

Contingency Plan Report Fourth Quarter 2011

Ambient Monitoring

MWRA gathers data from the outfall location in Massachusetts Bay on various thresholds in its Deer Island outfall discharge permit. This report shows relevant ambient monitoring results that became available in the October-December 2011 time period. There were two contingency plan threshold exceedances for sediment biodiversity.

SEDIMENT BIODIVERSITY - 2011

DIVERSITY

The annual survey of sediment-dwelling communities in 2011 showed that two measures of [benthic diversity](#) exceeded their thresholds.

Calculations of diversity in the bottom-dwelling community in the August 2011 monitoring data showed two measures above their upper diversity thresholds, triggering notification under the Contingency Plan (see http://www.mwra.state.ma.us/harbor/pdf/20111215amx_diversity.pdf.) MWRA samples the animals that live in the mud near the outfall every summer and measures the numbers and kinds of animals living there. These measurements are used in four indicators of biodiversity. In 2011, as in 2010, two of those four measures were slightly higher than the upper diversity threshold (there are upper and lower thresholds corresponding to the 97.5th percentile and 2.5th percentile of the baseline mean¹.) That is, the community was more diverse than in baseline, before the outfall came on-line.

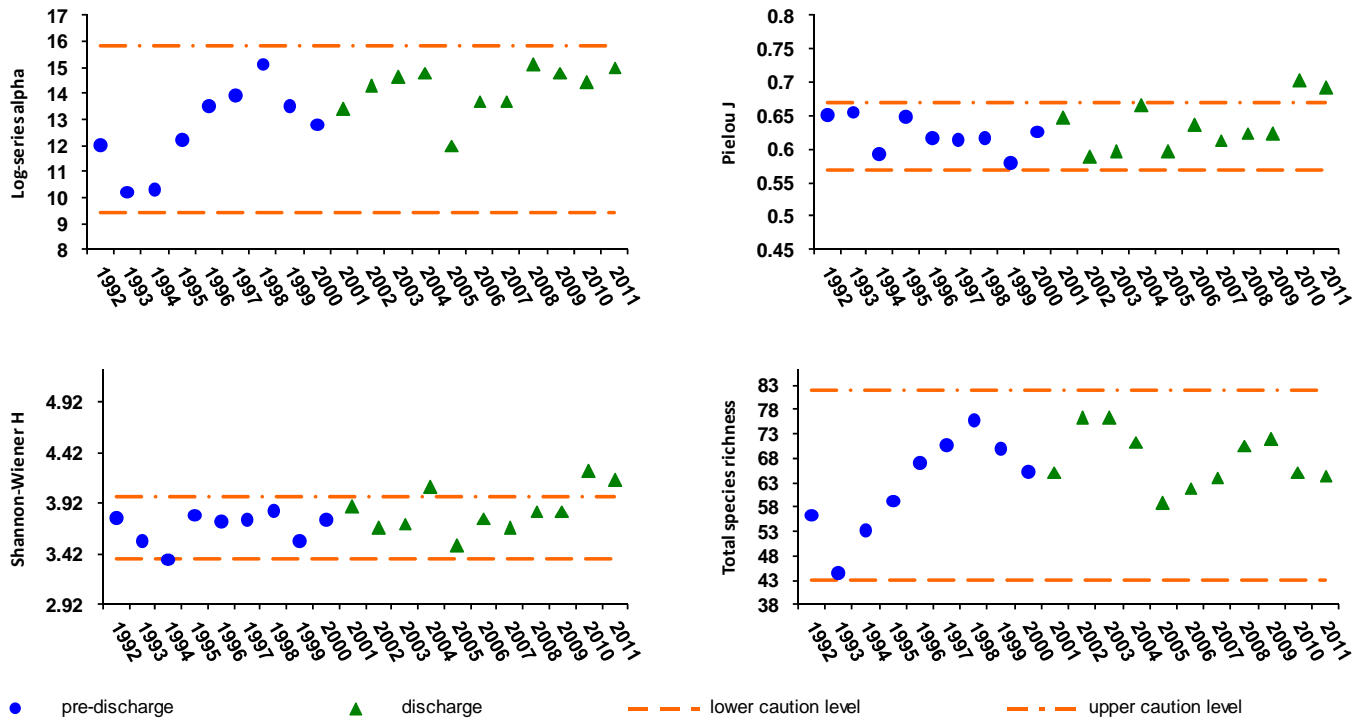
Other measures of the sediment animal community health including the other two diversity indices, sediment oxygenation, sediment quality, and the abundance of animals, showed no indication that excessive sediment enrichment was occurring, or that there has been a decline in sediment community health. The number of opportunistic animals remains extremely low. Therefore, all indications so far are that the increased diversity is a normal fluctuation of the sediment animal population.

A [similar exceedance](#) of the same two diversity indices in 2010 was evaluated and discussed at the June 2010 meeting of EPA's Outfall Monitoring Science Advisory Panel (OMSAP), with details of the evaluation included in the [2010 Outfall Benthic Monitoring Report](#). Those evaluations found that the 2010 exceedance probably represented natural fluctuations in the infaunal communities, and were not influenced by the outfall. Thus far, the 2011 data support the same conclusion. Given the strong year-to-year similarity normally observed in infaunal communities during MWRA's monitoring, it is not surprising that similar exceedances in the same parameters were observed in the 2011 monitoring as were seen in 2010.

¹ Thresholds recalculated for new study design: in a change from the sampling design in 2004-2010, where different sets of stations were sampled in even or odd years, and the results tested against "even" and "odd" thresholds, the revised monitoring plan calls for eleven nearfield stations to be sampled each year. The thresholds were recalculated using the baseline data from just these 11 stations. The thresholds are very slightly different from the old thresholds. The threshold for opportunists is not based on baseline data and is not affected by the study redesign.

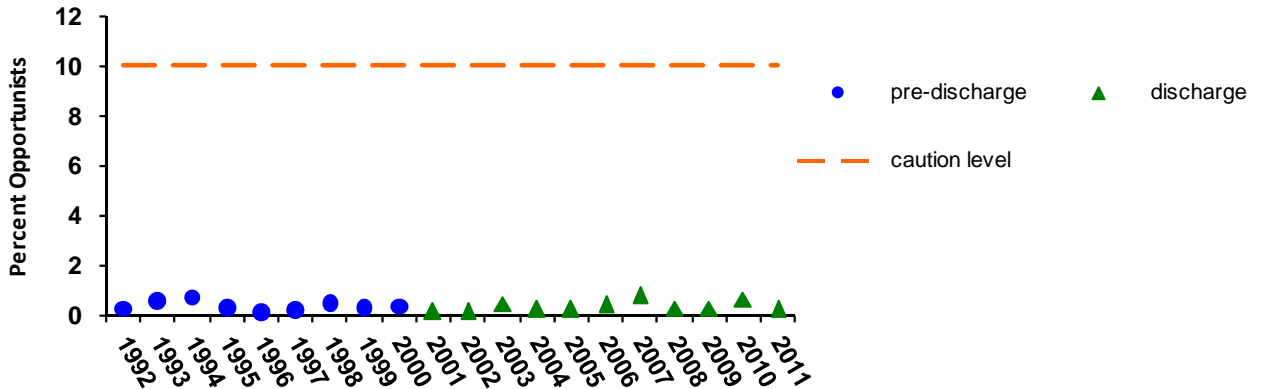
For each diversity measure, the graphs show the annual average for sediment samples collected within seven kilometers of the outfall discharge since 1992. The results shown for 1992-2003 and 2011 are from the current eleven monitoring stations (which are a subset of the stations sampled 1992-2003), reflecting the modified design that began in 2011. Data from 2004 through 2010 are the averages for the odd- or even-year stations sampled then, as not all of the 11 nearfield stations currently sampled were sampled in those years. This enables us to better compare the threshold results across years.

The threshold levels varied slightly through the monitoring period because of the differing station sets; for simplicity only the current thresholds are shown. (Although it appears that there was an exceedance of the Shannon-Weiner H' threshold in 2004, the threshold in effect at that time was slightly higher, so there was no exceedance.) The previous reports are at <http://www.mwra.state.ma.us/harbor/html/archive.htm#cpqamb>.



OPPORTUNISTS

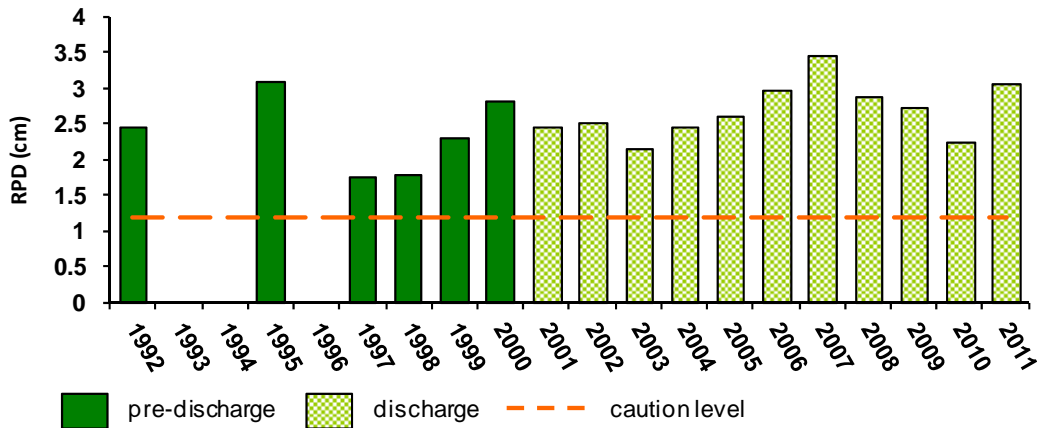
The annual sampling in 2011 showed that the numbers of [opportunistic benthic organisms](#) remain normal at the outfall site and did not exceed the caution threshold of 10% of the total population.



The graph shows the annual average for sediment samples collected within seven kilometers of the outfall discharge since 1992. As for the diversity measures, the results shown for 1992-2003 and 2011 are from the current set of eleven monitoring stations, reflecting the modified design that began in 2011. Data from 2004 through 2010 are the averages for the odd- or even-year stations sampled then, as not all of the 11 nearfield stations currently sampled, were sampled in those years. This enables us to better compare the threshold results across years. Earlier reports are at <http://www.mwra.state.ma.us/harbor/html/archive.htm#cpqamb>.

SEDIMENT ENRICHMENT - 2011

The 2011 annual sediment monitoring showed that the RPD depth was normal at the outfall site and did not exceed the threshold (did not fall below the minimum RPD threshold; see explanation below.)



The depth of the oxygenated layer in marine sediment is a measure of ecosystem health. A diverse bottom-dwelling community includes organisms that mix water and oxygen down into the sediment. In an over-enriched environment, organic material deposited on the sediment surface can use up the available oxygen and smother the bottom-dwelling community. Such areas, including some areas of Boston Harbor, have a thin or nonexistent oxygenated layer. The thickness of the oxygenated layer is called the redox potential discontinuity (RPD) depth. In MWRA's monitoring program, the RPD depth is estimated from sediment-profile images, cross-sections of the upper several centimeters of the sediment taken with a special mud-penetrating prism and camera. The threshold for RPD is half the mean measured in the baseline period (that is, if the thickness of the oxygenated layer fell to less than half the thickness measured pre-discharge, a caution threshold would be exceeded.)

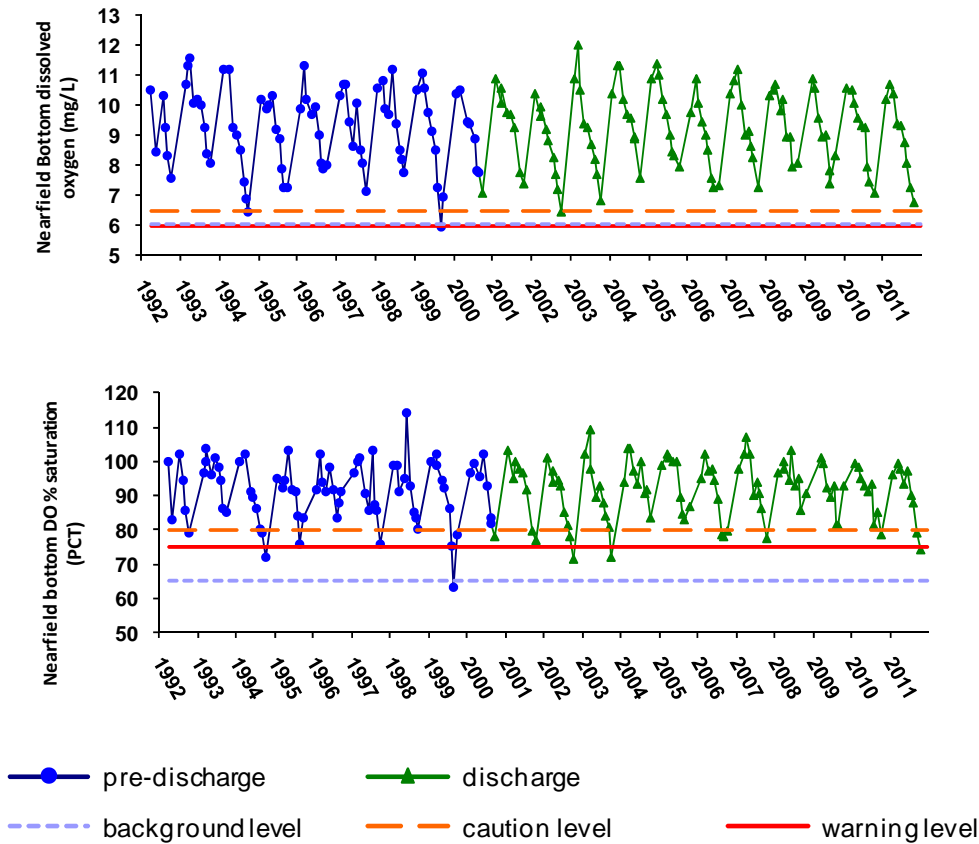
DISSOLVED OXYGEN (DO) –September-October 2011

Measurements of dissolved oxygen (DO) concentration and percent saturation in autumn 2011 did not fall below background levels and thus did not exceed thresholds.

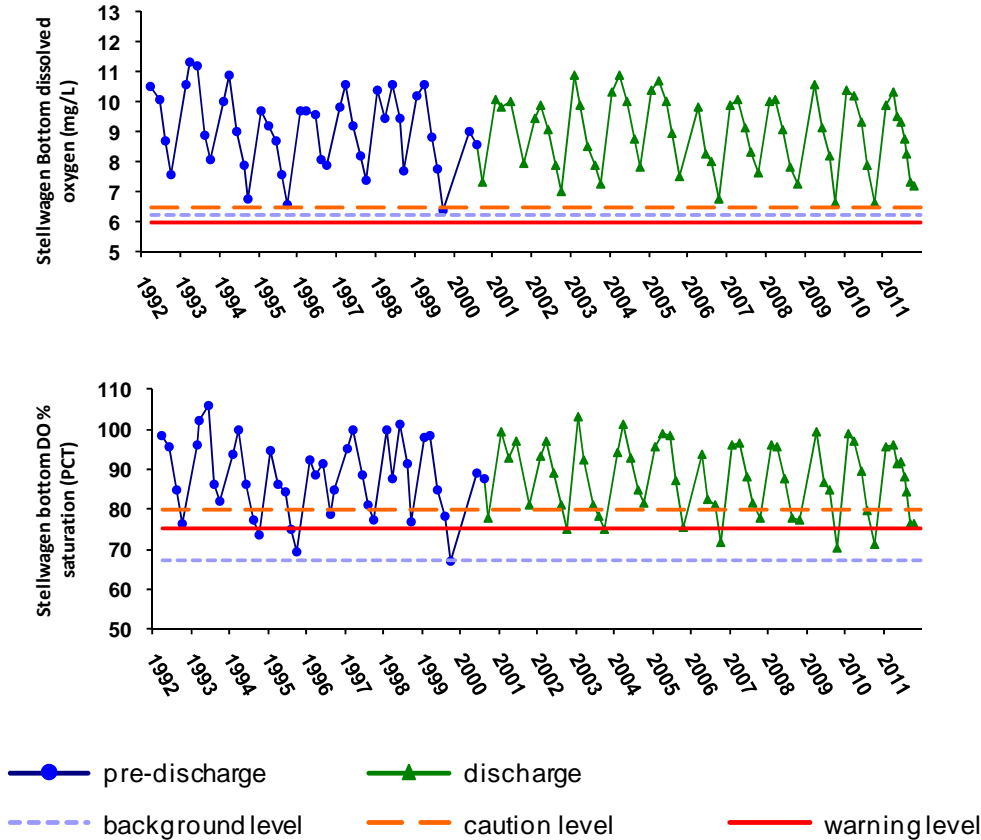
The current reporting period for [dissolved oxygen thresholds](#) is September - October 2011. During this period there were two surveys. Oxygen levels were similar to those seen in most baseline years. The graphs below show the natural annual fluctuation of DO and percent saturation, which is typically lowest in early autumn. The 1992-2010 data shown are a subset of all data reflecting the modified design that began in 2011, *i.e.* nine surveys per year, and one station rather than four in Stellwagen Basin. This enables us to better compare the threshold results across years. The previous reports are at <http://www.mwra.state.ma.us/harbor/html/archive.htm#cpqamb>.

Nearfield oxygen levels were somewhat low in September and October, but similar to those seen in some baseline years.

NEARFIELD

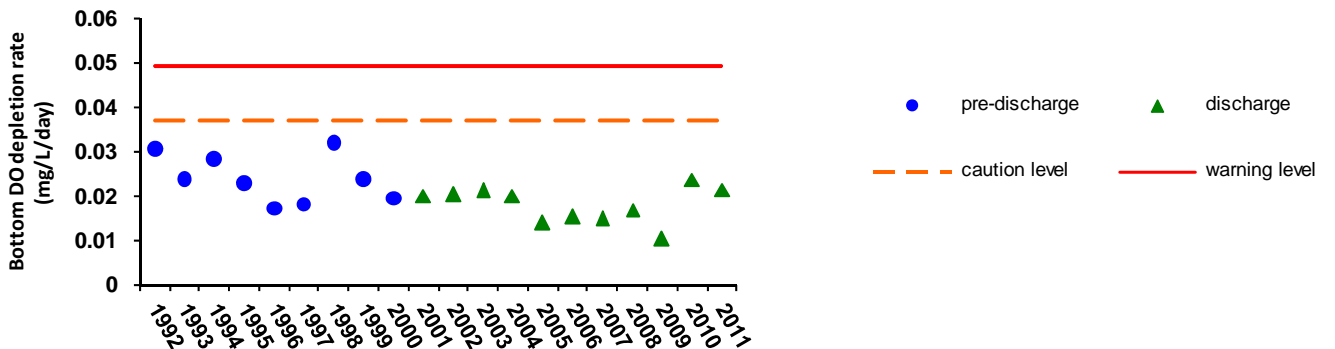


STELLWAGEN BASIN



DO DEPLETION RATE – summer 2011

An additional threshold measure of dissolved oxygen is the rate at which oxygen is depleted during the stratified summer period. The current reporting period for oxygen depletion rate is summer 2011, defined as June - October. The DO depletion rate for the summer of 2011 was higher than other post-discharge years, but typical of pre-discharge summers and well below the threshold.



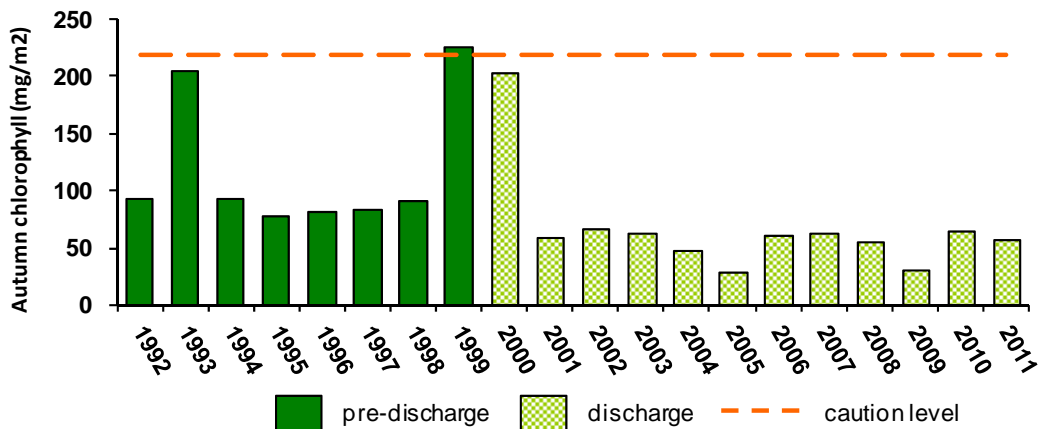
Even if dissolved oxygen concentrations remain healthy, an excessively rapid rate of decrease could signal a future problem. A low rate indicates DO dropped only slowly. The threshold for DO depletion rate is based on a change from the baseline rate; the caution threshold is a rate faster than 1.5 times the baseline mean rate, while the warning threshold is twice the baseline mean rate.

CHLOROPHYLL – September-November 2011 and Annual 2011

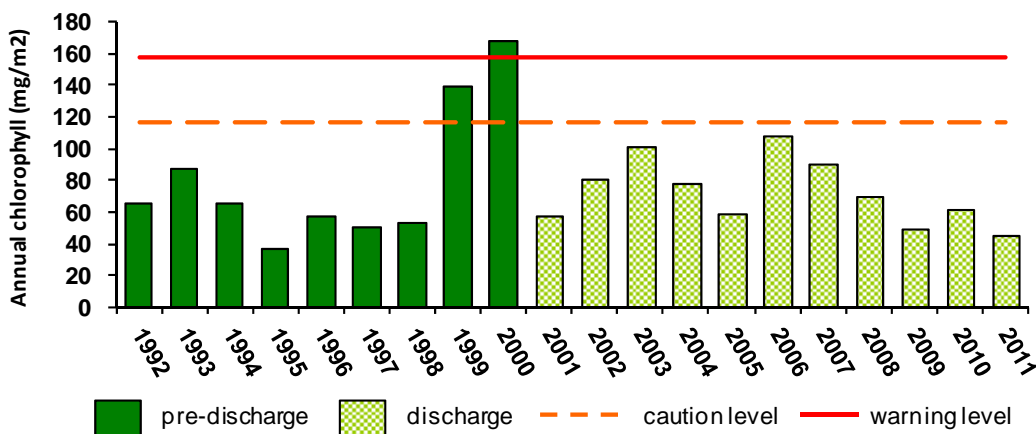
There were no [chlorophyll threshold](#) exceedances for either autumn 2011 or for the entire year. The nearfield mean areal average chlorophyll in autumn 2011 was 58 mg/m², well below the caution level threshold² for autumn of 218 mg/m² and in the lower end of the range typical of the pre-discharge period. The 2011 annual average was 45 mg/m², below the caution and warning thresholds³ for annual average chlorophyll of 117 and 157 mg/m², respectively. Both autumn and annual results were similar to other low-chlorophyll years in the pre-diversion and post-diversion periods.

The figures below compare chlorophyll data for autumn 2011 (September-October), which included two surveys, and data for all of 2011, to the corresponding thresholds. The graph includes data since the start of the monitoring program in 1992; however, the seasonal average values for 1992-2010 are calculated using a subset of all results reflecting the modified design that began in 2011, *i.e.* three winter/spring surveys, four summer surveys, and two autumn surveys. This enables us to better compare the threshold results across years. The previous reports are at <http://www.mwra.state.ma.us/harbor/html/archive.htm#cpqamb>.

Autumn



Annual



² Threshold recalculated for new survey schedule: in 2011, MWRA implemented a new outfall sampling design, which included dropping two autumn surveys. The baseline means and the thresholds (the 95th percentile of the baseline mean) were recalculated mathematically by deleting baseline data corresponding to the dropped surveys. The recalculated autumn threshold for chlorophyll is 218, very slightly higher than the old threshold of 212 mg/m².

³ Threshold recalculated for new survey schedule: The baseline mean and the thresholds (1.5 and 2 times the baseline mean) were recalculated mathematically by deleting baseline data corresponding to three dropped surveys (one spring and two autumn). The recalculated annual thresholds of 117 and 157 mg/m² are very close to the old thresholds of 118 and 158 mg/m².

NUISANCE ALGAE – SUMMER and AUTUMN 2011

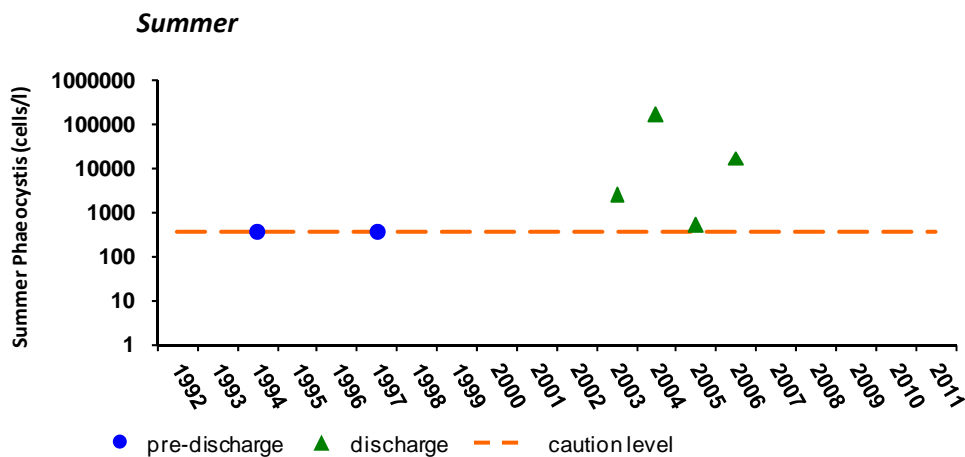
In the figures below, we compare *Phaeocystis* and *Pseudonitzschia* data to the [nuisance algae thresholds](#) for summer 2011 (May through August), which included four surveys, and autumn 2011 (September –October), which included two surveys⁴. We also compare *Alexandrium* data to the threshold for each sample in August – October 2011.

The graphs include data since the start of the monitoring program in 1992; however, the seasonal average values for 1992-2010 are calculated using a subset of all results reflecting the modified design that began in 2011, *i.e.* two rather than four autumn surveys. This enables us to better compare the threshold results across years. The previous reports are at <http://www.mwra.state.ma.us/harbor/html/archive.htm#cpqamb>.

There were no threshold exceedances for *Phaeocystis*, *Pseudonitzschia*, or *Alexandrium*.

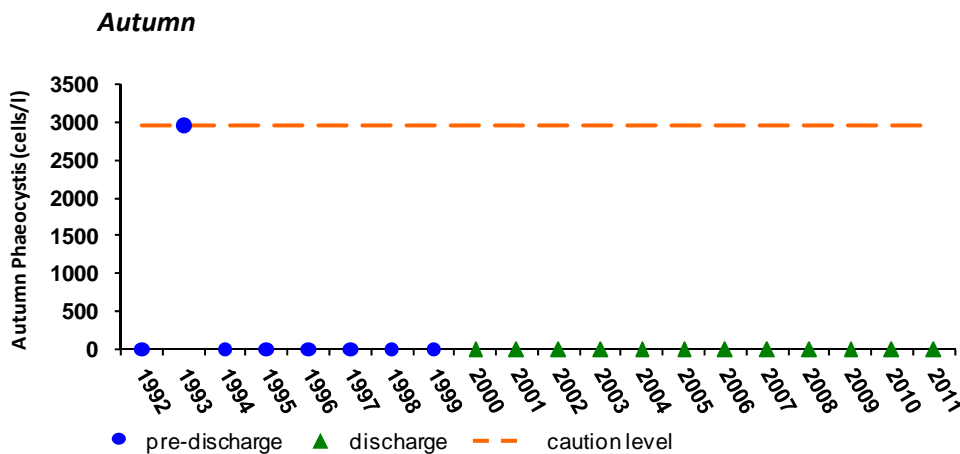
PHAEOCYSTIS

Phaeocystis pouchetii was not observed in the nearfield in summer or autumn of 2011 .



Summer <i>Phaeocystis</i> mean abundance (cells/liter)	
Caution threshold	357
Summer 2011	0

Note logarithmic scale. Years with no data point had zero summer average *Phaeocystis*.

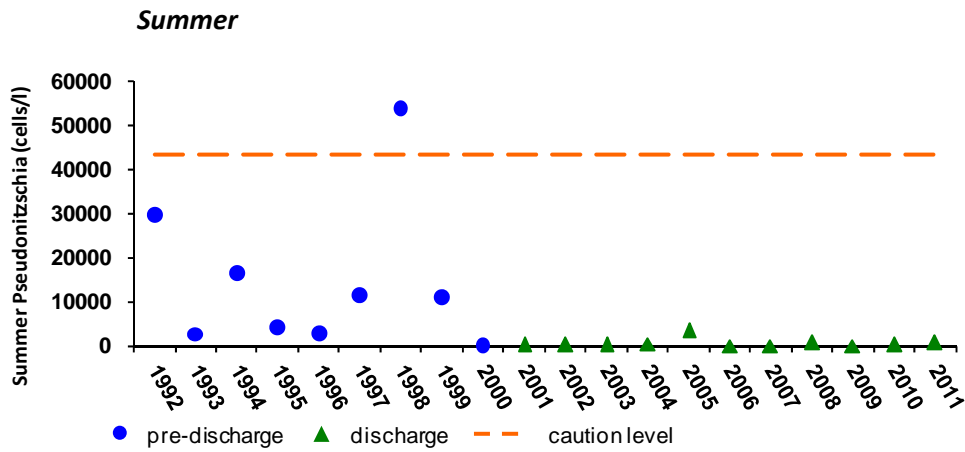


Autumn <i>Phaeocystis</i> mean abundance (cells/liter)	
Caution threshold	2,960
Autumn 2011	0

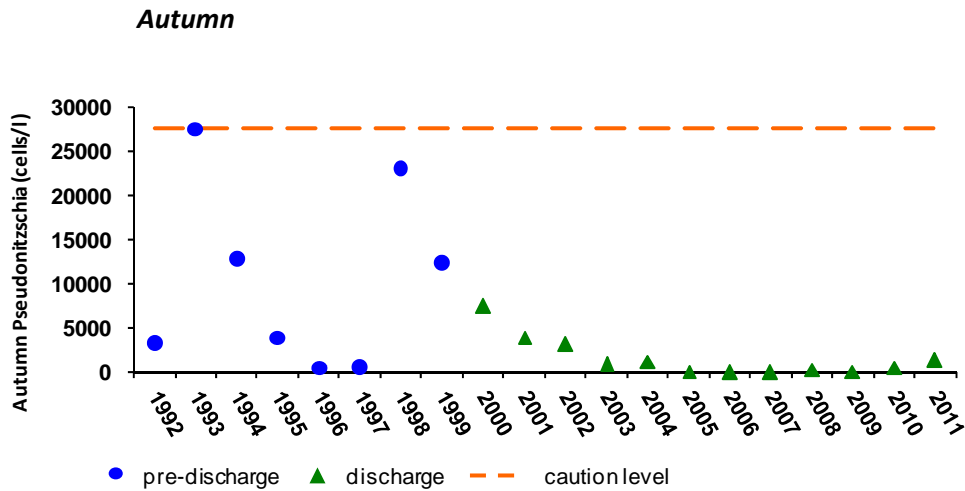
⁴ Thresholds recalculated for new survey schedule: There was no change in the summer survey schedule, so the summer thresholds are unchanged. The autumn threshold was recalculated after mathematically by deleting two autumn surveys. The autumn thresholds are very slightly higher than the old threshold of 2,540 cells/l (*Phaeocystis*) and 24,700 cells/l (*Pseudonitzschia*).

PSEUDONITZSCHIA

Pseudonitzschia was observed only at very low levels in the summer and autumn of 2011.



Summer <i>Pseudonitzschia</i> mean abundance (cells/liter)	
Caution threshold	43,100
Summer 2011	660

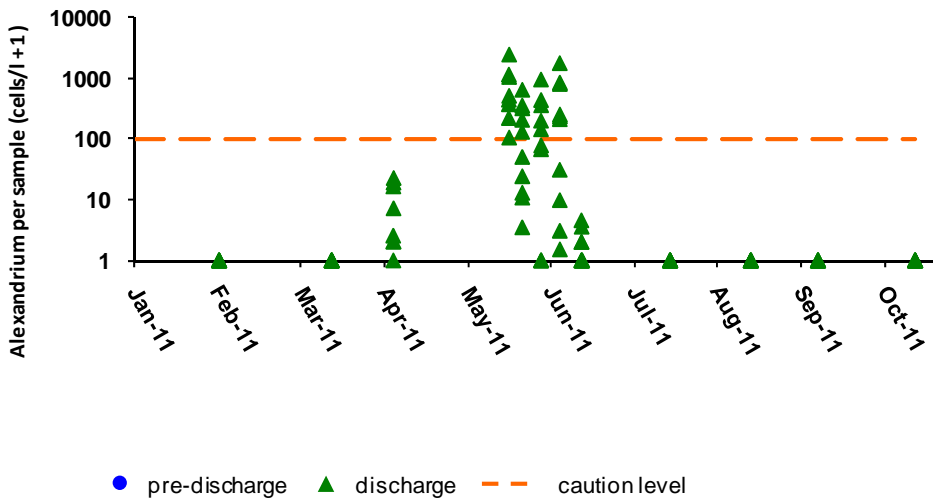


Autumn <i>Pseudonitzschia</i> mean abundance (cells/liter)	
Caution threshold	27,500
Autumn 2011	1,240

ALEXANDRIUM

The nuisance algae *Alexandrium* (“red tide”) can cause paralytic shellfish poisoning (PSP) in Massachusetts Bay. MWRA measures *Alexandrium* abundance in its monitoring program, and also checks state fisheries agency observations of shellfish PSP toxicity to keep track of the course of Gulf of Maine *Alexandrium* blooms.

In 2011 there was an *Alexandrium* bloom along the coast of Maine, New Hampshire, and Massachusetts. By early June 2011, the bloom had subsided in Massachusetts Bay. Results through July were reported in previous quarterly reports; this report includes results for August through October. The figure below includes results for each 2011 sample available through December 2011. (Note logarithmic scale for graph.)



August-October <i>Alexandrium</i> per-sample abundance (cells/liter)	
Caution threshold	100
August- October 2011	0*
* maximum of all samples collected between August 1 and October 31, 2011	