"Community Risk Reduction through Comprehensive Coastal Resiliency Enhancement for the Great Marsh Ecosystem, Upper North Shore Massachusetts"

Wetland Scientist Annual Meeting
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The Great Marsh Resiliency Partnership

Comprised of stakeholders from the various Great Marsh organizations

To address flooding issues and coastal problems in the Great Marsh

Background

Hurricane Sandy Relief

- **The Disaster Relief Appropriations Act of 2013 - $829M**
- **$100 million in "resiliency" oriented funding**
  - Focused on "**reducing communities' vulnerability to coastal storms**, sea level rise, flooding, and erosion through strengthening natural ecosystems that also benefit fish and wildlife"
  - Administered by **NFWF**
- **Four awards in MA**

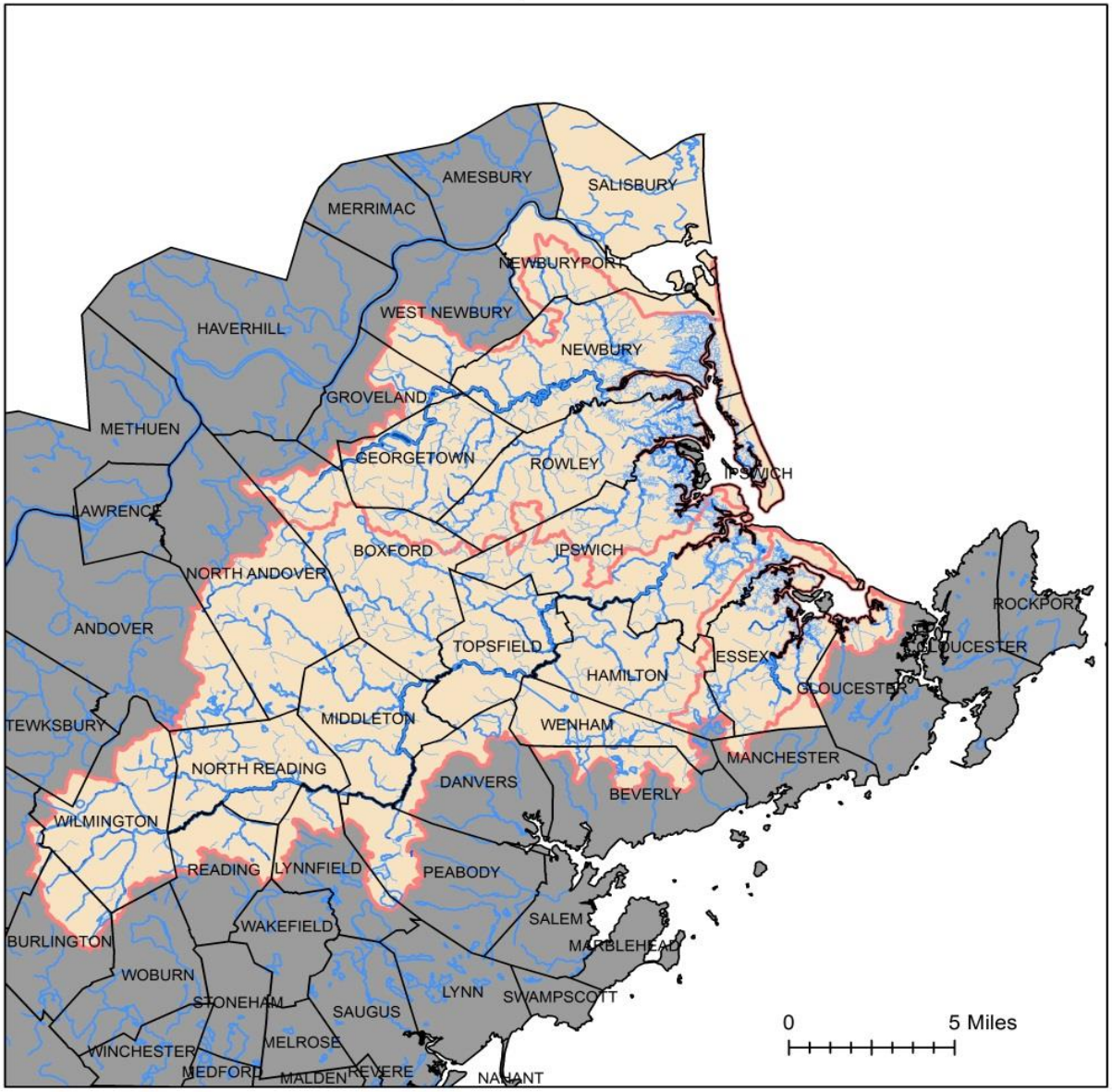
Great Marsh Hurricane Sandy Proposal:

The Great Marsh and its watersheds are **a relatively healthy ecosystem**, yet there are some aspects that are beginning to break down as a result of adjacent human activities. These compromised areas were identified as the areas to direct the focus of our proposal.

- **National Wildlife Federation and GMRP Core Partners;** PRNWR, MVPC, MBP, MAS, DCR, UNH, BU, CCS, IRWA
- **65 Supporting Partners**
  - Communities
  - Federal and State Agencies
  - Academic Institutions
  - Not-For-Profit Organizations
  - Federal and State Legislators
  - Private Partners

Great Marsh and its Coastal Communities

Great Marsh Coastal Resiliency Project Area



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Legend

- Project Area
- PIE Watershed Boundaries
- Town Lines
- Major Rivers
- Named Tributaries
- Unnamed Tributaries


Black Rock Creek


Rowley/Newbury Marsh


Essex River Marsh

Goal: Community Risk Reduction through Comprehensive Coastal Resiliency Enhancement

Community Resiliency Planning

1. Coastal Community Adaptation Plans

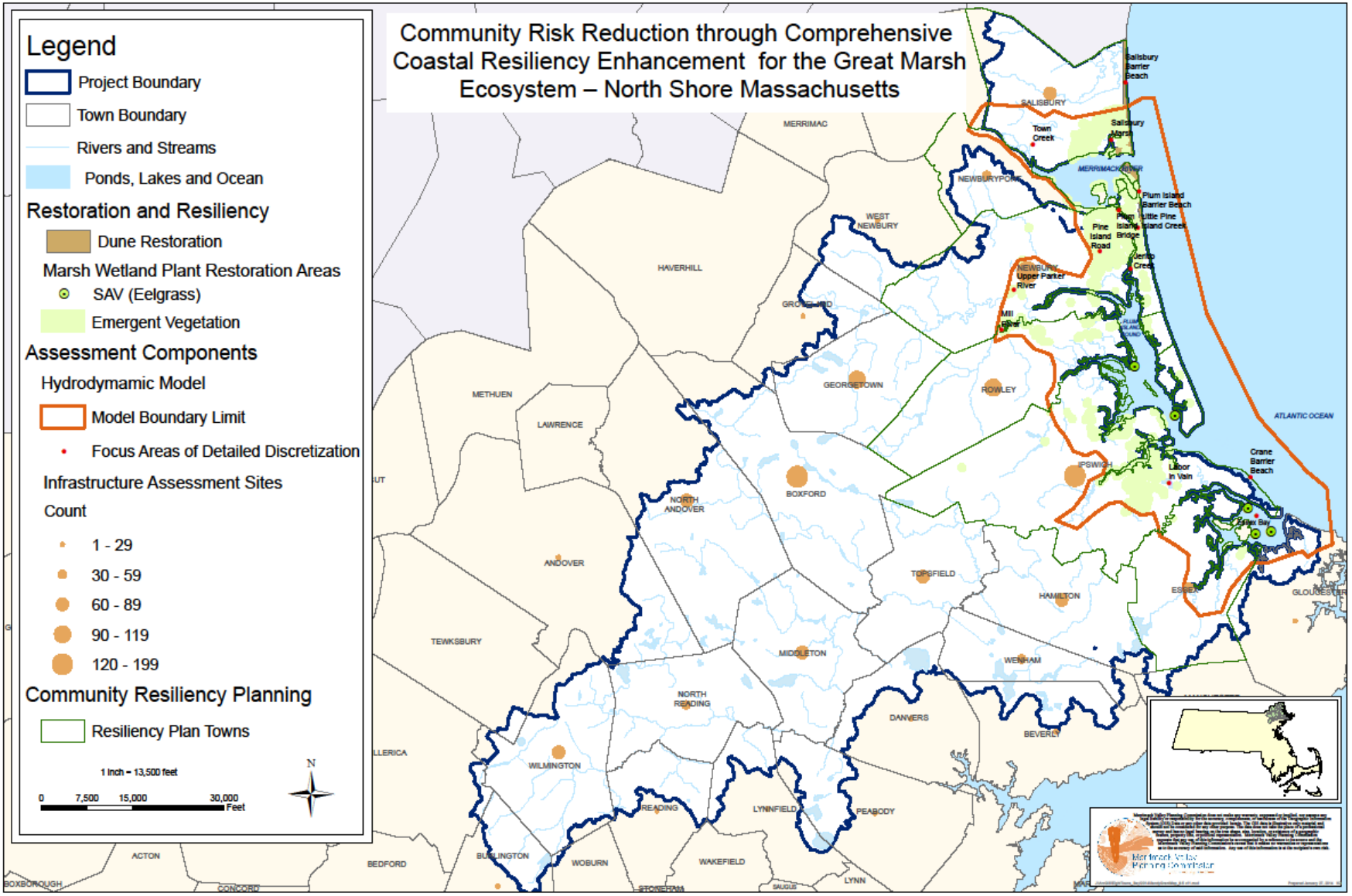
Assessment and Modeling

2. Hydrologic barriers assessment & prioritization
3. Hydrodynamic sediment transport & salinity modeling

Ecological Restoration and Enhancement

4. Dune nourishment & revegetation
5. **Saltmarsh & Sub-aquatic vegetation restoration**
   - **A. Native Saltmarsh Restoration**
   - **B. Eelgrass Restoration**
6. Student Conservation Association assistance

Outcome: 6 projects components that together comprehensively reduce risk to coastal communities and enhance the resiliency and adaptive capacity of the ecological systems those communities depend upon.


Community Risk Reduction through Comprehensive Coastal Resiliency Enhancement for the Great Marsh Ecosystem – North Shore Massachusetts
Legend
Project Boundary
Town Boundary
Rivers and Streams
Ponds, Lakes and Ocean
Restoration and Resiliency
Dune Restoration
Marsh Wetland Plant Restoration Areas
SAV (Eelgrass)
Emergent Vegetation
Assessment Components
Hydrodynamic Model
Model Boundary Limit
Focus Areas of Detailed Discretization
Infrastructure Assessment Sites
Count
1 - 29
30 - 59
60 - 89
90 - 119
120 - 199
Community Resiliency Planning
Resiliency Plan Towns
1 inch = 13,500 feet
0 7,500 15,000 30,000 Feet
N
MERRIMAC
SALISBURY
Salisbury Barrier Beach
Town Creek
Salisbury Marsh
NEWBURYPORT
WEST NEWBURY
Plum Island Barrier Beach
Little Pine Island Creek
Pine Island Road
Plum Island Bridge
Jenkins Creek
NEWBURY
Upper Parker River
Mill River
HAVERHILL
GROVELAND
GEORGETOWN
ROWLEY
METHUEN
LAWRENCE
IPSWICH
Labor in Vain
Crane Barrier Beach
Essex Bay
ATLANTIC OCEAN
NORTH ANDOVER
BOXFORD
ANDOVER
TOPSFIELD
HAMILTON
ESSEX
GLOUCESTER
TEWKSBURY
MIDDLETON
WENHAM
NORTH READING
DANVERS
BEVERLY
WILMINGTON
READING
LYNNFIELD
PEABODY
ACTON
BEDFORD
BURLINGTON
WOBURN
WAKEFIELD
LYNN
BOXBOROUGH
CONCORD
STONEHAM
SAUGUS

Community Resiliency Planning

Target Communities

- Essex
- Salisbury
- Rowley
- Ipswich
- Newbury
- Newburyport

Strategy:

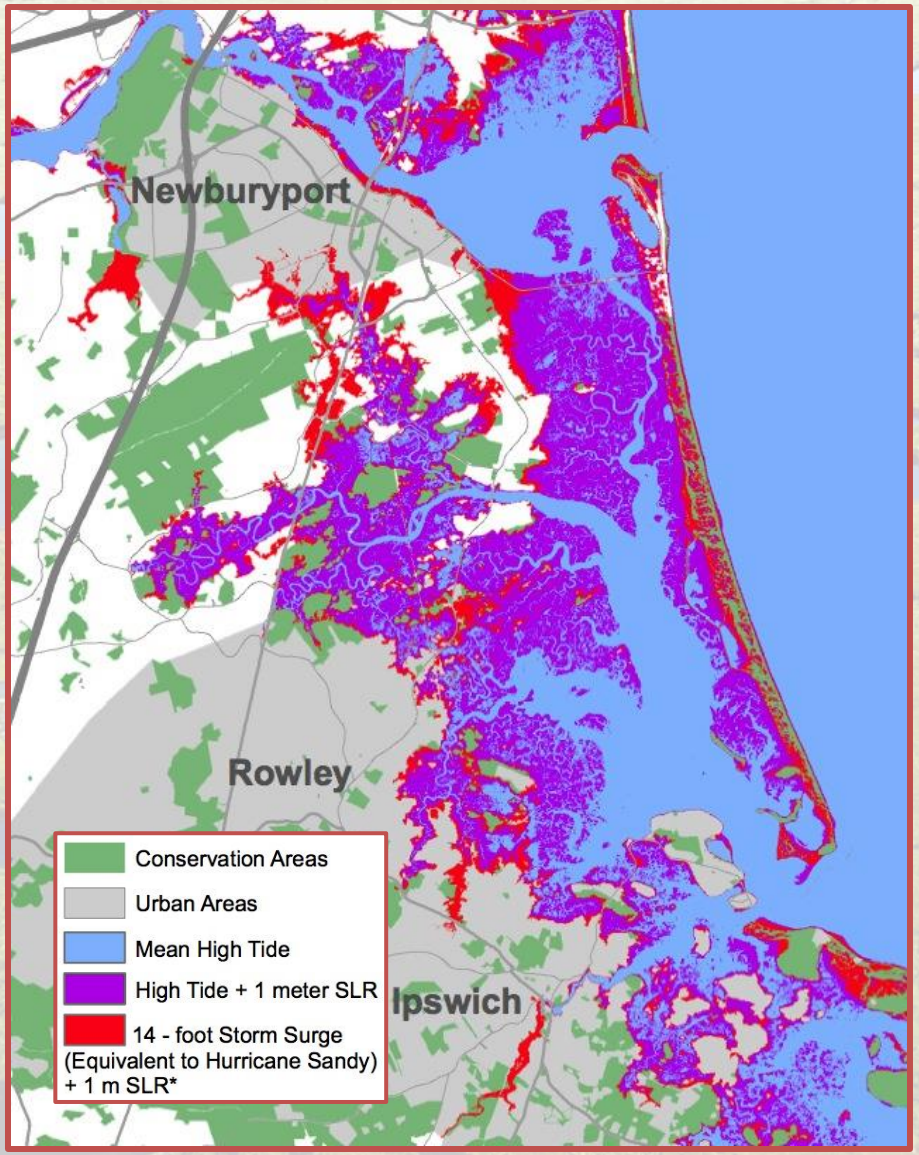
Implement a “model approach” to coastal planning

- Facilitated
- Community-specific
- Comprehensive (gray/green infrastructure)

Community Resiliency Planning

The Planning Process:

1. Create Community Planning Task Force
2. Identify target assets
3. Assess target vulnerabilities
4. Develop adaptation strategies
5. Categorize & prioritize strategies
6. Initiate strategy implementation



Assessment and Modeling

Hydrodynamic Sediment Transport and Salinity Modeling

Scope:

Model Transport and Erosion of Sediment

- Barrier Beach Erosion
- Channel Infilling
- Marsh Deposition for SLR

Model Salinity Movement

- Invasive species control
- Native Plant Restoration

Goals:

- Identify future sediment and salinity management options

Assessment and Modeling

Hydrodynamic Sediment and Salinity Modeling

Geographic Targets

1. Barrier Beaches along
   - Salisbury
   - Newburyport/Newbury
   - PRNWR
   - Crane Beach
2. Merrimack Estuary
3. Plum Island Sound
4. Ipswich Bay
5. Essex Bay

Partner-driven Modeling

Collaborators

- Boston University
- Virginia Institute of Marine Science
- Woods Hole Group

Supporters

- USGS, USACE, USFWS

Assessment and Modeling

Hydrological Barrier Assessment

- Survey and systematically prioritize over 1,200 dams, stream crossings and tidal restrictions across 26 communities and associated watersheds
- Prioritize based on public safety risk **AND** ecological impact
- Important tool to help towns and other entities set repair/upgrade schedules within limited budgets

Hydrological Barrier Assessment

- Between IRWA and DEP, over 800 crossings have been assessed in the three watershed area.

- Crossings are being scored based on how well they meet the MA stream crossing standards for aquatic organism passage. Of the 550 or so that we have scores for:
  - 9% (52) are "severe" or "significant" barriers
  - 35% (195) are "moderate barriers"
  - 39% (214) are "Minor" barriers

- **Most stream crossing issues relate back to the structures being undersized**

- **Undersized crossings ALSO tend to be problematic for road failure/infrastructure issues.**

- Road-stream crossings tend to be the biggest problem for small streams and tributaries. These tributaries hold more miles of habitat and are crucial for many early life stages of fish and other aquatic critters

- Not just an issue for aquatic organisms, more than 75% of road-kill is found at stream crossings

- Crossings that are built to the ecological standards seem to be fairing better during extreme storm events. Green Mountain National Forest had installed a number of crossings before Hurricane Irene and they were unfazed by the event.

Ecological Restoration and Enhancement

Dune Nourishment & Revegetation

- Salisbury, Newbury & Newburyport
- Plant 1000's native species over 15 acres of dune spanning 6 miles of coast
- DCR will renourish 1,800 c.y. of dune in Salisbury Beach State Reservation
- Develop a robust outreach and training program for local stakeholders

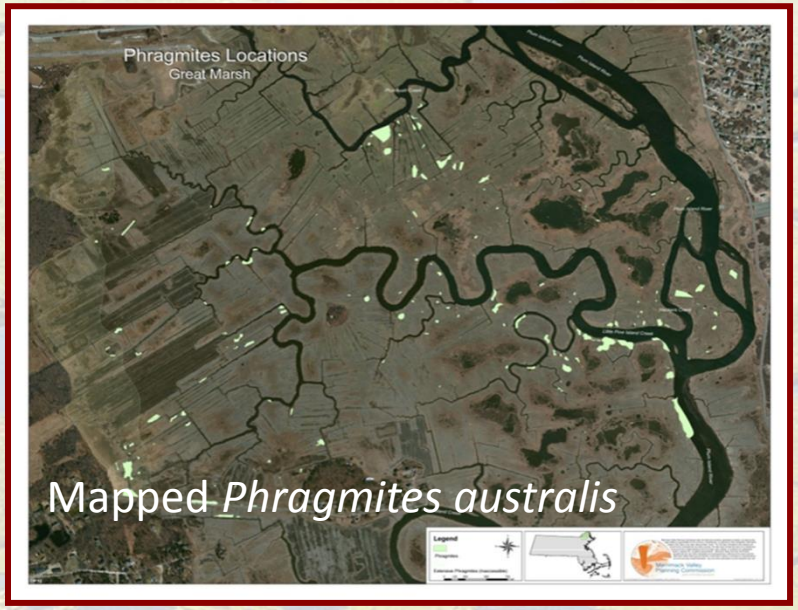
Outcome: Strategically stabilized dune system as a catalyst for further natural flood protection

Unique, Site Specific Fencing and Plant Palate Combinations, Couple with an Extensive Outreach Campaign

Ecological Restoration and Enhancement

Native Salt Marsh Restoration

Pepperweed removal

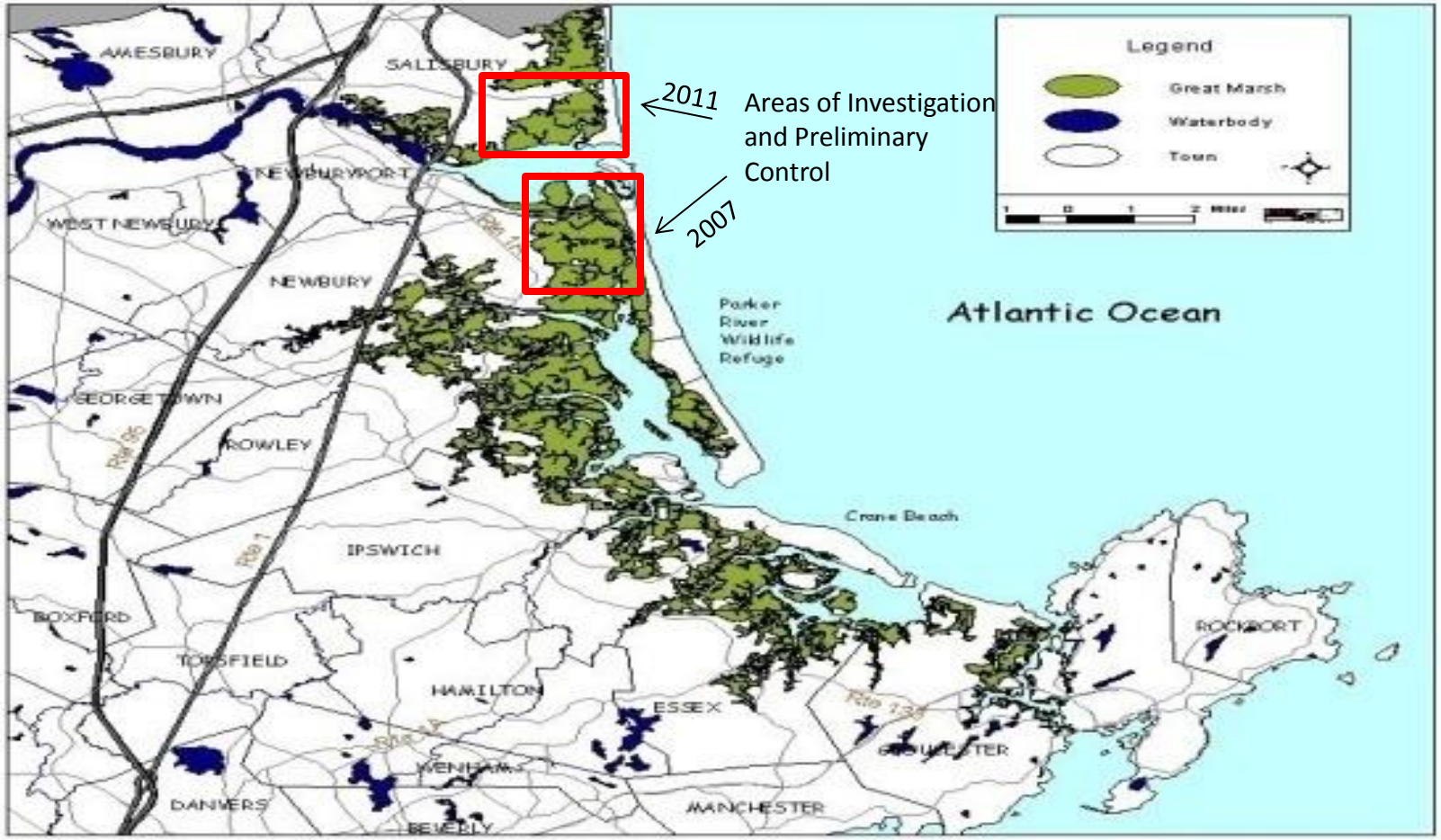


Mapped *Phragmites australis*

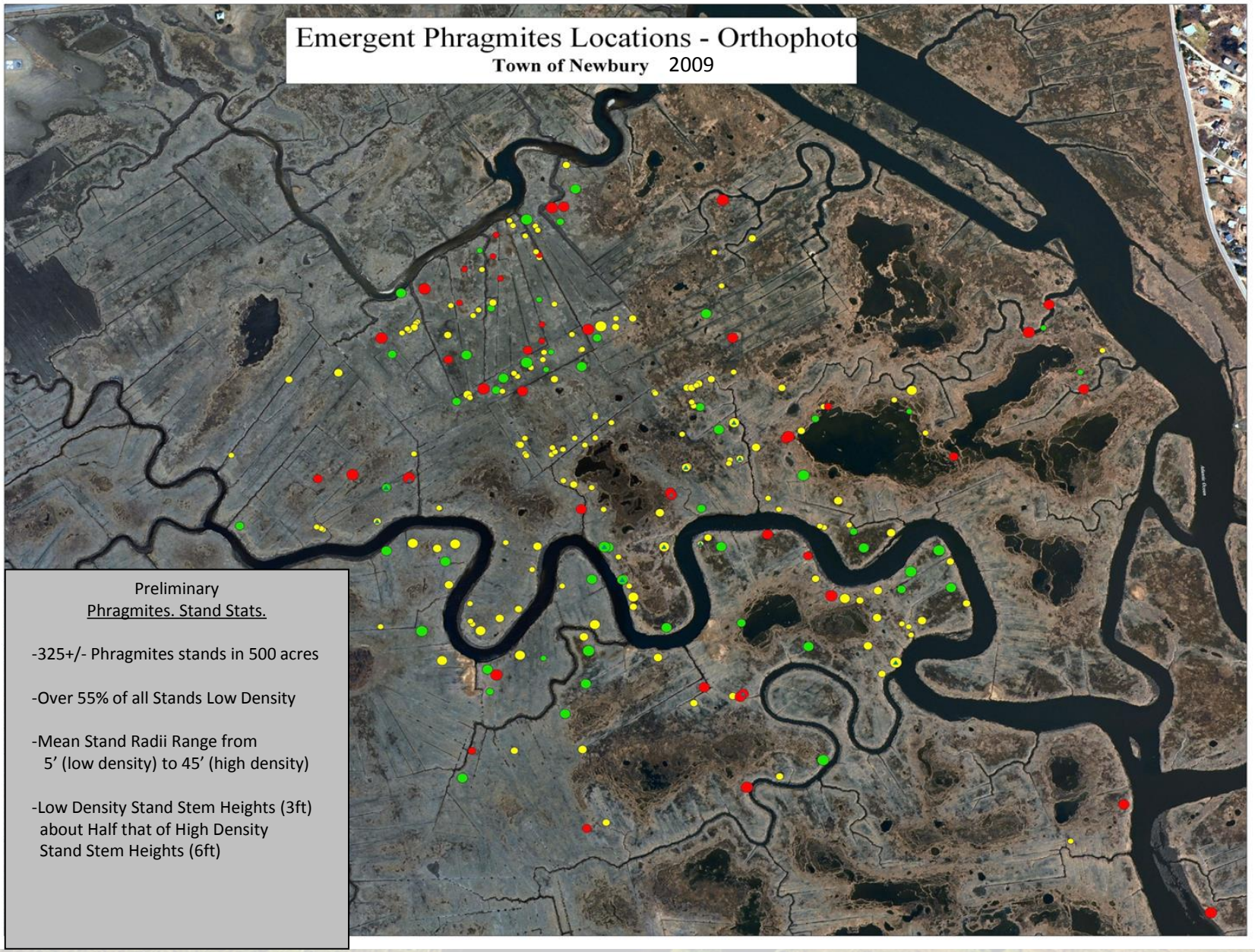
- Restoration of over **325 acres** of native marsh vegetation through the removal of two dominant non-native invasive plants (**perennial pepperweed and Phragmites**)
- Outcome: A stabilized marsh ecosystem affording natural, local flood protection

Native Vegetation Restoration

Invasive Phragmites Management



Massachusetts Great Marsh
Salisbury/Newbury Phragmites Treatment Sites


Emergent Phragmites Locations - Orthophoto
Town of Newbury 2009
Preliminary
Phragmites. Stand Stats.
-325+/- Phragmites stands in 500 acres
-Over 55% of all Stands Low Density
-Mean Stand Radii Range from
5' (low density) to 45' (high density)
-Low Density Stand Stem Heights (3ft)
about Half that of High Density
Stand Stem Heights (6ft)

Management techniques

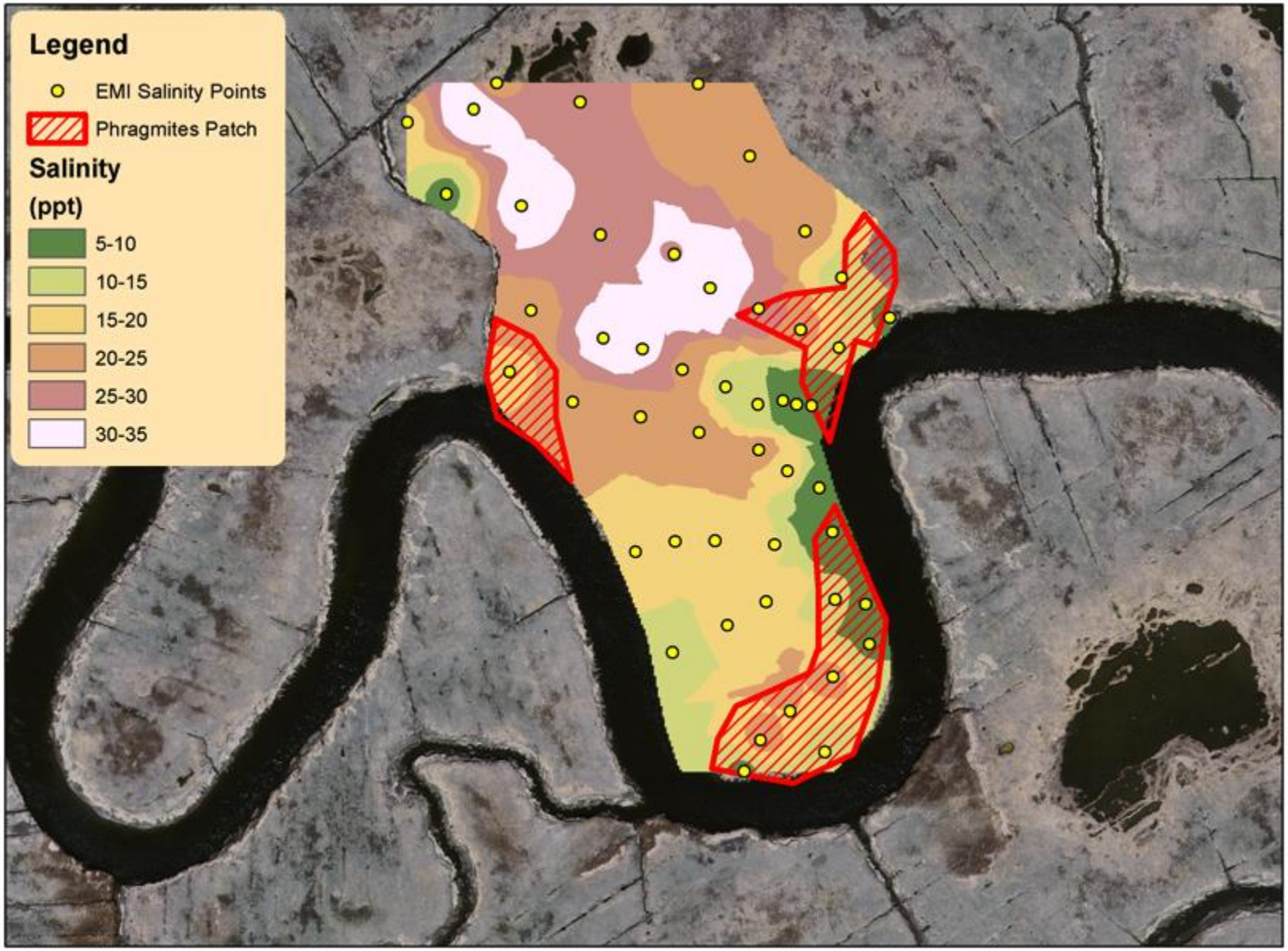
Mapping

Spray

Fire

Cut and Drip

Mowing


Legend
EMI Salinity Points
Phragmites Patch
Salinity
(ppt)
5-10
10-15
15-20
20-25
25-30
30-35

Results in Newbury Marshes

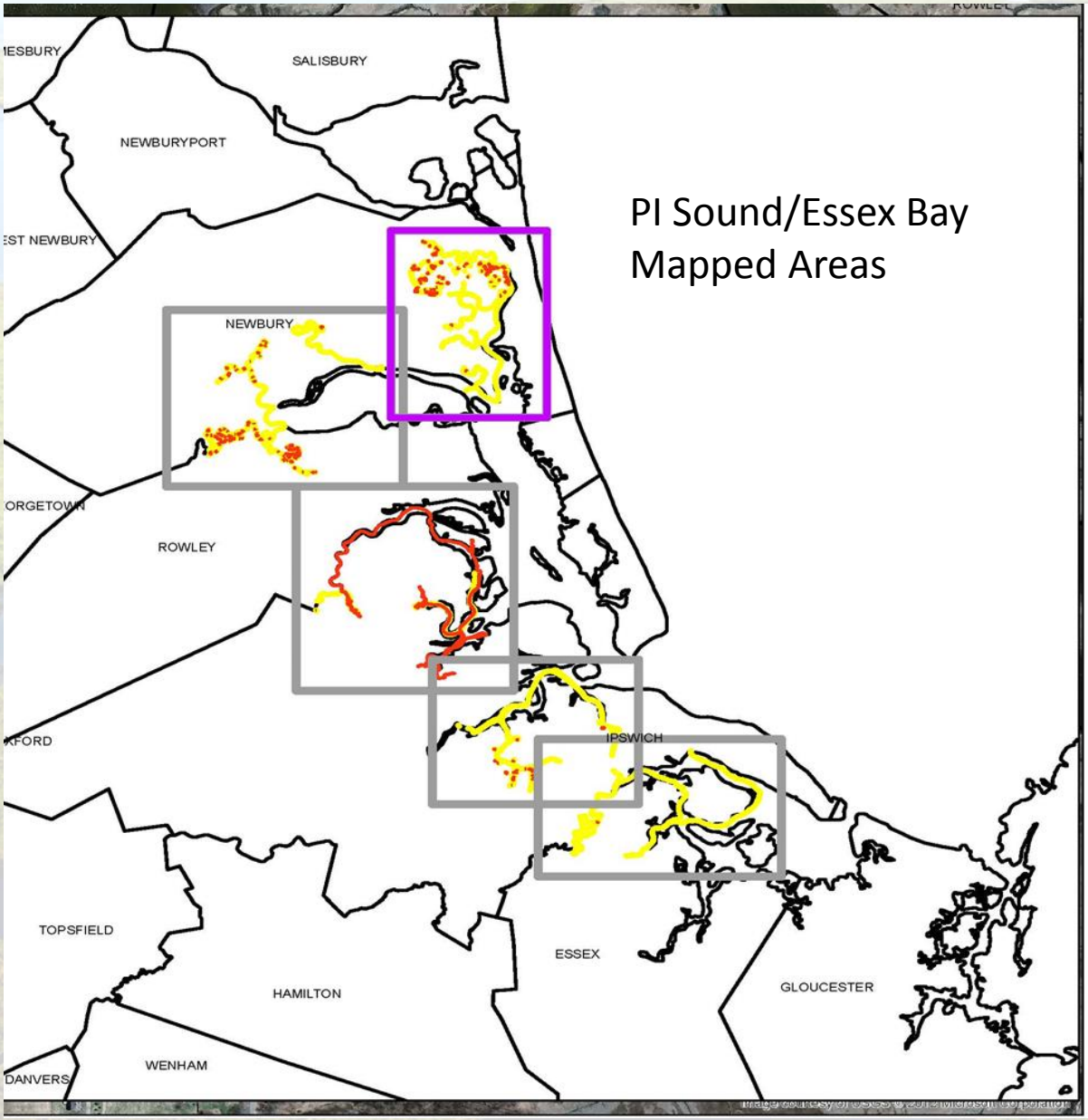
- Approximately 75 stands in the Plumbush Ceek to Pine Island Creek open marsh (down from over 300)
- 75% of those are low density stands
- Very few high density stands left
- Robust native vegetation as replacement

- However, new stands emerging every year
- Six years of effort, not full coverage each time

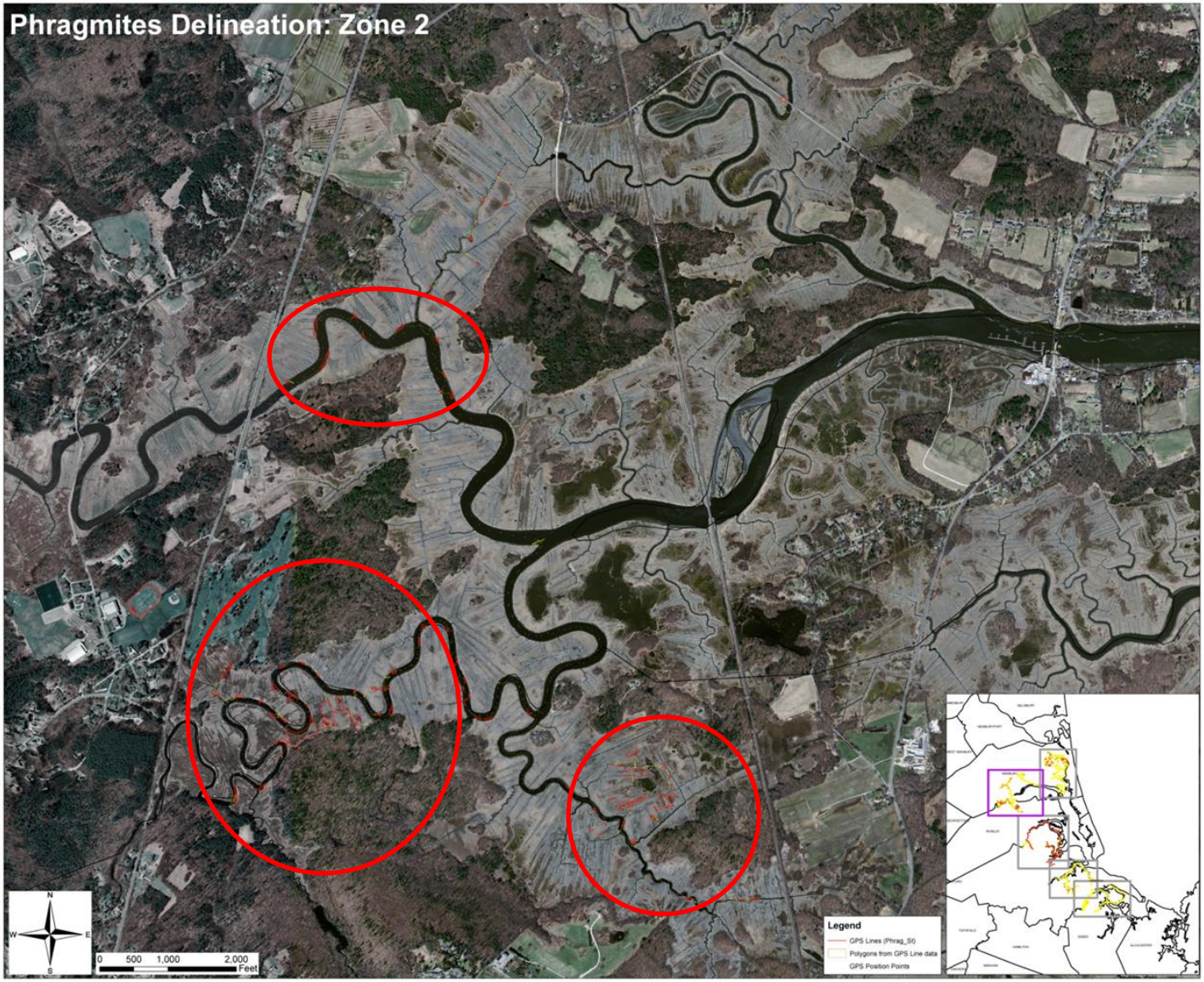
Results from Previous Year Treatments

- Reduction in Stand Size
- Re-vegetation with Native Plants

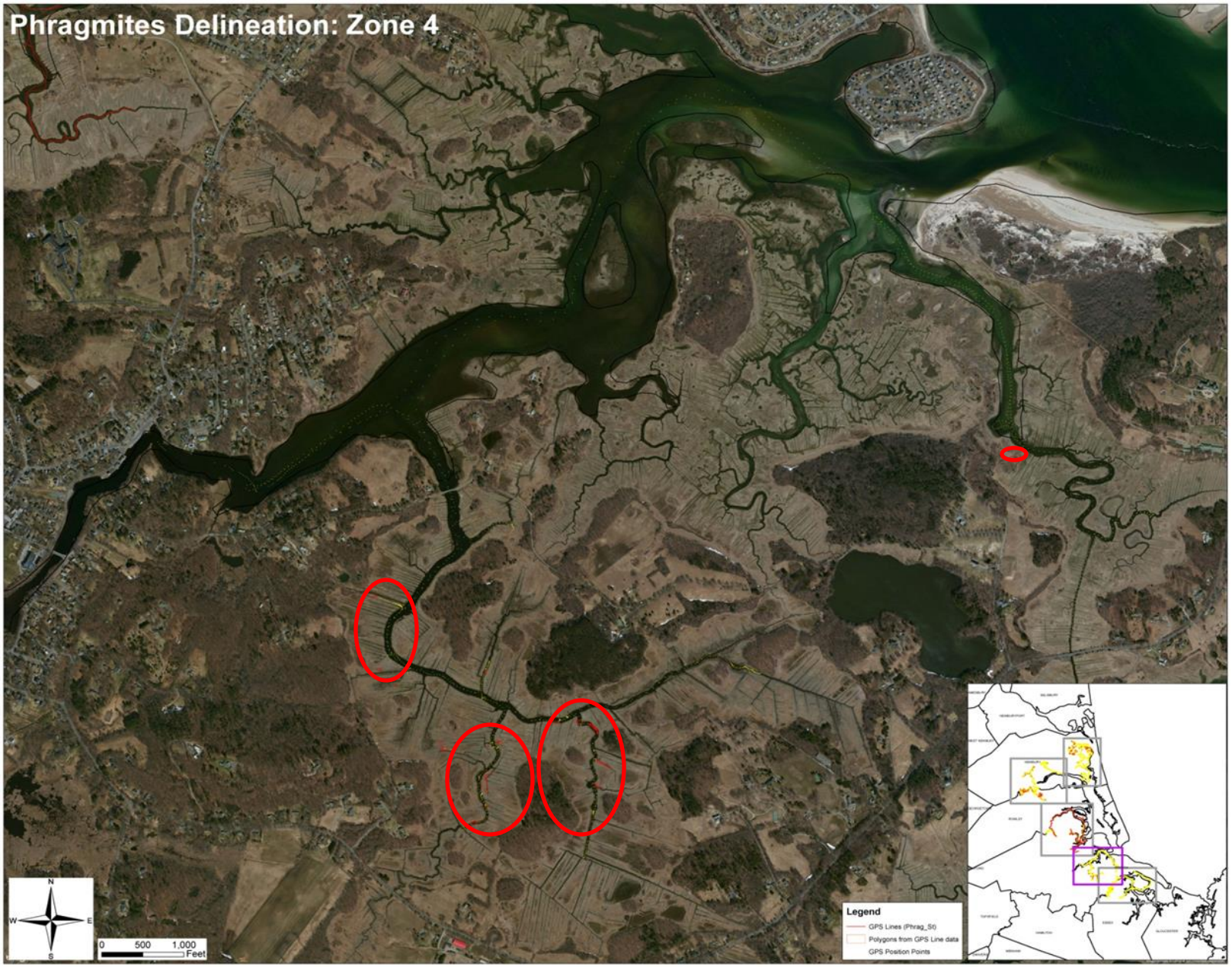
Hurricane Sandy Resiliency Grant Treatment Areas



Upper Parker and Mill River Phragmites Stands



Ipswich River Area



Bottom line

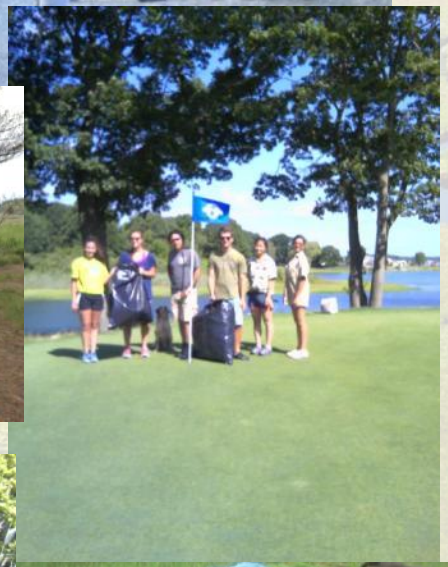
- Some sections of the open marsh require two or even three treatments
- We have seen a significant reduction in Phragmites most locations….and emergence of native vegetation
- New stands are appearing in low salinity areas….cannot treat the marsh forever
- Sandy funding has allowed us to develop a hydrodynamic model to identify salinity influx and concentrations patterns in the marsh
- Model recommendations will help us identify solutions to allowing more saltwater flow into the marsh and/or allow trapped freshwater to flow out of the marshes
- Without some sort of intervention and management it is predicted that in the most vulnerable open marsh locations, the marsh will become overwhelmed by Phragmites and loose much of its native habitat

Great Marsh Perennial Pepperweed Control

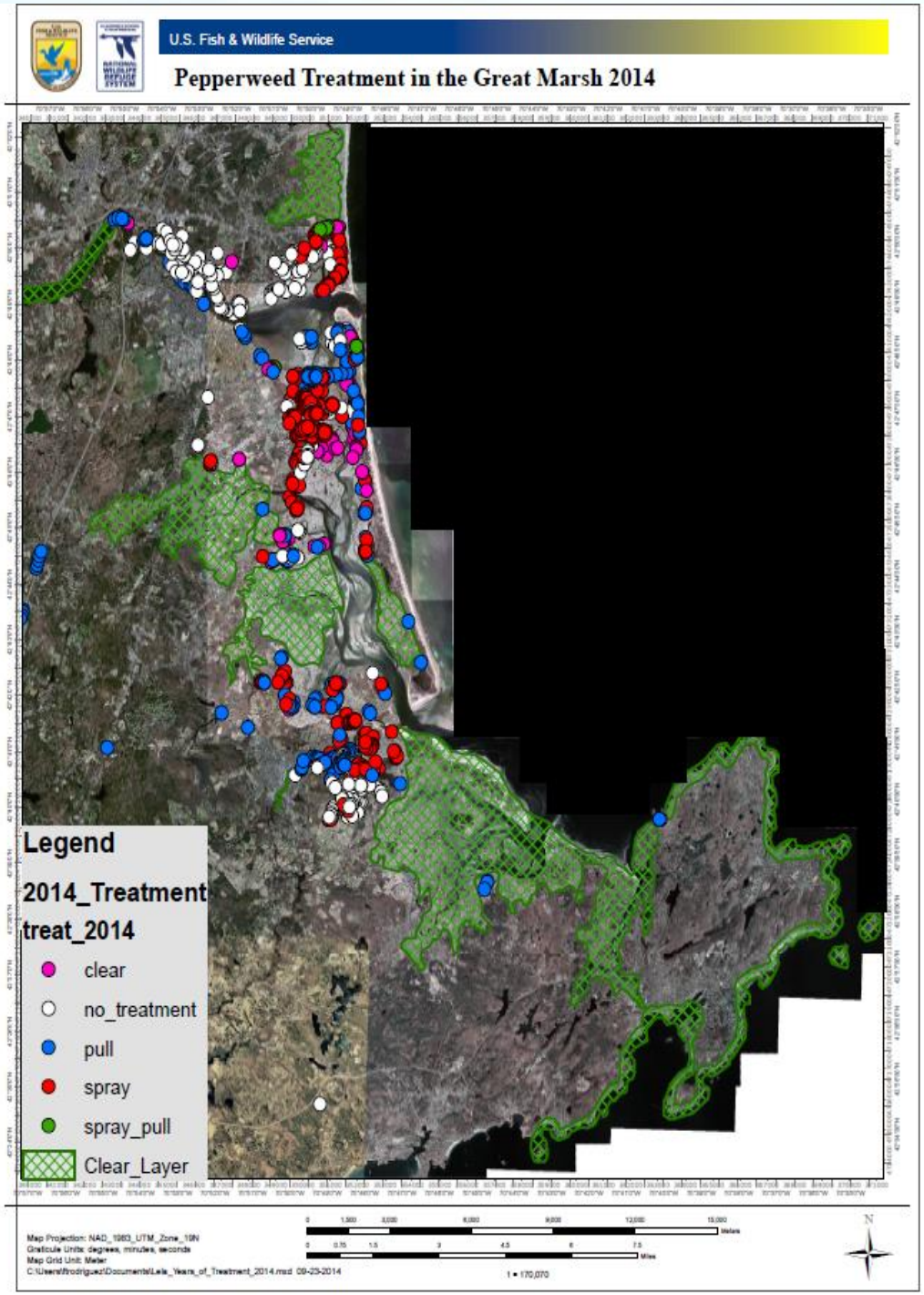






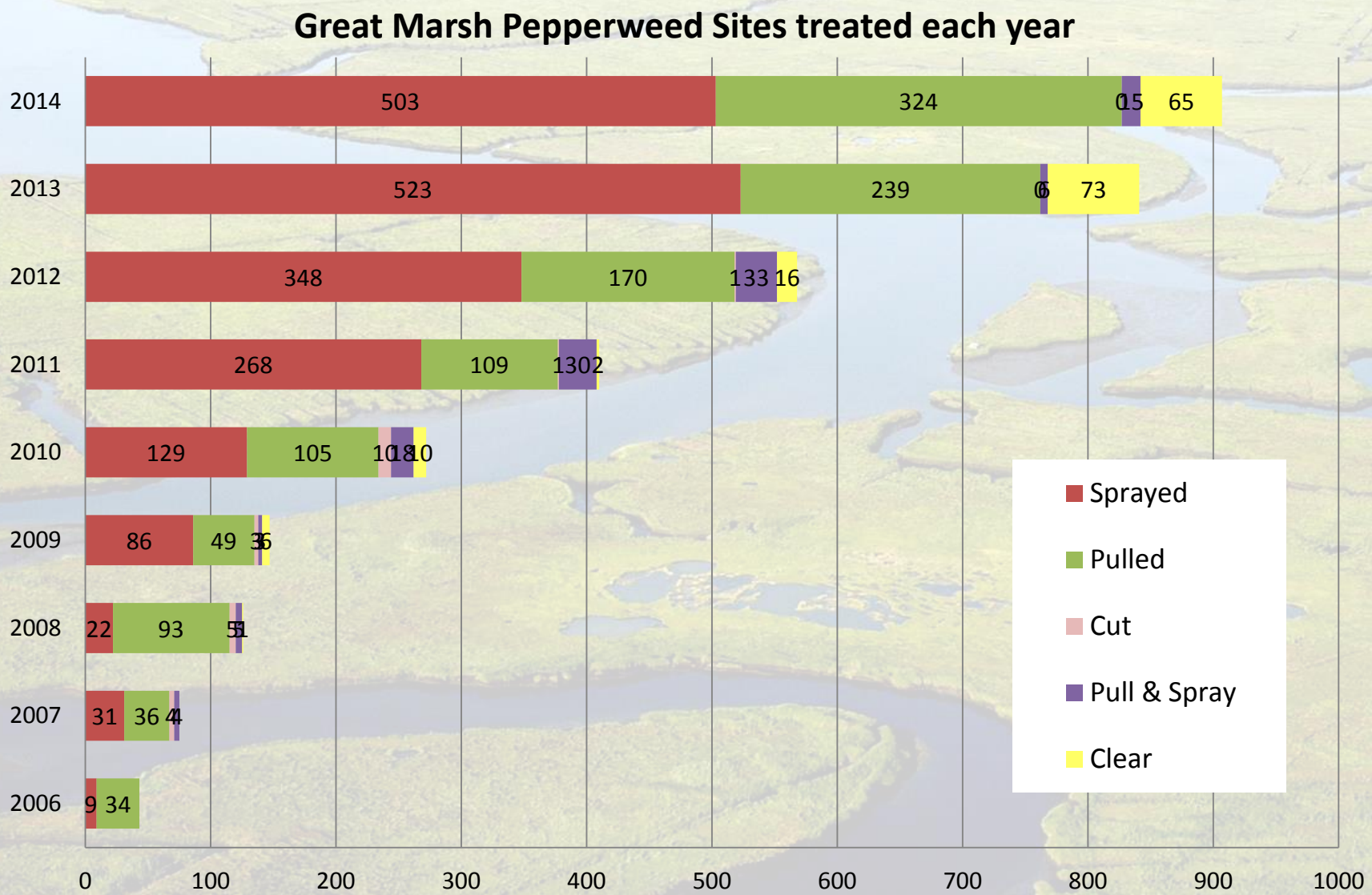







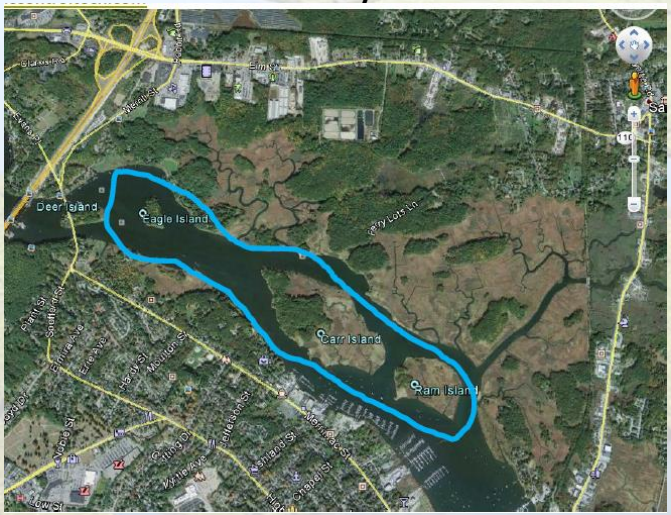
Great Marsh Treatment 2014

- 30,000 acres have been mapped for pepperweed.
- 22,000 acres have been found clear of the plant.
- 8,000 acres are infested with pepperweed or under imminent threat from it.
- 850 stands were treated protecting approximately 1,580 acres.
- 70% of all sites mapped were treated.

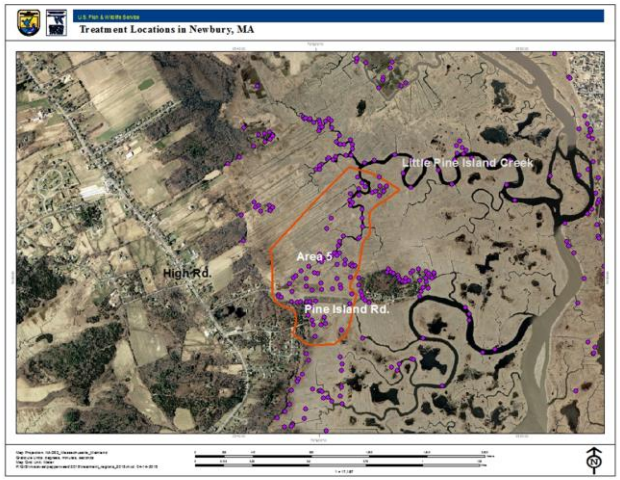

Great Marsh Pepperweed Sites treated each year
2014
2013
2012
2011
2010
2009
2008
2007
2006
503
324
15
65
523
239
6
73
348
170
133
16
268
109
13
2
129
105
10
18
10
86
49
3
6
22
93
5
1
31
36
4
9
34
0
100
200
300
400
500
600
700
800
900
1000
Sprayed
Pulled
Cut
Pull & Spray
Clear

2015 Pepperweed Treatment Areas

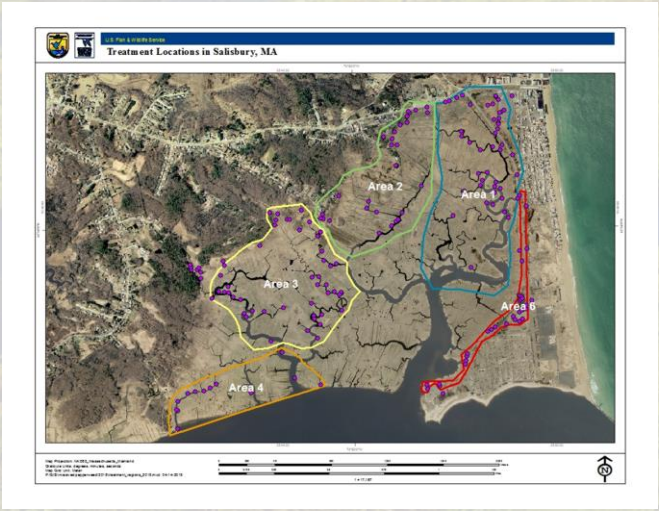
Salisbury Islands



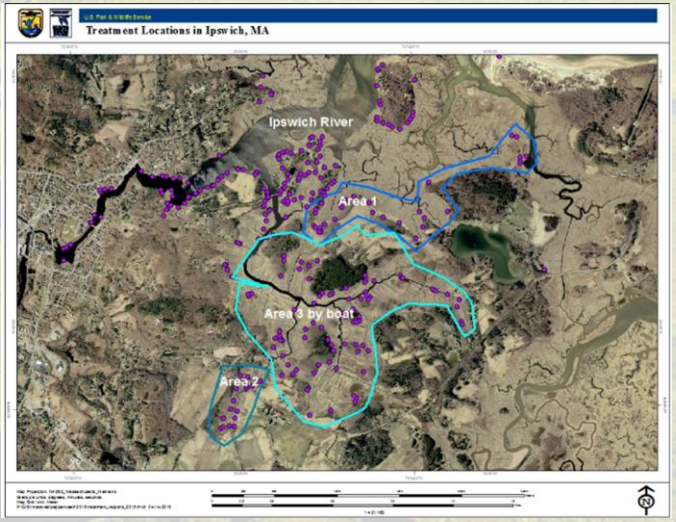
Newbury



Southeast Salisbury



Ipswich

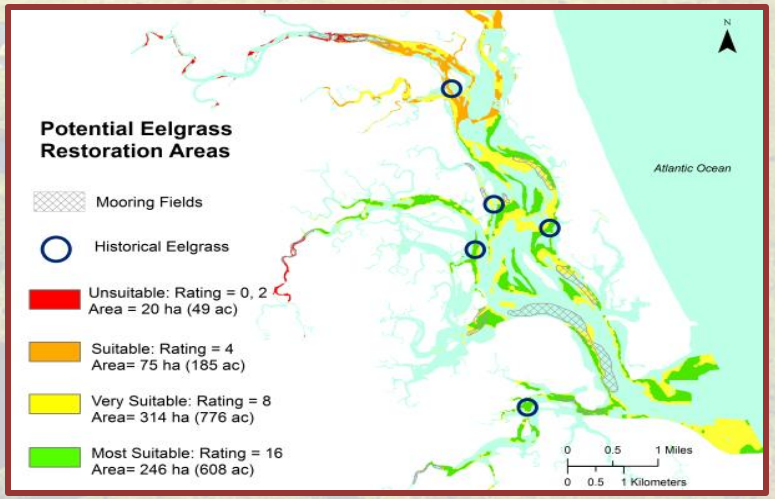


Ecological Restoration and Enhancement

Eelgrass Restoration

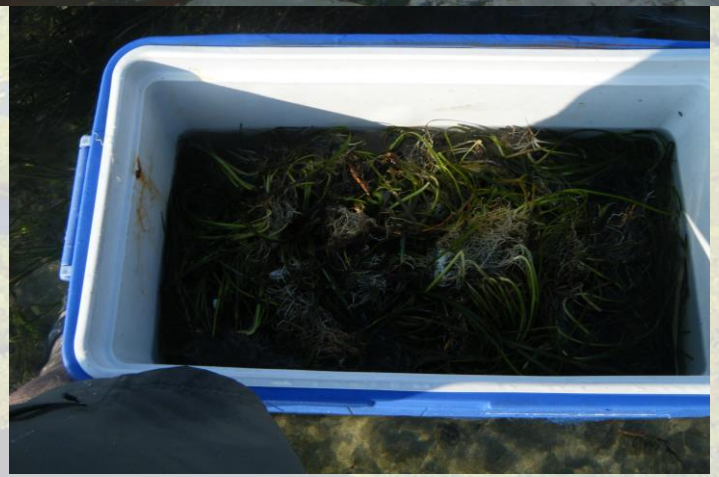
- Plum Island Sound and Essex Bay
- Transplant sites identified by modeling efforts
- Use multiple donor sources to build a genetically diverse population
- Green Crab Monitoring and Marsh Edge Erosion

Outcome: Restore 3 acres to naturally stabilize creek channels and tidal flats in Rowley, Ipswich, Essex and Gloucester



Genetic Diversity

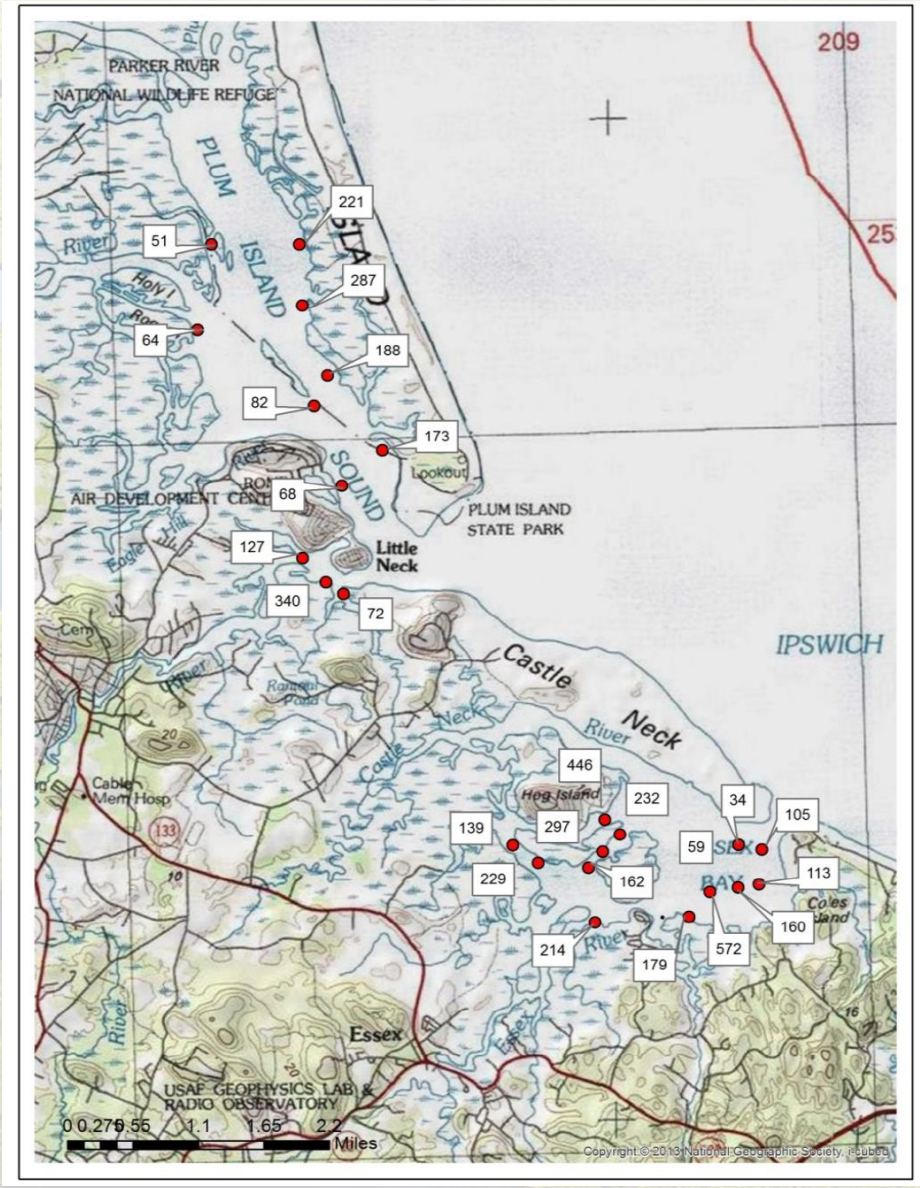
- Cape Code
- Scituate
- Nahant
- Great Bay
- Pleasant Bay
- Great Bay



Plant Sites Under Sandy Grant

- 80% survival mouth of Essex Bay
- 15% survival in other sections of Essex Bay
- 0% survival Plum Island Sound

Baseline Monitoring of Green Crab 2014



Spring 2014
- 1384 total
- 0 to 215 CPUE
- 2 x females
- carapace 1.5 to 2 in

Fall 2014
- 1720 total
- 15 to 226 CPUE
- females = males
- carapace 1.5 to 2 in

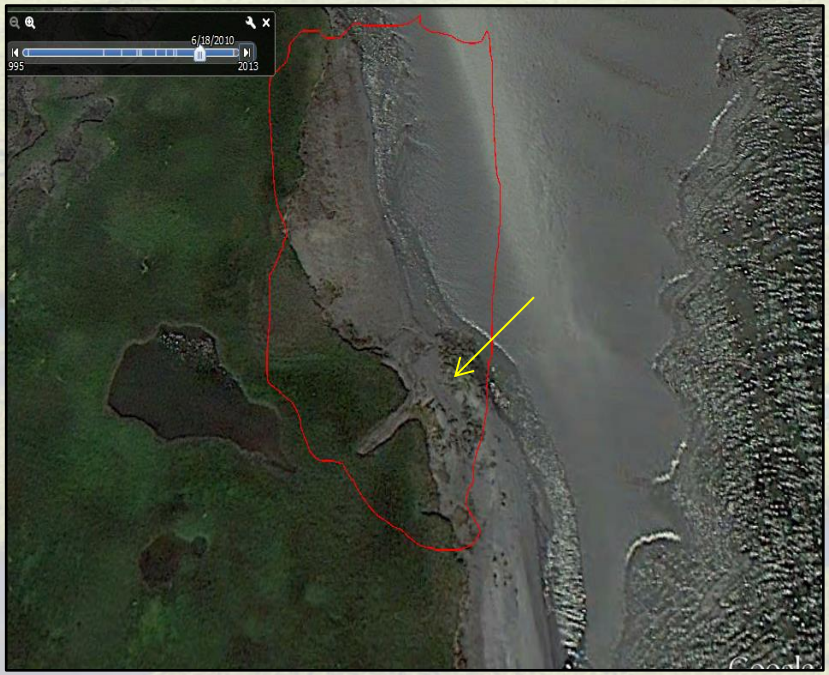
Summer 2014
- 4762 total
- 34 to 572 CPUE
- 3 x females
- carapace 1.5 to 2 in

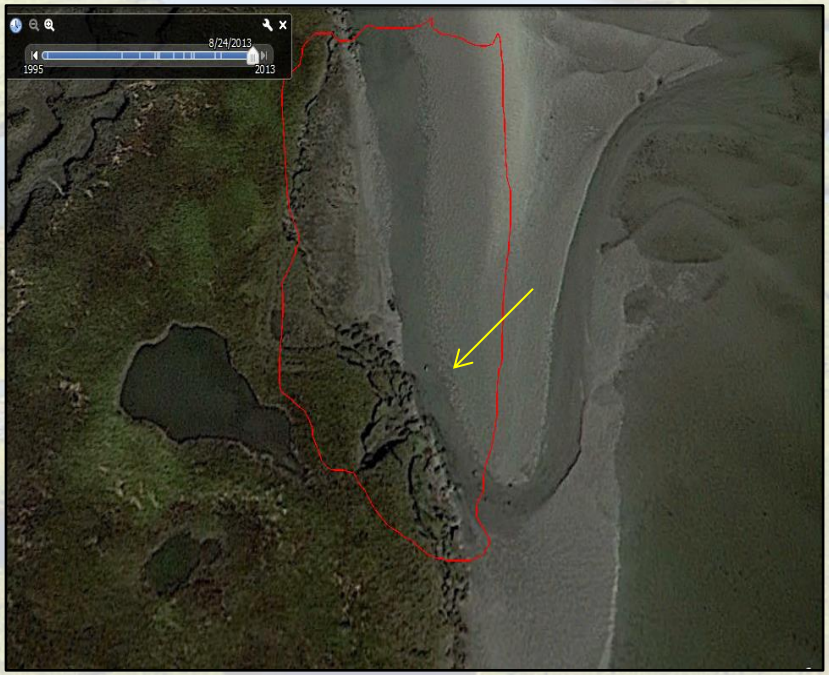
Spring 2015
-less than 100 crabs caught

Impact on Great Marsh Ecosystem

Marsh Edge Erosion (MEE) in the Great Marsh

- Assess impact of Green Crab on marsh platform
  - loss at Roger's Island (>5 m) between 2010 and 2013





12 Transects being monitored in Essex Bay and Plum Island Sound

Restoration Support through Youth Engagement Community Resiliency Planning

- Student Conservation Association
- Utilize volunteers
- Hire, train, and employ students for time-critical support project components

Summation

By 2017, the Great Marsh will be well on its way back to being a healthy, resilient, functioning system; protecting the natural ecosystems and communities infrastructure from SLR and coastal storms