Climate Change & Nature Based Solutions

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Key Observed Climate Changes in MA

Temperature:

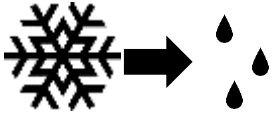
2.8°F

Since 1895

Growing Season:

10 Days

Since 1950



Sea Level Rise:

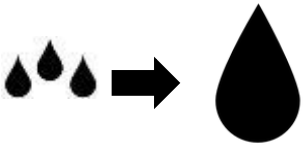
10 inches

Since 1922

Strong Storms:

71%

Since 1958



Future Expectations

Annual precipitation likely to increase

Extreme precipitation more likely

Outdated assessments do not capture continual change.

Sea level rise will drive greater flood risk.

There are real solutions.

One of the best adaptation practices is preserving natural areas.

-Based Solutions

Nature-Based Solutions *use* natural systems, *mimic* natural processes, or *work in tandem with* traditional approaches to address natural hazards like flooding, erosion, drought, and heat islands.

Incorporating nature-based solutions in local planning, zoning, regulations, and built projects can help communities reduce their exposure to these impacts, resulting in reduced costs, economic enhancement, and safer, more resilient communities.

What is Green Infrastructure?

A network of waterways, wetlands, woodlands, wildlife habitats, and other natural areas that support native species, maintain natural ecological processes, sustain air and water resources and contribute to health and quality of life.

(McDonald, Benedict and O'Conner, 2005)

Free ecosystem services:

Free services provided by the natural landscape

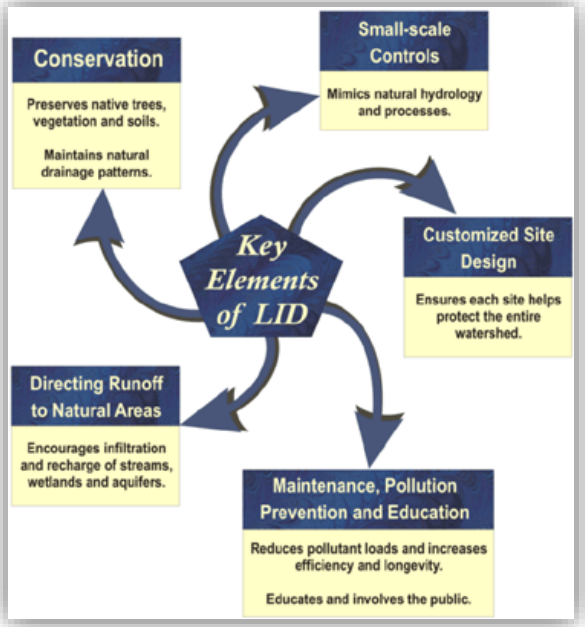
Every $1 invested in land conservation offers a ***$4 Return on Investment*** in terms of these ecosystem service values

- **Flooding**: Floodplains provide flood protection and reduce infrastructure damage
- **Public Health**: Managing stormwater and reducing retention ponds reduces creation of mosquito habitat
- **Air Quality & Public Health**: Trees reduce the urban heat island effect, reducing smog creation and resulting asthma occurrences as well as reducing nitrogen dioxide and particulate matter
- **Water Quality**: Streamside vegetation filters pollutants and reduces erosion
- **Water Quantity**: Forests and wetlands store water, improve water quality, and recharge groundwater
- **Recreation**: Clean, flowing waters support recreation, including boating, fishing, and swimming while open space provides areas for hiking and biking
- **Quality of Life**: Open space and street trees create a more enjoyable walking environment, benefiting community connection, health, and economic benefit in downtowns and commercial areas
- **Property Value**: Healthy, mature trees add an average of 10-30% to a property's value

What is Low Impact Development?

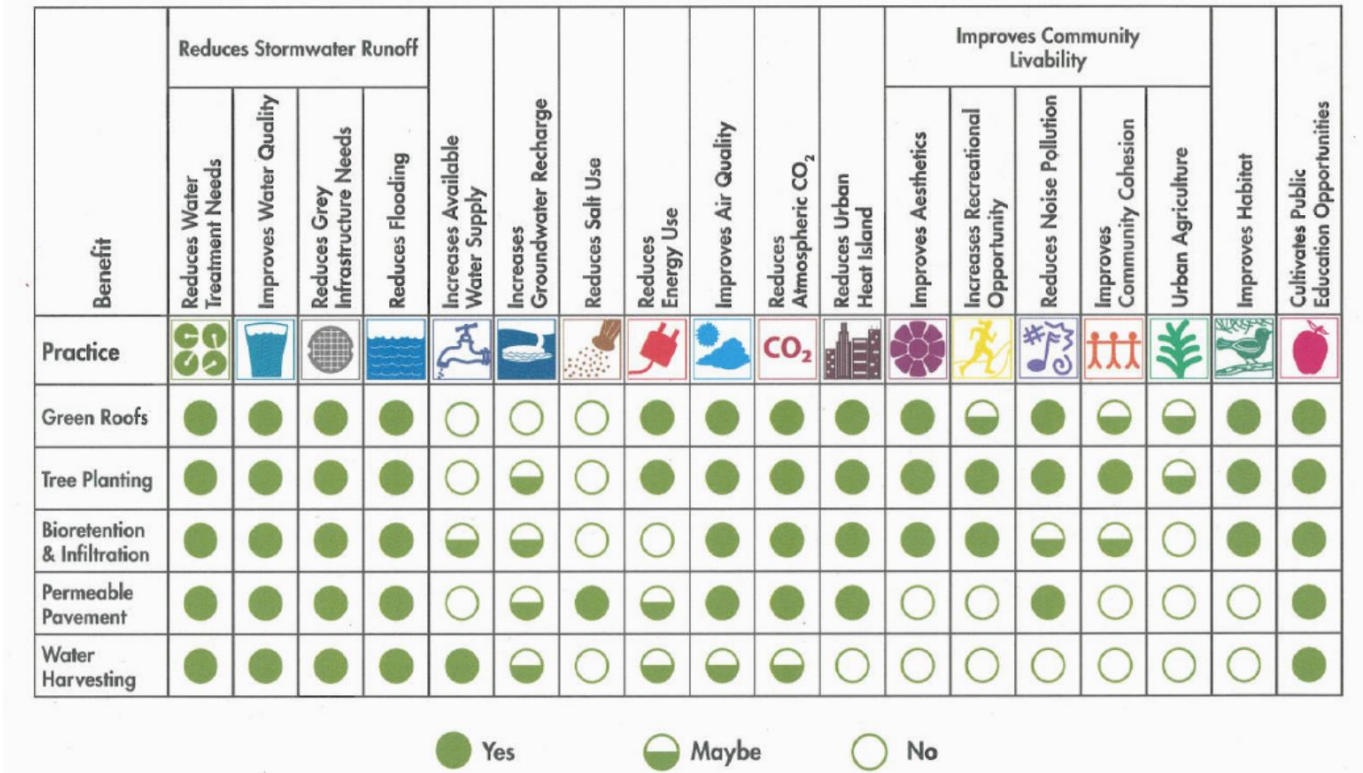
"LID is an approach to land development (or re-development) that **works with nature to manage stormwater** as close to its source as possible. LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that **treat stormwater as a resource** rather than a waste product."

- EPA



Source: Whole Buildings Design Guide, wbdg.com

Co-benefits



Source: Center for Neighborhood Technology's The Value of Green Infrastructure

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CHARLES D. BAKER
GOVERNOR

KARYN E. POLITO
LIEUTENANT GOVERNOR

By His Excellency
CHARLES D. BAKER
GOVERNOR

EXECUTIVE ORDER NO. 569

ESTABLISHING AN INTEGRATED CLIMATE CHANGE STRATEGY FOR THE COMMONWEALTH

WHEREAS, climate change presents a serious threat to the environment and the Commonwealth's residents, communities, and economy;

WHEREAS, extreme weather events associated with climate change present a serious threat to public safety, and the lives and property of our residents;

WHEREAS, the Global Warming Solutions Act (the "GWSA") directs the Secretary of Energy and Environmental Affairs and the Department of Environmental Protection to take certain steps to reduce greenhouse gas emissions and prepare for the impacts of climate change, including setting statewide greenhouse gas emissions limits for 2020, 2030, 2040 and 2050;

WHEREAS, the statewide greenhouse gas emissions limit for 2020 is 25% below the 1990 level of emissions and the corresponding limit for 2050 is 80% below the 1990 level of emissions, but no interim limits have yet been set for 2030 or 2040;

WHEREAS, the Commonwealth can provide leadership by reducing its own emissions from state operations, planning and preparing for impending climate change, and enhancing the resilience of government investments;

WHEREAS, the transportation sector continues to be a significant contributor to greenhouse gas emissions in the Commonwealth, and is the only sector identified through the GWSA with a volumetric increase in greenhouse gas emissions;

WHEREAS, the generation and consumption of energy continues to be a significant contributor to greenhouse gas emissions in the Commonwealth, and there is significant potential

Municipal **V**ulnerability **P**repardedness Process

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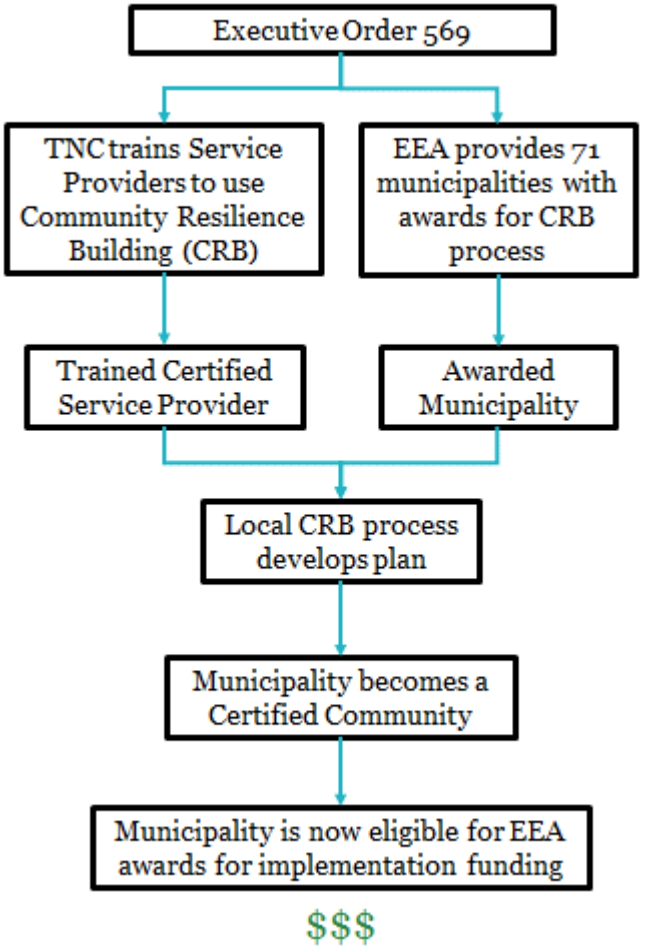
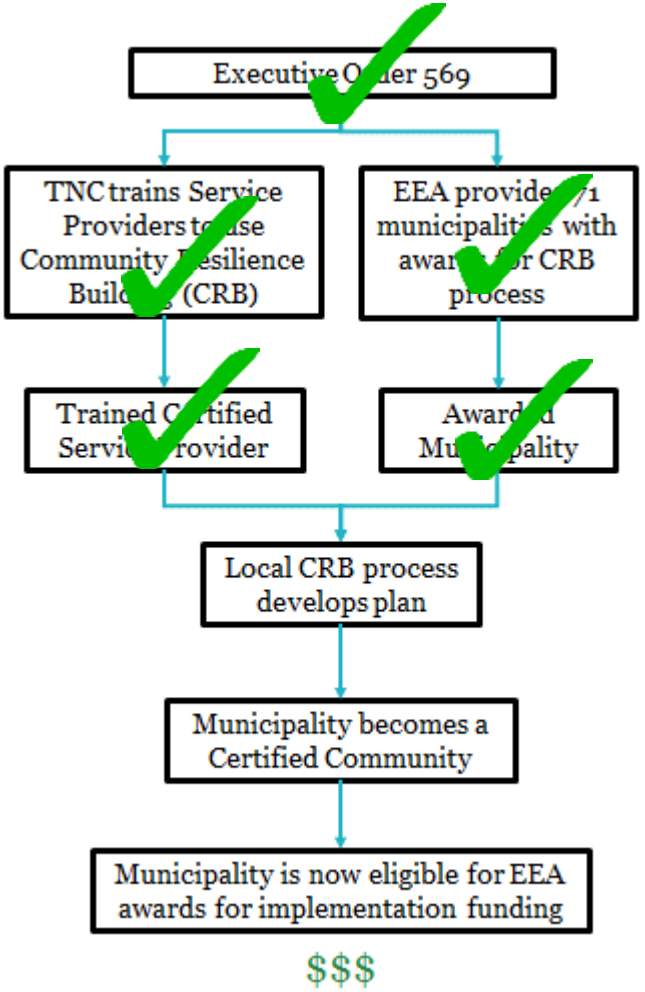


Where is MVP Now?

- Communities are choosing their provider
- Providers are planning their CRB process



Community Resilience Building

WORKSHOP GUIDE

- Stakeholder based vulnerability and strength identification process.
- Participants identify opportunities to increase resilience, develop solutions, and prioritize actions.
- Prioritized action plans are developed including time horizon information

Increased flooding


Photo Credit: Alison Bowden


Photo Credit: Alison Bowden


Photo Credit: Alison Bowden

Land protection = water protection

- Quabbin & Wachusett Reservoirs serve 2.5 million
- Over 20 years, Massachusetts Water Resources Authority spent $130M to protect 22,000 acres of watershed lands
- Avoided ratepayer cost of $250M on a filtration plant and $4M/yr in operations

Mill River: Whittenton Dam Removal, Taunton

- Costs
  - Estimated repair cost: $1.9M
  - Ongoing maintenance cost: variable
  - 2005 evacuation cost: $1.5M
  - Dam removal cost: $440,000
- Benefits
  - Increased revenue from river-based recreation
  - Increased property values
  - Improved water quality

DER Research on Dam Removal

DER projects produce an average employment demand of **12.5 jobs** and **$1.75 Million** in total economic output from each $1 Million spent, contributing to a growing “restoration economy” in Massachusetts

Massachusetts Department of Fish and Game
Division of Ecological Restoration
Invested in Nature and Community

Weir Village Park, Taunton

- Redevelopment project demolishing old F.B. Rogers Silver factory in Taunton
- Building new city park and boat ramp to improve access and public safety
- Working with TNC to construct rain gardens to reduce runoff impairments into Taunton River

Mass Audubon's Broad Meadow Brook Wildlife Sanctuary, Worcester

- Redevelopment at largest urban wildlife sanctuary in New England
- Capturing all stormwater on site through LID BMPs
    - Rain gardens
    - Pervious pavers
    - Rain barrels
    - No-mow areas
    - Stormwater grates

Natural Landscaping & Grasses vs. Traditional Turf

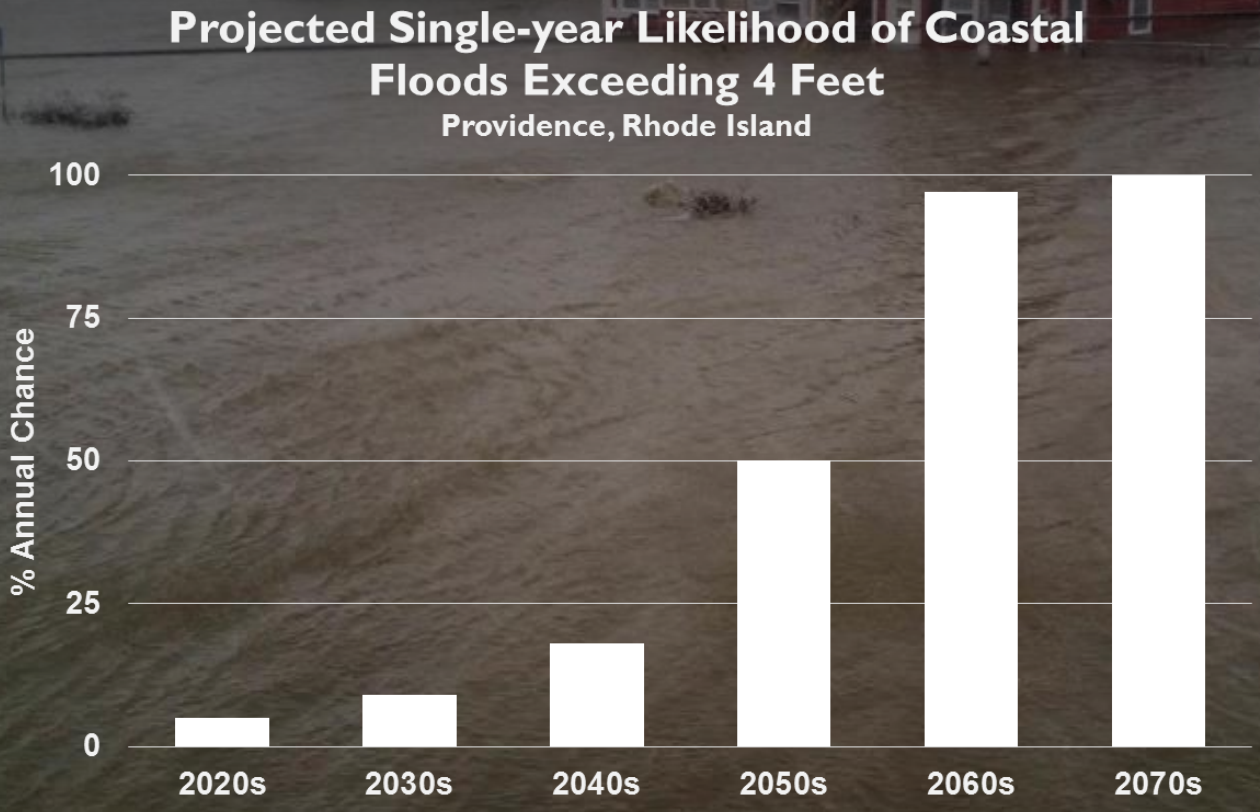
Cost Savings

- Annual maintenance savings: $4,500/acre
- Installation savings: $4,000-8,000/acre

Additional benefits

- increased curb appeal
- improved stormwater retention

Coastal Flooding



Nature on its own is resilient and reacts to changes

Source: Google Earth

Our infrastructure doesn't react the same way

HELP ME CHOOSE

Hazard Types

- [x] Coastal Erosion
- [ ] Tidal Flooding
- [x] Coastal Flooding
- [ ] Riverine Erosion
- [ ] Riverine Flooding
- [ ] Stormwater Flooding

Region

- [ ] Coastal West
- [ ] Great Lakes
- [ ] Gulf of Mexico
- [ ] Mid-Atlantic
- [ ] Midwest
- [x] Northeast
- [ ] Pacific Northwest
- [ ] Rocky Mountain West
- [ ] Southeast
- [ ] Southwest

Community Type

- [x] Rural
- [ ] Suburban
- [ ] Urban

Scale

- [ ] Community
- [x] Neighborhood
- [ ] Site

Cost

- [x] $
- [ ] $$
- [ ] $$$
- [ ] $$$$

CLEAR ALL

Coastal Marshes

Coastal Erosion | Riverine Flooding | Riverine Erosion | Coastal Flooding | Stormwater Flooding | Tidal Flooding

Coastal wetlands occur along marine, estuarine, and freshwater coastlines and may be...

Beaches and Dunes

Coastal Erosion | Riverine Flooding | Riverine Erosion | Coastal Flooding | Stormwater Flooding | Tidal Flooding

Beaches and dunes occur in a variety of shapes, sizes, compositions, and...

Restoring Offshore Features

Coastal Erosion | Riverine Flooding | Riverine Erosion | Coastal Flooding | Stormwater Flooding | Tidal Flooding

Restoration is the process of establishing or reestablishing a habitat that closely...

Restoring Coastal Features

Coastal Erosion | Riverine Flooding | Riverine Erosion | Coastal Flooding | Stormwater Flooding | Tidal Flooding

Natural coastlines have evolved to absorb wave energy and provide a buffer...

Regulatory and Policy Approaches to Address Hazards

Coastal Erosion | Riverine Flooding | Riverine Erosion | Coastal Flooding | Stormwater Flooding | Tidal Flooding

Flooding is a natural process that, in the absence of human settlements...

Planning Approaches to Reduce Natural Hazards

Coastal Erosion | Riverine Flooding | Riverine Erosion | Coastal Flooding | Stormwater Flooding | Tidal Flooding

Flooding is a natural process that, in the absence of human settlements...

Enhanced Floodplain Mapping

Coastal Erosion | Riverine Flooding | Riverine Erosion | Coastal Flooding | Stormwater Flooding | Tidal Flooding

Flooding is a natural process that, in the absence of human settlements...

Open Space Preservation through Land Acquisition

Coastal Erosion | Riverine Flooding | Riverine Erosion | Coastal Flooding | Stormwater Flooding | Tidal Flooding

This strategy focuses on the public acquisition of undeveloped land to lessen...

Living Breakwaters

Coastal Erosion | Riverine Flooding | Riverine Erosion | Coastal Flooding | Stormwater Flooding | Tidal Flooding

Breakwaters are offshore structures designed to limit wave energy by creating a...

http://nrcsolutions.org/

Swansea Marsh and Habitat Conservation

- 37 acres in Palmer River Corridor purchased and conserved by Town of Swansea, Wildlands Trust, and Blount Fine Foods for $110,000
- Major storms in 2010 and 2012 damaged stormwater and transportation infrastructure

Resilience Benefits

- Dissipated energy from storm, tide, and flood events
- Avoided cost of infrastructure repairs and replacement
- Protected water quality
- Future marsh migration

Massachusetts Forests Mitigate Climate Change

- MA forests **sequester 14%** of the state's gross annual carbon emissions
- Average acre stores **85 tons carbon**
- Capacity **increases** over time as forests mature

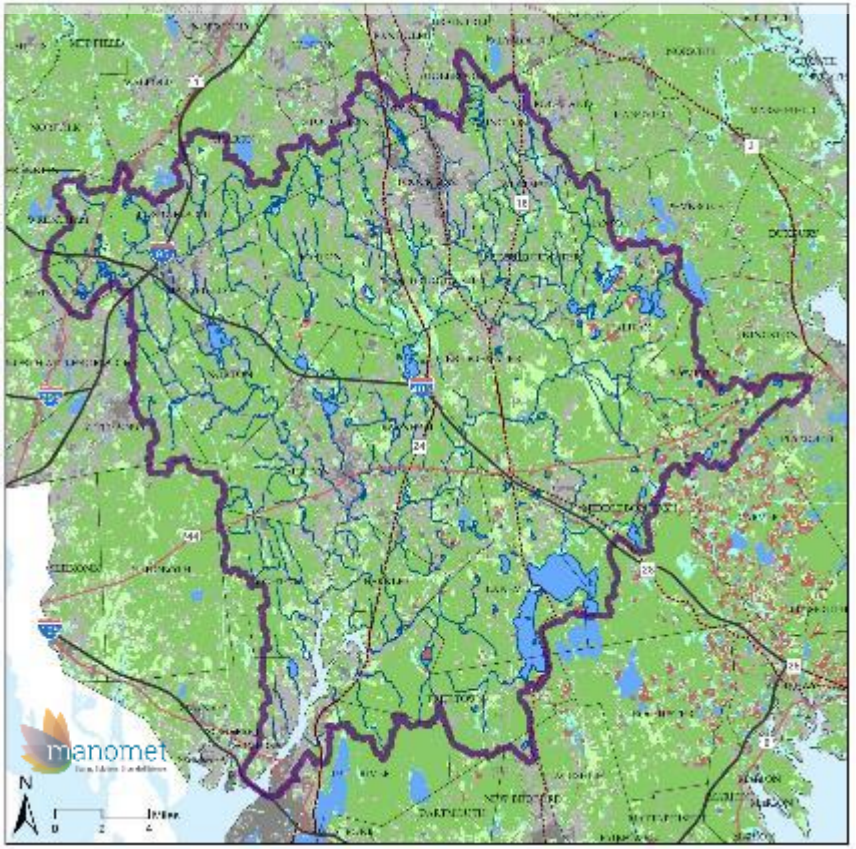
They also provide free ecosystem services

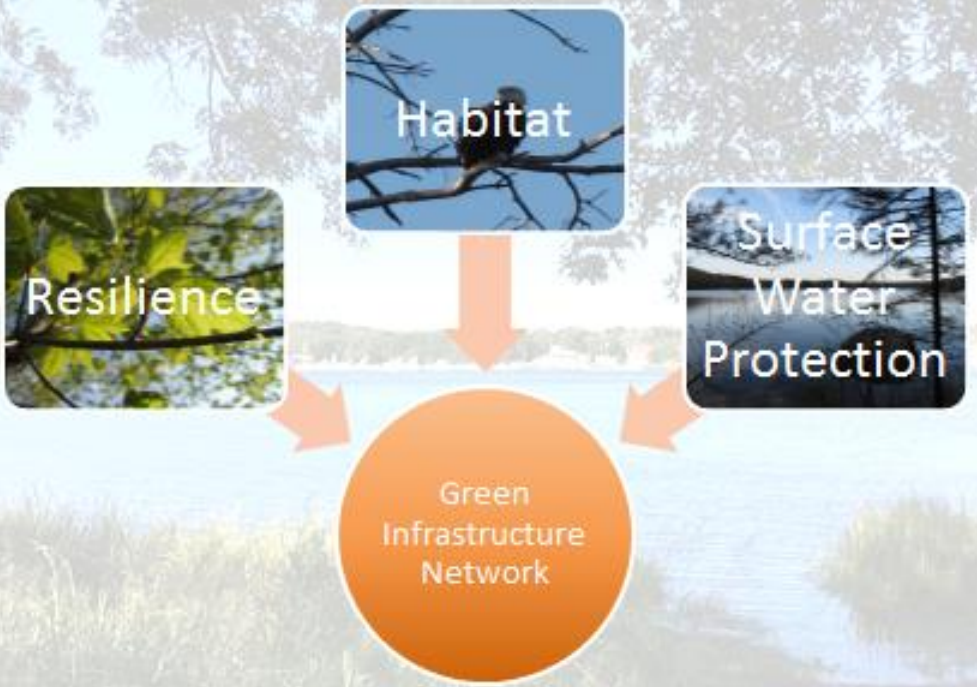
- Shade
- Windblock
- Shelter
- Sponge
- Carbon
- Filter

MA forests provide over **$3.8 billion** each year in free ecosystem services

UMass Amherst Guide: Increasing Forest Resiliency

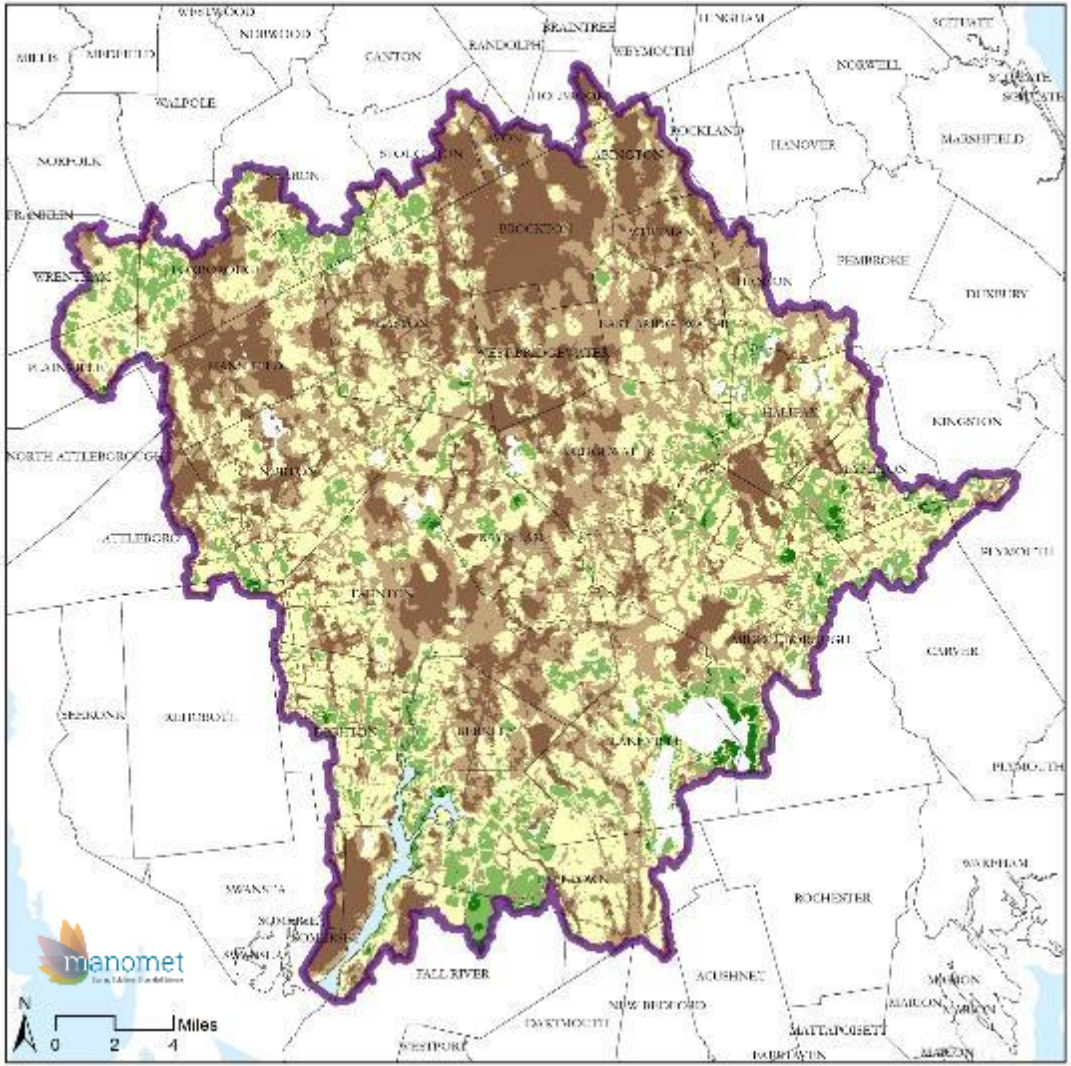
Green Infrastructure Mapping in Taunton Watershed




Habitat
Resilience
Surface Water Protection
Green Infrastructure Network

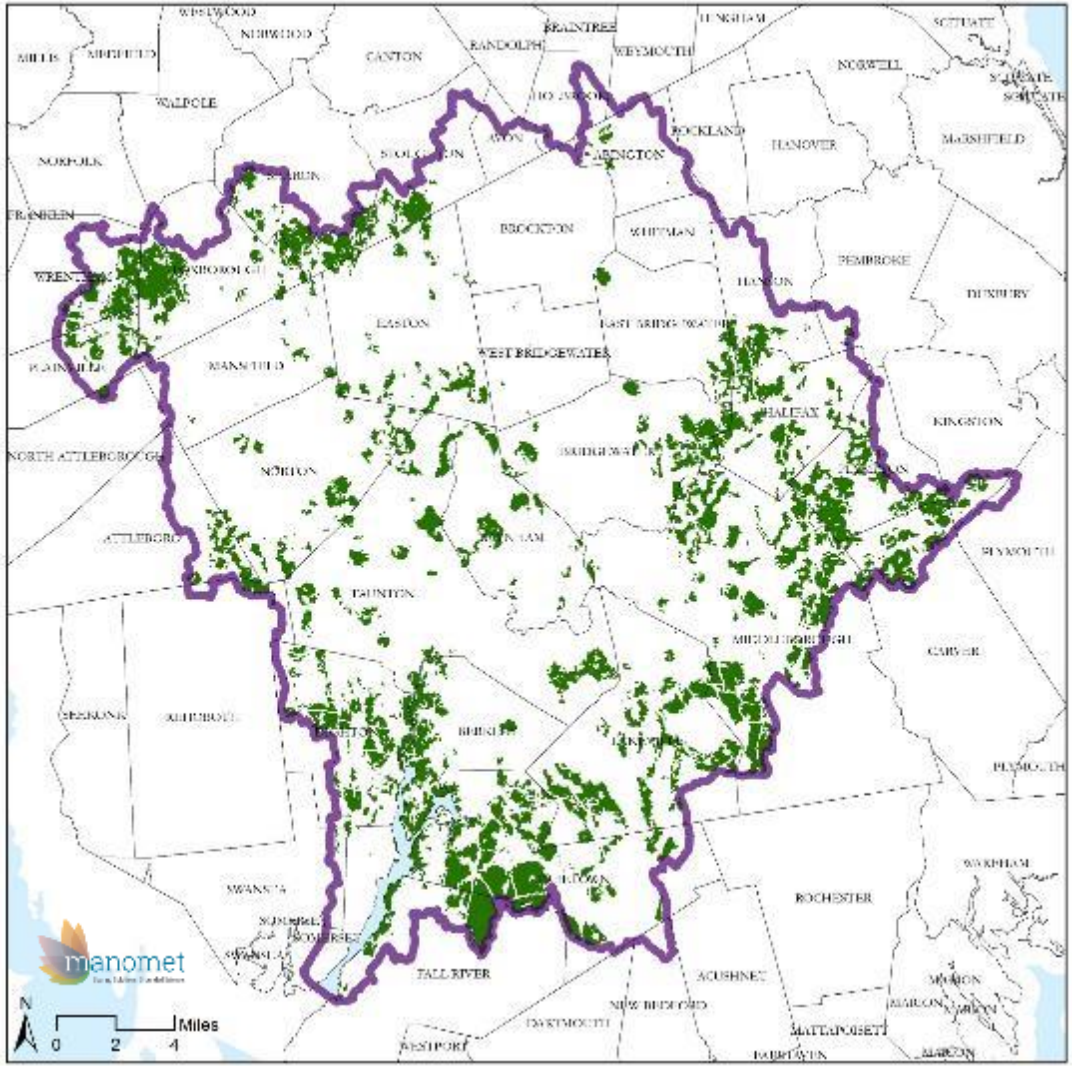
Resilient Landscapes

Complex
topography
+
Connected
natural cover
+
High quality
biodiversity features



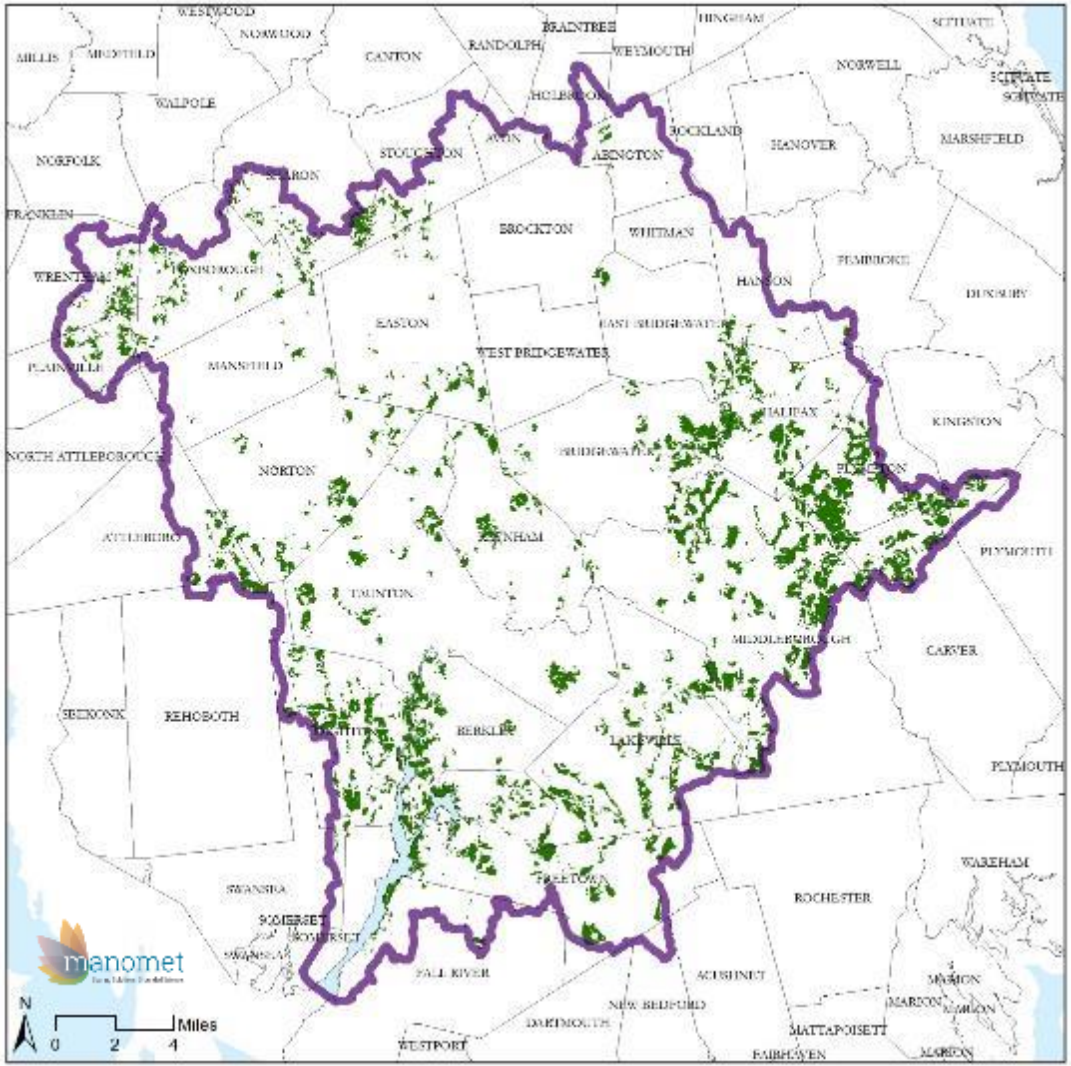
Resilient Landscapes

Areas of Above Average Resilience



Resilient Landscapes

Areas of Above Average Resilience that are **Undeveloped & Unprotected**



Legend

Taunton Watershed Boundary

Town Boundaries

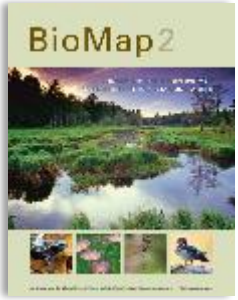
Resilience

Undeveloped and Unprotected Areas of Above Average Resilience

Green Infrastructure Network Components…

Areas of Above Average Resilience

BioMap2 Core and Critical Natural Landscape Areas that are **Undeveloped & Unprotected**



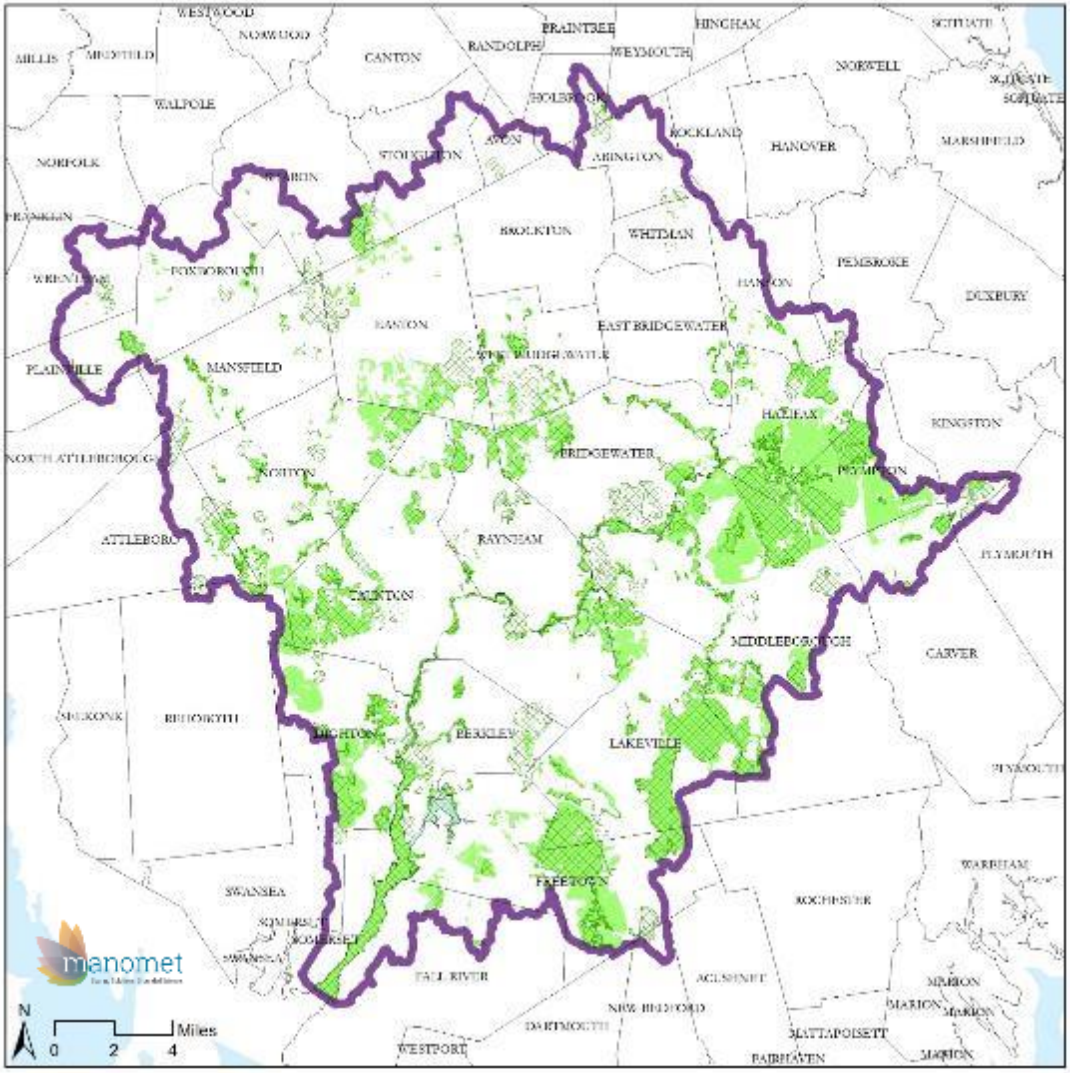
Legend

Taunton Watershed

Town

Undeveloped and Unprotected BioMap2 Core

Undeveloped and Unprotected BioMap2 Critical Natural

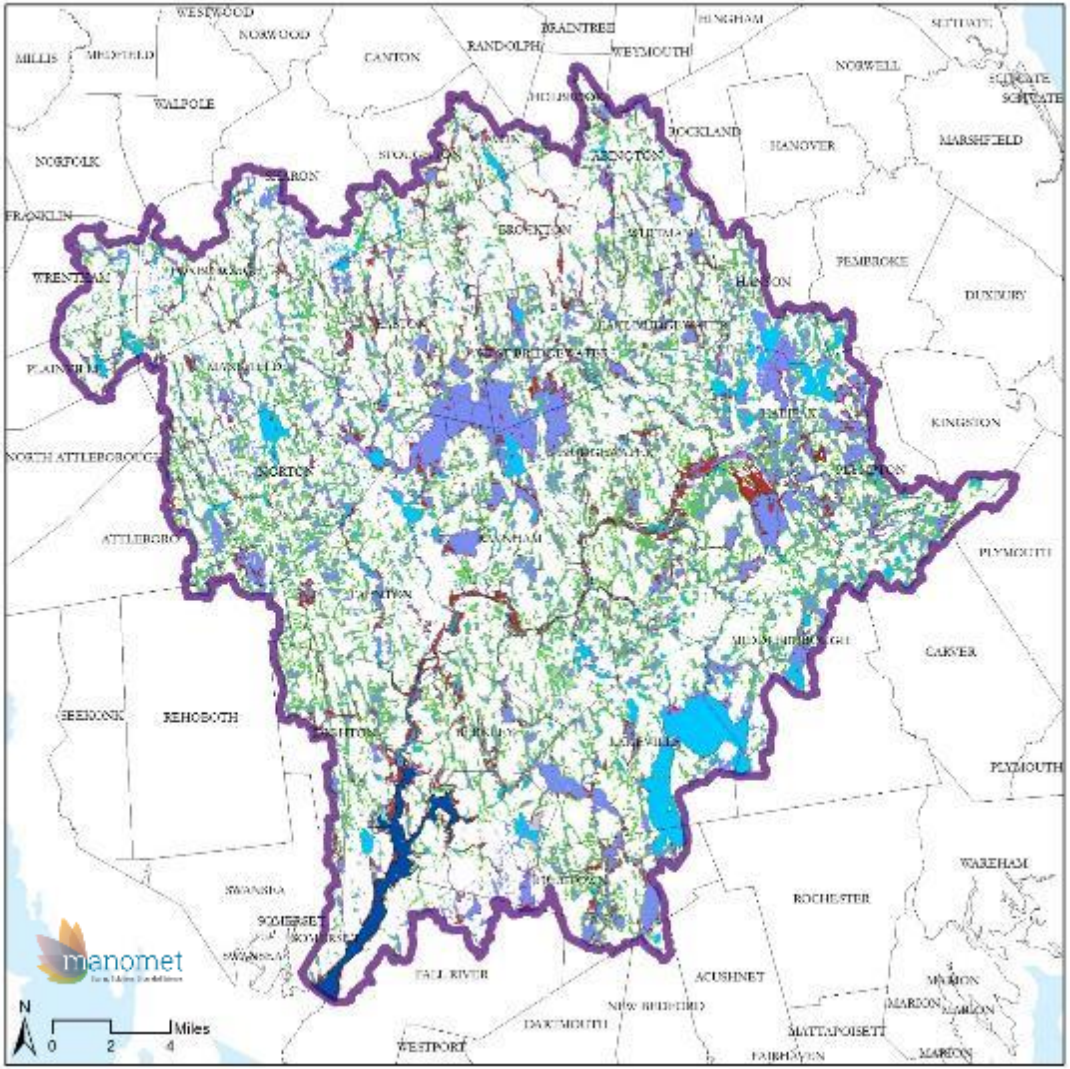


Green Infrastructure Network Components…

Areas of Above Average Resilience

BioMap2 Core & Critical Natural Landscape

Surface water, wetlands, and Riparian buffer areas that are **Undeveloped & Unprotected**



Legend

- Taunton Watershed Boundary
- Town Boundaries
- Undeveloped and Unprotected areas within 100ft of surface waters, wetlands, and flood zones
- 100-yr and High Risk Coastal Flood Areas

Surface Waters & Wetlands

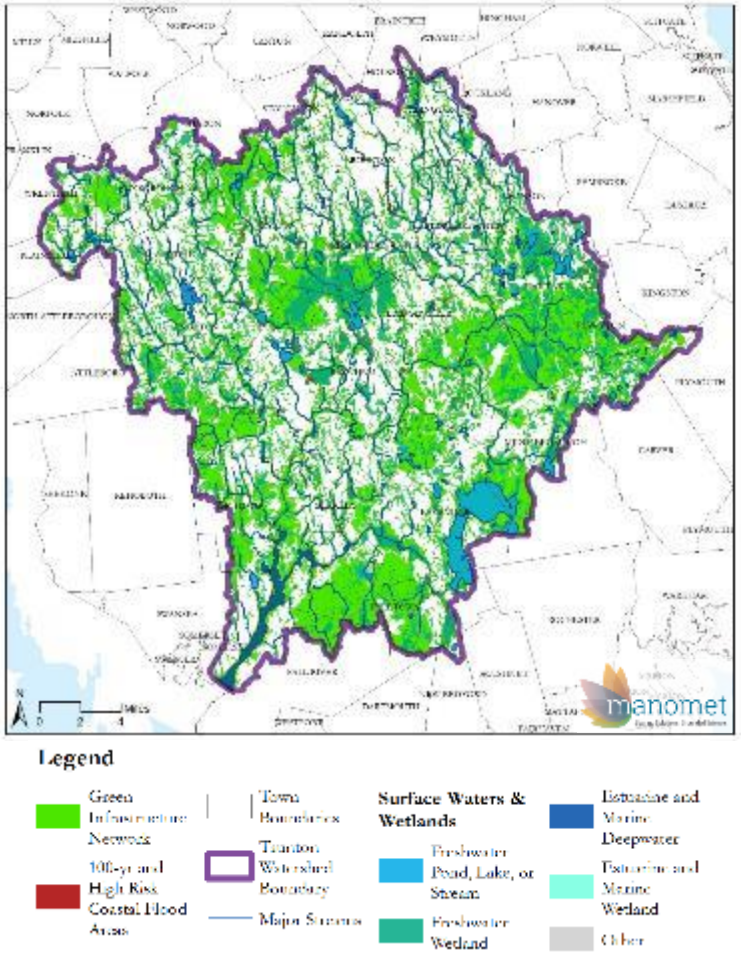
- Freshwater Pond, Lake, or Stream
- Freshwater Wetland
- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Other

Green Infrastructure Network Components…

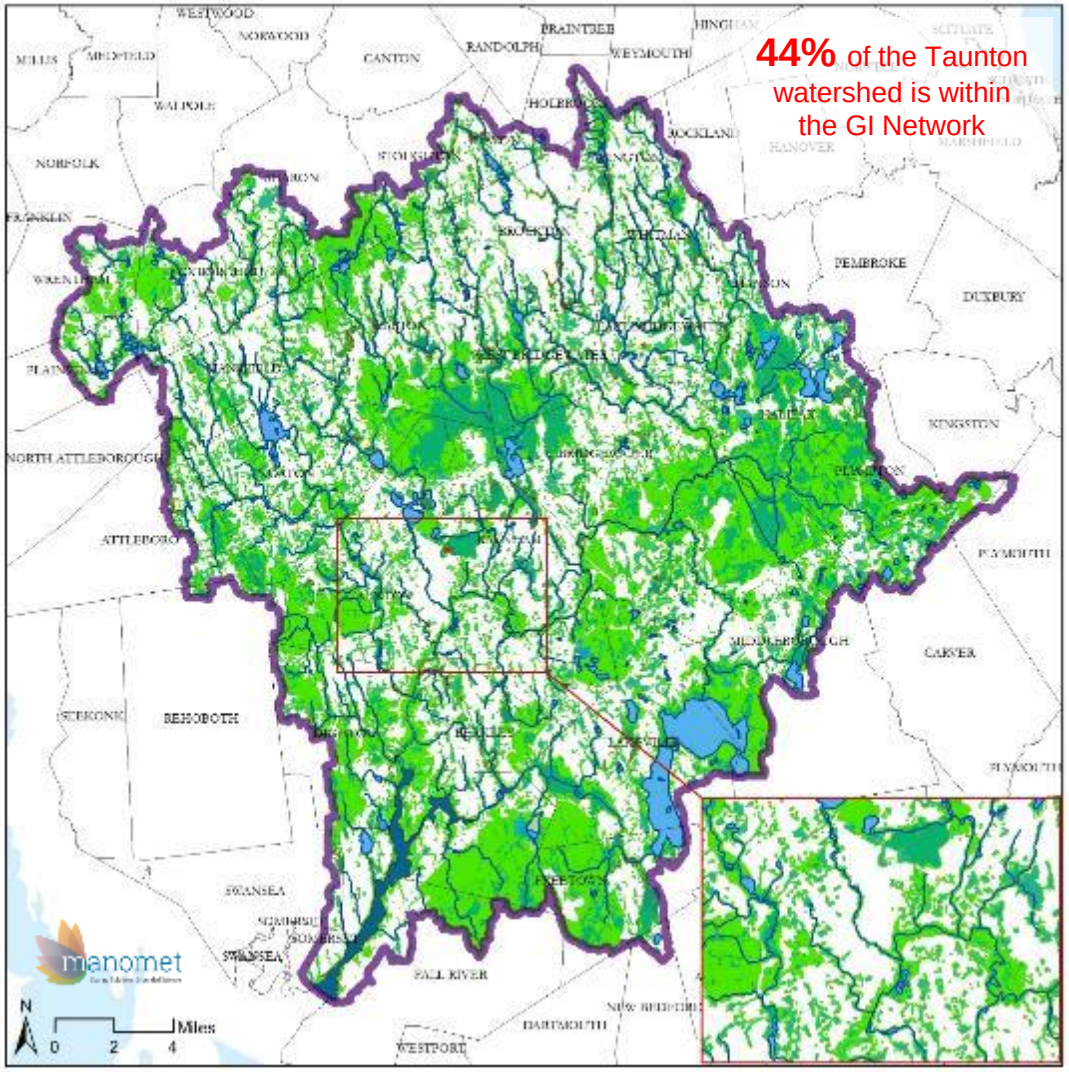
Areas of Above Average Resilience

BioMap2 Core & Critical Natural Landscape

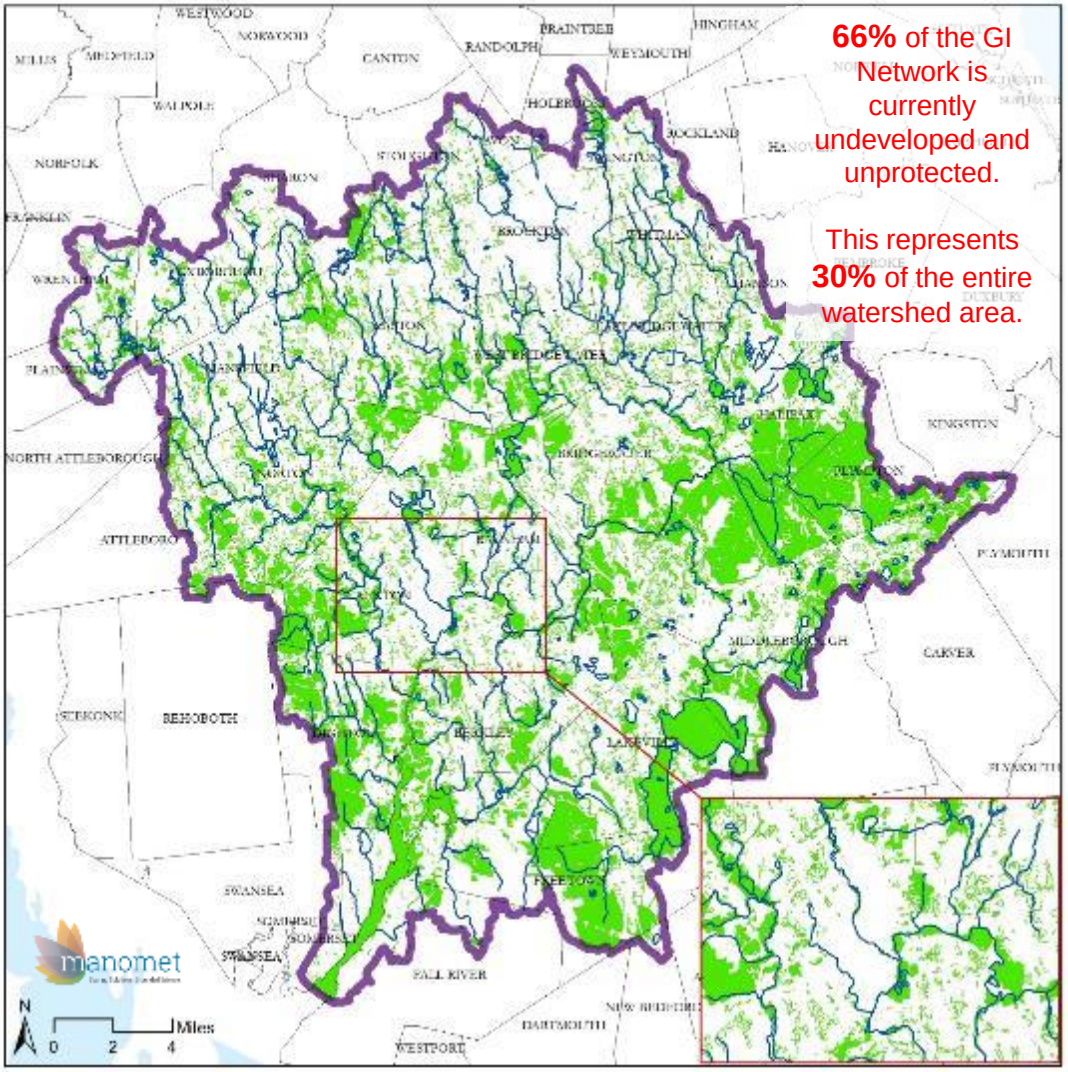
Areas within 100ft of Surface Waters, Wetlands, and Flood Zones; Areas </= 4m elevation (vulnerable to sea level rise)



Taunton Watershed **Green Infrastructure Network**



Taunton Watershed
Undeveloped & Unprotected (non surface/wetland) Green Infrastructure Network



66% of the GI Network is currently undeveloped and unprotected.

This represents **30%** of the entire watershed area.

Legend

- Undeveloped and Unprotected Green Infrastructure Network
- Town Boundaries
- Taunton Watershed Boundary
- Major Streams

Resources for Nature-Based Solutions

Guidance/Case Studies

- Naturally Resilient Communities successful project case studies from across the country to help communities learn and identify nature-based solutions
- EPA's Soak Up the Rain stormwater outreach tools, how-to guides and resources
- EPA's RAINE database of vulnerability, resilience and adaptation reports, plans and webpages at the state, regional and community level.
- Climate Action Tool explore adaptation strategies and actions to help maintain healthy, resilient wildlife communities in the face of climate change.

Mapping/Planning

- Mapping and Prioritizing Parcels for Resilience (MAPPR) identify the priority parcels for protection and climate change resilience
- Living Shorelines in New England: State of the Practice and Profile Pages for Solutions are case studies, siting criteria, and regulatory challenges for coastal resilience in New England.
- Low Impact Development Fact Sheets cover valuing green infrastructure, conservation design, development techniques, regulations, urban waters, and cost calculations.

Cost/Benefit

- EPA's Green Infrastructure cost/cost-benefit/tools Database of tools for comparing solution costs
- Massachusetts Division of Ecological Restoration's economic benefits of aquatic restoration based on Massachusetts case studies

Bylaws/Ordinances

- EEA's Smart Growth Toolkit access to information on planning, zoning, subdivision, site design, and building construction techniques
- Guide for Supporting LID in Local Land Use Regulations provides a framework for communities to review their zoning, rules, and regulations for a number of factors.

Conclusion

- Importance of stewardship, planning ahead for these critical resource areas
- GI offers efficient ways to both mitigate and adapt to climate change in many types of environments (beach, forest, watershed protection)
- Many options to implement site specific LID practices, including urban areas


Thank you!
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