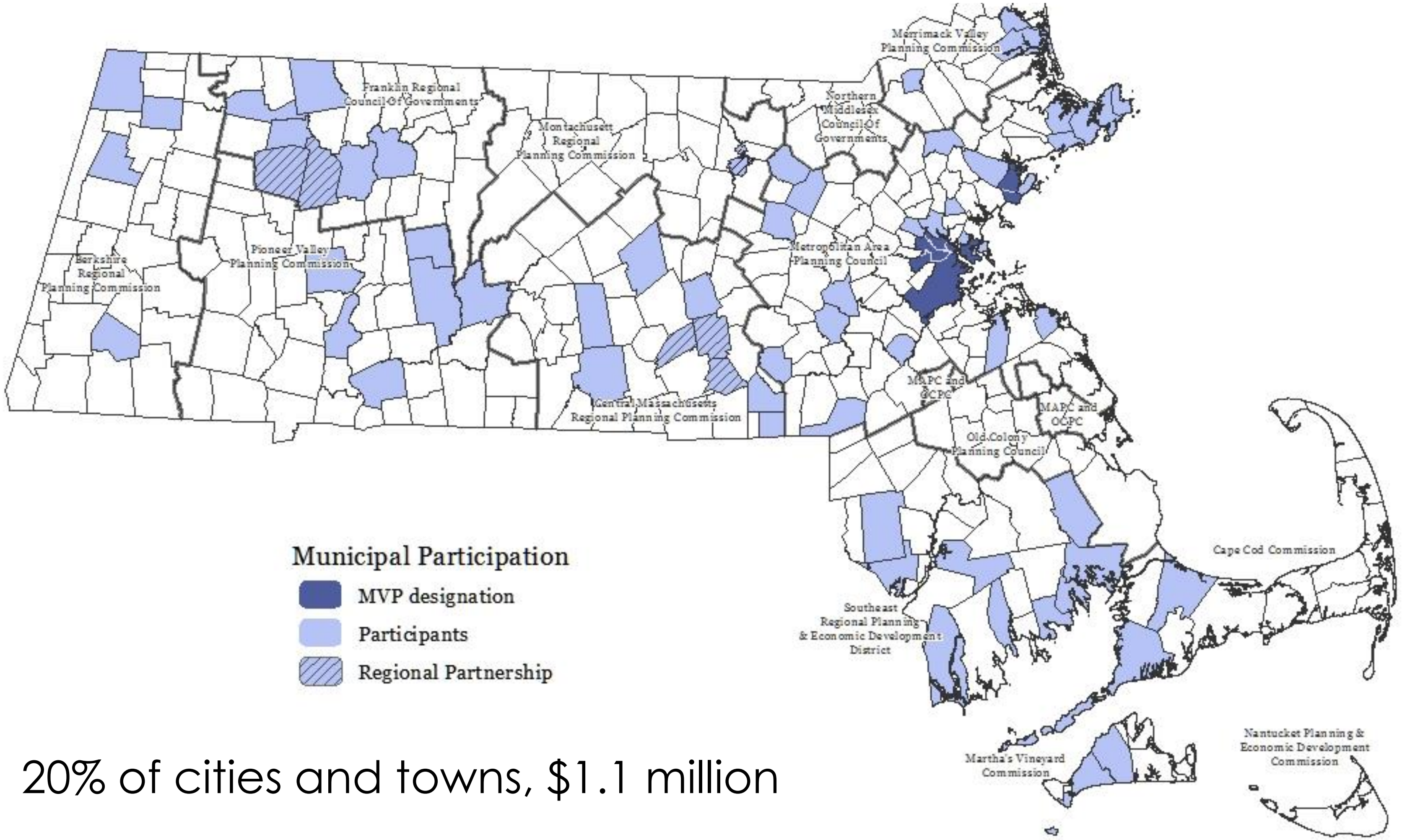
Municipal Vulnerability Preparedness (MVP)

State and local partnership grant to build resiliency to climate change

1. Engage Community
2. Identify CC impacts and hazards
3. Complete assessment of vulnerabilities & strengths
4. Develop and prioritize actions
5. Take Action

MVP Program 2017-2018



20% of cities and towns, $1.1 million

MVP Program
Learn more

https://www.mass.gov/municipal-vulnerability-preparedness-program

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NATURE-BASED SOLUTIONS

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The Nature Conservancy
Protecting nature. Preserving life.

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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

Baker Administration's Support

EO Language:

"…strategies that conserve and sustainably employ the natural resources of the Commonwealth to enhance climate adaptation, build resilience and mitigate climate change…"

Nature-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.

Green Infrastructure

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).

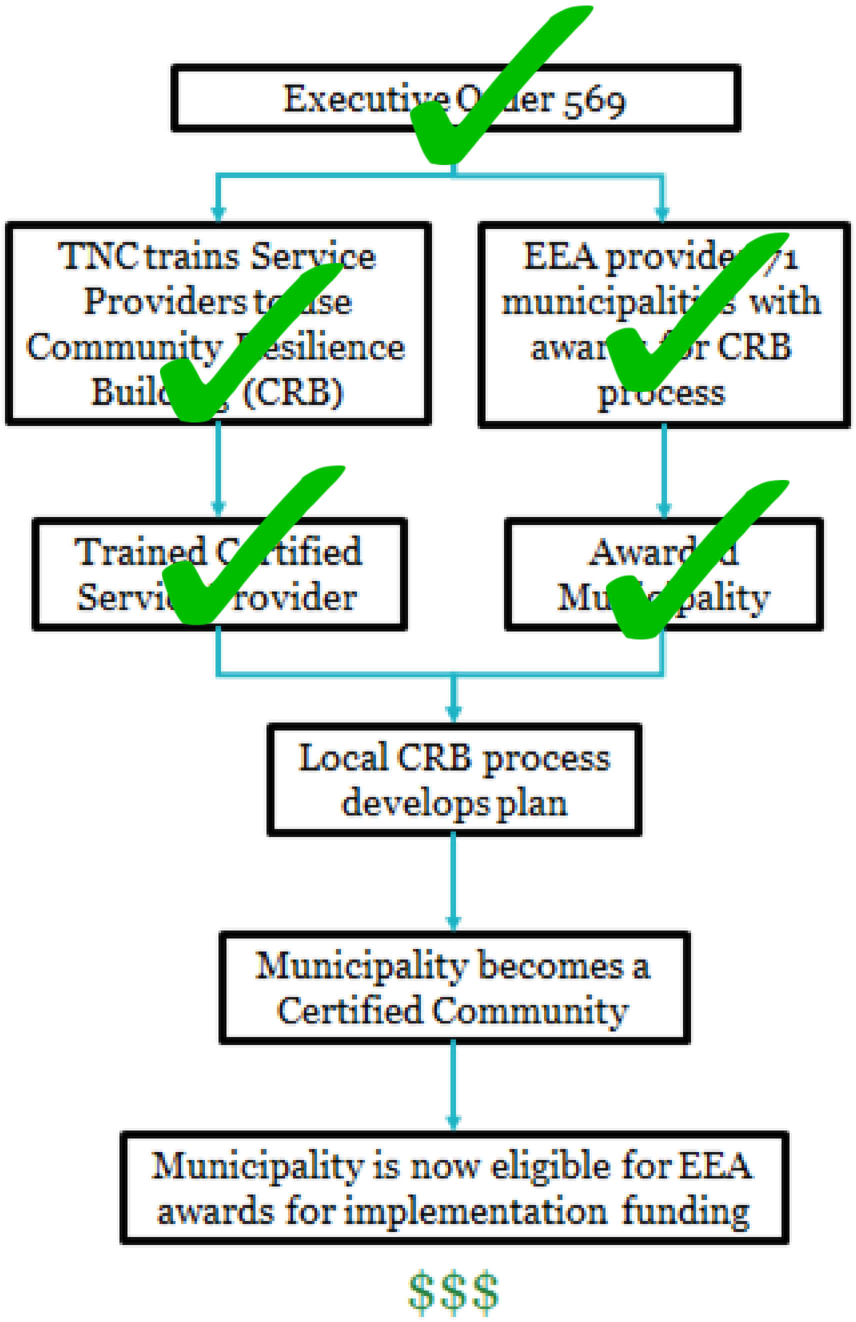
Low Impact Development (LID)

LID is a category of **Green** Infrastructure (GI):

- **Works *with* nature**
- **Manages stormwater** as close to the source as possible
- **Preserves natural landscape** (or creates natural features).
- **Treats rain as a resource** rather than a waste product.

Where is MVP Now?

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



Nature-Based Solutions and CRB

3

Identify **environmental** vulnerabilities and strengths (small teams).

Cataloguing the vulnerabilities and strengths of natural systems can be complex. Existing factors such as pollution, haphazard development/redevelopment, and invasive species can reduce the ability of natural systems to respond and assist with hazard impact reduction. Previous and ongoing open-space protection in high-risk areas (i.e., unstable slopes, low-lying floodplains) is viewed as a strength that often directly increases community resilience. Other benefits of natural systems to communities include flood storage, recreation, tourism, elevated property values, cooling during heat waves, and water filtration, among others. Understanding these factors can help facilitate collaborative approaches between development and conservation that fosters community resilience building.

(i) List environmental features. On the **Risk Matrix**, list environmental features. Consider natural resources that are vulnerable to hazards or that can provide protection for people, property, and amenities from top hazards. Refer to "Triggering Questions" to accelerate dialogue.

(ii) Describe locations via participatory mapping. For each feature, describe the location. Be as specific as possible. Legibly mark the location on the community basemap provided. *Example:* Identify where wetlands are in relation to current development (e.g., marinas, road crossings, fire stations, historic building, cemeteries, neighborhoods, nursing homes, etc.).

Triggering Questions:

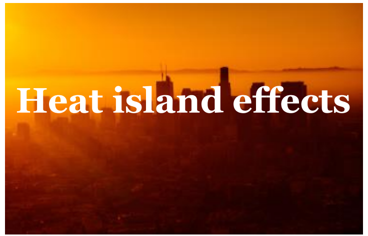
- What natural resources are important to your community?
- What benefits do these natural resources provide (storm buffering, fire breaks, erosion control, water quality improvement, slope stabilization, recreation)?
- Which natural resources are exposed to current and future hazards?
- What have been the effects of these hazards on these natural resources?
- Where are the high-risk areas and what vulnerabilities exist for the environment?

How to Talk about…

- Use: Nature Based Solution, NOT natural infrastructure

- Highlight Benefits:
  - Enhancing Safety
  - Avoiding Costs
  - Natural Assets:
    - Recreation
    - Public Health

Hazards



Nature-based solutions

Open space preservation

Ecosystem restoration

Low Impact Development

Municipal benefits

Avoided Costs

Enhanced Safety

Environmental Services

Enhance Safety: Charles River Natural Valley Storage Area. US Army Corps of Engineers

- 8,095 Acres purchased or protected in the middle and upper Charles River watershed since 1977. Project Cost of $8,300,000

- From 1977 through September 2016, the project has provided $11,932,000 in flood protective services (not counting for inflation).

- Co-benefits include recreation and natural resource benefits

http://www.nae.usace.army.mil/Missions/Civil-W
Risk-Management/Massachusetts/Charles-River-NV

Avoid Costs: Land Protection as 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

Preserve Services: 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

Return on Investment Studies in MA : Trust for Public Lands Study

- Outdoor recreation generates:
  - $10 billion in consumer spending
  - $739 million in state and local tax revenue
  - 90,000 jobs
  - $3.5 billion in annual wages and salaries
- Agriculture, forestry, commercial fishing, and related activities generate:
  - $13 billion in output
  - 147,000 MA Jobs
- **Conservation Projects Return $4 : $1 spent**

DER Research on Aquatic Restoration

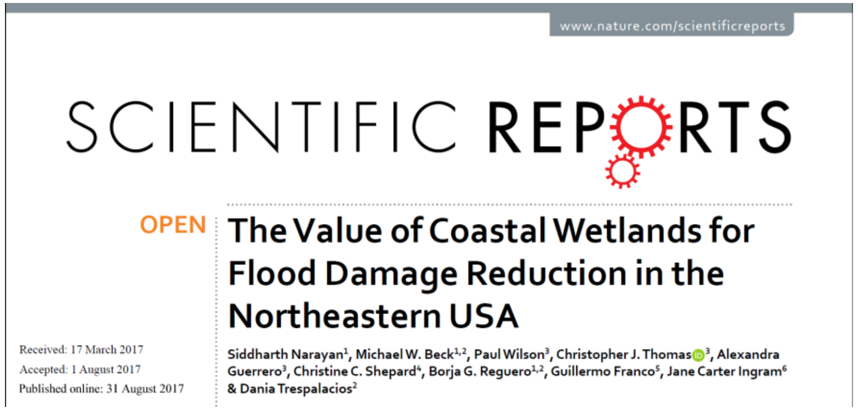
DER projects produce an average employment demand of **12.5 jobs** and **$1.75 Million** in total economic output from each $1 Million spent, contributing to a growing "restoration economy" in Massachusetts

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

Photo Credits: SRPEDD

Return on Investment Studies:

- In Hurricane Sandy, wetlands protected $625,000,000 in property value in New Jersey
- In New England, wetlands reduce storm damage by approximately 16%


www.nature.com/scientificreports

SCIENTIFIC REPORTS

OPEN

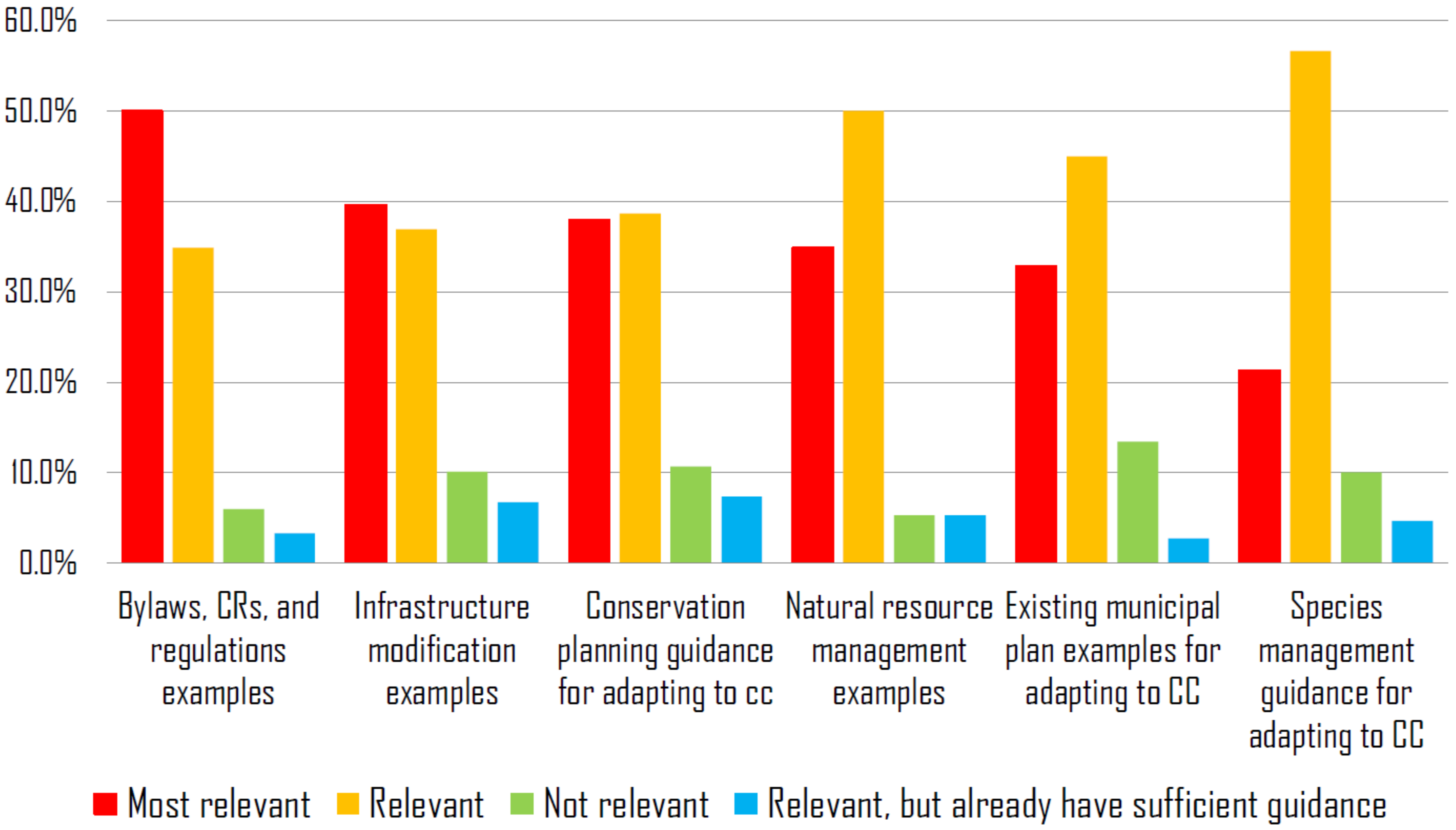
The Value of Coastal Wetlands for Flood Damage Reduction in the Northeastern USA

Received: 17 March 2017
Accepted: 1 August 2017
Published online: 31 August 2017

Siddharth Narayan[1], Michael W. Beck[1,2], Paul Wilson[3], Christopher J. Thomas[3], Alexandra Guerrero[3], Christine C. Shepard[4], Borja G. Reguero[1,2], Guillermo Franco[5], Jane Carter Ingram[6] & Dania Trespalacios[2]

Needs and Wants

From the Climate Action Tool survey, 2015



*Note! 70% of respondents were municipal professionals, but most already engaged in land conservation.

Needs and Wants

The most relevant needs across the board were for examples!

Needed Examples:

1. Bylaw, conservation restrictions, and regulation
2. Infrastructure Modification
3. Conservation and planning
4. Existing municipal climate change adaptation plans

Resources for Nature-Based Solutions

Prepared for municipalities at the launch of the Municipal Vulnerability Preparedness Program based on a survey on the needs of municipal practitioners and recommendations of a diverse team of engineers, planners and ecologists. For future updates to this list and a broader range of resources on climate change adaptation and resiliency, please see the Climate Change web site of the Executive Office on Energy and Environmental Affairs

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.

- Enhanced Safety by reducing risks from flooding and heat risks to vulnerable populations and community assets.
- Avoided infrastructure costs of unplanned repairs and improving safety due to flooding and failure from intense rain events.
- Securing the natural resource benefits of water quality, wildlife habitat and community resiliency.

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 costs between solutions
- **Massachusetts Division of Ecological Restoration's** economic benefits of aquatic restoration based on Massachusetts case studies

Bylaws and 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.

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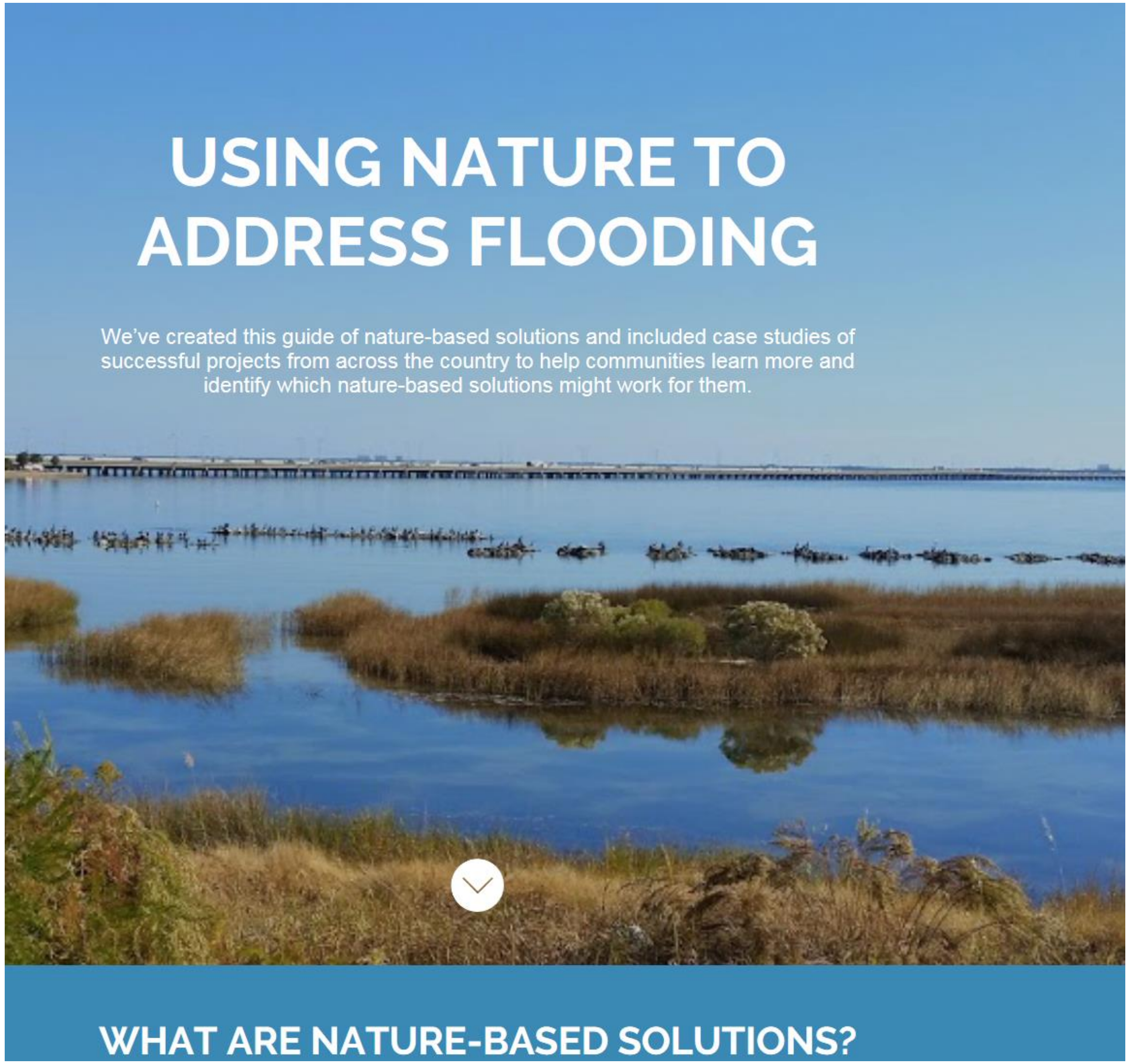
Naturally Resilient Communities

Yelp for Nature Based Solutions

You Choose:

1. Hazard Types
2. Region
3. Community type
4. Scale
5. Cost



HELP ME CHOOSE

Hazard Types

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

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

Scale

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

Cost

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

CLEAR ALL

DOWNLOAD PDF

Coastal Marshes

Beaches and Dunes

Restoring Offshore Features

Restoring Coastal Features

Coastal Erosion Riverine Flooding Riverine Erosion

Open Space Preservation through Land Acquisition

Moving People Out of Harm's Way: Property Buyouts

Horizontal Levees

Living Shorelines

Floodplain Buyout: Woloski Park, Middleborough, MA

- 10 homes in Taunton River floodplain
- Buyout funded by FEMA's Hazard Mitigation Grant Program (HMGP). Total cost ~$1,003,745, with FEMA grant covering 75%
- Resilience benefits:
  - Avoided emergency evacuation and property recovery costs.
- Additional benefits
  - High quality habitat is restored, floodplain and ecosystem services recovered.

Prepared for municipalities at the launch of the Municipal Vulnerability Preparedness Program based on a survey on the needs of municipal practitioners and recommendations of a diverse team of engineers, planners and ecologists. For future updates to this list and a broader range of resources on climate change adaptation and resiliency, please see the Climate Change web site of the Executive Office on Energy and Environmental Affairs

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Living Shorelines Introduction

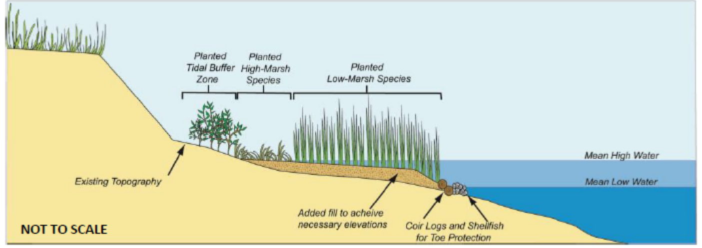
A detailed profile page was created for each of the eight (8) living shoreline types listed below. The purpose of these profile pages is to provide a comprehensive overview of the design recommendations, siting criteria and regulatory topics pertinent to a range of living shorelines designs that practitioners and regulators can use as a quick reference in the field or as an informational tool when educating home owners.

Living Shoreline Types

1. Dune – Natural
2. Dune – Engineered Core
3. Beach Nourishment
4. Coastal Bank – Natural
5. Coastal Bank – Engineered Core
6. Natural Marsh Creation/Enhancement
7. Marsh Creation/Enhancement w/Toe Protection
8. Living Breakwater

Design Schematics

The following living shoreline profile pages provide an example design schematic for each of the eight living shoreline types. Each schematic shows a generalized cross-section of the installed design. In addition, they illustrate each design's location relative to MHW and MLW, whether plantings are recommended, if fill is required, and any other major components of the design. It is important to note that these are not full engineering designs, and due to each sites unique conditions, a site specific plan, developed by an experienced practitioner is required for all living shoreline projects. Also note that these design schematics are meant to provide a general concept only, and are not drawn to scale.



Case Study

One example case study, with the following information, is provided for each living shoreline type.

Project Proponent	The party responsible for the project.
Status	The status of the project (i.e. design stage, under construction, or completed) and completion date if appropriate.
Permitting Insights	This section notes any specific permitting hurdles that occurred, or any regulatory insights that might help facilitate similar projects in the future.
Construction Notes	This section identifies major construction methods or techniques, any unique materials that were used, or deviations from a traditional design to accommodate site specific conditions.
Maintenance Issues	If the project is complete and has entered the maintenance phase, this section will note whether the project has functioned correctly, if it is holding up, and/or if any specific maintenance needs have been required since construction.
Final Cost	This section provides costs for the project, broken down into permitting, construction, monitoring, etc. when possible.
Challenges	This sections highlights any unique challenges associated with a particular project and how th [illegible] handled.

Explanation of Design Overview Tables

Materials	A description of materials most commonly used to complete a living shoreline project of this type.
Habitat Components	A list of what types of coastal habitats are created or impacted by a living shoreline project of this type.
Durability and Maintenance	Although specific timelines are impossible to provide in this context, general guidelines and schedules for probable maintenance needs, and design durability are detailed here.
Design Life	Although specific design life timelines will vary by site for each living shoreline type, this section provides some insight into factors that could influence design life.
Ecological Services Provided	This section provides an overview of the ecological services that could be provided or improved through the installation of that particular type of living shoreline project.
Unique Adaptations to NE Challenges (e.g. ice, winter storms, cold temps)	This section provides any unique practices or design improvements that could be made to improve the performance of the design given New England climactic and tidal challenges.

Acronyms and Definitions

cy	Cubic yards; one cubic yard equal 27 cubic feet. Project materials are often measured in cubic yards.
MHW	Mean High Water: The average of all the high water (i.e. high tide) heights observed over a period of time.
MTL	Mean Tide Level: The average of mean high water and mean low water.
MLW	Mean Low Water: The average of all the low water (i.e. low tide) heights observed over a period of time.
SAV	Submerged aquatic vegetation, which includes seagrasses such as eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*).
[illegible]	Naturally occurring materials that have been broken down by weathering and erosion. Finer, small-grained [illegible]e silts or clays. Slightly coarser sediments [illegible]en larger materials are gravels or cobbles.

Misquamicut Beach Dune Restoration, Westerly, RI
Photo courtesy of Janet Friedman

Beach Nourishment

Beach nourishment projects are appropriate for almost any tide range or grain size, and can be done independently, or in conjunction with a dune restoration project.

Regulatory and Review Agencies

Maine	Municipal Shoreland Zoning, Municipal Floodplain, ME Dept. of Environmental Protection, ME Land Use Planning Commission, ME Coastal Program, ME Department of Marine Resources, ME Department of Inland Fisheries and Wildlife, ME Geological Survey, and ME Submerged Lands Program.
New Hampshire	Local Conservation Commission, NH Natural Heritage Bureau, NH Department of Environmental Services (Wetlands Bureau, Shoreland Program, and Coastal Program), and NH Fish & Game Department.
Massachusetts	Local Conservation Commission, MA Dept. of Environmental Protection (Waterways and Water Quality), MA Division of Fisheries and Wildlife (Natural Heritage and Endangered Species Program), MA Environmental Policy Act, and MA Office of Coastal Zone Management.
Rhode Island	Coastal Resources Management Program, and RI Dept. of Environmental Management.
Connecticut	Local Planning and Zoning Commission, and CT Department of Energy and Environmental Protection.
Federal (for all states)	U.S. Army Corps of Engineers, National Marine Fisheries Service, U.S. Environmental Protection Agency, and U.S. Fish and Wildlife Service.

Siting Characteristics and Design Considerations

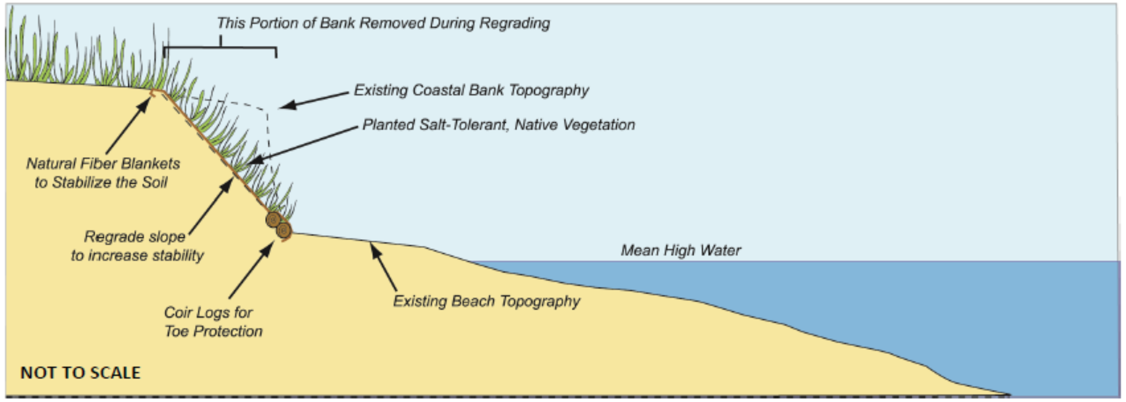
Selection Characteristics	Detail
ES Energy State	Low to high
EE Existing Environmental Resources	Coastal beach; subtidal
SR Nearby Sensitive Resources	Endangered and threatened species; shellfish. The added sand may result in shoaling of adjacent areas and increase turbidity during the placement of the sand, which can cause temporary adverse effects.[6] Nourishment can also bury native vegetation. Nourished sediment may also adversely affect nesting and foraging of shorebirds and other coastal animals, but can be avoided through a time of year restriction.[11]
TR Tidal Range	Low to high
EL Elevation	Above MHW to Below MLW. When designing beach berm elevations, consider increasing elevation above existing berm elevation.
IS Intertidal Slope	Flat to steep. Beach nourishment is most effective where a gently sloping shoreline is present, but it can also be appropriate for use on other slopes.
BS Bathymetric Slope	Flat to steep. However, areas with steep bathymetric slope may result in offshore transport carrying sediment past depth of closure. A steep bathymetric slope will also produce larger waves.
ER Erosion	Low to high. The erosion rate at the site is one of the most important elements when designing a beach nourishment project; if the rate is high then beach nourishment may not be appropriate.[6]
Other Characteristics	**Detail**
Grain Size	It is important to utilize sediment with a grain size, shape and color compatible to the site.[5] The percentage of sand-, gravel-, and cobble-sized sediment should match, or be slightly coarser than, the existing sediments.[1] The shape of the material is also important, especially for larger sediment, and should be rounded rather than angular.[1]
Impairment Level	Consideration should be given to invasive species, level of existing armoring, and extent of public use. Beach nourishment projects are more successful is they are located where there are already existing beaches. The longer and more contiguous the project is, the more resilient the project will be.
Surrounding Land Use	Beach nourishment is best suited where natural beaches have existed at a site and where there is a natural source of sand to help sustain the beach.[6] Beach nourishment is also suitable to help restore sediment supply to a sediment-starved system. Not generally well-suited for application to most major urban centers or areas with large port and harbor facilities because of the space requirements and the level of risk reduction desired.[10] Existing structures on site, like seawalls, may force beach nourishment projects to have a steeper slope than desirable. Steeper slopes leave little opportunity for wave energy dissipation.[13]

Coastal Bank - Natural

Coastal bank protection, including slope grading, and toe protection and planting of natural vegetation will reduce the steepness and protect the toe of the bank from further erosion. Coir logs, root wads protect bank toes from erosion, while planted vegetation develops strong root systems.

Objectives: erosion control; shoreline protection; dissipate wave energy; enhanced wildlife habitat.

Design Schematics

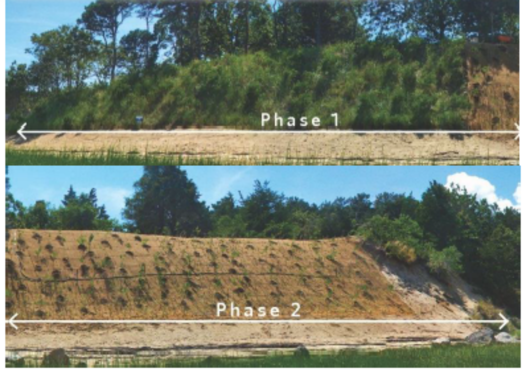


Case Study

Coastal Bank Stabilization, Orleans, MA

Wilkinson Ecological Design developed a plant-focused coastal bioengineering project, determined not to be a coastal engineering structure by the local municipality and MA DEP. The project included a robustly anchored fiber roll array at the bottom of the bank and intensive planting and stabilization through the remainder of their coastal bank, which falls within a mapped FEMA Velocity Zone.

Pleasant Bay Bank Stabilization, Orleans, MA
Photos courtesy of Wilkinson Ecological Design



Project Proponent	Private property owners. The project spans three properties with multiple owners.
Status	Phase 1 constructed in 2010, Phase 2 constructed in 2013 and Phase 3 constructed in 2015.
Permitting Insights	The project involved one permit under the MA Wetlands Protection Act for each phase, three wetland permits in total.
Construction Notes	Regraded the over steepened bank, installed six rows of coir rolls at the toe of bank, installed natural fiber blankets on the bank face above the coir rolls, planted the bank face with native, salt-tolerant grasses and shrubs, and covered fiber rolls with sand.
Maintenance Issues	Monitor vegetation monthly throughout the growing season to ensure plant success; temporary irrigation for first three years; monitor coir rolls twice annually and after storms. Replant and retighten fiber roll anchoring system as needed.
Final Cost	Permitting: $10,000 Construction: $1,000/ linear foot Maintenance : $8,000/yr
Challenges	No substantial challenges in the permitting, construction or maintenance phases of work and has performed well through storms.

Overview of Technique

Materials	Sediment, if fill is needed, to establish a stable slope. Coir rolls or root wads from fallen trees to minimize erosion. Coir rolls, typically rolls 12-20" in diameter and 10-20 feet long, packed with coir fibers and held together by mesh.[1] (Coir rolls can be pre-vegetated to head start the growing process.) A high-density roll may be necessary at the toe, while lower-density rolls could be used above.[5] Wooden stakes for blankets, earth anchors for rolls, or a combination of the two are necessary to anchor the system.[1] Other naturally occurring woody material or root wads may also be utilized to stabilize the toe of the coastal bank in some sites. Salt-tolerant vegetation with extensive root systems are often used in conjunction with fiber rolls to help stabilize the site.[1] Natural fiber blankets can be used to stabilize the ground surface while plants become established.[1] (Blankets should be run up and down the slope rather than horizontally across it.)
Habitat Components	Because they are made with natural fibers and planted with vegetation, natural fiber blankets also help preserve the natural character and habitat value of the coastal environment.[1]
Durability and Maintenance	Installing coir rolls at the toe of a bank stabilization project can provide increased stability while the vegetation becomes established,[1] but bioengineering projects with coir rolls and vegetation require ongoing maintenance, such as resetting, anchoring, or replacement, to ensure their success.[1,6] Coir logs must be securely anchored to prevent wave and tidal current-induced movement.[11] Invasive species management should be incorporated into the project.[1] Runoff and groundwater management will also be crucial to project success.[6]
Design Life	As the coir rolls disintegrate, typically over 5-7 years, the plants take over the job of site stabilization.[1] The bank slope is extremely important. Often the existing condition of the slope is steep or undercut. Before installing coir logs or planting vegetation, the bank slope should be stabilized.[1] This is often done by regrading the bank slope by removal of sediment from the top of the bank rather than adding sediment to the toe of the slope.[1]
Ecological Services Provided	Upland plantings stabilize bluffs and reduce rainwater runoff.[11]
Unique Adaptations to NE Challenges (e.g. ice, winter storms, cold temps)	Shorter planting and construction window due to shorter growing season. Utilization of irrigation to establish plants quickly. Freeze and thaw processes can damage this design. Consideration should be given to the slope aspect and the implications on plant growth and microbiome from shading and sun exposure.

Swansea Marsh and Habitat Preservation: Conservation

- 37 Acres purchased and conserved by the Town of Swansea, Wildlands Trust, and Blount Fine Foods in the Palmer River Corridor 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 repair and replacement

- Additional Benefits:
  - Protected water quality
  - Future marsh migration

Cost-Benefit

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

Green Infrastructure

Green Infrastructure Cost-Benefit Resources

Green infrastructure can be a cost-effective approach to improve water quality and help communities stretch their infrastructure investments further by providing multiple environmental, economic, and community benefits. On this page, learn more about how other communities have realized cost savings through their green infrastructure programs as well as about tools you can use to inform your own cost-benefit analysis.

On this page:

- Cost Analysis
- Cost-Benefit Analysis
- Tools

Cost Analysis

Mill River: Whittenton Dam Removal, Taunton, MA

Whittenton Mill Dam was removed in 2013

- Costs
  - Estimated Cost of Dam Repair = $1.9 Million
  - Ongoing Cost of Dam maintenance = variable
  - 2005 Evacuation Costs = $1.5 Million
  - Dam Removal Costs = $440,000
- Benefits
  - Increased revenue from river based recreation
  - Increased Property Values
  - Water quality benefits

Bylaws and 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.

How to Compare Local Land Use Regulations with Best Practices

Key Areas of Analysis

The following analysis framework is designed to assist communities in Massachusetts in applying cost-effective Low Impact Development (LID) techniques. Specifically, this template enables you to evaluate local land use regulations in relation to models and examples from the Commonwealth of Massachusetts' Smart Growth/Smart Energy Toolkit and other sources in relation to the use of LID and Green Infrastructure (GI) techniques. The focus is primarily on residential development, but the concepts are also applicable to other forms of development and redevelopment.

Best practices minimize the alteration of natural green infrastructure such as forests; reduce creation of impervious surfaces; support retention of naturally vegetated buffers along wetlands and waterways; minimize grading and alterations to natural flow patterns; and support the use of LID techniques as the preferred, most easily permitted methods for managing stormwater.

Get more details on LID's many cost-savings and other benefits, and our customizable bylaw review chart, at: www.massaudubon.org/LIDCost.

Local coordination across municipal boards and permits is also important for supporting LID. Application of these practices can result in significant savings in infrastructure maintenance costs, as well as improved water quality and protection of water supplies, while supporting property values and overall quality of life. Sustainable development

1 Introduction | 2 OSRD Overview | 3 Zoning Subdiv SPR SW Overview | 4 Other Considerations | 5

Review bylaws, ordinances, zoning, and other considerations for overall site design, LID project standards, and maintenance and operations considerations.

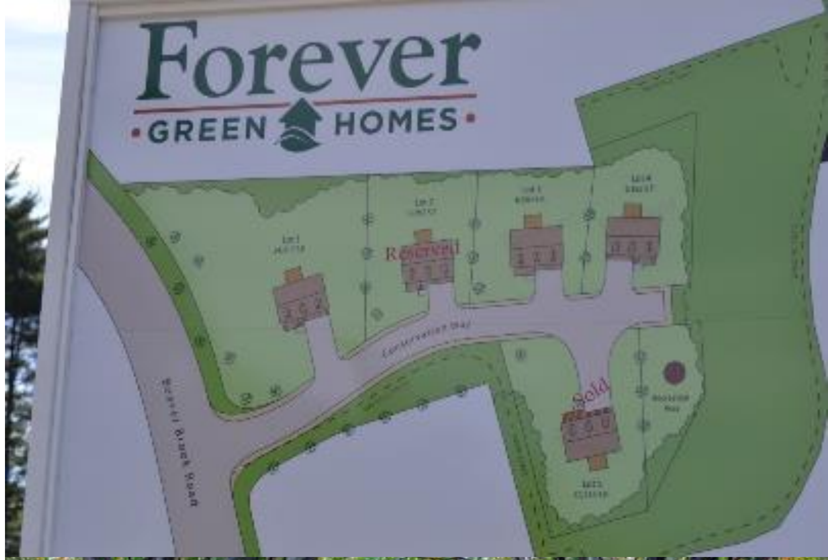
Factors	Conventional	Better	Best	Community's Zoning	Community's Subdivision Rules & Regulations	Community's Site Plan Review	Community's Stormwater/LID Bylaw/Regulations
GOAL 1: PROTECT NATURAL RESOURCES AND OPEN SPACE							
Soils managed for revegetation	Not addressed	Limitations on removal from site, and/or requirements for stabilization and revegetation	Prohibit removal of topsoil from site. Require rototilling and other prep of soils compacted during construction	*(Not applicable)*			
Limit clearing, lawn size, require retention or planting of native vegetation/naturalized areas	Not addressed or general qualitative statement not tied to other design standards	Encourage minimization of clearing/ grubbing	Require minimization of clearing/grubbing with specific standards				
Require native vegetation and trees	Require or recommend invasives	Not addressed, or mixture of required plantings of native and nonnative	Require at least 75% native plantings				
GOAL 2: PROMOTE EFFICIENT, COMPACT DEVELOPMENT PATTERNS AND INFILL							
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, preferrably constructed with permeable pavers or pavement				*(Not applicable)*

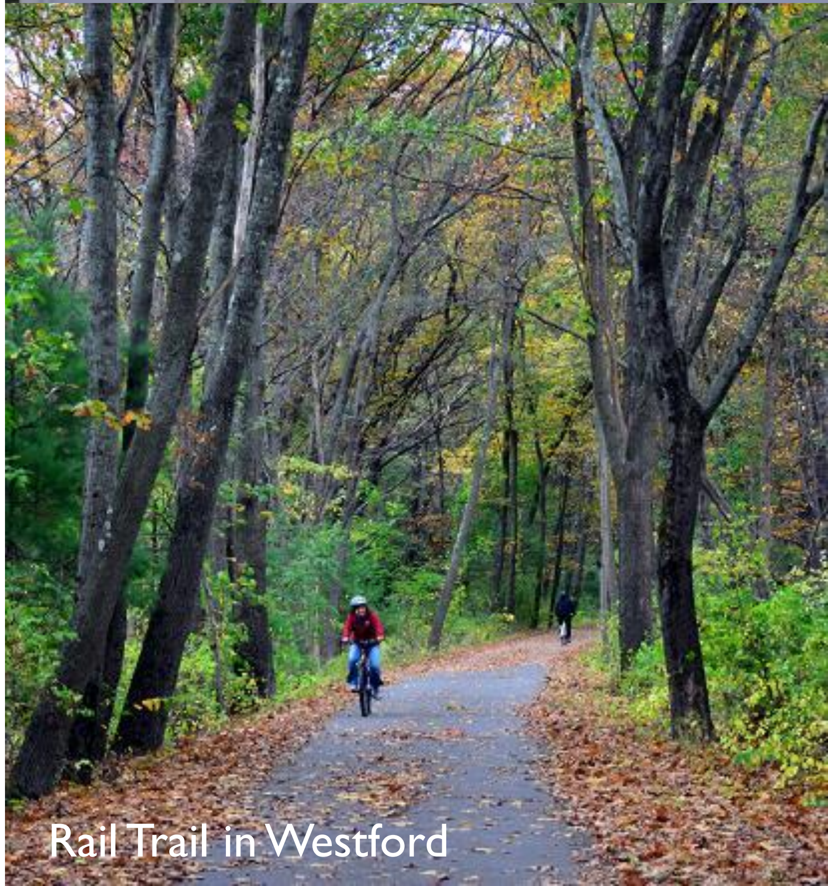
The power of a bylaw: Westford

- Adopted a Conservation Subdivision bylaw in 1978
- Requires conservation and conventional plans

Benefits

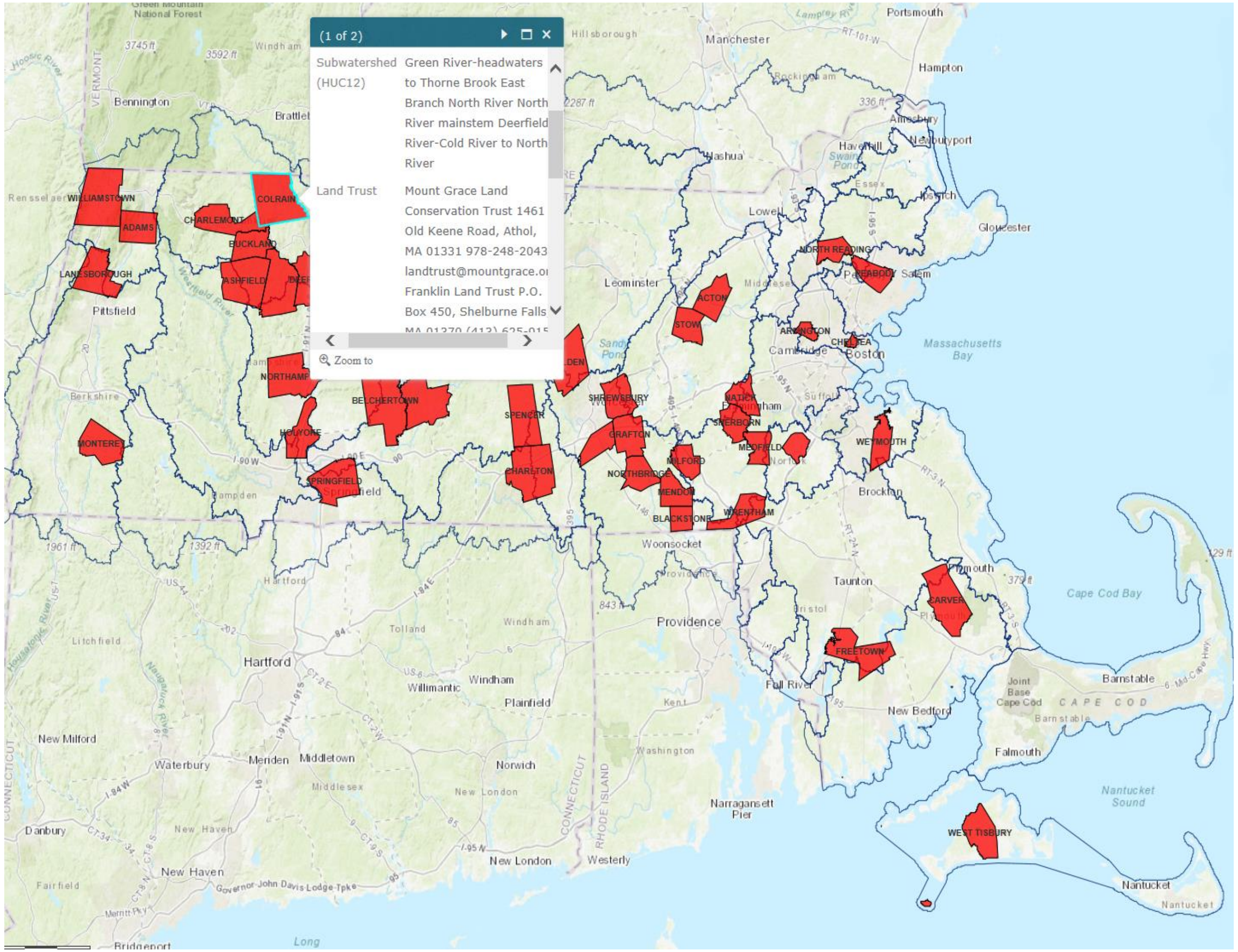
- 1,700 Acres of land Protected
- Preserved local habitat and water resources
- Created 13 miles of hiking trails & public recreation
- Town saved millions of dollars




Rail Trail in Westford

Potential Partners:

- **Land Trust – Mass Land Trust Coalition**
- **Watershed Associations – Mass Rivers Alliance**
- **Climate Action Groups – Mass Climate Action Network**

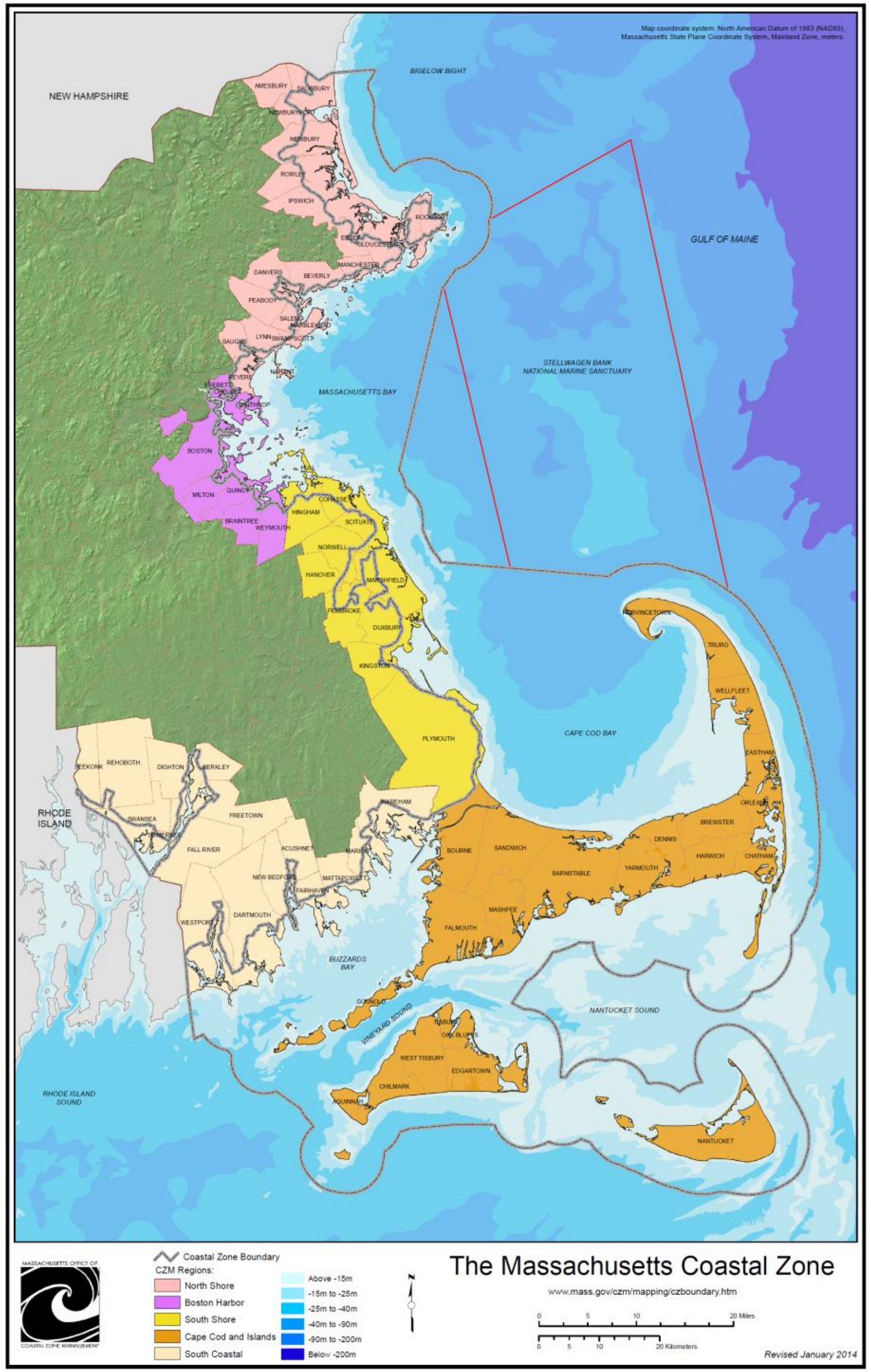


http://tnc.maps.arcgis.com/apps/View/index.html?appid=eb68b8f45e4548a59a1283b4d8c3a2e3

Potential Partners, cont'd:

CZM Regional Offices:

- North Shore
- Boston Harbor
- South Shore
- Cape and Islands
- South Coastal



http://www.mass.gov/eea/agencies/czm/regional-offices/



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The Nature Conservancy
Protecting nature. Preserving life.



Resources Discussed in Q&A

- Blue carbon calculator https://www.mass.gov/blue-carbon-calculator

Eelgrass

- Historic trends in Salem Sound, MA https://www.mass.gov/files/2017-08/2016_Salem%20Sound%20Eelgrass.pdf
- DMF guidelines for delineation, restoration, and monitoring of eelgrass in MA http://www.mass.gov/eea/docs/dfg/dmf/publications/tr-43.pdf
- Northeast Ocean Data http://www.northeastoceandata.org/eelgrass/
- Guide to site selection for eelgrass restoration http://nbep.org/publications/NBEP-95-113.pdf