Creating Healthy, Resilient Communities
through Green Infrastructure and Low Impact Development

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SHAPING the Future of YOUR COMMUNITY

Agenda

1. Introduction and context
2. Green infrastructure analysis at the watershed scale
3. Linking local actions and regional planning
4. Challenges & lessons learned

Resilient Taunton Watershed Network (RTWN) Project Partners

SRPEDD

manomet
Soaring Solutions. Grounded Science.

The Nature Conservancy
nature.org

Mass Audubon
Protecting the Nature of Massachusetts

MAPC

SHAPING the Future of YOUR COMMUNITY

Manomet

Applying Science and Engaging People to Sustain our World

Programs:

- Shorebird Recovery
- Landbird Conservation
- Sustainable Economies
- Climate Services

Website: www.manomet.org

Mass Audubon: Shaping the Future of Your Community

Mass Audubon
Protecting the Nature of Massachusetts

SHAPING the Future of YOUR COMMUNITY

Helping communities chart a more sustainable future

- ✓Customized workshops
- ✓Planning advice
- ✓Technical assistance

massaudubon.org/shapingthefuture

RTWN: Who we are & our goals

Formed in 2104, we're a **collaboration** of local, non-profit, regional organizations, and state and federal government representatives who care about the future health and resilience of the Taunton River Watershed **and believe that ecological and economic resilience go hand in hand.**

- ✓**Promote environmental, economic, and social resiliency**
- ✓**Provide education and resources to local officials and residents**

srpedd.org/rtwn

RTWN Members

Bridgewater State University
Horsley Witten Group
Manomet Inc.
MA Department of Environmental Protection (DEP)
MA Division of Ecological Restoration (DER)
MA Executive Office of Energy and Environmental Affairs (EEA)
Mass Audubon
Metropolitan Area Planning Council (MAPC)
Narragansett Bay Estuary Program
The Nature Conservancy (TNC)
Old Colony Planning Council (OCPC)
Save the Bay
Southeastern Regional Planning and Economic Development District (SRPEDD)
Taunton River Watershed Alliance (TRWA)
Tighe & Bond
US Environmental Protection Agency (EPA)
National Park Service
Wildlands Trust

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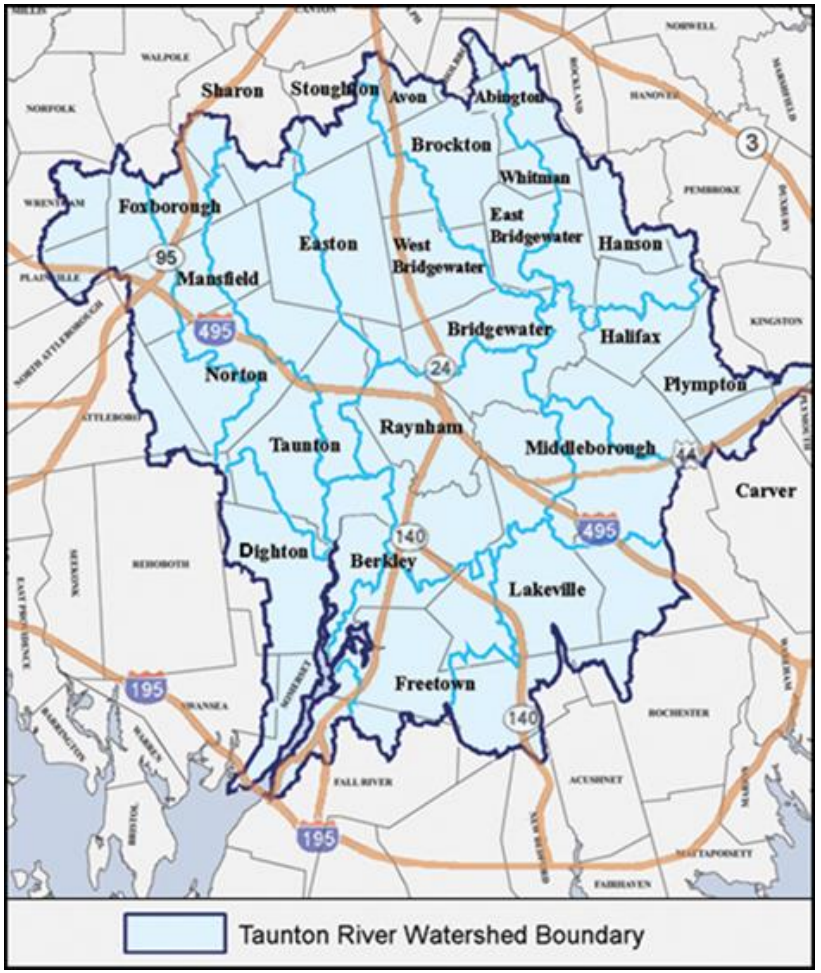
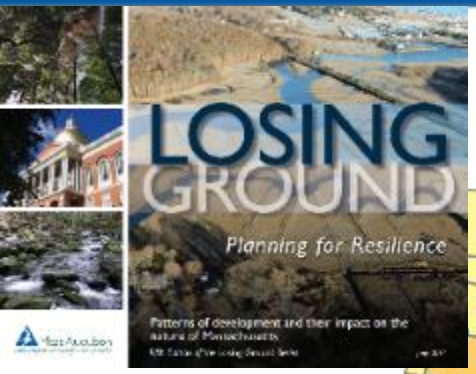
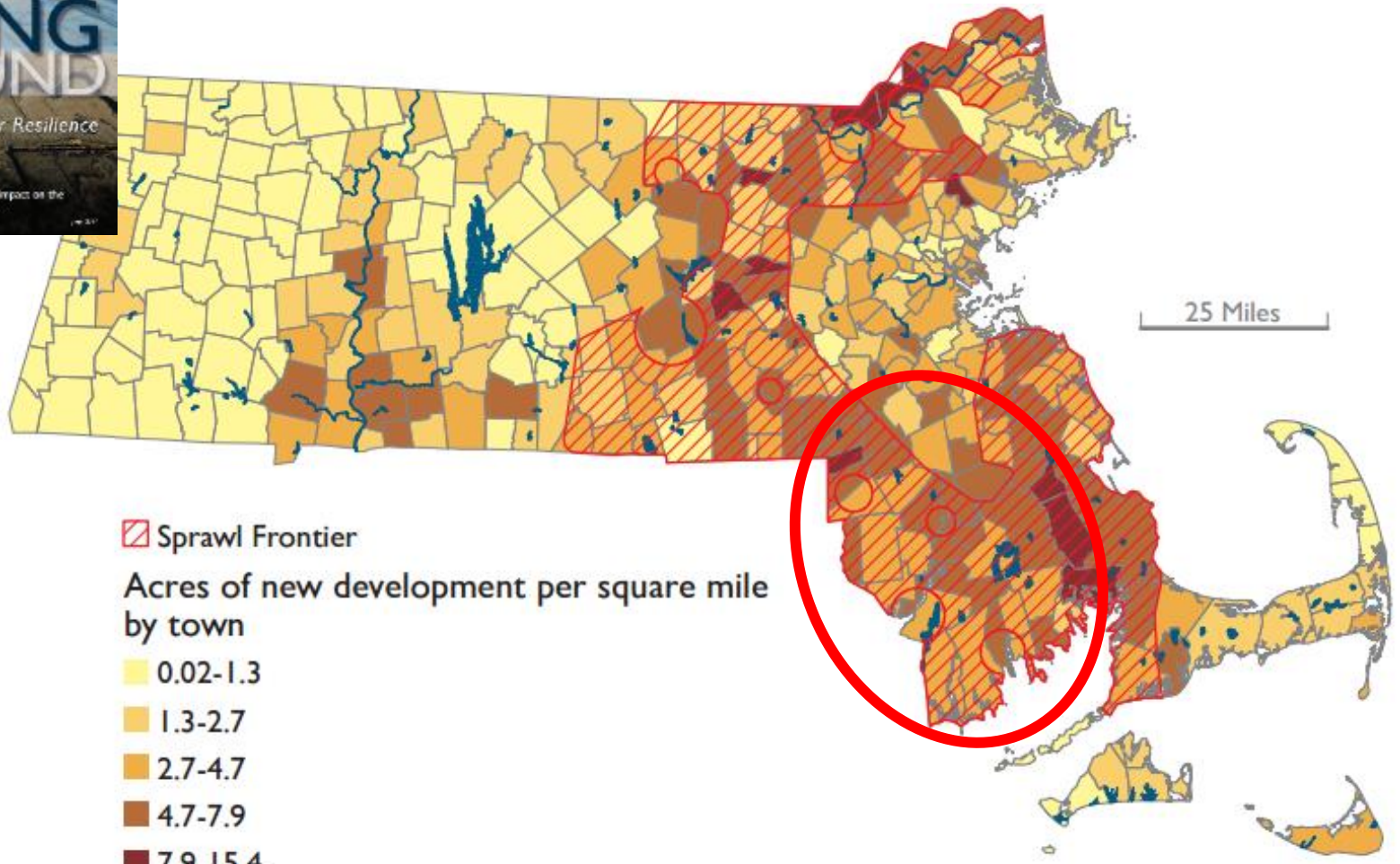
Why pilot this in the Taunton Watershed of Massachusetts?



1. The Taunton is the fastest developing watershed in MA





2. It's home to critical natural resources – threatened by climate change

- Taunton Wild and Scenic River is longest undammed coastal river in New England
- One of two largest contributors of fresh water to the Narragansett Bay
- Home to 150 species of birds, 29 native fish, and over 350 plant species
- Low-lying watershed, susceptible to inland flooding
- Existing issues exacerbated by climate change

3. We have an enormous opportunity

There is huge opportunity for improving future resilience

- **60%** of the land is **undeveloped**
- Only **15%** of the land is protected

How we will develop and conserve land in the future?

Key Observed Climate Changes in MA

Temperature: **2.8°F**

Since 1895

Growing Season: **10 Days**

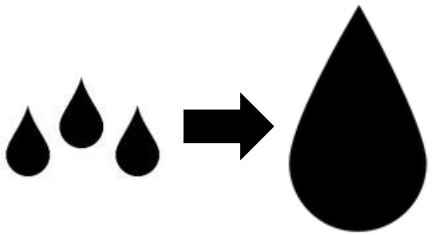
Since 1950

Sea Level Rise: **10 inches**

Since 1922

Strong Storms: **71%**

Since 1958



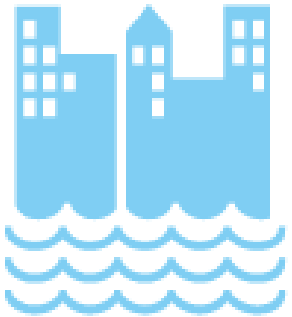
Future Expectations

Annual precipitation likely to increase

Extreme precipitation more likely

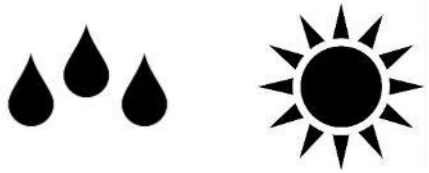
Outdated assessments do not capture continual change

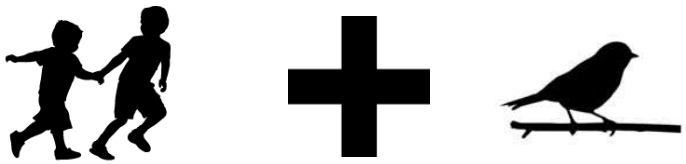
Sea level rise will drive greater flood risk



Project Goals

- Maximize the benefits provided by intact, healthy ecosystems
  - Climate change resiliency
  - Control of tax burden and infrastructure costs
  - Improve health and safety, quality of life





Project Structure

- Regional green infrastructure analysis:
  - Network of lands of highest conservation value due to the multiple ecosystem services that they provide
- Case Studies
- Five workshops throughout watershed on climate change and benefits of GI/LID
  - Work with local land managers to integrate local planning and development decisions with the watershed-scale green infrastructure network

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.

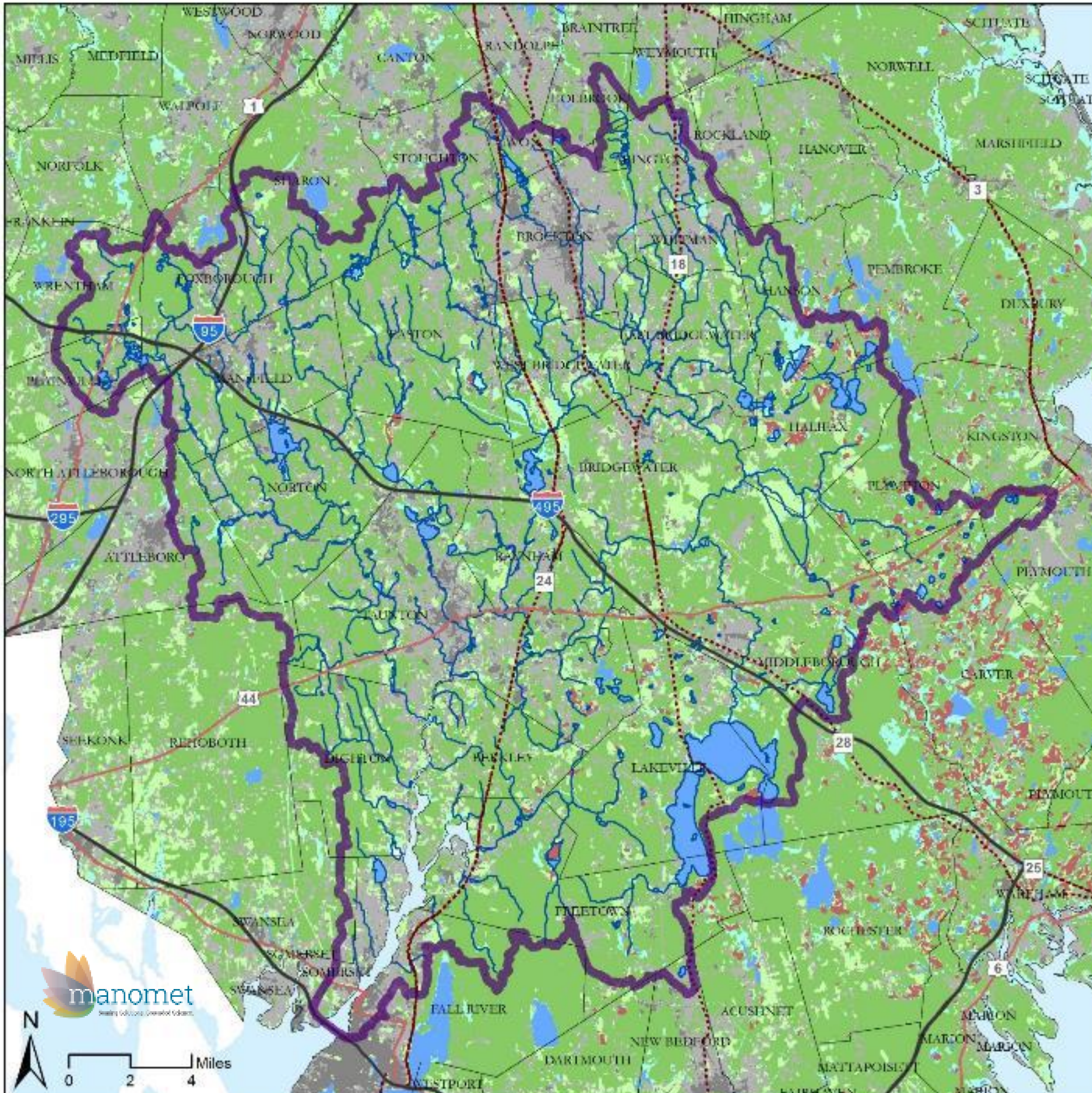
(McDonald, Benedict and O'Conner, 2005)

Low Impact Development

In the context of this project we are using the phrase "low impact development" to refer to local and site specific practices such as green roofs, bio-retention and infiltration, pervious pavement, etc.

Taunton Watershed Green Infrastructure Network

Context



Legend

Taunton Watershed Boundary

Streams

Town Boundaries

Land Use/Land Cover

Open (Ag; Bare; Non-forest vegetation)

Commercial/Industrial/High Dens Res

Low Density Residential

Forest (incl. Forested Wetland)

Wetland

Water

Cranberry Bog

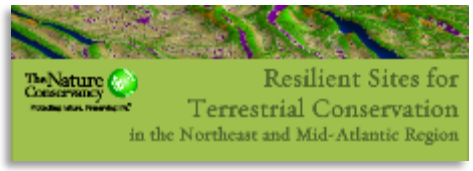
Major Routes, by Administrative Type

Interstate

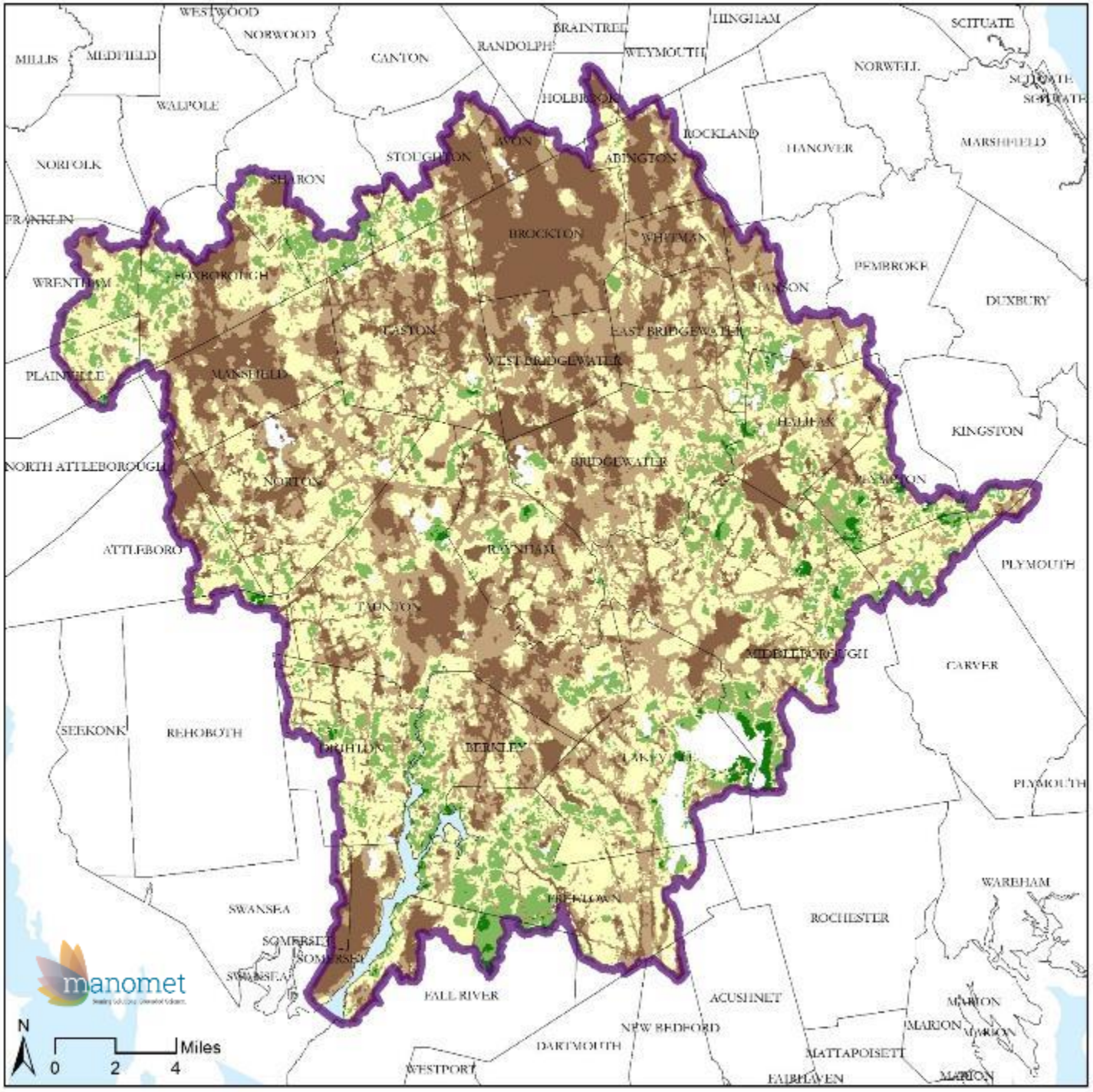
U.S. Highway

State Route

Resilient Landscapes



Complex
topography
+
Connected
natural cover
+
High quality
biodiversity features



Legend

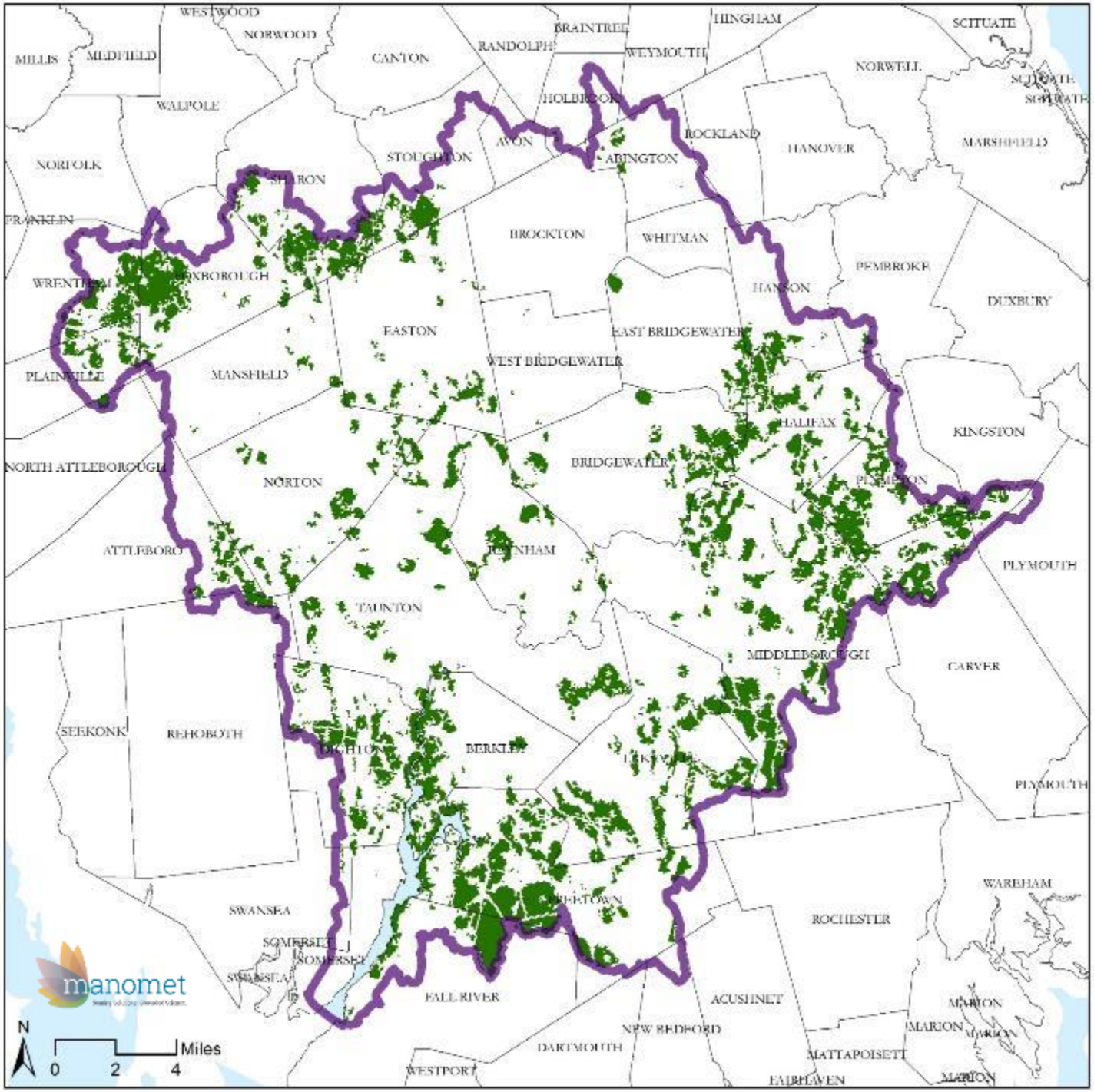
- Taunton Watershed Boundary
- Town Boundaries

Resilience

- Well Above Average
- Slightly Above Average
- Average
- Slightly Below Average
- Well Below Average

Resilient Landscapes

Areas of Above Average Resilience



Legend

- Taunton Watershed Boundary
- Town Boundaries

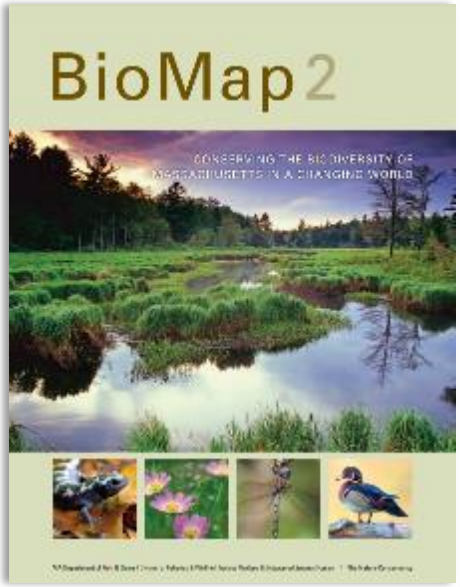
Resilience

- Areas of Above Average Resilience

Green Infrastructure Network Components…

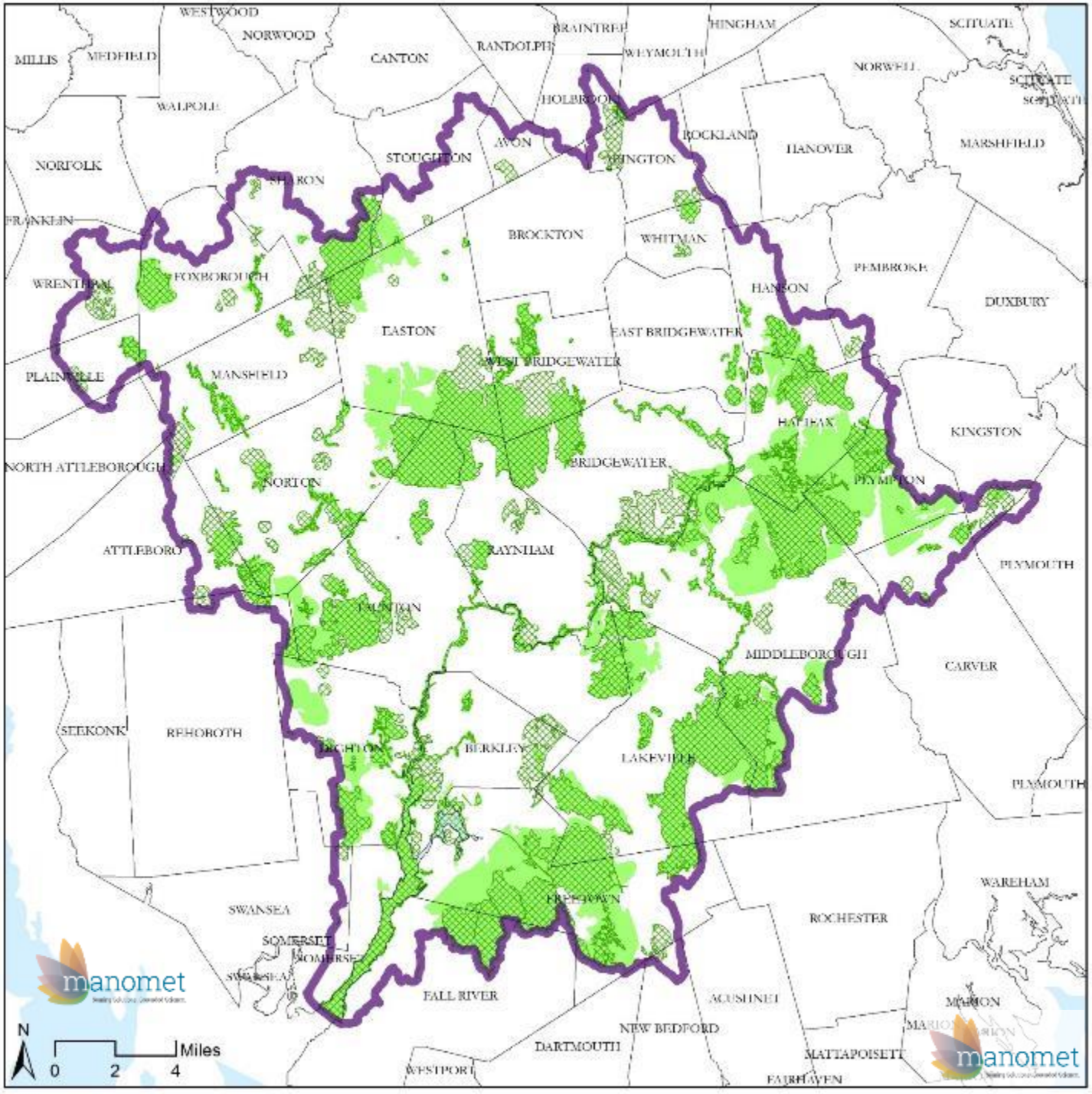
Areas of Above Average Resilience

BioMap2:
Core & Critical
Natural Landscape



Legend

- Taunton Watershed Boundary
- Town Boundaries
- BioMap2 Core Areas
- BioMap2 Critical Natural Landscape

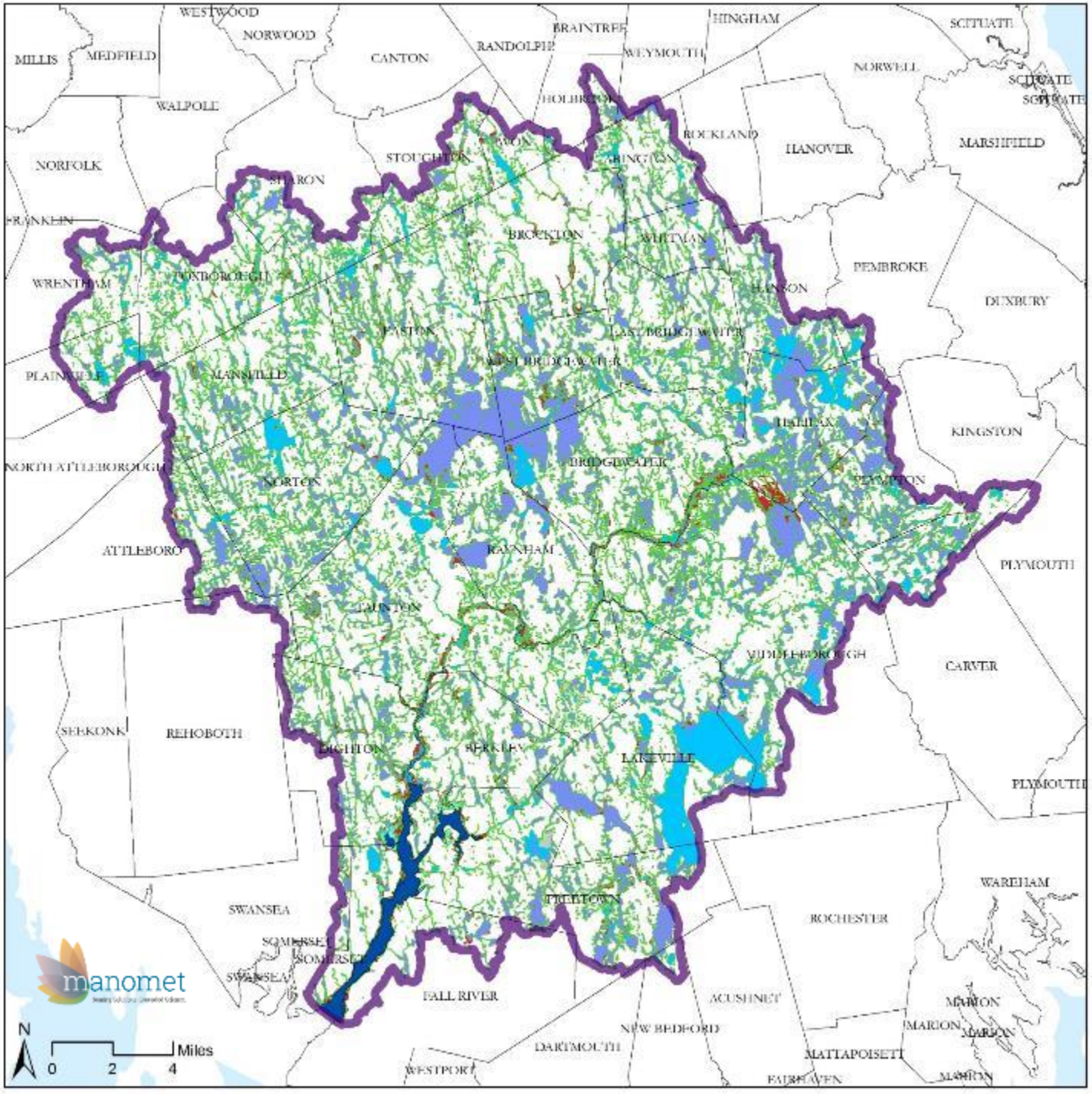


Green Infrastructure Network Components…

Areas of Above Average Resilience

BioMap2 Core & Critical Natural Landscape

Riparian Buffers



Legend

- Taunton Watershed Boundary
- Town Boundaries
- 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

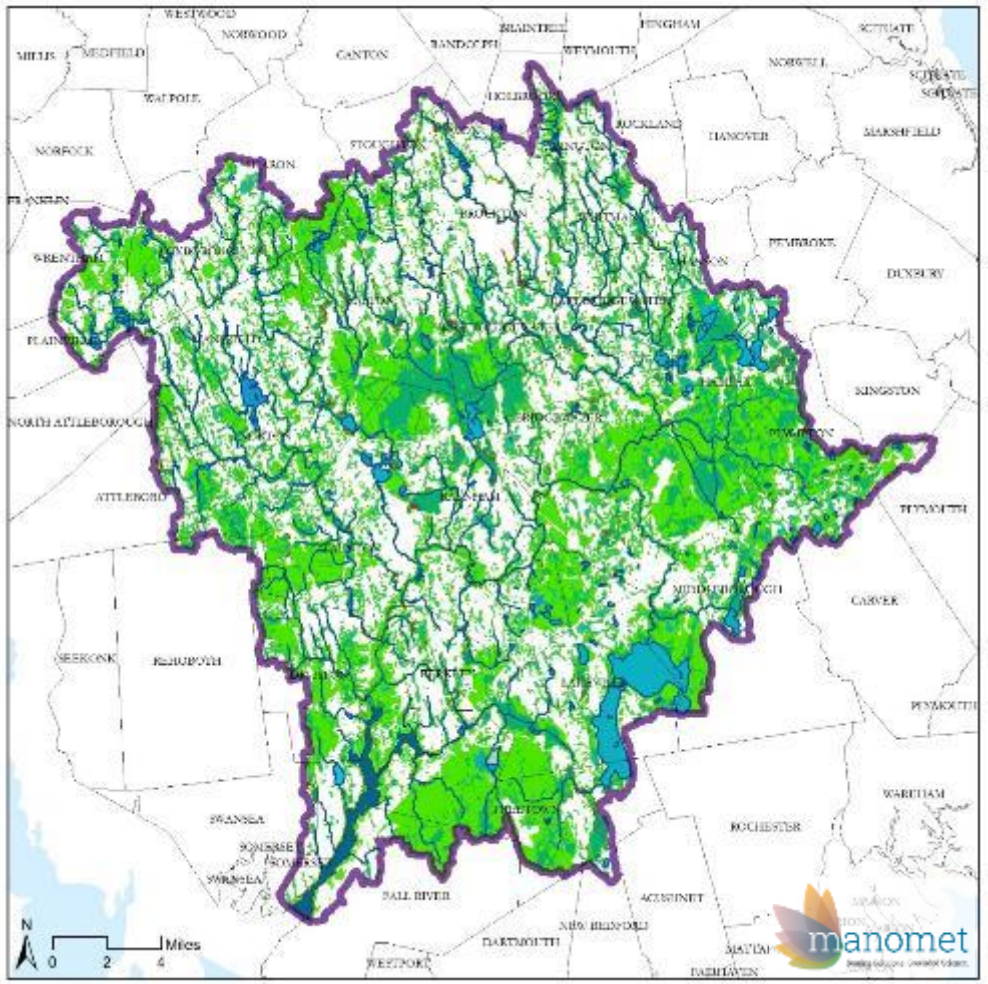
Areas within 100ft of Surface Waters, Wetlands, and Flood Zones; Areas </= 4m elevation (vulnerable to sea level rise)

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)



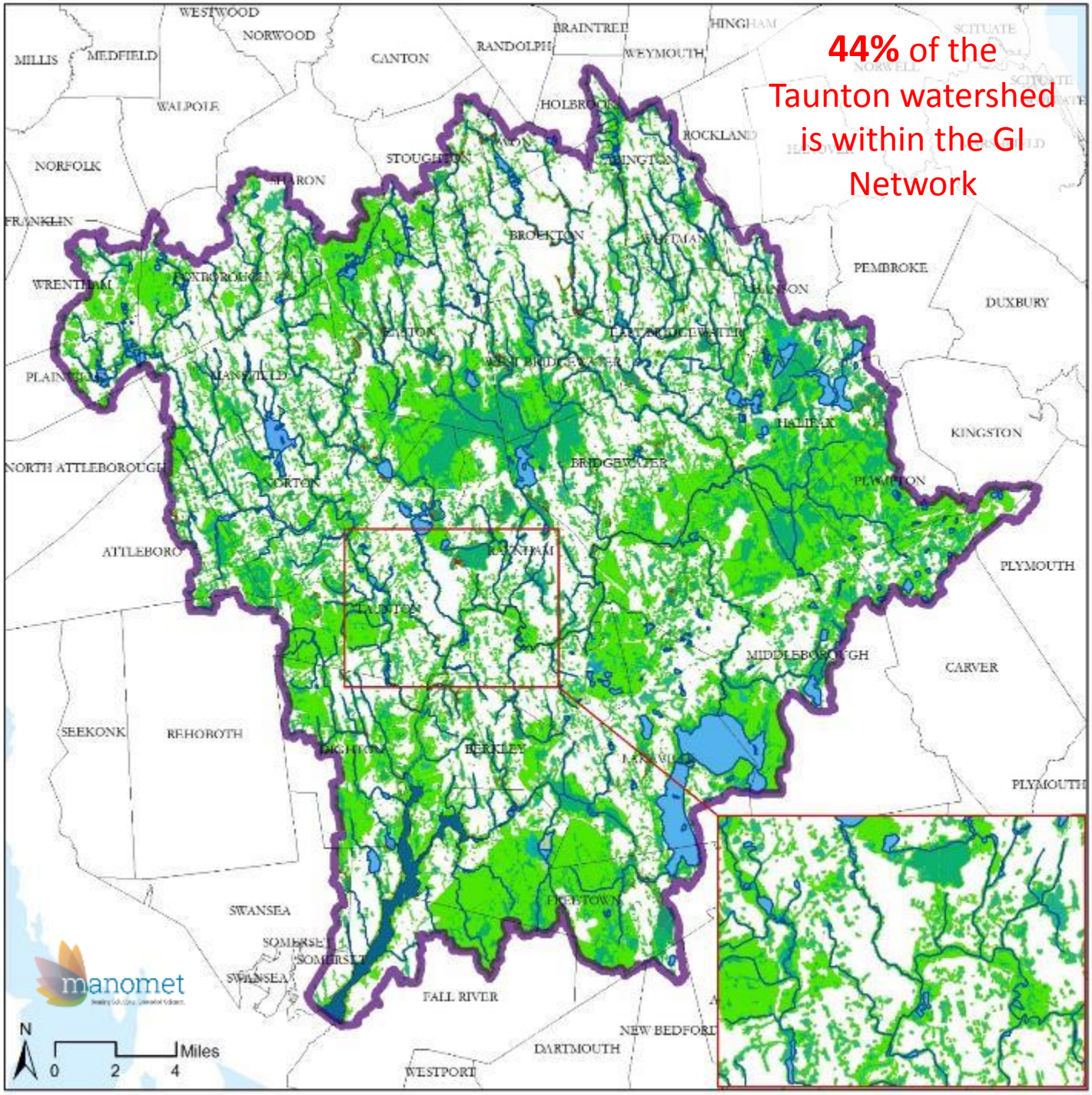
Legend

- Green Infrastructure Network
- 100-yr and High Risk Coastal Flood Areas
- Town Boundaries
- Taunton Watershed Boundary
- Major Streams

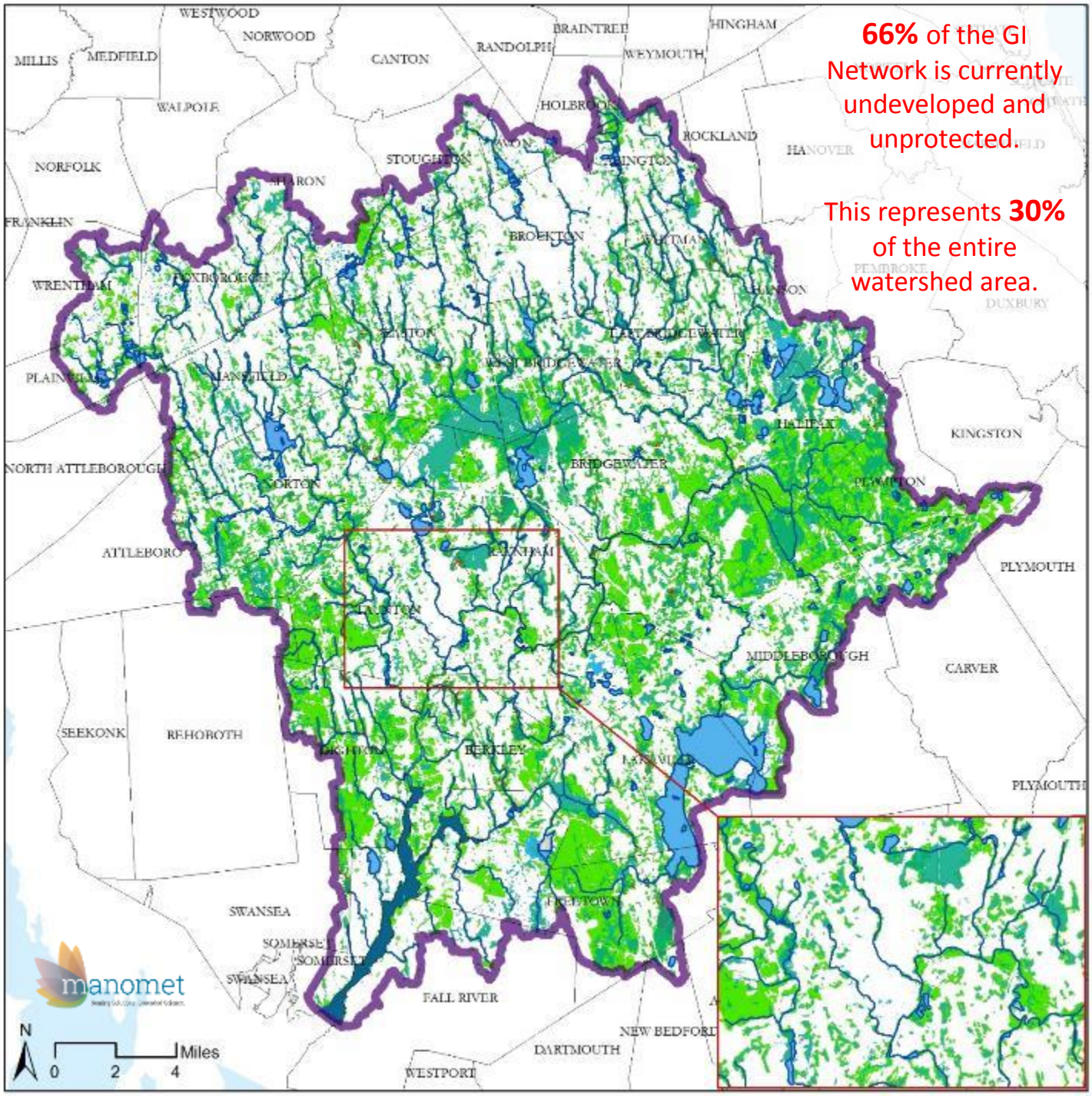
Surface Waters & Wetlands

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

Taunton Watershed **Green Infrastructure Network**



Taunton Watershed **Undeveloped & Unprotected Green Infrastructure Network**



Services Provided by the Taunton Green Infrastructure Network

- Control flooding and nonpoint source water pollution
- Maximize groundwater recharge
- Limit flooding associated with sea level rise
- Support biodiversity
- Control tax rates and reduce infrastructure costs
- Enhance quality of life

Linking Local and Regional Green Infrastructure

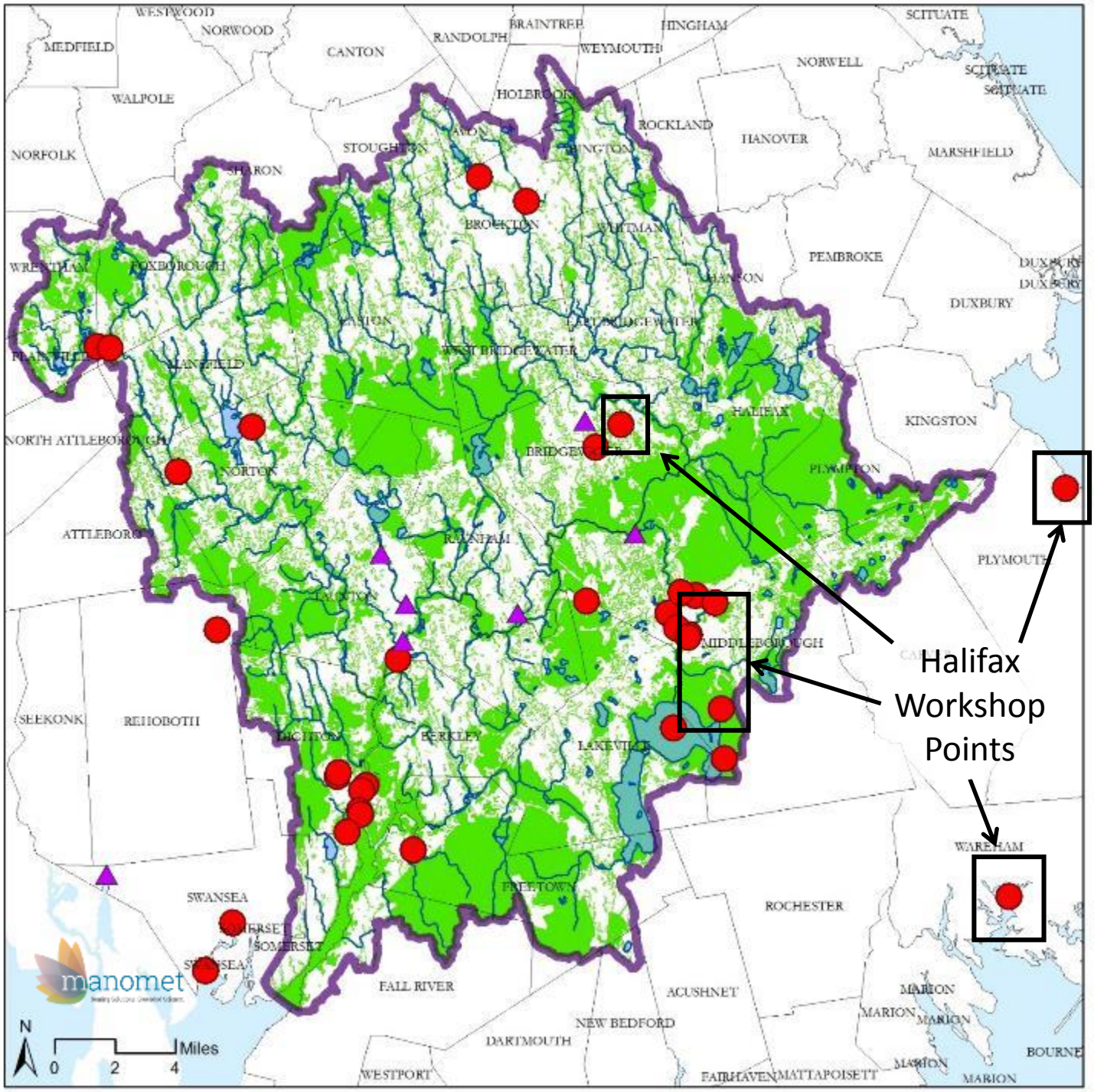
- **Benefits of linkage:**
  - Contribute to watershed-scale approach to addressing water balance, water quality and flooding concerns
  - Maximize the utility of local conservation planning

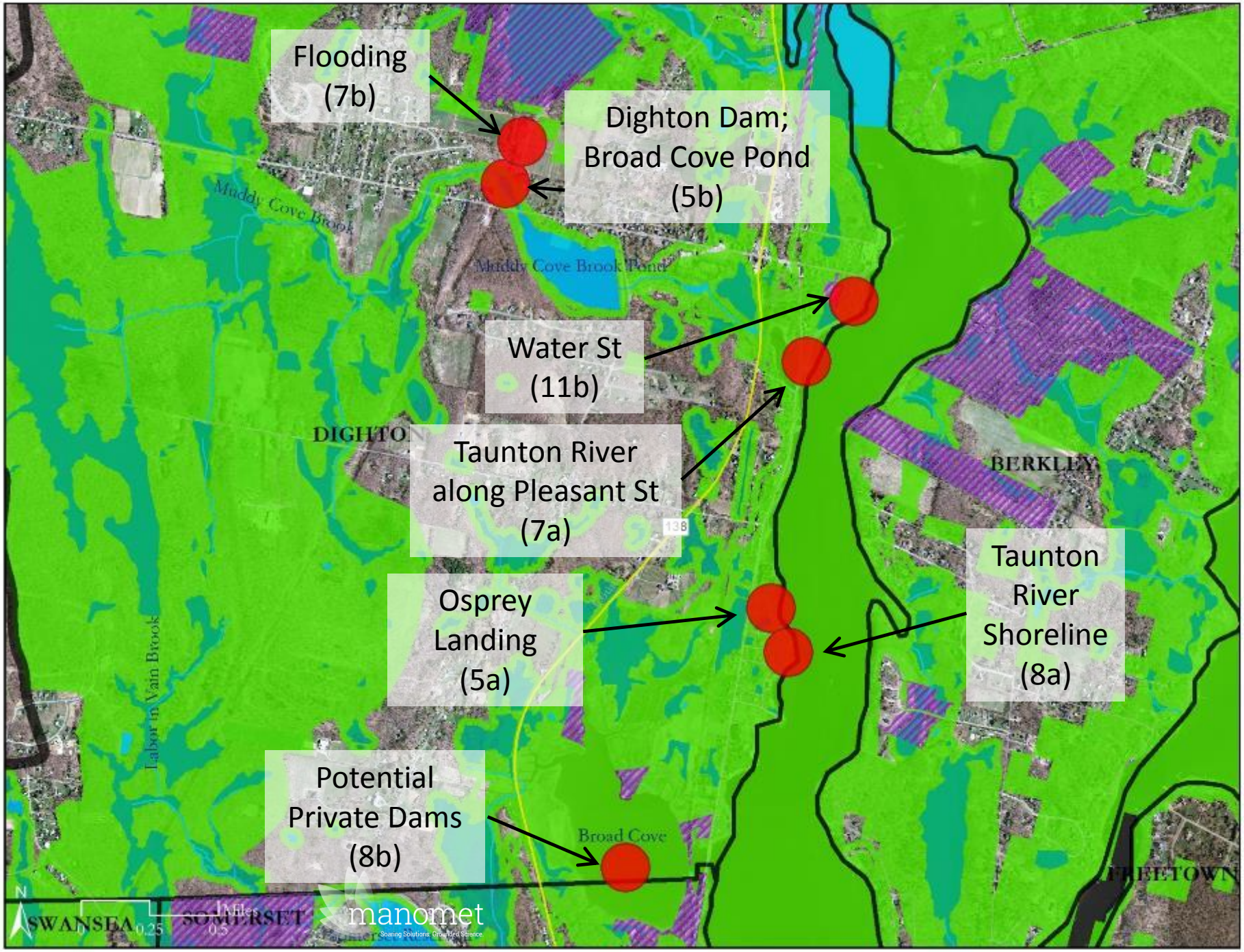
Linking Local and Regional Green Infrastructure

- **Mechanisms for linkage:**
  - Comprehensive/Master Plans,
  - Cluster subdivision requirements,
  - Open space districts,
  - Transfer of development rights,
  - Water resource protection overlay districts,
  - Floodplain management,
  - Wetland protection districts and bylaws,
  - Open space plans.

Taunton Watershed Green Infrastructure Network

Vulnerable Places & Case Studies




Flooding (7b)
Dighton Dam; Broad Cove Pond (5b)
Water St (11b)
Taunton River along Pleasant St (7a)
Osprey Landing (5a)
Taunton River Shoreline (8a)
Potential Private Dams (8b)
Muddy Cove Brook
Muddy Cove Brook Pond
Labor in Vain Brook
Broad Cove
DIGHTO
BERKLEY
SWANSEA
SOMERSET
FREETOWN
138
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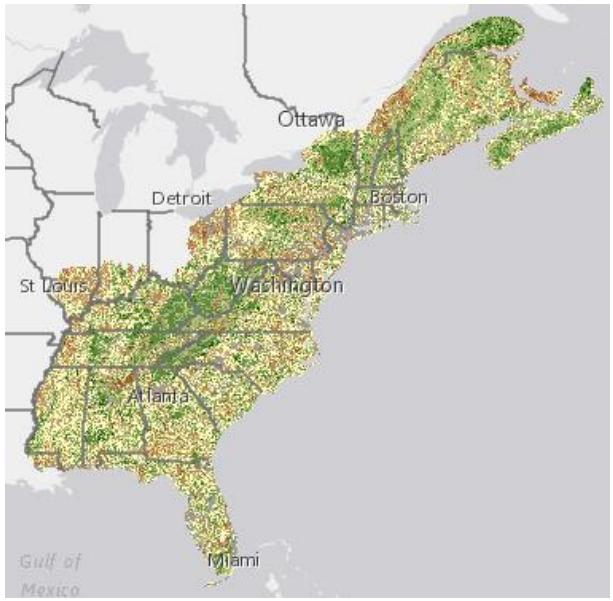
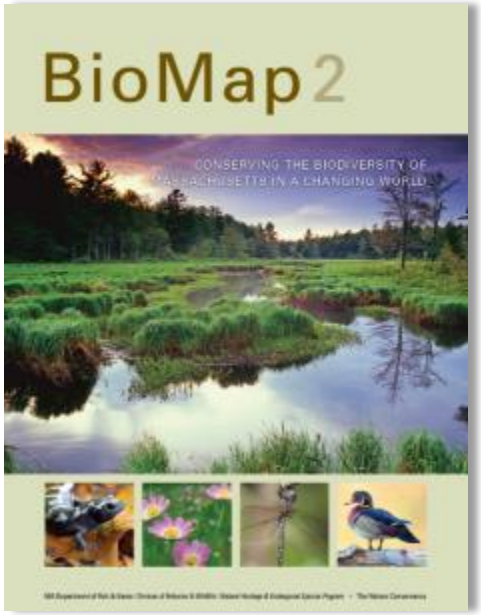
Transferability

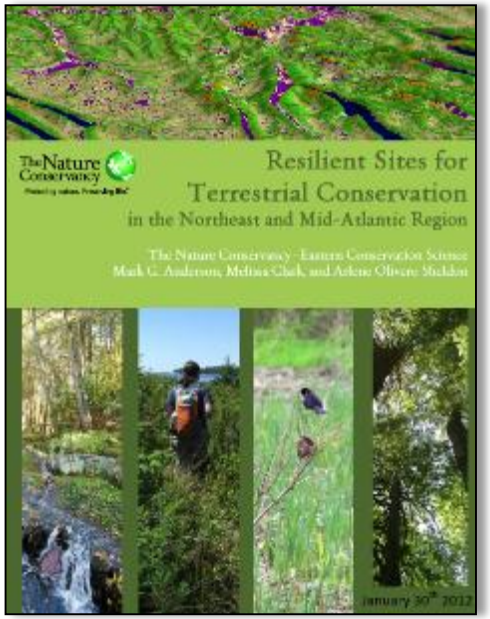
- Resilient Landscapes data availability for much of the eastern U.S.
- Biomap2 available for all of Massachusetts. Many other states have similar offerings
- All states should have the GIS layers to develop a set of aquatic and wetland buffers



MAPPR: Mapping And Prioritizing Parcels for Resilience



BioMap2:
Habitat, Biodiversity



TNC Resilience:
Climate Adaptation

Critical Linkages:
Ecological Connectivity

massaudubon.org/mappr

MAPPR: 3 Steps

massaudubon.org/mappr

1

Select a study area

Study Area

Choose a category

- Town
- County
- Watershed
- Multi-town Land Trusts
- Mass DFW Districts

2

Choose model (or choose your own adventure)

Pre-calculated Models

- Balanced Model
- Resilience Model
- Aquatic Model
- Biological Model

Assign Model Values

- Resilient Sites for Conservation
- Critical Linkages Priorities
- BioMap2 Core Habitat
  - BioMap2 Priority Natural Communities
  - BioMap2 Forest Cores
  - BioMap2 Vernal Pool Cores
  - BioMap2 Wetland Cores
  - BioMap2 Aquatic Cores
  - BioMap2 Species of Conservation Concern
- BioMap2 Critical Natural Landscape
  - BioMap2 Landscape Blocks
  - BioMap2 Coastal Adaptation
- Prime Farmland
- Surface Water Protection Zones
- Wellhead Protection Areas

3

Run & Review Results

Filter by Parcel Size

select min parcel size

Filter by Block Size (Unprotected Acres)

select min block size

Constrain Model Only Adjacent to Protection

Misc. Controls

- Show parcel priority ranks
- Show parcel export IDs
- Hide parcel labels
- Parcel priority rank colors
- Mass GIS Open Space Layer
- Blocks of Contiguous Parcels

Map Type Selector

- Street Map
- Satellite

Run Model >

MAPPR in Halifax, MA – Balanced Model

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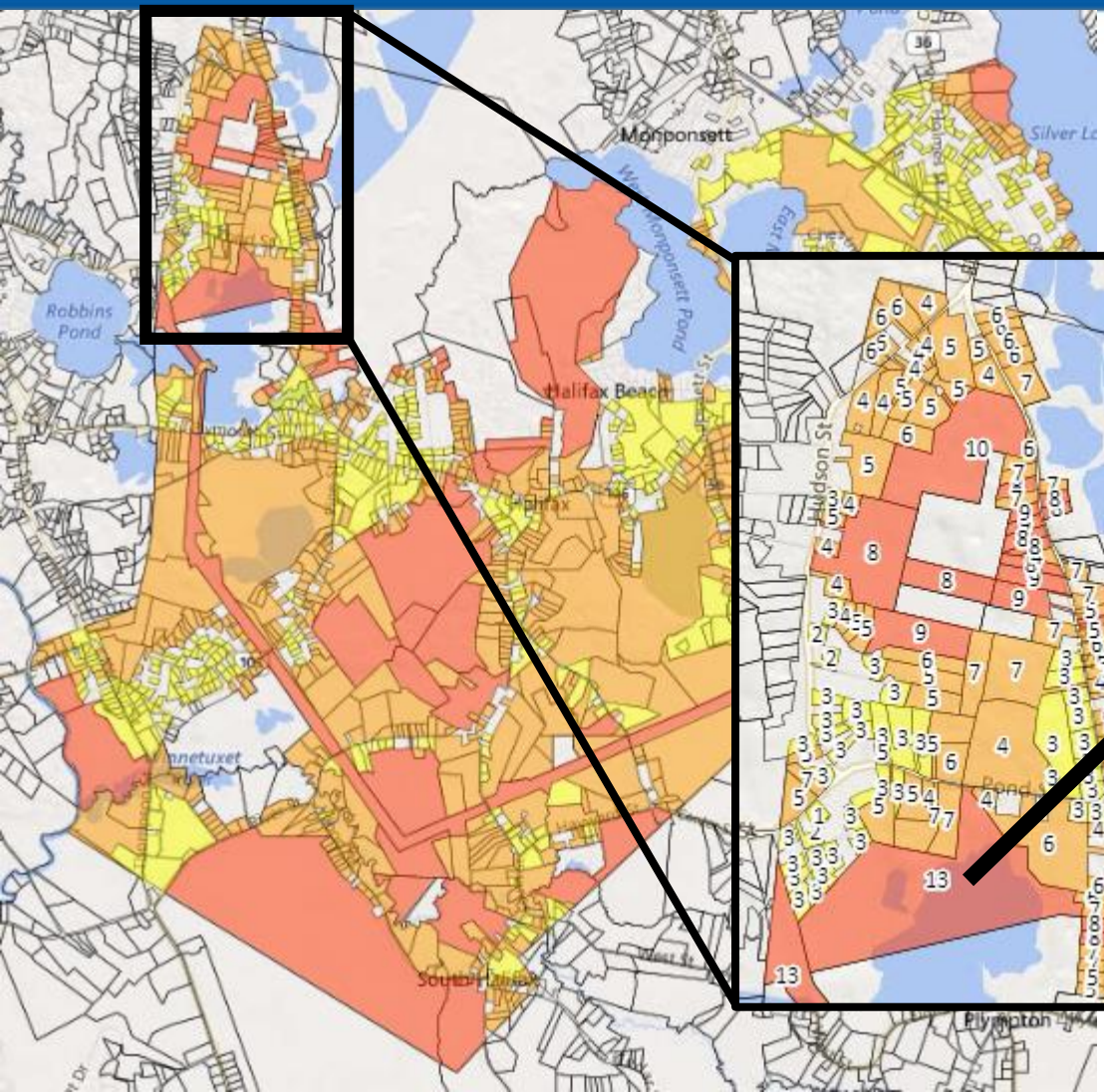
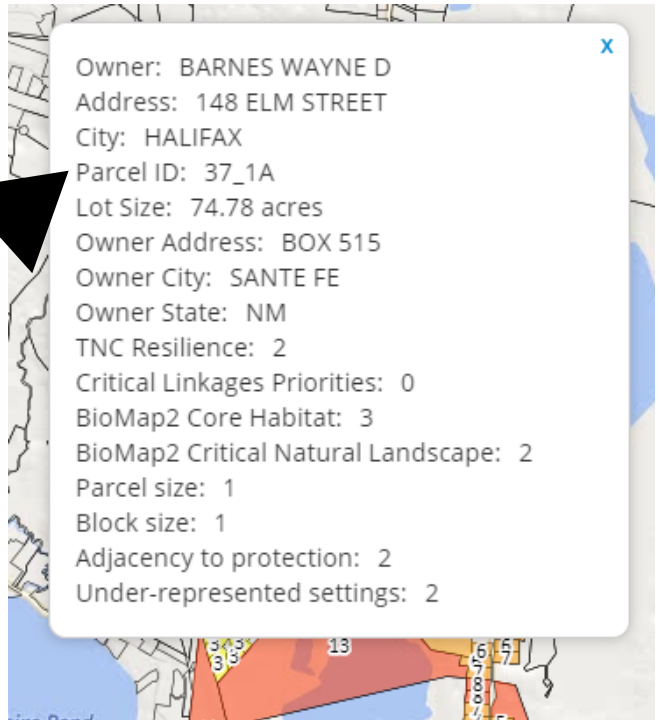


Priority

- High Priority Parcels — Higher #
- Medium Priority Parcels
- Lower Priority Parcels — Lower #



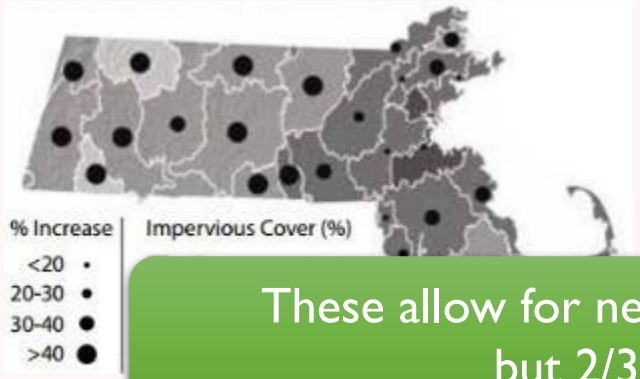
x

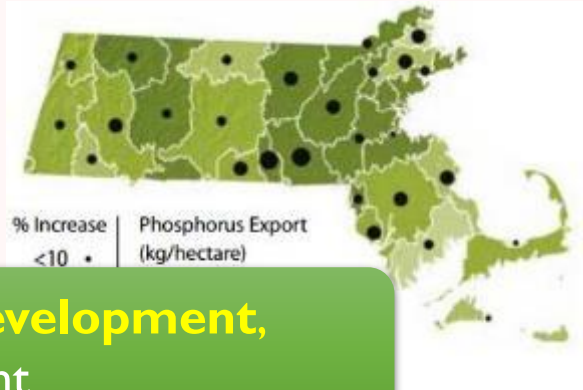
Owner: BARNES WAYNE D
Address: 148 ELM STREET
City: HALIFAX
Parcel ID: 37_1A
Lot Size: 74.78 acres
Owner Address: BOX 515
Owner City: SANTE FE
Owner State: NM
TNC Resilience: 2
Critical Linkages Priorities: 0
BioMap2 Core Habitat: 3
BioMap2 Critical Natural Landscape: 2
Parcel size: 1
Block size: 1
Adjacency to protection: 2
Under-represented settings: 2

How we develop – local choices in resilience

Source: Harvard Forest *Changes to the Land* 2014

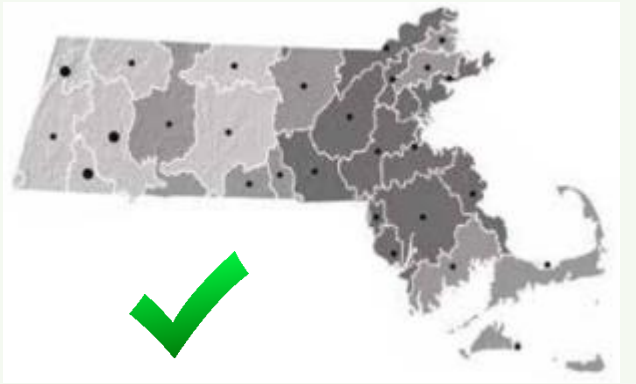
If we continue to follow opportunistic growth, in 2060:

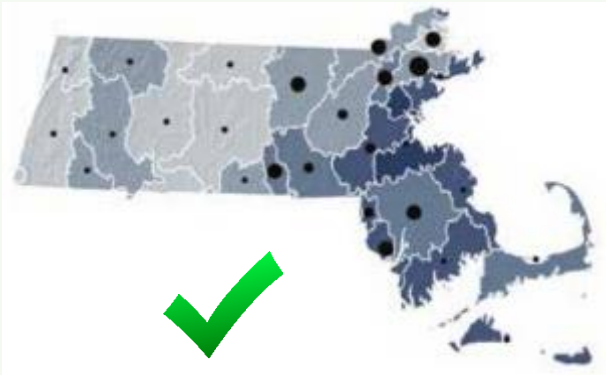


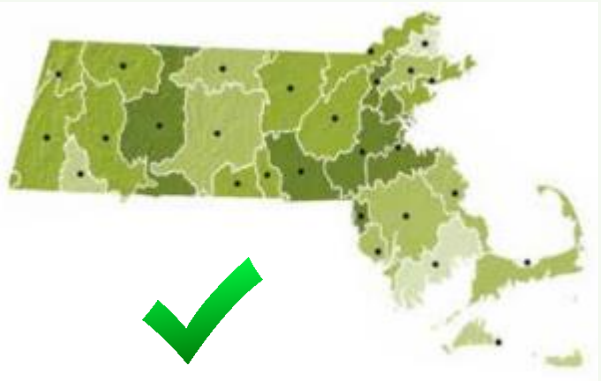


These allow for nearly the **same amount of development**, but 2/3 of it is **clustered** development

If we value forests as infrastructure, in 2060:







Start here.

Conserve the natural green infrastructure already providing free ecosystem services

Integrate LID and green infrastructure design into development

Restore the resiliency of urban landscapes through LID in redevelopment

Conserve

Conserve the natural green infrastructure already providing free ecosystem services

Integrate LID and green infrastructure designs into current development projects

Restore the resiliency of urban landscapes through LID in redevelopment

Image credits:
Rhode Island Conservation Development Manual, 2003

http://www.dem.ri.gov/programs/bpoladm/suswshed/pdfs/condev.pdf

Integrate

Conserve the natural green infrastructure already providing free ecosystem services

Integrate LID and green infrastructure designs into current development projects

Restore the resiliency of urban landscapes through LID in redevelopment

Restore

Conserve the natural green infrastructure already providing free ecosystem services
Integrate LID and green infrastructure designs into current development projects
Restore the resiliency of urban landscapes through LID in redevelopment

North Street, Pittsfield, MA

Five things you can do now to improve community resilience

1. Take Advantage of Nature
2. Be Smart with Regulations and Bylaws
3. Think Ahead and Plan
4. Be Opportunistic & Work Together
5. Look Around for Easy Fixes




GI & LID meet multiple requirements & benefits

Possible Action	Addresses stormwater management	Addresses groundwater supply issues	Improves climate resilience
Revise bylaws to allow for & encourage LID	x	x	x
Replace culverts to meet stream crossing standards	x	x	x
Acquire/preserve property for resource protection	x	x	x

Master plans & Open space plans

Planning Document	What does it do?	What should I look for?	How do I change it?
Master Plan (MP)	Comprehensive guiding document that sets **community goals**	• **Current**, reflects changing priorities? • Prioritizes **sustainable development?** • Defines specific measures to retain local **community character** & values?	Planning Board often with assistance of a special Master Planning Committee
Open Space and Recreation Plan (OSRP)	Identifies local **natural** resource and recreation priorities and plans for protection and management	• **Current**, reflects current parcel status, priorities? • Allows variety of OS uses: recreation, conservation? • Considers **land and water** resources? • Consider **local context** of existing OS?	Conservation Commission, often with assistance of a special OS Committee. Must meet state guidelines

Supporting LID through local regulations – framework for review

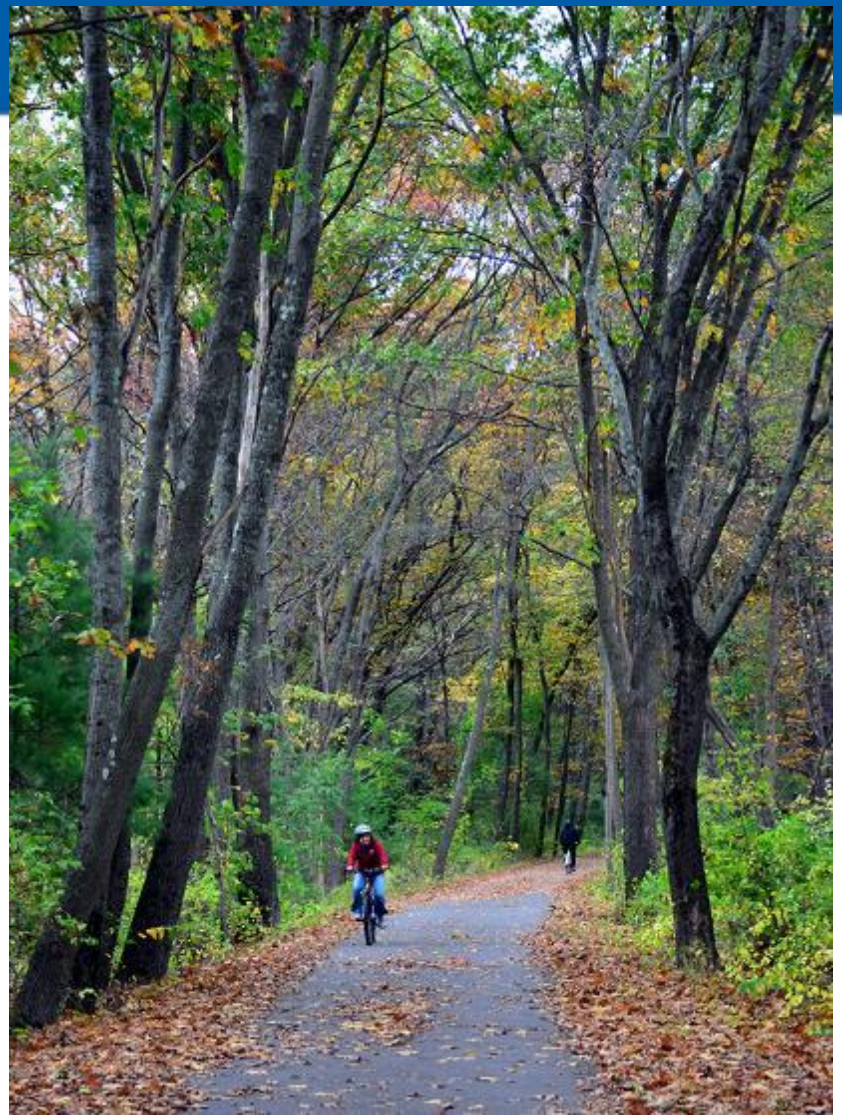
Factors	Conventional	Better	Best	Community's Zoning Bylaws	Community's Subdivision Rules and Regs	Community's Site Plan Review	Community's Stormwater/LID Bylaw/Regs
DIMENSIONAL REQUIREMENTS							
Lot size	Required minimum lot sizes	OSRD/NRPZ preferred. Special permit with incentives to utilize	Flexible with OSRD/NRPZ by right, preferred option		*(Not applicable)*	*(Not applicable)*	*(Not applicable)*
Setbacks	Required minimum front, side, and rear setbacks	Minimize, allow flexibility	Clear standards that minimize and in some instances eliminate setbacks		*(Not applicable)*	*(Not applicable)*	*(Not applicable)*
Frontage	Required minimum frontage for each lot/unit	Minimize especially on curved streets and cul-de-sacs	No minimums in some instances, tied into other standards like OSRD design and shared driveways.		*(Not applicable)*	*(Not applicable)*	*(Not applicable)*
Common driveways	Often not allowed, or strict limitations	Allow for 2-3 residential units	Allow for up to 4 residential units				*(Not applicable)*
Limit impervious area – Rural Districts In high density areas, require post-development infiltration to = or > predevelopment	Not usually addressed in zoning and subdivision regs for rural/suburban residential?	<15%	<10%				
Allow easy siting of LID features (bioretention, swales, etc.)	Often not addressed, may require waivers from subdivision standards	Encouraged along road ROW	Allowed on lots, common open space, or road ROW, easement recorded				*(Not applicable)*

The power of a bylaw: Westford, Massachusetts

- Adopted a Conservation Subdivision bylaw in 1978
- Requires developers to submit both conservation and conventional & Planning Board chooses preferred
- 48 developments protected over1,700 of land

The power of a bylaw: Westford

- Preserved local habitat
- Protected water resources
- Created 13 miles of hiking trails & public recreation
- Town didn't have to purchase the land themselves, saving millions of dollars



Rail Trail in Westford

Weir Village Park – Taunton, Massachusetts

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

Weir Village Park - Benefits

✓**Economic**

✓**Environmental**

✓**Community**

Benefits

Pollutant Reductions	Environmental Benefit	Economic Benefits
90% Removal of Total Suspended Solids	Clearer Water, Clean Riverbed Surfaces	Healthier Fish Communities
30-50% Removal of Total Nitrogen	Nitrogen control helps prevent harmful algal blooms in saltwater habitats	Healthier Shellfish Communities
30-90% Removal of Total Phosphorus	Phosphorus control helps prevent harmful algal blooms in freshwater habitats	Higher levels of oxygen lead to healthier Fish and freshwater shellfish habitat
40-90% Removal of Metals	Metals can be toxic in high concentration	Healthier fish and shellfish communities

Regional Challenges and Lessons Learned

Challenges:

- Integrating the regional green infrastructure analysis into local planning and development decisions is a long term process

Lessons:

- Despite extensive analysis in the scientific literature many local decision makers still don't fully understand the functional and fiscal value of green infrastructure

Local Challenges

- Capacity
  - Few full time staff in small towns
  - Comprehensive planning takes time

- Public understanding
- Local champions to stay the course over time
- Need for interdepartmental cooperation and integration – Planning, conservation, public works, fire & safety, etc.

Local Lessons Learned

- Need to share with broad range of constituencies and explain multiple benefits to each (from their point of view)
- Case studies and examples at various scales & settings key
- Offers suite of solutions relevant to your locale
- Tours of demonstration sites – make it real
- Follow up and resources – be part of the community and solution

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Thank you!
For more information, contact us or go to srpedd.org/rtwn

Questions?

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SHAPING the Future of YOUR COMMUNITY