MASSACHUSETTS WATER RESOURCES AUTHORITY
Charlestown Navy Yard
100 First Avenue, Building 39
Boston, MA 02129

Frederick A. Laskey
Executive Director

Telephone: (617) 242-6000
Fax: (617) 788-4899
TTY: (617) 788-4971

January 16, 2020

Ms. Karen McGuire
Office of Environmental Stewardship
U.S. EPA Region 1
5 Post Office Square, Suite 100
Mail Code OES04-5
Boston, MA 02109-3912

Ms. Catherine Vakalopoulos
Department of Environmental Protection
1 Winter Street
Boston, MA 02108

RE: Massachusetts Water Resources Authority
Permit Number MA 0103284
MWRA Contingency Plan Threshold Exceedance: Effluent Nitrogen Annual Load 2019

Dear Ms. McGuire and Ms. Vakalopoulos:

One of the effluent parameters that MWRA monitors under its Contingency Plan[1] (CP) is annual loading of total nitrogen in the effluent from MWRA's Deer Island Treatment Plant (DITP). MWRA has received final nitrogen data from effluent monitoring conducted in 2019. On Monday, January 13, MWRA completed a Quality Assurance review of calendar year 2019 effluent nitrogen and calculated the annual nitrogen loading to compare with the Contingency Plan thresholds.

That value was 13,217 metric tons, which exceeds the Caution level threshold for annual nitrogen loading of 12,500 tons per year, triggering a notification under the Contingency Plan. This letter constitutes the notification for the threshold exceedance.

Parameter	Caution Level Threshold	Warning Level Threshold	2001-2018 Range	2019 Results
Effluent Nitrogen Annual load	12,500 metric tons (mt)	14,000 mt	10,920 – 12,448 mt	**13,217 mt Caution Level Exceedance**

It is important to note that the 2019 annual effluent nitrogen load is an exceedance of a Contingency Plan Caution level threshold, but does not constitute a NPDES Permit violation. Operations at the Deer Island Treatment Plant continued to be exceptional in 2019. Deer Island has qualified for a National Association of Clean Water Agencies Platinum 13 Peak Performance Award for 2019, awarded to facilities with 100% compliance with permit effluent limits over thirteen consecutive years.

[1] *Massachusetts Water Resources Authority Contingency Plan Revision 1*. 2001. Report 2001-ms-071. http://www.mwra.state.ma.us/harbor/enquad/trlist.html.

The observed 2019 effluent nitrogen loading is below the Contingency Plan Warning threshold (Figure 1) – which was based on projections made in 1988 of sewered population and nitrogen loading in 2020.

Importantly, monitoring data and water quality model simulations demonstrate there have been no signs of eutrophication or adverse environmental impacts as a result of the effluent discharge. The last time MWRA was near the Nitrogen load Caution threshold was in 2016. At that time MWRA conducted receiving water modeling runs increasing the 2016 load by 20%, which projected negligible effects on the environment.

Details on the threshold and water quality are discussed later in this notice.

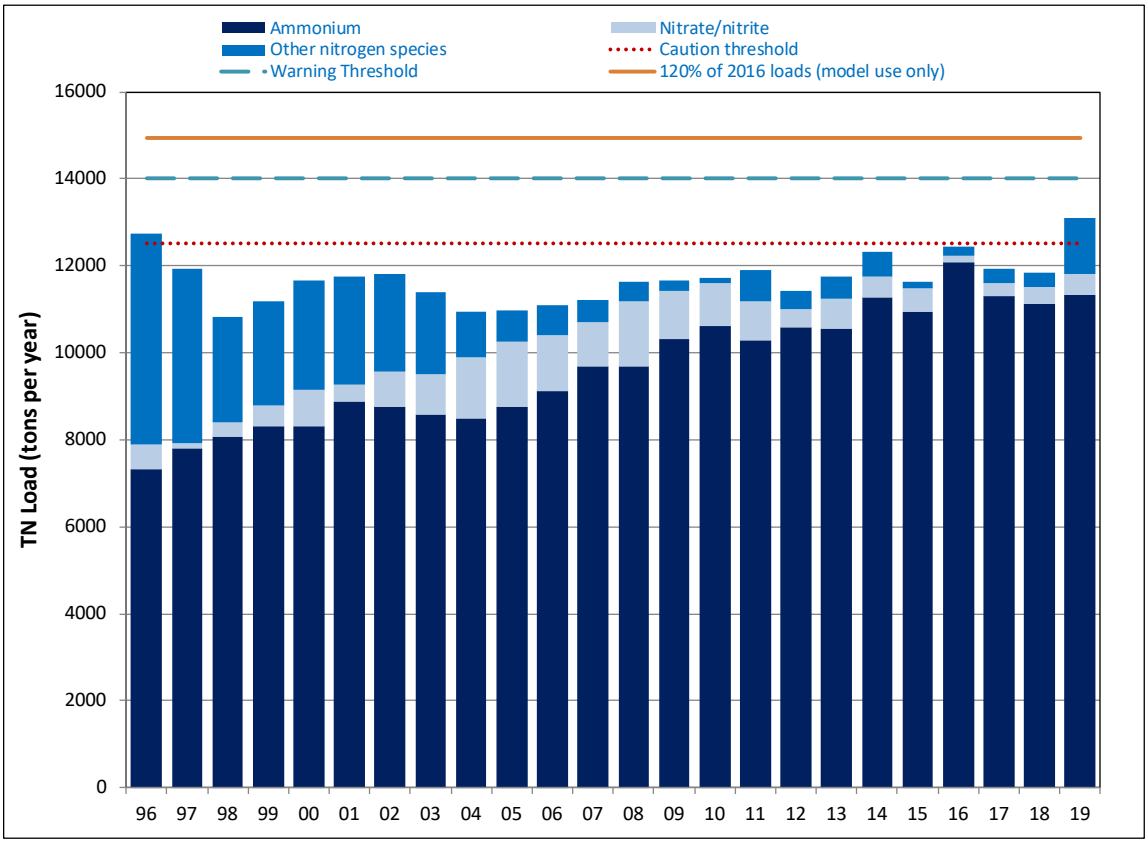

Figure 1. Annual Nitrogen Discharges, 1996-2019. Also shown are the Caution and Warning level thresholds and the 14,937metric tons (120% of 2016 load) used in water quality model runs.

Contingency Plan Thresholds for nitrogen. The Contingency Plan nitrogen load threshold was developed in response to concerns that moving MWRA's treated wastewater discharge from Boston Harbor into Massachusetts Bay could adversely impact the environment. The Warning level was set at 14,000 metric tons of total N/year, based on estimates in planning documents and in EPA's Supplemental Environmental Impact Statement for the offshore outfall of sewered population in 2020 and resulting domestic wastewater flow and loading. The Caution level was set at 90% of that, rounded down to 12,500 metric tons.

Nitrogen in MWRA effluent About 32% of the nitrogen in MWRA's wastewater influent is removed by treatment at Deer Island, but the biological treatment process also converts some organic forms of nitrogen to ammonium. Also, ammonium-rich liquids from the biosolids pelletizing plant, built as part of the Boston Harbor Project to end biosolids discharge to the harbor, are reintroduced to DITP for treatment, adding to the ammonium load. As required by its permit, MWRA annually evaluates nitrogen-removal technologies[2].

In 2005, the treatment process at Deer Island reached its current configuration. MWRA has observed a gradual increase in nitrogen load since January of 2006, both in treatment plant influent and in final plant effluent (Figure 2). Effluent nitrogen load has increased from an average of 30.4 metric tons/day in 2006 and 2007 to an average of 34.2 metric tons/day in 2018 and 2019.

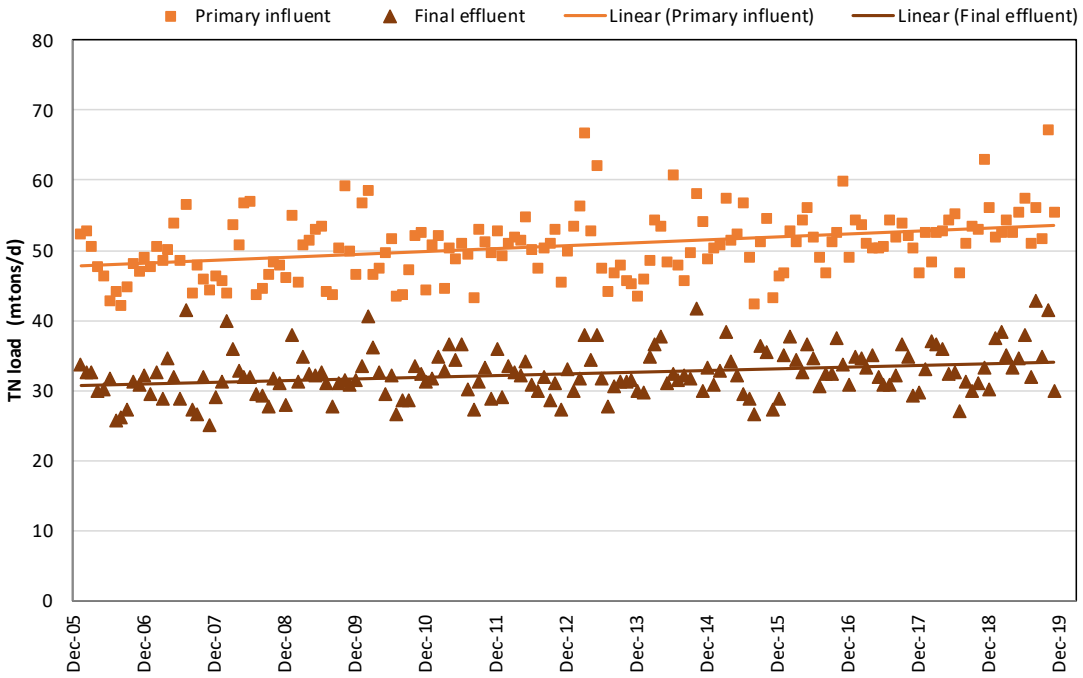

Figure 2. Total Nitrogen load (monthly averaged metric tons/day) in influent and final effluent at the Deer Island Treatment plant, January 2006-November 2019.

MWRA believes this increase in nitrogen load is largely due to increases in the population it serves. Between 2010 and 2018, for example, the estimated sewered population in MWRA's district increased by over 8%, from 2.07 million to 2.25 million people.

Importantly, despite growth in the population served by MWRA, effluent nitrogen load in 2019 remained below the 14,000 metric ton loading (Contingency Plan Warning Level) originally projected for 2020.

Preliminary evaluation of Ambient Monitoring results in 2020. MWRA's permit-required ambient monitoring includes measurements of nutrients, oxygen, phytoplankton, chlorophyll,and nuisance algae in the water column (among other parameters). This is in response to concerns raised that

[2] Smolow M. 2019. Technical survey of nitrogen removal alternatives for the Deer Island Treatment Plant. Boston: Massachusetts Water Resources Authority. Report 2019-02. 46 p.

moving the discharge from Boston Harbor to Massachusetts Bay might cause changes. While field sampling results from 2019 are still undergoing QA/QC review, preliminary evaluations of the 2019 results do not indicate adverse impacts resulted from effluent nitrogen. This is consistent with results obtained since discharge began through the offshore outfall in September 2000, and supports the inferences derived from water quality model projections that show negligible effects on the water column in Massachusetts and Cape Cod Bays [3] even at effluent levels as high as 15,000 metric tons of nitrogen.

Nitrogen As can be seen in Figure 3, total nitrogen concentrations were relatively high in summer 2019 at station N21 at MWRA's outfall. As has been seen in previous years, though, high nitrogen concentrations did not extend to stations distant from the outfall.

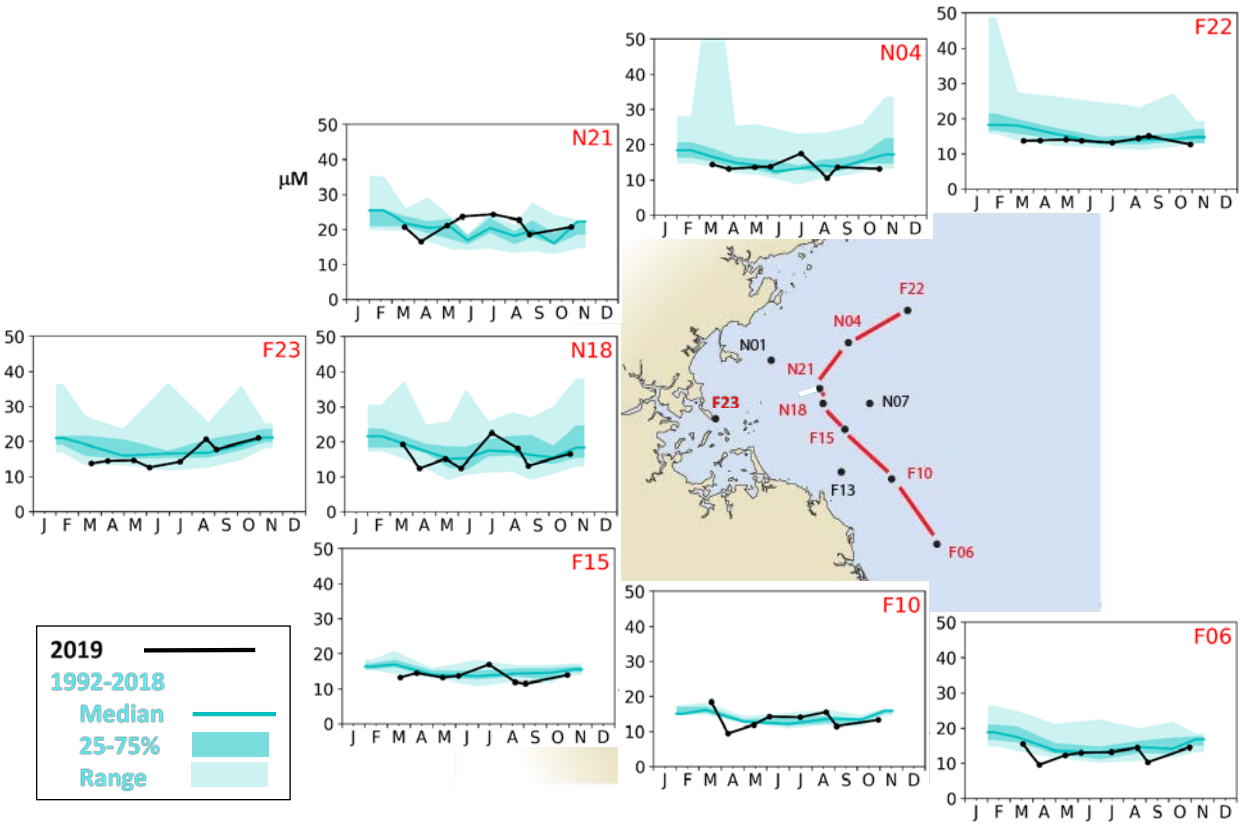

Figure 3. Total Nitrogen (micromolar) at selected monitoring stations in 2019. Results from 2001–2018 are in blue: line is the 50th percentile, dark shading spans the 25th to 75th percentile, and light shading spans the range. White line on map is MWRA's outfall.

Phytoplankton biomass (Chlorophyll). There were no Contingency Plan exceedances in 2019 for chlorophyll, a measure of phytoplankton biomass. 2019 was a moderately high chlorophyll year, with concentrations near MWRA's outfall (See Figure 4) similar to other years before and after the Bay discharge began.

[3] Zhao L, Beardsley RC, Chen C, Codiga DL, Wang L. 2017. Simulations of 2016 Hydrodynamics and Water Quality in the Massachusetts Bay System using the Bays Eutrophication Model. Boston: Massachusetts Water Resources Authority. Report 2017-13. 111p. Avvailable at http://www.mwra.state.ma.us/harbor/enquad/pdf/2017-13.pdf

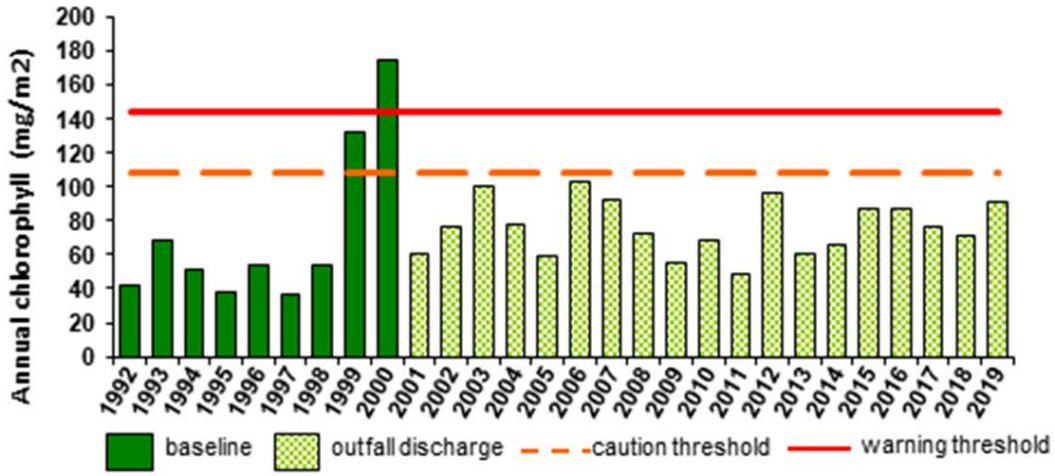

Figure 4. Annual average chlorophyll at monitoring stations near MWRA's offshore outfall, 1992-2019. "Baseline" data were collected before the September 2000 startup of the outfall, when effluent was discharged in Boston Harbor.

Dissolved Oxygen. In 2019, bottom-water dissolved oxygen (DO) concentration and percent saturation (Figure 5) near the Bay discharge were comparable to many baseline and post-discharge years and remained well above the Caution threshold. In addition to thresholds associated with DO concentration and percent saturation, there were concerns during the outfall siting process that effluent discharge would result in faster decreases in bottom-water DO during the stratified summer season. In 2019, the seasonal decline in nearfield bottom water concentrations seen in Figure 5 was well below the threshold value for that parameter.

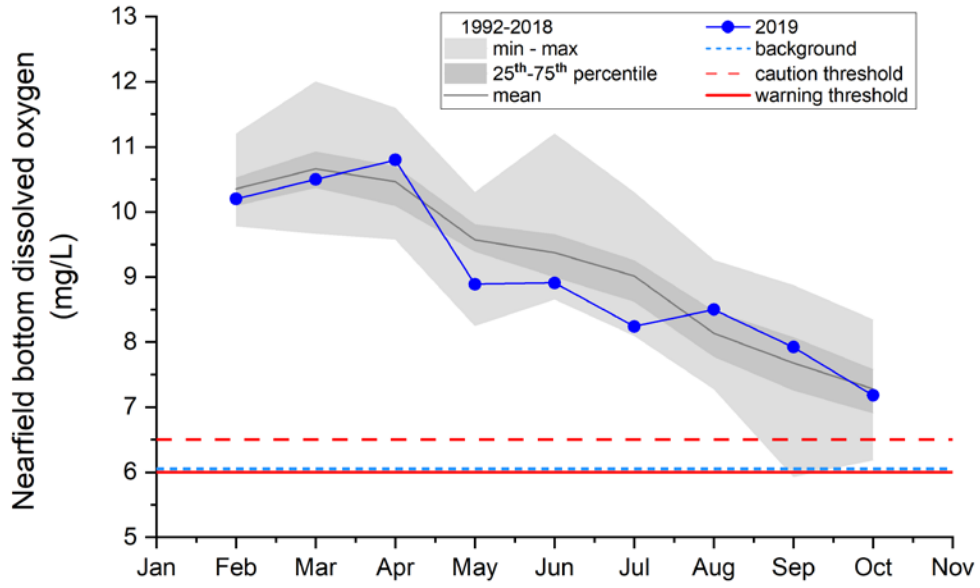

Figure 5. Near-bottom dissolved oxygen levels at stations near MWRA's outfall compared to results from 1992 to 2018

Nuisance Algae. A relatively strong bloom of the dinoflagellate associated with red tide in New England waters, *Alexandium catenella (Alexandrium)*, occurred in Massachusetts Bay in May through July 2019, resulting in an exceedance of the associated Contingency Plan Caution threshold[4]. MWRA discussed this bloom with regulators and their Outfall Monitoring Science Advisory Panel (OMSAP) at an October 3, 2019 meeting. Results available so far suggest that, as discussed with OMSAP, MWRA's discharge had little or no effect on the bloom, with the bulk of the cells transported into Mass Bay with waters from the north, as has been observed during blooms in previous years. The 2019 *Alexandrium* bloom and possible contributions of nutrients will be further evaluated in MWRA's reporting on 2019 ambient monitoring results.

Additionally, in August and September of 2019, MWRA and many others observed a strong brown tide caused by a bloom of the dinoflagellate *Karenia mikimotoi* in Boston Harbor and nearby coastal waters. There is no evidence that this bloom was associated with the bay discharge, as monitoring has shown that only a small fraction of effluent reaches Boston Harbor.

Inferences from MWRA's water quality modeling. MWRA's NPDES permit for DITP includes the requirement that MWRA run the three dimensional hydrodynamic water quality "Bays Eutrophication Model" annually, to help evaluate the impacts of nutrients on the Massachusetts Bays environment.

In addition to annual model runs, MWRA undertook two supplementary studies, one while modeling 2013 conditions and the other for 2016, to better understand changes to the bay that might follow increases in effluent nitrogren. In its report on water quality modeling of 2013 conditions[5], MWRA and its modeling team compared a "control" model run, which used the effluent nitrogen load observed in 2013, to projection scenarios in which effluent nitrogen was increased by 10% and by 100%, respectively. The 10% increase projection exceeded the Caution threshold by >400 metric tons, while the 100% increase projection, which doubled effluent nitrogen load, exceeded the Warning level threshold by over 9,500 metric tons. All other model inputs were kept the same between the three model runs.

The model projections showed that there was essentially no difference between the control model runs and the 10% increase projections, with nearly identical modeled dissolved inorganic nitrogen concentrations in surface waters, even at the outfall location. Even a doubling of nitrogen resulted in only modest changes to nitrogen concentrations. Similar results were observed for inorganic nitrogen in bottom waters. The model projected that changes in phytoplankton biomass (chlorophyll) and dissolved oxygen under these scenarios would be smaller than changes in nitrogen. These projections indicate that even substantial increases in MWRA effluent nitrogen would not result in significant environmental consequences, which is understandable given that MWRA's effluent discharge makes up only a small fraction (estimated at about 3% in 1999)[6] of the nitrogen inputs to Massachusetts and Cape Cod bays.

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[4] http://www.mwra.com/harbor/pdf/20190531amx.pdf

[5] Zhao L, Chen C, Beardsley RC, Codiga DL, Leo WS, Mickelson MJ. 2015. Modeling 2013 in Massachusetts Bay using the unstructured-grid Bays Eutrophication Model. Boston: Massachusetts Water Resources Authority. Report 2015-03. 102 p. Available at http://www.mwra.state.ma.us/harbor/enquad/pdf/2015-03.pdf.

[6] Hunt CD, Kropp RK, Fitzpatrick JJ, Yodzis P, Ulanowicz RE. 1999. A review of issues related to the development of a food web model for important prey of endangered species in Massachusetts and Cape Cod Bays. Boston:

As mentioned on page 2, MWRA's modeling of 2016 conditions further evaluated possible impacts of the relatively high nitrogen load measured that year (12,448 mt). In addition to the control run with actual 2016 effluent nutrient load, modelers conducted a projection run, artificially introducing a 20% increase in effluent nitrogen above the 2016 load, to nearly 15,000 metric tons of nitrogen. As was seen with the projection runs in the 2013 model report, results of the projection run were nearly indistinguishable from those of the control run[7].

As reported at OMSAP's October 2019 meeting, MWRA is currently on schedule in its project to modernize the permit-required water quality model. A report on modeling of conditions in 2019, which could include increased nutrient scenarios similar to those that have been run in the past, are scheduled to be available in 2021.

Conclusions In brief, while evaluation of these results is just beginning, it appears that effluent nitrogen load in 2019, while exceeding the Contingency Plan Caution Level threshold, do not represent an issue of environmental concern. MWRA's ambient monitoring results continue to indicate that MWRA's treated wastewater is not degrading the environment in Massachusetts Bay. MWRA's evaluations of effluent and ambient monitoring results will be more advanced in a couple of months, and we would be happy to meet with you and with others to discuss them.

Sincerely,

David Coppes
Chief Operating Officer

Massachusetts Water Resources Authority. Report 1999-14. 62 p. Available at http://www.mwra.state.ma.us/harbor/enquad/pdf/1999-14.pdf.

[7] Zhao et al. (2017).

Cc:

Environmental Protection Agency, Region I
Karen McGuire (hard copy)
Matthew Liebman (hard copy)
Todd Borci

National Marine Fisheries Service
Kimberley Damon-Randall (hard copy)

Stellwagen Bank National Marine Sanctuary
Peter DeCola (hard copy)

US Food and Drug Administration
Martin Dowgert

MA Executive Office of Energy and Environmental Affairs
Vandana M. Rao

MA Department of Environmental Protection

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Lealdon Langley
Nihar Mohanty

MA Division of Marine Fisheries

Jeff Kennedy
Terry O'Neil

MA Dept of Public Health
Michael Moore

Cape Cod Commission
Tom Cambareri

Outfall Monitoring Science Advisory Panel
Robert Beardsley
Virginia Edgcomb
Robert Kenney
Mark Patterson
Judith Pederson
Jeffrey Rosen
Juliet Simpson
Juanita Urban-Rich

Public Interest Advisory Committee
Bruce Berman

Save the Harbor / Save the Bay
Tani Marinovich

Hyannis Library
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