

The Water is Coming...Vulnerability, Adaptation, and Nature-Based Solutions



Stefanie Covino
scovino@massaudubon.org
Sara Burns
Sara.burns@tnc.org

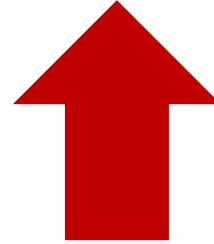
Outline

- Climate change & communication resources
- Nature based solutions and co-benefits
- Case studies, tools, and resources
- MVP
- Next steps / Q&A



Key Observed Climate Changes in MA

Temperature:

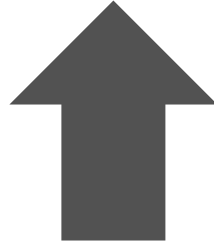


2.9°F

Since 1895

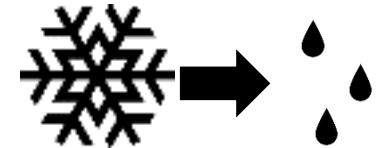


Growing Season:

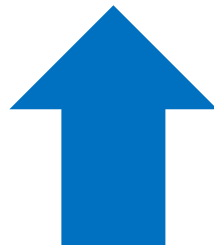


11 Days

Since 1950



Sea Level Rise:

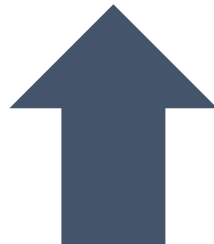


11 inches

Since 1922

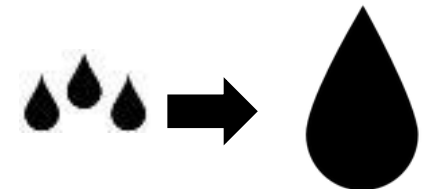


Strong Storms:



55%

Since 1958



Recommended resource: massaudubon.org/climate

Addressing Misconceptions



MOST USED Climate Myths

and what the science really says...

- 1 Climate's changed before
 - 2 It's the sun
 - 3 It's not bad
 - 4 There is no consensus
 - 5 It's cooling
 - 6 Models are unreliable
 - 7 Temp record is unreliable
 - 8 Animals and plants can adapt
 - 9 It hasn't warmed since 1998
 - 10 Antarctica is gaining ice
- [View All Arguments...](#)

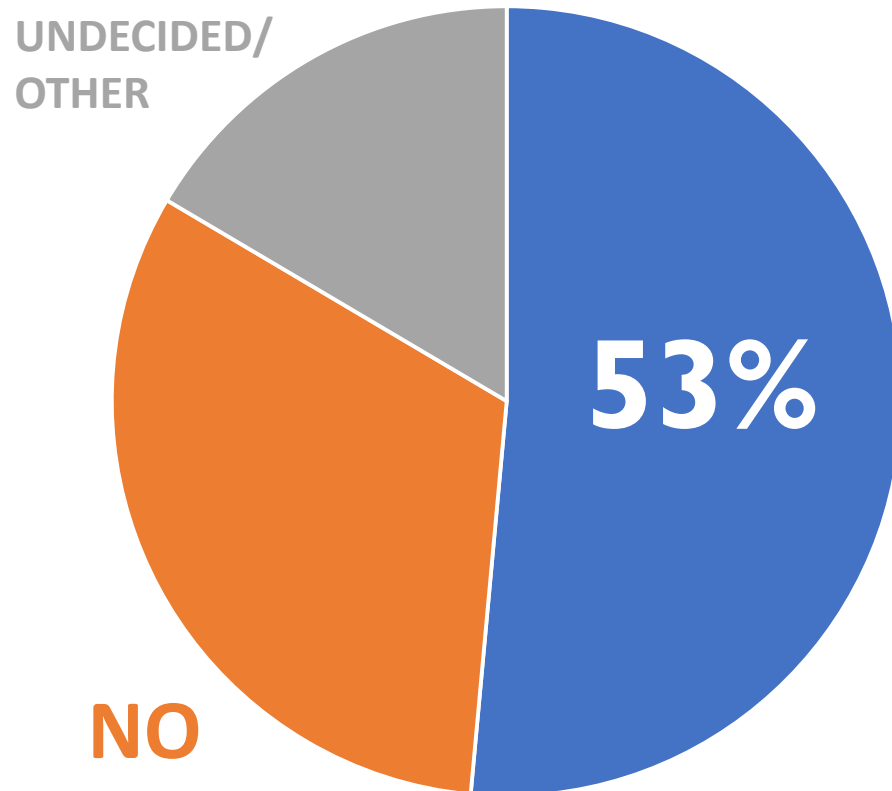
Many leaders often feel uncomfortable discussing climate change.

“Inoculate” them to common skepticism, alarmism and inaccuracies. It improves their comfort and depth of knowledge.

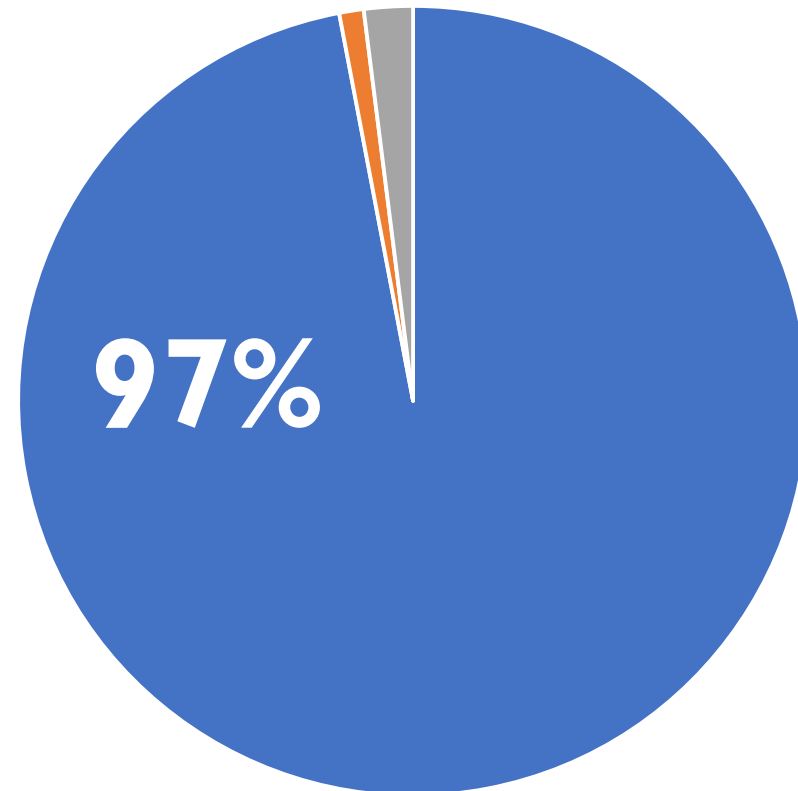
Recommended resource: skepticalscience.com

Say Climate Change is Happening and Human-caused

American Adults



Climate Scientists

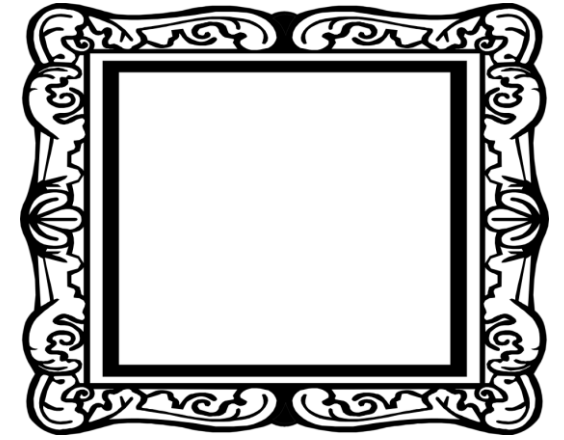


Sources: Yale Project on Climate Communication (2015) and Cook et al. (2013)

Framing Strategies

- **Protect** natural resources for *future generations* and *public health*.
- **Responsible management** of natural and fiscal resources.
- **Sense of place** connects people to specific challenges.

Let the science guide you but stay out of the weeds. Ground your responses in values.

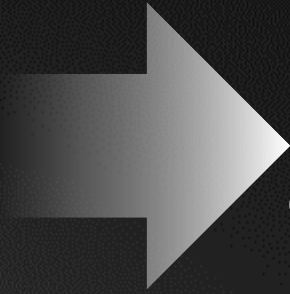


**Why do rising temperatures also
bring more precipitation?**

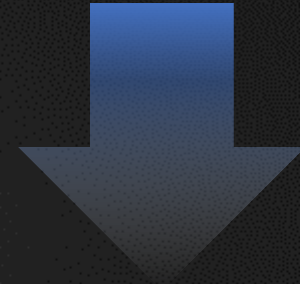


...consider your
morning coffee.

**More
evaporation**



**More
fuel for storms**



**More
precipitation**

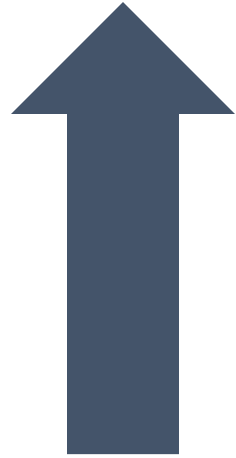
*warmer air holds
more moisture aloft*

**More
Heat**



How Much More Precipitation?

**Total annual precipitation
has increased by:**



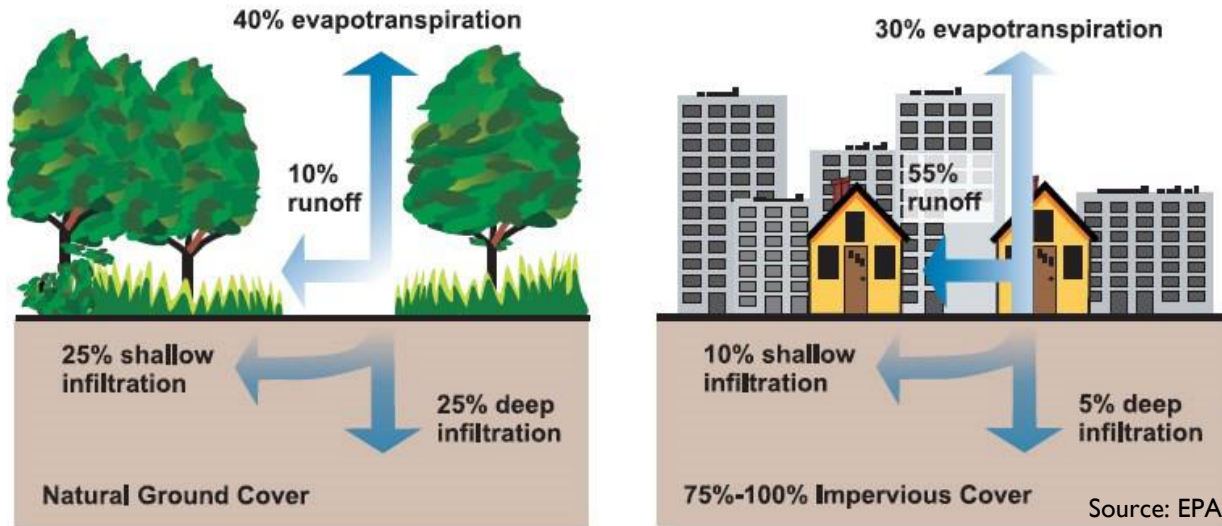
15%

***1.2 trillion more gallons* of
water or equivalent snow falling
on Massachusetts each year.**

~9,700 filled Prudential Towers



What's the problem?



Impervious surface



Runoff



Large lawns

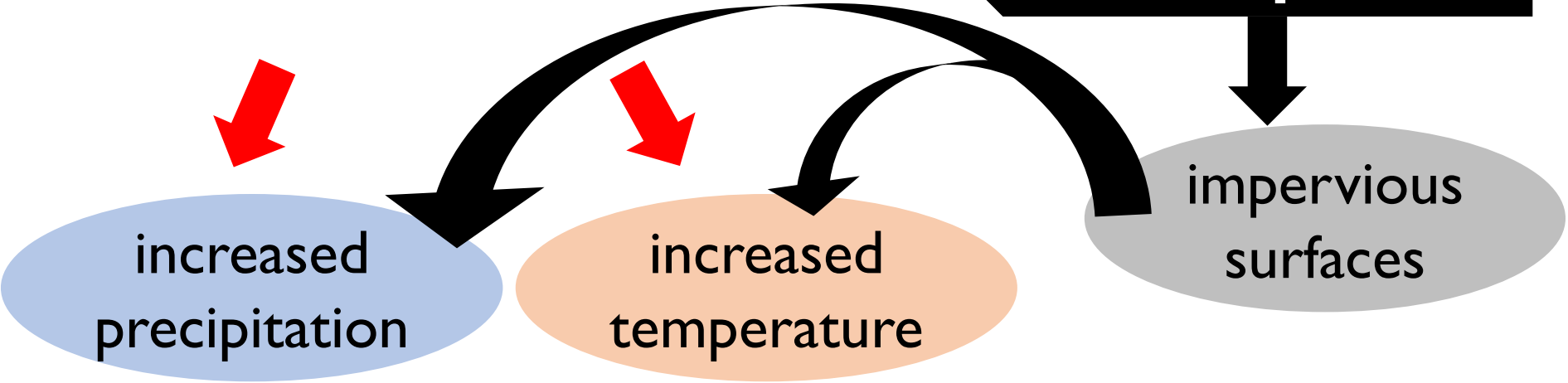


Fertilizer



Climate change

Sprawling Development



stormwater &
WQ issues

flooding &
infrastructure
damage

heat-related
illnesses

more cooling
shelters



Impacts: dry rivers, flooding, algae blooms, beach closures



There are real solutions.

**One of the best adaptation practices
is preserving natural areas.**



Hazards



Nature-based solutions

Open space preservation

Ecosystem restoration

Low Impact Development

Municipal benefits



Avoided Costs



Enhanced Safety



Environmental Services

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**.



**Green
Infrastructure**



**Low Impact
Development (LID)**

Co-benefits



Yes



Maybe



No

Benefit	Reduces Stormwater Runoff				Increases Available Water Supply	Increases Groundwater Recharge	Reduces Salt Use	Reduces Energy Use	Improves Air Quality	Reduces Atmospheric CO ₂	Reduces Urban Heat Island	Improves Community Livability					Improves Habitat	Cultivates Public Education Opportunities
	Reduces Water Treatment Needs	Improves Water Quality	Reduces Grey Infrastructure Needs	Reduces Flooding								Improves Aesthetics	Increases Recreational Opportunity	Reduces Noise Pollution	Improves Community Cohesion	Urban Agriculture		
Practice																		
Green Roofs	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Maybe	Yes	Maybe	Maybe	Yes	Yes
Tree Planting	Yes	Yes	Yes	Yes	No	Maybe	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Maybe	Yes	Yes
Bioretention & Infiltration	Yes	Yes	Yes	Yes	Maybe	Maybe	No	No	Yes	Yes	Yes	Yes	Yes	Maybe	Maybe	No	Yes	Yes
Permeable Pavement	Yes	Yes	Yes	Yes	No	Maybe	Yes	Maybe	Yes	Yes	Yes	No	No	Yes	No	No	No	Yes
Water Harvesting	Yes	Yes	Yes	Yes	Yes	Maybe	No	Maybe	Maybe	Maybe	No	No	No	No	No	No	No	Yes

Nature based solutions at every scale

Rural, suburban, or urban

Conserve available open space providing ecosystem services



Integrate low impact development (LID) designs into new development at neighborhood scales



Restore resilience in urban areas at site specific scale



Avoided 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



MassLive



Avoided Costs

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



**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



Enhanced Safety

<http://www.nae.usace.army.mil/Missions/Civil-Works/Risk-Management/Massachusetts/Charles-River-NVS/>

Return on Investment Studies in MA: Trust for Public Land

- 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



Avoided Costs



**Environmental
Services**

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 \(MAPPR\)](#) ID 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 MA 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.

SOLUTIONS

6 Results

CASE STUDIES

0 Results

HELP ME CHOOSE

Hazard Types

- Coastal Erosion
- Tidal Flooding
- Coastal Flooding
- Riverine Erosion
- Riverine Flooding
- Stormwater Flooding

Region

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

Community Type

- Rural
- Suburban
- Urban

Scale

- Community
- Neighborhood
- Site



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...



Green Streets

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

Green streets incorporate depressed planted areas, typically located between the roadway pavement...



Urban Trees + Forests

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

Urban forestry is the planned installation and management of trees within an...



Floodwater Detention and Retention Basins

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

A detention basin is an area that has been designed and designated...



Horizontal Levees

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

A horizontal levee consists of a hardened structure (levee) setback from the...



Daylighting Rivers and Streams

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

Daylighting rivers or streams is the process of removing obstructions (such as...

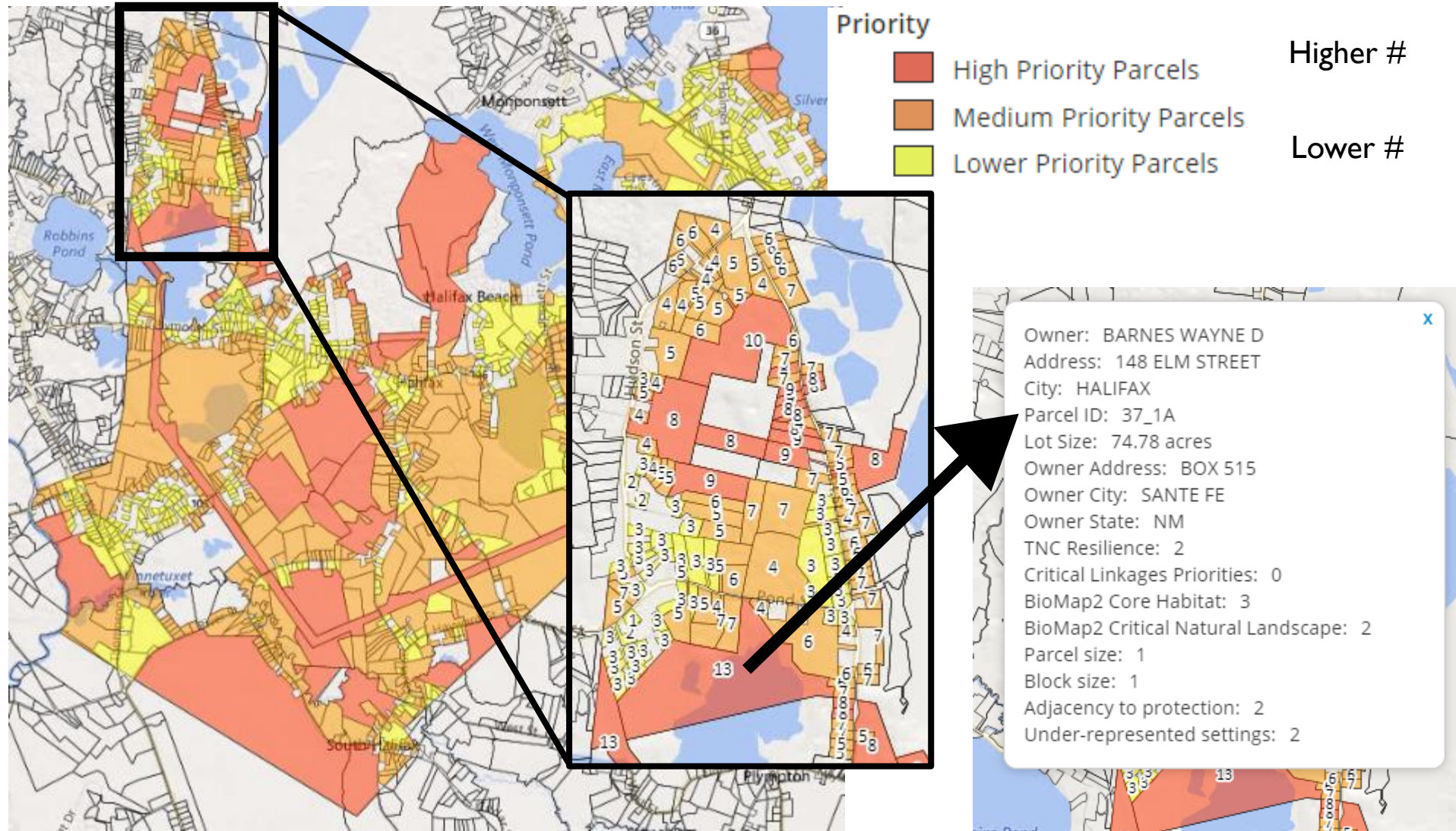
<http://nrcsolutions.org/>

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, preferably constructed with permeable pavers or pavement				(Not applicable)
2 OSRD Overview 3 Zoning Subdiv SPR SW Overview 4 Other Considerations 5 OSRD Analysis 6 Zoning Subdiv SPR SW Analysis 7 Common Acronyms 8 Resources & Model Bylaws 9 Acknow							

massaudubon.org/lidcost or [download here](#)

Mapping local priorities

massaudubon.org/mappr



Linking Local and Regional

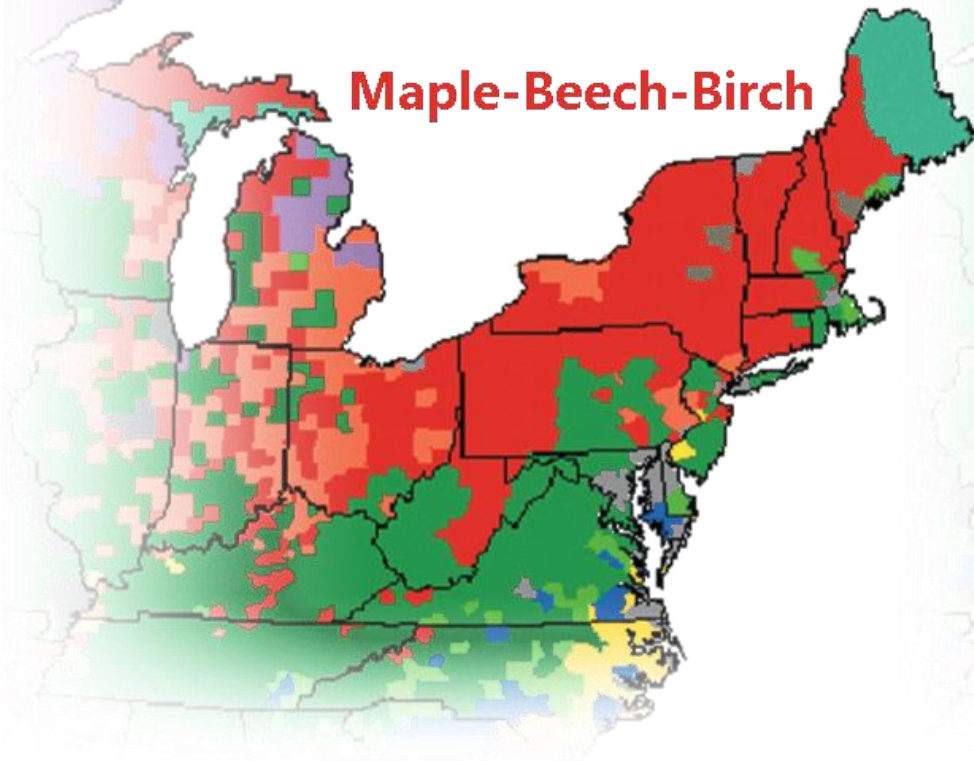
<http://www.srpedd.org/rtnw>

- Link local priorities with regional priorities
 - MAPPR
 - GI Network in the Taunton watershed
 - Linking to local comprehensive/Master Plans and other planning documents such as OSRD
- Consider climate change impacts

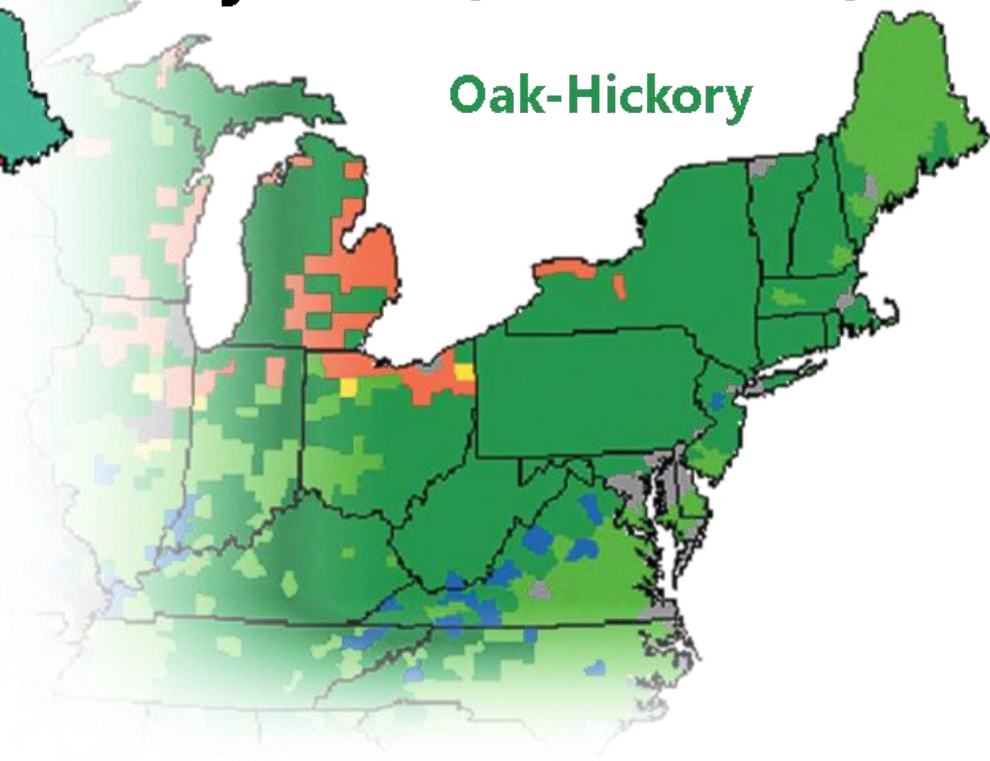


Future Forests

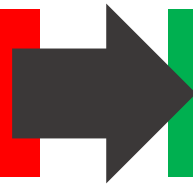
Current (1960-1990)



Projected (2070-2100)



Maple, Beech, Birch



Oak, Hickory

UMass Amherst Guide: Increasing Forest Resiliency

[Guide Available here](#)

Characteristics of Resilient Forests

Formal plans for the future of the property



Minimal forest stress from invasive plants, insects, and diseases, and deer

High Forest Complexity



- ✓ Diversity of tree species
- ✓ Vigorous trees of various sizes and ages
- ✓ Ample tree regeneration of future-adapted species
- ✓ Variety of tree arrangements
- ✓ Appropriate amount of deadwood



Healthy soil and water

Protected threatened, endangered, and at-risk species



Step 1

Assess Forest Resiliency

(Check all that apply)

GOAL 1: Keep Forest Forested and Connected

- 1.1: Formal plans have NOT been made to keep the forest as forest.
- 1.2: The property is either part of a resilient forest or connected to large areas of forest.

GOAL 2: Reduce Stresses

- 2.1: Invasive plants are found on or near the property.
- 2.2: Invasive insects or tree diseases are found on or near the property.
- 2.3: There are significant effects from deer on the vegetation.
- 2.4: There is significant soil compaction or erosion.

GOAL 3: Reduce Vulnerability

- 3.1: The forest does NOT have many different types of tree species of various sizes, ages, and spatial arrangements.
- 3.2: The forest does NOT have young trees predicted to be well adapted to future conditions.
- 3.3: The forest has a high abundance of preferred host species for invasive insects or diseases.
- 3.4: The forest has areas with dense, crowded tree stems.
- 3.5: There are NOT 3 or more large snags (1-16" diameter) per acre.
- 3.6: There are NOT 5 or more large logs (1-16" diameter) per acre.
- 3.7: Water resources do NOT have forested buffers.

GOAL 4: Provide Refuge

- 4.1: The property includes threatened, endangered, or at-risk species.
- 4.2: The property can harbor species that we may lose from the landscape.

Step 2

Increase Forest Resiliency

(Implement the necessary steps for each statement marked)

GOAL 1: Keep Forest Forested and Connected

- ACTIONS**
- 1.1: Engage in conservation-based estate planning.
 - 1.2: Conserve resilient forests and the connections between them.

GOAL 2: Reduce Stresses

- ACTIONS**
- 2.1: Identify and remove invasive plants, and prevent their introduction.
 - 2.2: Monitor for invasive insects and diseases, and implement measures to control or slow their spread.
 - 2.3: Manage deer to ensure ample regeneration.
 - 2.4: Maintain or restore soil and water health by avoiding soil compaction, stabilizing soil eroded sections, and establishing forested buffers around water resources.

GOAL 3: Reduce Vulnerability

- ACTIONS**
- 3.1: Maintain and/or promote diverse species, sizes, ages, and spatial arrangements.
 - 3.2: Promote the establishment of tree species predicted to be well adapted to future moisture and temperature conditions.
 - 3.3: Increase the representation of non-host tree species.
 - 3.4: Reduce stem crowding by thinning to concentrate limited resources on remaining trees in order to increase forest vigor.
 - 3.5: Increase the amount of large snags.
 - 3.6: Increase the amount of large logs.
 - 3.7: Establish forested buffers around all water resources.

GOAL 4: Provide Refuge

- ACTIONS**
- 4.1: Protect threatened, endangered, and at-risk species.
 - 4.2: Identify areas of your land that may support species predicted to occur in well, and establish small reserves around these and other areas of high ecological value.

Step 3

Monitor and Evaluate



Evaluate past conservation actions to ensure that the goals have been reached



Monitor your woods for stresses and vulnerabilities

Revisit Steps 1 and 2 if past actions haven't achieved goals or new stresses or vulnerabilities arise

Step 1

Assess Forest Resiliency

Step 2

Increase Forest Resiliency



OFFICE OF THE GOVERNOR
COMMONWEALTH OF MASSACHUSETTS
STATE HOUSE • BOSTON, MA 02133
(617) 725-4000

16 PM 12:14
GOVERNOR'S DIVISION

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;

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

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;

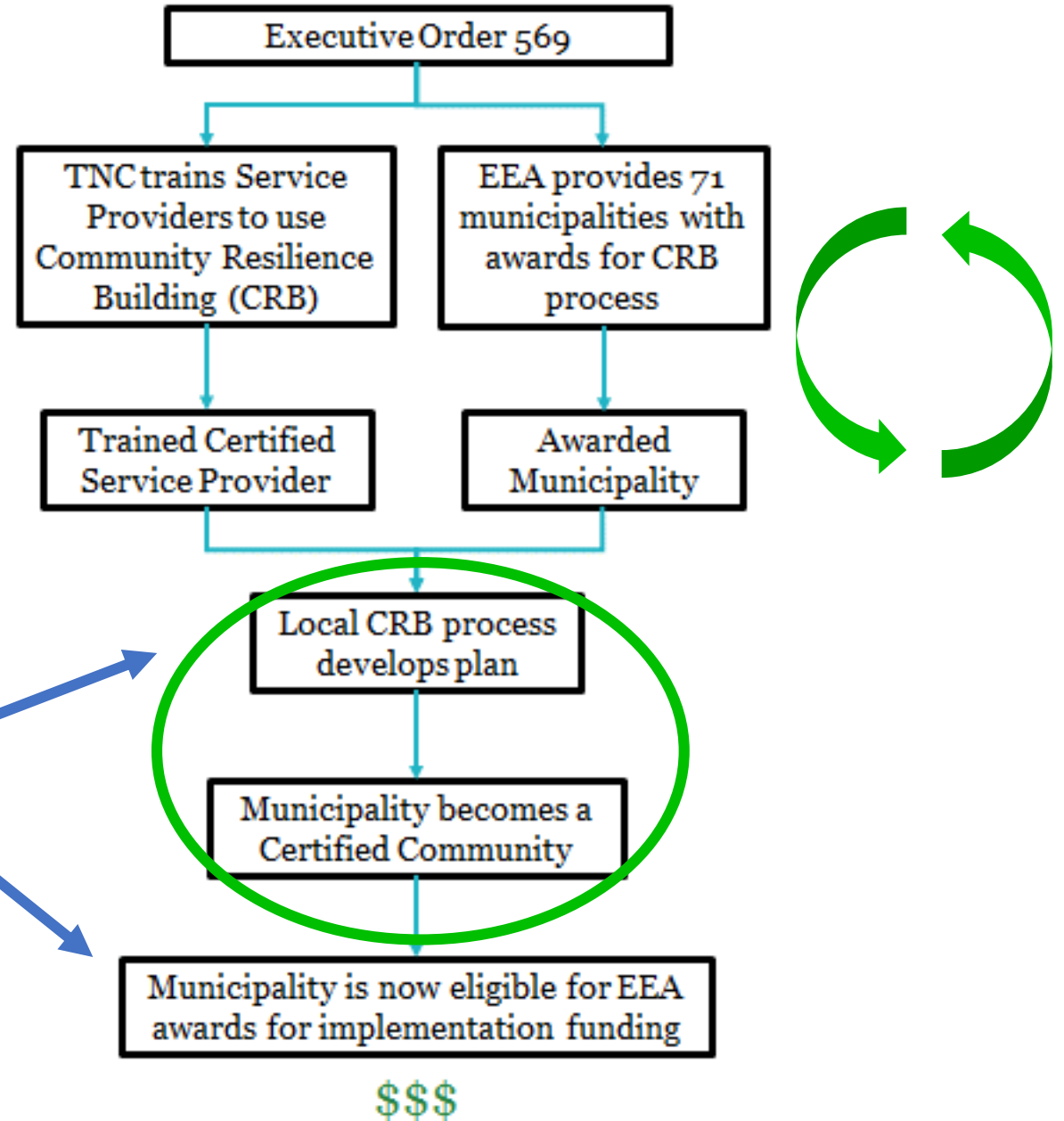
WHEREAS, the generation and consumption of energy continues to be a significant contributor to greenhouse gas emissions in the Commonwealth, and there is significant potential



Where is MVP Now?

A new round of municipal applications for funding coming soon!!!!

Land trusts can participate here



Benefits of MVP



Municipal Vulnerability Preparedness (MVP)



State and local partnership grant to build resiliency to climate change

- Land trusts and properties can contribute to MVP process and increase climate resilience
- Preferred/prioritized funding from state
- “90% of the way there” for Hazard Mitigation planning
- Community of practice & support available to you, like [Mass ECAN](#)
- Creation of technical resources and [webinars](#) available to you

Ensuring Success Webinars

MVP Tool Box

mass.gov/municipal-vulnerability-preparedness-program

- Working with MVP Service Providers: [View recording](#)
- Advancing Social Equity in Climate Adaptation Planning: [View recording](#)
- **Alternatives for engaging your community: [View presentation slides](#)**
- The importance of listening: [View recording](#)
- Bylaw Review –Encouraging Nature Based Solutions: [View recording](#)
- **Nature Based Solutions: [View recording](#)**
- Characterizing coastal flood hazards and increasing resilience: [View recording](#)

5 things you can do as land trust

1. Encourage your community to become an MVP community & participate in the core team
2. Talk to your neighbors, local board members, and community members about climate change and nature based solutions
3. Advocate to adopt the Community Preservation Act or support CPA projects
4. Preserve land! And educate others why it's a great climate adaptation tool
5. Vote in local, state, and federal elections to promote candidates that support climate smart solutions and funding



Ten things local homeowners & citizens can do

1. Divert your downspouts
2. Plant a rain garden
3. Replace impervious surfaces
4. Adopt a drain – and encourage others to
5. Don't wash your car in the driveway



6. Pick up pet waste
7. Reduce fertilizer and pesticide use
8. Replace lawn with native plants
9. Reduce lawn watering and mowing
10. Pick up leaf litter (compost/dispose of properly)

Thank you!
Questions!



Stefanie Covino
scovino@massaudubon.org
Sara Burns
Sara.burns@tnc.org