



Minutes

Nov 5, 2021

Remote via zoom

Attendees:

WAC Members: **Wayne Chouinard** (Chair, Town of Arlington), **Kannan Vembu** (Vice-Chair), Adrianna Cillo (BWSC), **Craig Allen**, **Dan Winograd**, George Atallah, **James Guiod** (AB), **Karen Lachmayr**, Martin Pillsbury, **Mary Adelstein**, Philip Ashcroft, **Stephen Greene**, Taber Keally (NepRWA) (Members in attendance in **bold**)

Guests: Wendy Leo, Charles Ryan, Maret Smolow, Chad Whiting (MWRA), Lou Taverna (AB), Erika Casarano, Don Walker AECOM, Stephen Perkins (MyRWA), Charlie Jewell, Amy Schofield (BWSC), Vandana Rao (EoEA), Joe Savage (Save the Harbor), Kerry Snyder (NepRWA), Juliet Simpson (MIT SEA Grant, OMSAP), Mike Armes (AES Environmental Services), Paul Lauenstein (WSCAC), Viki Zoltay (Office of Water Resources), Van Du, Anne Herbst (MAPC),

Staff: Andreae Downs

VOTE: June and October minutes

WAC Letter on Sewage Notification Law draft regulations

Andreae shared a draft letter on the draft regulations of the sewage notification law, including cautions around too many notifications, to be produced and planned for too fast. Members asked about what other agencies were doing, and MWRA, BWSC (Boston Water & Sewer Commission) and the Advisory Board are also sending comment letters. Members asked about blending. Since blending is treated to meet NPDES (National Pollutant Discharge Elimination System) permit limits for public safety, the letter recommends not sending out emergency notifications to every resident, but instead allowing these notices to be posted to a website. Andreae explained that too many notifications could cause residents to tune out and turn them off, when the purpose of the law is to give residents useful information on when a sewage release is dangerous to public health.

Members supported the letter and some plain-language messaging in the notifications.

VOTE: approve sending the letter in concept. Small edits to be incorporated.

REPORTS:

MWRA: Lots of job openings at MWRA.

Poster & essay contest is open “What a Clean Boston Harbor Means to Me”

Reports:

Industrial Waste Report (TRAC)

<https://www.mwra.com/annual/tracindustrialwastereport/iwr-2021.pdf>

O&M Report and Status Sheets

(maintenance) <https://www.mwra.com/harbor/pdf/omstatus21.pdf>

CSO (Combined Sewer) post-construction performance assessment - Semiannual Report #7

https://www.mwra.com/cso/pcmpa-reports/07_010121-063021.pdf

MWRA participated in a Massachusetts Bays Partnership workshop around the Cape Cod hypoxia—possibly due to a dinoflagellate bloom

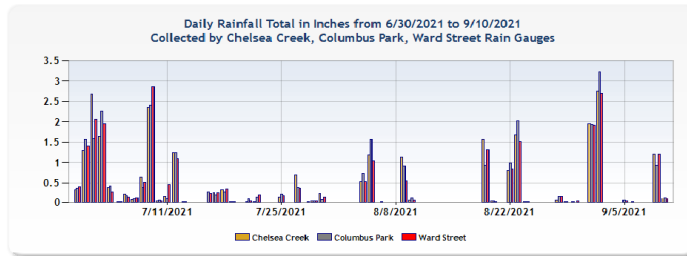
Director: added that the Combined Heat & Power study has been delayed a few months.

Advisory Board: wastewater metering project is close to being finished. Important to communities because wastewater flow is one of the inputs that determines sewer assessments. AB has a video on how those sewer assessments were created.

PRESENTATION: Big Rain, Big Projects

Andreae introduced Charles Ryan, director of wastewater operations and maintenance for the MWRA.

Slide showing amount of rain Boston had in the summer via each of the headworks Over 25” over the summer—or about 58% of the average in 2.5 months.



Chelsea Creek: 25.77" Columbus Park: 26.10" Ward Street: 25.15"

Typical annual rainfall for Boston area = 43 inches

2021 rainfall through September 43.43 inches

2021 rainfall through October = 48.54 inches

MWRA had 29 CSO activations this summer, and 2 SSOs (sanitary sewer overflows). Had to cancel a lot of vacations so that there was enough staff during rain events at the CSO facilities and at the headworks.

The vast majority of the CSOs go through a treatment plant, so meters capture how much volume is entering public waters. These are also mostly treated/disinfected. SSOs are unexpected, so are challenging to estimate volumes. Disinfected flow has little effect on public health.

Projects

Nut Island Odor Control—repairing still from a fire in the odor control room. Adding new controls. Important because the island is now a beautiful public park (it used to be a place where Boston discharged sewage & sludge. The area now includes a headworks, but all sewage is pumped to Deer Island). Don't want to be the stinky neighbor.

Challenging because of a tight footprint to replace equipment while running a headworks.

Creating redundant odor control—both wet scrubbers, which use chemicals, blowers and whiffle-ball-like structures to scrub air, and carbon beds.

Huge new fans:



Lots of new conduit, piping, etc. All underground & under grass.

Also replaced the spillway gates;



These are only for emergencies, for instance if MWRA lost pumping capability at Deer Island and was releasing to not cause an upstream backup.

Also removed the underground fuel tanks and replaced with fiberglass tanks. Easier to replace than former tanks.



Also replaced boilers—had to build from scratch. Will be very efficient and on automatic controls. Other efficiency measures—LED lighting, variable pumps and motors.

Prison Point CSO Facility

Contract just signed. Located across the train tracks from the Museum of Science. Most of the facility is underground.

Prison Point is over 40 years old, and has both wet and dry flow from parts of Boston, Cambridge & Somerville

This project replaces:

- Influent wet weather gates
- Catenary bar screens
- Bar screens (which collect debris)
- Conveyor (which conveys debris to a dumpster)
- Storm pump engines—diesel and have no replacement parts. New engines will be easier to maintain
- Electrical room will be moved
- New SCADA (systems control) system
- Dry weather pumps (3)
- Generator (also a diesel engine)
- Chemical tanks and feed system—used to treat flow, disinfection and dichlorination
- Will also have to remove the roof
- Force main will be cleaned and lined

2-year project, double shifts, because capacity at all time will be down by 1/3.

Typical year, Prison Point will discharge 17 times. This summer, so wet, discharged 11 times. It can store up to a million gallons, MWRA stores the water & then sends it to Deer Island for processing. Some times without a discharge, sometimes with one.

Even without a major renovation project, MWRA is installing stop logs and other measures to protect each low-lying facility from storm surges and sea level rise. That's been done at the Chelsea Screen House. The decision to put up flood measures has to happen days in advance of a storm.

What about access to Deer Island? That's planned for, but is someone else's responsibility.

What about longer-term climate effects & prison point? Bringing in a second source of power and additional transformers. All of these will be raised. Prison Point and Nut Island are not in the flood zone.

Are there incentives to contractors if they finish on time and on budget?

No, but there are penalties for finishing late.

Andreae thanked Charlie for the presentation. Next WAC meeting is January of 2022.

Director's Report Oct-Nov 2021

Water Resources Commission 10/14

Executive director's report: MA recovered from drought, except groundwater. This next week, WRC is joining #Imagine a Day Without Water. Intern working on messaging on water conservation.

Hydrologic Report: Warmest September on record. Significant rainfall. Cleared up drought on Cape and across the state.

Foxborough's request for monitoring reductions at its Witch Pond Wells.

Witch Pond supports a white cedar swamp, headwaters of Ten Mile Basin, habitat for Hessel's hairstreak butterfly and the spotted turtle.

Foxborough's wells are pulling water from the swamp and discharging to the Taunton basin (interbasin transfer). Not allowed to pump in dry season.

The baseline conditions were better than after pumping started--including invasive species, dryer habitat, etc. No plans to address.

Foxboro has reduced residential water consumption, but unaccounted for water is greater than 30% for the last 4 years.

WRC wants more controls on pumping, more monitoring, minimizing time when pumping results in going over safe water withdrawal thresholds, additional reporting over time. Also water conservation by industries. Will allow a streamlined annual report. But want 48-hour notification of any non-compliance to their requirements

Foxborough's Maura Callahan:

1. Natural for white cedar swamps to have a dry season
2. Mansfield is pumping from this aquifer.
3. Local septic systems and new development is causing eutrophication
4. Climate change is also impacting water levels

DEP 314 CMR regulations revisions--improving clarity of tables & figures 1-27

Updated CSO qualifiers.

Changes to Toxic pollutant criteria may impact NPDES permits--probably only for Clinton, not for DI.

Aluminum criteria changes for fresh water will probably not affect Nashua River (Clinton), because background levels are still well under proposed limits.

MWRA Board 10/20

Fred Laskey: MWRA is 98% vaccinated

Administration & Finance

Internal Audit (report: <https://www.mwra.com/monthly/bod/boardmaterials/2021/OS%202021-10-20%20Board%20Materials.pdf>) includes over \$1m in HEEC-related over charges.

Financial Update Variance in the first quarter is \$10m, mostly direct expenses (wages & salaries, as head count is 32 below budget) and debt service savings (variable interest rates). DCR still hasn't staffed up watershed operations--133.3 vs budgeted 150)

Wastewater Committee:

Annual Outfall Monitoring 2020

MWRA's 29th year of monitoring and 20th anniversary of the 9-mile outfall. COVID interrupted some monitoring. 14th year of no limit exceedances. Almost all effluent had secondary treatment; solids at 12 tons/day is a fraction of 1990 levels. No nitrogen exceedances, after touching them in 2019.

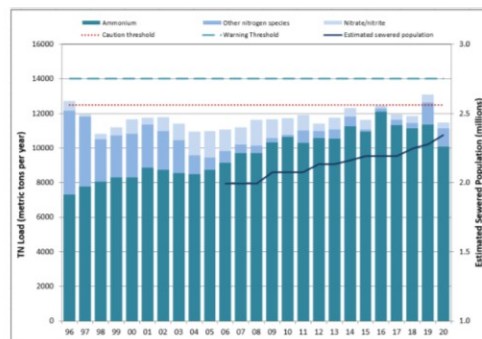


Figure 3. Annual effluent nitrogen load and MWRA sewered population.

Minerals low; no adverse effects from outfall.

New *Karenia mikimotoi* dinoflagellate may have contributed to lack of dissolved oxygen in Cape Cod Bay. *Alexandrium catenella* (red tide) cysts found in Mass. Bay for the first time in 2019, and again in 2020. Moderate blooms in 2020 and 2021.

The report is worth reading in more detail.

TRAC new director is Matthew Dam.

COVID meant that many TRAC functions went online and remote--this was efficient, and will continue.

TRAC was also initially involved in wastewater testing for the virus.

The Office of Technical Assistance and MWRA offered significant industrial users help in identifying & reducing PFAS this year. Data collected will help MWRA identify sources.

Contract changes

--Prison Point--increase in funding, not time

--Combined Heat & Power Study--three-month extension, no increase in funding--allows a review of the findings by outside experts.

--Clarifier rehab. Foti asked why it was so late--but had COVID pause, plus single bid, so sent it out again for bids. Came in for contract extension of time & more money

Water Supply:

Tunnel project:

Geotechnical investigations--deep test borings are nearly done. Includes bedrock permeability. Each one takes about 8 weeks to complete. Have mapped out bedrock outcrops (above ground way to collect geology information) at 26 locations.

10 borings--4 in Waltham, one in Weston (Norumbega tower), one in Wellesley, one in Needham, one in Newton (near NSHS), one in Brookline and one in Boston at Boston Light/American Legion Hwy.

What finding? --hard quartz in Waltham. Some pink granite. In Brookline puddingstone. 3800 linear feet of rock core so far.

Also doing seismic refraction--non-invasive survey that determines subsurface conditions

In the middle of MEPA review. Six comment letters--all favorable. Met with all 10 communities in the study area, plus key organizations.

Lot of work on Alternatives Evaluation. Figuring out how to put shaft sites together. Already narrowed down. Drilling at School St. in Waltham now.

One concern is the presence of a fault along the route of the northern pipe.

Boston Harbor Ecological Network-Climate Resilience Conference 10/26

120 participants

Chancellor Marcelo Suárez-Orozco, UMass--we can reduce the threat of climate change still. Need data and concepts being shared in this conference, but need to think deeply about them and apply them to climate resilience.

Cathy Stone, donor to the Stone Living Lab (UMass Boston): Rate of sea level rise faster than predicted. History of the lab.

Kathleen Theoharides, Secretary, EoEA--notes extreme weather, warmer than normal temperatures, aggressive emissions targets in MA. Need to adapt. Resilience is critical as well as preventing climate change.

Significant infrastructure is at risk now from climate impacts.

MVP program, examples of using parks for water storage, combatting heat island effects. Announcement: EoEA and DCR entering an MOU with Boston, Boston Harbor Now, UMass to address climate change. Supporting nature-based solutions in parks, and shoreline resilience.

Questions--what questions is EoEA trying to answer? Lots--much hasn't been tested. Ecological restoration results, removing invasives, accretion in salt marshes...will send a list.

Biggest challenge in Boston area? Heavily developed--not many salt marshes or dunes left to buffer us with.

Opportunities? Ecological restoration. Returning shorelines and rivers to ability to flood. Making sure that elderly and non-English-speaking populations aren't left alone in a crisis.

Lightning Rounds

Kirk Bosma, Woods Hole: Robust monitoring of nature-based solutions: Stone Living Lab--nature-based solutions are being deployed, but not measured for effectiveness. SLL looked at ones only in MA. Looked at sustainability, side effects, maintenance needs, effectiveness, both pre-and post-construction. Particularly interested in cobble berms. Gathering data to use to improve designs. Also collecting data on how to model these constructions

Julia Knisel, CZM: Many of Bosma's projects funded by Coastal Zone Management. Looking at restoring sediments and attenuating waves. Constructed 11 projects, 3 more are being built now. Taking a higher-level effectiveness look--what can be seen, in terms of sustainability, surviving wave action, etc.

Jerrett Byrnes SLL. Looking at future of our shorelines & nature-based solutions. Rainsford Island. How do changes to the shoreline impact the life in the surrounding sea? Using other islands as controls. Comparing with Salem Harbor work. Trying to establish also background effects as the climate changes.

Megan Rokop UMass. Identifying species with iNaturalist. Thompson Island. Overnight. Measuring student engagement in a citizen science project. Found increased engagement and that the students found data that was useful to the Park Service and scientists.

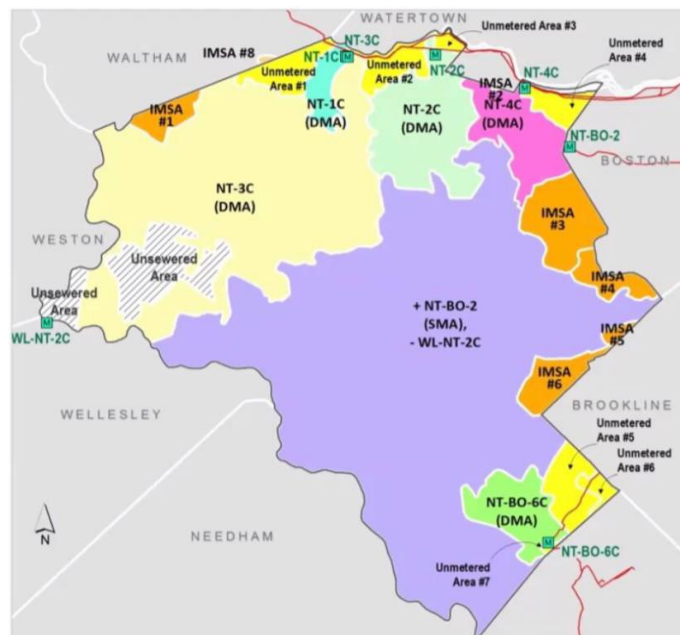
Melanie Garate, MyRWA--Resilient Mystic Collaborative. Capacity to deal with climate is beyond individual municipalities, so combine 11 communities. Bring forth regional strategies, and include economic justice communities. One project is “Wicked Hot Mystic” talking about heat. Volunteer science campaign--measure temperatures, ambient and air quality. Looking at targeted interventions--white roofs, etc.

Jessica Torosian--MassDOT Tide Gates Many put up in colonial times--function as a temporary dam as the tide comes in to protect some assets. Sometimes closed gates can cause damage--preventing saltwater intrusion, and protecting homes, allows phragmites to take over and these can ignite/burn quickly.

Advisory Board Operations Committee 10/28

Wastewater Meter Installation Update Ethan Wanger, director SCADA & Metering, Michael Greeley, manager, metering & monitoring and Stephen Estes-Smargiassi, director, planning and sustainability

Mike Greeley--there are several methods for measuring wastewater flow, depending on the design of the sewers--Newton, here has all of them:



- Direct
- Subtraction
- unmetered/estimated (under 50,000 gallons/day)

The new meters are Area/Velocity meters Takes 2 sensors, either laser, pressure or ultrasonic for depth and a doppler or laser tool to measure velocity. The latter is the most finicky. Laser is pricier but more accurate, so kept to the largest interceptors.

Added 174 new meters, 21 are laser. Rest are pressure or ultrasonic. 91 of those are submerged.

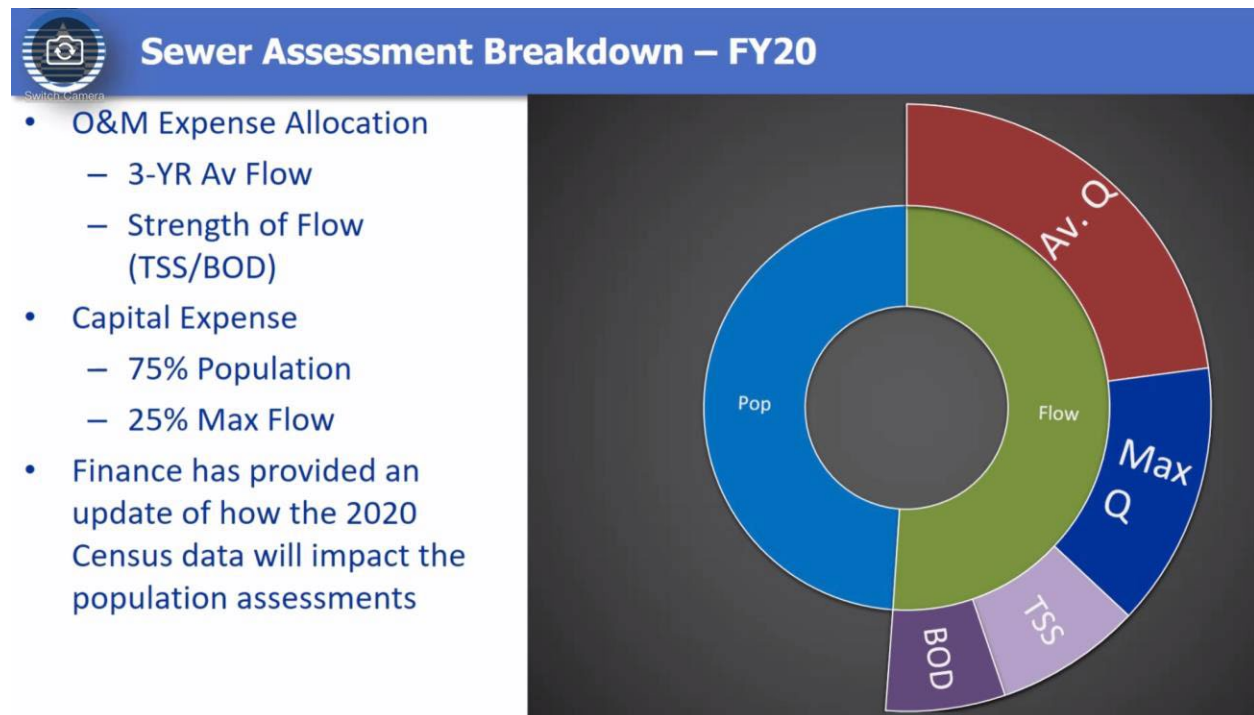
Now at nearly 94.5% metered, vs. 90% before the new installation.

Once installed, the Authority confirms and calibrates data a minimum of twice and over a minimum of 2 weeks.

Have 92% installed, expect to have all done by January 1. Confirm and calculate by municipality as well as the system share analysis. The latter can't be done until all the communities have confirmed the data.

Flow is highly weather dependent. Past few months have posed a challenge because of high rain and flows. Looking for outliers and are trying to compare similar rain months. So far, no big red flags.

Goal is for every community to get a final number of just their flow so MWRA can generate a share summary.



Currently everyone is paying a rate/share based partly on the last 3 years average for each month prior to the meter installation start--the hold harmless period.

Going forward, the first year will include hold harmless numbers for $\frac{2}{3}$ of the average and only the first year of data--it will smooth the change going into the new shares. Second year $\frac{1}{3}$. FY26

will the first year calculated entirely on **actual** flow numbers from the new meters. Don't expect dramatic changes anyway, except for the unmetered areas. MWRA was surprised that some unmetered areas had substantially more flow or less flow.

Sewer Assessments by Fiscal Year							
FY22	Metering System (CY18, CY19, CY20)			Meter Installation (CY21)	New Metering System (CY22, CY23, CY24)		
	CY18	CY19	CY20				
FY23		CY19	CY20	CY18 CY19 CY20			
FY24			CY20	CY18 CY19 CY20	CY22		
FY25				CY18 CY19 CY20	CY22	CY23	
FY26	Annual Billing entirely on New Meters				CY22	CY23	CY24

Jon Szarek is the new Carl Leone, who retired after distributing the billionth dollar to communities. John started Monday.

Steve advises communities to keep MWRA updated on new development or closure of industries in unmetered areas, and MWRA will be reaching out more regularly to ask about unmetered areas.

Water quality issues with drinking water--chlorine residuals.

Why are we seeing some water quality issues? Lots of rain Wachusett usually is 50% Quabbin, the rest from Wachusett tributaries. When we have a lot of rain (July, Sept), more of the water comes from Wachusett tributaries. That means more organic matter in the water. More organic matter requires more chlorine. Chlorine decays in the pipes over time, which means chlorine residuals in the water. If you are far from the source, your water may arrive without much chlorine remaining, but high residuals. When bacteria are present, can get nitrification of the water. Once it takes hold, it can be difficult to remediate.

With colder temperatures, should see improvements.

Some communities think they are getting biofilm coming out of the tap--seeing on filters, greasy feeling.

Cape Cod Bay Hypoxia Science Panel 10/29

Over 100 participants

Judy Pederson: Background on OMSAP -ensure that the outfall would not adversely affect the bay. Developed a monitoring plan, 1998 permit appointed OMSAP. What the plan involves. OMSAP responsibilities.

Reminded participants of the other discharges in Mass Bay besides MWRA.

Nitrogen trends: 1996-2000, MWRA Annual Report 2020 for 2019

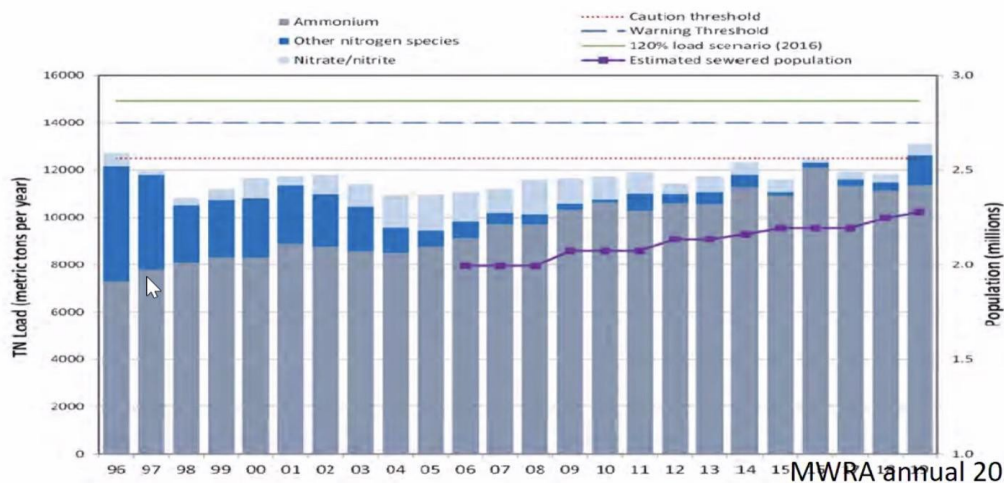


Figure 2-7. Annual nitrogen discharges, 1996–2019, and estimated population of the MWRA service area, 2006–2019. During outfall planning, experts estimated that discharges would total 14,000 metric tons per year by 2020. The warning threshold was set at that level, and the caution level was set at about 90% of that projected load. A water-quality model simulation using 120% of the 2016 discharge (green line) projected negligible environmental effect.

This led to a discussion of Cape Cod Bay and the question of whether there should be more information on why Cape Cod had hypoxia.

O2 saturation this year in Stellwagen Bank and near the outfall is high this year.

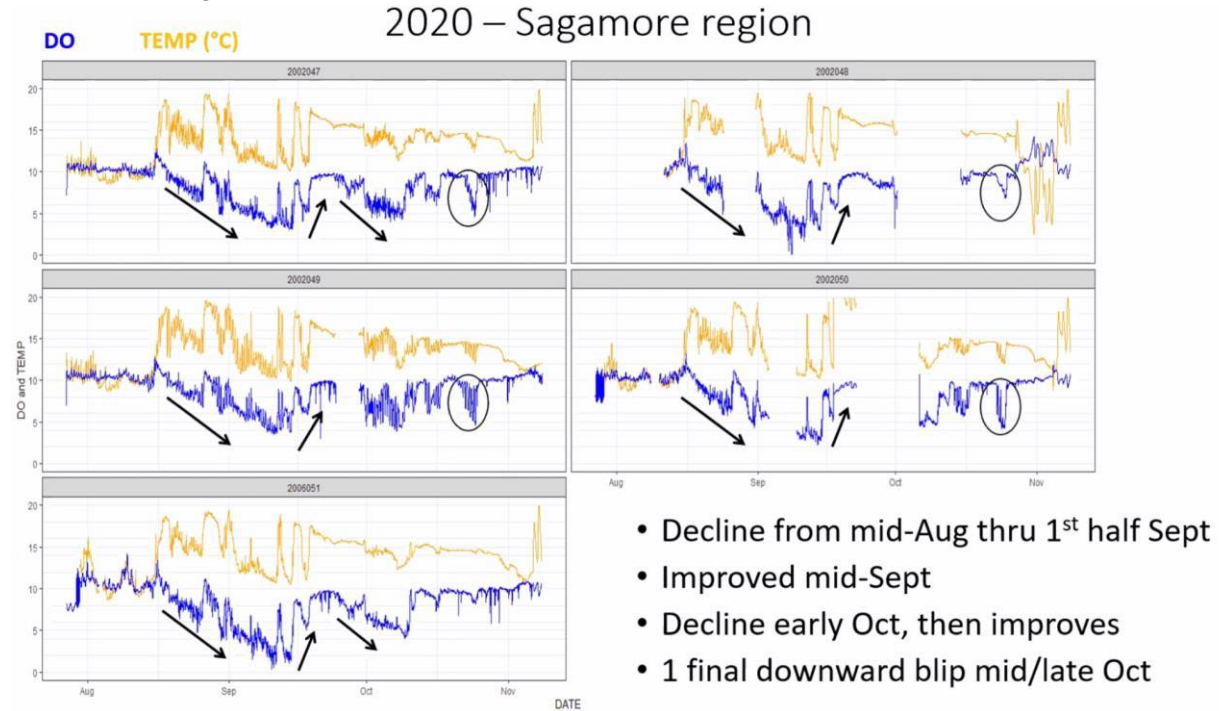
What other factors? Temperature? Other nutrients? What other climate related changes are occurring. Can the MWRA eutrophication model be useful?

Tracy Pugh--the 2019 Cape Cod Hypoxia and how it can form--nutrient input, algae blooms, algae dies & decomposes. Stratified water. Most animals who can move, do move.

Concern that southern CC bay will become a seasonal dead zone because of warmer waters. Gulf of Maine is warming faster than many other parts of the world's ocean.

To understand--need better understanding of what's driving the conditions for hypoxia.

New monitoring efforts developed for 2020. Measured DO and temperature.

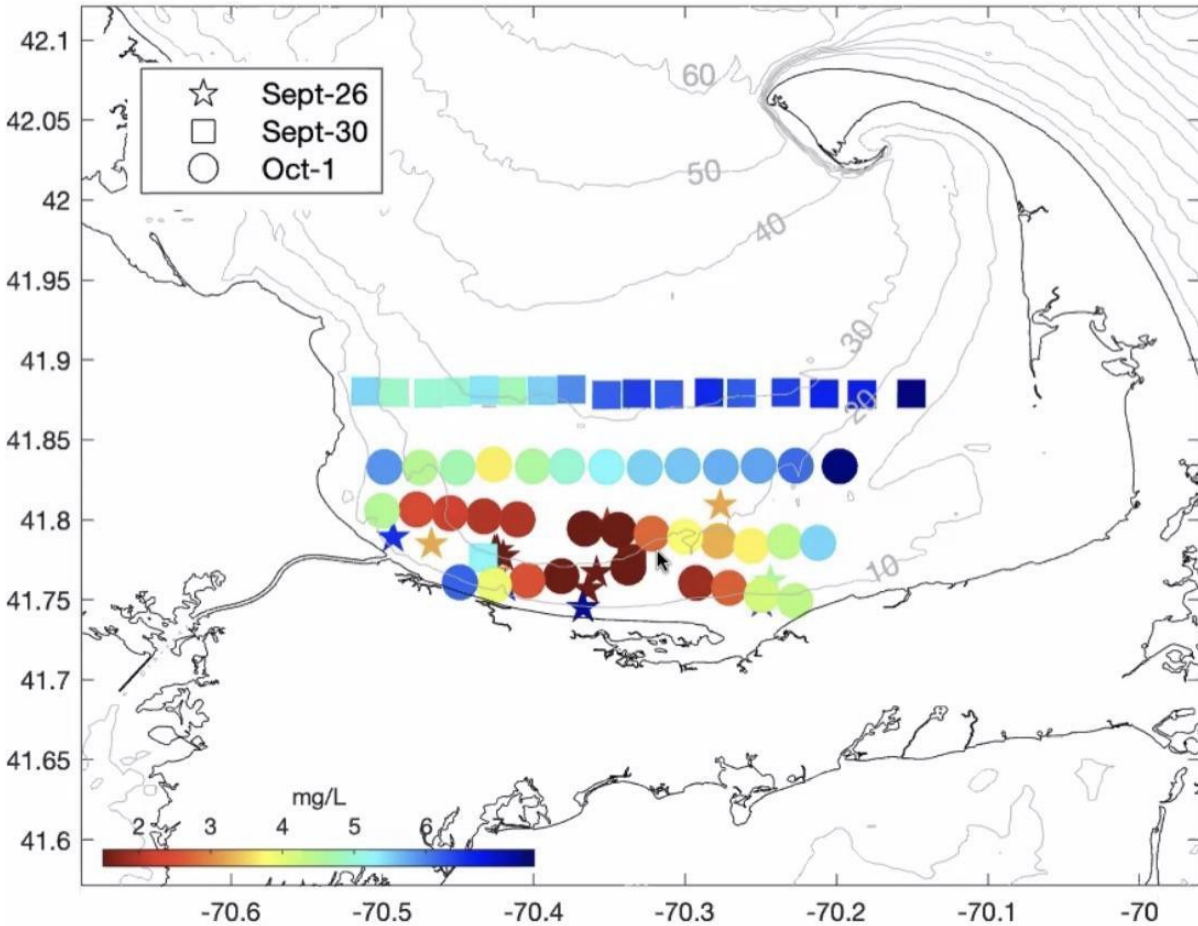


Now have a data dashboard, updated automatically.

Web app is coming so lobster fishermen and others can log in and see conditions before putting down traps.

Retrospective analysis of 2019 and 2020 Malcom Scully, Woods Hole

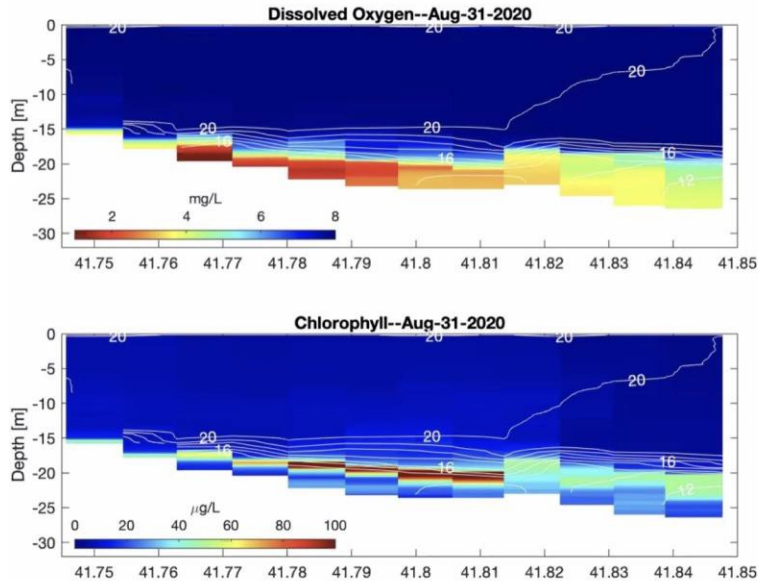
Bottom Oxygen from 2019



Found a second hypoxia even in late summer 2020--mostly bottom.

Their bottom loggers and lobster fleet caught the event--it lasted from Aug. 31 to Sept. 20th. Strong downwelling winds ended the 2019 event.

Detailed Across-shelf Surveys from 2020



- 1) Hypoxia Water is confined to thin layer below the thermocline.
- 2) Lowest DO occurs where bottom layer is thinnest
- 3) There is intense chlorophyll fluorescence at the base of the thermocline.

Hypoxic waters associated with stratification and lowest DO occurring where the bottom layer is thinnest. High sub-surface chlorophyll fluorescence before the hypoxia.

What was different about 2019 and 2020?

- *Much higher algae bloom (fluorescence)
- * Decrease in bottom nutrients on deep bottom afterwards

What is using these nutrients and depleting O₂?

New species of phytoplankton detected in 2017, and high in 2019 and 2020: *Karenia mikimotoi*. Higher in sub-surface samples than in surface samples. Correlation.

MWRA Effluent/Nitrogen & Cape Cod Bay, Dan Codiga, MWRA

This study is not focused on Cape Cod Bay

Outfall ammonium signature (what outfall most affects).

Ammonium dissipates after about 5 miles -- not seeing a correlation with chlorophyll or organic carbon

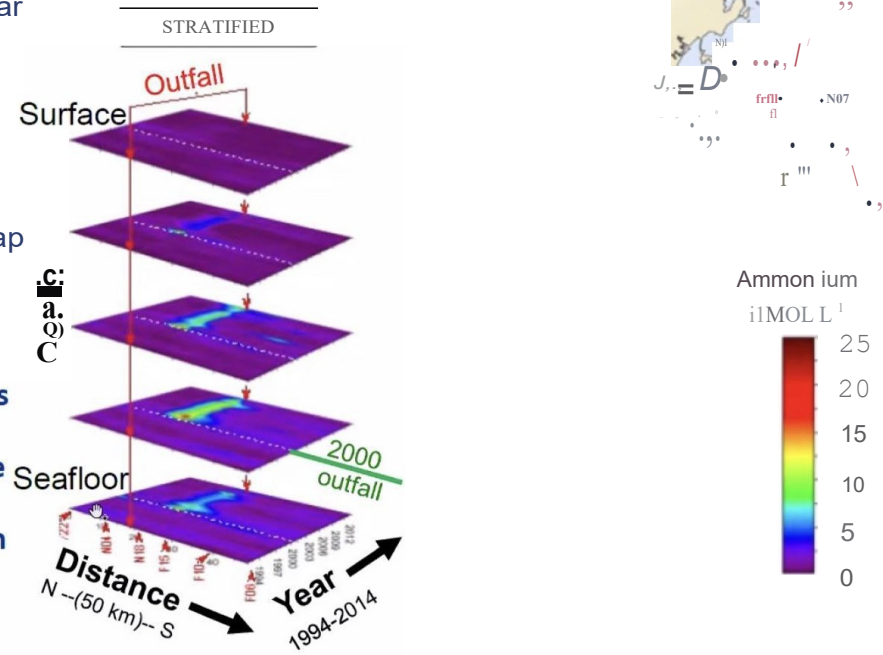
Observed outfall ammonium signature

Observed Jun-Sep (stratified) and Dec-Mar (unstratified) mean ammonium signature.

Variations in depth, distance along 50 km transect (see red in map inset) through outfall, and year.

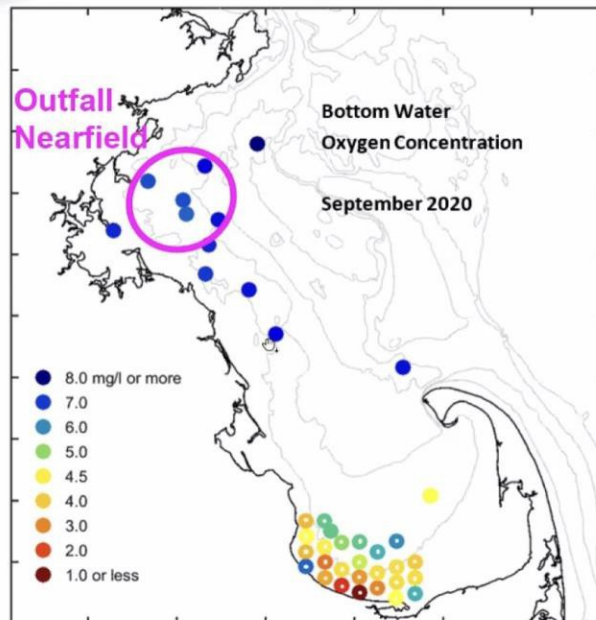
“Ammonium increases are localized within about 10-20 km of the outfall, and concentrated at depth during stratification and near the surface otherwise.”

Reilley et al., 2018.





View of Cape Cod Bay hypoxia with Mass Bay in context



- Hypoxia is localized in southern Cape Cod Bay
- No hypoxia in Massachusetts Bay

Solid dots:

Measured 9/8/2021 by MWRA

Open dots:

Measured 9/2/2021, credit Tracy Pugh MA DMF

Werme et al., 2021 (DRAFT)

Conclusions:



Summary

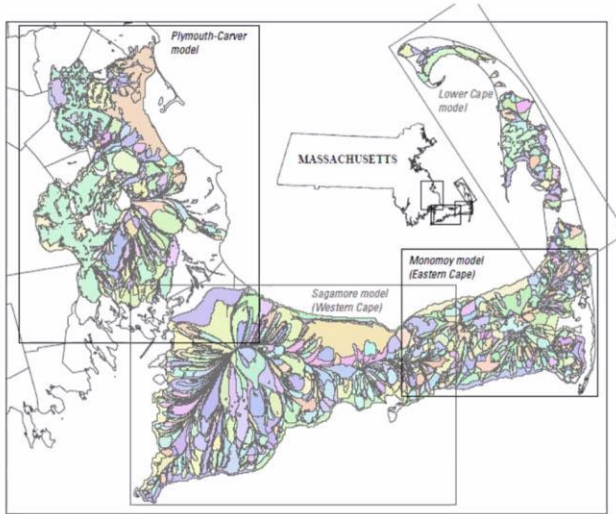
- Cape Cod Bay is 37 km from the outfall, at a minimum
- **Observations** indicate:
 - Distance from the outfall of detectable effluent nitrogen enrichment is
 - up to 10-20 km on a temporally and spatially variable basis
 - about 8 km for the long-term average, vertical mean
 - Effluent affects ambient NH_4 most strongly (DIN and TN to lesser extent)
 - concentrated at depth during stratification, near surface otherwise
 - Outfall influence not evident on chlorophyll, nor particulate organic carbon
- **Model results** are consistent with observations, and indicate:
 - Dilution of effluent in Cape Cod Bay is at least 400:1
 - Offshore exchange dominates nutrient balances for Massachusetts and Cape Cod Bays, and contributions of effluent are minor
 - Even for a 2X increase in current effluent load, well above the Contingency Plan warning level, changes in Cape Cod Bay chlorophyll are very minor
- 2021 Contingency Plan exceedance for D.O. Percent Saturation in Stellwagen Basin: unrelated to outfall, and unrelated to Cape Cod Bay conditions

Groundwater & Nitrogen Jeff Barbaro, USGS

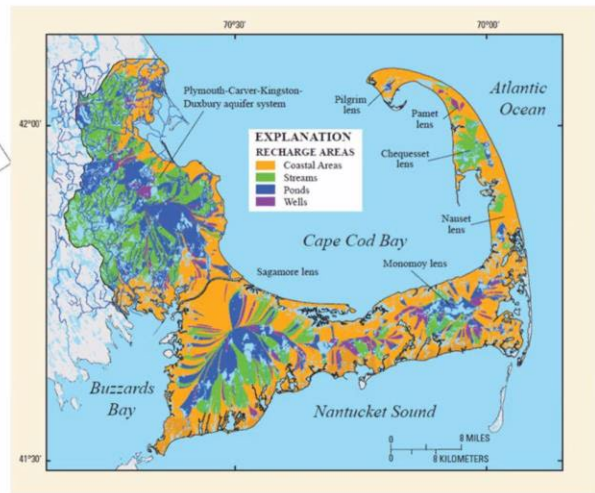
Cape cod hydrology--Cape is composed of 6 discrete groundwater lenses. Flows from the high points of land toward the coast.

Flow model

Regional Estimation of Groundwater Discharge to Coastal Areas



(Carlson and others, 2017)

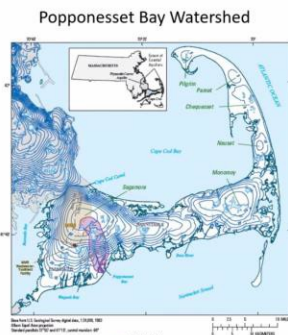


(Masterson and Walter, 2009)

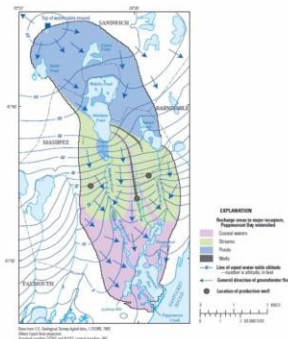
Each of these creates hydrologic budgets--portions of the water that goes to streams, wells, or to the coast. About 69% of the Cape's fresh water ends up on the coast.

Nitrogen transport via groundwater & its discharge to coastal areas mapped in one groundwater shed:

Estimation of Nitrogen Transport and Discharge to Coastal Areas



(Walter, 2013)



Water-table altitudes, groundwater flow directions and recharge areas to major ecological receptors in the Popponesset Bay subregional model

Notes that groundwater moves slowly--there's a reservoir of Nitrogen there. Fairly short--4-6 years. Nitrogen load starts to decline as septic is moved to sewers.

Karenia Mikimotoi in the MA Bay Region.

David Borkman, DEM RI

Does phytoplankton monitoring for the MWRA bay stations. 10 stations for MWRA, 3 Cape Cod, mostly surface.

Karenia M. is a dinoflagellate, does not have a series of thick cellulose plates around it.

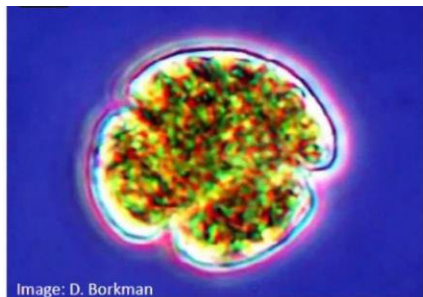


Image: D. Borkman

Approx 30 um diameter



SavetheHarbor.org, September 2019

Karenia mikimotoi

- Dinoflagellate, athecate
- Taxonomic confusion
 - *Gyrodinium aureolum* ?
- Blooms (Japan, North Sea, Gulf St. Lawrence, US East & West Coasts)
- Eurythermal
- Harmful effects?
 - NO Human Health effects
 - Toxins (?) Gymnocin (ichthyotoxic, mucus, allelopathy)
 - Ecosystem effects
 - Biomass bloomer
 - Low DO
 - Noticeable blooms!
- MWRA: 1st observed Aug. 2017

When it blooms in high numbers, water looks like coffee. Very noticeable. Draws down DO--shellfish, any fish in fish farms, lobsters in traps--die of suffocation

Well-suited to life in low light areas. Can swim. Can consume bacteria. Prefers ammonia, only takes up nitrate when there's sun. Moderate growth rate.

Can over-winter. Lots of carbon in each cell. Other dinoflagellates don't grow when Karenia is present.

First identified in Japan in 1935. History of unexpected appearances.

Woods Hole and HI saw it in the 1950s, but misidentified it as *G. aureolum*.

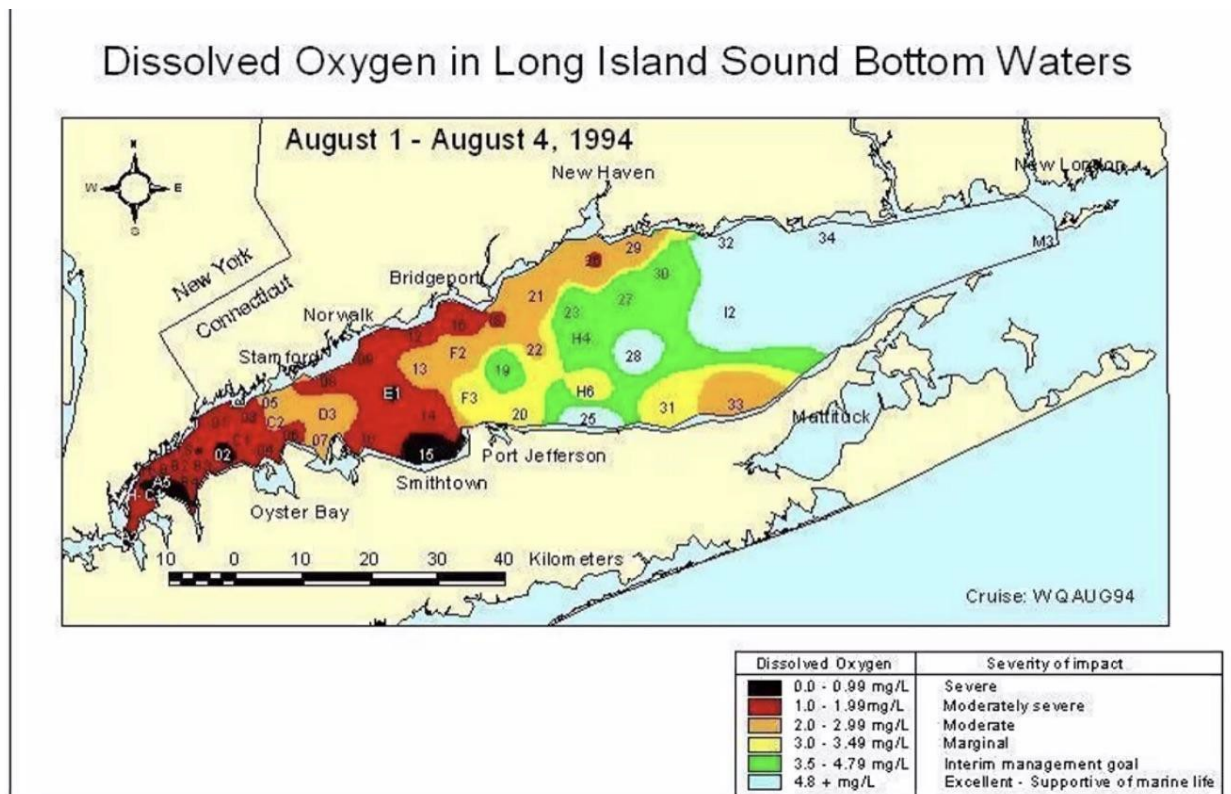
Not observed in MA Bay 1992-2016, but showed up all at once in various parts of the bay in 2017. More abundant in the deep layer vs. the surface. Shown up every year since.

If it hangs around, will see more hypoxia events, esp. With warmer waters.

Case Study: Responding to Hypoxia in LI Sound

Mark Tedesco, LI Sound Study

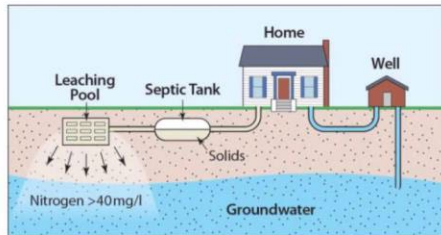
1994--levels of DO



Reduced Point source nitrogen loads, and also watershed loads from 7 major tributaries. Also, from air depositions as part of the Clean Air Act.

Opportunities that remain are more difficult to control--impervious area, septic waste, and fertilization of turf

Reductions to major sources but opportunities remain



Source	Trend	Description
WWTPs (CT, NY)	↓	100% of WLA trade equalized target
Atm. Deposition	↓	26% ↓ TN, 50% ↓ NO ₃
Agricultural	↓	25-40% ↓ in fertilizer and livestock
Urban storm water	↑	2-3% ↑ in impervious areas
Septic	↑	8% ↑ in basin population (1990-2010)*
Turf Fertilizer	↑	1-2% ↑ in turf/grass areas

On-site wastewater, turf fertilizer, and stormwater can be dominant sources to embayments

Mass Bays Estuary Partnership: Forum to Investigate and Respond to Hypoxia in Cape Cod Bay, October 29, 2021

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Size of the area of hypoxia has decreased 50% since 1987. But improvements have been dampened by warming waters.

Other eutrophication impairments continue--harmful algal growth, etc.

Next: Are further nitrogen load reductions needed? Expanding the model to include the Atlantic side of the island, reviewing septic sources, improving nutrient load estimates, expanding open water assessments.

Panel Discussion

Nutrients have been there for years--but prior to *Karenia*, there were no organisms that could use them.

In LI, not seen a major shift in *Karenia* or other bloom organisms that took over as with Cape Cod. Have had *Alexandria* (red tide) blooms.

Working with the lobstering community is very helpful.

Because of MWRA research, we know it's NOT the outfall. Looks like it's *Karenia*, and is localized. So fleet can respond well to that.

Need an early-warning system for *Karenia* the way we have one for red tide. Controlling nutrients is key to helping the situation.

BUT--difficult to predict *Karenia* blooms.

So--what role or actions can regulatory agencies take?

Difficult now, because we don't really know whether past events are really Karenia, but we didn't realize it.

Some advocate continuing work on controlling nitrogen. Especially since temperatures are getting warmer, making blooms more prevalent even with lower nitrogen levels.

Next Steps

Summary, Mass bays staff will circulate.