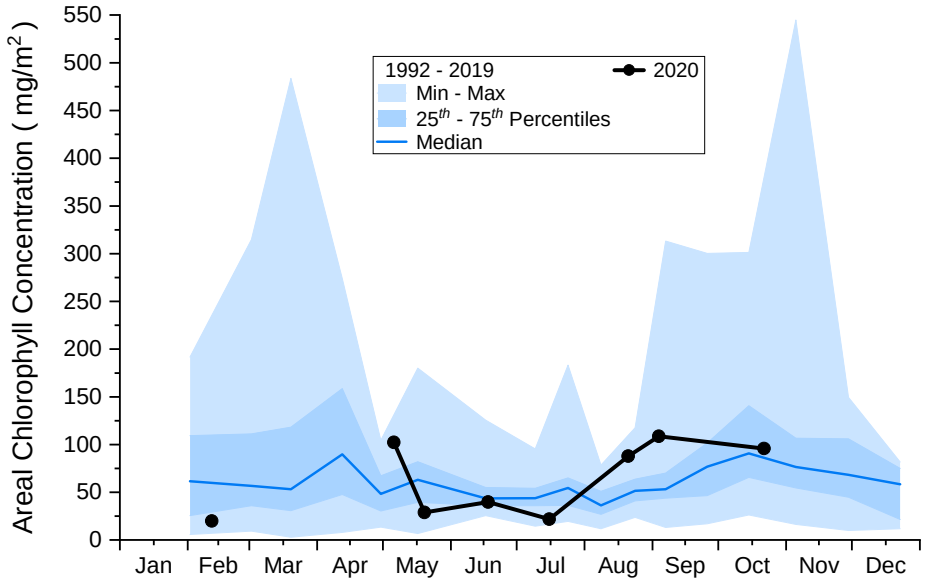

Figure 8. Mean area chlorophyll concentrations per survey in Nearfield (1992 – 2020)

DISSOLVED OXYGEN (DO) – October 2020

The DO thresholds are compared to results collected in deep water (within 5 meters of the seafloor) from nearfield and Stellwagen Basin stations from June through October each year. During this period, warmer temperatures cause lower solubility and water column stratification, which can further reduce dissolved oxygen concentration and saturation in bottom water. Because these seasonal cycles historically resulted in DO lower than the selected threshold values, "background" values were established based on results from 1992-1999, before outfall discharge began. For a threshold exceedance to be triggered, results have to be below both the numeric threshold and the background values.

The graphs below show the annual fluctuation of bottom DO and percent saturation from nearfield stations and in Stellwagen Basin, which are typically lowest in early autumn. To better compare the threshold results across years, only a subset of data collected during 1992-2010 are used, which corresponds to the revised design of the Massachusetts Bay monitoring program that began in 2011.

In October 2020, results collected from the regular water column survey show that bottom-water oxygen concentration (Figure 9 & Figure 10) and percent saturation (Figure 11 & Figure 12) at both nearfield and Stellwagen Basin stations are within the range of previous years. The oxygen percent saturation in the nearfield and in Stellwagen Basin decreased below the caution threshold of 80 percent and warning threshold of 75 percent during October survey, but was well above their corresponding background levels. All other measurements remained above both caution levels and background levels. Thus, there were no threshold exceedances during this period.

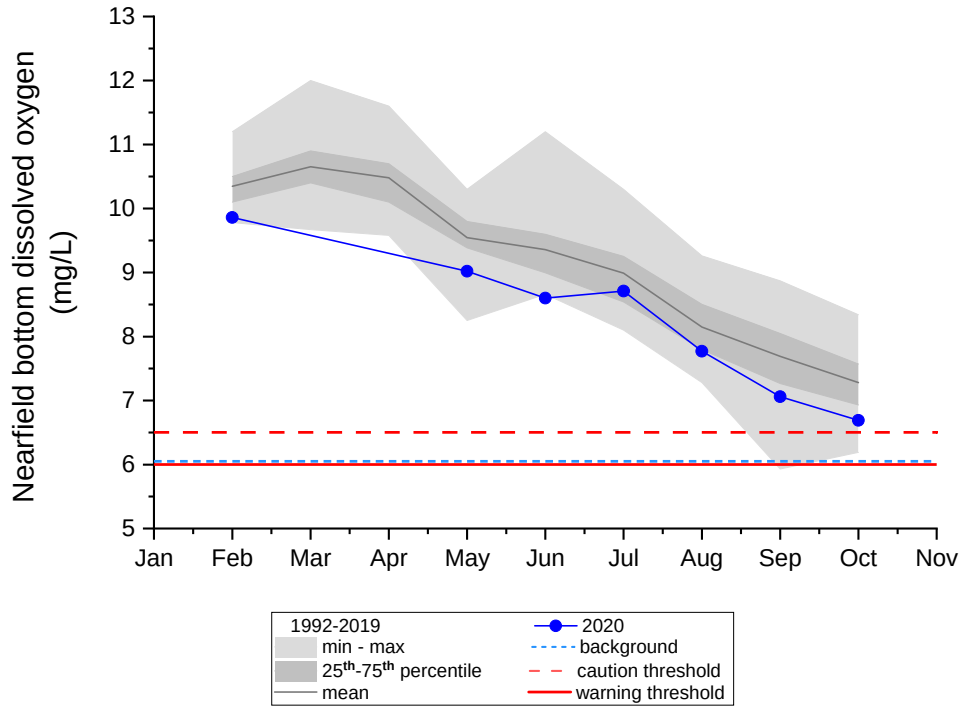

Figure 9. Bottom dissolved oxygen in the Nearfield (1992 – 2020)

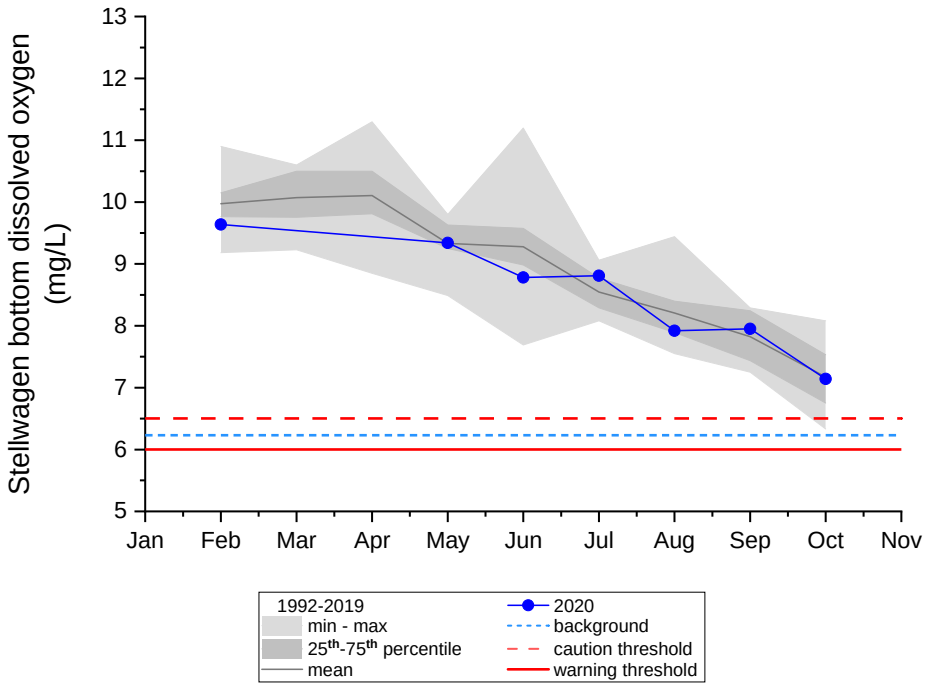

Figure 10. Bottom dissolved oxygen in Stellwagen Basin (1992 – 2020)

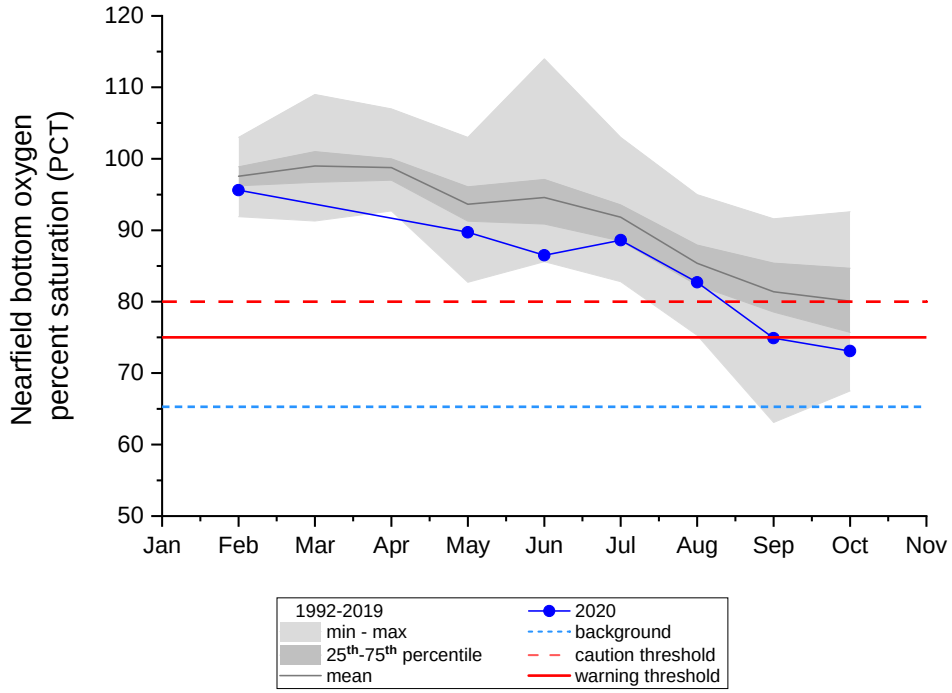

Figure 11. Bottom oxygen percent saturation in the Nearfield (1992 – 2020)

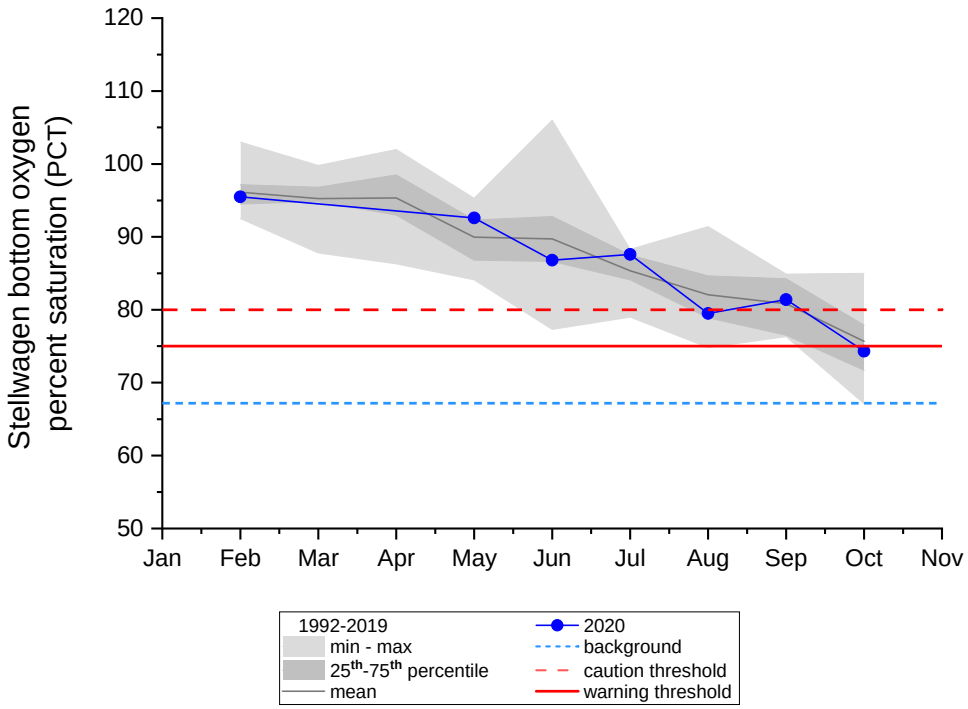

Figure 12. Bottom oxygen percent saturation in Stellwagen Basin (1992 – 2020)

DISSOLVED OXYGEN DEPLETION RATE – summer (June – October) 2020

An additional threshold measure of dissolved oxygen is the bottom-water dissolved oxygen depletion rate, which measures the rate at which oxygen in the bottom water decreases during stratified summer period from June to October. During the period, the dissolved oxygen concentrations in the bottom water decrease to lower levels. Even if the concentration measurements remain healthy, an excessively rapid decline could signal a future problem. A low depletion rate indicates DO dropped only slowly.

The threshold values for the oxygen depletion rate are based on the measurements from the baseline years; the caution threshold is a depletion rate at 1.5 times of the baseline mean rate, while the warning threshold is twice of the baseline mean rate.

The DO depletion rate for the summer 2020 (Figure 10) was 0.018 mg/L/day, which was well below the caution-level threshold 0.037 mg/L/day and the warning-level threshold 0.049 mg/L/day.

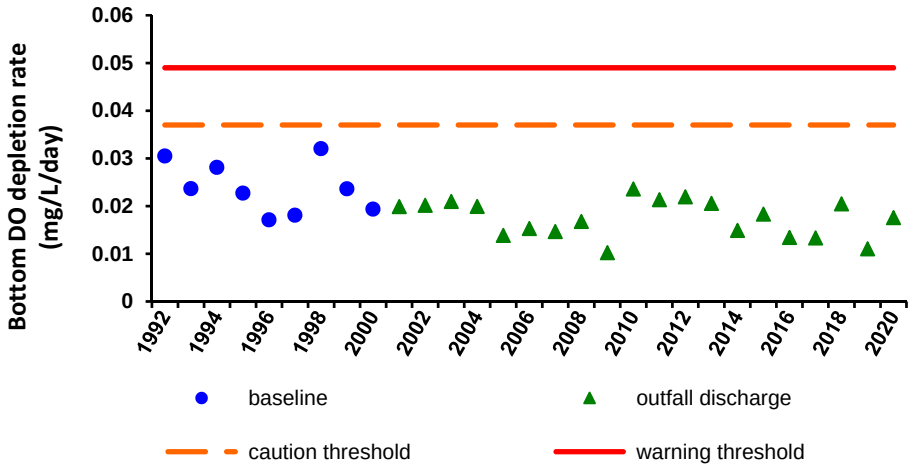

Figure 13. Bottom oxygen depletion rate in Nearfield (1992 – 2020)

SEDIMENT BIODIVERSITY - 2020

Every summer MWRA collects samples to measure the condition of benthic community (organisms living on and in the sea floor) near the outfall. These measurements are used to calculate four indicators of sediment biodiversity, and an additional important indicator of benthic habitat quality, the proportion of opportunistic animals in the benthic community. Opportunistic animals are found to predominate in degraded sediments.

DIVERSITY

In 2020, all four biodiversity indicators show that the sediment habitat in the vicinity of the outfall support highly diverse populations of benthic species. All indicators are above the Contingency Plan Caution Level thresholds. The Caution Level thresholds are calculated as the 2.5th percentile of the baseline mean measurements of these indicators.

The graphs (Figure 14) below show the annual average of each diversity indicator for sediment samples collected since 1992. To better compare the threshold results across years, a subset of data collected during 1992-2003 are used, reflecting the modified design of the Massachusetts Bay monitoring program that began in 2011. Data from 2004 through 2010 are the averages for the odd- or even-year stations sampled then, and not all of the nearfield stations in current design were sampled in those years.

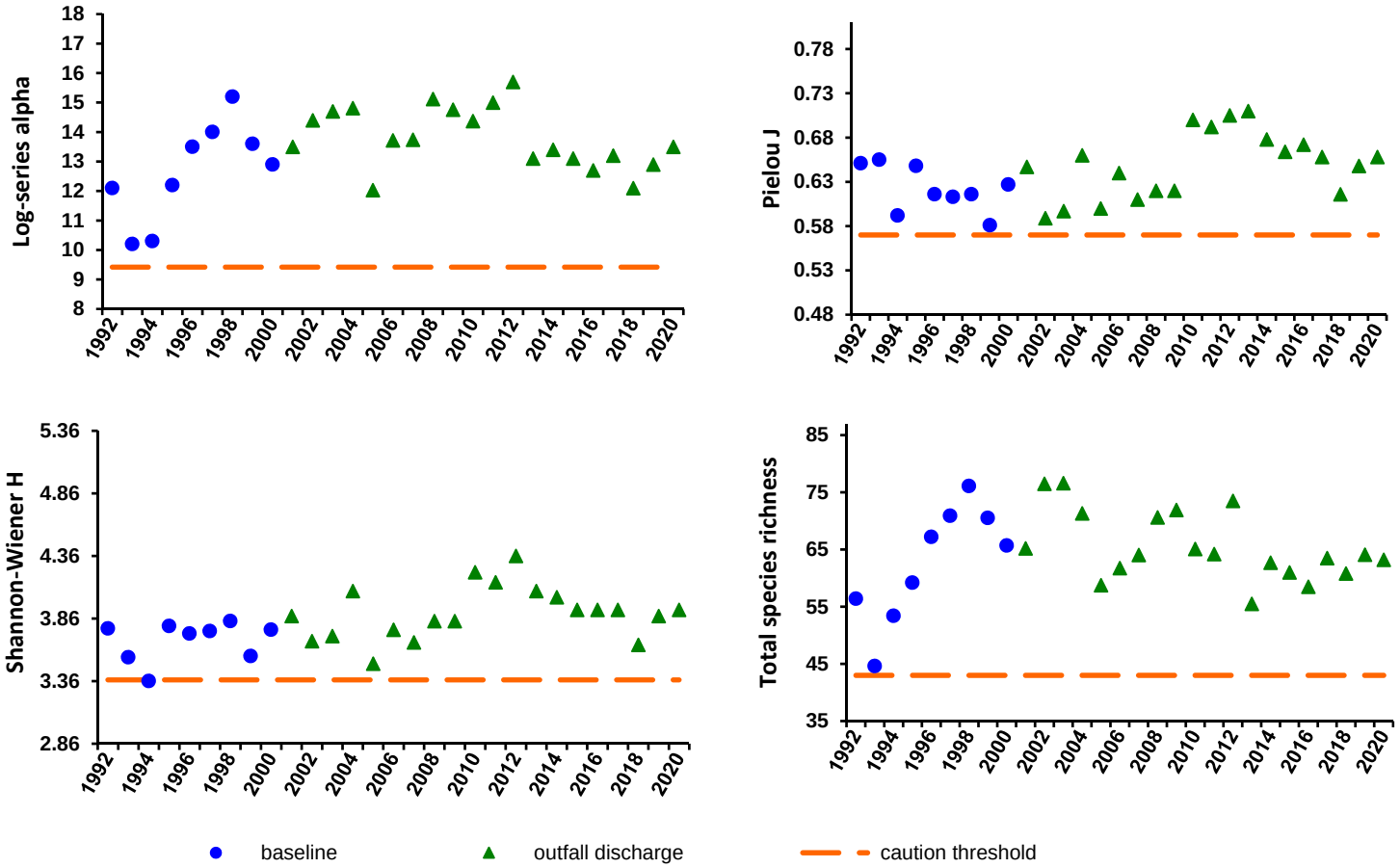

Figure 14. Benthic biodiversity indicators in nearfield (1992 – 2020)

OPPORTUNISTS

In 2020, the average percent opportunists is within the range of previous years in the baseline (pre-discharge) and post-discharge years and remains far below the Caution Level threshold of 10% of the total population (Figure 15).

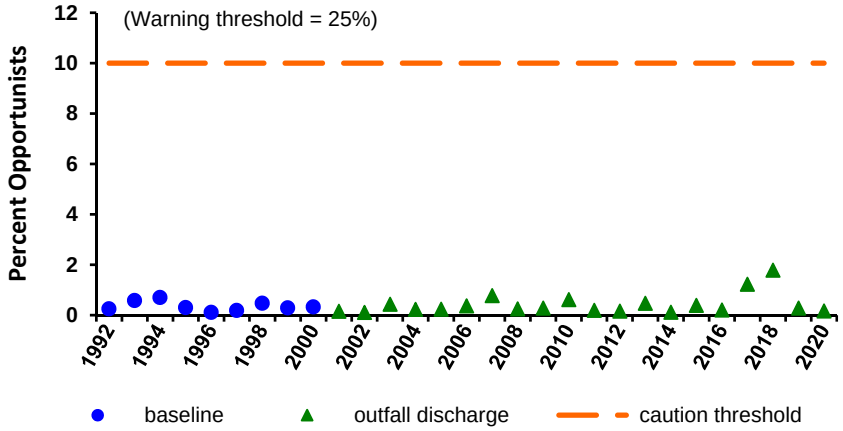

Figure 15. Percent opportunists in nearfield (1992 – 2020)