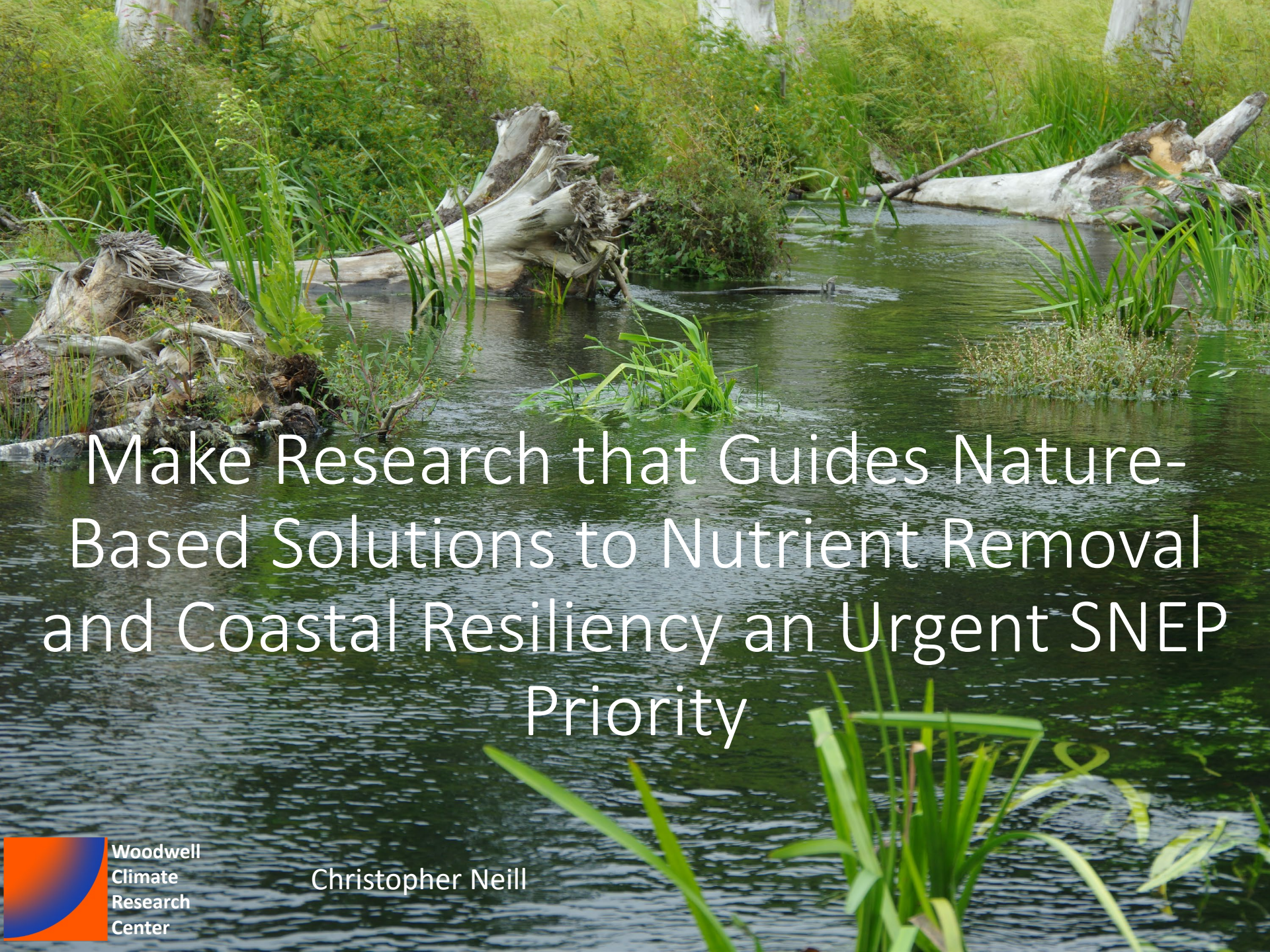


Make Research that Guides Nature-Based Solutions to Nutrient Removal and Coastal Resiliency an Urgent SNEP Priority

Christopher Neill

Woodwell Climate Research Center

Nature Based Solutions

We Don't Need More Life-Crushing Steel and Concrete

The long-term needs of ecosystems should come before our knee-jerk expectations about infrastructure.

Paul Greenberg and Carl Safina (2021)

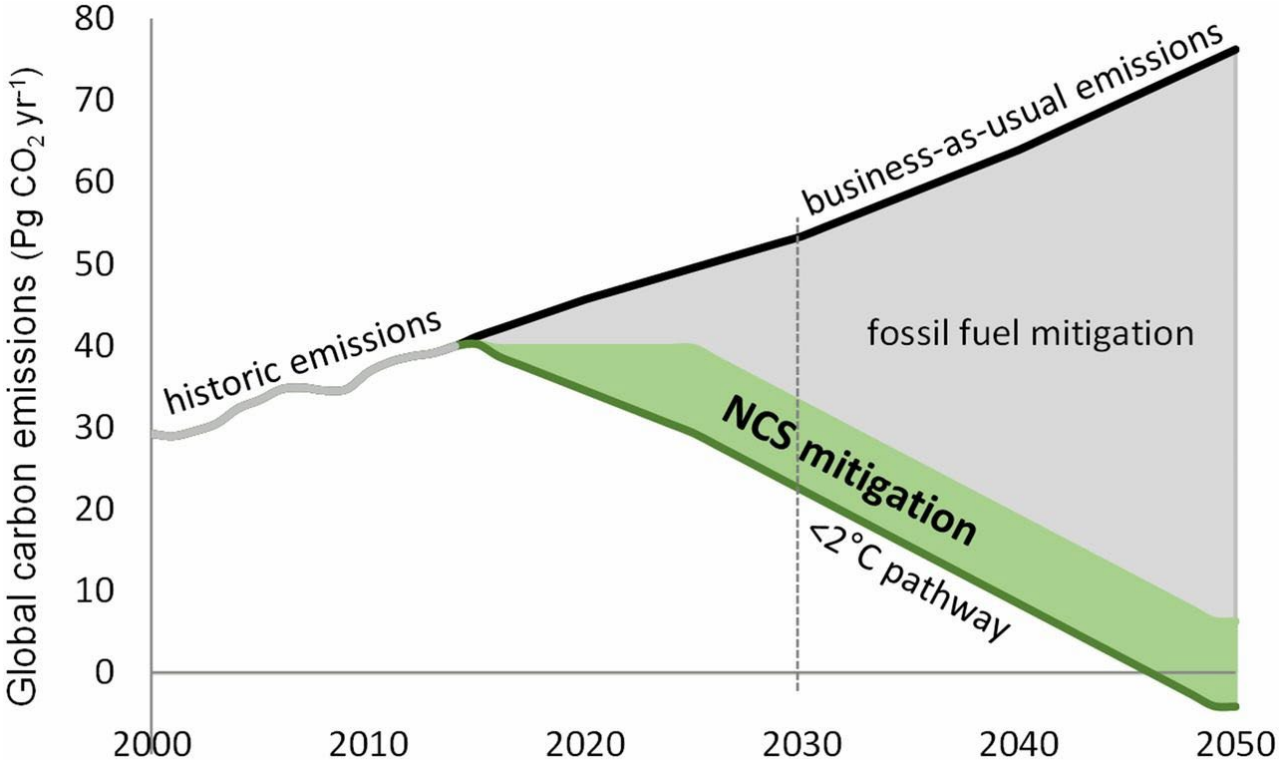
"What nature needs is for us to get out of its way and let its systems function in the manner that billions of years of evolution enabled them to do."

Buzzards Bay Coalition 2021

Nature Based Solutions

Potential to offset 22% of US fossil fuel emissions (Fargione et al. 2018)

NO pathway to 2 ^{o}C exists without NCS



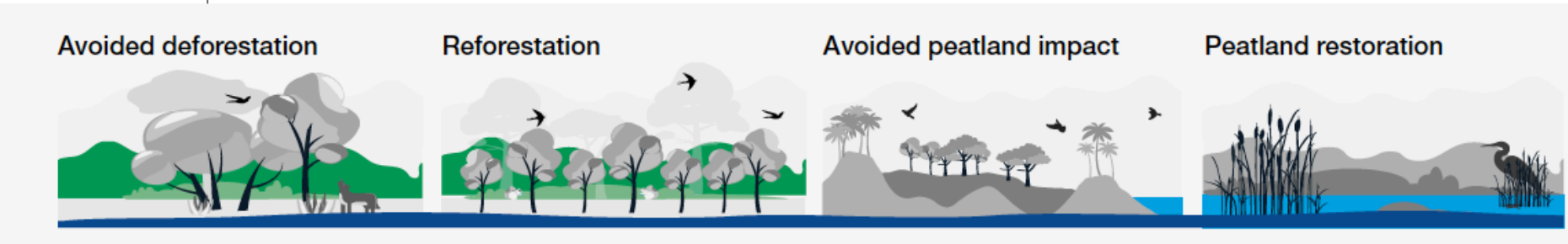
Nature Based Solutions Come With Large Co-benefits

Water quality protection

Biodiversity

What rises to the top?

FIGURE 5 | The environmental co-benefits of NCS[1]



World Economic Forum 2021

Natural Climate Solutions Come With Large Co-benefits

Potential Investments in Natural Climate Solutions

MA MVP: $65 M to date, $150 M in new funds

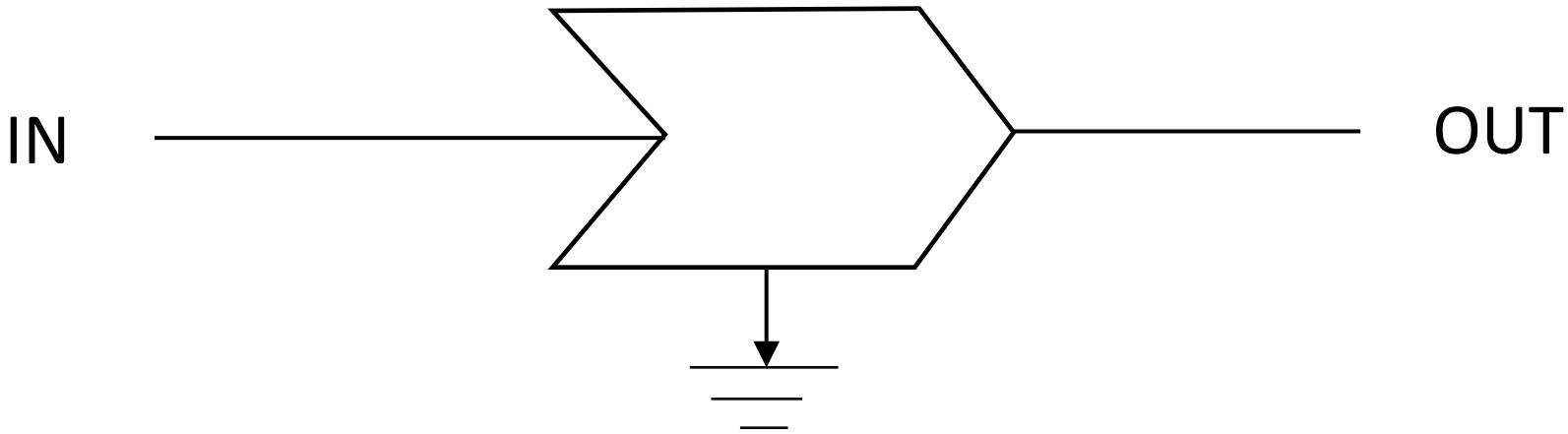
RI MRP: $4.9 M in 2022

LWCF MA & RI: $9 M in 2021

MA Covid recovery: $15 M

Build Back Better Civilian Climate Corps: $10 B

Concept of a Work Gate, or Multiplier



Credit to H. T. Odum

Key Questions for SNEP

How do you “set the stage” for salt marshes?

How do you “set the stage” for salt marshes?

How do you “set the stage” for salt marshes?

How do you “set the stage” for salt marshes?

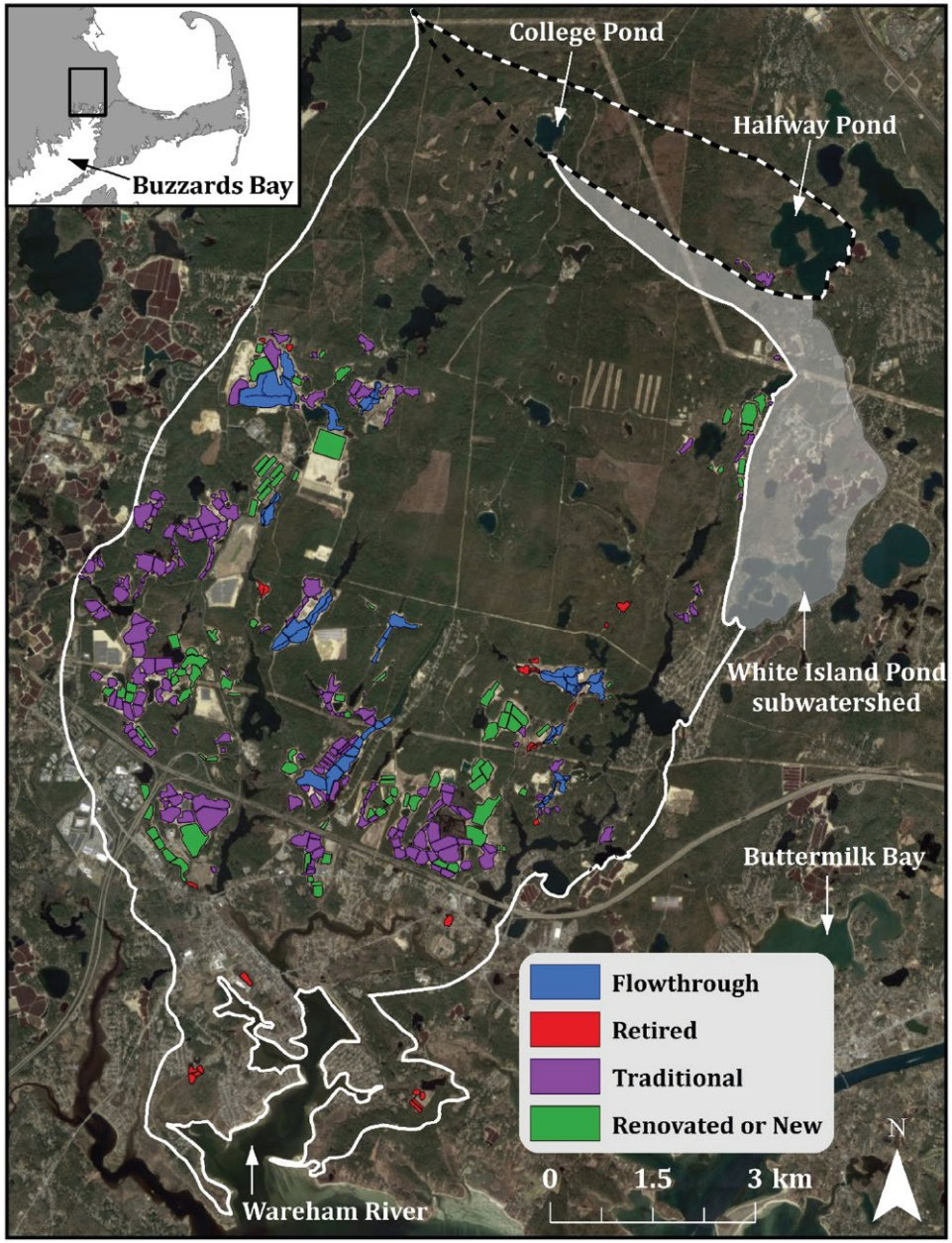
Photo: Dexter Mead

Key Questions for SNEP

How do you rewild watersheds?

How do you rewild watersheds?

How do you rewild watersheds?

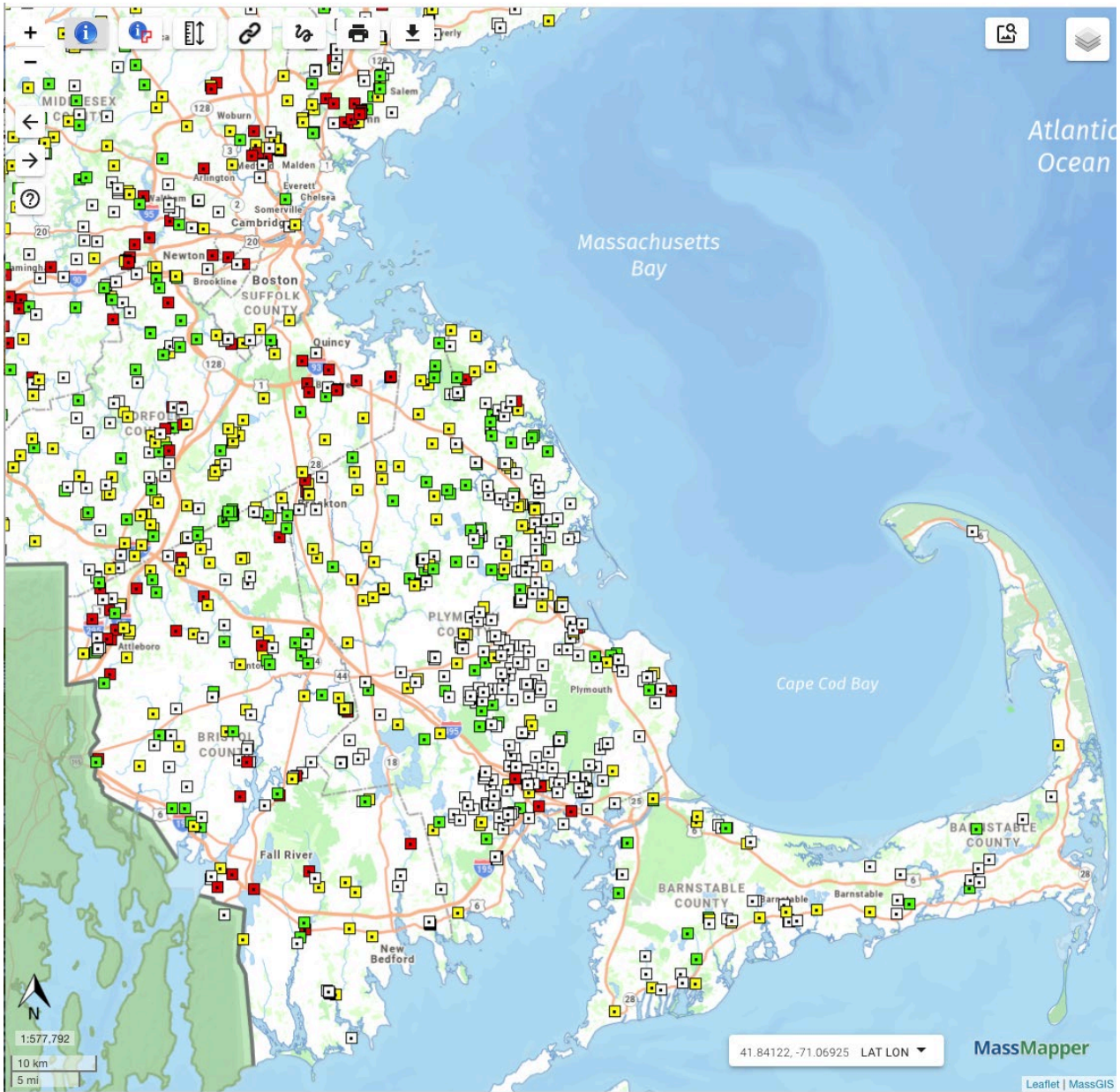


Hoekstra et al. 2020

How do you rewild watersheds?

How do you rewild watersheds?

How do you rewild watersheds?



How do you rewild watersheds?

How do you rewild watersheds?

Concept of a Work Gate, or Multiplier

Project

Project

Project

Project

Project

Project

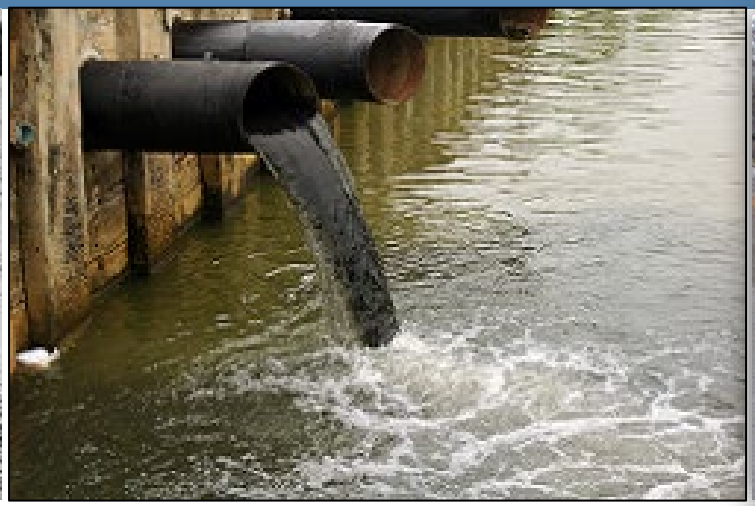
Building Climate Resilience:
From Watershed Planning to Site Design

Anjali Joshi, RA, SITES AP, MA, RI
Principal, Anjali Joshi Design LLC.

Pallavi Kalia Mande
Founding Director, Tamraparni.org
Design Critic and Studio Instructor, Harvard GSD

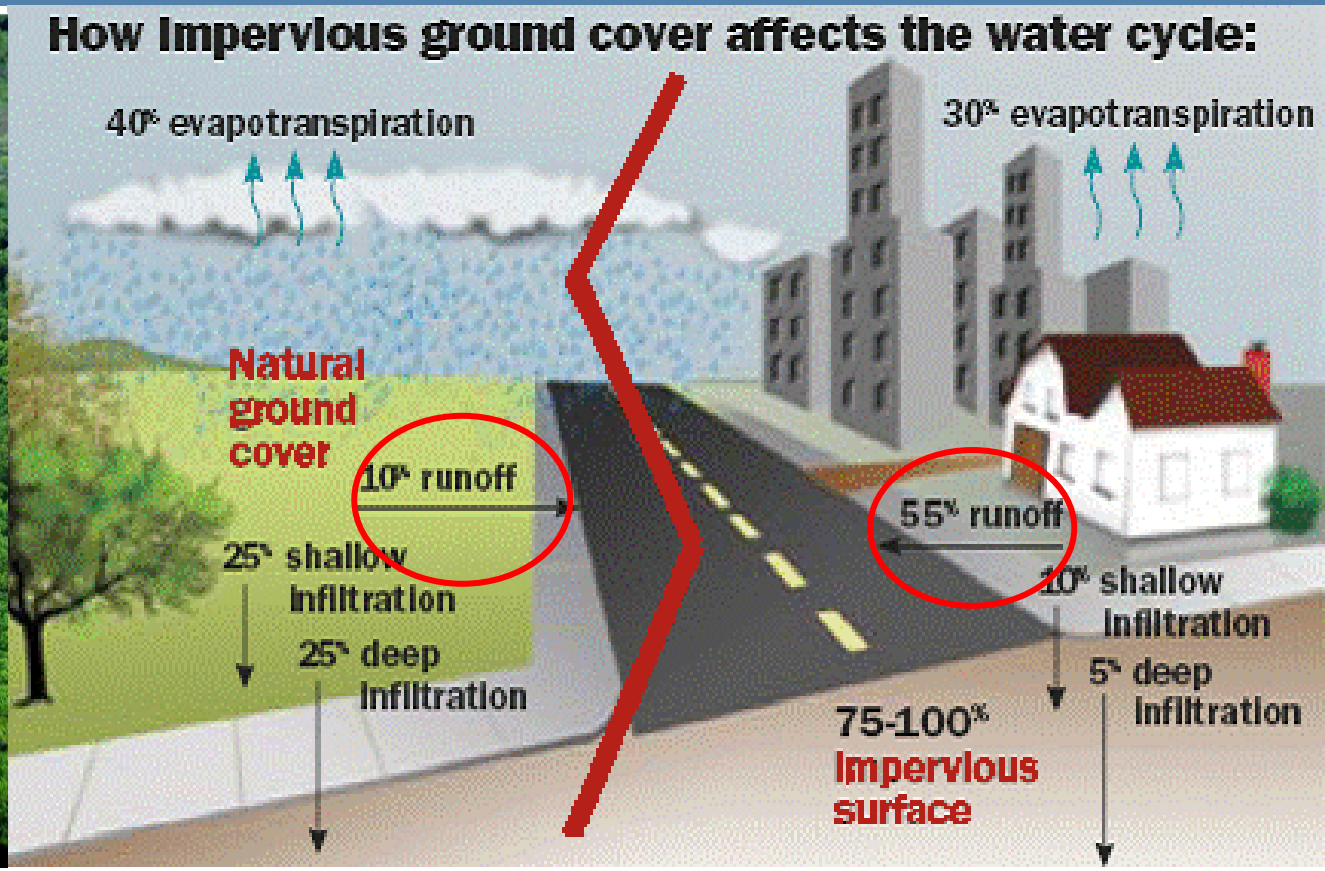
Southeastern New England Program

Water Resource Impacts of Urbanization and a Changing Climate



Impacts of Urbanization on Natural Water Cycle



In Massachusetts, average annual ***runoff increases*** from 4.2” to 23” and groundwater ***recharge decreases*** from 21” to 6.3”.

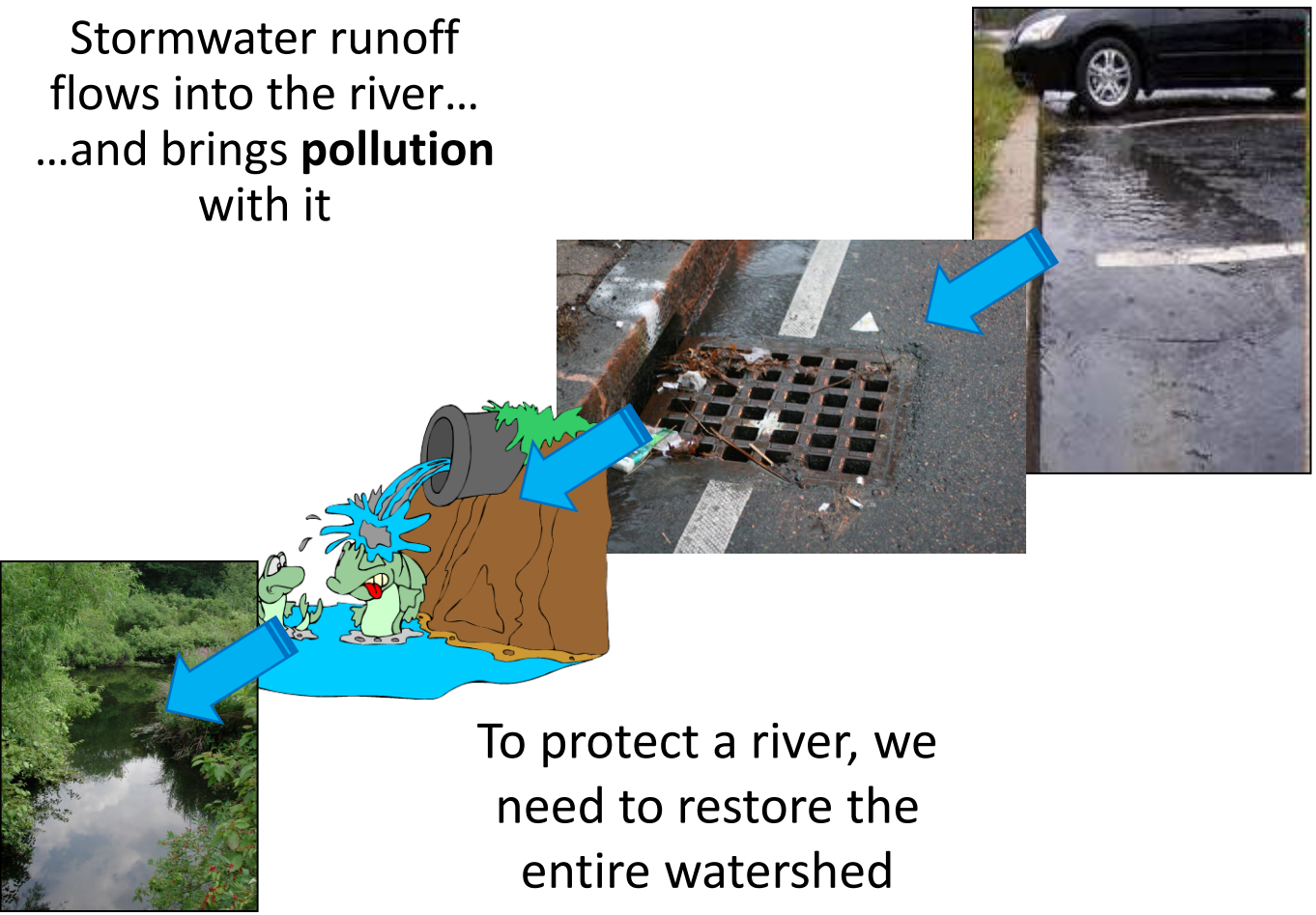
Restoring the Natural Water Cycle in an Urban Watershed

Replacing Grey with Green Infrastructure

Using soil and vegetation (green infrastructure) to treat stormwater and recharge groundwater in order to restore the natural water cycle in the built environment

The Watershed Approach to Climate Resilience

Stormwater runoff flows into the river…
…and brings **pollution** with it



To protect a river, we need to restore the entire watershed

Use of science, advocacy, law, planning and education

The Watershed Approach to Climate Resilience

Educatio
n


Tree Trench, Boston

Desig
n


Parking Lot Rain Garden, Waltham

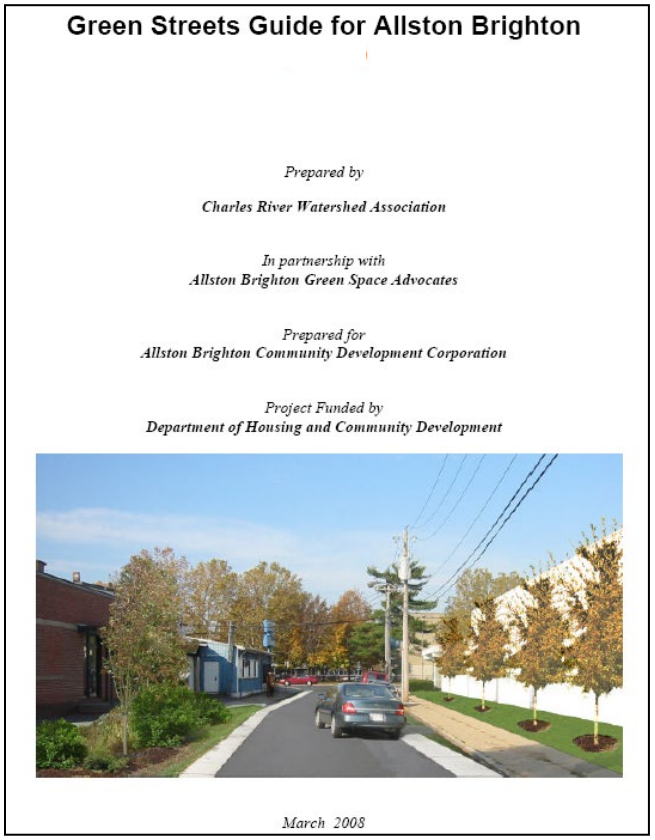
Constructio
n


Green Street,
Watertown

The Watershed Approach to Climate Resilience

Neighborhood / Street Scale Projects

- Green Streets Guide for Allston Brighton, Boston



The Watershed Approach to Climate Resilience

Site Scale Demonstration Projects:

- Waltham Watch Factory, Waltham
- Mace Apartments, Chelsea
- Peabody Square, Dorchester
- Porous Alley Retrofit, Boston

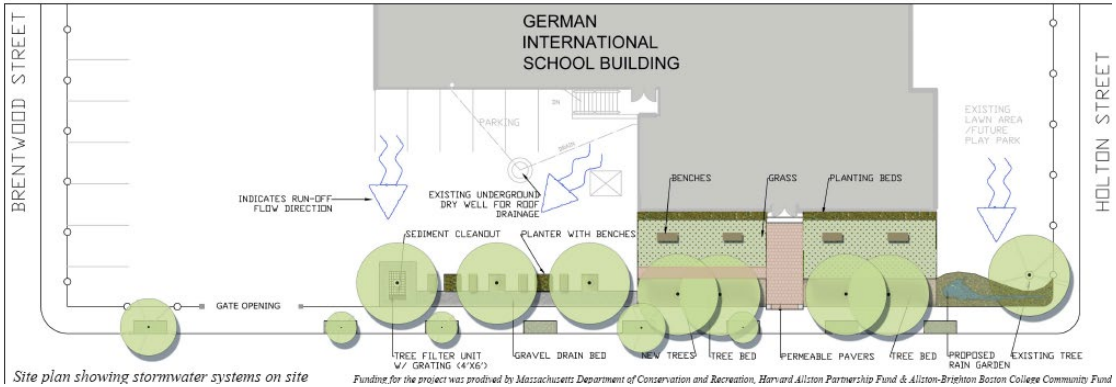
The Watershed Approach to Climate Resilience

Site Scale Demonstration Projects

- German International School, North Allston

Site before project implementation

Site after project implementation



Site plan showing stormwater systems on site

Funding for the project was prodived by Massachusetts Department of Conservation and Recreation, Harvard Allston Partnership Fund & Allston-Brighton Boston College Community Fund

The Watershed Approach to Climate Resilience

Site Scale Demonstration Project

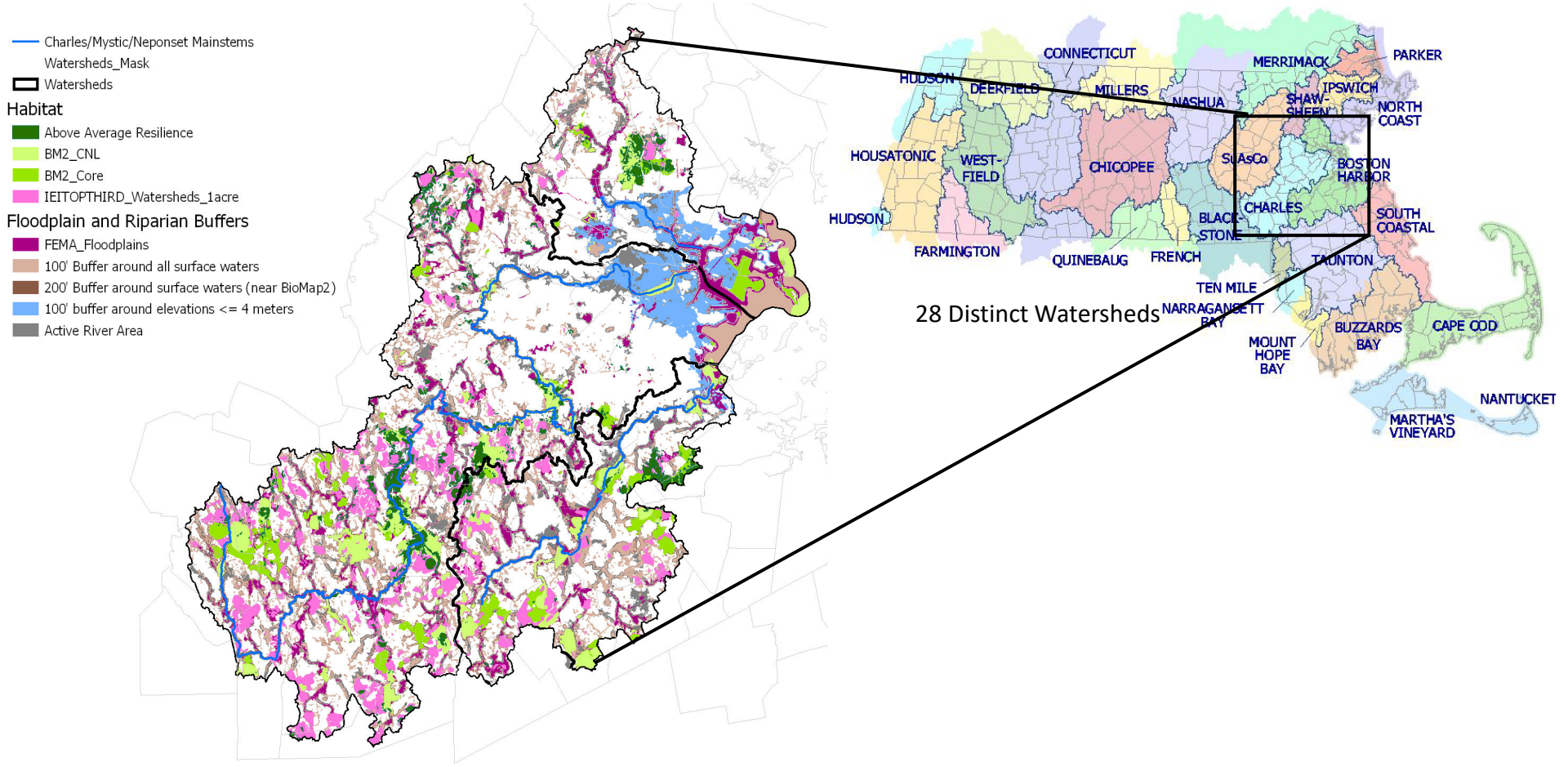
- German International School, North Allston

The Watershed Approach to Climate Resilience

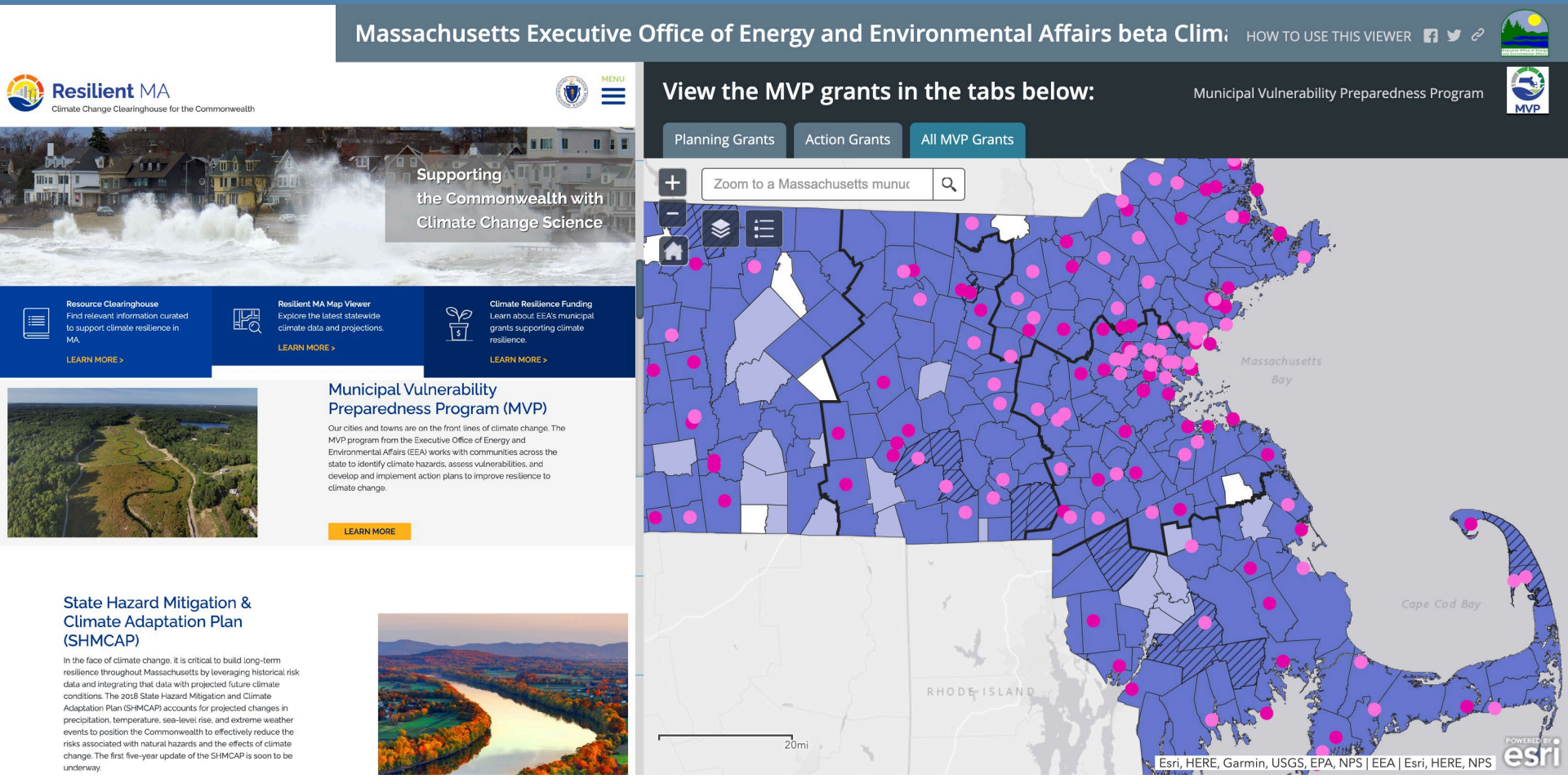
Site Scale Demonstration Project

- Mace Housing Complex, Chelsea

Investing in Climate Resilience Across Watersheds in MA

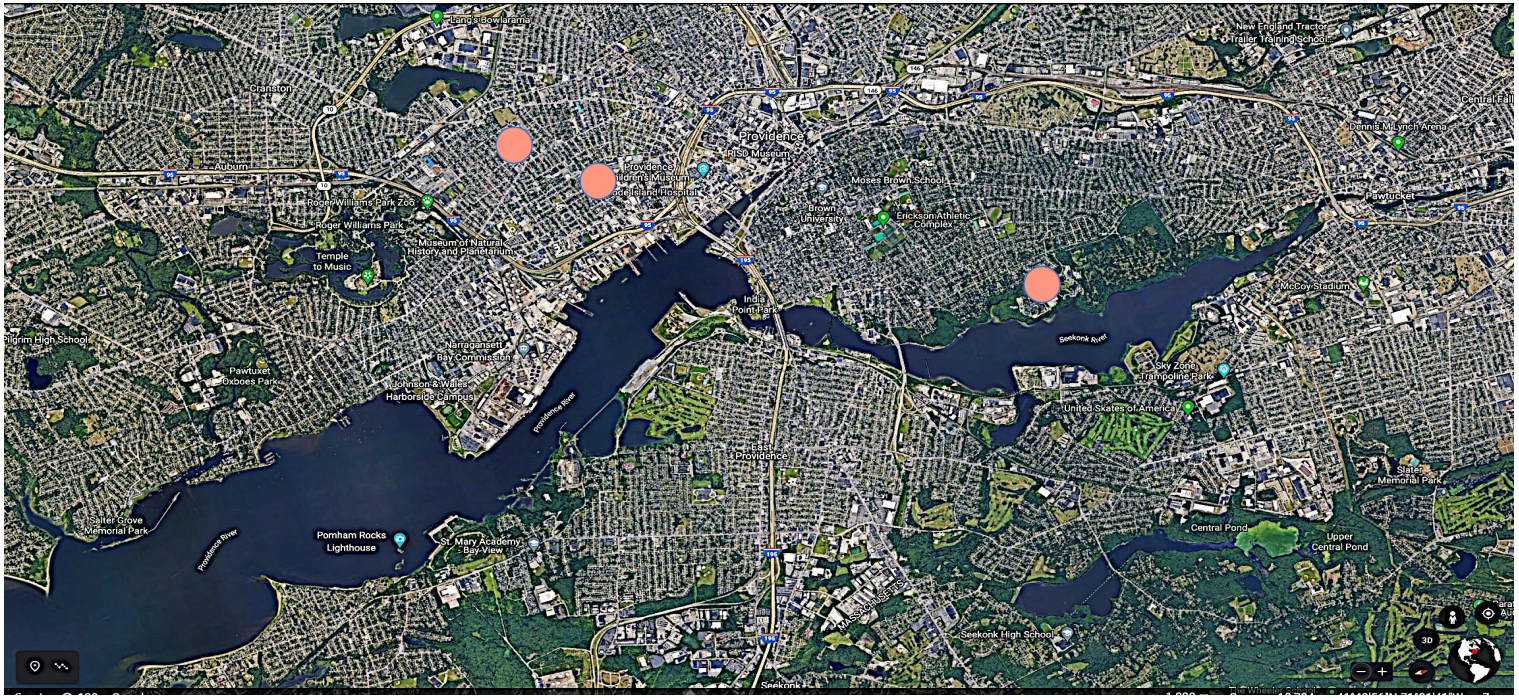


Investing in Climate Resilience Across Municipalities in MA



BUILDING CLIMATE RESILIENCE:

MOVING FROM THE WATERSHED SCALE TO AN URBAN SITE



DESIGN APPROACH + STRATEGIES FOR STORMWATER WITH SMALL URBAN SITES

Challenges with Regulations, Stormwater budget, Construction Practices

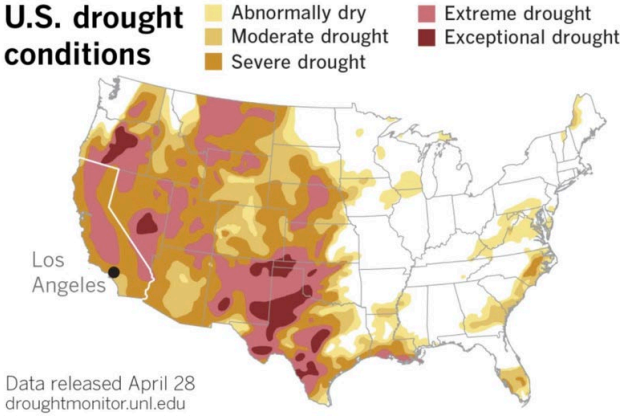
CHALLENGES **urban areas local vs global show WATER shortage with record high temperatures**

- **Regulatory Challenges and Public ROW**
- **Construction and Engineering Practices, Material choices**
- **No Budgets for Green Infrastructure**
- **Maintenance equipment upgrades and reset**

Dramatic photos from NASA highlight severity of California's drought

Satellite imagery shows Shasta Lake in July 2019, left, and June 2021. The state's largest reservoir is at about 35% of its capacity, officials said.

With water running out, California faces grim summer of dangerous heat, extreme drought



California faces severe and extreme drought after two consecutive La Niña years, and the hot, dry summer season hasn't even started. (Paul Duginski / Los Angeles Times)

'Some Faint, Some Die': These People Are Living Through the World's Worst Heat Wave

Roughly 99 million people are surviving record-breaking heat that experts say is nearly impossible to survive.

Pallavi Pundir | MAY 06 2022 | 8:36 AM

A boy runs across a patch of parched riverbed of Yamuna, India's longest tributary river, which runs through India's capital New Delhi. Photo: Sajjad Hussain / AFP

Summer in the Pakistani city of Jacobabad brings its nearly 200,000 residents on a war footing every year.

Impervious Cover, Tree Canopy loss, Not Pedestrian friendly

OPPORTUNITIES

WATER AND PEOPLE FLOW DON'T SEE INVISIBLE PROPERTY LINES

RESTORE ECOLOGY

Carbon sequestration
Phytoremediation
Nature in the City
Restoring Soils

CONNECTING GREEN AREAS AND PEOPLE

- Connecting green spaces
- Parklets and neighborhood resource

BUILD WATER STORAGE CAPACITY

- **Permeable paving**
- **Recycling water for graywater**
- **use and irrigation**
- **Expanded Street Tree pits and Green Roofs, Bioretention areas**

Building Water Storage Capacity on Site EXISTING BUILDINGS

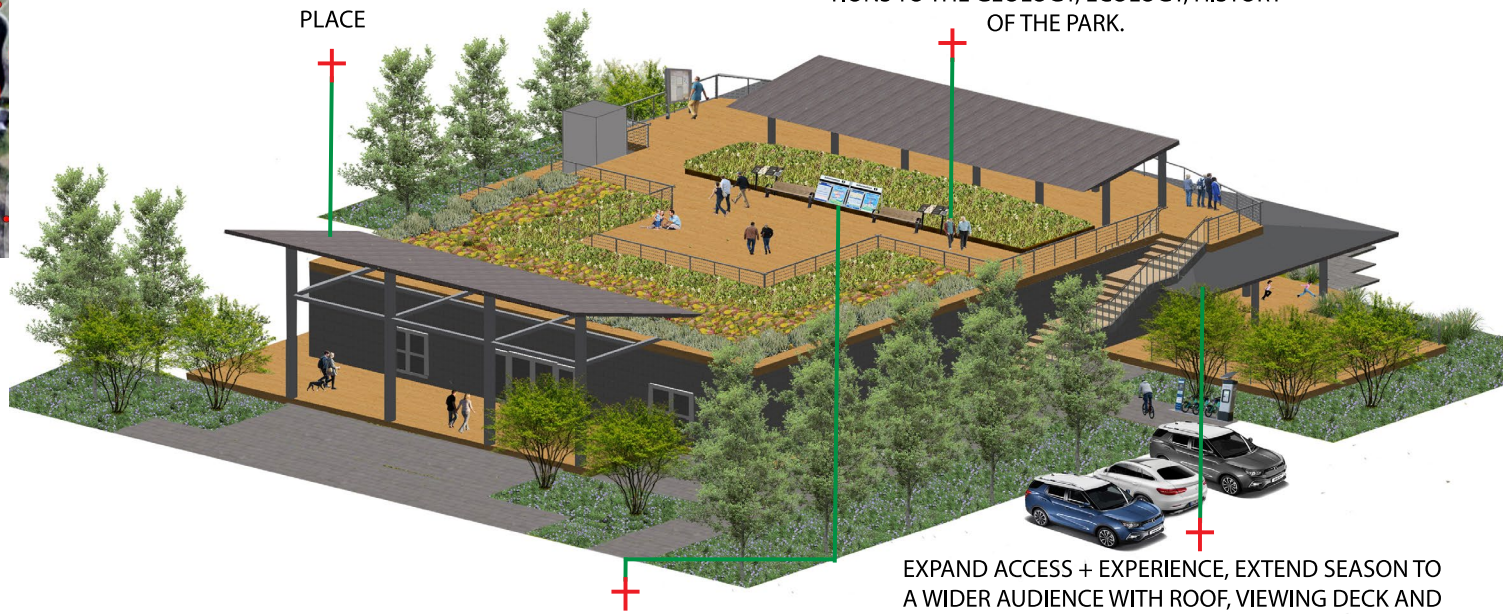
School One,
Providence, RI

Building Water Storage Capacity on Site EXISTING BUILDINGS

ESTABLISHING 'NEW' IDENTITY OF SKI LODGE....

ESTABLISH IDENTITY AS A GREEN GATEWAY TO PARK AND A GATHERING PLACE

RECONNECT THE SKI LODGE TO ITS SURROUNDING CONTEXT. CREATING CONNECTIONS TO THE GEOLOGY, ECOLOGY, HISTORY OF THE PARK.



EXPAND ACCESS + EXPERIENCE, EXTEND SEASON TO A WIDER AUDIENCE WITH ROOF, VIEWING DECK AND ADDED CANOPIES WITH FLEXIBLE PROGRAMMING.

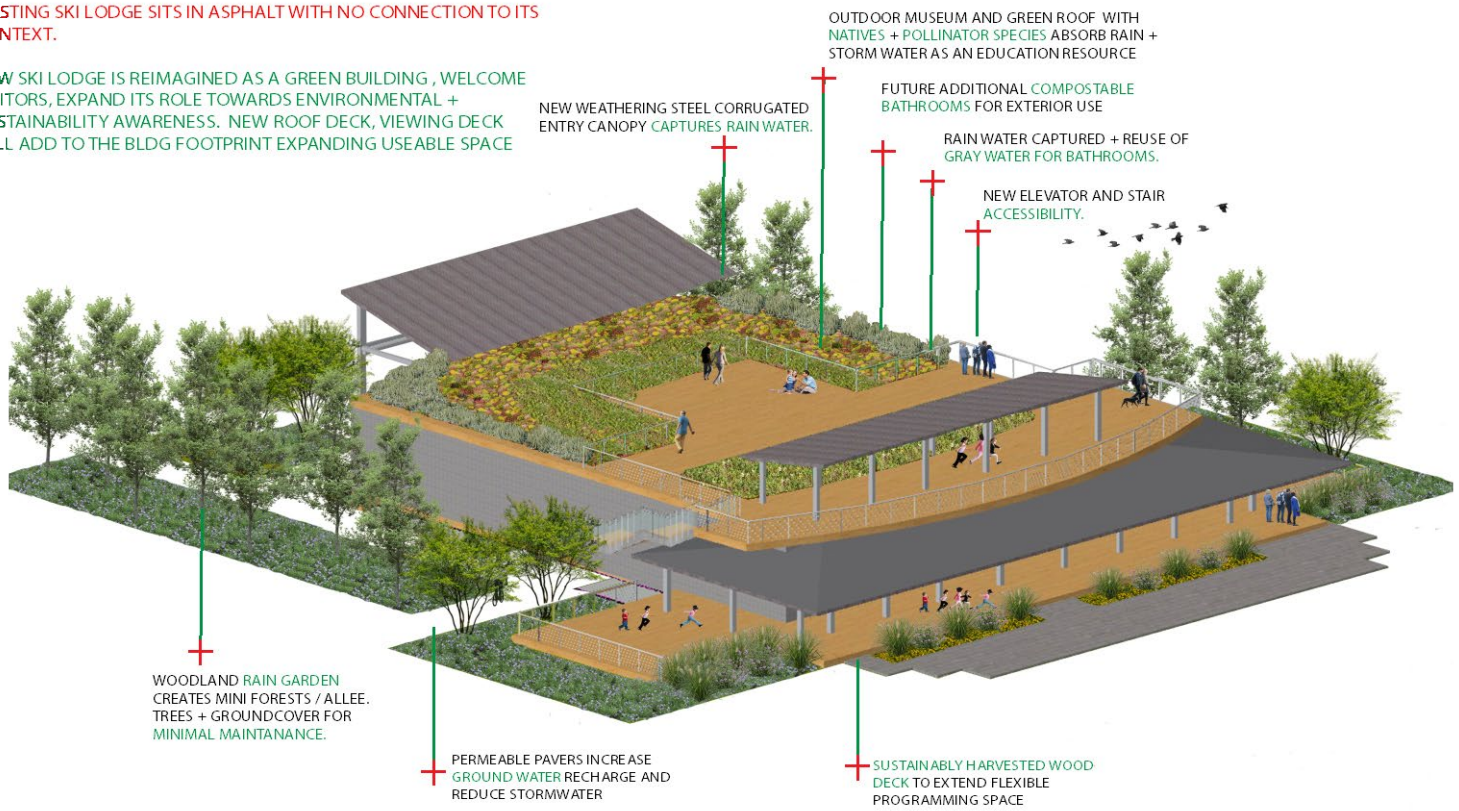
BUILDING AN EDUCATIONAL MISSION INTO THE PROJECT WITH SIGNAGE ON SUSTAINABILITY AND HISTORY

Building Water Storage Capacity on Site EXISTING BUILDINGS

NEW SKI LODGE AS A "GREEN GATEWAY" TO DIAMOND HILL PARK

EXISTING SKI LODGE SITS IN ASPHALT WITH NO CONNECTION TO ITS CONTEXT.

NEW SKI LODGE IS REIMAGINED AS A GREEN BUILDING , WELCOME VISITORS, EXPAND ITS ROLE TOWARDS ENVIRONMENTAL + SUSTAINABILITY AWARENESS. NEW ROOF DECK, VIEWING DECK WILL ADD TO THE BLDG FOOTPRINT EXPANDING USEABLE SPACE



Building Water Storage Capacity on Site

NEW BUILDIINGS

WATER RECAPTURE AND USE CALCULATIONS BY WATER RECYCLING SYSTEMS FOR
SCHOOL ONE, PROVIDENCE RI

Rainfall amounts for the Providence area

- Annual rainfall is 47" to 49"
- Wettest month March with 5", next is November at 4.5"
- Driest months are February and July at 3.3"

Building footprint 5,850 square ft roof to capture rainfall.
March ability to capture and store **18,200 gallons**
February and July **12,012 gallons**

SEWER ABATEMENT WATER METER IS USED TO MONITOR WATER FLOW THAT DOES NOT ENTER THE SANITARY SEWER AND IS USED
FOR IRRIGATION OR GRAY WATER USE

Narragansett Bay Commission

NSF/ANSI STANDARD 350
FOR WATER REUSE TREATMENT SYSTEMS

Questions and Answers

011

Q: WHAT MARKETPLACE NEED IS ANSWERED BY THESE STANDARDS?

A: The acceptable quality of reuse water for on-site applications is determined by local and state regulations, not federal. This has created varying criteria and product approval requirements across the country.

- What NSF/ANSI 350 and 350-1 sets forth is a comprehensive method of evaluation and effluent quality criteria that has national level recognition (through the American National Standards Institute, ANSI).

Q: WHAT TYPES OF SYSTEMS ARE INCLUDED IN THE STANDARDS?

A: Residential or Commercial (non-industrial) onsite graywater and blackwater treatment systems that serve single or multiple buildings within the same property. Residential systems are defined as those that treat wastewater from a single residence. Commercial systems are those that treat wastewater from multi-family dwellings and from businesses such as:

- Lodging establishments
- Business parks and campuses
- Shopping facilities
- Laundering facilities for hospitals, hotels, rental uniforms, etc.
- Car wash facilities

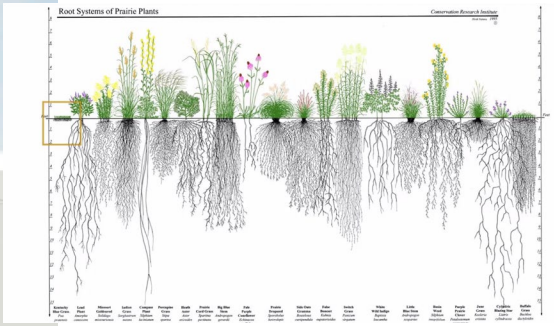
Q: HOW DO THE NSF/ANSI 350 AND 350-1 STANDARDS COMPARE WITH OTHER NSF WASTEWATER STANDARDS?

A: The water reuse standards build on previous NSF onsite wastewater treatment standards. The table below compares the NSF350 standard to NSF/ANSI Standards 40 and 245, both for residential wastewater treatment applications. Each subsequent standard builds on the prior one, adding additional testing requirements. The NSF/ANSI 350 standards require the same testing as the prior standards, but add tests for turbidity and bacteria (e-coli).

TEST	NSF/ANSI 40	NSF/ANSI 245	NSF/ANSI 350
Biological Oxygen Demand (BOD)	X	X	X
Total Suspended Solids (TSS)	X	X	X
Nitrogen Reduction		X	X
Turbidity			X
Bacteria (e-coli)			X

Looking Beyond Site + Property Bounds

Community Music Workshop Providence, RI
Water retention Parklet and Pollinator garden



Deep Rooted perennials for carbon sequestration over traditional turf grasses

Restoring Ecology, Soils, Carbon Sequestration

Cross roads Summer Street Apartments, Providence, RI
Proposed Woodland Garden

Community Music Workshop, Providence, RI
Streams edge wetland Garden

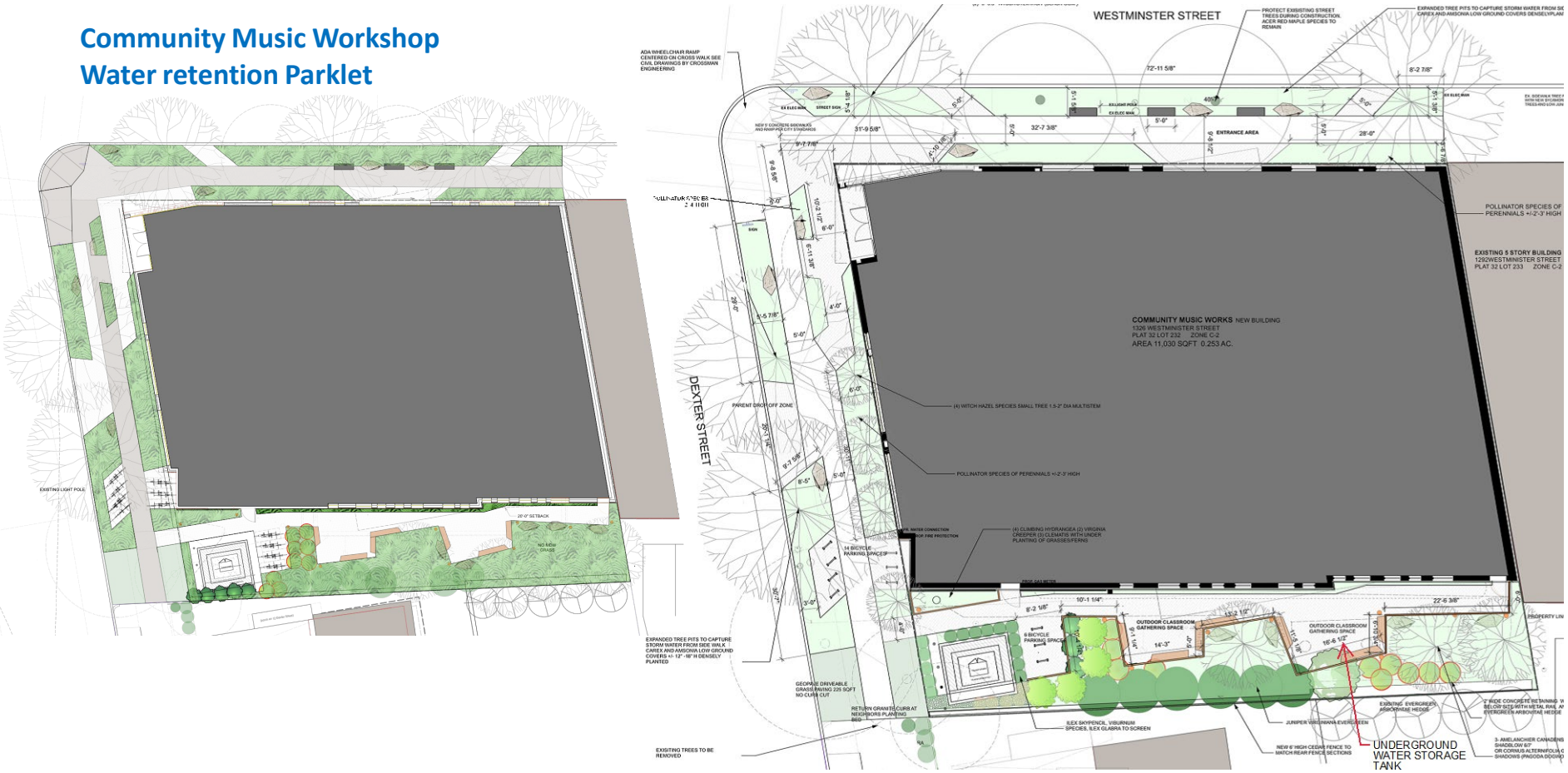
Site design Approach for Watershed+ Climate resilience

School One, Providence, RI

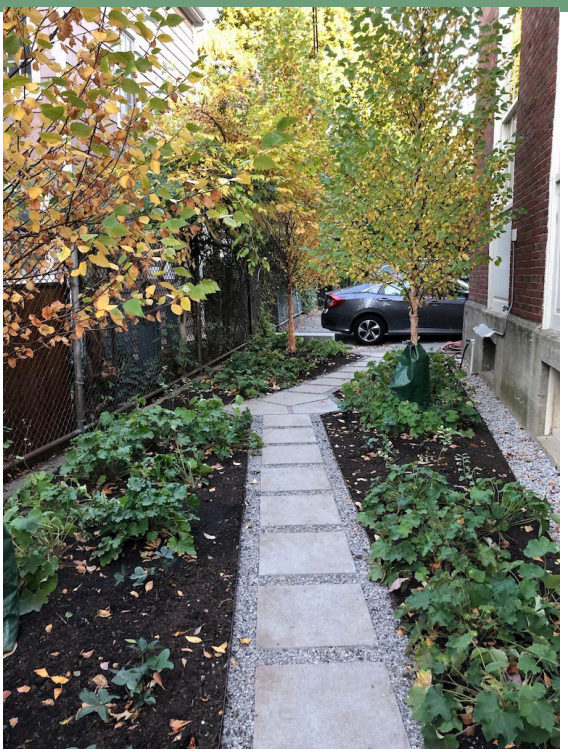
Rain Gardens, Expanded tree pits, outdoor classrooms, seating for students and the neighborhood

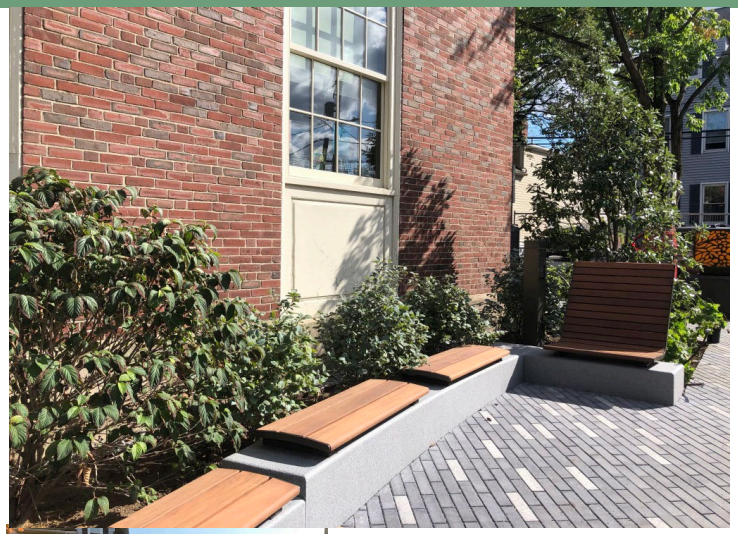
Site design Approach for Watershed+ Climate resilience

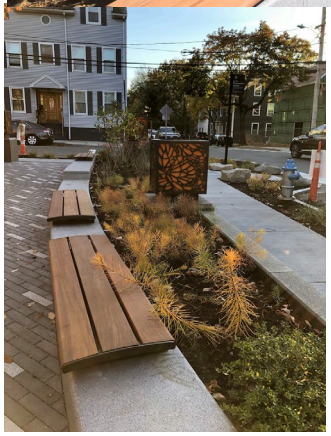
Community Music Workshop
Water retention Parklet



Longterm Benefits vs short term costs, Maintenance







Oconnell Library Reading garden and pocket park Cambridge, MA

Woodland walk, Poetry reading areas, Storytime, Wifi stations, Expanded tree pits, a neighborhood gathering spot

Canoe River Aquifer Resilience Through Regional Application of Nature Based Solutions

Kimberly Groff
Massachusetts Liaison, SNEP Network
May 18, 2022

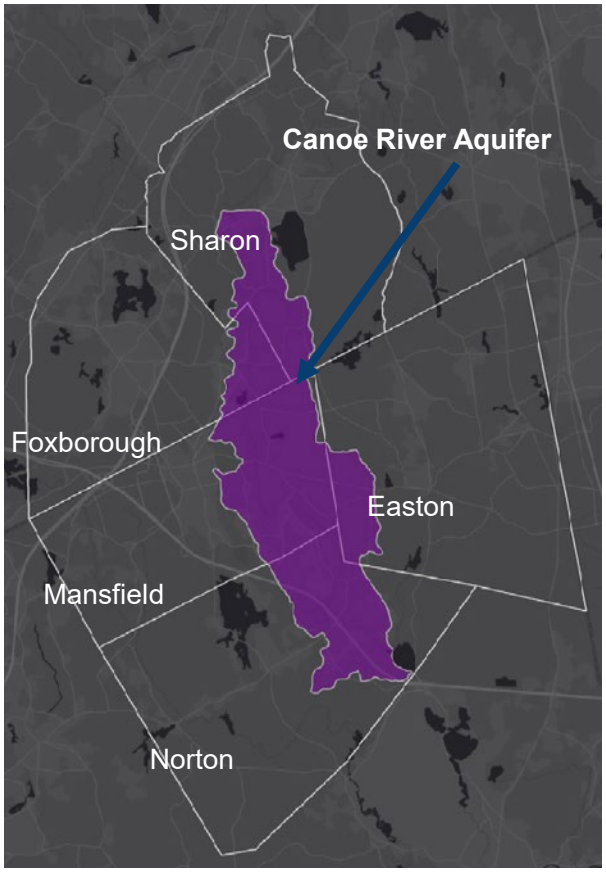
Outline: Canoe River Aquifer Resilience Project

1. Background
2. Project approach
3. Project short list
4. Observations & Opportunities

Canoe River Aquifer Resilience

Why are we here?

- Taunton River Watershed – longest undammed river in Massachusetts, designated Wild & Scenic
- The area is experiencing rapid change from development and that is compounded by climate change (more frequent/intense storms, flooding, and higher temperatures)
- SNEP Network is assisting local towns to protect the Canoe River Aquifer
- For many people in these communities, it is the ONLY viable source of drinking water



It is critical to protect this water and the natural systems around it that keep it clean!

SNEP NETWORK

Visit our story map: https://snepnetwork.org/taunton-river-watershed/

Canoe River Aquifer Resilience

Five communities developed Massachusetts Municipal Vulnerability Preparedness (MVP) Plans - *Explore Natural Hazards, Identify Strengths and Vulnerabilities, Identify Potential Actions*

What can we do now, as a region to move potential projects forward?

- Identify priorities from aggregate of 300 projects
- Evaluate the intersection between built infrastructure and Nature Based Solutions (NBS)
- Connect projects with NBS implementation funding
  - *MassMVP Action Grants*
  - *SNEP Watershed Implementation Grants*
  - *FEMA BRIC hazard mitigation*
  - *MassDER priority projects*
  - *NFWF/NOAA climate resilience opportunities*
  - *MassDEP 319 Nonpoint Source*
  - *MassDEP 604b*

Nature Based Solutions (NBS)

NBS can be things we build to mimic nature or simply making sure nature is protected and can do its job!

CONSERVE existing forests and wetlands

RESTORE degraded habitats

IMPROVE developed areas to mimic nature

NBS help preserve the natural landscape and minimize impervious surfaces to make stormwater more of a resource than a waste product.

Goals

- Build off the MVP and other planning activities
- Conduct facilitated planning for five communities
- Employ nature-based solutions (NBS) for watershed resilience
- Prioritize up to 10 NBS projects for implementation

Gain insight into common barriers to NBS implementation, look for ways to overcome obstacles

SNEP NETWORK

SNEP

Southeast New England Program

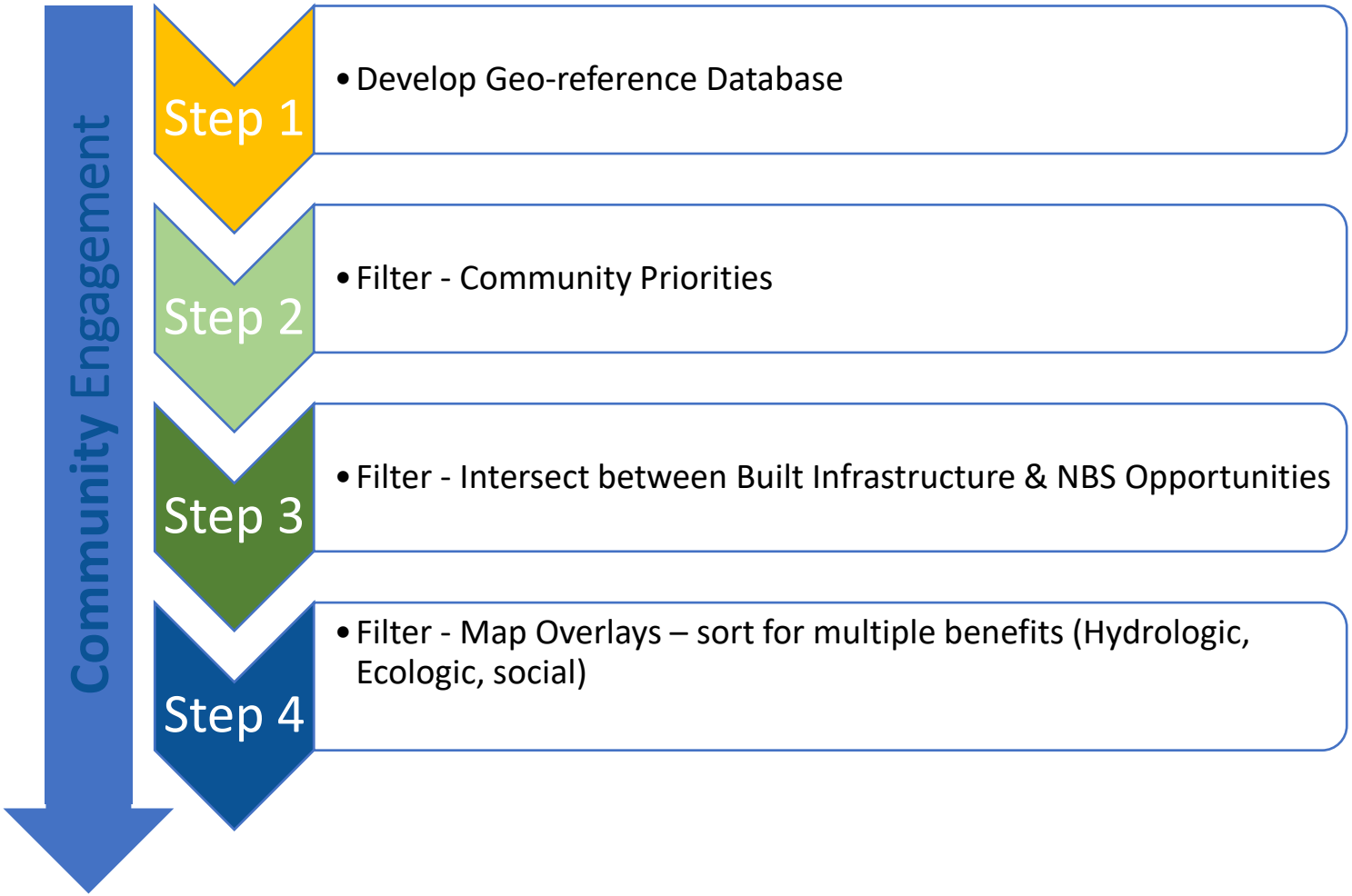
Approach to Project Prioritization

Picking up where MVP left off

Approach: How do we choose?

1. **Scientific Analysis –** which NBS are going to have the greatest ecological impact? Hydrologic impact?
2. **Regional Benefits** – which NBS will have positive impacts across the towns?
3. **Ready to Go –** which NBS have local support to get built soon and be properly maintained?
4. **Environmental Justice** – which NBS are going to help people and communities most vulnerable to climate change?
5. **Community Needs –** which NBS are going to best address what residents care about most?

Approach

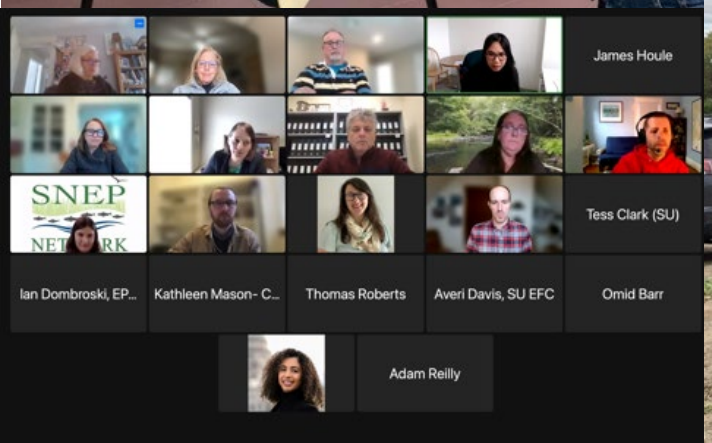


SNEP NETWORK

What's been done to date:

- Towns have identified problems and areas of concern (MVP Programs, etc.)
- Steering Committee formed: January 2021
- Outreach began: May 2021
  - Public Participation Plan (PPP)
  - Project website
  - Public Workshop #1 (9-30-2021) - Edith Reed Conservation Land Environmental Center, Easton)
  - Listening stations at local libraries: Fall 2021
  - Online questionnaire hosted by SRPEDD
  - Town One-on-One meetings: Winter 2022
  - Public Workshop #2 (4-28-2022) – Via Zoom

Community Engagement



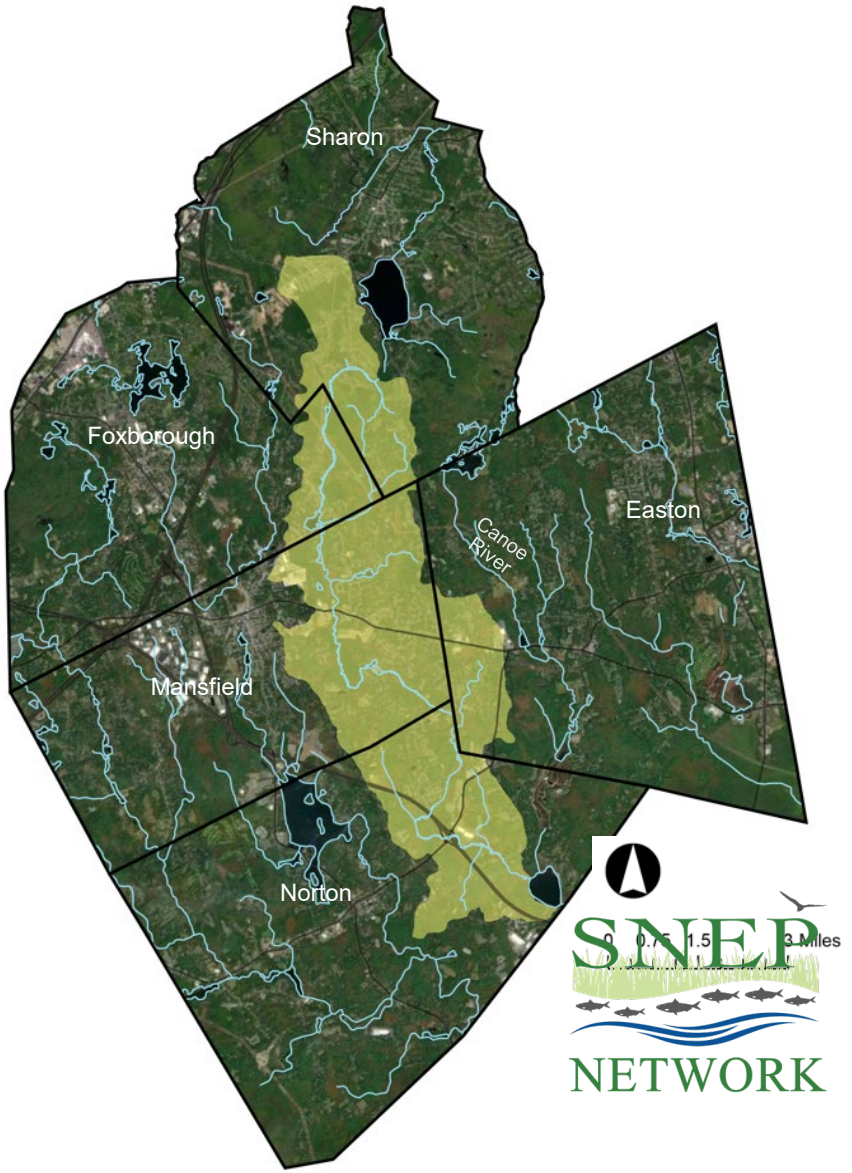
SNEP NETWORK

Step 1: Project Database

Project dataset

Categorize each project

1. Water Supply and Drought Resilience
2. Flooding, Stormwater, Dams, and Culverts
3. Forests, Habitats, and Invasive Species
4. Public Health and Emergency Preparedness



Canoe River Aquifer Area

Canoe River Aquifer

Major streams and surface water bodies

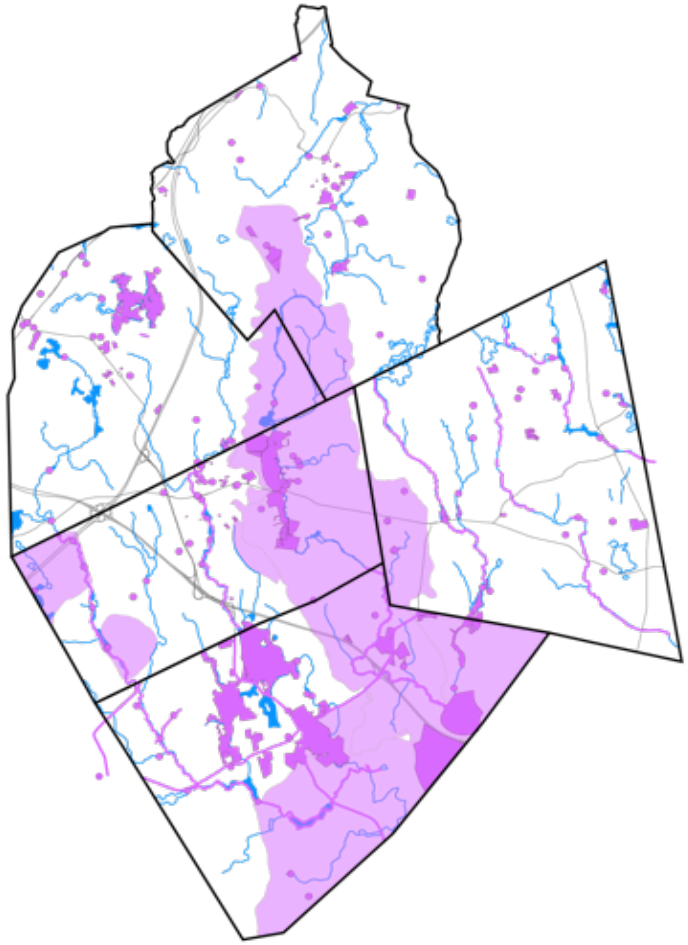
Major roads

Step 2: Community Priorities

Geo-reference Database – 5 communities

Initial Categorization

- Category 1. Water Supply and Drought Resilience
- Category 2. Flooding, Stormwater, Dams, and Culverts
- Category 3. Forests, Habitats, and Invasive Species
- Category 4. Public Health and Emergency Preparedness



Project dataset

198 unique projects

(212 features)

- Sharon = 52
- Norton = 40
- Easton = 39
- Foxborough = 34
- Mansfield = 31
- Regional = 2

Step 3: NBS Opportunities to Address Built Infrastructure Hazards

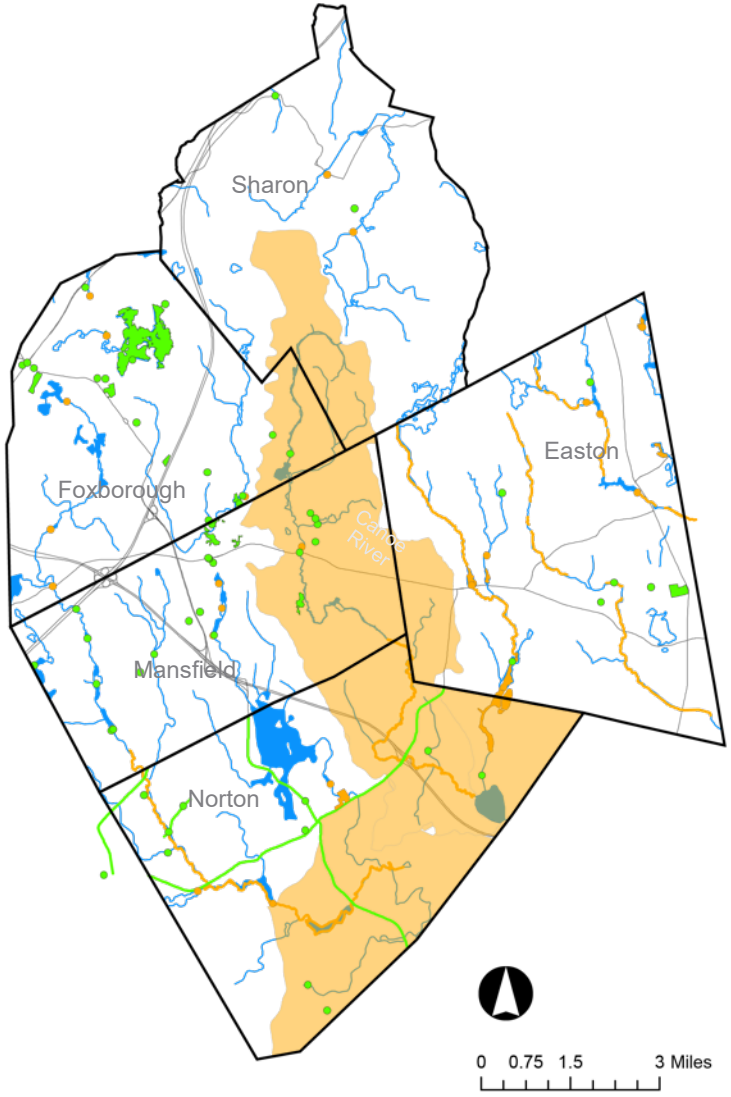
INCLUDE projects that…

- include built infrastructure component
- NBS opportunity to address water supply, water quality, flooding, drought resilience

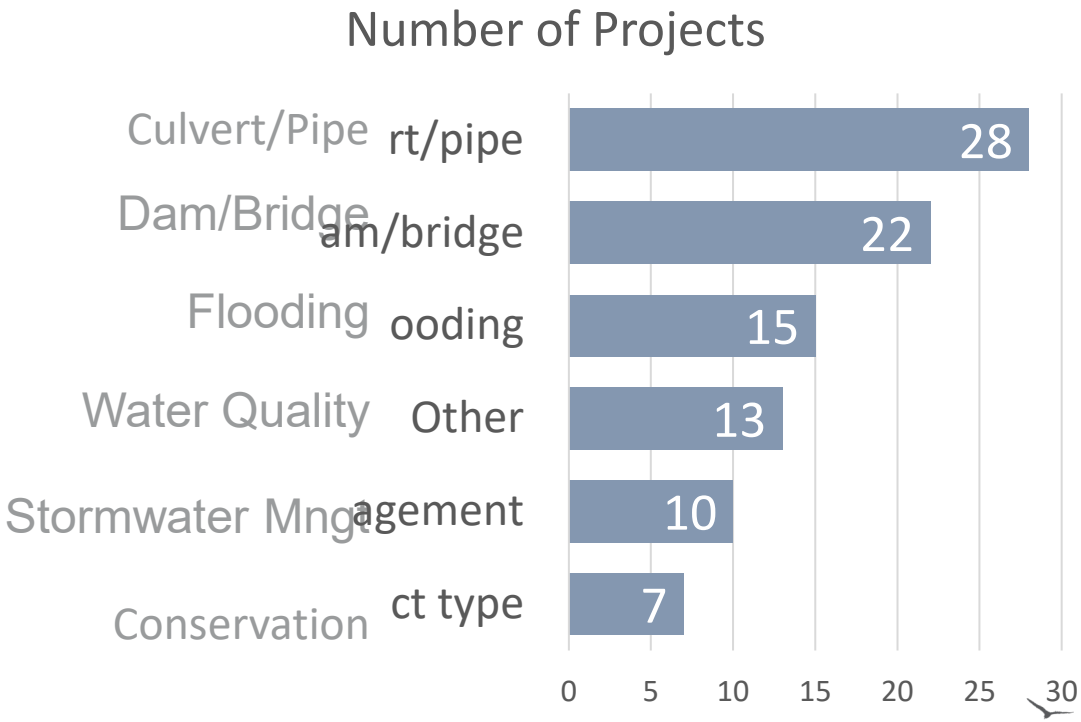
Capture water with this

Rather than this

Step 3: Project Filtering



95 candidates left



SNEP NETWORK

Step 4: Project Prioritization

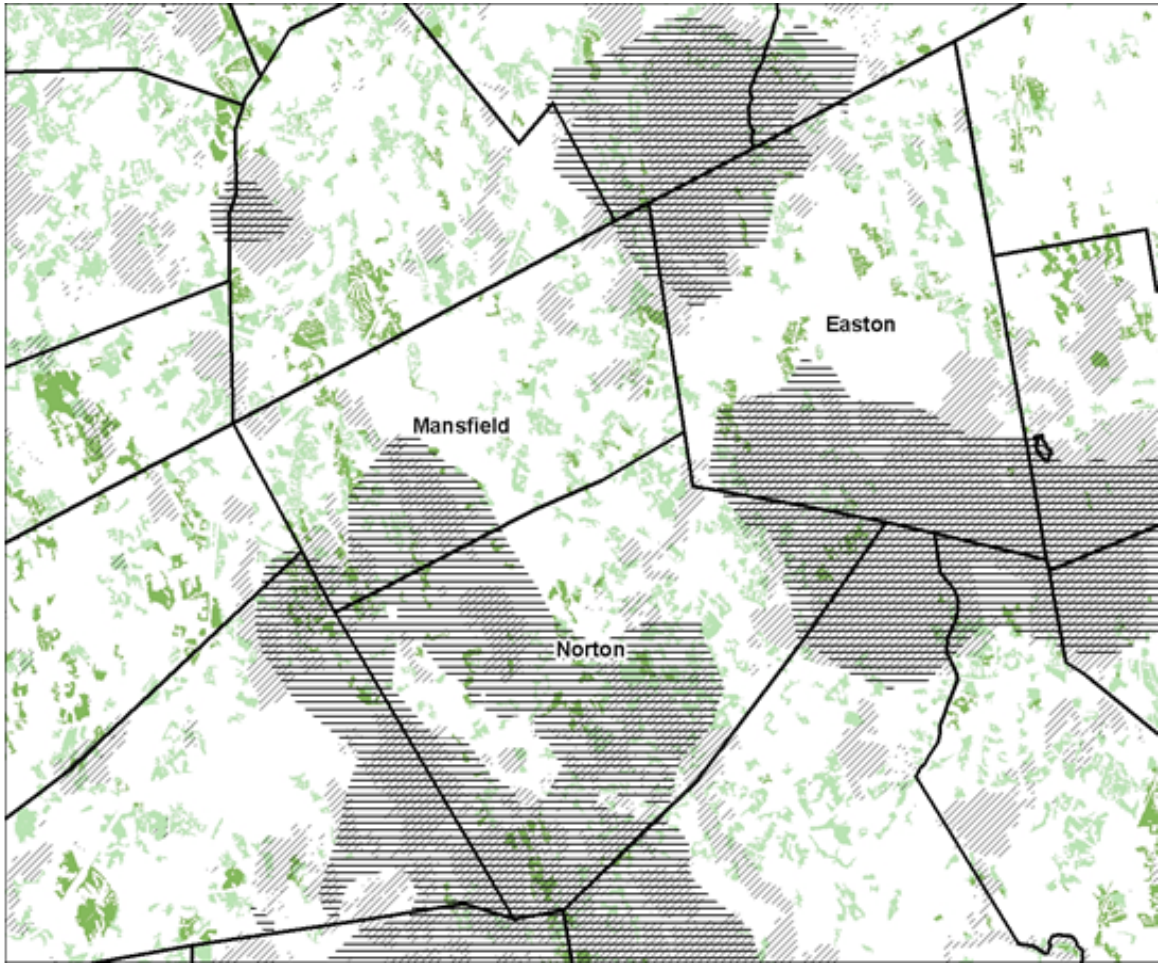
Local Characteristics & Potential Benefits

- Ecological Value
  - Assess potential benefits from NBS projects that result in hydrologic restoration, aquatic connectivity, or other ecosystem services
- Culverts & Dams
  - Ecological values and benefits
  - Hydrologic relationships
- Socioeconomic Values
  - Public input from outreach
  - Vulnerable populations, Environmental justice neighborhoods
  - Flooding on roads and neighborhoods

Step 4: Filter

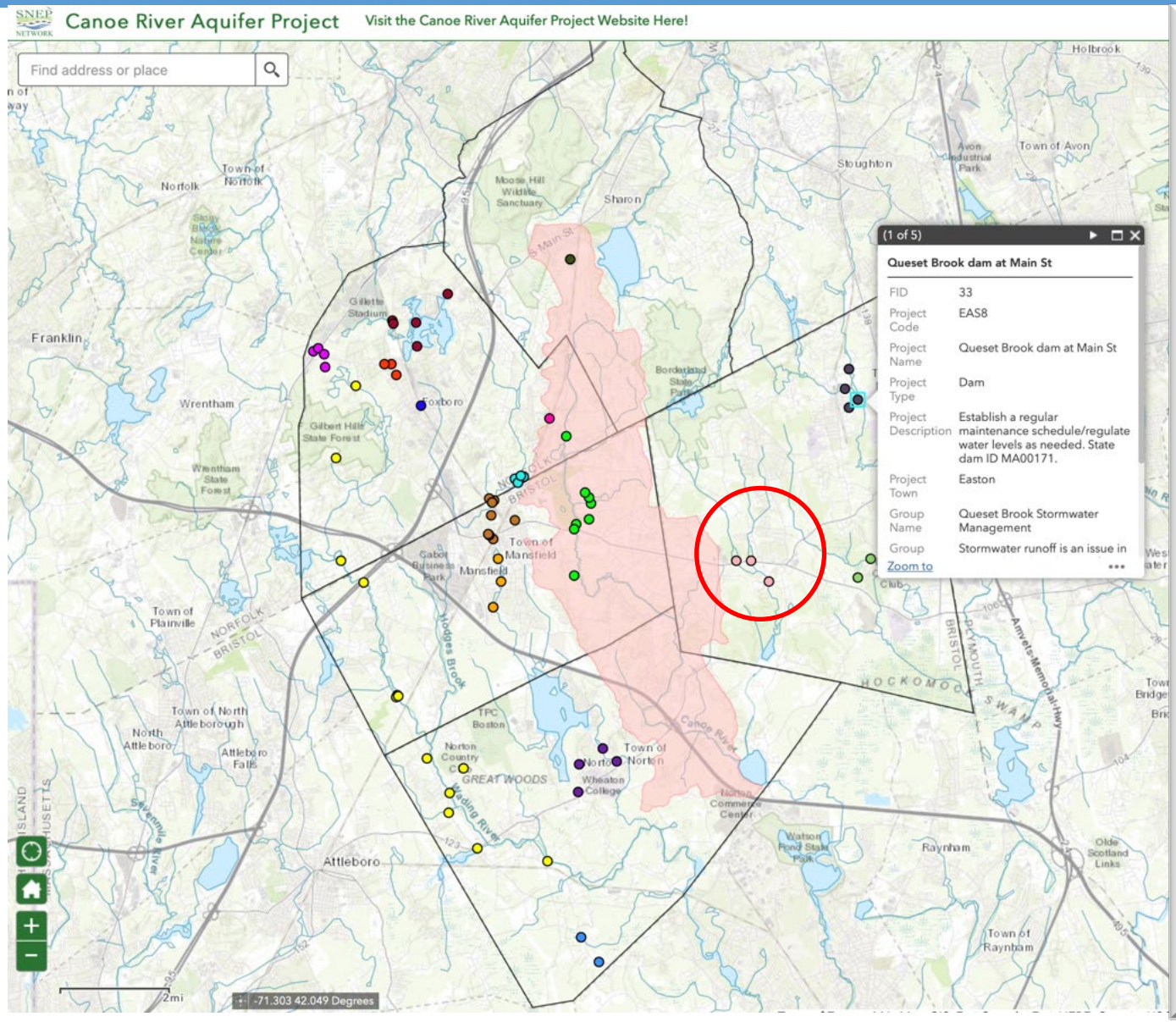
Conserve-Drought resilience and habitat

- Conserve for High Quality Habitat
- Conserve for Regional Habitat Connectivity
- Good Aquifer Recharge Potential
- Best Aquifer Recharge Potential



Intersections to identify projects or clusters of projects where multiple benefits can be realized. NBS protect, manage, and restore ecosystems to mitigate threats to the watershed, primarily by increasing the ability of the landscape to absorb and filter water.

Canoe River Priority NBS Projects



Sharon
- Great Cedar Swamp

Easton
- Prospect and Purchase St.
- Queset Brook
- Mulberry Meadow Brook

Norton
- Rt 123/140
- Meadow Brook

Mansfield
- Fulton Pond
- Rumford River

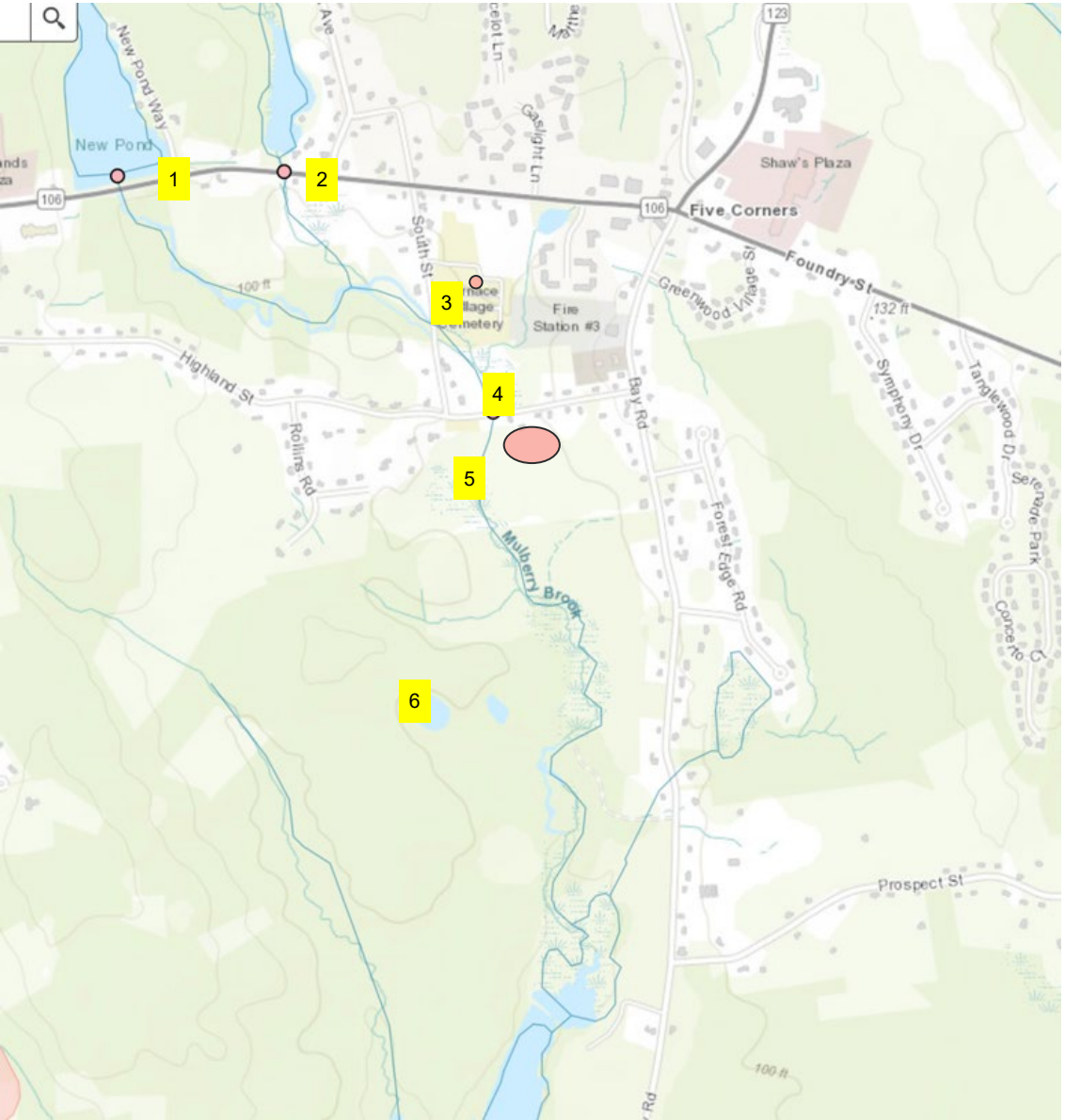
Foxborough
- Neponset Reservoir
- Chestnut St.
- Morse St.
- Washington St.
- Cocasset St.

Regional
- Wading River
- Franklin St.

Easton: Mulberry Meadow Brook Watershed

- **Hazards Identified** – localized flooding of roads, risk of dam and culvert failure (prioritized by MassDOT), drought, water quality
- **Solutions** – evaluate and monitor dam, replace undersized and failing culverts, remove impervious cover and increase wetland storage capacity, improve riparian buffer on tributary streams, aquifer recharge

Easton: Mulberry Meadow Brook Watershed

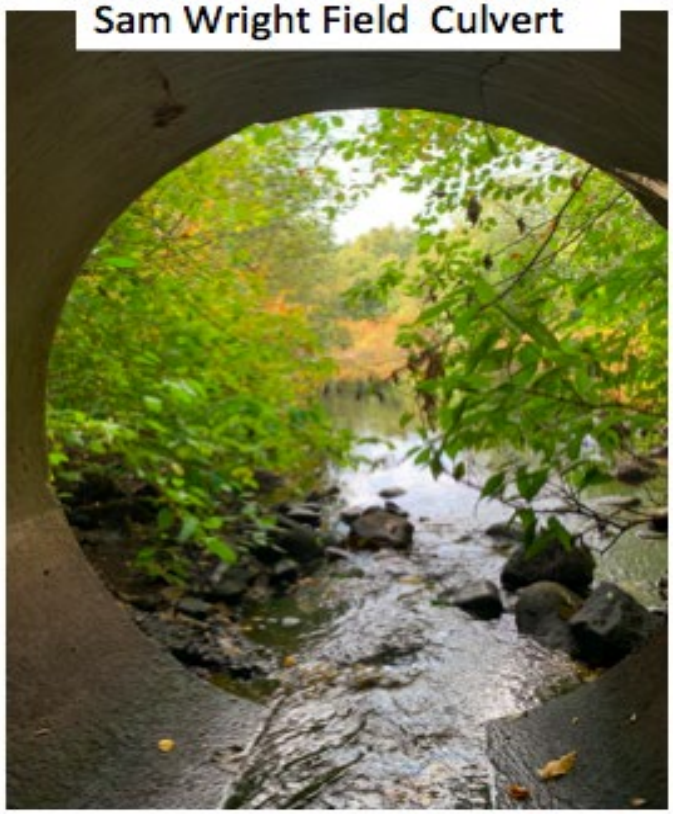


1. New Pond Dam
2. Foundry Street Culvert
3. South Street Culvert - *Complete*
4. Highland Street Culvert
5. Sam Wright Field Wetland Restoration
6. Conservation Wheaton Farm

Easton: Mulberry Meadow Brook Watershed

New South Street Culvert

Aging Highland Street Culvert



Sam Wright Field Culvert

Easton: Mulberry Meadow Brook Watershed

Sam Wright Field Wetland Restoration

- Expand flood storage capacity (FEMA Zone A)
- Remove concrete structures
- Reestablish wetland soils and elevation grade
- Seeding and planting
- Remove and manage invasive plant species
- Establish no-mow zones

Community Engagement

Next Steps

- Work with communities to identify projects that they have interest in advancing toward implementation
- Ongoing technical assistance to further develop priority projects and connect to funding opportunities
- Identify needs for training/workshops that support communities efforts to advance projects
- Continued engagement with communities

Observations:

Communities:

- Have capacity limitations in setting priorities and positioning themselves for funding
- Struggle with competing demands on their time, challenge for engagement
- Immediate demands often negate ability to look at projects from perspective of multiple benefits
- Competition for consulting services
- Significant investment of time/effort is needed to position projects to apply for funding and advance them to implementation

Public:

- Does not understand the connection between their involvement and implementation
- Need for resources to translate the benefits of NBS to the public

Opportunities

- Focused community assistance helps build momentum
- Local champions serve a vital role in advancing projects - Easton
- Mulberry Meadow Brook example will serve as a model to educate communities across the region
- Benefits of working at watershed scale *(focused effort over time on multiple interventions, combined with multiple benefits)*

Thanks for your time today!

Please share additional thoughts, questions, comments with:

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