

# Pleasant Bay Watershed Permit Case Study

Presentation to Cape Coastal Conference



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## Pleasant Bay

- 21,600-acre estuary located in four towns
- State-designated Area of Critical Environmental Concern
- Towns formed Pleasant Bay Alliance to develop/coordinate Resource Management Plan
- Watershed nitrogen loading a priority management issue
  - 19 TMDLs for TN

# Watershed Permit Background

- 2018 - Pleasant Bay towns received 1st Watershed Permit for nitrogen removal issued by MA Department of Environmental Protection (DEP)
- Permit followed a 2-yr pilot project coordinated by Alliance & DEP
- 6-yr mark – progress, challenges, lessons for other shared watersheds
- Alliance role - intermunicipal coordination
  - Watershed Work Group - focus and structure
  - Coordinate annual reporting
  - Grant funding for studies



# Gaining Support of the Towns to Apply for the Permit

- Develop composite Comprehensive Wastewater Management Plan
  - Based on existing town plans
  - Verify efficacy of town plans to meet watershed-wide removal needs
- Inter-municipal resolution
  - Codify each town's nitrogen contributions/removal responsibility
  - Agree to participate in MA Department of Environmental Protection pilot project



# Key Components of the Permit

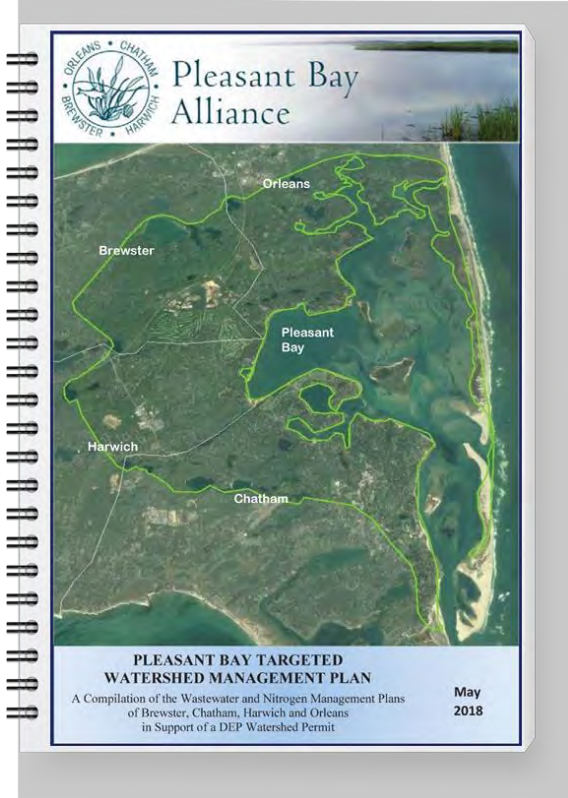
- Targeted Watershed Management Plan
  - Implementation schedule identified each town's removals by technology over the 20-yr permit
  - Mix of traditional and non-traditional technologies
  - Demonstrates required removals
- Terms and Conditions
  - Enforcement forbearance
  - Reporting requirements
- Inter-municipal Agreement
  - Mutual accountability
  - Alliance coordination role
- Consistency Determination
  - Sec. 208 Area-wide Water Quality Management Plan
  - MEPA



# Performance Under the Permit

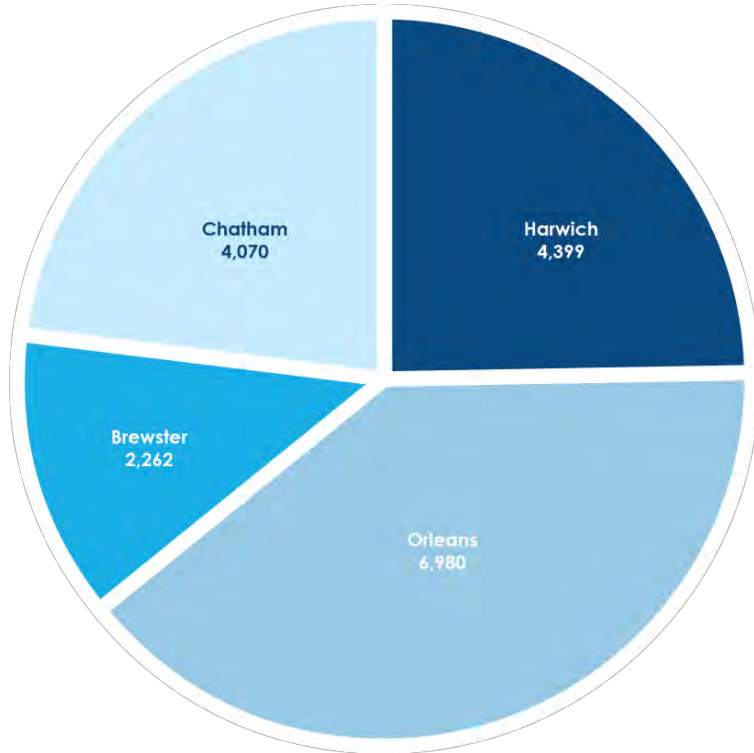
Mike Giggey, P.E., Senior Vice President, Wright-Pierce

# What is the Technical Basis for the PB Watershed Permit?



- **Nitrogen loads**
  - Un-attenuated watershed load 54,500 kg/yr
  - Attenuation 6,100 kg/yr
  - Attenuated watershed load 48,500 kg/yr
  - Threshold loads 30,800 kg/yr
  - Nitrogen removal needs 17,700 kg/yr
- **Sources of nitrogen in the Pleasant Bay watershed**
  - Septic systems 75%
  - Lawn and golf course fertilization 16%
  - Stormwater 9%
- **Assessment of embayment impairment**
  - 19 sub-embayments ranging from unimpaired to significantly impaired, requiring 36% nitrogen removal

# The Commitments of the Four PB Watershed Towns, kg/yr



Orleans	39%
Harwich	25%
Chatham	23%
Brewster	13%

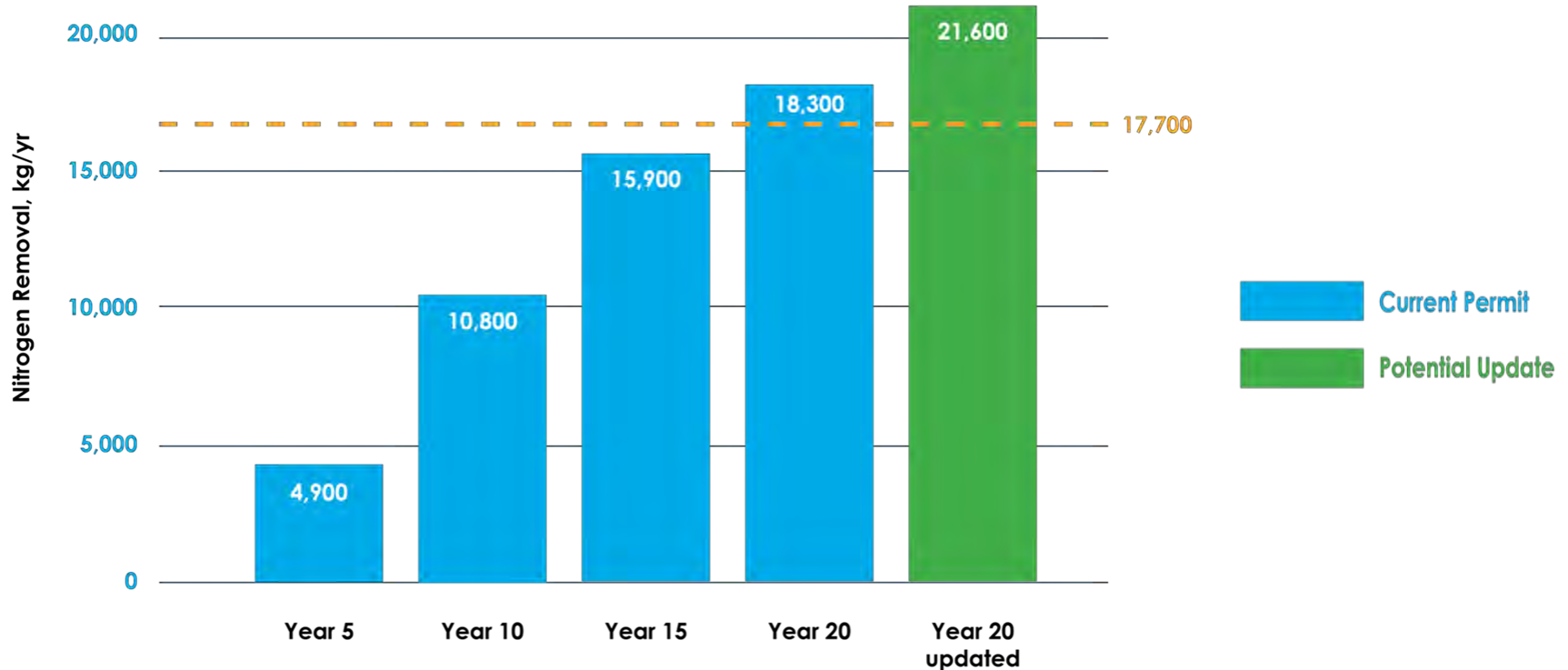


# Simplified Implementation Plan, kg/yr removal commitments

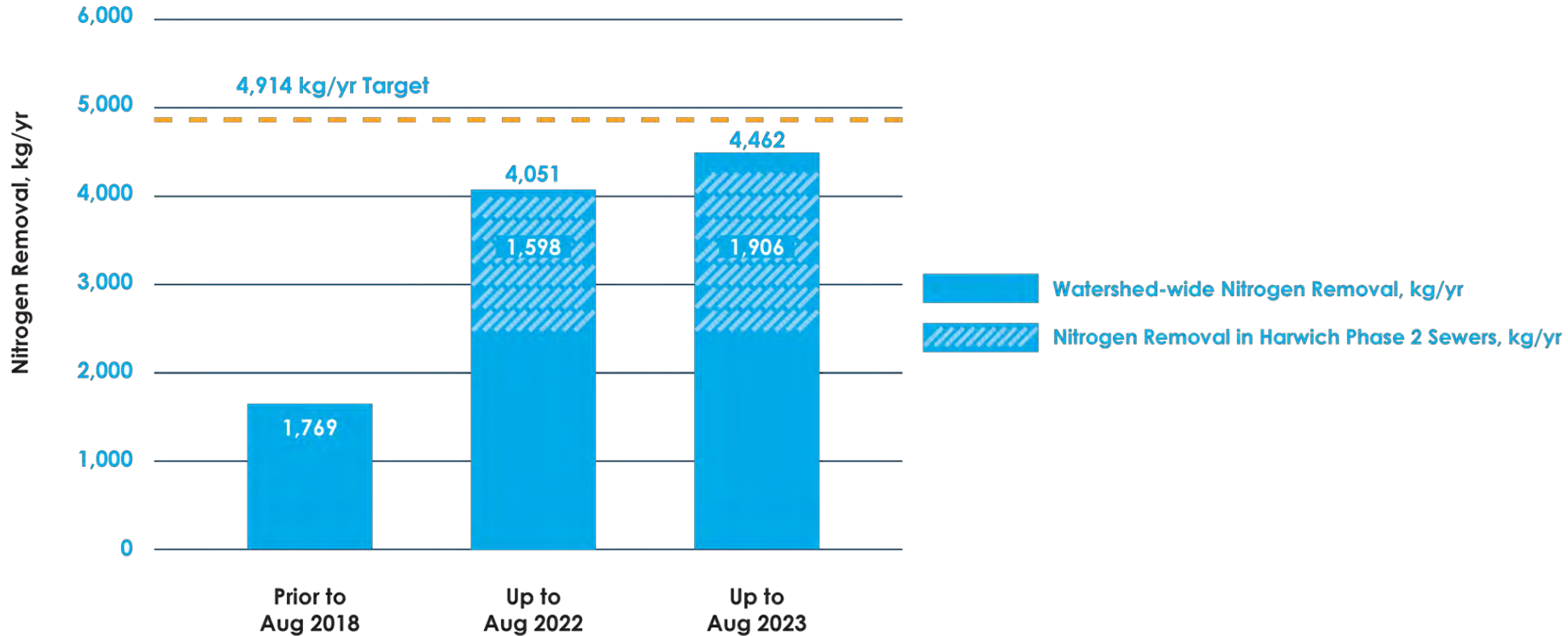
	Brewster	Chatham	Harwich	Orleans	Total
Years 1 to 5	1,281	247	2,872	514	4,914
Years 6 to 10	118		1,565	4,204	5,887
Years 11 to 15	118	3,408		1,581	5,107
Years 16 to 20	118	1,597		675	2,390
After Year 20	236	7,807	103		
Total Removal Goal	2,262	4,076	4,399	6,980	17,717

Towns have already made some changes to this schedule

# 20-year Nitrogen Removal Plan



# Nitrogen Removal Progress – After 5 Years



# Nitrogen Removal Technologies

## In place

Shellfish Aquaculture	Orleans	67 kg/yr
Residential fertilizer controls	All towns	809 kg/yr
Golf course fertilizer reduction	Brewster	930 kg/yr
Golf course fertigation	Brewster	230 kg/yr
Public sewers	Chatham, Harwich	<u>2,426 kg/yr</u>
Total		4,462 kg/yr

## Proposed

Permeable reactive barriers	Orleans
Public sewers	Orleans

See appendices to TWMP for protocols for determining credits by technology

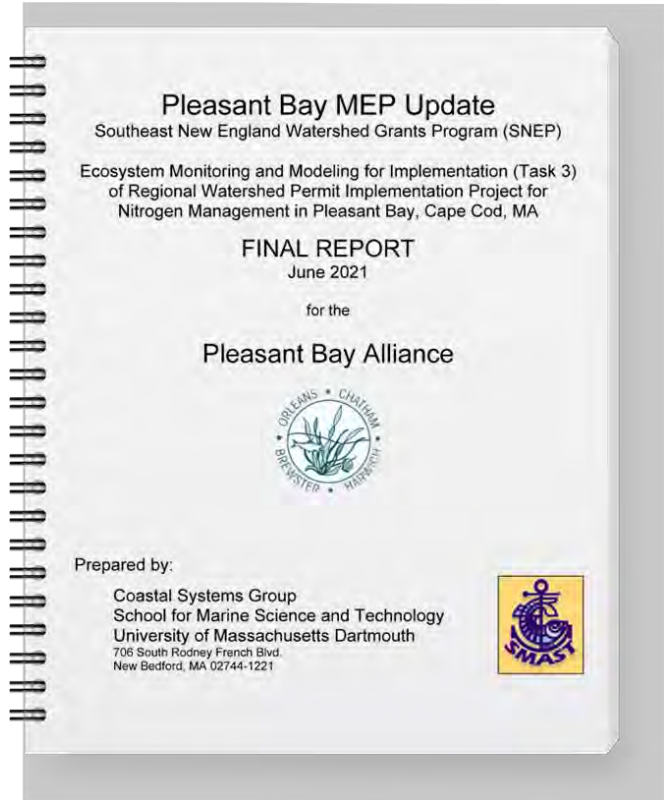
Concurrence by towns

Approved by DEP

# Important Technical Studies over First 5 Years of Permit

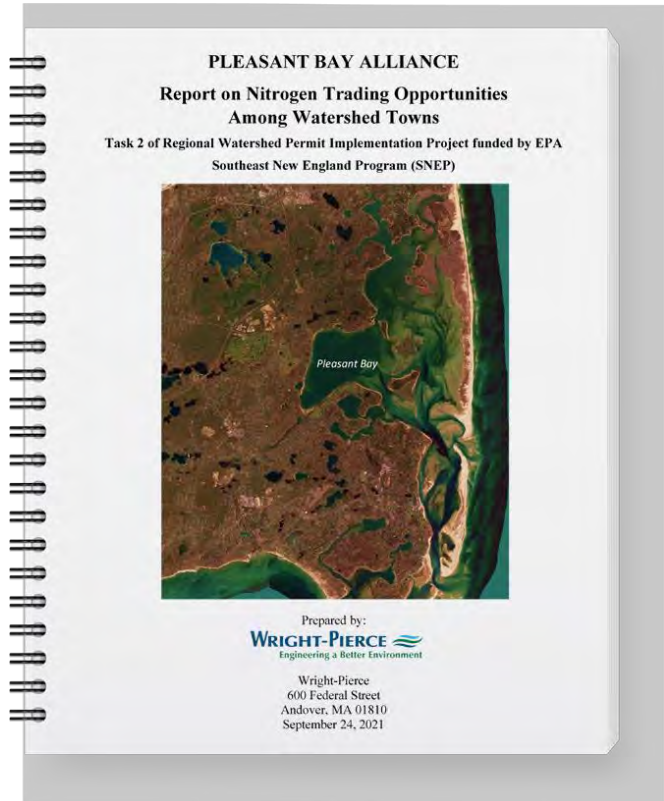
1. Updated watershed nitrogen loads from MEP basis and remodeling Bay water quality
2. Feasibility of nitrogen credit trading
3. Estimates of nitrogen credits for stormwater management
4. Practical applicability of I/A system in Brewster
5. Improving estimates of natural attenuation
6. Importance of saltmarsh preservation

# 1. Updating Watershed Loads and Bay Water Quality — 2021



- Permit based on MEP nitrogen loads (water use in 2002 to 2006)
- Update used 2011-to-2015 water use records
- Revised MEP model included
  - Updated watershed loads
  - More recent water quality data
  - Revised attenuation estimates
  - Improved hydrodynamics (2007 Bay outlet)
- Model indicated that TMDLs could largely be met if CWMPs are implemented

## 2. Feasibility of Nitrogen Credit Trading — 2021



- Towns develop nitrogen removal plans specific to their circumstances
- Project costs vary widely in terms of \$/lb of N removed
- Why do costs vary?
  - Fundamental differences among technologies
  - Economies of scale
  - Site suitability
  - Natural attenuation
- Credit trading looks beyond town boundaries to effect savings:
  - Do more of low-cost projects in Town A
  - Do less with high-cost projects in Town B
- Town A takes on responsibility for some of Town B's removal responsibilities
- Towns A and B share the cost savings

# 3. Estimating Nitrogen Credits for Stormwater Management — 2023

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### Report on the Feasibility of Nitrogen Removal Credits Related to Stormwater Management

Task 2 of the Regional Watershed Permit Implementation Project funded by EPA  
Southeast New England Program (SNEP--2020)



Prepared by:  
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March 24, 2023

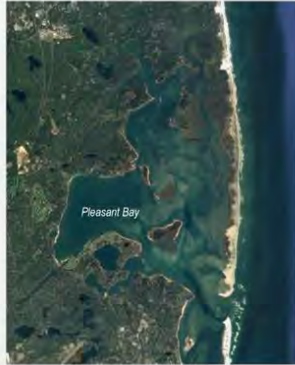
- Towns are addressing MS4 stormwater management requirements
- Can these independently-funded actions generate nitrogen removal credits under a watershed permit?
- 208 Plan suggests 25% credit for stormwater nitrogen
- Limited space in PB towns restrict the use of vegetated BMPs, like grassed swales
- EPA curves for infiltration BMPs overstate N removal
- In a case study sub-watershed, existing practices provide only 8% removal of stormwater N
- More aggressive non-structural BMPs hold promise (street sweeping, CB cleaning and leaf pick-up), but added expenses may not justify the relatively small nitrogen credit.
- Pleasant Bay towns are not including stormwater credits in their plans



## 4. Applicability of I/A Systems — 2020

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Task 1A: On-Site Denitrification Systems  
Summary Report

Southeast New England Program (SNEP)  
Grant - Regional Watershed Permit  
Implementation Project for Pleasant Bay



Prepared by:



Horsley Witten Group, Inc.  
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Sandwich, MA 02563

July 28, 2020

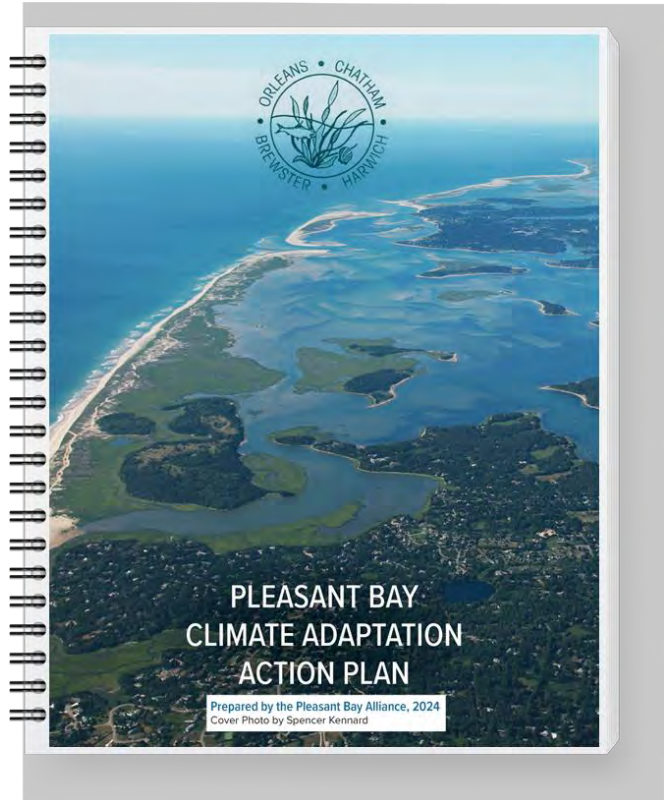
- Is it feasible for Brewster to use I/A systems to gain a 960 kg/yr credit under the Watershed Permit?
- Barnstable County reviewed technology options and suggested 12 mg/l effluent nitrogen
- Horsley-Witten located 319 homes in watersheds with no attenuation
- Wright-Pierce developed a cost model to estimate capital and O&M expenses
- DEP defined the sampling and monitoring requirements to allow credit under the permit
- Horsley-Witten drafted a municipal bylaw to implement an I/A program
- Overall result: a thorough determination of cost, performance and regulatory issues that towns can use to judge the feasibility of using I/A systems to meet watershed permit requirements.

# 5. Improved Estimates of Natural Attenuation — 2023-24



- 2006 MEP Report documented 6,100 kg/yr of attenuation (11% of un-attenuated load)
- Some uncertainty in estimates, in part due to benthic flux changes
- Nitrogen Mass Exchange studies conducted at two locations in 2022/3
- Re-interpretation of data by HydroAnalysis in 2022 and 2024
- Updated attenuation estimates
  - Muddy Creek 10% increased to 30%
  - Tar Kiln Stream 0% increased to 60%
  - Pochet Neck 0% increased to 40%
- Overall Increase in attenuation amount:  
2,900 kg/yr (47% increase)

## 6. Importance of Salt Marsh Protection/Restoration – 2024



- PBA Climate Adaptation Action Plan includes identification and characterization of salt marshes and their susceptibility to sea level rise
- Recommendations for protection and restoration are based on many factors including water quality benefits
- Future work may quantify the nitrogen attenuation potential of these marshes and place a value on preservation and enhancement with respect to nitrogen attenuation and carbon capture

# Expected Permit Modifications in Year 6

- Incorporating growth in watershed loads
- Improved estimates of natural attenuation
- Revised town plans for nitrogen removal technology
- Greater specificity in location of removals by sub-watersheds
- Revised pace of nitrogen removals
- Dealing with “over-removals” in nitrogen loads
- Addressing other aspects of new DEP regulations

# Updating the Watershed Permit for Growth in Watershed Loads

		Brewster	Chatham	Harwich	Orleans	Total
Attenuated Loads	TWMP	6,359	16,572	10,929	14,643	48,503
	Updated	6,912	19,720	12,172	15,524	54,328
	Growth	9%	19%	11%	6%	12%
Load Removal Needs	TWMP	2,259	4,099	4,407	6,912	17,684
	Updated	2,812	7,247	5,783	7,800	23,642
	Increase	24%	77%	31%	13%	34%

All growth estimates are in progress. New attenuation estimates are not included in removal needs.

# Lessons Learned

- Adaptive Management is crucial
- MEP reports are a key starting point, but updating and fine-tuning is needed
- Consider long-term changes in hydrodynamics and sea level rise
- A single watershed permit for a multi-town watershed has important benefits
- Town staff provide a valuable steering committee for permit implementation; diverse ideas contribute to effective approaches
- Pooling of resources and active collaboration lead to robust solutions
- Grant funding for supplemental studies has been available and has been critical to permit implementation (SNEP, MVP, SNEP Network)
- Annual reporting has allowed regular updating of data and steady resolution of issues as they come up

# Orleans Status Report

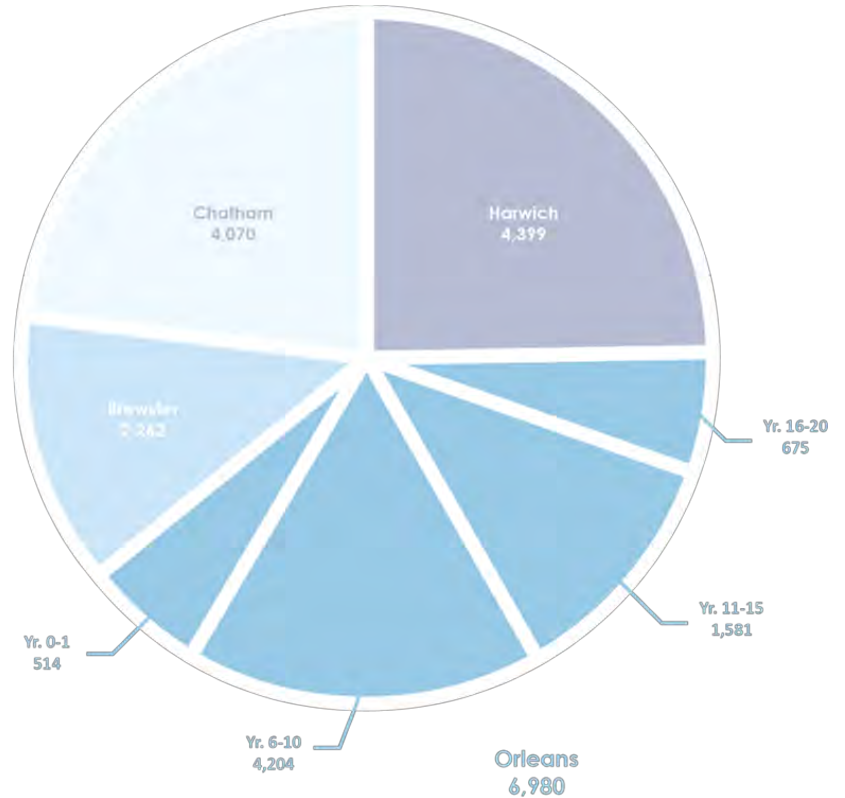
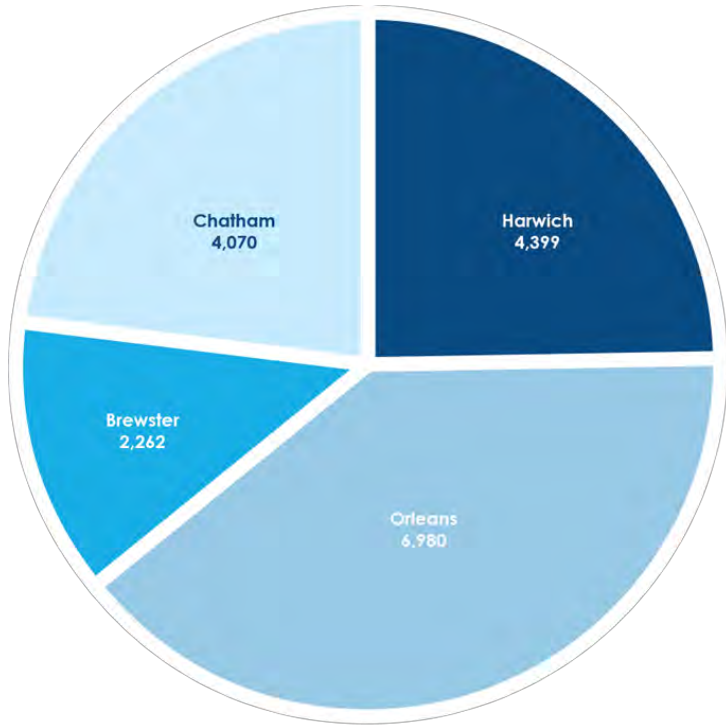
Mike Giggey, P.E., Senior Vice President, Wright-Pierce

# Orleans Nitrogen Management Planning History

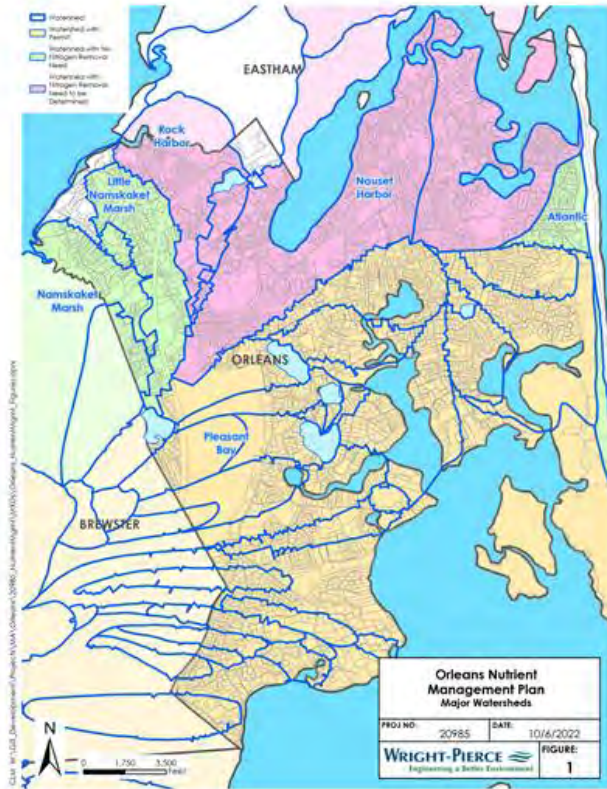
- 2010 CWMP and MEPA review
- 2011 lack of voter approval of appropriation
- 2015 Water Quality Advisory Panel and 2017 Consensus Agreement
  - Limited sewers
  - Shellfish aquaculture
  - I/A systems
  - Coastal habitat restoration, floating constructed wetlands, PRBs
- 2017 to 2022: evaluation of non-traditional technologies
- 2023 start-up of 0.35-mgd wastewater treatment facility
- 2023 Amended CWMP and Sewer Master Plan
  - Lonnie's Pond aquaculture
  - 15-phase sewer plan
  - PRBs to supplement sewers



# The Commitments of the Four PB Watershed Towns, kg/yr



# Orleans' Major Watersheds



## Legend:

**Green**

Watershed with no N Removal Need

**Gold**

Watershed with documented N Removal Need and with a Watershed Permit

**Pink**

Watershed with Likely N Removal Need, but no Permit yet

# Chatham Status Report

Greg Berman, P.G., CFM, Director of Natural Resources, Town of Chatham

# Chatham's Plan for Pleasant Bay

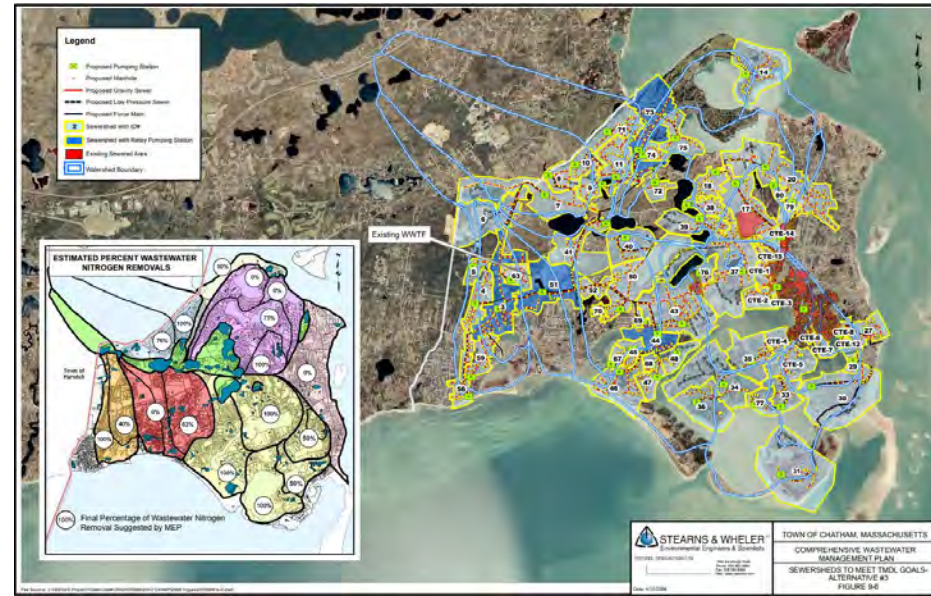


## Overview

30% of the Watershed is in Chatham

Chatham Contributes 23% of the Nitrogen Load

Overall strategy is sewer



# Remaining Nitrogen Load for Chatham



Planning, designing, and implementing nitrogen mitigation efforts for coastal embayments since 1998

Approved Comprehensive Wastewater Management Plan (CWMP) in 2009 to address nitrogen TMDLs that they have been implementing since 2010

Green font and shading

indicate the amount a town plan is over the TMDL (2018 TWMP)

Muddy Creek Upper <i>Amount Town Plans Over/Under</i>	245
Muddy Creek Lower <i>Amount Town Plans Over/Under</i>	608
Ryder's Cove <i>Amount Town Plans Over/Under</i>	720
Crows Pond <i>Amount Town Plans Over/Under</i>	1,248
Bassing Harbor <i>Amount Town Plans Over/Under</i>	514
Frost Fish Creek <i>Amount Town Plans Over/Under</i>	29
Pochet <i>Amount Town Plans Over/Under</i>	
Pleasant Bay (including Little Pleasant Bay) <i>Amount Town Plans Over/Under</i>	388
Chatham Harbor <i>Amount Town Plans Over/Under</i>	5,229
Total (All Subembayments) <i>Amount Town Plans Over/Under</i>	8,982

# Remaining Nitrogen Load for Chatham



Currently appropriated over \$140 million dollars since 2010

Scheduled to appropriate between \$10 and \$20 million every 2-3 years until project completion (> 2040)

Phase	Years		Chatham		
			Activity	kgN/yr*	
	up to 2018		Res. fertilizer control Muddy Creek Bridge	247	
1 **	1 to 5	2019 to 2023	develop TWMP; demonstrate 208 cons Harwich connection		
2 ***	6 to 10	2024 to 2028			
3 ***	11 to 15	2029 to 2033	Frostfish Creek sewers Ryders Cove sewers	803 2,605	
4 ***	16 to 20	2034 to 2038	Muddy Creek sewers	1,597	
	after year 20	after 2038	Crows Pond sewers Bassing Harbor sewers Pleasant Bay sewers Chatham Harbor sewers	1,214 511 901 5,181	
				<b>Total</b>	<b>13,059</b>

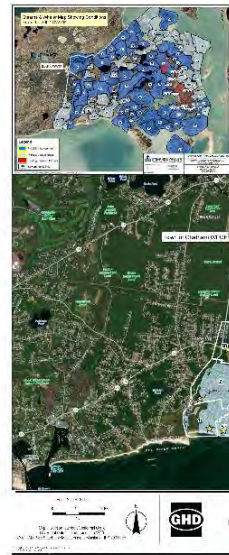
# Town of Chatham Strategy



Still following the CWMP

Phase 1 includes areas to be sewered to achieve TMDL compliance in all Chatham watersheds (including Pleasant Bay)

Phase 2 calls for sewerage of the remainder of the Town



# Town of Chatham Strategy



Short Term - Awarded NSNRA grant to update townwide water use data for the evaluation of flows and nitrogen removal needs compared to 2009 CWMP to assess growth.

This will be used to update the planning horizon for the overall implementation of the plan.





# Brewster Status Report

Mark E. Nelson, P.G., Principal Horsley Witten Group

# Brewster's Plan for Pleasant Bay

## Overview

25% of the Watershed is in Brewster

Brewster Contributes 13% of the Nitrogen Load

Captains Golf Course is a Significant Nitrogen Source

Reducing Fertilizer Applications Provides 87% of the Existing Load Reduction the Town Must Accomplish





# Changes in Captains Golf Course Fertilizer Loads

Initial Loads Based on Higher Fertilizer Use Soon After the Course Was Built – Applications Reduced in Following Years

More Recent Reductions in Fertilized Areas – Especially Golf Course Rough Areas

Use of Sprayed vs. Granular Fertilizers – Reduces Amount of Fertilizer Needed

GPS Monitored Spraying of Fertilizers Confines Applications to the Correct Areas



# Proposed Strategies to Meet the Final Permit Goals

Remaining Load to Manage	646 kg/year
Update to Fertilizer Leaching Rate at the Golf Course	262 kg/year
Reduction in Rough Areas at Cape Cod National GC	38 kg/year
Nitrogen Capture from PWS Wells in PB Watershed	310 kg/year
<b>Total Additional Removal Provided</b>	<b>610 kg/year</b>
Removal Percentage Accomplished	98%

Proposed Strategies to be Evaluated During Upcoming Permit Renewal

# Pleasant Bay Alliance – Permit Collaboration

Collaboration with Chatham, Harwich and Orleans Works Well

Helpful to Share Plans and Strategies and Discuss Updates to the Watershed Model and How it Impacts the Permit

Input from DEP on Alternative Strategies is Very Helpful – Further Discussions on Leaching Rate Study and PWS Well Nitrogen Withdrawal Needed as Permit is Revised

# Pleasant Bay Watershed Permit Case Study

Thank You!

Questions & Discussion



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