Buzzards Bay Salt Marshes: Vulnerability and Adaptation Potential

Callista Macpherson, Buzzards Bay Coalition

SNEP Symposium, June 12, 2024

Photos courtesy of Buzzards Bay Coalition

Community Concern

From an email to the Buzzards Bay Coalition:

“The marsh grass is dying off in patches, leaving just mud that the water now flows into and is creating new smaller canals/rivulets when the tides are high.

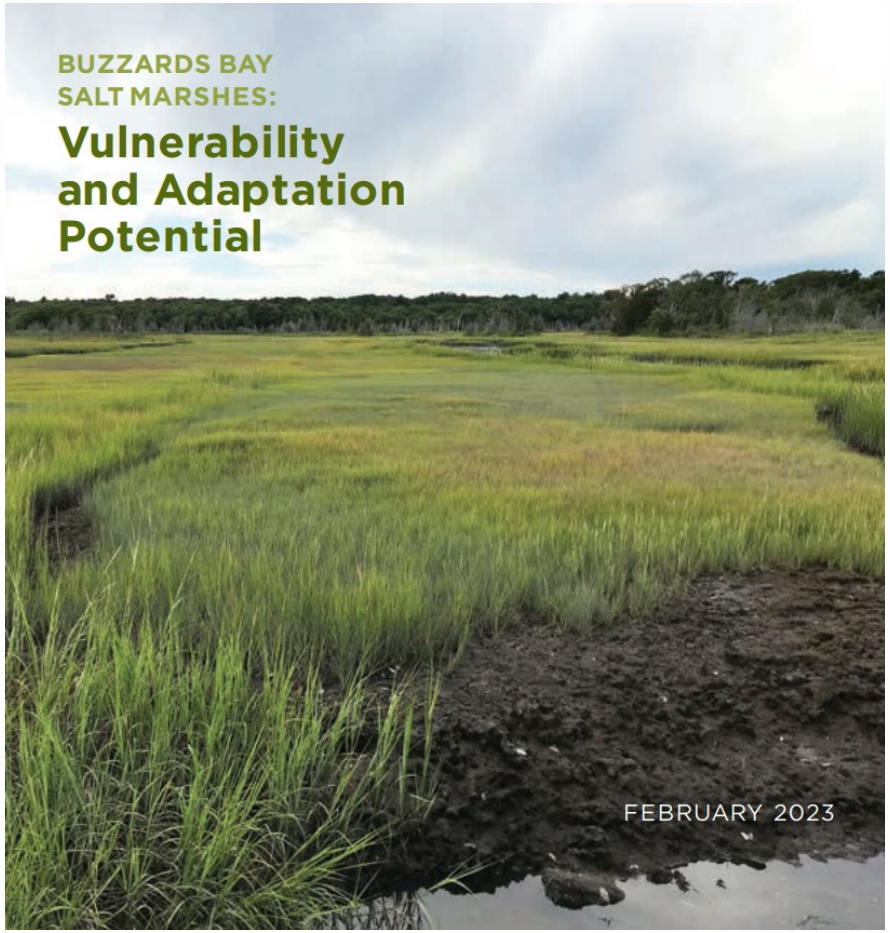
The grass die-off is [a] …recent phenomenon, within the last year from what I’ve seen.

The shoreline itself, which my property abuts, has not changed or been affected yet, though once the marsh goes I would imagine that would soon follow.

This area has brought us so much peace and joy; **we are willing to do quite a lot to save it.”**

Outline

- **Overview**
- Methods and Metrics
- Current Conditions
- Results and Conclusion



Salt Marshes in the Landscape

- Coastal wetlands dominated by grasses

Salt Marshes in the Landscape

- Coastal wetlands dominated by grasses
- Ecosystem Services
  - Provisioning

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- Coastal wetlands dominated by grasses
- Ecosystem Services
  - Provisioning
  - Regulating

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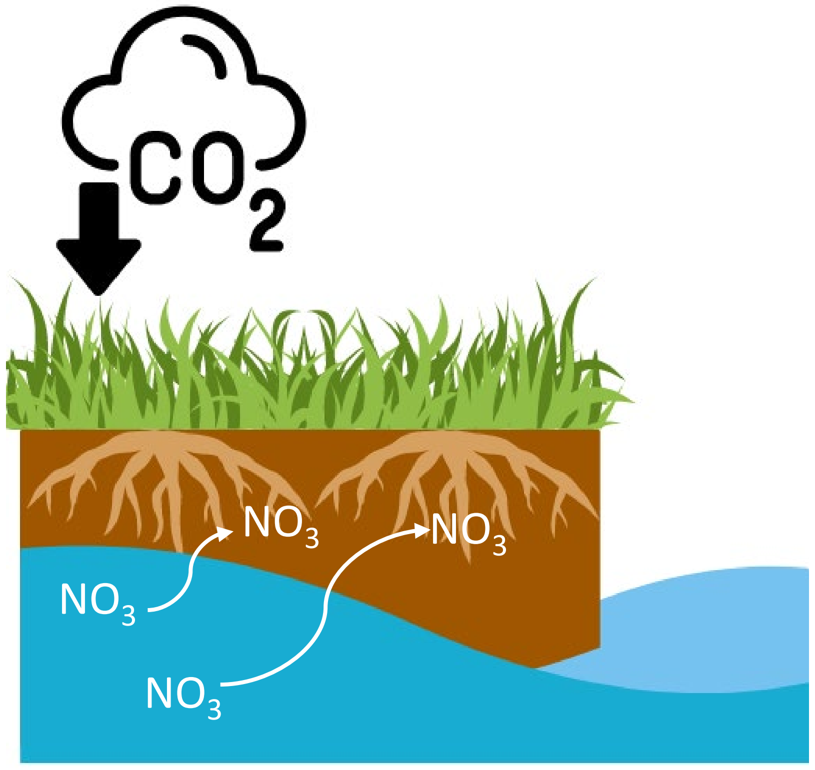
  - Provisioning
  - Regulating
  - Supporting



Salt Marshes in the Landscape

- Coastal wetlands dominated by grasses
- Ecosystem Services
  - Provisioning
  - Regulating
  - Supporting
  - Cultural

Marsh loss around Buzzards Bay

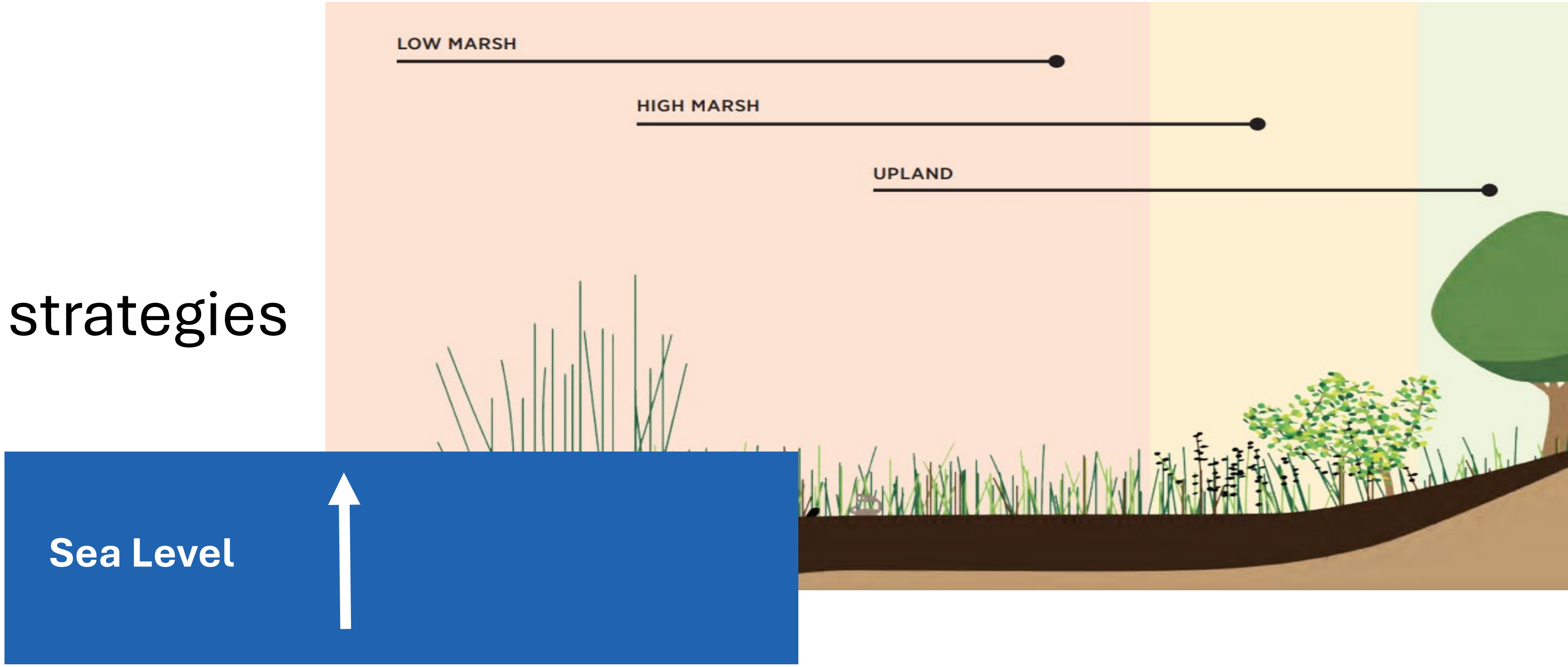

Dartmouth


Mattapoisett


Westport River

Marsh Resilience

- Marsh Migration
- Elevation
- Plant Community
- Active adaptation strategies



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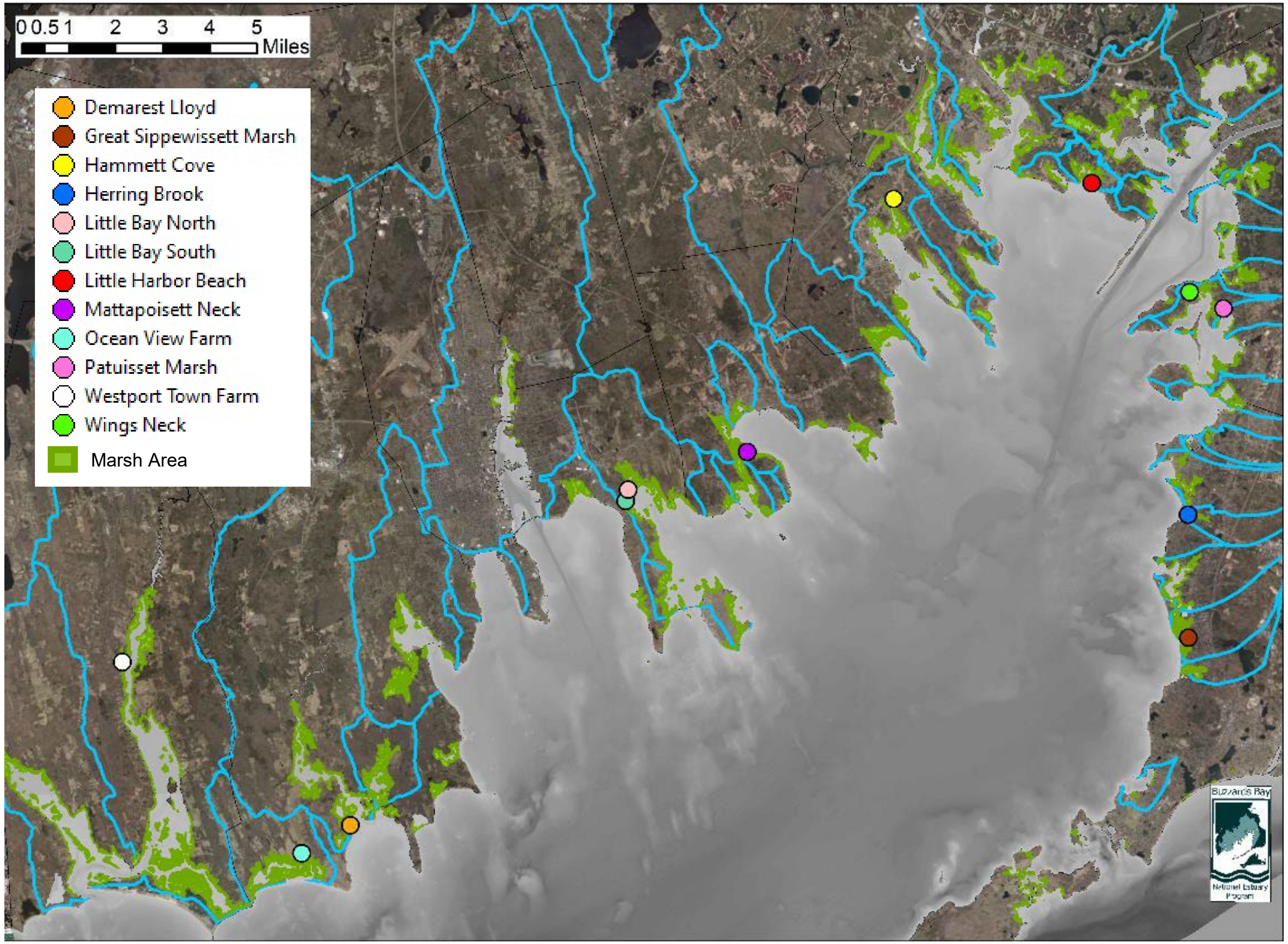
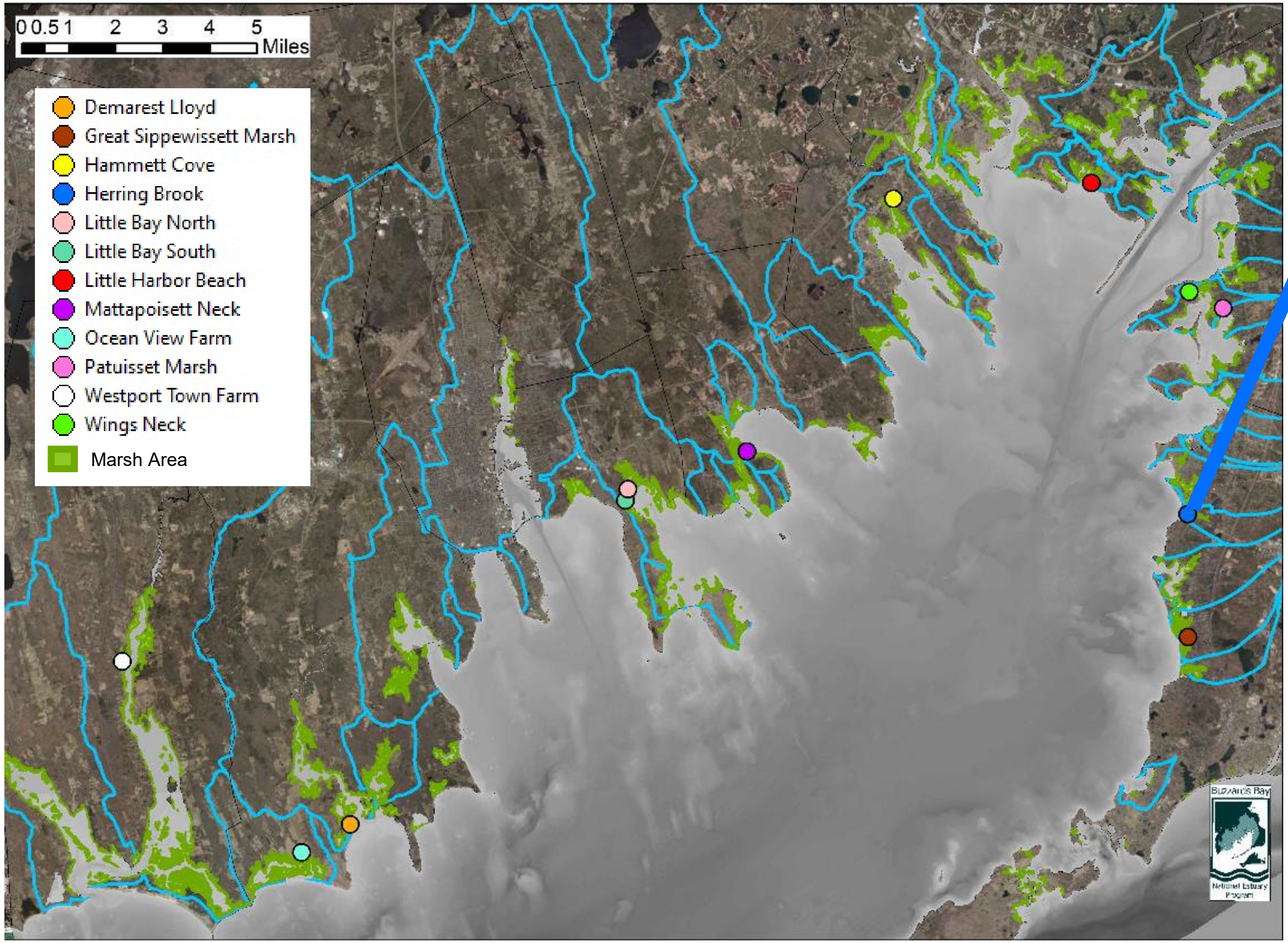
Sites



0 0.5 1 2 3 4 5
Miles
Demarest Lloyd
Great Sippewissett Marsh
Hammett Cove
Herring Brook
Little Bay North
Little Bay South
Little Harbor Beach
Mattapoisett Neck
Ocean View Farm
Patuisset Marsh
Westport Town Farm
Wings Neck
Marsh Area

Sites



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HBR

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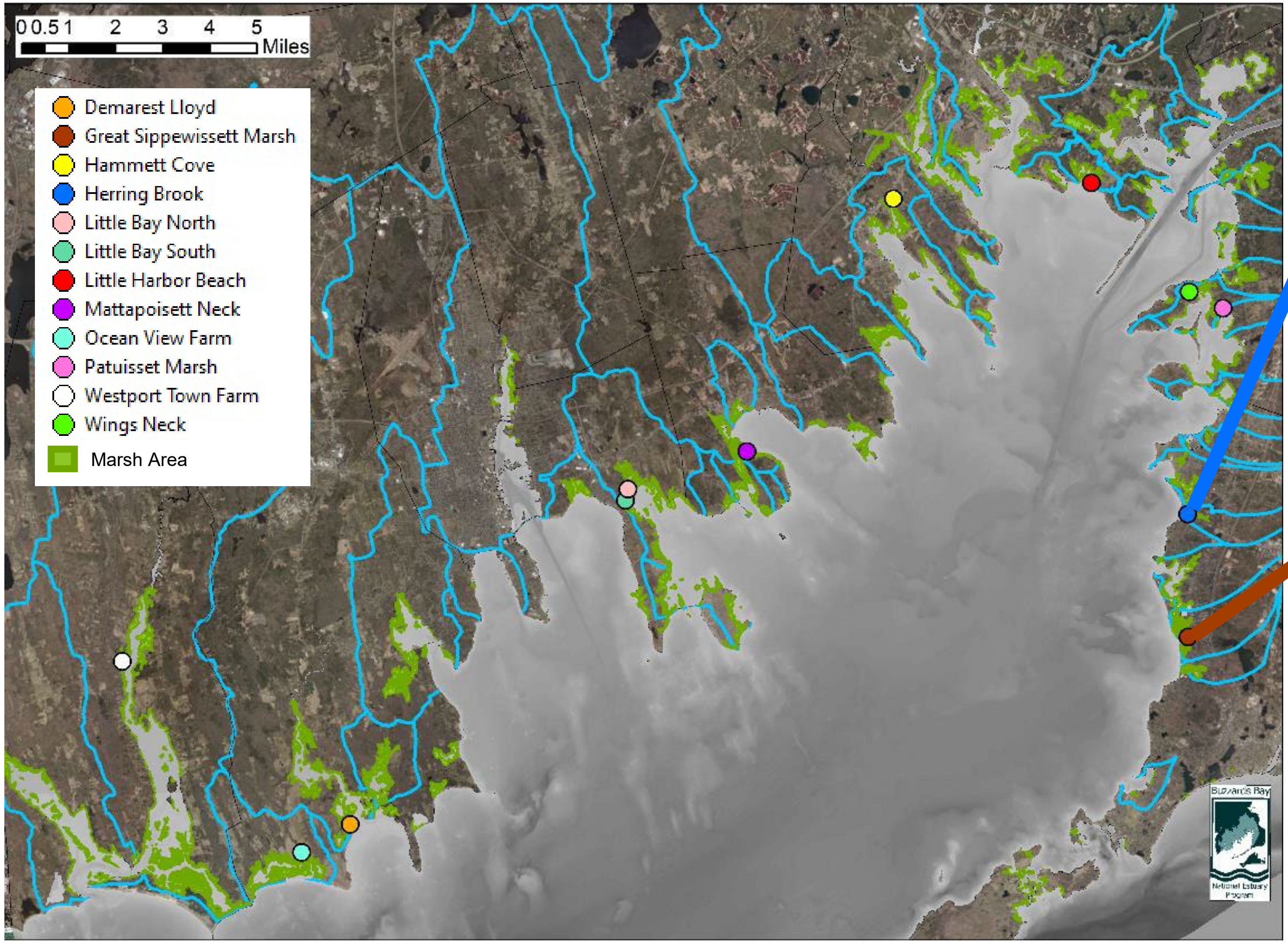
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GSM

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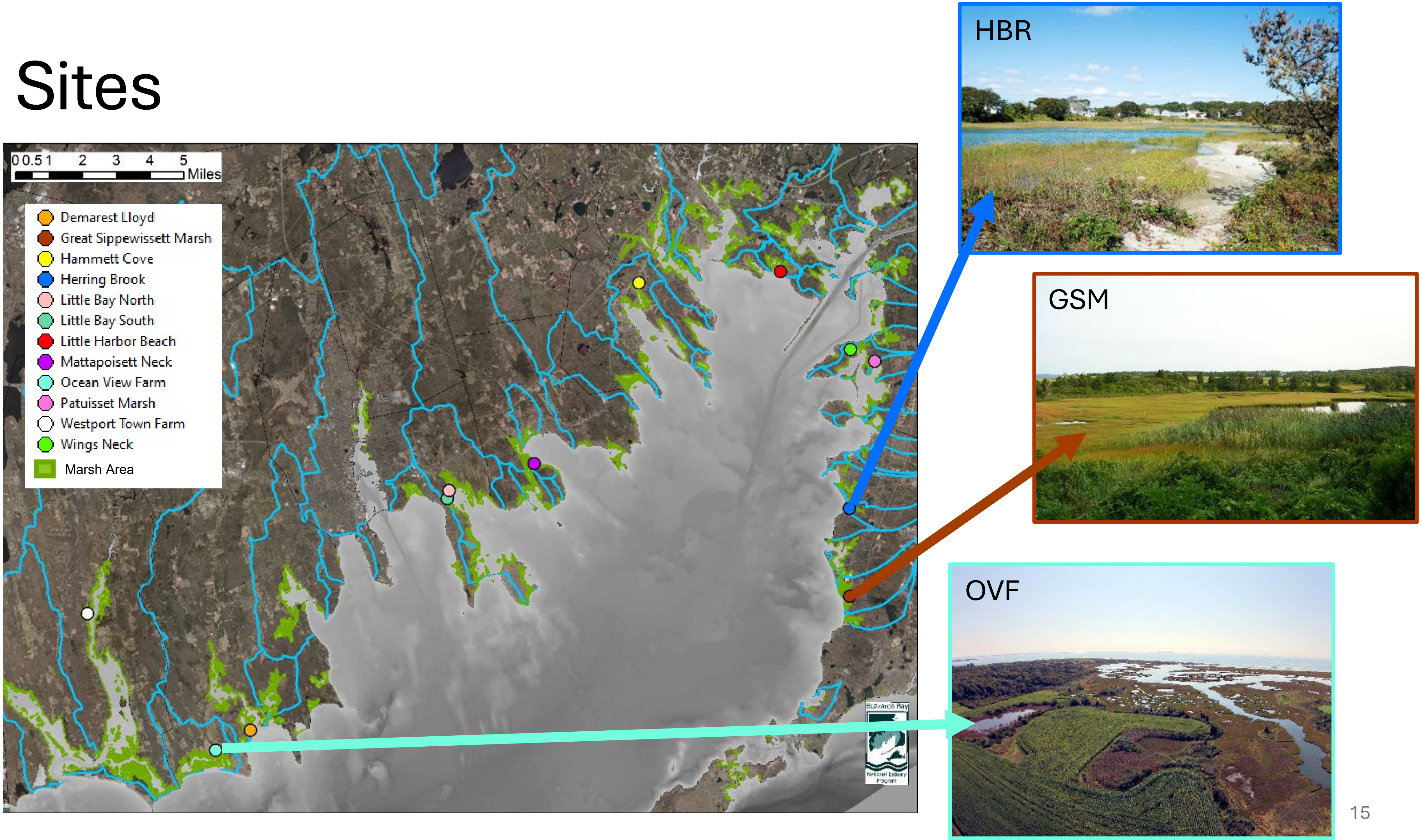

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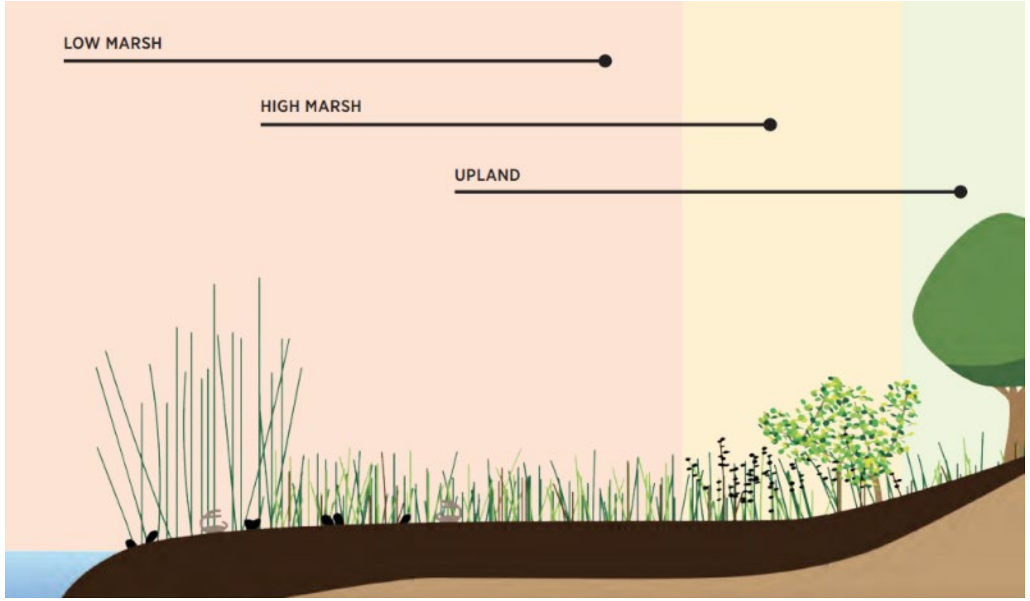
GSM
OVF

Methods & Metrics

- **Percent low-lying**
- Nitrogen
- Tidal restrictions

- **Percent above mean high**
- **Plant community**
- Percent resilient

- **Percent vegetated**
- Unvegetated to Vegetated ratio (UVVR)
- Marsh loss



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Herring Brook (HBR)

Stressors

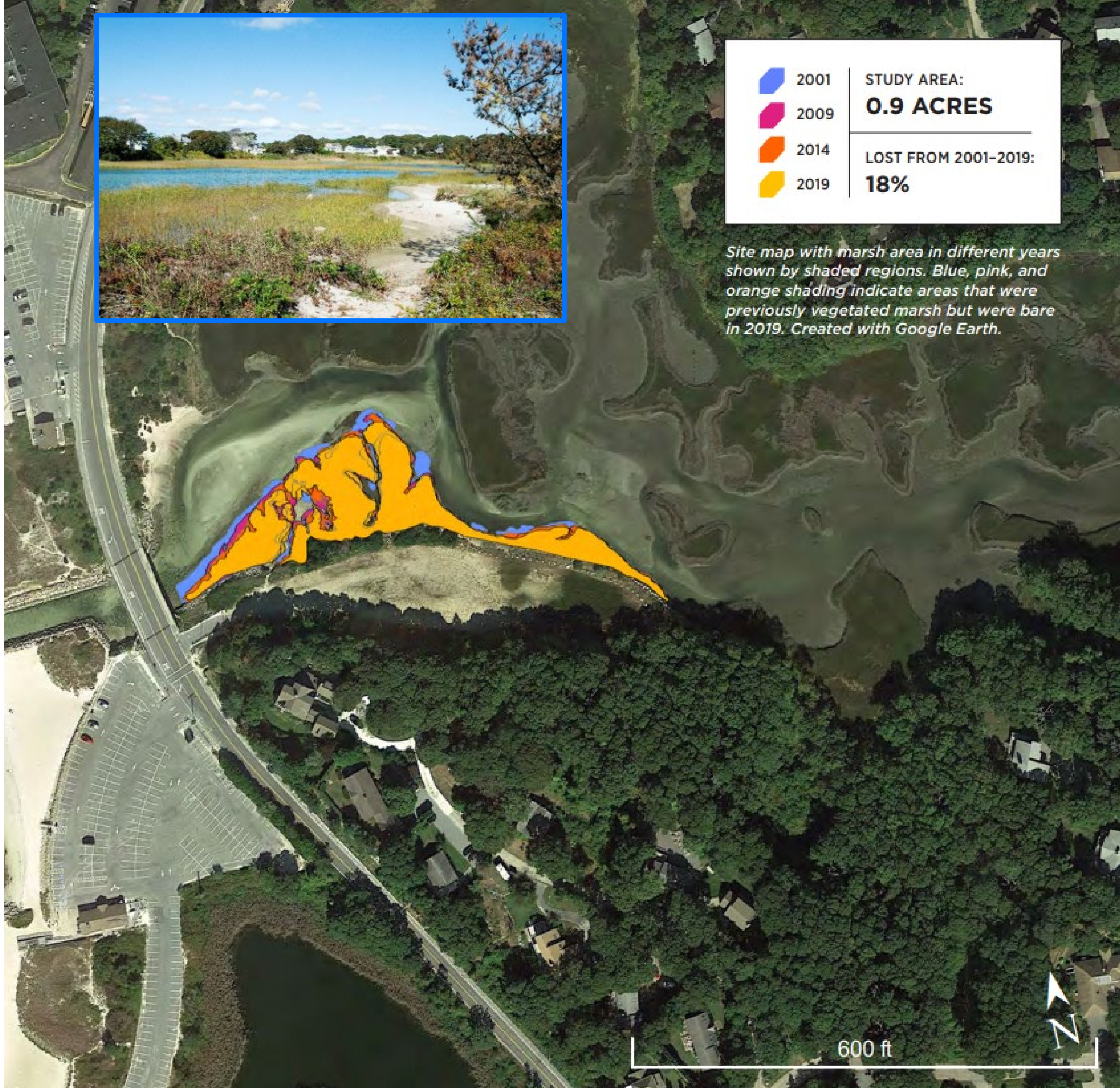
Percent Low-Lying	**21%**
Nitrogen Pollution	**0.7** mg/L estuary

Current Conditions

Percent Unvegetated	**1%**

Potential for Adaptation

Plant Community	**31%** High Marsh **69%** Low Marsh
Percent Above MHW	**36%**



Site map with marsh area in different years shown by shaded regions. Blue, pink, and orange shading indicate areas that were previously vegetated marsh but were bare in 2019. Created with Google Earth.

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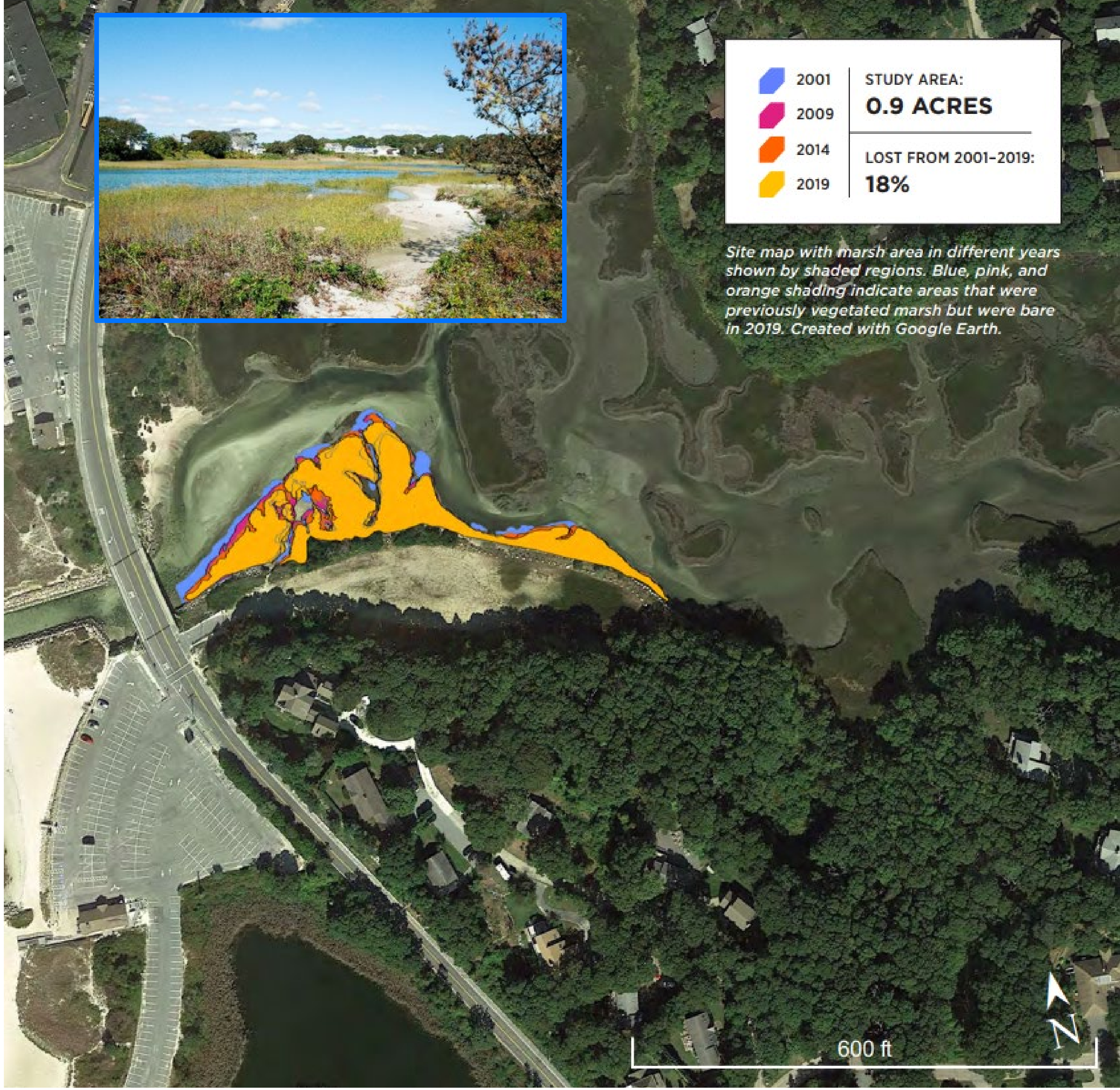

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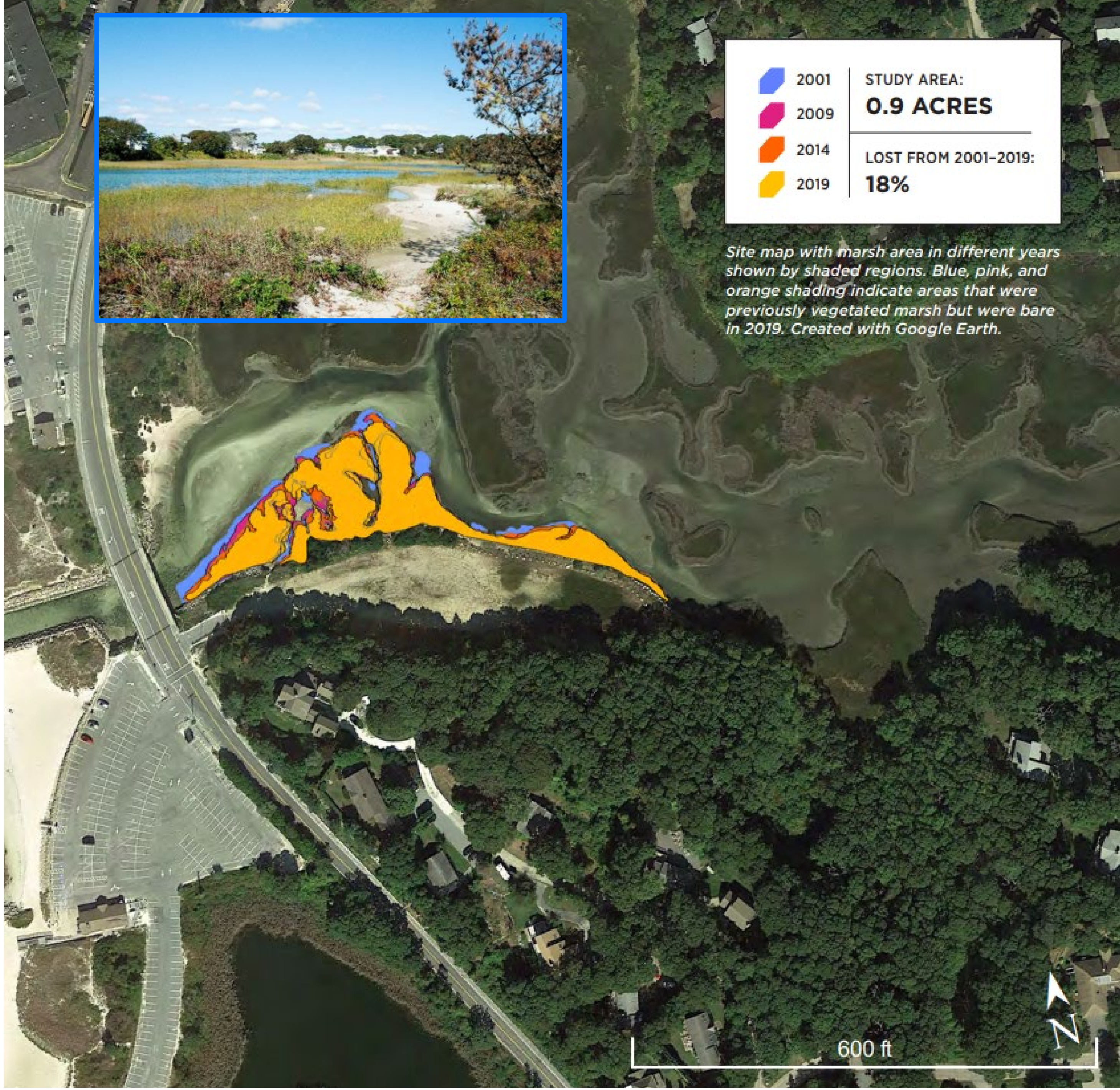

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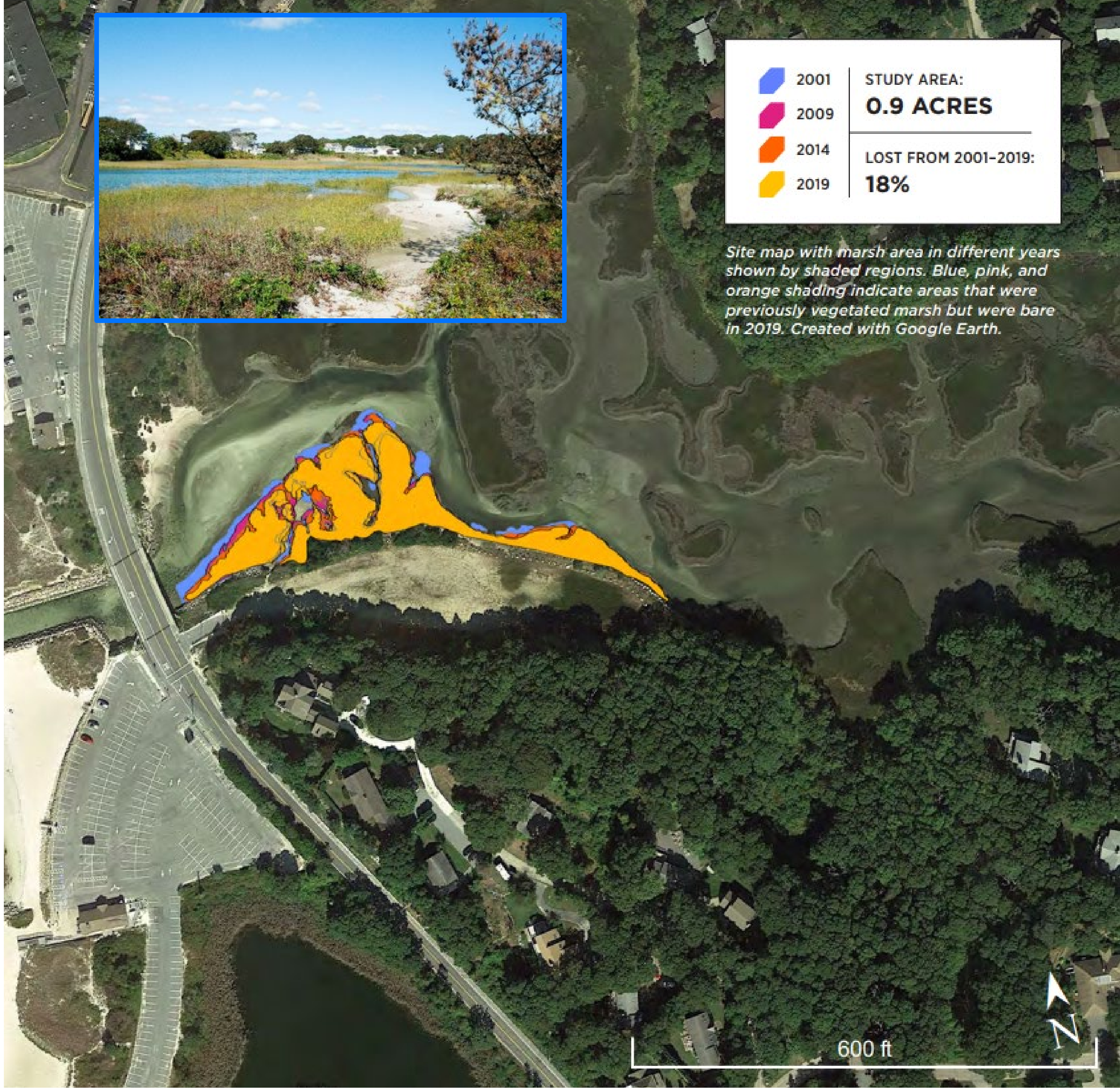

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Great Sippewisett Marsh (GSM)

Stressors

Percent Low-Lying	**2%**
Nitrogen Pollution	**0.5*** mg/L estuary

Current Conditions

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Potential for Adaptation

Plant Community	**41%** High Marsh **59%** Low Marsh
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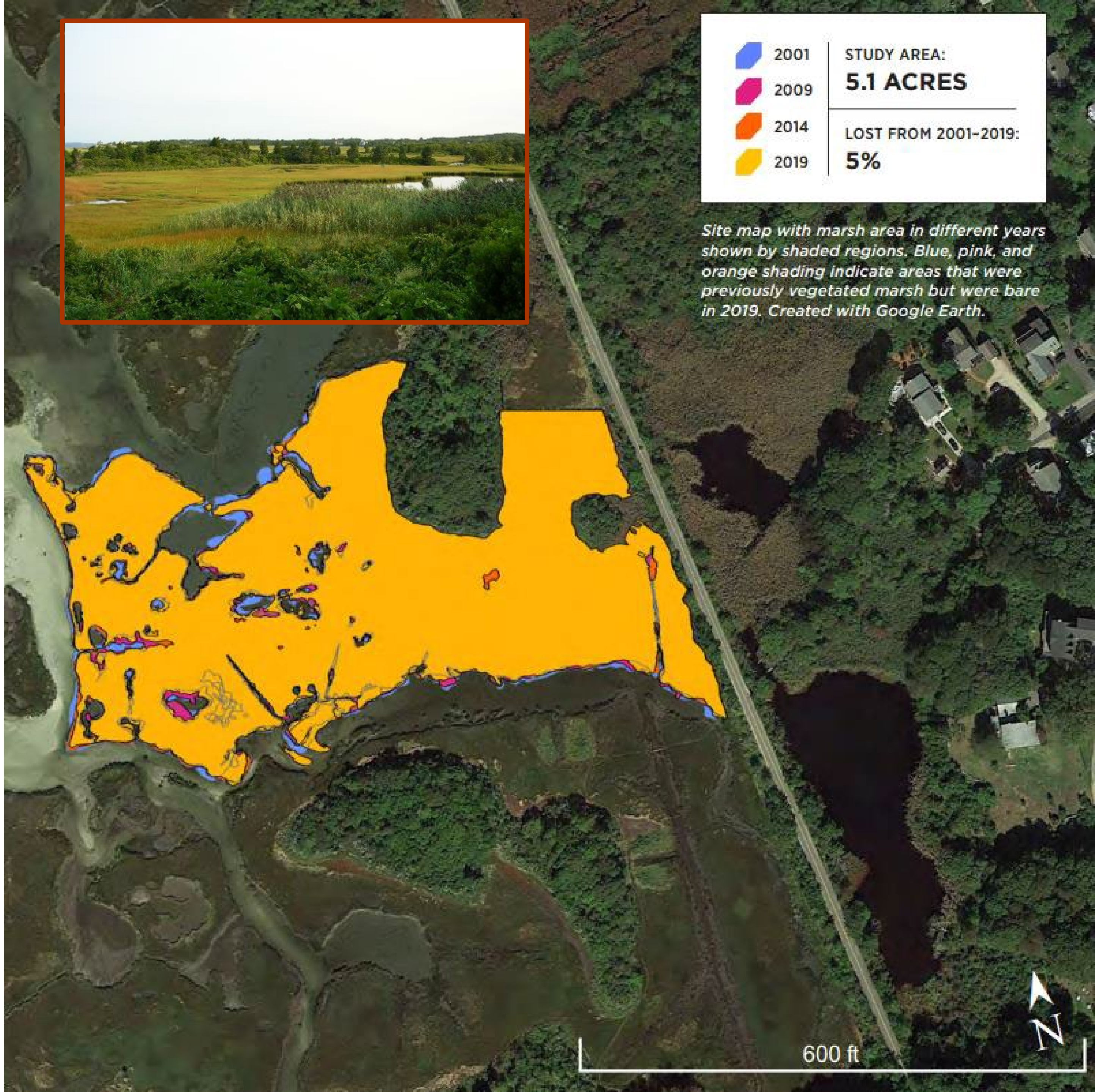

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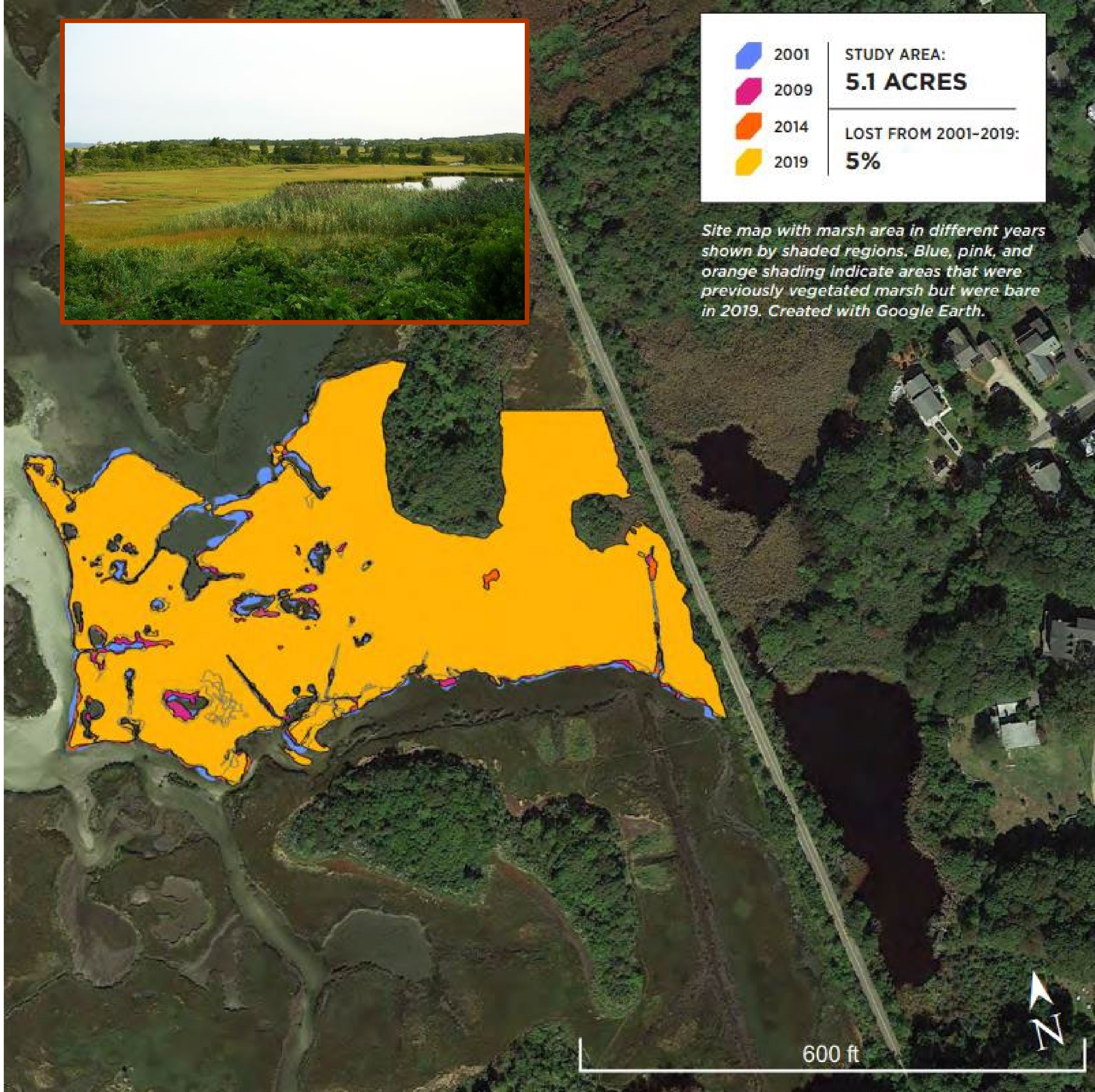

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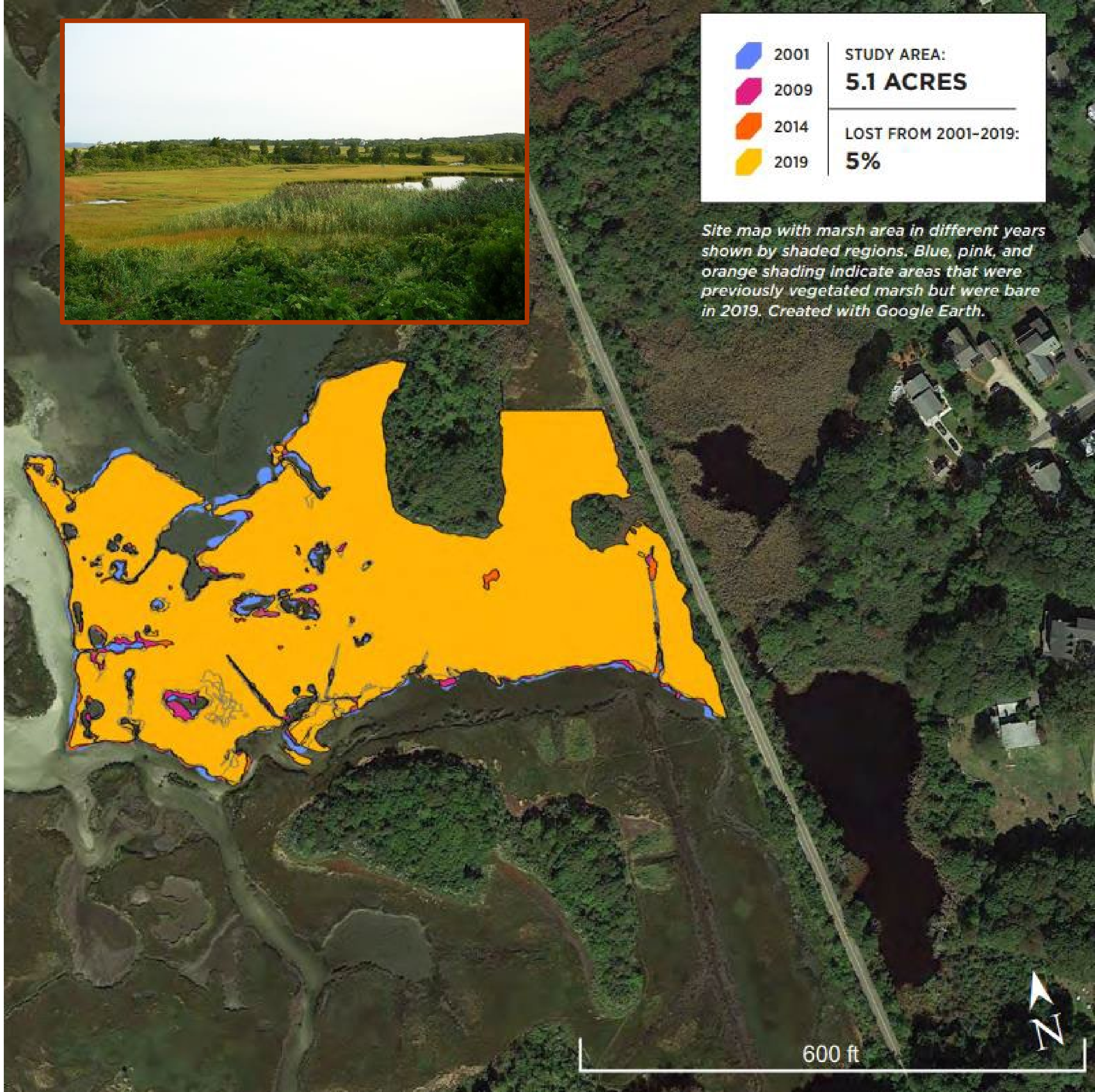

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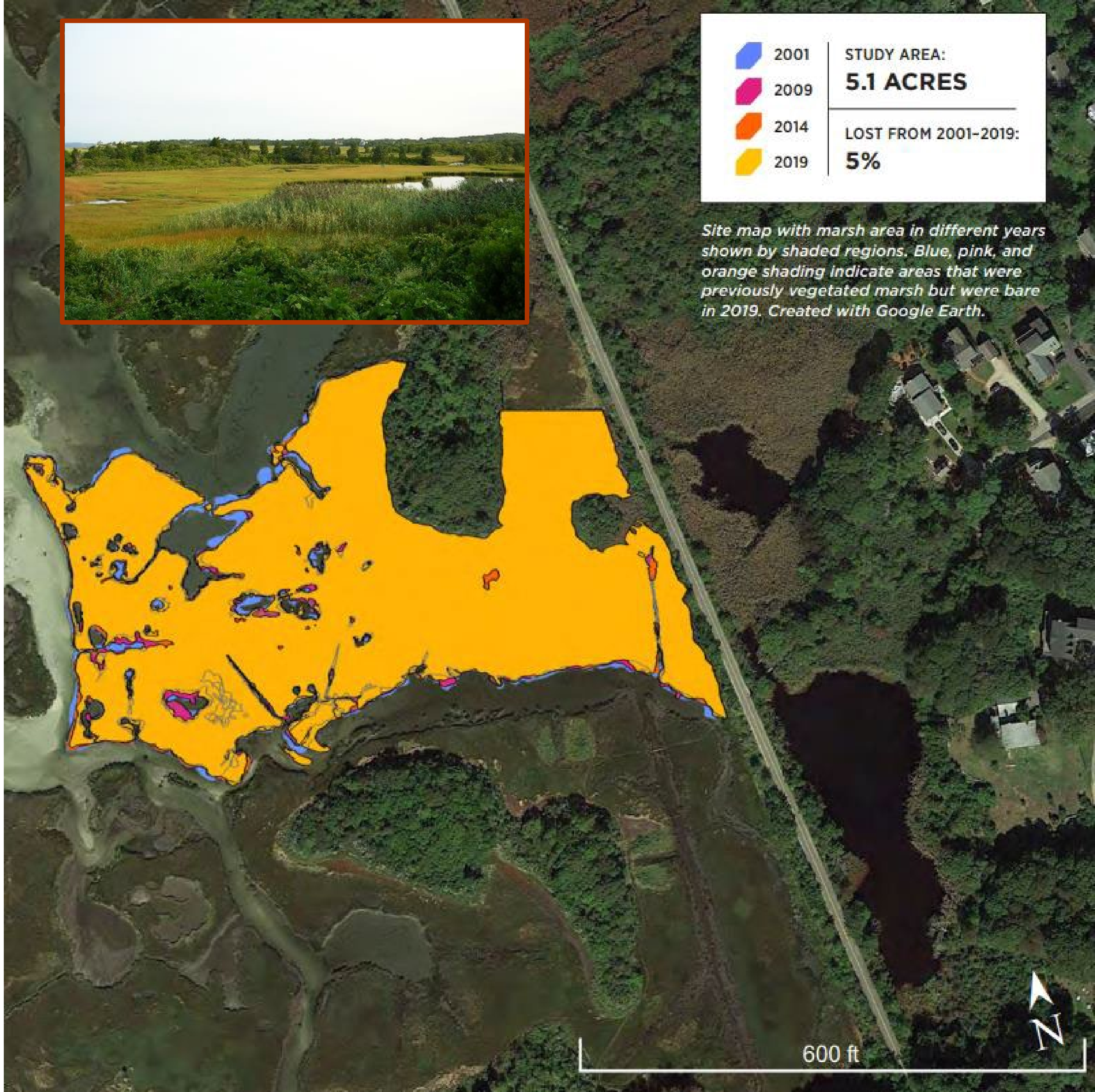

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Ocean View Farm (OVF)

Stressors

Percent Low-Lying	5%*
Nitrogen Pollution	0.9 mg/L estuary

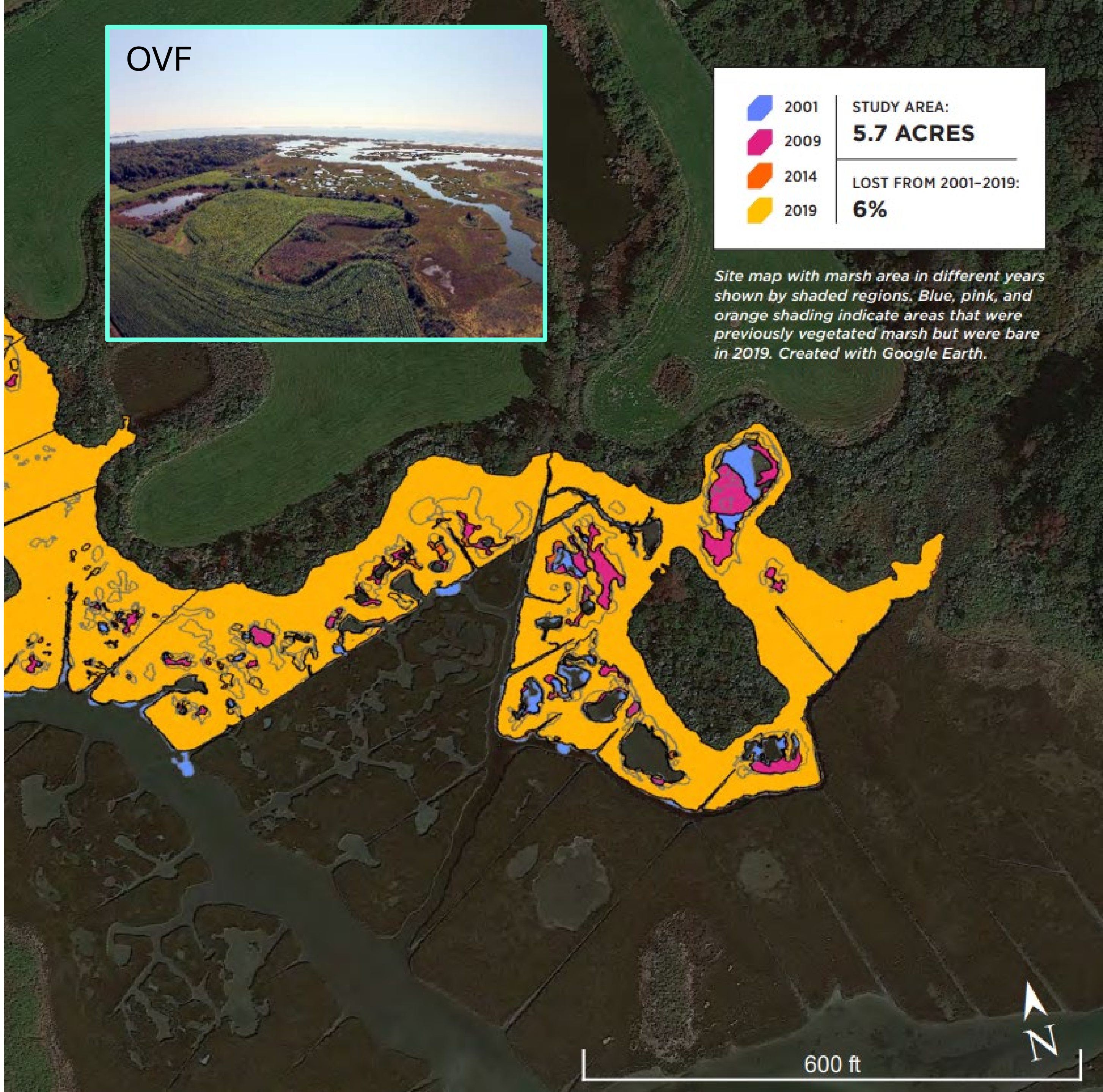
Current Conditions

Percent Unvegetated	16%*

Potential for Adaptation

Plant Community	27% High Marsh 73% Low Marsh
Percent Above MHW	47%

*Runnel test site. On the ground measurements were collected using a modified sampling design



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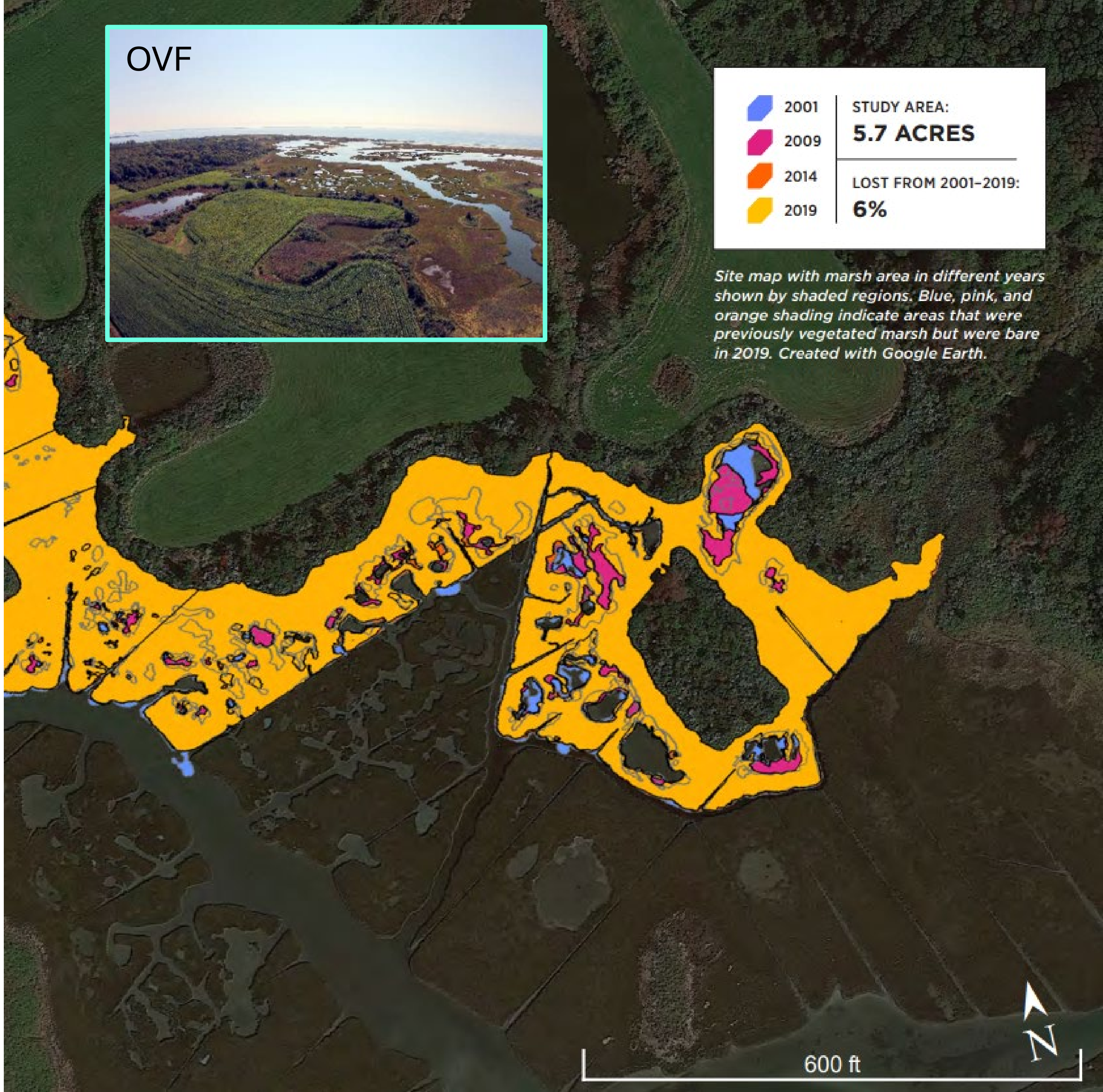

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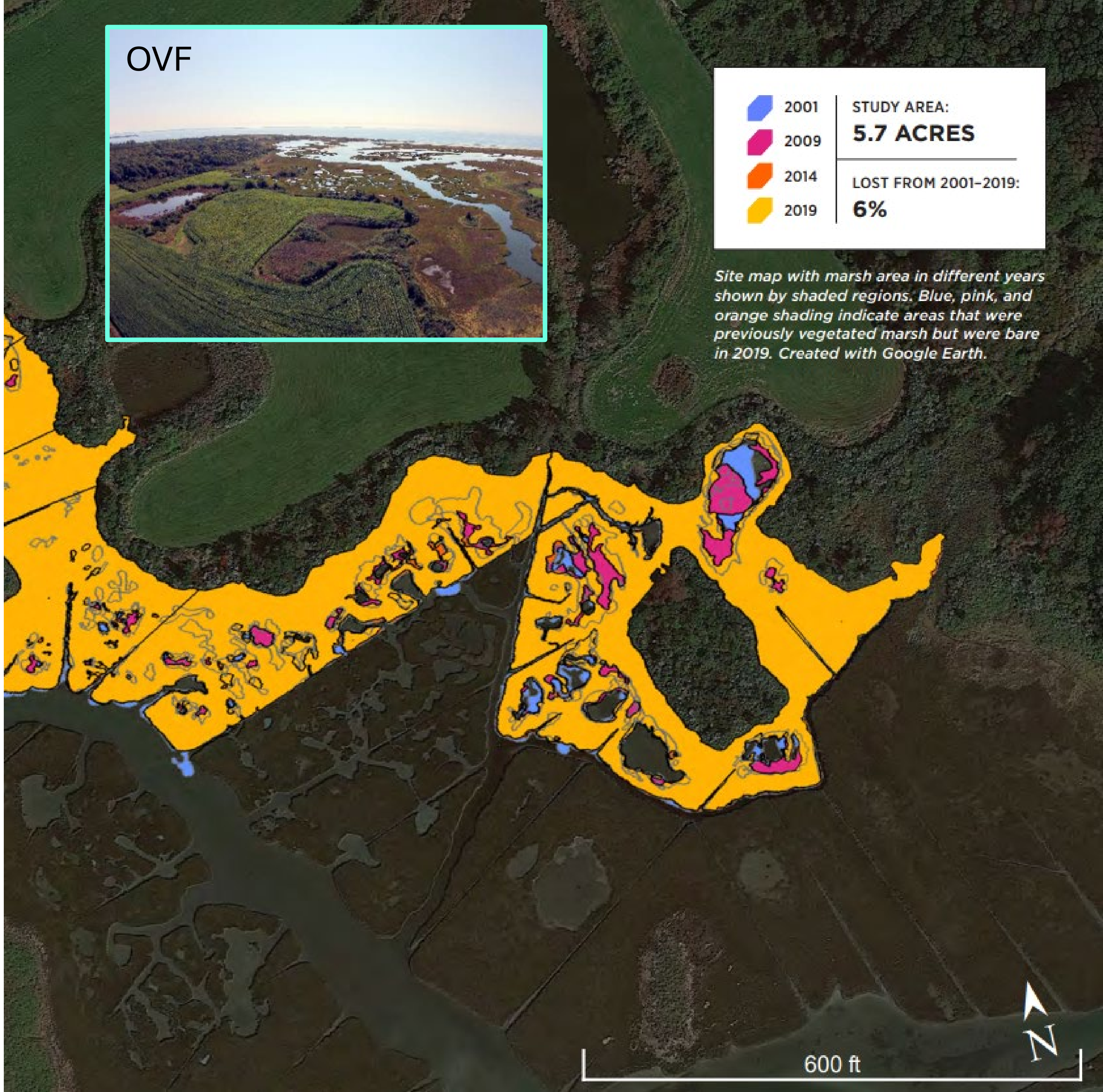

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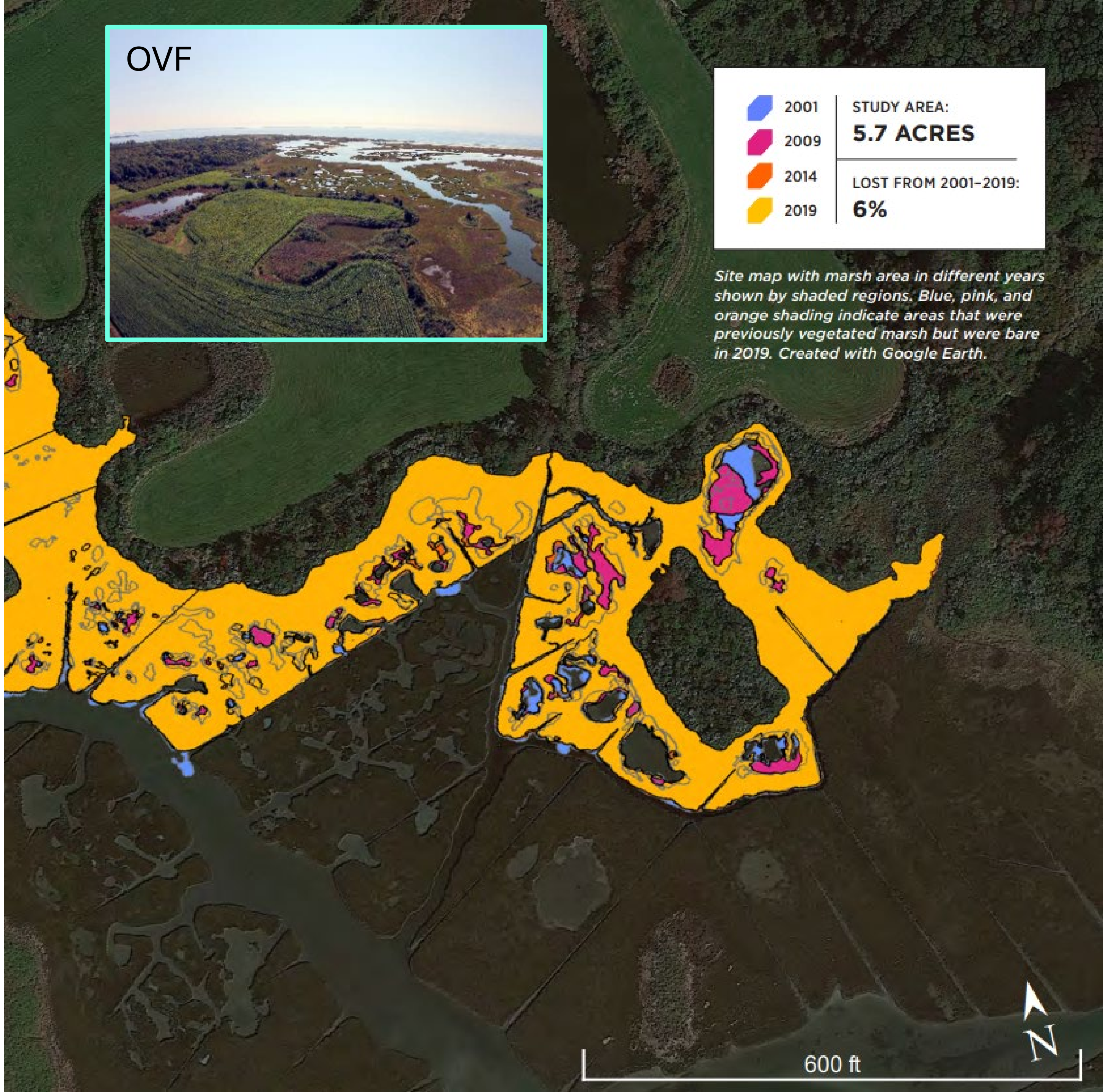

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buzzards BAY COALITION

Results

- Between 2001-2019, 2 acres of marsh loss
  - Suggests 200 acres baywide

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- Tidal restrictions → higher UVVR

Results

- Between 2001-2019, 2 acres of marsh loss
  - Suggests 200 acres baywide
- Tidal restrictions ➡ higher UVVR
- 68% of marshes are at a **resilient elevation**

Conclusions

- Marshes are diverse
- Land protection to facilitate marsh migration
- Monitoring is essential



Acknowledgements

Project Team

Rachel Jakuba, Alice Besterman, Lillie Hoffart, Neil Ganju, Linda Deegan, Joe Costa, Wenley Ferguson, Diana Brennan

Landowners, Collaborators, and Students / Interns

Linda Vanderveer (Dartmouth Natural Resource Trust), Whitney McClees (Town of Fairhaven), Hillary Sullivan, Melissa Herring, Gizella Spencer, Julia Holtzer, Kara Falvey, Nico Gentile, Shea Stobaugh, Dawson Little, Jennifer Sepanara, Erica Judd, Melissa Belen Gonzalez, Cameron Forehand, Devon Bolt, Sj Brusini, and Rosie Hazelton

Questions? Comments?

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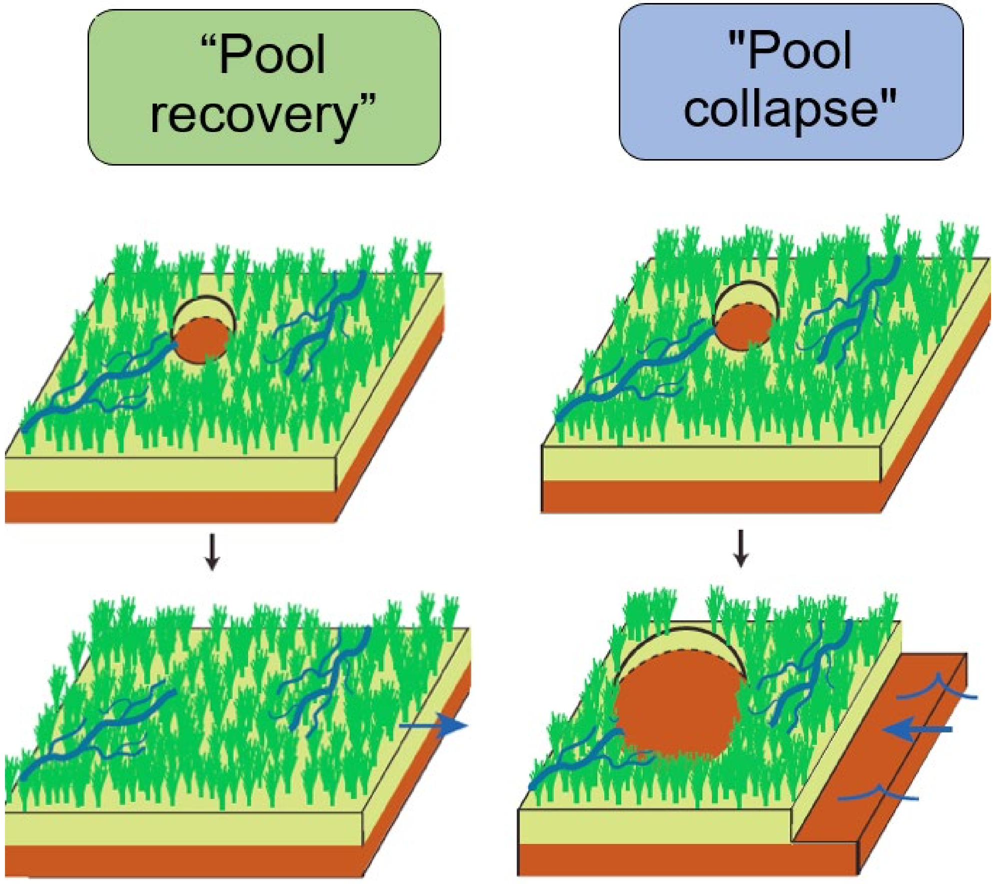
Buzzards Bay Coalition, Research Assistant

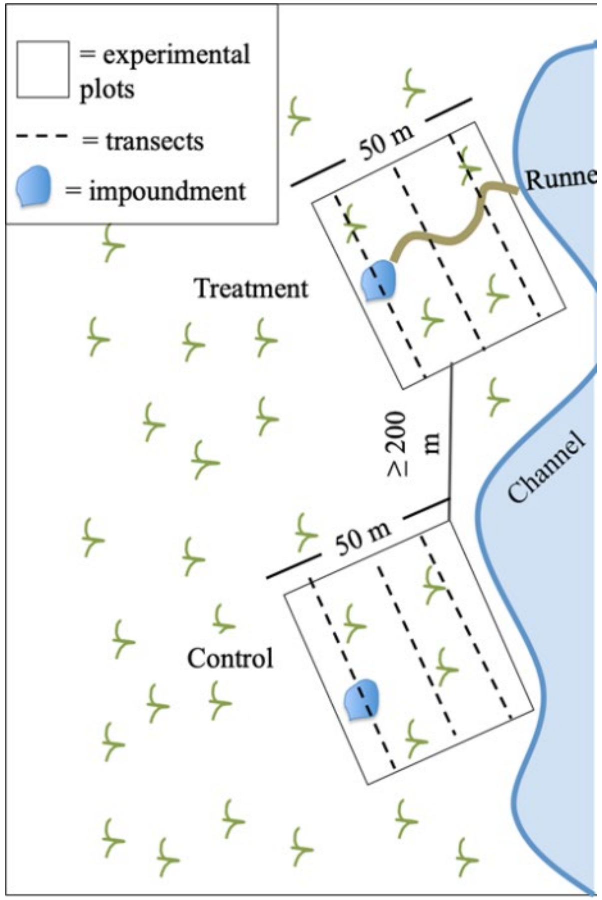
Macpherson@savebuzzardsbay.org

Buzzards Bay Coalition Salt Marsh 2023 Report

Runnels



Adapted from Mariotti 2016



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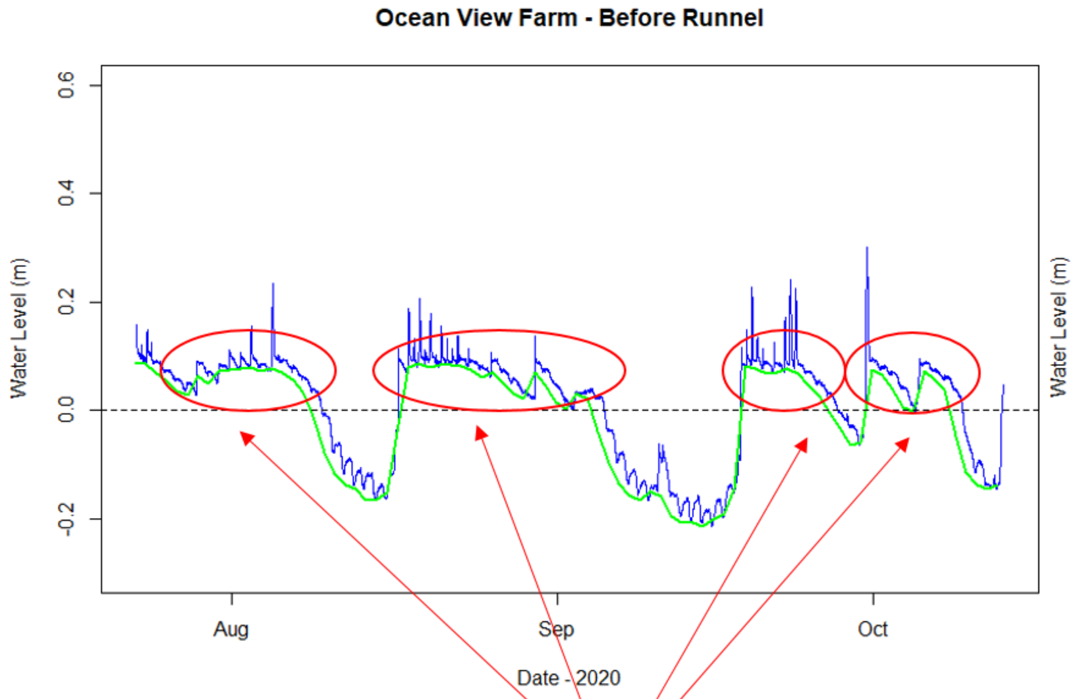
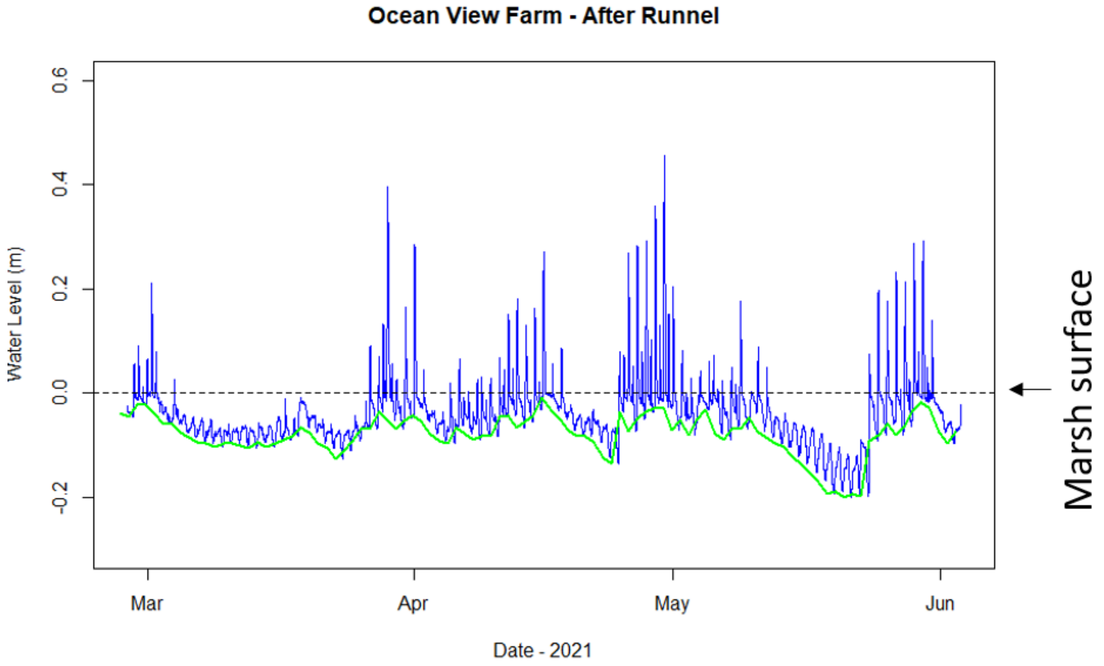


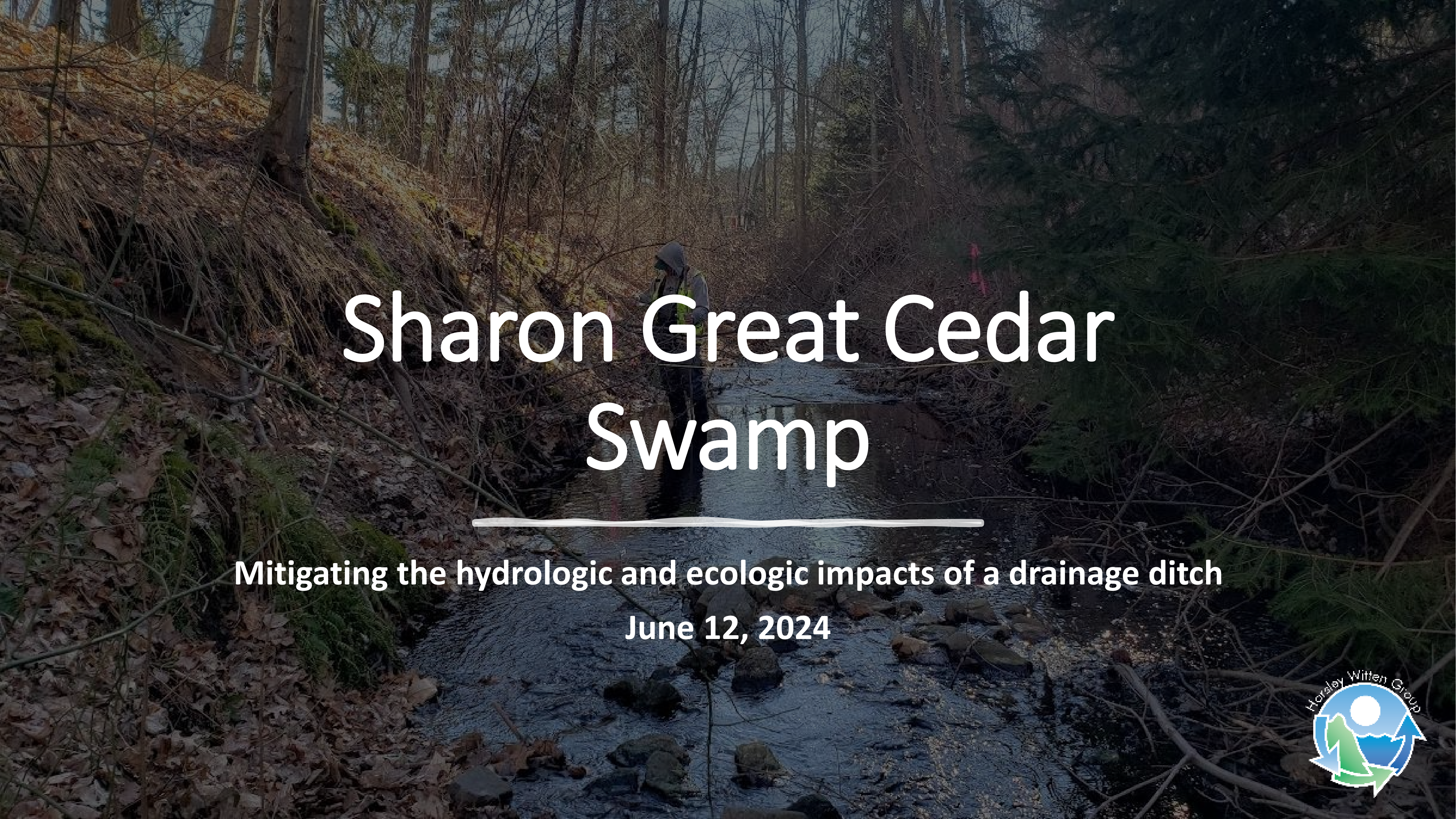


Before the runnel- extended periods of standing water

Runnels

Ocean View Farm - Before Runnel

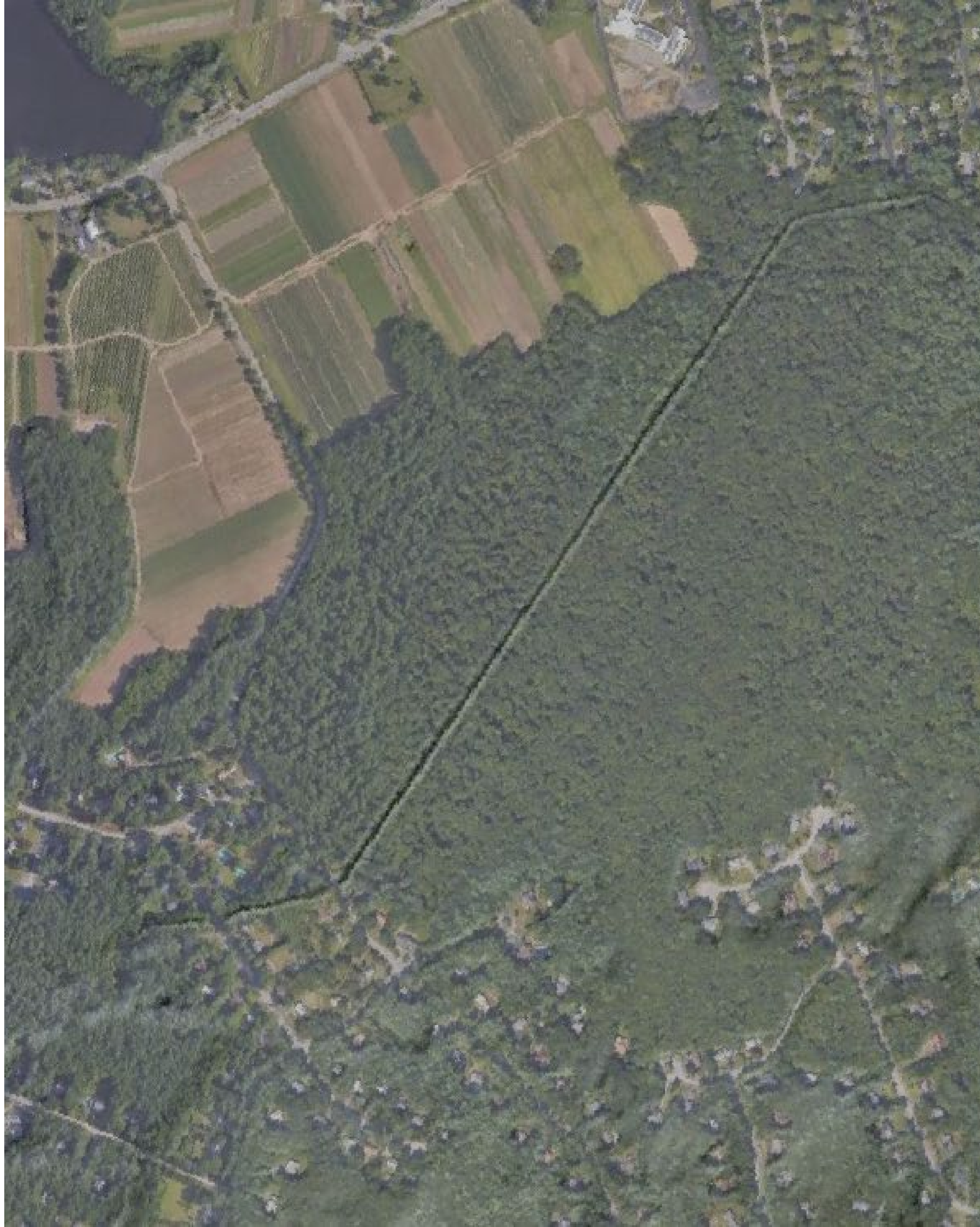
Ocean View Farm - After Runnel



Sharon Great Cedar Swamp

Mitigating the hydrologic and ecologic impacts of a drainage ditch

June 12, 2024



Site Description

- Inland Atlantic Cedar Swamp
- Approximately 250 acres
- Residential properties on multiple sides
- Impaired by a drainage ditch

The position, hydrology, and ecology of the GCS provide many benefits:

- Globally rare ACS habitat
- Organic rich soils act as a carbon sink
- Water quality benefits

Reduced groundwater levels in the swamp have led to:

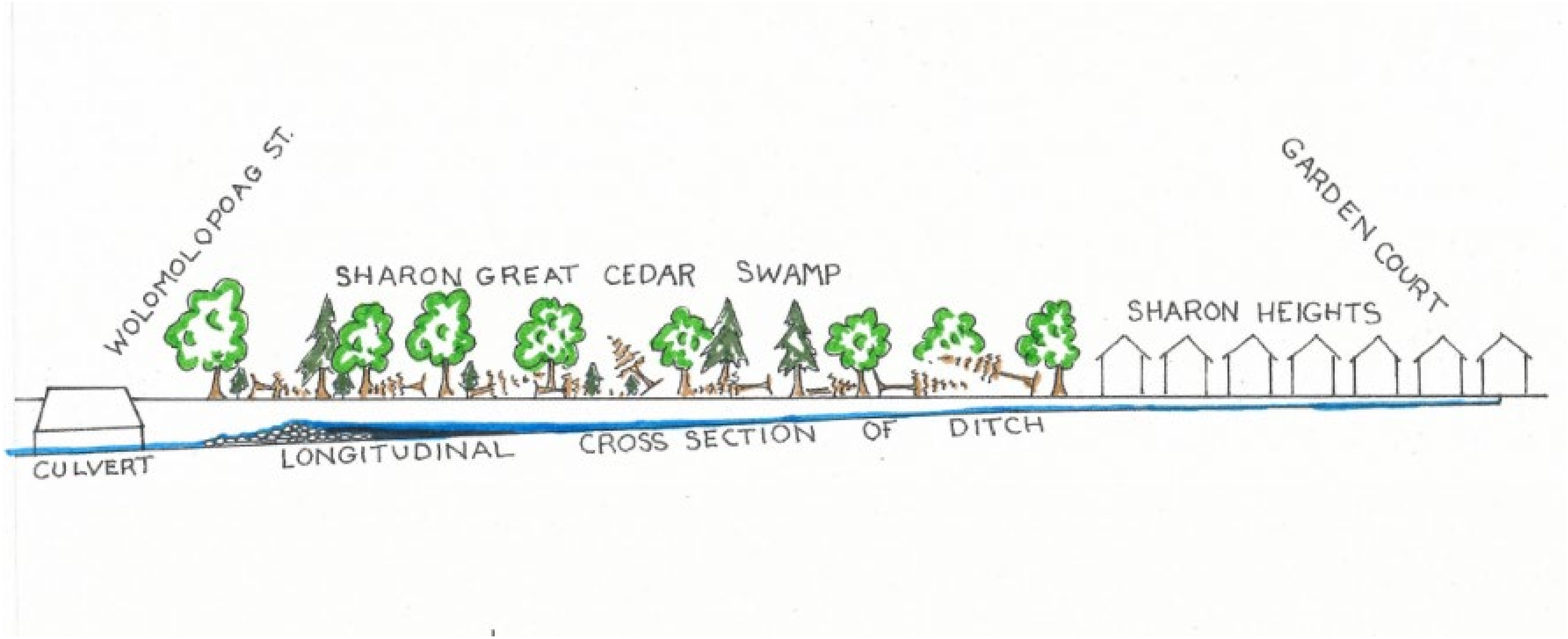
- Death of stands of Cedar trees
- Replacement of wetland plants with common and invasive species
- Subsidence of ground surface elevations
- Increased threat of wildfire

Image from Fletcher et al., Sharon GCS Progress Report, 2012

Field Investigations

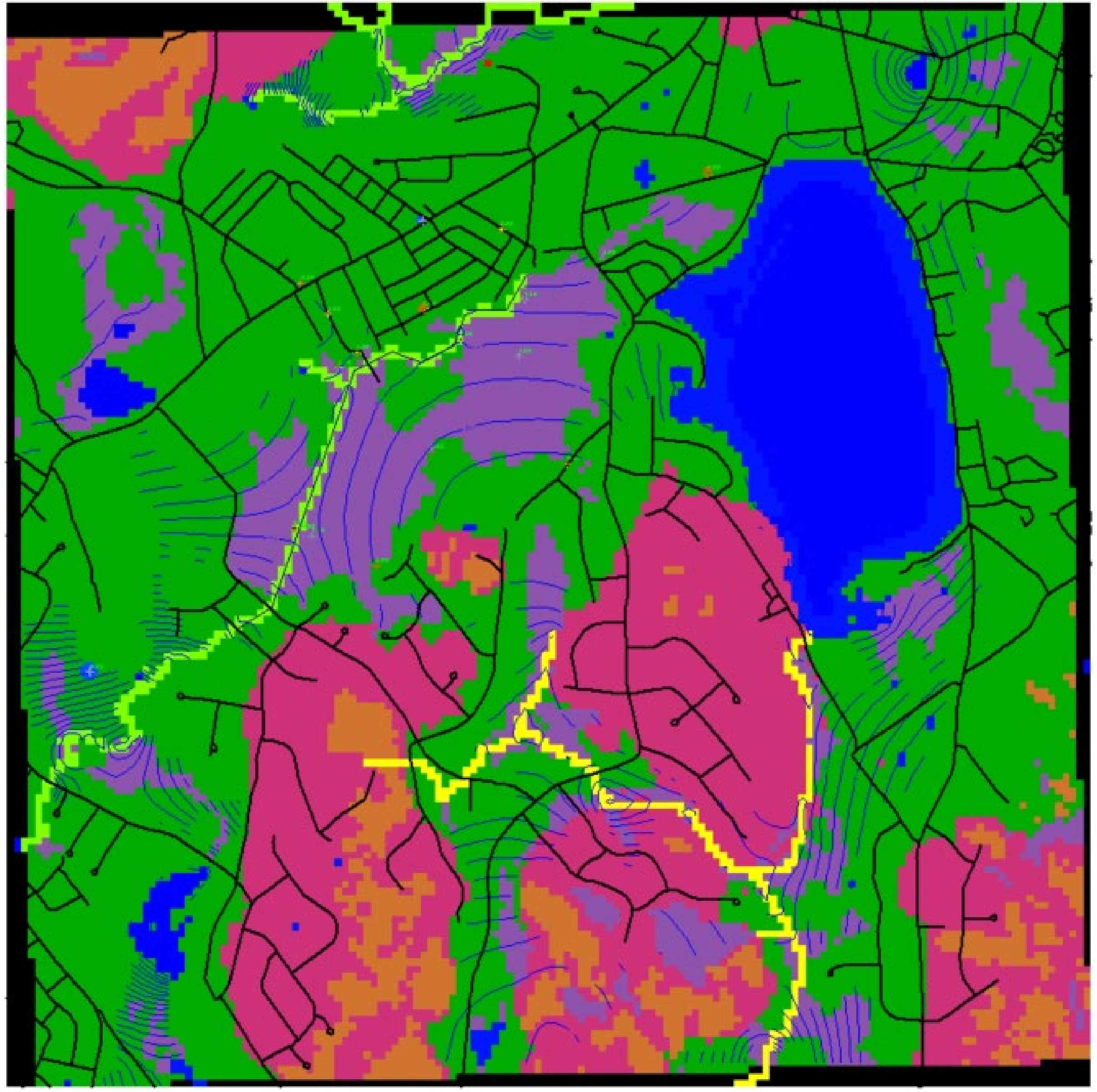
- Vegetation and Wildlife Studies (Fletcher et al., 2010)
- Soil Investigations (Fletcher et al. 2008)
- Groundwater monitoring, topographic survey of wells, and water table mapping (HW, 2010)
- Streamflow monitoring in ditch

Proposed Solution

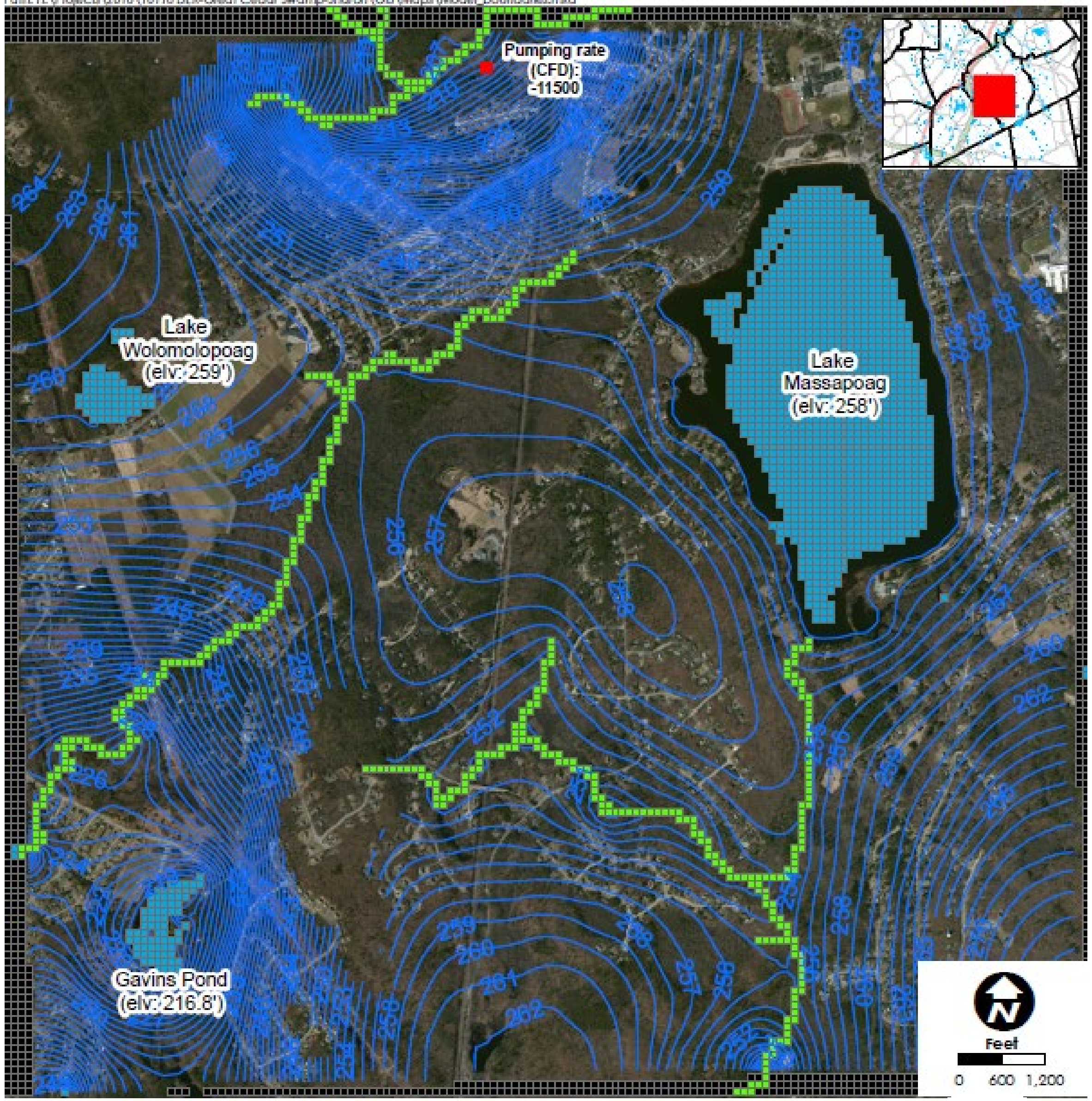



Baffle structure installed November 2012


Current Efforts
Balance of objectives:
Raise swamp water levels while avoiding impacts to surrounding property
Horsley Witten Group



Groundwater Modeling



Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, IGN, and the GIS User Community

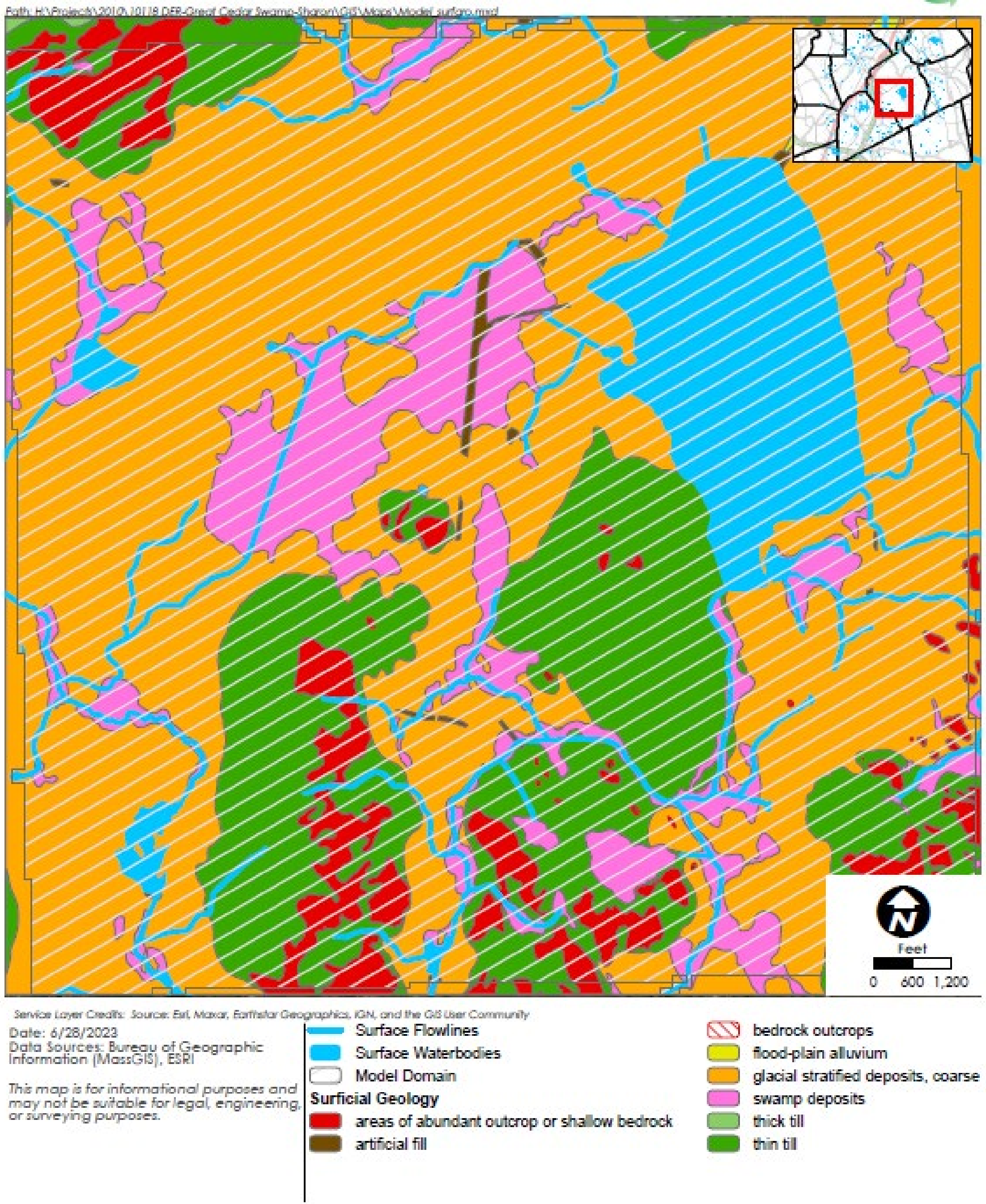
Date: 6/27/2023
Data Sources: Bureau of Geographic Information (MassGIS), ESRI

This map is for informational purposes and may not be suitable for legal, engineering, or surveying purposes.

- Pumping Well
- Constant Head Boundaries
- No-flow
- Stream (Ditch)
- Model Contours (ft)

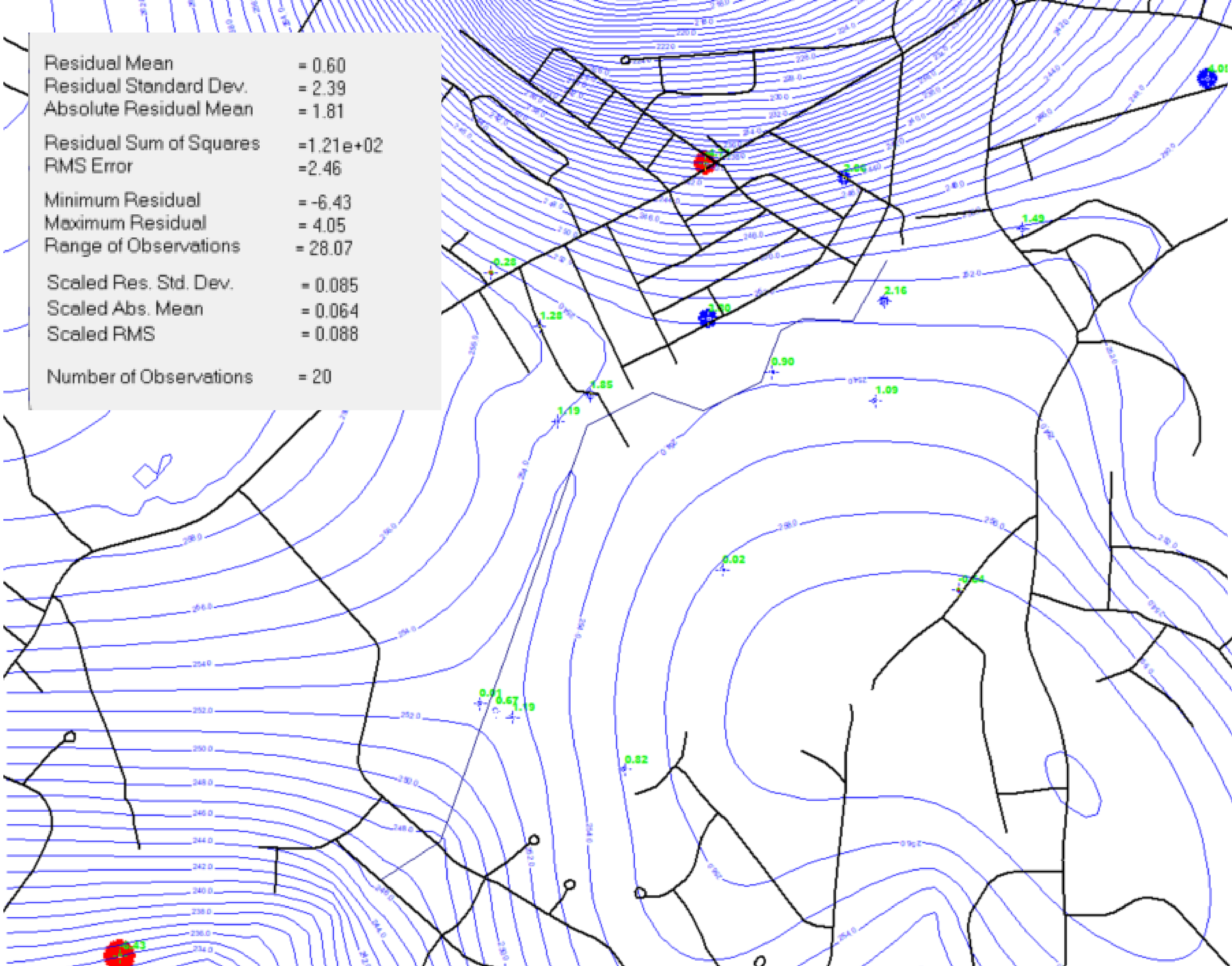
Model Setup

- Field Data
  - 2010 and 2023 surveys
- USGS surficial geology
- Subsurface boring logs
- Hydrography data
- LiDAR elevation data
- Previous water table maps



Calibration

- 2010 water table maps
- 2023 streamflow measurements and monitoring



Conceptual Approach – Profile

How will a flow control structure influence groundwater elevations in and around the swamp?

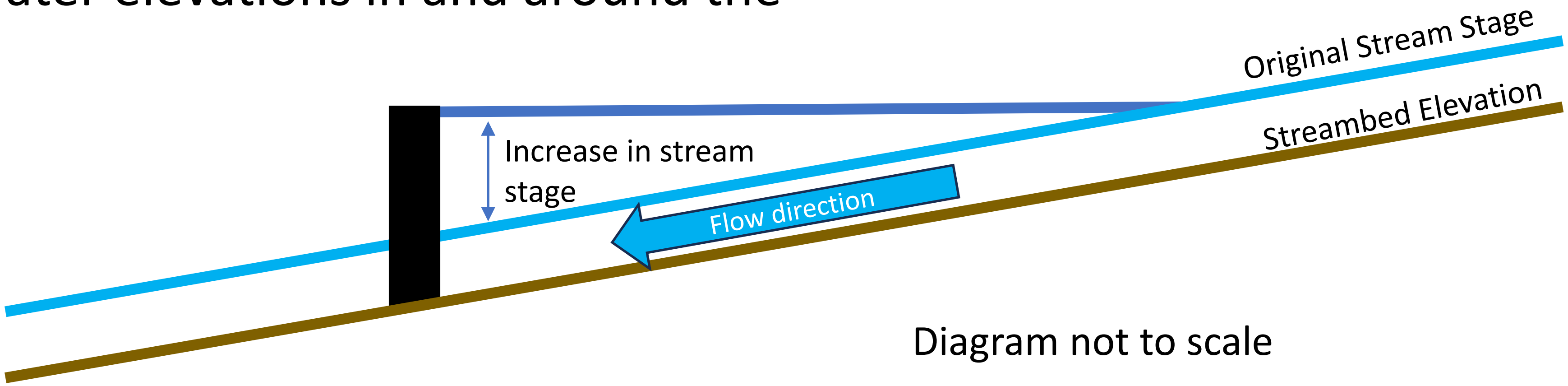
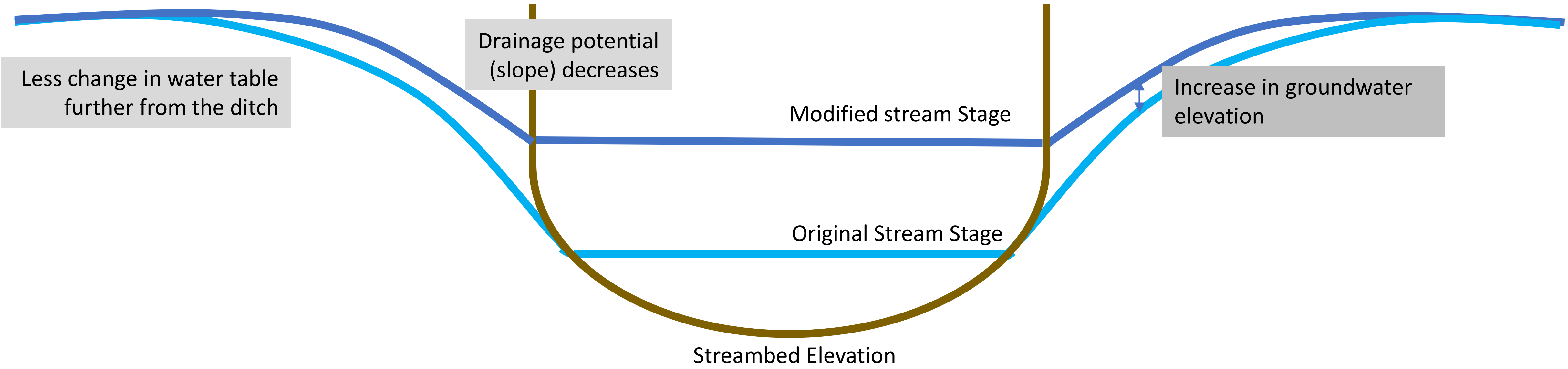


Diagram not to scale

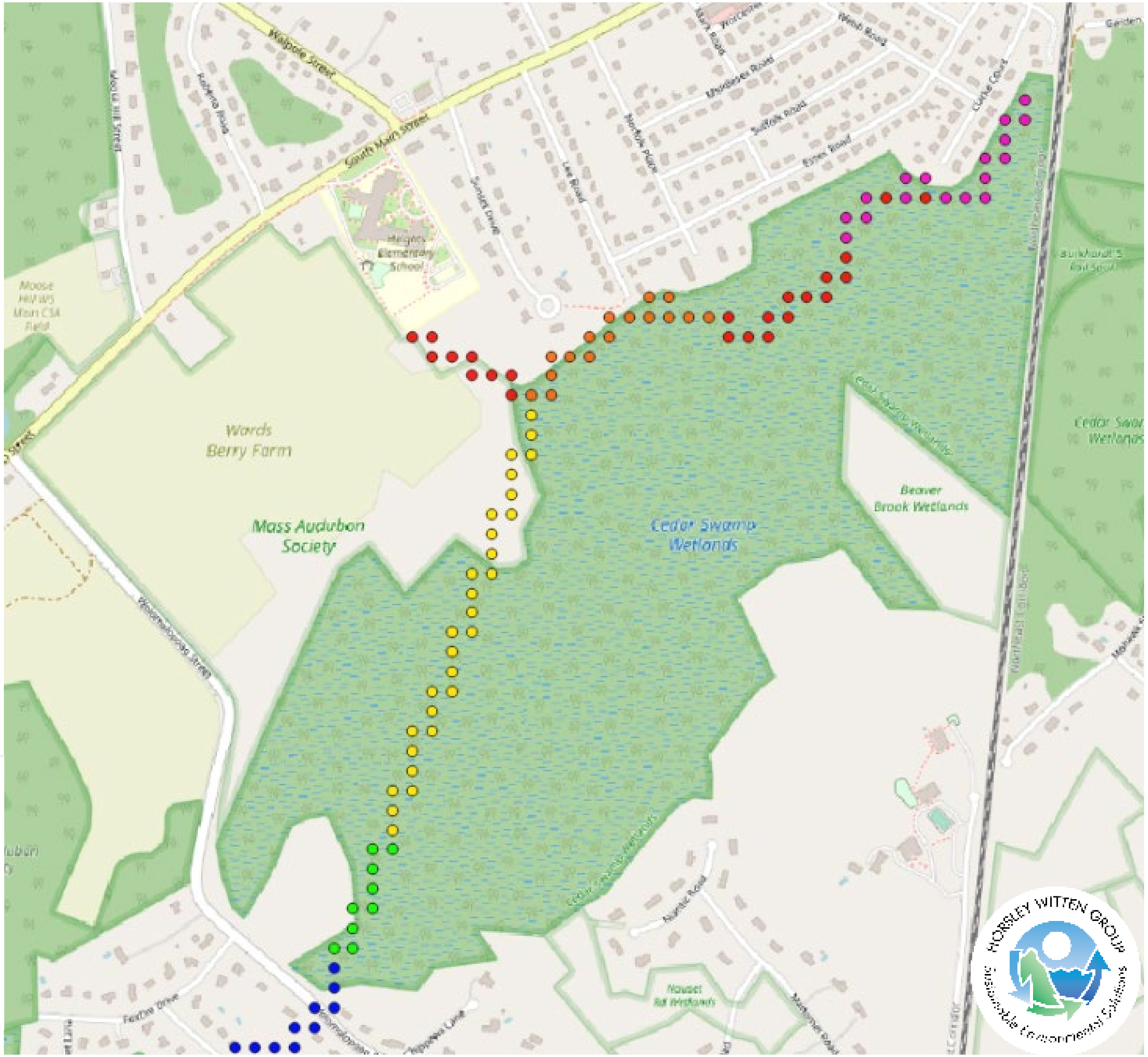
This approach conservatively assumes the ditch will always be filled with water to the level of the flow control structure.

Conceptual Approach – Cross Section

Increased water elevation in the ditch reduces the potential from drainage



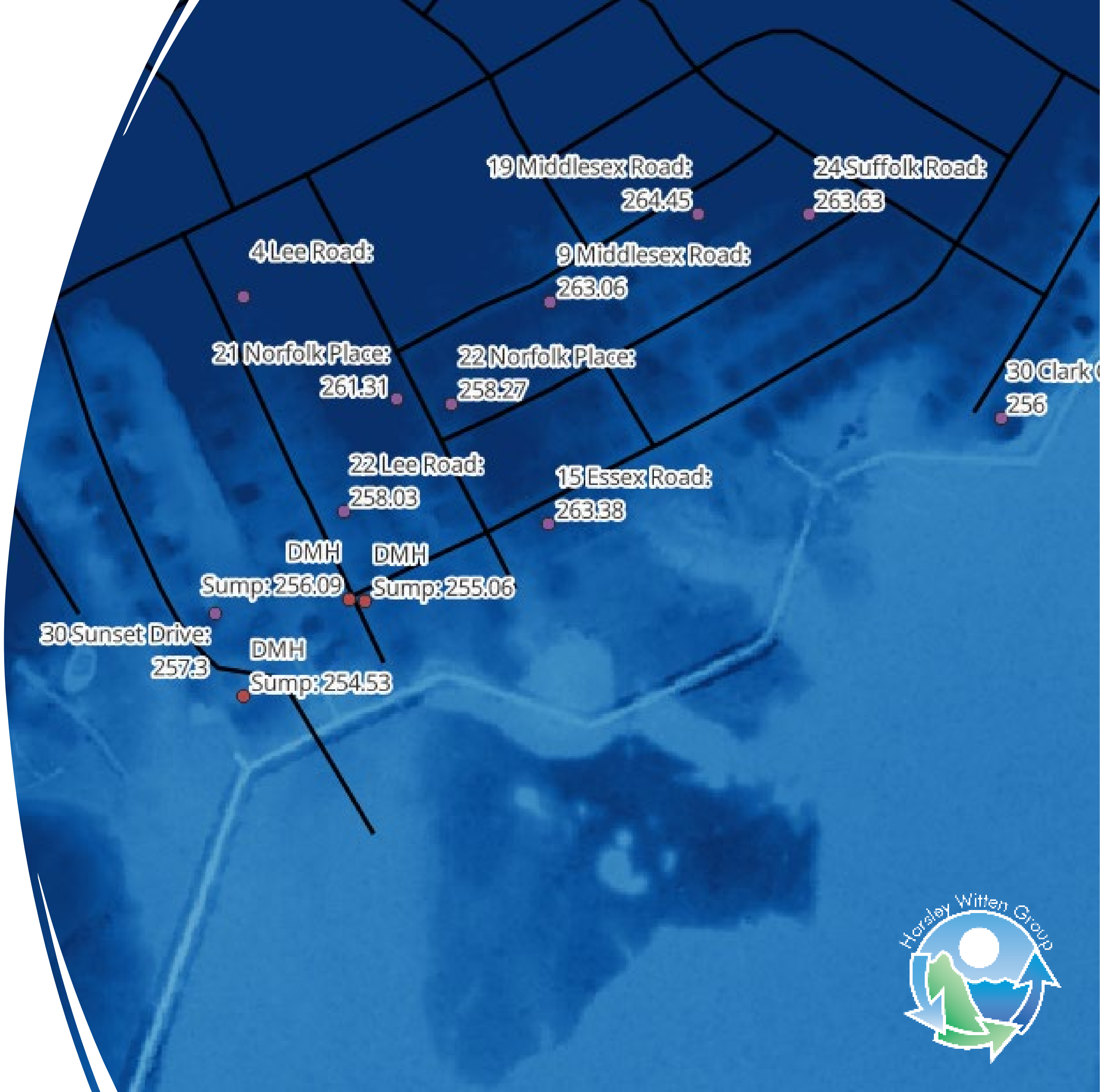
Projected water level changes within ditch



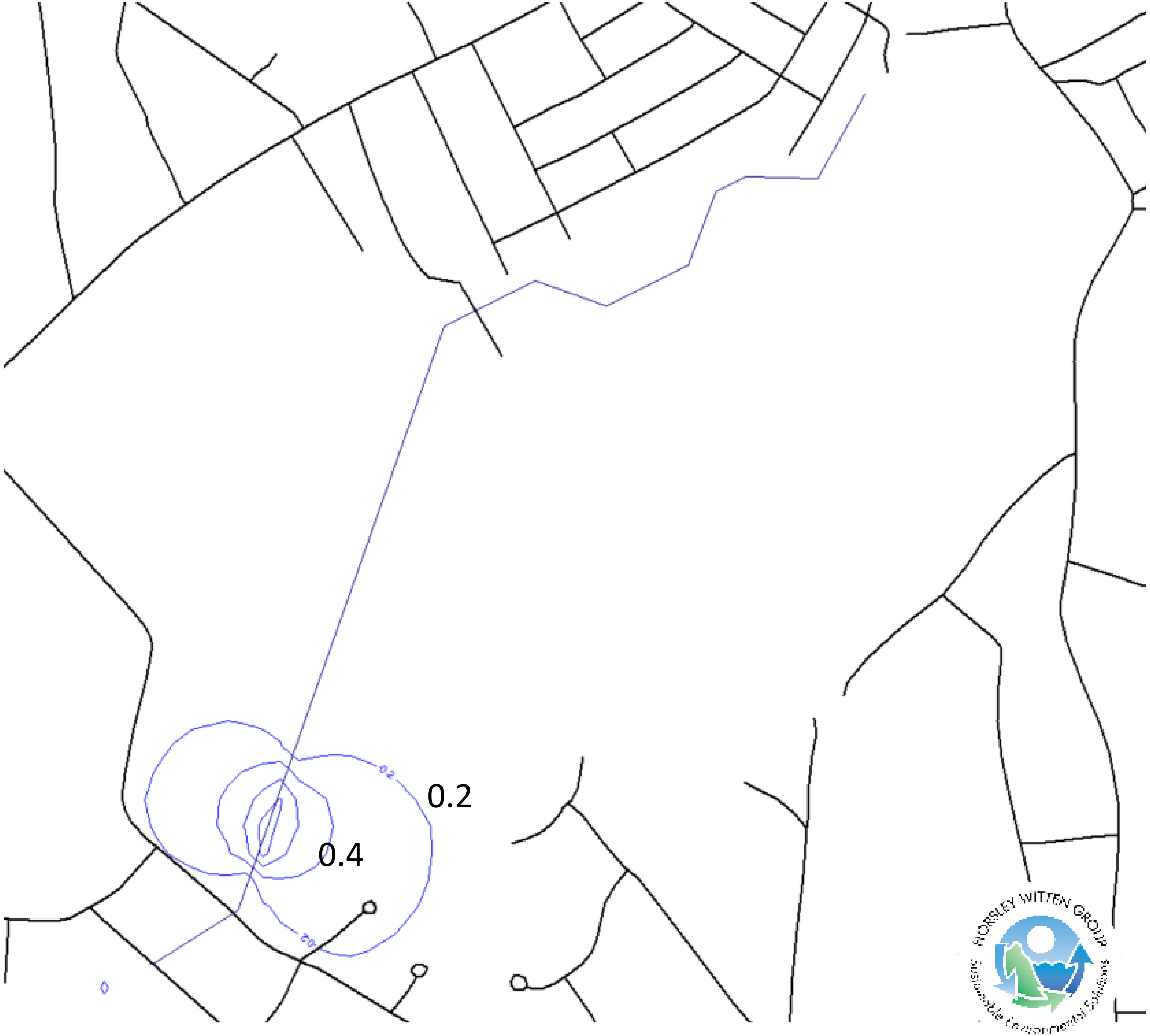
- 1-foot structure
- 2-foot structure
- 3-foot structure
- 4-foot structure
- 5-foot structure
- Other model stream cells

Available Data Infrastructure Constraints

- Available septic elevations and field surveyed stormwater infrastructure.
- All elevations available were provided by engineer <u>without</u> datum information.
- Some septic plans do not include groundwater elevations, lack of test pit, etc.



1-foot Increase at Ditch Control Structure

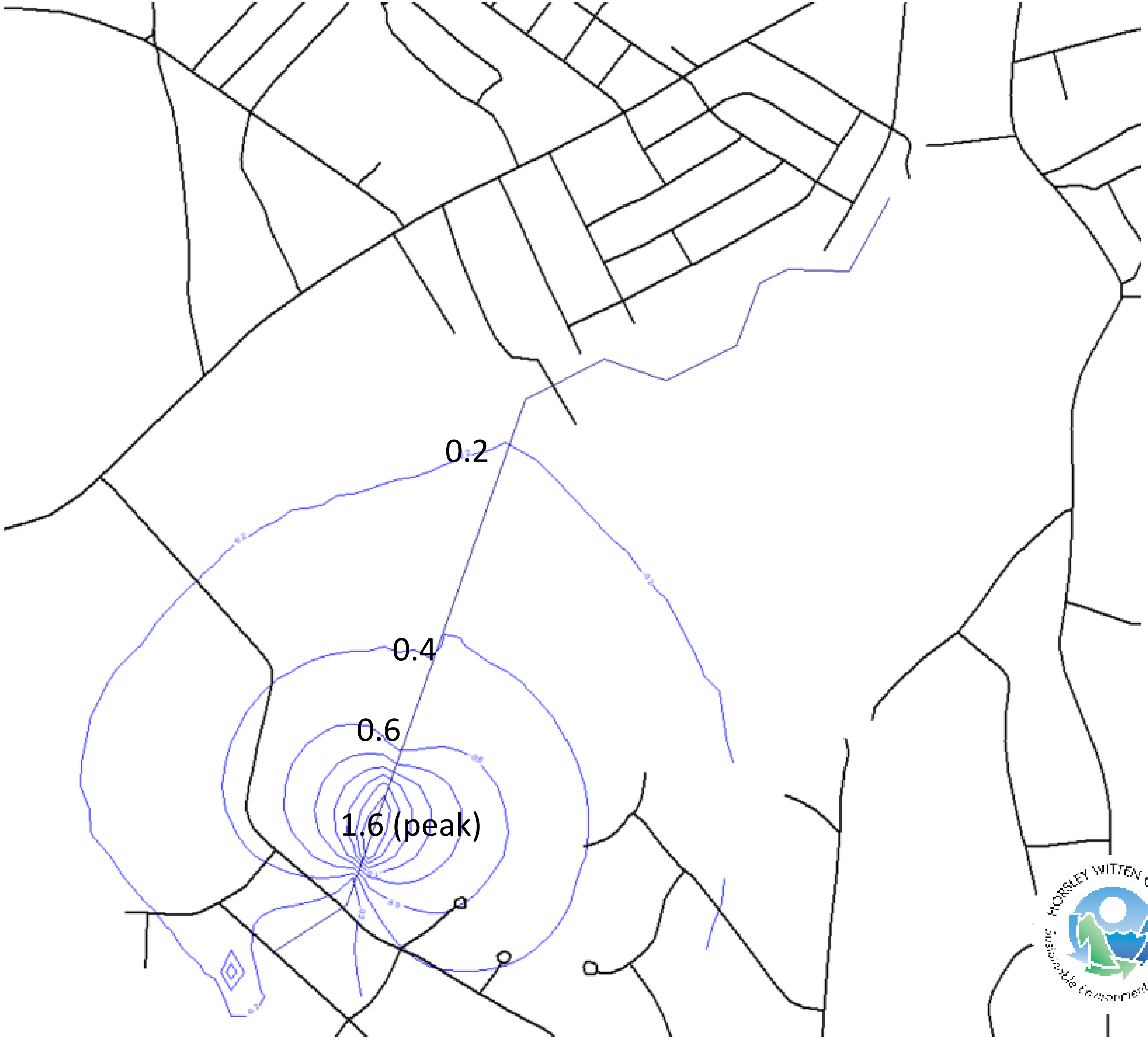


Increase in long-term average groundwater levels, reported in feet

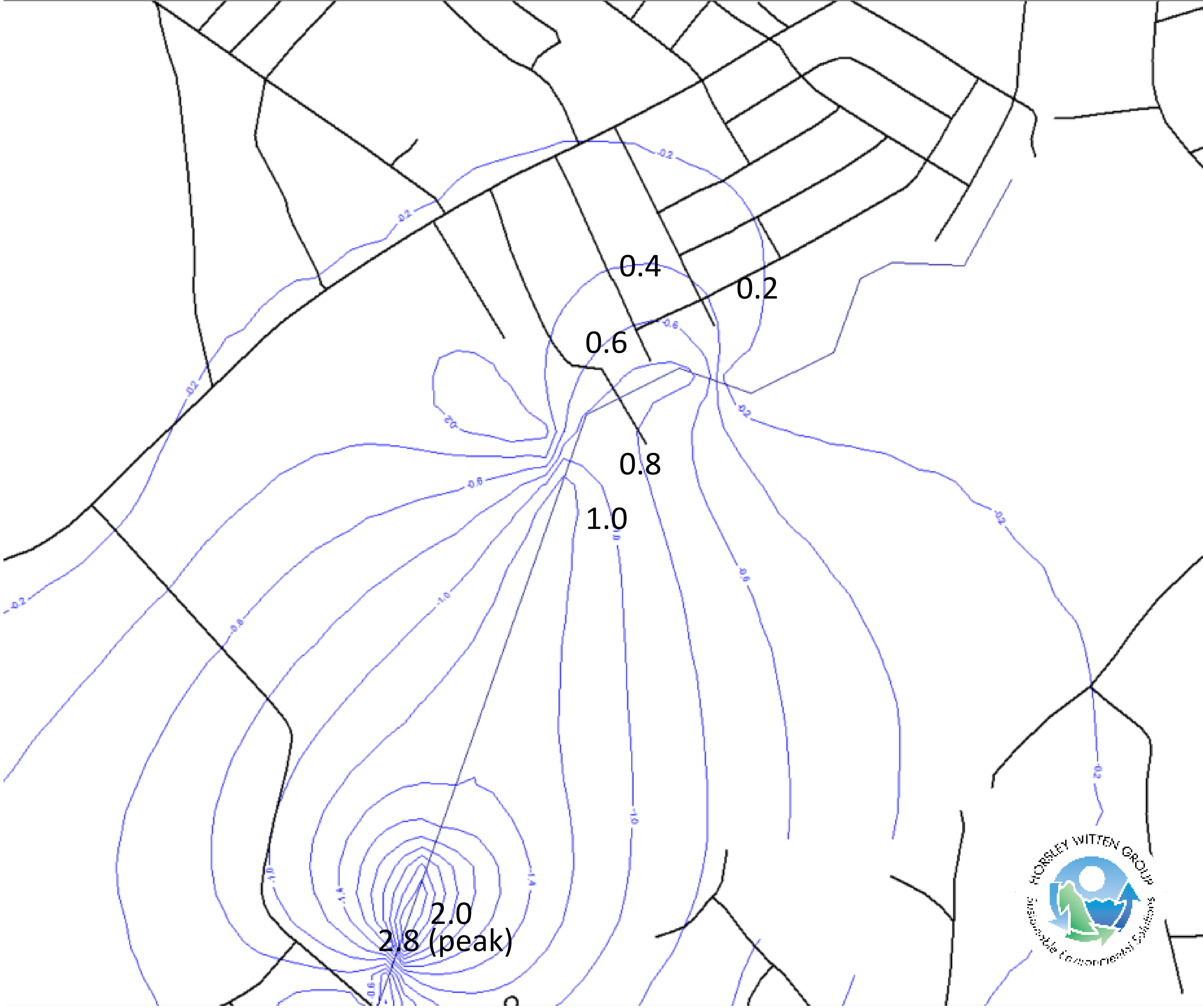
Increase *over* existing riffle structure

2-foot Increase at Ditch Control Structure

Increase in long-term average groundwater levels, reported in feet



3-foot Increase at Ditch Control Structure



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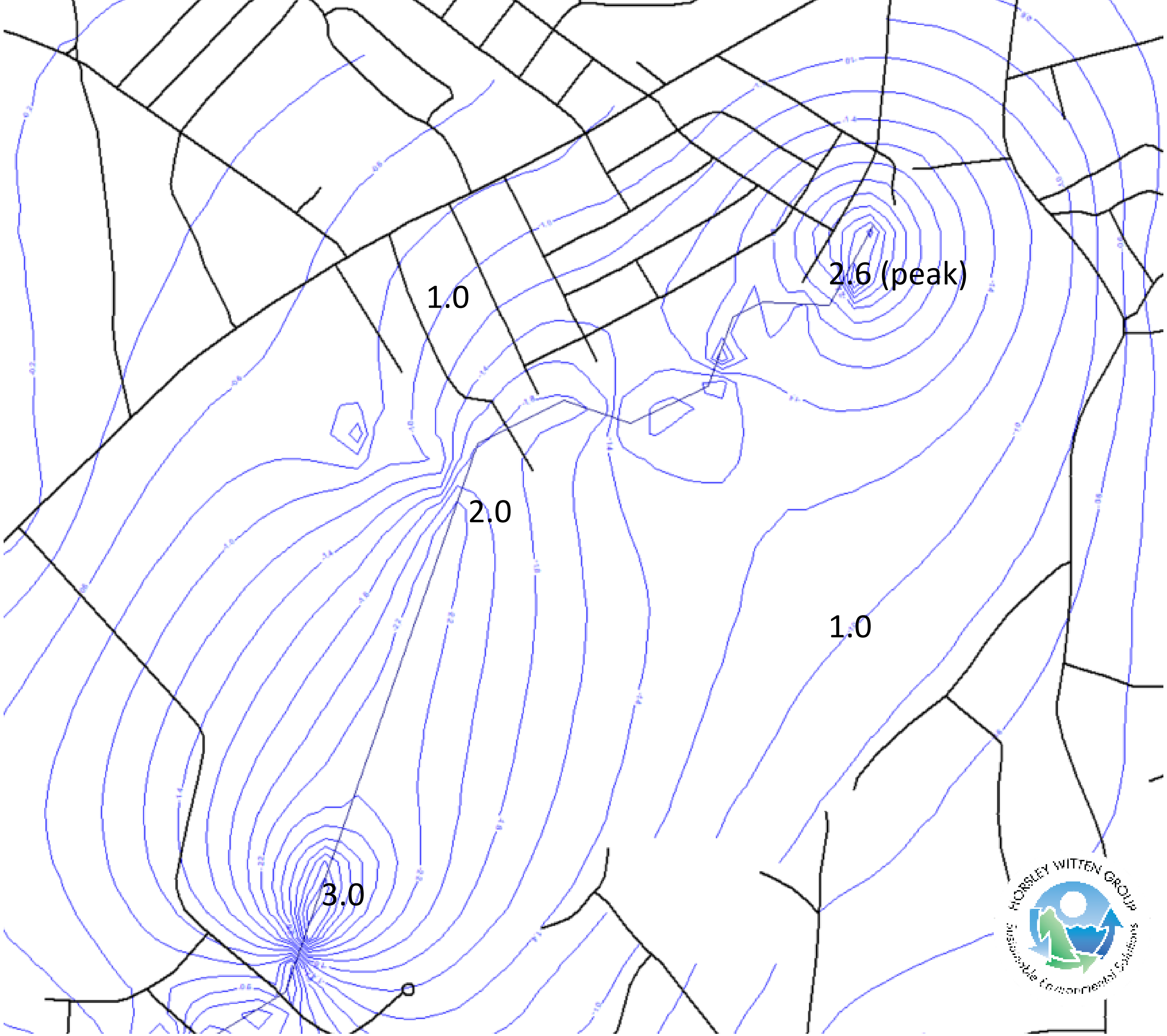
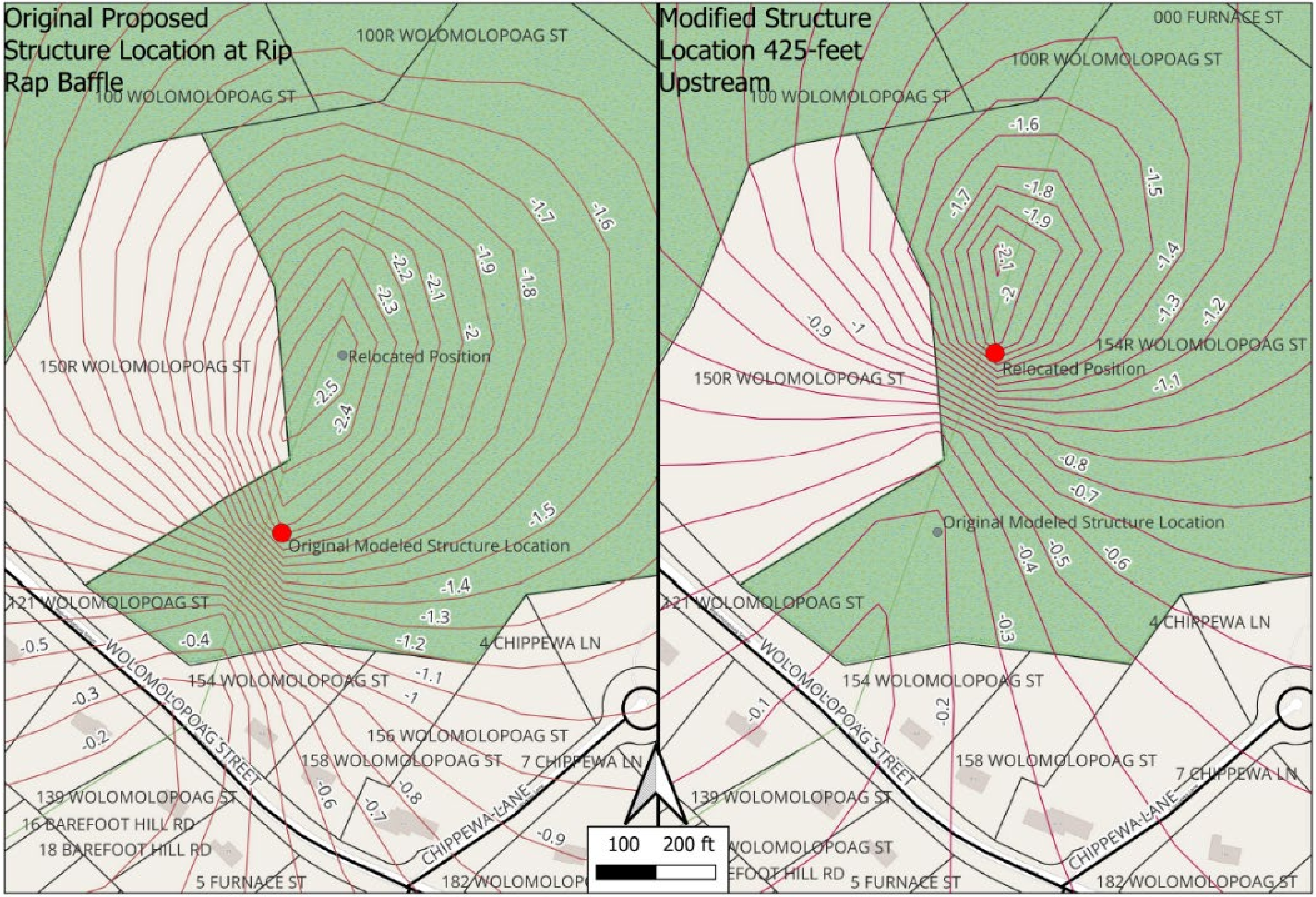
4-foot Increase at Ditch Control Structure

Increase in long-term average groundwater levels, reported in feet





HORSLEY WITTEN GROUP
Sustainable Environmental Solutions

Next Steps

- Permit-level designs for a variable flow-control structure are underway
- Development of a monitoring and adaptive management plan
- Public outreach and education
- Pre-permit coordination with relevant agencies

Partners and preceding research:

Current and former members of the Sharon Conservation Commission; MA Div. of Ecological Restoration; SNEP; Peter Fletcher and others

Horsley Witten Group

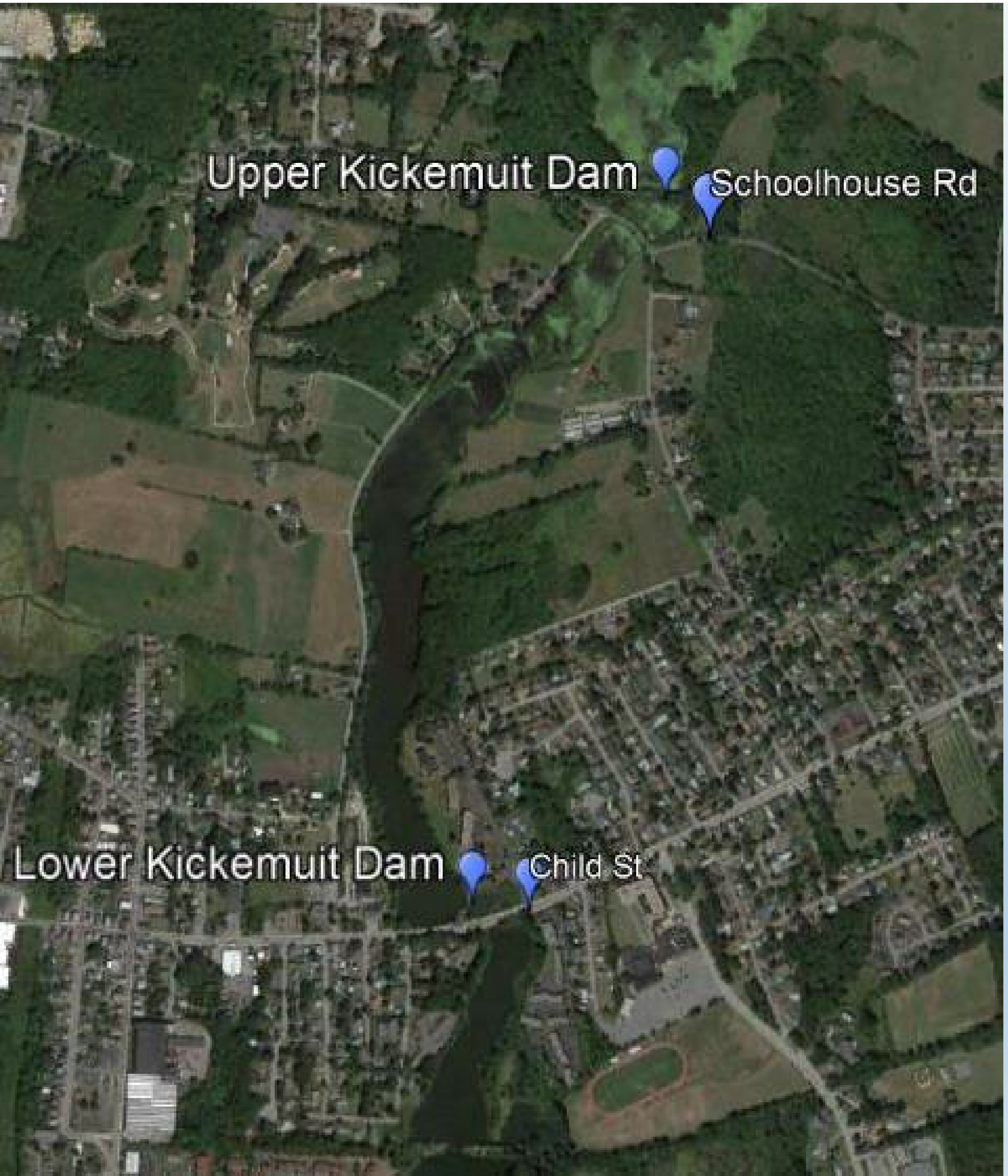
Restoring the Kickemuit Estuary

SNEP Symposium
June 12, 2024

BCW Bristol County Water Authority

SAVE THE BAY® NARRAGANSETT BAY

Upper Kickemuit River
-watershed in Swansea and Warren

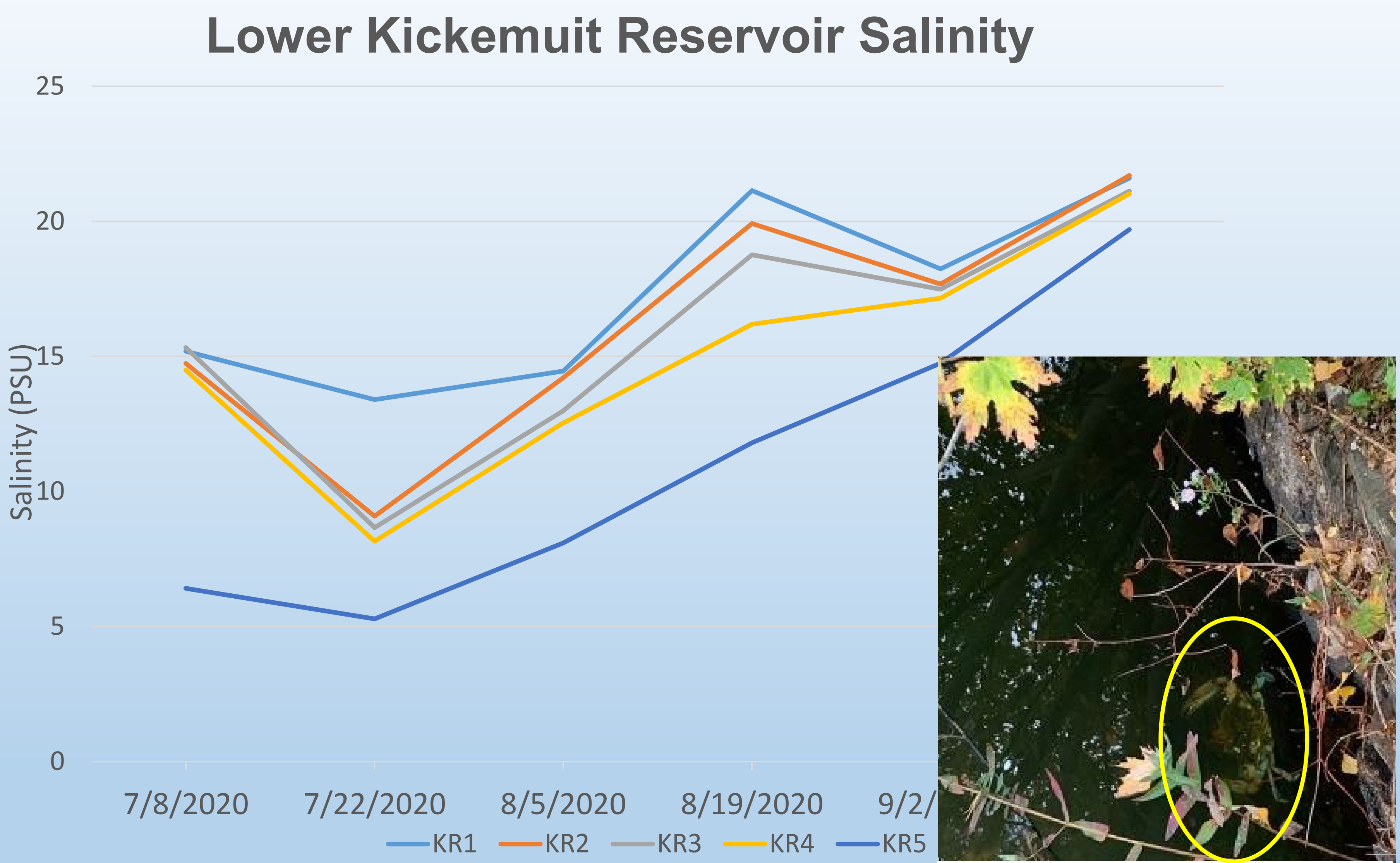


Project goals:

- Restore estuarine habitat
- Increase connectivity for estuarine species
- Improve water quality
- Increase community resilience
- Enhance marsh migration corridor
- Reduce maintenance costs

Lower Kickemuit Reservoir Dam

- Head of tide dam built in 1883 for water supply
- Never a good water source: poor water quality and insufficient quantity
- BCWA connected to Providence Water system in late 1990s rendering dams obsolete

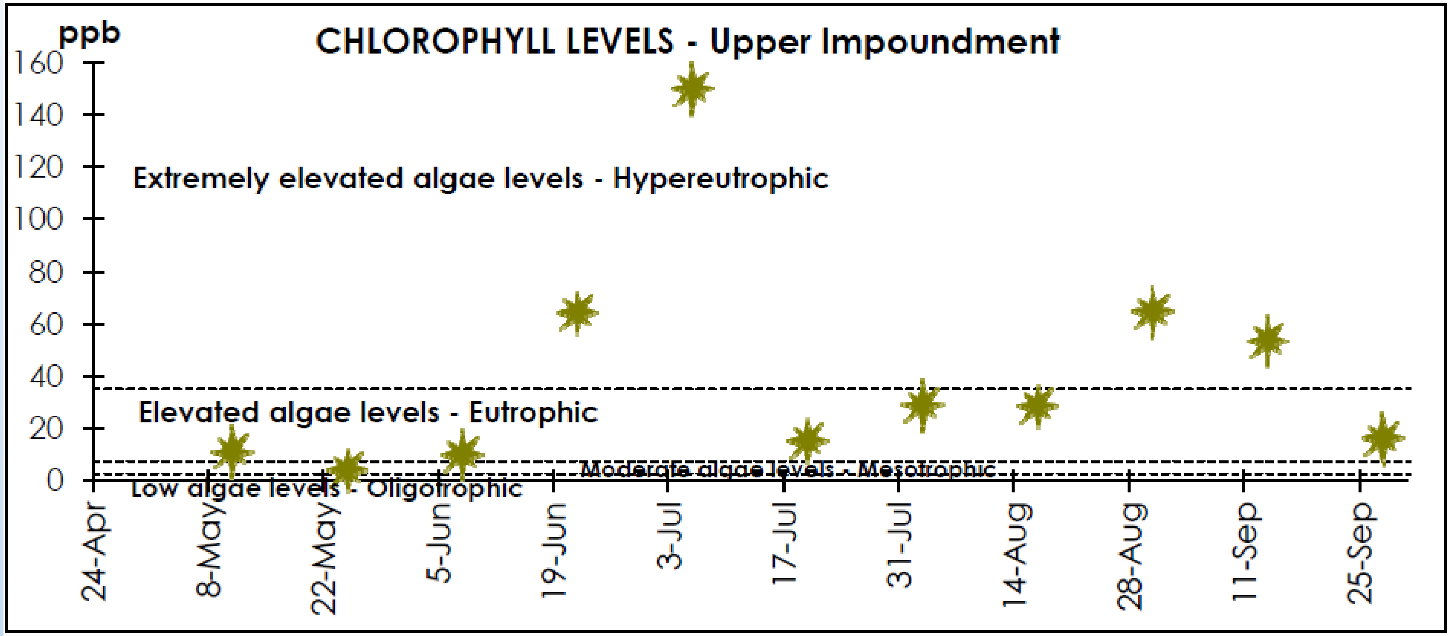


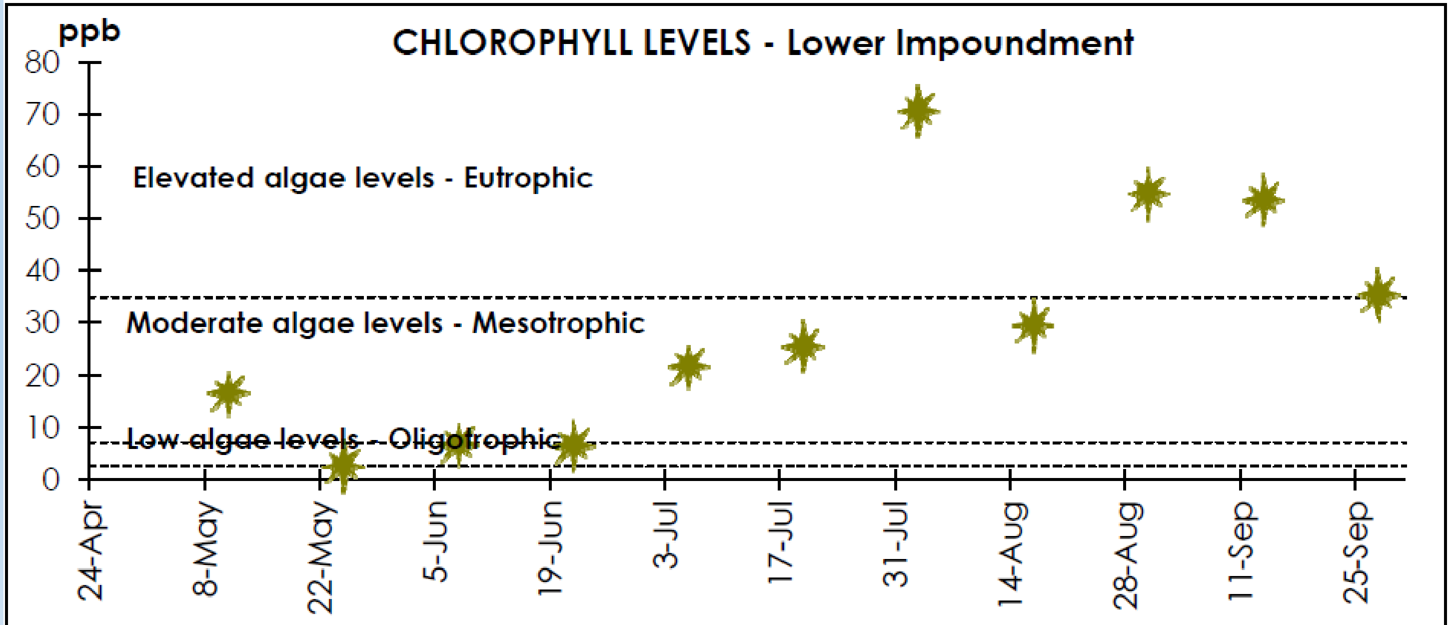
Lower impoundment at former water intake

Upper Kickemuit Reservoir Dam

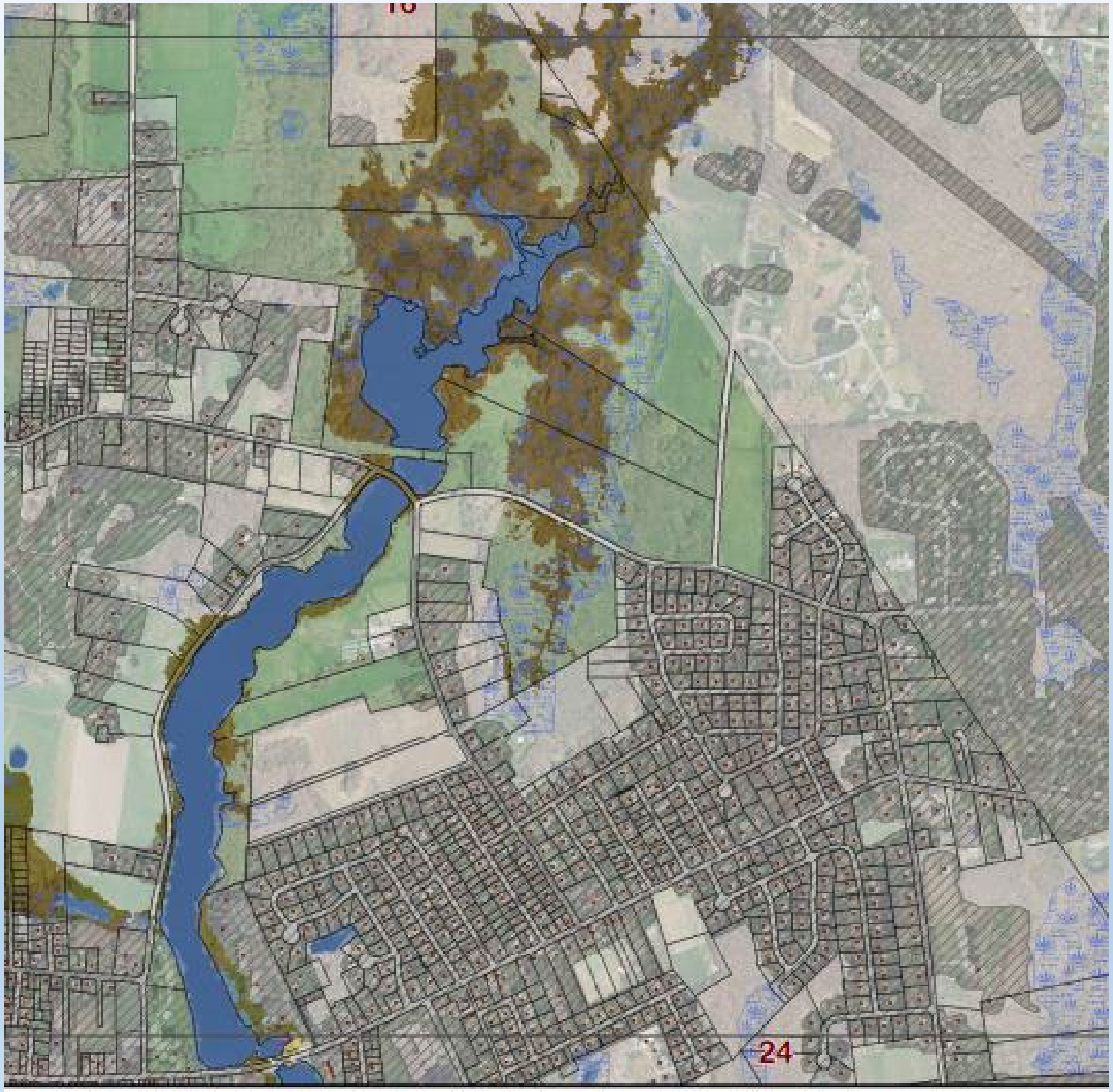
- Berm built in 1961 to protect water supply during coastal storms
- Dam requires repairs and not built to current State standards

Monitoring pre-restoration conditions





Marsh Migration: 3 feet of Sea Level Rise



Project Timeline

2012: BCWA begins to secure a new back up water supply

2015: BCWA hires consultant to conduct Upper Dam removal assessment

2017: BCWA decides to remove Upper Dam; H and H modeling & sediment sampling conducted

2018: Modeling determines Lower and Upper Dam have to removed together and Schoolhouse Road needs to be elevated

2018: Outreach to RIDOT about elevation and installation of new culverts at Schoolhouse Road

2019: RIDOT agrees to conduct work; engineering of removal of both dams; ongoing public outreach

2020: BCWA submits permit application for dam removals

2021: RIDOT upgrades Schoolhouse Road

2023: Final permits received; dam removal begins

2024: Upper dam removal to be completed

2025-2027: Monitoring and adaptive management

Phase 1: State elevated state-owned road and resized culverts (2022)

Phase 2: Lower Dam Removal

Fall 2023 – Winter 2024

Relocation of oysters located just below Lower Dam prior to dam removal activity

Phase 3: Upper Dam Removal

- Full removal in Summer 2024

Public Concerns

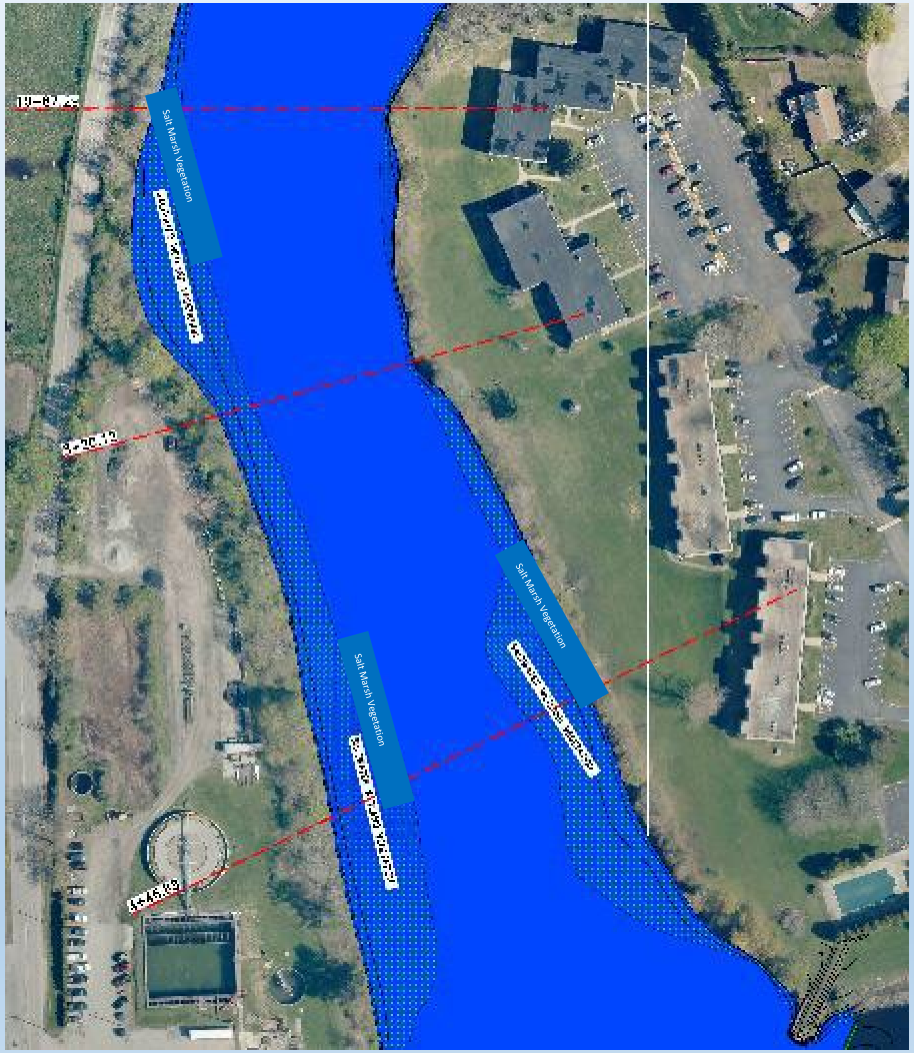
- Environmental health of the Kickemuit Reservoir
- Flooding concerns
- Historic preservation – historic cemetery adjacent to the reservoir
- Private property impacts - concern with salinity within private wells/BCWA offered to conduct testing pre and post dam removal for abutting properties
- Aesthetics post dam removal
- Community partner committee established in early project phase
- Multiple public meetings before and during COVID, outreach to abutters

Response to public concerns:

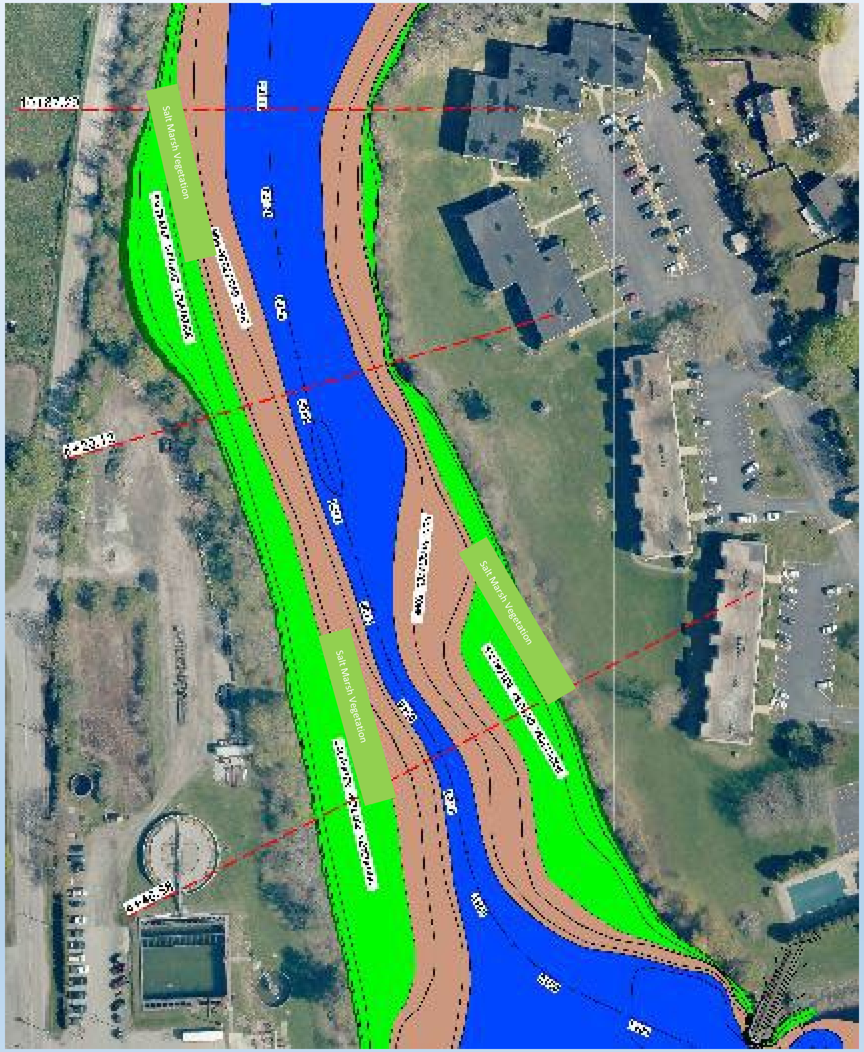
- Flap gates installed at culverts along Serpentine Road

Modeling and hydraulic analysis provided visuals at public meetings

Tidal Conditions at the Waterview Condominiums

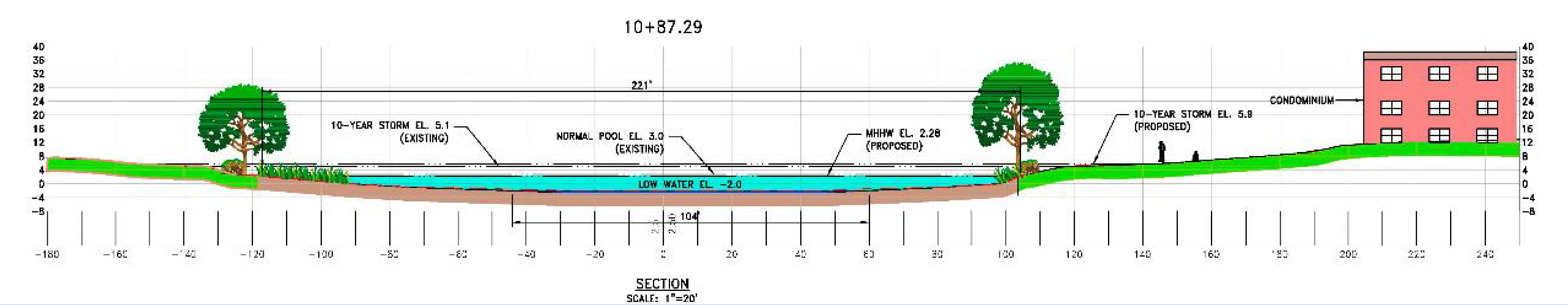


High Tide



Low Tide

Cross Section



Project Challenges

- Multi-jurisdictional permitting
- Bid Prices significantly higher than engineer’s cost estimates
- Value engineer project resulted in savings of $500,000
- Work during winter months with record rainfall and tidal surges
- Sediment removal was potential challenge however there was very little sediment migration during removal of the Lower Dam Lower Dam Project

Next Steps

- Lower Dam project essentially complete
- Dam fully removed

- Upper Dam to be completed in Summer 2024

- Shoreline plantings, long-term monitoring and adaptive management by Save The Bay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Thanks to Our Partners

NFWF

NOAA

DEM RHODE ISLAND

CRMC
COASTAL RESOURCES MANAGEMENT COUNCIL

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

SNEP
Southeast New England Program

RESTORE AMERICA'S ESTUARIES