

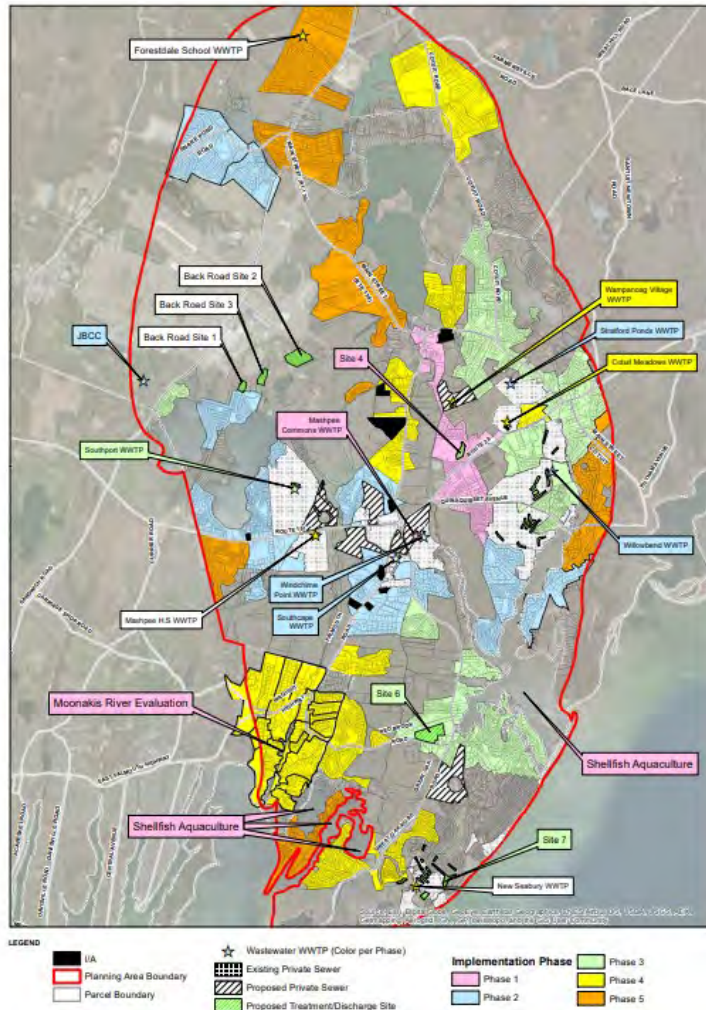
Incorporation of a Robust Shellfish Program Into Mashpee's Comprehensive Watershed Nitrogen Management Plan Scaling, Initial Results, Difficulties and Future of the Program



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2015 CWNMP Adaptive Management Plan Approach



Embayment System	Embayment	Percent Removal to Meet Threshold ⁽²⁾	Updated Percent Removal to Meet Threshold ⁽³⁾
Popponneset Bay System ⁽¹⁾	Popponneset Bay	0%	0%
	Popponneset Creek	100%	100%
	Pinquisset Cove	0%	0%
	Ockway Bay	100%	100%
	Mashpee River	100%	100%
	Shoestring Bay	100%	100%
	Mashpee River ⁽⁴⁾	49%	49%
	Santuit River ⁽⁴⁾	35%	35%
	Quaker Run River ⁽⁴⁾	0%	0%
	Waquoit Bay System ^{(2) (6)(7)}	Hamblin Pond	75%
Upper Hamblin Pond		75%	100%
Little River		75%	100%
Lower Great River		100%	100%
Upper Great River		100%	100%
Jehu Pond		100%	100%
Upper Quashnet River		67%	67%
Lower Quashnet River		67%	67%
Red Brook ⁽⁴⁾		75%	90%
Quashnet River ^(4, 5)		67%	67%

Phases of Planning

- Shellfish Propagation – Phase 1 Underway
- Sewering – Mashpee River, Shoestring Bay, Hamblin Pond, Jehu Pond, and other areas – Phases 1 and 2 Underway
- Smaller Cluster Systems – Areas less suited for in ground piping for collection and treatment. NEW
- Town / Private System Exploration – JBCC and other built facilities. TBD – FS-1 Site Exploration.
- Nutrient Mitigation Tech – Fertigation, Floating Constructed Wetlands, Urine Diverting Toilets, Storm water Treatment BMPs. Underway
- Nutrient Bylaws and Board of Health Changes – Nutrient Control Bylaw, Flow Neutral Bylaw, and 1,000 ft. buffer to Wetlands = IA Tech or Denitrification System Requirements. Underway
- Wetland Restoration and Green Infrastructure. Underway

Mashpee Shellfish N Content

Oysters and Quahogs 0.5% N/live wt

Barnstable County Cooperative Extension 2012

Shellfish Sample Data - Barnstable County - Mashpee
 all shellfish collected were marked with bands prior to freezing
 shellfish were held frozen until lab can process

Wet Weight

C#	Sampling	Date	Vol(ml)	shell		Tissue	Condition	Soft Tissue N		Shell N		Total	%N whole wet weight	%N whole average	%N whole average	%N whole average
				Whole	Shell			Meat	N	Shell	N					
88	Spring	6/22/12	50	63.59	75.52	47.07	2.71	8.82	8.61	0.23	0.18	0.09	0.32	0.407		
90	Spring	6/22/12	25	50.7	58.56	23.18	1.38	8.59	8.28	0.13	0.13	0.03	0.16	0.414		
91	Spring	6/22/12	40	60.07	66.67	39.59	1.84	4.22	8.41	0.10	0.23	0.09	0.19	0.279		
92	Spring	6/22/12	30	35.36	47.95	29.68	1.76	9.05	7.97	0.14	0.21	0.06	0.20	0.422	0.390	
93	Spring	6/22/12	40	62.65	72.16	45.21	2.20	8.18	9.07	0.20	0.29	0.13	0.33	0.460		
94	Spring	6/22/12	35	58.51	57.29	33.89	1.72	7.34	8.46	0.15	0.17	0.05	0.20	0.352		
95	Spring	6/22/12	35	57.98	63.17	41.11	1.79	8.10	8.67	0.16	0.16	0.05	0.22	0.347		
98	Spring	6/22/12	25	50.45	42.32	26.98	1.28	8.32	9.00	0.11	0.20	0.05	0.17	0.400	0.390	
149	Fall	10/11/12	35	58.53	55.1	34.16	3.52	16.53	8.12	0.29	0.25	0.09	0.37	0.674		
150	Fall	10/11/12	30	54.72	47.13	25.05	3.22	17.80	8.38	0.27	0.25	0.08	0.35	0.734		
151	Fall	10/11/12	40	60.05	60.66	37.88	3.64	15.97	8.78	0.25	0.20	0.07	0.32	0.630		
152	Fall	10/11/12	40	62.27	69.09	42.33	5.11	19.10	7.05	0.36	0.16	0.07	0.43	0.622	0.640	0.470
157	Fall	10/11/12	30	50.29	38.28	24.34	2.84	18.84	8.17	0.22	0.15	0.04	0.25	0.686		
158	Fall	10/11/12	30	59.27	52.46	32.2	2.89	14.29	7.27	0.21	0.14	0.04	0.25	0.485		0.507 quahogs
159	Fall	10/11/12	25	51.74	37.25	23.21	2.33	16.59	8.04	0.19	0.17	0.04	0.23	0.611		
160	Fall	10/11/12	30	54.29	42.44	27.43	2.60	17.33	8.20	0.21	0.24	0.07	0.28	0.660	0.603	0.544
165	Fall	10/11/12	35	91.28	55.8	30.13	3.92	15.28	7.23	0.26	0.17	0.05	0.33	0.599		
166	Fall	10/11/12	25	80.86	38.07	18.85	2.73	14.19	6.60	0.19	0.30	0.05	0.24	0.622		
167	Fall	10/11/12	40	90.18	59.65	31.83	3.80	13.54	6.88	0.26	0.16	0.05	0.31	0.520		
168	Fall	10/11/12	35	80.42	51.14	24.66	4.00	15.11	6.20	0.25	0.18	0.04	0.29	0.670	0.578	
173	Fall	10/11/12	60	83.53	93.7	55.62	5.86	15.40	5.99	0.35	0.21	0.12	0.47	0.499		
174	Fall	10/11/12	50	90.1	88.45	58.08	3.80	12.83	7.35	0.29	0.13	0.08	0.36	0.411		0.510 oysters
175	Fall	10/11/12	60	92.12	97.46	57.09	8.45	13.50	5.99	0.33	0.16	0.09	0.42	0.431		
176	Fall	10/11/12	50	84.92	72.96	43.53	4.15	14.11	5.35	0.28	0.11	0.05	0.31	0.425	0.442	



Recall This Figure From a Past Cape Cod Coastal Conference ???

Original Shellfish Plan -2014 Conditions

Table ES-1 Shellfish Plan for Nitrogen Removal

Area	Nitrogen Removal ⁽¹⁾ Required (MEP) Metric Tons (MT) N/year	Removal by Shellfish MT N/year	Shellfish Harvest MT Live/year	Number of Shellfish Million/Species
SC19 + SC20 (Shellfish Resource Areas)				
Popponeset Bay/Creek	1.46	1.46	292	4.87/quahogs ⁽²⁾
Ockway Bay	0.87	0.87	174	2.45/quahogs ⁽²⁾
Mashpee River	5.01	2.5	500	5.00/oysters ⁽³⁾
Shoestring Bay	4.03	2.00	400	4.00/oysters ⁽³⁾
Total	11.37	6.83	1,366	16.32
SC16 (Shellfish Resource Areas)				
Hamblin Pond	3.41	3.41	682	11.37/quahogs ⁽²⁾
Little River	0.32	0.32	64	1.07/quahogs ⁽²⁾
Jehu Pond	1.05	1.05	210	3.50/quahogs ⁽²⁾
Great River	0.98	0.98	196	3.27/quahogs ⁽²⁾
Total	5.76	5.76	1,152	19.21
Total SC16, 19 + 20	17.13	12.59	2,518	35.53

Notes:

1. Nitrogen removal required calculated from: MEP Report, Howes et al. 2004. Table ES-2 page ES 10
2. Littleneck quahogs @ 60 g. N
3. Oysters @ 100 g



Need to Scale Up



Mashpee's First FLUPSY – 2015



Falmouth's Design – Unsuccessful in Mashpee Waters ☹️

Nitrogen Reduction Required: MEP/TMDL Reports

Waquoit Bay (Little and Great River Systems) SC16

Sub-embayment	Present** Watershed (kg N/day)	Threshold** Watershed (kg N/day)	Reduction Required (kg N/day)	Reduction Required (kg N/year)
Hamblin Pond	12.395	3.049	9.346	3,411
Little River	1.096	0.211	0.885	323
Jehu Pond	3.912	1.025	2.887	1,054
Great River	3.671	0.997	2.674	976
Total			15.792	5,764

*Commonwealth of Massachusetts 2006. Table B-1, page 25 (Howes et al. 2004. Table VIII-1, page 125).

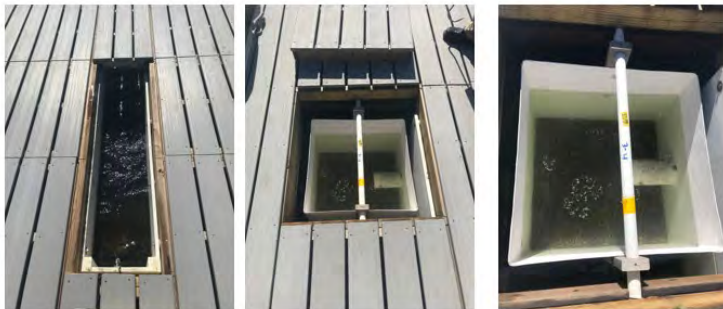
**Howes et al. 2011. Table ES-2, page ES 13.



2 Land Based DuraTech Downweller/ Upweller tanks – 48 x 2' diameter silos, 4 pool pumps, plumping, electric \$\$\$

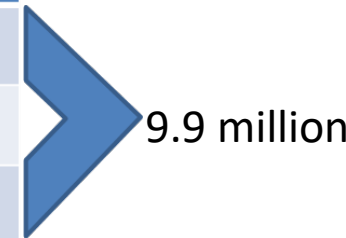


Overflow gear and bottom netting.. Gear, upon gear, upon gear!



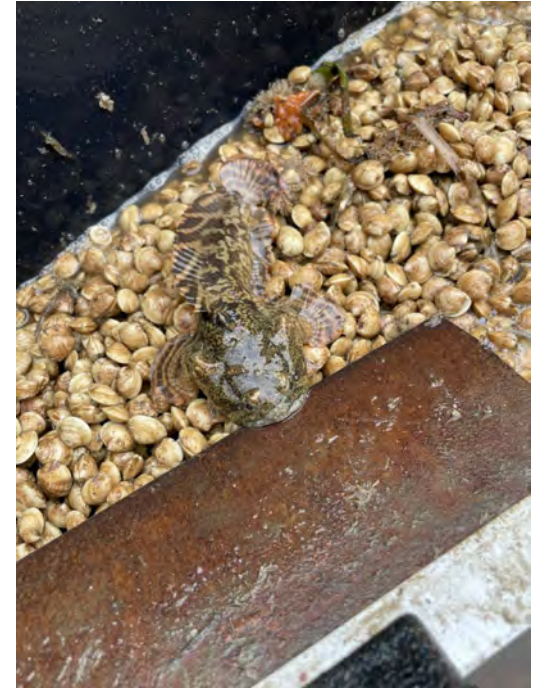
7 x 8' x 20' FLUPSY Docks

Year	Total Seeded in SC16
2014	2,976,700
2015	2,385,782
2016	4,550,000
2017 (Planted in Fall after summer monitoring data)	8,122,669



9.9 million

VOLUNTEERS



Initial Success from 2016 to 2017

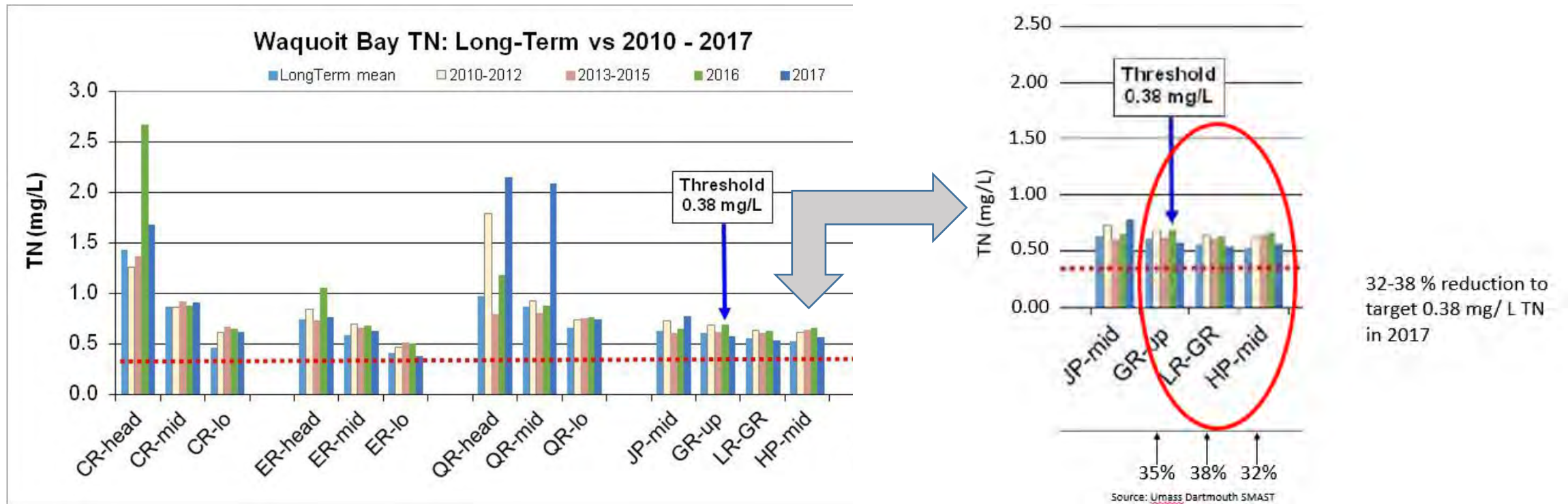


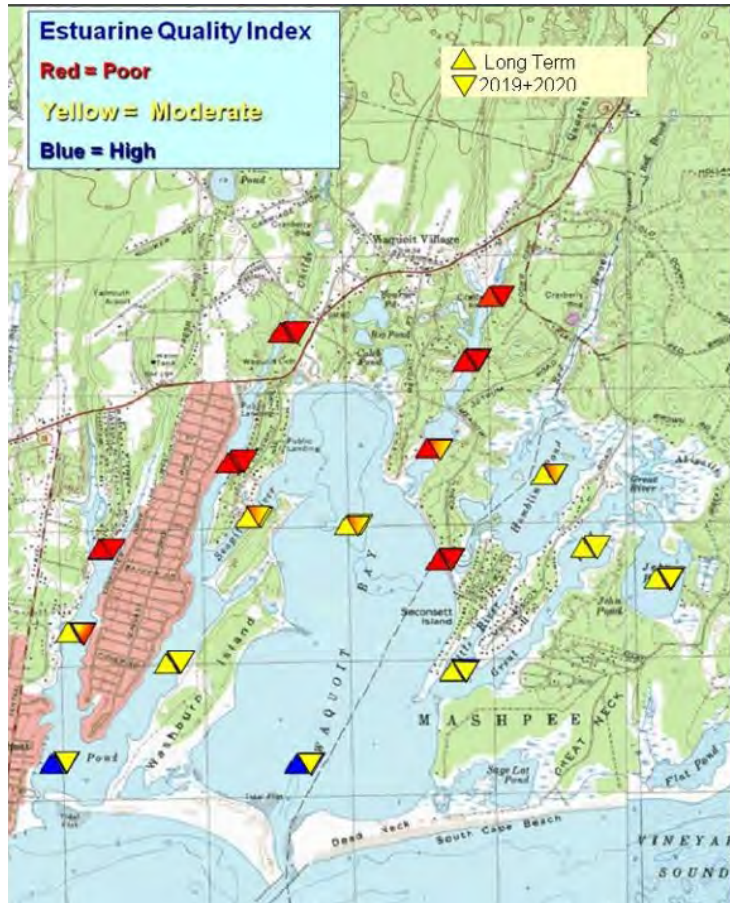
Figure 7. Distribution of Total Nitrogen within the Waquoit Bay Estuarine System, long-term and during the summers of 2010 through 2017. Nitrogen enters through groundwater inflows all along the shoreline, with additional "point" loads from the upper regions of the watershed via Moonakis River, Childs River, and Red Brook. These nitrogen loads plus recycling within the estuary mix with the low nitrogen waters of Nantucket Sound entering through the tidal inlets to create the observed gradient. CR - Childs River, ER - Eel River, QR - Quashnet River, JP - Jehu Pond, GR - Great River, LR-GR - Little River-Great River confluence, HP - Hamblin Pond, SeaR - Seapit River, WB - Waquoit Bay main basin; head - uppermost reach, mid - middle reach, lo - lower basin near mouth or inlet. The red line shows the offshore TN concentration (0.28 mg/L) and "Threshold" is the TMDL target for restoration. [SMAST 7-6]

Shellfish Component of CWNMP Phase I Implementation Plan for 2019 Update
September 13, 2018
Richard York, DNR Director

Adaptive management changes to the Comprehensive Watershed Nitrogen Management Plan (CWNMP) Phase I implementation for 2019 are necessary due to reduced funding for 2019. The changes are reduction of the planned number of quahog seeding by the Mashpee Department of Natural Resources (DNR) and increased production at shellfish farms (Shellfish Aquaculture Grants) with the potential for continuation of the water quality improvements in Great River, Little River and Hamblin Pond in 2017. Water quality monitoring results had significant lower total nitrogen in 2017 compared to 2010 through 2016. The changes are:

- 1) Replacement of planned quahog seeding by the DNR in Hamblin pond with the expansion of a 1 acre shellfish farm (grant) to 10 acres to facilitate the production of 3.5 million oysters annually removing 1,750 kg of nitrogen. Enhanced denitrification in the oyster farm is estimated to remove another 1,750 kg N for a total of 3,500 kg nitrogen reduction. The target in the CWNMP is 3,400 kg N reduction for the pond.
- 2) Reduction of planned quahog seeding by the DNR in Great River to 2.5 million in 2019, taking into consideration the potential increased production at the new 1 acre shellfish farm at the south end of Great River to remove more nitrogen and make significant improvements in water quality.
- 3) Reduction of planned quahog seeding by the DNR in Little River to 1 million, and in Jehu Pond to 1 million. Seeding 1 million quahogs in Jehu Pond is far short of the number needed to harvest 3.5 million quahogs there as specified in the CWNMP.

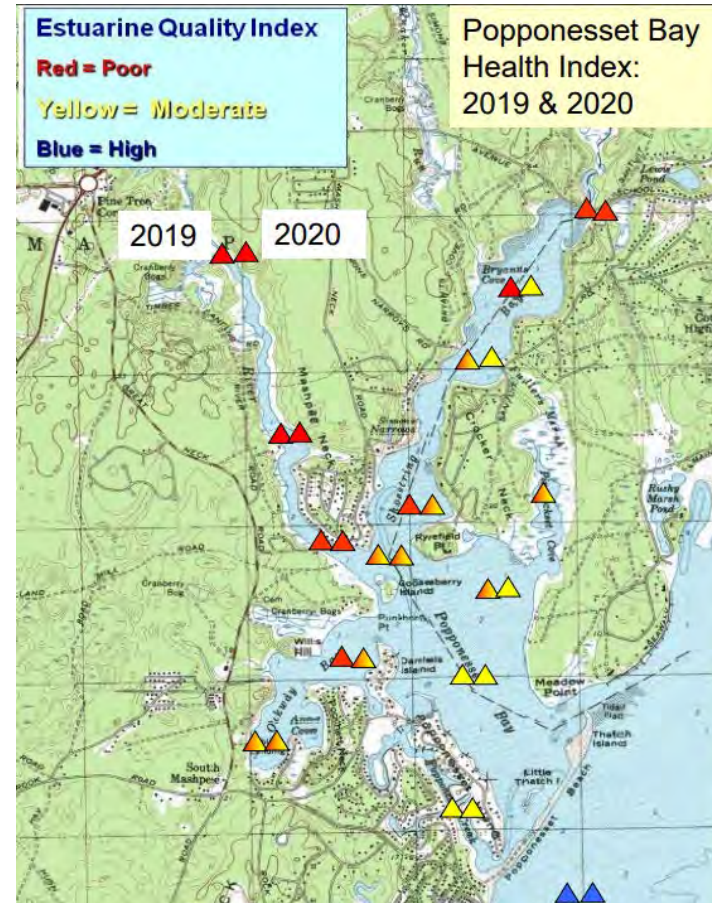
Decline in Water Quality – No Advancement in Sewering (Phase 1) . ETA ~ 2025



Waquoit Bay Water Quality

2019-2020

- No High water quality areas remain,
- TN levels gradually increasing
- Phytoplankton Blooms increasing
- Overall System showing gradual decline
- Eastern embayments moderately N enriched
- Quashnet continues to have poor water quality
- 2019-2020 terminal pond water quality, declined (Hamblin, Jehu).



Popponeset Bay Water Quality

- Large and Significant N enrichment in upper tributaries; nutrient impairments throughout
- Increasing Large phytoplankton blooms each summer
- No High water quality areas remaining
- 100% eelgrass loss
- Benthic Habitat impaire through most of system.

Bottom gear removal in Mashpee River

The substrate in all of our rivers and upper bays have degraded to the point where the mud is sometimes 3-5 feet deep, making it very difficult to perform our needed responsibilities'.



Floating gear deployment

Utilizing new and effective methods of propagation to raise animals in the areas needed for Nitrogen mitigation is proving to be effective. However, total conversion to new gear has its challenges – Budget's, area of deployment, NIMBYism, etc. Plus, developing new strategies to effectively sort, tumble and reduce densities within pre defined work hours.



Oyster Gear locations:

Hamblin Pond, Jehu Pond(Great River), Shoestring Bay, Mashpee River, Popponesset Creek, Little River. These area are targeting thresholds needed to meet TMDL's in respective water bodies.



Quahog Gear

Bottom trays near shore, FLUPSY docks, upweller tanks.

The Town of Mashpee has invested in the infrastructure to add FLUPSY docks, and upweller systems. Future upgrades to power, water and areas on the water are our focus to meet the needs of nitrogen mitigation.



Revised Shellfish Program - 2022

Area	Nitrogen Removal Required <i>Metric Tons (MT) N/year</i>	Removal by Shellfish <i>MT N/year</i>	Number of Shellfish Town	% Removal to TMDL
SC19 + SC20				
Popponeset Bay/Creek	1.46	1.46	1,460,000	100.00%
Ockway Bay	0.87	0.87	870,000	100.00%
Mashpee River	5.01	1.00	500,000	19.96%
Shoestring Bay	4.03	0.50	500,000	12.41%
Total	11.37	3.83	3,330,000	
SC16				
Hamblin Pond	3.41	1.00	1,000,000	29.33%
Little River	0.32	0.32	320,000	100.00%
Jehu Pond	1.05	0.50	500,000	47.62%
Great River	0.98	0.98	980,000	100.00%
Total	5.76	2.80	2,800,000	

6.1 Million Animals Total

Purchased seed 2023

Distributor	Animal Type	Total Delivered	Total Remaining		
ARC	QH	5,173,500	-173,500		
ARC	Oys	494,000			
Cape Cod Oysters	Oys	471,000	29,000		
Clam Daddy	QH	590,000			
Bay Farm	QH	2,500	2,500		
				Total QH:	5,766,000
				Total Oys:	1,156,000



Quahog seeding locations

2023 – 5.76 million quahogs seeded



2023	Number of Quahogs		Area
8/22/2023	295,000	Broadcasted	Seaconsett Causeway Family Area
8/22/2023	15,000	Broadcasted	Popponesett Island Bend, Northside Inside
8/22/2023	20,000	Broadcasted	Daniel's Island, Outside Bridge
8/22/2023	20,000	Broadcasted	Popponesett Island Bend, Northside Outside
8/22/2023	240,000	Broadcasted	Popponesett Spit, Poppy Creek to end of spit
10/12/2023	200,000	Broadcasted	Waquoit Bay, Cali's Beach
10/13/2023	448,000	Broadcasted	Waquoit Bay, Dead Neck Beach, Seaconsett Causeway
10/13/2023	483,000	Broadcasted	Popponesett Bay, Spit Family Area
10/16/2023	60,000	Broadcasted	Little river, Hamblin pond family Area
10/16/2023	60,000	Broadcasted	Riverbend, Monomoscoy point
10/16/2023	40,000	Broadcasted	Great river family area
10/17/2023	202,000	Planted	Popponesett Bay, Thatch Island
10/17/2023	40,000	Broadcasted	Popponesett Island, Ockway Mouth
10/18/2023	575,000	Broadcasted	Waquoit Bay, Cali's Beach, Seaconsett Causeway
10/18/2023	297,000	Planted	Popponesett Bay, Thatch Island
10/19/2023	265,000	Broadcasted	Waquoit Bay, Dead Neck
10/20/2023	525,000	Broadcasted	Popponesett Bay, Spit Family Area
10/20/2023	405,000	Broadcasted	Popponesett Bay, Ockway bay points, Bridge, Thatch Island
10/23/2023	320,000	Broadcasted	Great River Family Area, Great River
10/23/2023	320,000	Broadcasted	Popponesett Bay Family spit area
10/24/2023	424,000	Broadcasted	Popponesett Bay Family spit area
10/24/2023	28,000	Broadcasted	Waquoit Bay, Riverbend
10/24/2023	182,000	Planted	Waquoit Bay, Riverbend
10/25/2023	190,000	Planted	Waquoit Bay, Riverbend
10/25/2023	112,000	Broadcasted	Waquoit Bay, Dead neck and Cali's Beach
		Total	5,766,000

Thank you

