Outfall Monitoring Science Advisory Panel (OMSAP) Annual Meeting
February 10, 2023
Leighton Hall (U.S. EPA Region 1 Office), 5 Post Office Square, Boston, MA
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9:00 – 9:20 AM	**Welcome and Introductions** Judy Pederson, MIT Sea Grant, OMSAP Chair Alexa Sterling, U.S. Environmental Protection Agency (EPA) Region 1 Cathy Coniaris, Massachusetts Department of Environmental Protection
9:20 – 10:10 AM	**Massachusetts Water Resources Authority (MWRA)'s outfall monitoring: 2021 results** Dave Wu, MWRA (in-person) 35 min presentation with 15 min Q&A
10:10 – 10:50 AM	**Long-term trends in Massachusetts Bay temperature and oxygen** Dan Codiga, MWRA (in-person) 15 min presentation with 25 min Q&A
10:50 – 11:05 AM	BREAK
11:05 – 11:30 AM	**Bays Eutrophication Model (BEM) updates** Dan Codiga, MWRA (in-person) 10 min presentation with 15 min Q&A
11:30 – 12:00 PM	**Assessing the seasonal and storm-impacted transport and biological fate of micro- and nanoplastics discharged from wastewater treatment facilities into Massachusetts coastal waters** Scott Gallagher and James Churchill, Woods Hole Oceanographic Institution (virtual) 20 min presentation with 10 min Q&A
12:00 – 1:00 PM	LUNCH
1:00 – 1:20 PM	**PFAS Matters** Matt Dam and Betsy Reilley, MWRA (in-person) 20 min presentation
1:20 – 1:40 PM	**Concentrations of chemicals of emerging concern are mediated by seasonal hydrodynamics in an offshore marine environment** Anna Ruth Robuck, U.S. EPA Office of Research and Development (virtual) 20 min presentation
1:40 – 2:00 PM	**Q&A with all PFAS speakers**
2:00 – 2:25 PM	**OMSAP discussion**
2:25 – 2:45 PM	**Public comment**
2:45 – 3:00 PM	BREAK
3:00 – 4:00 PM	**PIAC Meeting** Bruce Berman, Save the Harbor/Save the Bay, PIAC Chair (virtual)

Outfall Monitoring Science Advisory Panel (OMSAP) Annual Meeting
February 10, 2023 – Hybrid Meeting - Microsoft Teams +
Leighton Hall (U.S. EPA Region 1 Office), 5 Post Office Square, Boston, MA
Meeting Minutes

Annual Review of the Massachusetts Water Resources Authority (MWRA) Outfall Monitoring Program

There was a total of 57 attendees that included 19 in person and 38 online. A list of attendees is included at the end of these notes.

Welcome and Introductions (9:00 – 9:10)

Judy Pederson, MIT Sea Grant, OMSAP Chair
Alexa Sterling, U.S. Environmental Protection Agency (EPA) Region 1

Massachusetts Water Resources Authority (MWRA) Outfall Monitoring: 2021 Results (9:10 – 9:45)

Dave Wu, MWRA (in-person), presented 24 slides summarizing the 2021 outfall monitoring results, also including some available and preliminary 2022 observations and data.

Questions/Comments:

- Jeff Rosen – How did the level of the noted exceedances compare with older data? Dave Wu – For *Alexandrium*, concentrations that were above the threshold were not close to the historical maximum. The widespread depressed dissolved oxygen (DO) percent concentration results in 2022 had not been observed previously.
- Bruce Berman – What suite of chemicals were analyzed in the flounder and lobster tissue monitoring? Dave Wu – The 2021 Annual Report includes links to the supporting investigation reports with details of the tissue analysis.
- Judy Pederson – What hypotheses are being explored for Alexandrium distribution? Dave Wu and Betsy Reilley – The data indicates the potential for local cyst beds but the timing of a potential bed is unclear given the lack of historical sampling. Don Anderson is reviewing this data with Battelle scientists, including sediment samples taken in 2022.
- Mark Patterson – Is DO measured in the effluent leaving the plant? Dave Wu and Betsy Reilley – DO is not a compliance measurement; it is expected that the treatment processes result in an oxygenated effluent. The monitoring includes a nearfield station very close to the outfall discharge point.
- Bruce Berman initiated a general discussion on the concern level regarding the long-term trend in DO concentrations and the increase in DO threshold exceedances. Ken Keay noted the relevance of tracking the rate of concentration drawdown as a measurement. Jeff Rosen noted that he had acquired and reviewed the historical record of station measurements of DO from MWRA ambient monitoring; there was one recorded measurement below 4.0 mg/L at farfield station F02. Based on the distribution of DO concentrations, his opinion was that the DO depression appears regional and not the result of the outfall discharge. Judy Pederson explained the difference between "caution" and "warning" levels in the contingency plan. Dave Wu noted that other states in New England (as well as New York) had lower DO water quality standards than the 6.0 mg/L standard in Massachusetts.

Long-term Trends in Massachusetts Bay Temperature and Oxygen

Dan Codiga, MWRA (in-person) presented 10 slides summarizing the long term trend analysis in temperature and DO that the full monitoring data set made possible.

Questions/Comments:

- Jeff Rosen and Dan Codiga plan on collaborating on a power analysis of the long-term data set.
- Loretta Fernandez – Is it possible to determine if increased stratification has been a contributor to the downward DO concentration trend? Dan Codiga – Yes. He has shown that there is no trend in stratification, implying it is not contributing to the DO trend. However, he has looked at the top to bottom density difference, and further work could be done to examine the shape of the pycnocline within the water column.
- Jeff Rosen – Calculating the confidence interval around the DO vs. temperature regression shown on Figure 2 (slide 7) would be helpful.
- Judy Pederson initiated a discussion on identifying any connections between DO concentrations and phytoplankton abundance. Dan Codiga noted that nutrient concentrations remain similar. Juanita Urban-Rich noted that just looking at chlorophyll concentrations could miss changes in the planktonic community composition, e.g. size fraction, pigmentation. Dan Codiga noted that more detailed phytoplankton data are available.
- Phil Colarusso – Has the DO – temperature regression on slide 7 been evaluated over shorter time interval such as decades. Dan Codiga noted that the full set of data plots are available in the appendix. Additional analysis would need to be run decade-by-decade to compare the rate of increase between them.
- Bruce Berman emphasized the importance of this continuous data record that allows this level of analysis.
- Carlton Hunt suggested evaluating what nutrient levels would be low enough to be limiting for phytoplankton growth. This might be a challenge for individual species, but general groupings, e.g. diatoms might be possible.

BREAK (10:20 – 10:35)

Bays Eutrophication Model (BEM) Update (10:35 – 11:30)

Dan Codiga, MWRA (in-person) presented 10 slides summarizing the hydrodynamic and eutrophication modeling results.

Questions/Comments:

- Jeff Rosen – How far afield are nutrient effects from the outfall observed? Dan Codiga – Persistent elevations of ammonium are identified from 5-10 km from the outfall, and intermittent elevations from 10-20 km.
- Judy Pederson – How was the model calibrated? Dan Codiga – The five-year period 2012-2016 was used in calibration.
- Julie Simpson – Are the same model parameters used each year? Dan Codiga – The model coefficients were fixed during calibration for best fit.

- Loretta Fernandez – Does the plume reach the surface? Dan Codiga – Yes, during winter conditions but it can remain trapped with development of a pycnocline during the summer.
- Dan Codiga - Clarifying model discussion responding to several general questions. Although the model is not run in "forecast" mode (full predictive mode), it has been used in "scenario" evaluations where one input parameter is changed over a given hindcast period. Examples include increasing the nitrogen loading from the outfall by 1.5x – this scenario resulted in increased ammonium levels in the nearfield, but no discernable chlorophyll increases. Other parameters could be changed, e.g., temperature, but MWRA has only evaluated eutrophication scenarios.
- Jim Churchill – Would MWRA consider a model to model comparison with the work WHOI researchers are doing? He is interested in interannual variability such as wind fields. Betsy Reilley – MWRA is happy to compare and share parameters and can coordinate offline.
- Carlton Hunt – Did the CORMIX model use the dye study data as input? Dan Codiga – Deltares (consultant performing the modeling) did not directly use the data from the dye study as input to the model but they did show that the CORMIX results were consistent with the dye study results.
- Carlton Hunt noted that he saw the value in the insight gained from model scenario runs but questioned the value of running the model in hindcast each year. (Note: running the model annually is a requirement in the Deer Island Treatment Plant NPDES permit, Part I.7.a). This sparked a general discussion with Jeff Rosen, Judy Pederson, Pam DiBona, and Bruce Berman about potential model scenarios that could be of value to explore, e.g., windfield changes, temperature of water coming into the Bay system from the Gulf of Maine. Jeff Rosen reiterated that he believed the major question of the monitoring/modeling (impact of the outfall on the ecosystem) had been answered, and noted that to address other questions, there may be a need to expand the monitoring and data analysis. Dan Codiga added the caveat that the model, designed to identify potential outfall effects on eutrophication, may not be appropriate to effectively address other questions.

Assessing the Seasonal and Storm-impacted Transport and Biological Fate of Micro- and Nanoplastics Discharged from Wastewater Treatment Facilities into Massachusetts Coastal Waters (11:30 – 12:20)

Scott Gallagher and James Churchill, Woods Hole Oceanographic Institution (virtual) presented 32 slides summarizing their combined field measurements and modeling efforts for the MWRA effluent/discharge as well as wastewater treatment plants in Wareham and New Bedford.

Questions/Comments:

- Loretta Fernandez – Was the much higher microplastic concentration (approximately three orders of magnitude) at the New Bedford outfall as compared to the MWRA outfall related to diffuser design or just the efficiency of the plant treatment system? Jim Churchill noted the very different outfall configuration – the New Bedford outfall is a single pipe opening that creates a large boil at the surface.

- Julie Simpson – Would a large stormwater influx through the system be expected to increase or reduce the microplastic concentration? Scott Gallagher noted that the term "concentration" can be misleading as different microplastic forms (particle vs. filament) have very different behaviors.
- Judy Pederson noted that a follow up meeting would be scheduled to further review this data set.
- Juanita Urban-Rich – Does the type of wastewater treatment process influence the shape/type of microplastic particle that is discharged? Scott Gallagher noted that his group hasn't evaluated that, but they have images for all of the counted particles. The variation in drag coefficients related to the different particle shapes can have a significant effect on their fate and transport.
- Steve Rhode – Beyond the counts, has the volume of material been evaluated? Scott Gallagher – they haven't at present but have the data to be able to estimate volume.
- Bruce Berman noted if the researchers have trouble gaining access to the New Bedford facility to be able to directly sample the effluent (as they did during this study), he would be willing to help with access.
- Pam DiBona – Have biofilms been considered that might change both the density and shape of particles? Scott Gallagher noted that research on that topic is ongoing at WHOI; the samples that his team collected have been preserved and could be analyzed at a future date using scanning electron microscopy (SEM).

LUNCH (12:20 – 1:00)

PFAS Matters (1:00 – 1:20)

Matt Dam and Betsy Reilley, MWRA (in-person) presented 11 slides summarizing MWRA's Toxics Reduction and Control (TRAC) program and ongoing PFAS analysis of influent, effluent, and biosolids at Deer Island.

Concentrations of Chemicals of Emerging Concern are Mediated by Seasonal Hydrodynamics in an Offshore Marine Environment (1:20 – 1:45)

Anna Ruth Robuck, U.S. EPA Office of Research and Development (virtual) presented 30 slides summarizing research on the distribution of PFAS and active pharmaceutical ingredients in Massachusetts and Cape Cod Bays.

Q&A with All PFAS Speakers (1:45 – 2:00)

Questions/Comments:

- Barbara Moran – Was there any difference in the types of PFAS coming into the Deer Island plant vs. in the effluent? Betsy Reilley – The levels are similar between influent and effluent but there could be some transformation taking place, particularly in the biosolids. MWRA is in the early stages of gathering all the possible information from the existing data.
- Barbara Moran – Are there precursors to PFOS and PFOA that could be transformed in biosolids? Betsy Reilley – Yes, it's possible that PFOA and PFOA are reduced or

transformed given the treatment process/heating that takes place with the biosolids. The Water Research Foundation study was looking at these transformations and are also evaluating which specific compounds are more likely to leach out.

- Jeff Rosen – How do background levels compare to EPA health advisory levels? Anna Robuck noted that the health advisory levels are for drinking water and are very low (part per quadrillion [ppq] level) versus the part per trillion (ppt) levels found in the ambient offshore environment.
- Jeff Rosen – Are there current limits on concentrations in biosolids? Betsy Reilley – There are no consistent limits at present.
- Todd Callaghan noted that PFAS as well as other contaminants of emerging concern (CECs) may be entering the MWRA monitoring area from around Cape Ann. The effect of the Merrimack River discharge could be taken into account when scheduling sampling efforts. Carlton Hunt noted that the potential Merrimack River influence could be evaluated through modeling.
- Todd Callaghan – How does the Stellwagen area station compare with other Massachusetts Bay locations? Anna Robuck – The Stellwagen station is on the lower end of the range of concentrations.
- Julie Simpson noted the importance at looking at source water, i.e., some of the influent to the Deer Island plant is not coming from the MWRA reservoir system.
- Barbara Moran – Does MWRA have any plans to stop moving biosolids into land applications? Betsy Reilley – This question is still being assessed; it is important to note that the nutrients in biosolids have a highly beneficial use.

OMSAP General Discussion and Public Comment (2:00 – 2:35)

Dissolved Oxygen:

- Judy Pederson noted that given that DO % saturation is triggering the contingency thresholds, we should be thinking about the ecological significance of the levels.
- Cathy Coniaris noted that NPDES permits now look to State water quality standards which are now just DO concentration and do not include DO % saturation.
- Jeff Rosen noted that it was accepted that there are generally no ecological issues at DO concentrations above 5 mg/L. Looking at the full DO record, the lowest recorded nearfield DO concentration was 5.17 mg/L at station N21 in 2022. This record does not indicate a relationship between the outfall discharge and the low DO levels in Cape Cod Bay that was identified by MA DMF with sensors in traps.
    - Jeff has data from Brennan, Blanchard, and Fennel 2016 summarized in a table: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0167411
- Julie Simpson noted that physiologically relevant low DO concentrations vary among different species. Todd Callaghan noted the State had compiled a review of relevant low DO concentrations. Cathy Coniaris will look for the list of DO levels triggering effects on individual species.
- Loretta Fernandez noted that although the outfall doesn't appear to be linked to the low DO events, should its impact be further evaluated compared to other sources of impacts and should a tracer study be considered. Betsy Reilley noted that a dye study had been

performed and that it was a significant effort. These threshold triggers send an inaccurate message of the exceedance as a potential outfall related issue.

- Judy Pederson offered that the 6.5 mg/L "caution" level should potentially be revisited.

Other Discussion Related to Upcoming Re-issuance of the NPDES Permit

- Judy Pederson requested that OMSAP members think about any monitoring recommendations, e.g., microplastics.
- Jeff Rosen suggested that CECs be considered for inclusion in the monitoring. Todd Callaghan agreed and referenced the three white papers on CECs by OMSAP to help guide decisions.
- Bruce Berman noted that although there are not criteria for CECs, having started monitoring of them sooner may well prove useful at some point in the future.
- Juanita Urban-Rich noted that the reported 80% retention of microplastics at the Deer Island plant was good news relative to the discharge at the outfall but questioned where it ends up (in the biosolids?) additionally noting that some contaminants bind to plastics. Dave Wu reported that there is currently no data on microplastics in biosolids. Vi Patek asked if the fertilizer being sold is tested. Betsy Reilley noted the material is categorized as Class A biosolids with testing for metals and other compounds, and that PFAS 16 was recently added to the analytical list prior to sale in Massachusetts and other states.
- Cathy Coniaris stressed the importance of commenting on the draft permit when it is released.

BREAK (2:35 – 2:45)

Public Interest Advisory Committee (PIAC) Meeting (2:45 – 3:00)

Bruce Berman, Save the Harbor/Save the Bay, PIAC Chair (virtual) summarized the value that OMSAP has provided and stressed the importance of continuing the OMSAP in some form, if not directly related to the outfall, then as a Science Advisory Panel, and opened the floor to public questions and comments.

- Vi Patek asked if the monitoring considered potential endocrinal impacts of the outfall discharge. Bruce Berman responded that flounder results show low incidence of liver disease. Betsy Reilley pointed to the annual and supporting reports for flounder data.
- Bruce Berman asked if EPA could provide insight on the permit schedule. Michele Barden noted a target May 1 public notice with a 60 day comment period (double the normal length) with a public meeting and hearing halfway through the comment period.

Documents and resources related to the 02/10/2023 OMSAP Annual Meeting

MWRA 2021 Outfall Monitoring Overview: https://www.mwra.com/harbor/enquad/pdf/omo.pdf

Tracking dissolved oxygen with the Cape Cod Bay Study Fleet and DMF: https://www.mass.gov/info-details/tracking-dissolved-oxygen-with-the-cape-cod-bay-study-fleet-and-dmf

Scully et al. 2022. Unprecedented summer hypoxia in southern Cape Cod Bay: an ecological response to regional climate change? https://bg.copernicus.org/articles/19/3523/2022/bg-19-3523-2022-discussion.html

Brennan, Blanchard, and Fennel. 2016. Putting temperature and oxygen thresholds of marine animals in context of environmental change: a regional perspective for the Scotian Shelf and Gulf of St. Lawrence. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0167411

This BEM report (on 2020) has the 1.5X run starting on page 74 (pdf-page 76): https://www.mwra.com/harbor/enquad/pdf/2022-08.pdf

This BEM report (on 2019) has the 0X run starting on page 72 (pdf-page 74): https://www.mwra.com/harbor/enquad/pdf/2022-07.pdf

Name	Attendance	Meeting Role	Affiliation
Judith Pederson	in-person	OMSAP Chair	MIT Sea Grant
Jeff Rosen	in-person	OMSAP	Corona Environmental
Julie Simpson	in-person	OMSAP	MIT Sea Grant
Loretta Fernandez	in-person	OMSAP	Northeastern University
Mark Patterson	virtual	OMSAP	Northeastern University
Peter R. Burn	virtual	OMSAP	Suffolk University
Juanita Urban-Rich	in-person	OMSAP	UMB
Robert Kenney	virtual	OMSAP	University of Rhode Island
Bruce Berman	virtual	PIAC Chair	Save the Harbor/Save the Bay
Heather McElroy	virtual	PIAC	Cape Cod Commission
Pam DiBona	in-person	PIAC	MassBays NEP
Vi Patek	virtual	PIAC	Safer Waters in Massachusetts
Jeff Kennedy	virtual	IAAC	FWE
Todd Callaghan	virtual	IAAC	MA CZM
Cathy Coniaris	in-person	IAAC	Mass DEP
Meagan Riley	virtual	IAAC	NOAA
Alice Stratton	virtual	IAAC	NOAA - Stellwagen Bank NMS
Aaron Hopkins	virtual	IAAC	US ACE NAE
Alexa Sterling	in-person	IAAC	EPA Region 1
Anna Robuck	virtual	Presenter	EPA ORD
Betsy Reilley	in-person	Presenter	MWRA
Dan Codiga	in-person	Presenter	MWRA
David Wu	in-person	Presenter	MWRA
Matthew Dam	virtual	Presenter	MWRA
Jim Churchill	virtual	Presenter	WHOI
Scott Gallager	virtual	Presenter	WHOI
Ellen Baptiste Carpenter	virtual		Battelle
Scott Libby	virtual		Battelle
Ido Dinnar	in-person		Brandeis University (Student)
Mark Cantwell	virtual		EPA ORD
Michaela Cashman	virtual		EPA ORD
Regina Lyons	in-person		EPA Region 1
Steven Wolf	in-person		EPA Region 1
Michele Barden	virtual		EPA Region 1
Phil Colarusso	virtual		EPA Region 1
Melissa Campbell	virtual		FWE
Ryan Joyce	virtual		FWE
Prassede Vella	in-person		MassBays NEP
Carolyn Fiore	in-person		MWRA

Chris Goodwin	in-person		MWRA
Becky Weidman	virtual		MWRA
Devon Winkler	virtual		MWRA
Fang Yu	virtual		MWRA
Jianjun Wang	virtual		MWRA
Maret Smolow	virtual		MWRA
Sally Carroll	virtual		MWRA
Steve Rhode	virtual		MWRA
Wendy Leo	virtual		MWRA
Debbie Rutecki	virtual		Normandeau Associates, Inc.
Ken Keay	in-person		Retired
Carlton Hunt	virtual		Retired
Matt Liebman	virtual		Retired
Barbara Moran	in-person		WBUR
Andrew	virtual		
Beckett Colson	virtual		
Christine Werme	virtual		
Joice	virtual		