

## Contingency Plan Report Fourth Quarter 2012

### 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 2012 time period. There were two contingency plan threshold exceedances for sediment biodiversity. There was one contingency plan threshold exceedance for nuisance algae.

#### FISH AND SHELLFISH TISSUE CONTAMINATION - FLOUNDER 2012

The fish tissue contamination thresholds are designed to identify unexpected effects on marine life. There were no exceedances of flounder tissue contamination thresholds in 2012.

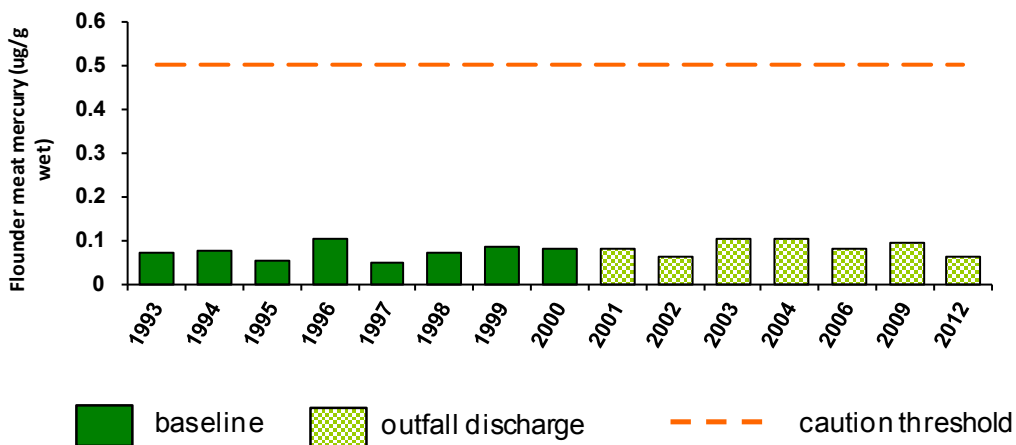
Contaminants are measured in three species of seafood: flounder, lobster, and mussels. For mercury and PCBs in flounder, lobster, and mussels, caution and warning thresholds are set at 50% and 80% of the FDA action limits. The threshold for lead in mussels is based on EPA risk assessment of lead in drinking water. Other fish/shellfish tissue contamination thresholds are based on change from baseline conditions at the outfall site.

Data available this quarter include tissue contamination in winter flounder from the outfall site.

#### FLOUNDER

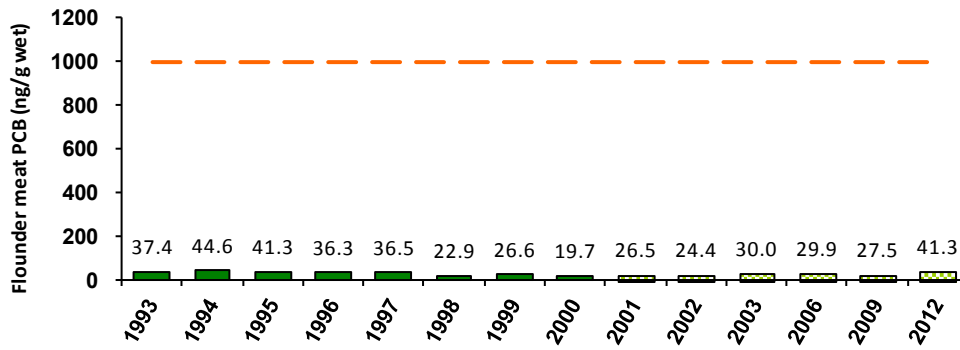
Flounder were sampled at the outfall site in April 2012. Flounder meat contamination remained low and similar to other years.

#### Mercury

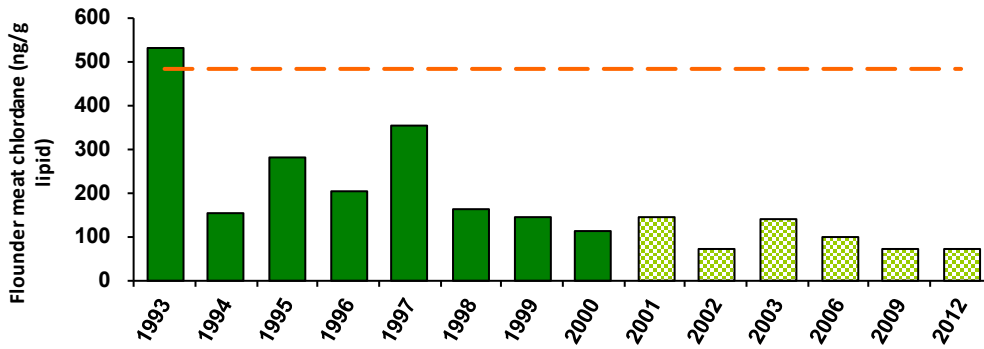


Flounder tissue contaminant levels (continued on next page)

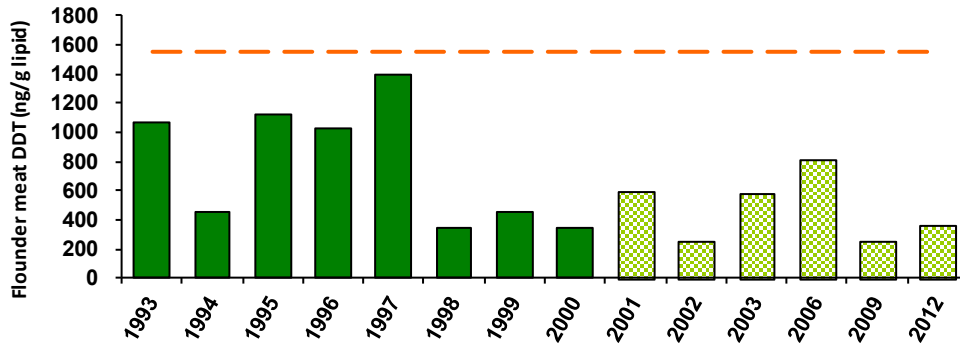
**PCBs**



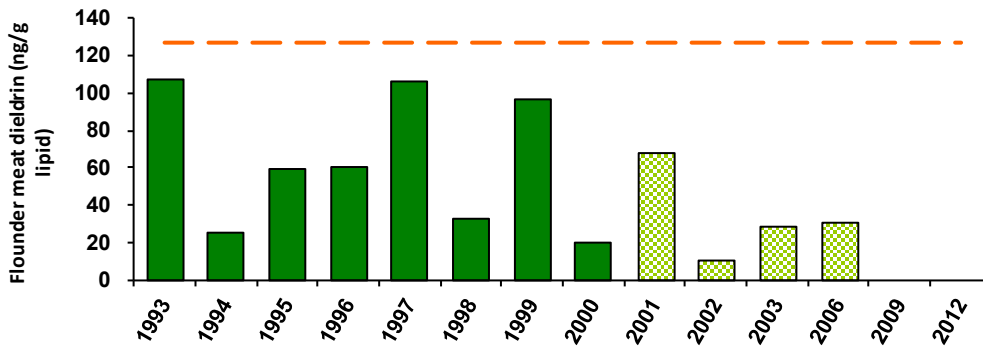
**Chlordane**



**DDT**



**Dieldrin**



**Flounder tissue contaminant levels (continued)**

## SEDIMENT BIODIVERSITY - 2012

### **DIVERSITY**

The annual survey of sediment-dwelling communities in 2012 showed that two measures of [benthic diversity](#) exceeded their thresholds.

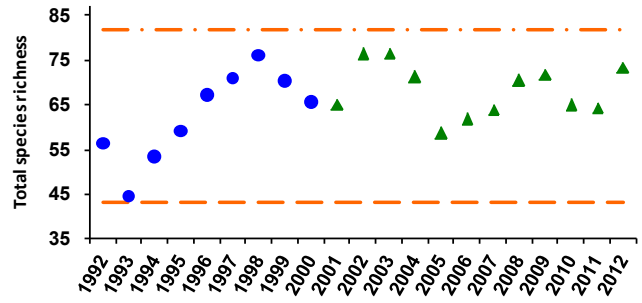
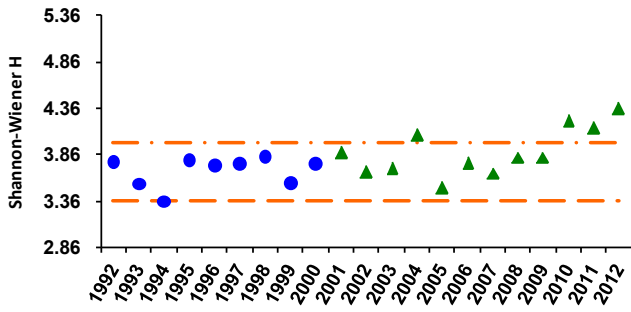
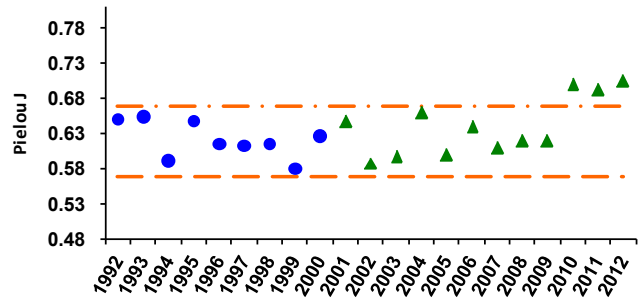
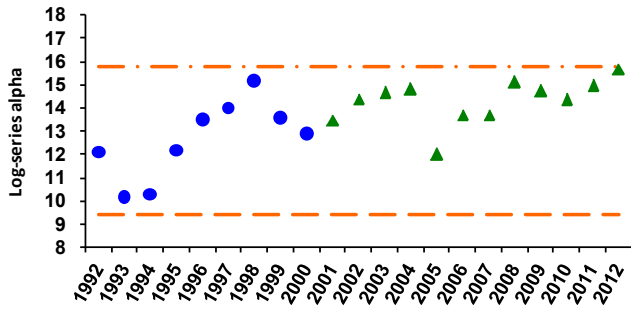
Calculations of diversity in the bottom-dwelling community in the August 2012 monitoring data showed two measures above their upper diversity thresholds, triggering notification under the Contingency Plan (see [http://www.mwra.state.ma.us/harbor/pdf/20121214\\_amx.pdf](http://www.mwra.state.ma.us/harbor/pdf/20121214_amx.pdf).) 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 2012, as in [2010](#) and [2011](#), 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 mean.) 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.

The similar 2010 exceedance of the same two diversity indices 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](#). The 2011 exceedance was evaluated in more detail in the [2011 Outfall Benthic Monitoring Report](#). Those evaluations found that the 2010 and 2011 exceedances probably represented natural fluctuations in the infaunal communities, and were not influenced by the outfall. Thus far, the 2012 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 2012 monitoring as were seen in the past two years.

For each diversity measure, the graphs below show the annual average for sediment samples collected within seven kilometers of the outfall discharge since 1992. The results shown for 1992-2003, and 2011-2012 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.

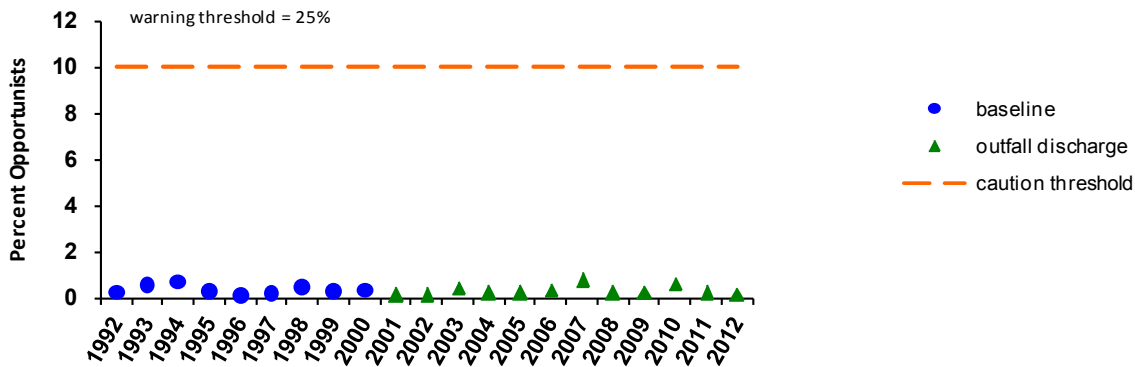
The threshold levels varied slightly through the monitoring period because of the differing station sets; for simplicity only the current thresholds are shown. (Although it appears that there was an exceedance of the Shannon-Weiner H' threshold in 2004, the threshold in effect at that time was slightly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



● baseline      ▲ outfall discharge      — lower caution threshold      - - - upper caution threshold

### OPPORTUNISTS

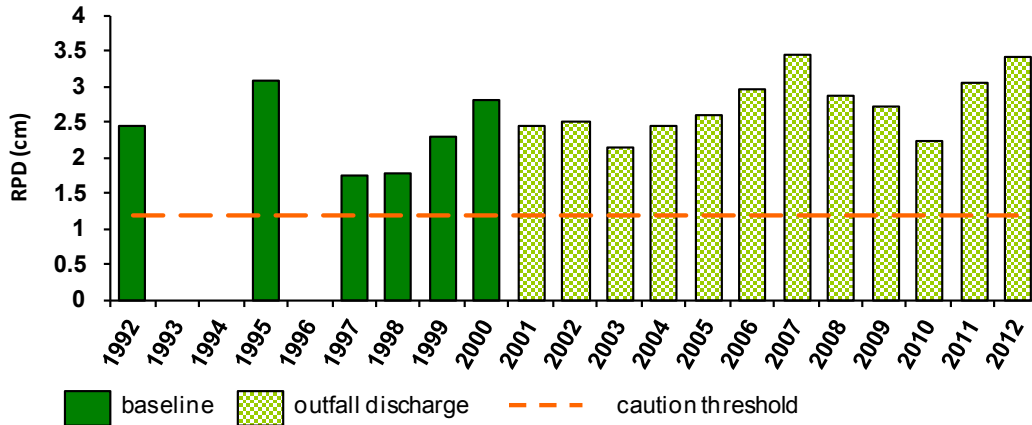
The annual sampling in 2012 showed that the numbers of [opportunistic benthic organisms](#) remain normal at the outfall site and did not exceed the caution threshold of 10% of the total population. The warning threshold is 25% of the total population.



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 2011-2012 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 - 2012

The 2012 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.)

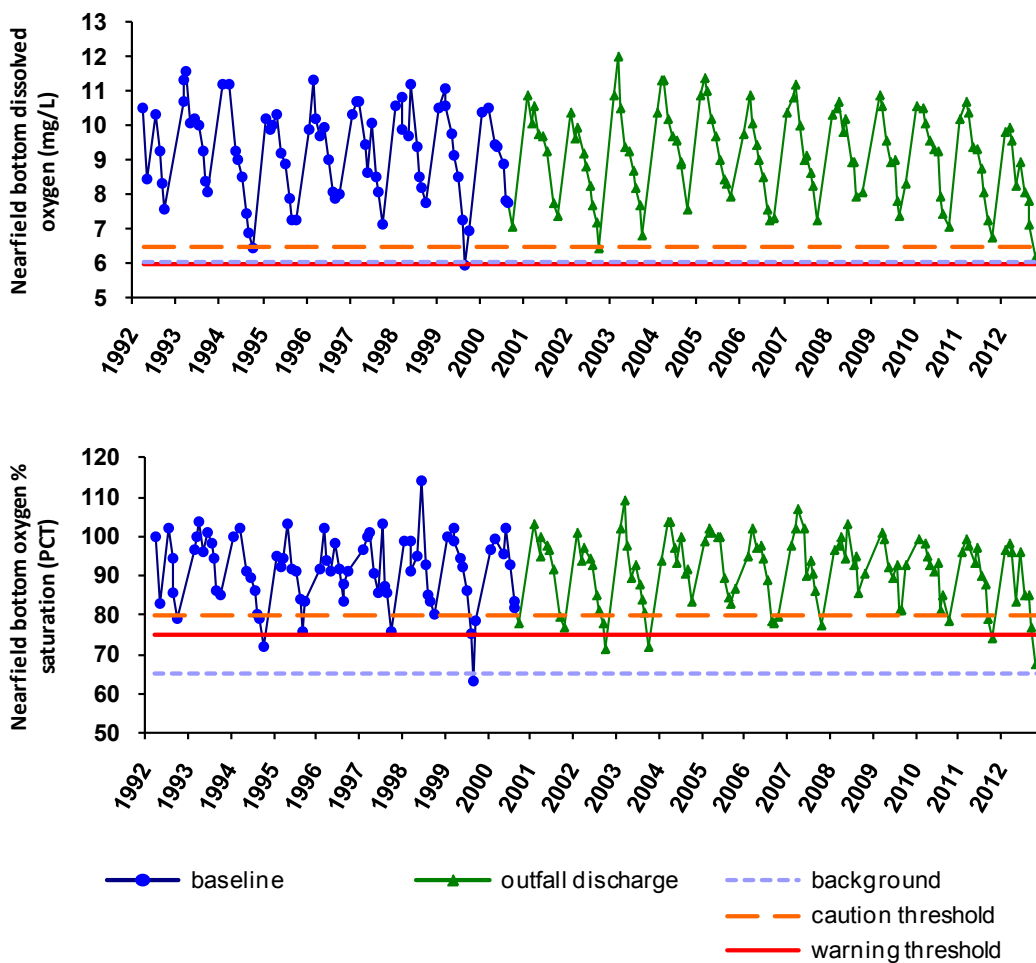
## DISSOLVED OXYGEN (DO) –September-October 2012

Measurements of dissolved oxygen (DO) concentration and percent saturation in autumn 2012 did not fall below background levels and thus did not exceed thresholds.

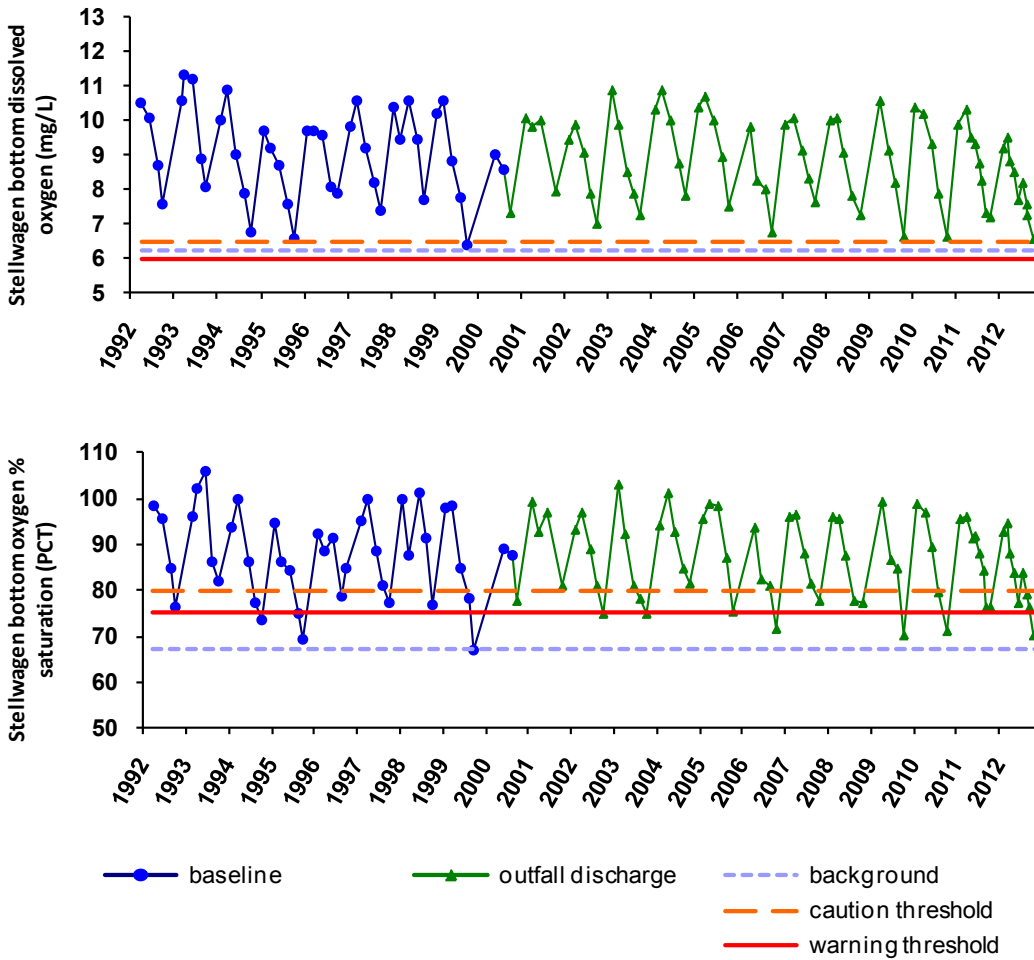
The current reporting period for [dissolved oxygen thresholds](#) is October 2012. During this period there were two surveys. Oxygen levels were similar to those seen in most baseline years. The graphs below show the natural annual fluctuation of DO and percent saturation, which is typically lowest in 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 quite low in October 2012, but similar to those seen in a few baseline years.

### NEARFIELD

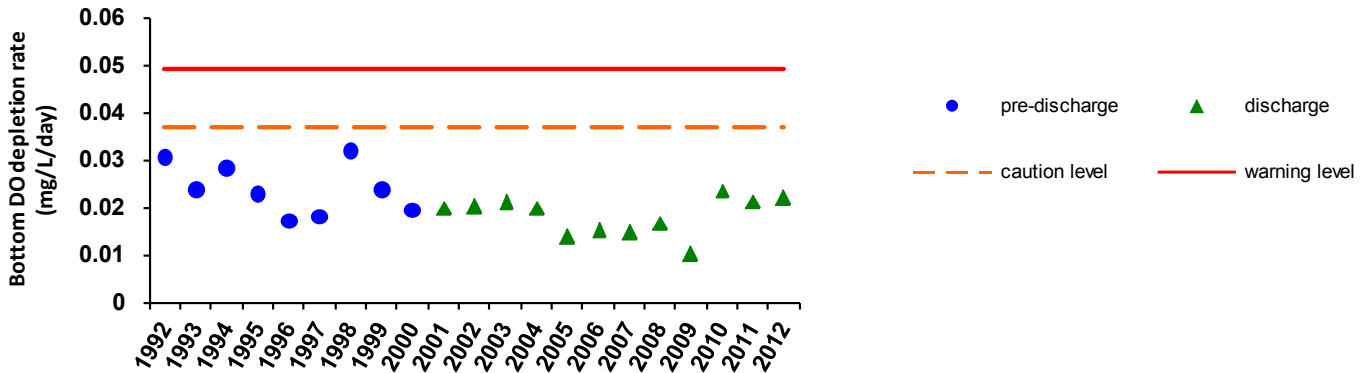


**STELLWAGEN BASIN**



**DO DEPLETION RATE – summer 2012**

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 2012, defined as June - October. The DO depletion rate for the summer of 2012 was higher than some other post-discharge years, but typical of pre-discharge summers and well below the threshold.



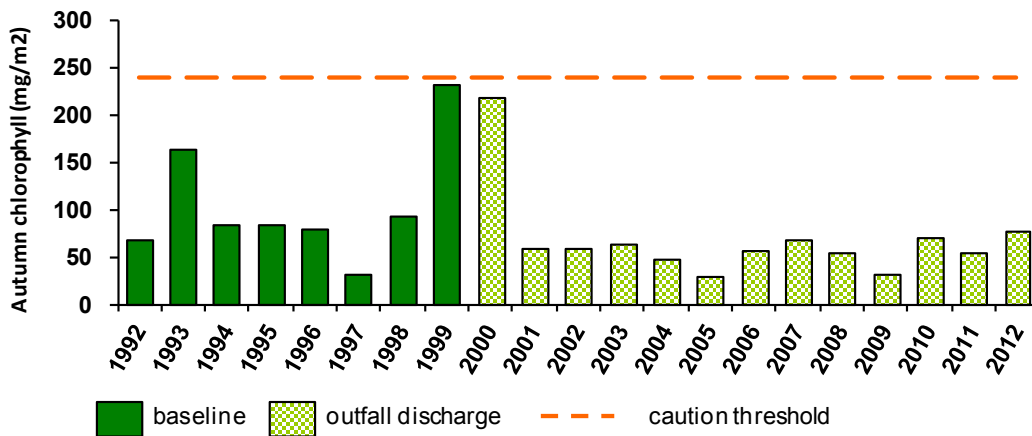
Even if dissolved oxygen concentrations remain healthy, an excessively rapid rate of decrease could signal a future problem. A low rate indicates DO dropped only slowly. The threshold for DO depletion rate is based on a change from the baseline rate; the caution threshold is a rate faster than 1.5 times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

## CHLOROPHYLL – September-November 2012 and Annual 2012

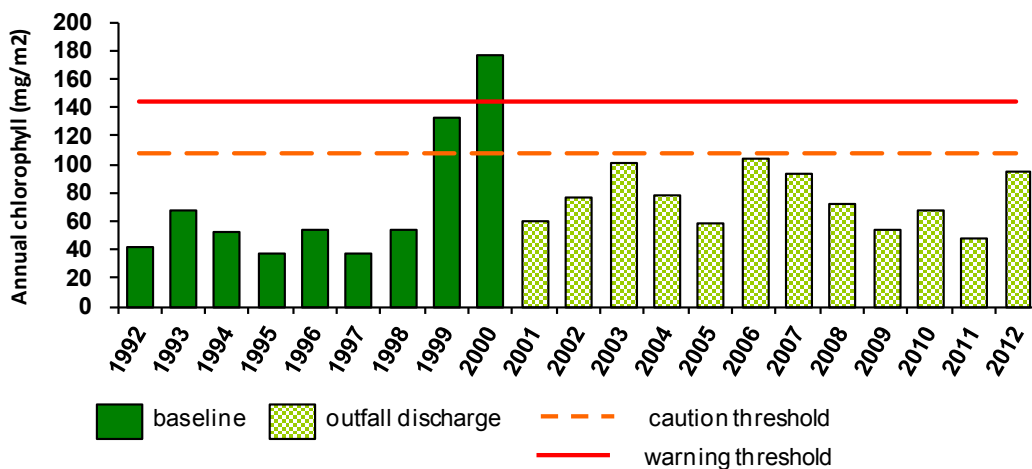
There were no [chlorophyll threshold](#) exceedances for either autumn 2012 or for the entire year. The nearfield mean areal average chlorophyll in autumn 2012 was 78 mg/m<sup>2</sup>, well below the caution level threshold for autumn of 239 mg/m<sup>2</sup> and in the lower end of the range typical of the pre-discharge period. The 2012 annual average was 96 mg/m<sup>2</sup>, below the caution and warning thresholds for annual average chlorophyll of 108 and 144 mg/m<sup>2</sup>, respectively. Both autumn and annual results were similar to other higher-chlorophyll years in the pre-diversion and post-diversion periods.

The figures below compare chlorophyll data for autumn 2012 (September-October), which included two surveys, and data for all of 2012, 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





## NUISANCE ALGAE – SUMMER and AUTUMN 2012

In the figures below, we compare *Phaeocystis* and *Pseudonitzschia* data to the [nuisance algae thresholds](#) for summer 2012 (May through August), which included four surveys, and autumn 2012 (September –October), which included two surveys. We also compare *Alexandrium* data to the threshold for each sample in August – October 2012. (January-July *Alexandrium* data were reported in earlier quarterly reports.)

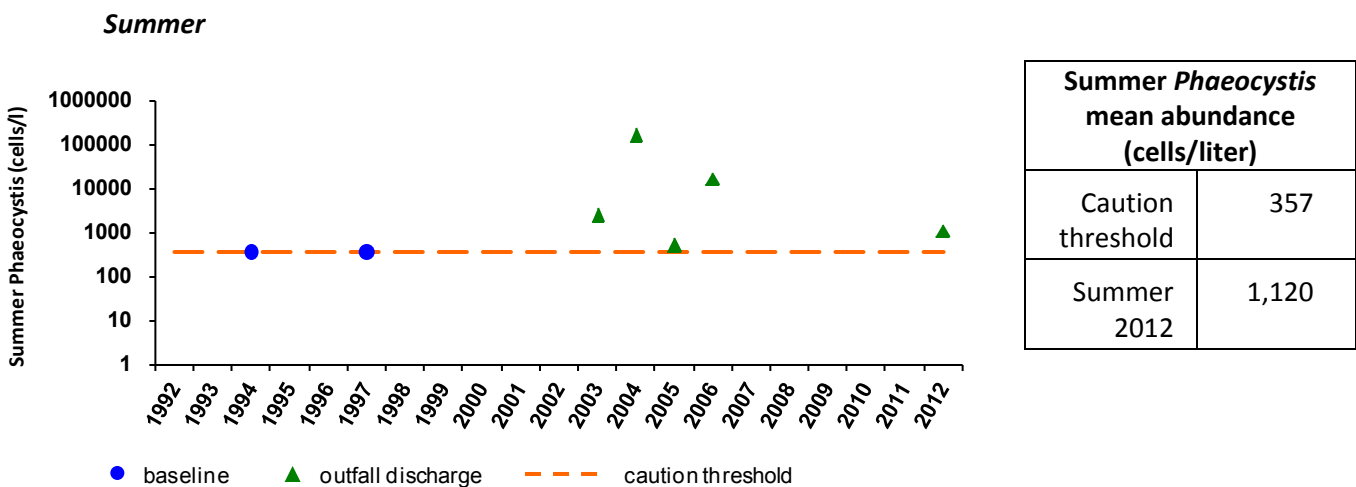
For the summer season, there was a threshold exceedance for *Phaeocystis* but not for *Pseudonitzschia*. For the autumn season, there were no threshold exceedances for *Phaeocystis*, *Pseudonitzschia*, or *Alexandrium*. There was no threshold exceedance for *Alexandrium* in August – October 2012.

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>.

### PHAEOCYSTIS

As in some other post-diversion years, *Phaeocystis pouchetii* exceeded the very low summer threshold in summer 2012 (See [notification](#)). One out of eight samples collected in the nearfield on May 15, 2012 contained moderate numbers of cells of *Phaeocystis*, apparently the “tail end” of the relatively small *Phaeocystis* bloom that occurred this spring. A 2006 report<sup>1</sup> evaluated regional *Phaeocystis* blooms through 2005 and concluded that persistence of cells past May 1 in recent years probably results from a delay in water column warming in recent years, rather than to some outfall effect. No *Phaeocystis* cells were observed in June, July, or August samples.

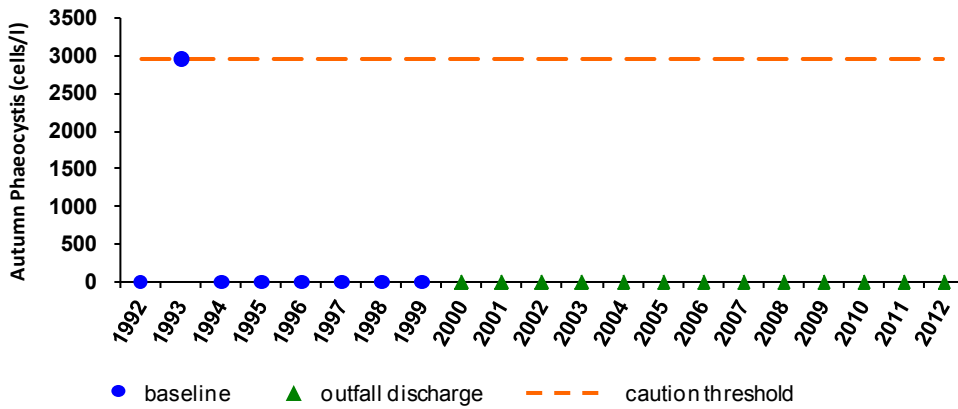
*Phaeocystis pouchetii* was not observed in the nearfield in autumn of 2012.



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

<sup>1</sup> Libby PS, Borkman DG, Hunt CD and Brawley JW. 2006. 2005 Nutrient Issues Review. Boston: Massachusetts Water Resources Authority. Report 2006-02. 65 p.

### Autumn

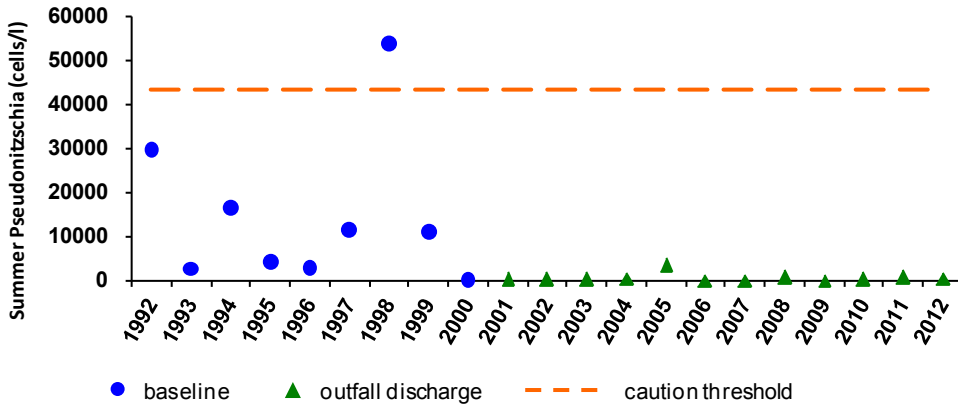


Autumn <i>Phaeocystis</i> mean abundance (cells/liter)	
Caution threshold	2,960
Autumn 2012	0

### PSEUDONITZSCHIA

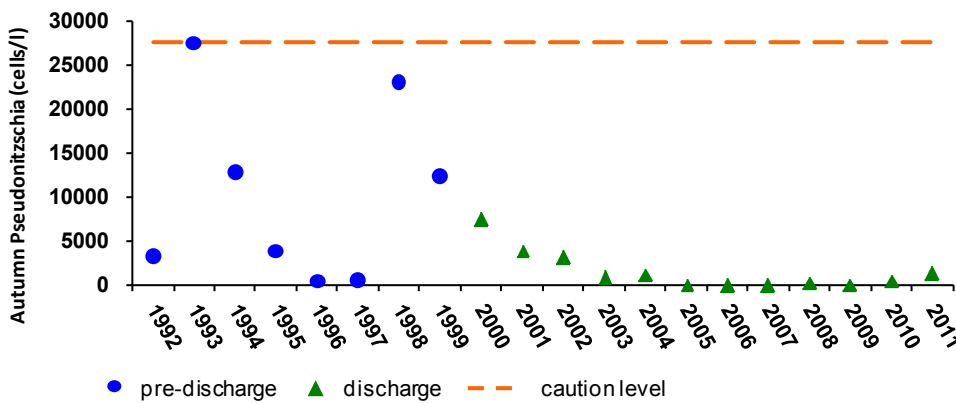
*Pseudonitzschia* was observed only at very low levels in the summer and autumn of 2012.

#### Summer



Summer <i>Pseudonitzschia</i> mean abundance (cells/liter)	
Caution threshold	43,100
Summer 2012	388

#### Autumn

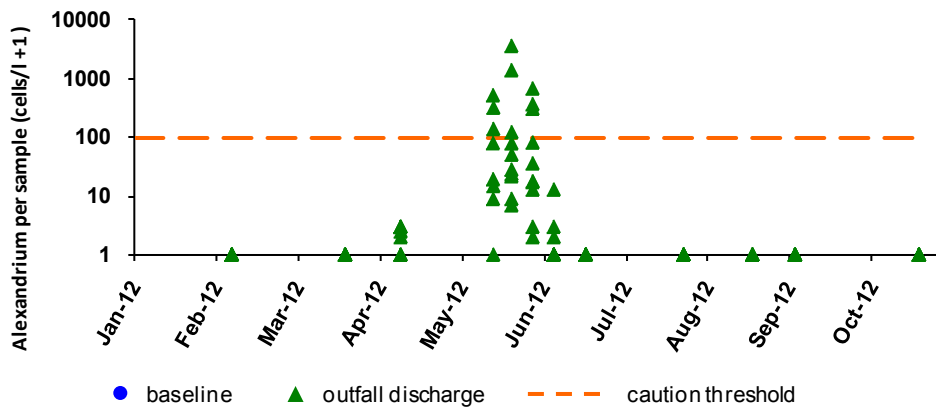


Autumn <i>Pseudonitzschia</i> mean abundance (cells/liter)	
Caution threshold	27,500
Autumn 2012	2,820

## 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 spring 2012 there was an *Alexandrium* bloom along the coast of Maine, New Hampshire, and Massachusetts. By early June 2012, 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 2012 sample available through December 2012. (Note logarithmic scale for graph.)



August-October <i>Alexandrium</i> per-sample abundance (cells/liter)	
Caution threshold	100
August- October 2012	0*
* maximum of all samples collected between August 1 and October 31, 2012	