



Session 4: Resilience Solutions Green Infrastructure, Planning, & LID

Halifax, MA

June 23, 2017

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Goal of Session 4: Resilient Solutions

1. Preserve intact GI

- Why
- Where
- How

2. Incorporate LID

- Bylaw changes
- BMPs

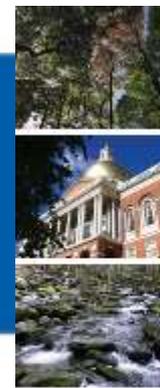
3. Have the community you want

- Community character
- Safe, sustainable, meet regulations, save money

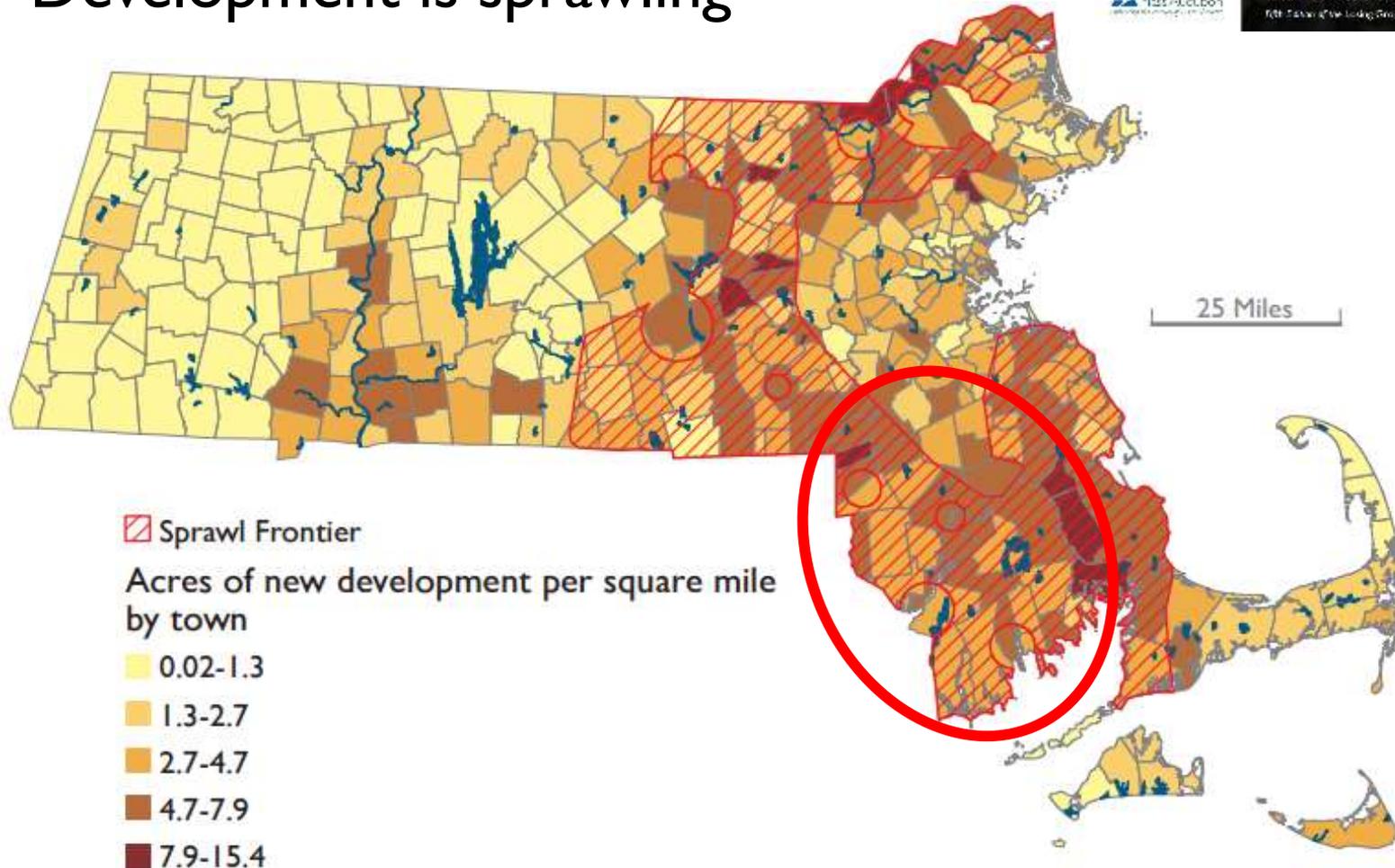
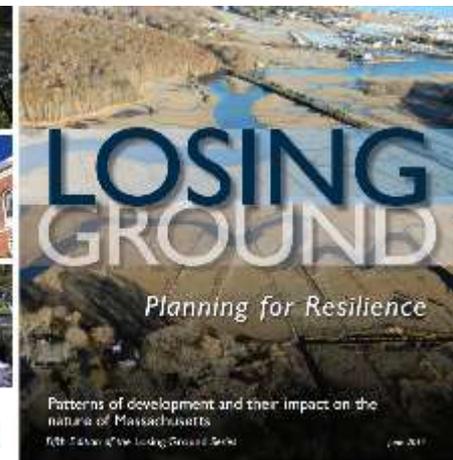


What's the problem?

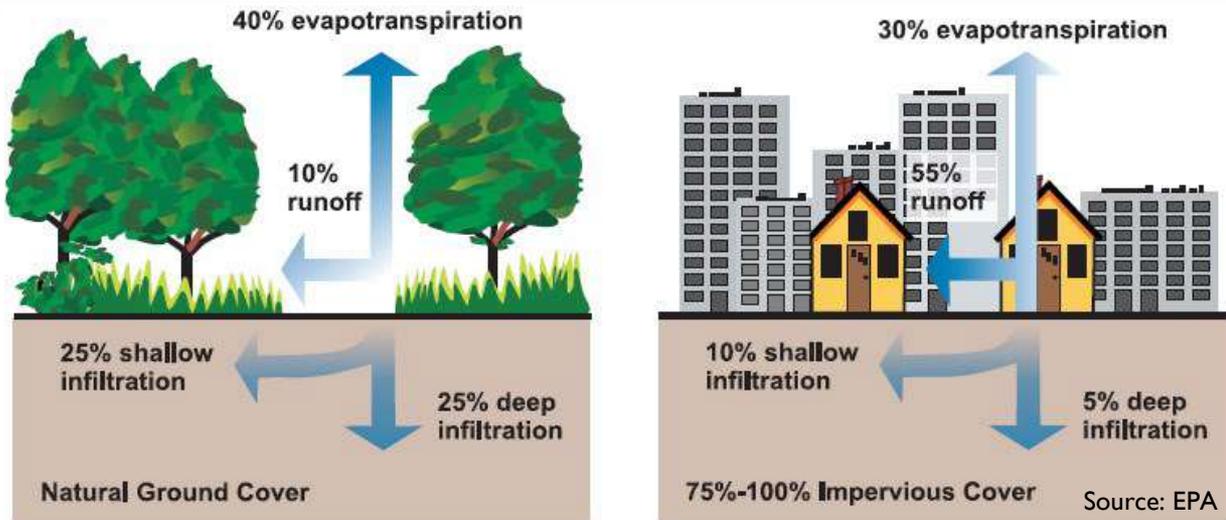
Development is sprawling



Mass Audubon
www.massaudubon.org



What's the problem?



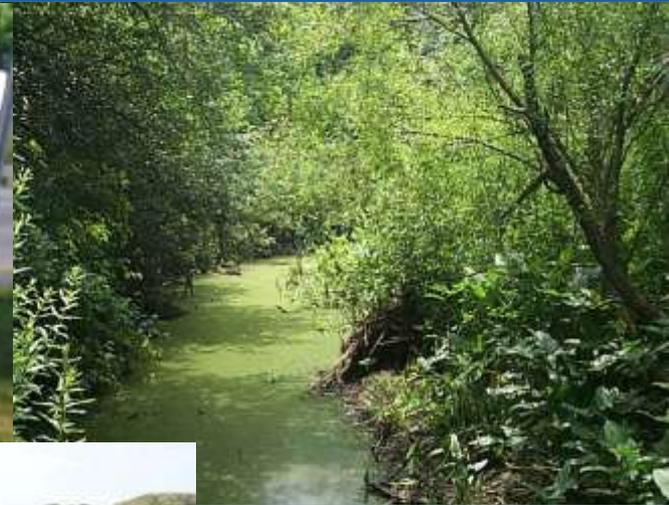
Impervious surface



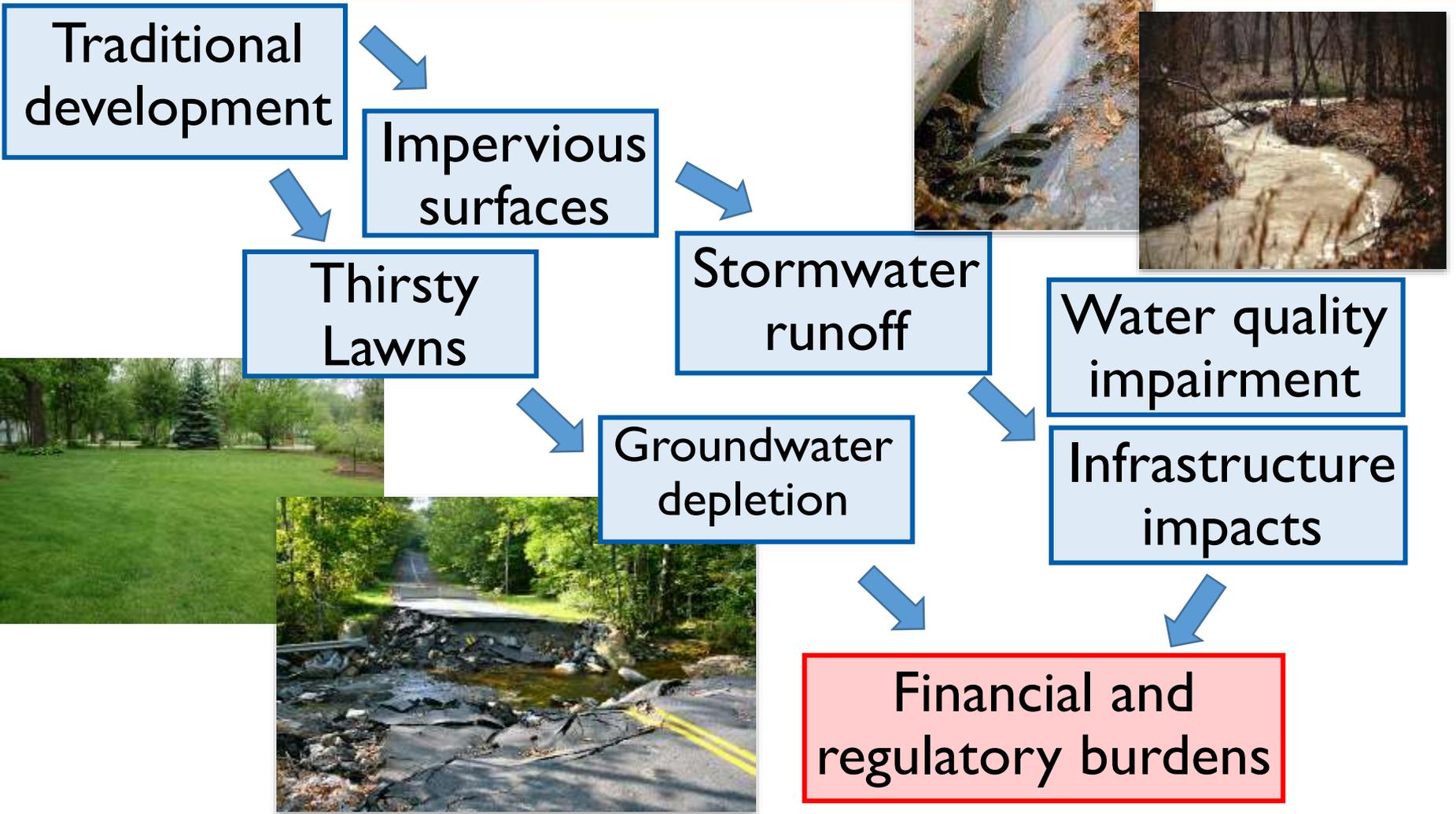
Runoff



Impacts: dry rivers, flooding, algae blooms

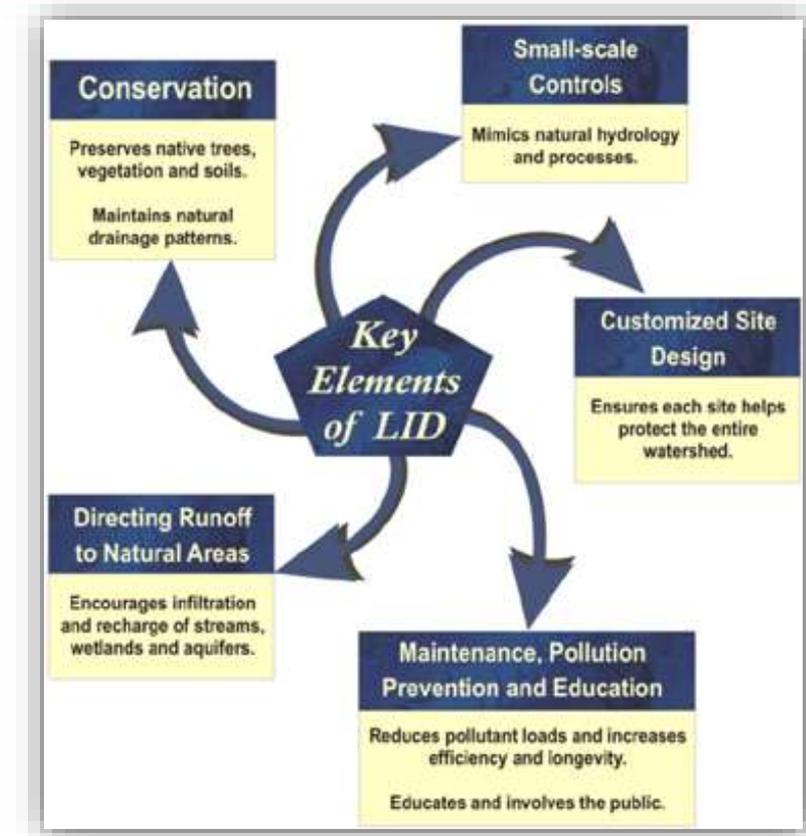


We need to change course



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. ”



Source: Whole Buildings Design Guide, wbdg.com

LID keeps water where you need it most

Communities are running out of water and having to purchase MWRA water

This takes money away from infrastructure repairs that we need to solve these issues

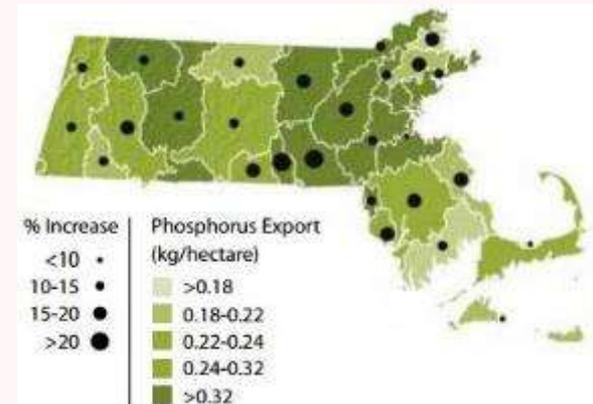
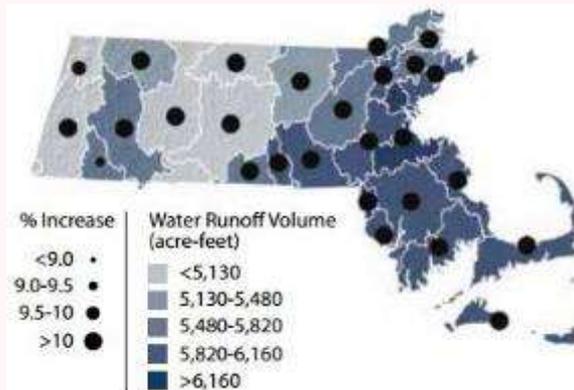
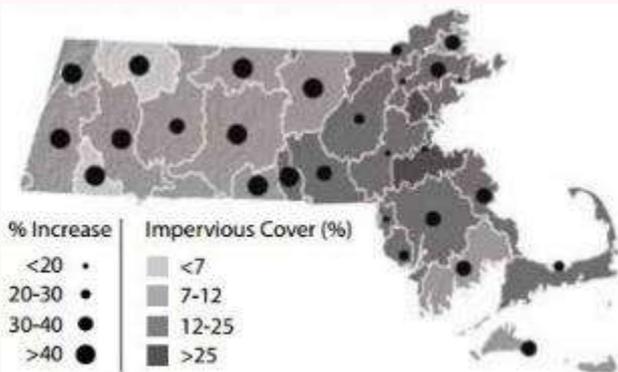


make
sure
water that
falls in our
communities
stays in our
communities

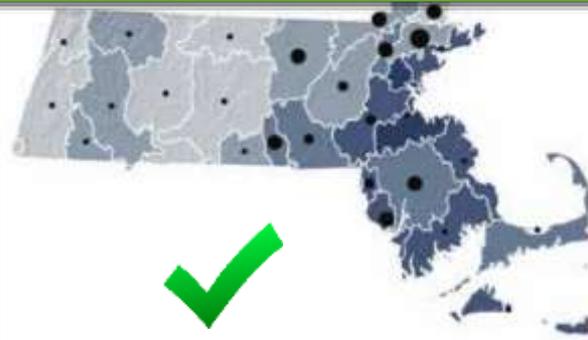
The value of green: impervious, runoff, nutrients

Source: Harvard Forest *Changes to the Land* 2014

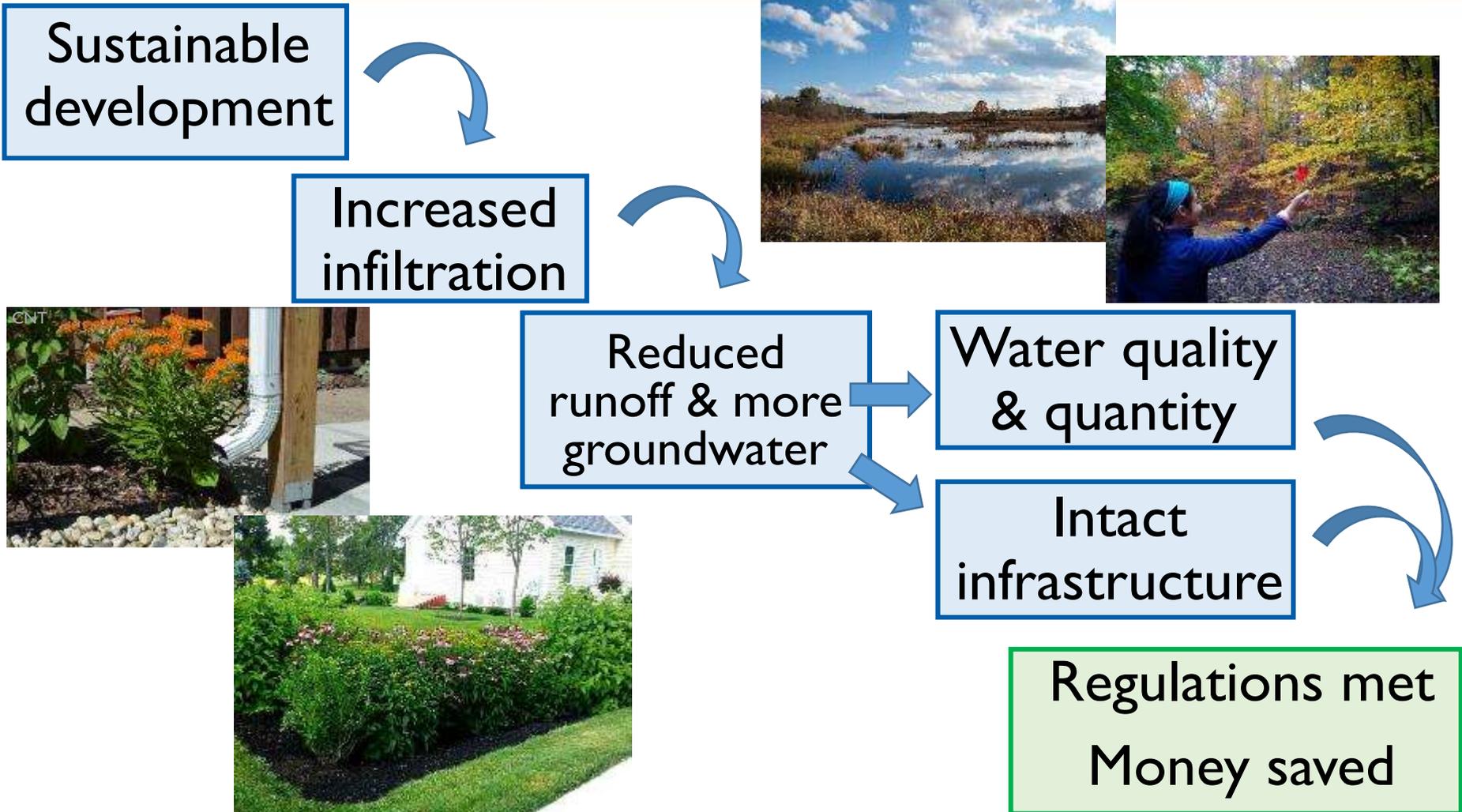
If we continue to follow opportunistic growth, in 2060:



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



A different direction: Greening your community



Benefits of LID practices

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	●	●	●	●	○	○	○	●	●	●	●	●	◐	●	◐	◐	●	●
Tree Planting	●	●	●	●	○	◐	○	●	●	●	●	●	●	●	●	◐	●	●
Bioretention & Infiltration	●	●	●	●	◐	◐	○	○	●	●	●	●	●	◐	◐	○	●	●
Permeable Pavement	●	●	●	●	○	◐	●	◐	●	●	●	○	○	●	○	○	○	○
Water Harvesting	●	●	●	●	●	◐	○	◐	◐	◐	○	○	○	○	○	○	○	●

● Yes

◐ Maybe

○ No

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



restore



protect



save money

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



Integrate

Conserve the natural green infrastructure already providing free ecosystem services

Integrate LID and green infrastructure designs into current development projects

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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



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

The value of green: Reduced paving costs

Road Diets

Narrowing just 2 miles of road by 4 feet/lane saves

\$ **500,000** \$

Plus savings on repair, salting, plowing...

Not building the road through a sprawling development in the first place? Savings grow to the *millions*.

The value of green: Reduced clearing & grading costs

- A 20-unit development with two-acre lots requires 40 acres to be cleared and graded
- Conservation subdivisions offer the same amount of housing but preserve 50% of land – and \$200,000+



The more
land you save,
the more
money you
save.

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

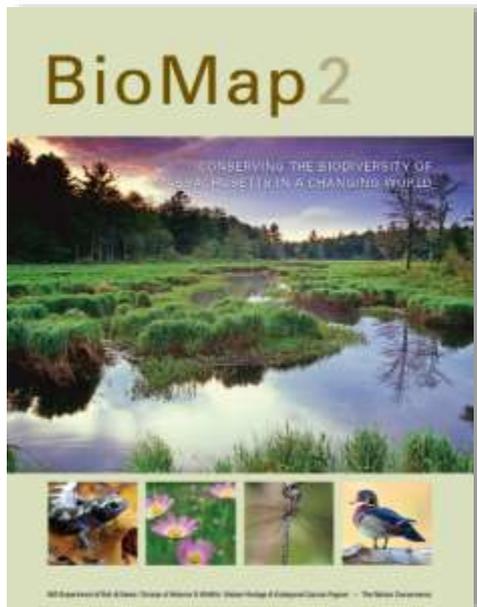


Where to protect?

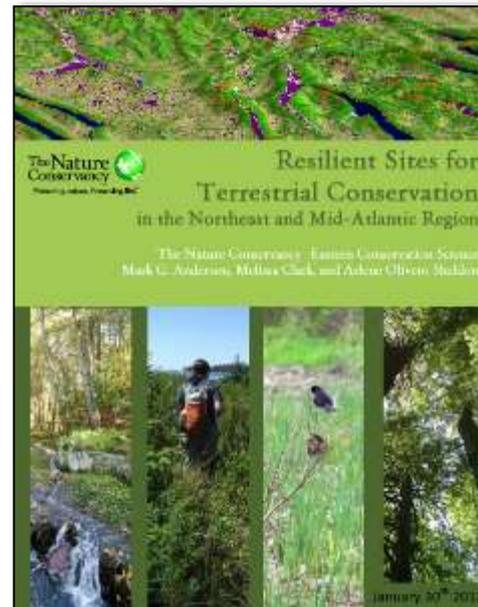
Resilient places



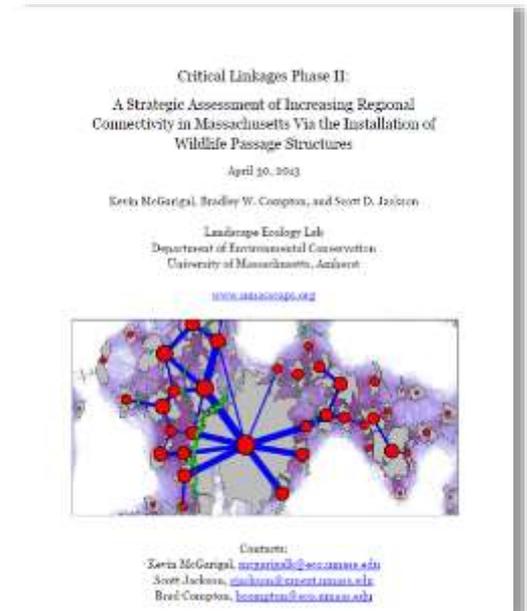
MAPPR: Mapping And Prioritizing Parcels for Resilience



BioMap2:
Habitat, Biodiversity



TNC Resilience:
Climate Adaptation



Critical Linkages:
Ecological Connectivity

MAPPR: 3 Steps

1

Select a study area

- Town, county, or watershed
- *Coming soon: Land Trust Region and regional planning agency region*

2

Choose model

- Choose a pre-calculated model (balanced, resilience, aquatic, or biological)
- Choose specific model values

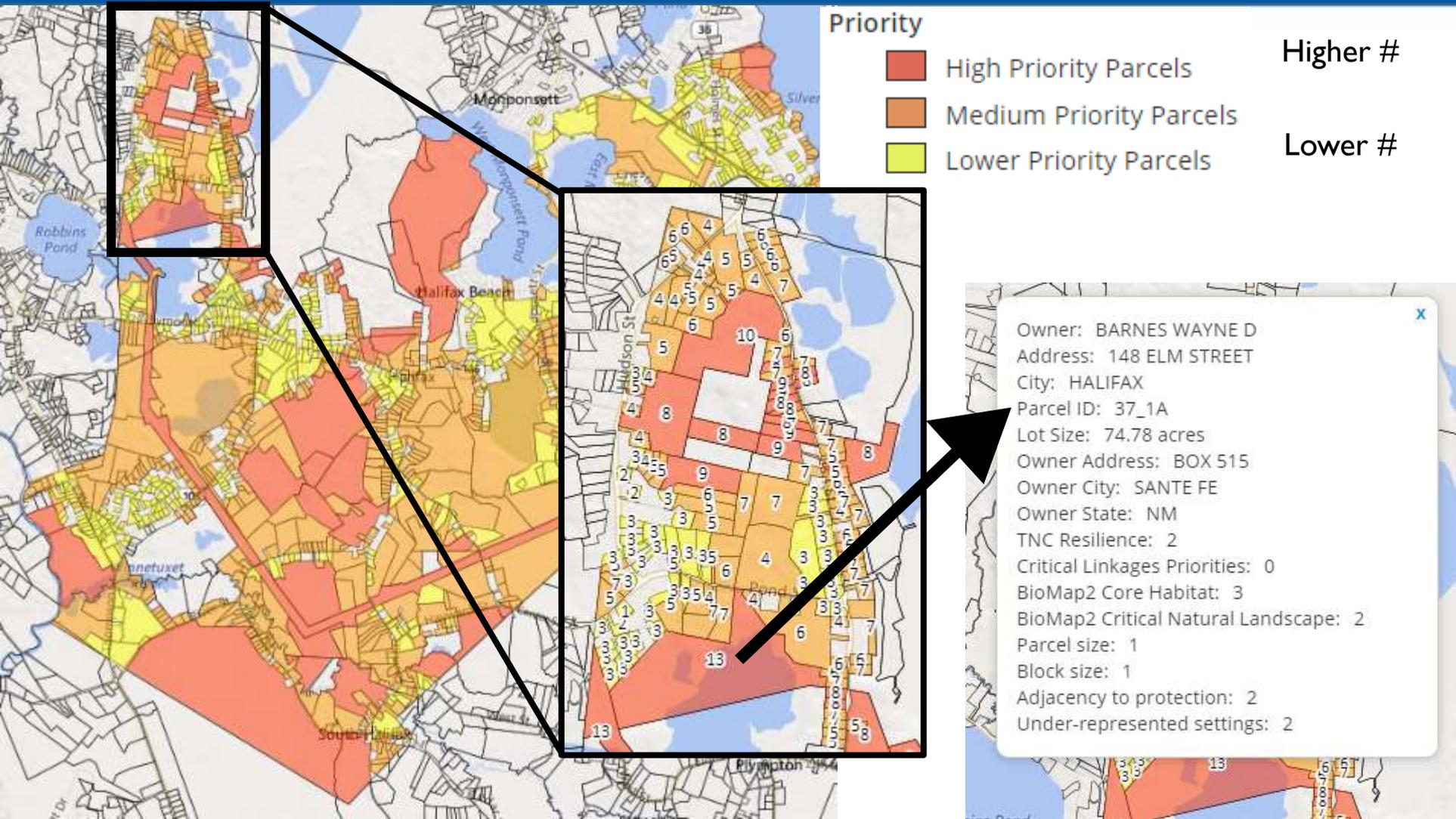
3

Run & Review Results

- Review results, including priority scoring and parcel ownership
- Adjust optional filters and constraints

Values: Resilient Sites for Conservation, Critical Linkages Priorities, BioMap2 Core Habitat, Parcel Size, Block Size, Adjacent to Protection

MAPPR in Halifax – Balanced Model



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



Just Keep In Mind...

**Don't change everything,
just think about GI/LID
*within what you already do***

Doing road repairs?

Planning a development?

Creating a new park?

Fixing flooding issues?

Consider narrowing it too

Think about where & how

Conserve priority land

Plant a rain garden too

Actions that meet multiple requirements & benefits

Possible Action	Addresses Stormwater (MS4)	Addresses Water Management Act Mitigation	Helps with 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
Adopt the Community Preservation Act to fund conservation efforts	x	x	x

Community Preservation Act

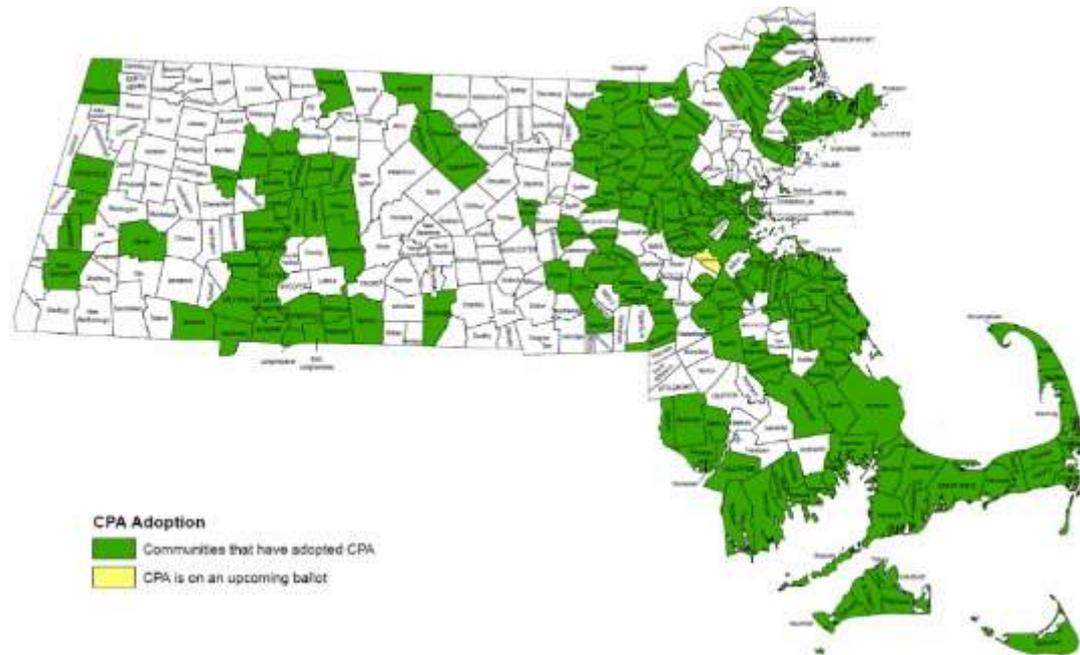
- A state law enabling cities and towns to create a dedicated fund to
 - Preserve open space
 - Preserve historical resources
 - Create community housing
 - Create outdoor public recreation areas
- 0.5-2.0% on local property tax bill



Community Preservation Act

CPA to date:

- 172 communities
- \$1.6 billion raised
- > 8,100 projects
- >23,000 acres of open space



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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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

Factors	Conventional	Better	Best
Curbing	Curbing required full length both sides of road	Allow curb breaks or curb flush with pavement to enable water to flow to vegetated LID features	Open drainage with roadside swales and no curbs preferred
Roadside Swales	Allowed as an option	Preferred over closed drainage	Preferred, with criteria for proper design.
Utilities	Off sets required contributing to wide road ROWs	Not specified, flexible	Allow under road, sidewalks or immediately adjacent to roads to enable placement of roadside swales.
Sidewalks	Concrete or bituminous	Some flexibility in material and design	Prefer permeable pavement
Sidewalks	Required both sides of road	Allow on only 1 side of road especially in low density neighborhoods	Prefer siting with land contours and for best pedestrian utility (e.g. connect with common areas and shared open spaces) – not necessarily immediately parallel to road.
Sidewalks	Drains to road closed drainage system	Not addressed	Disconnect drainage from road system – e.g. adjacent green strips or within vegetated areas that can absorb sheet flow

- Zoning
- Subdivision Rules & Regulations
- Site Plan Review
- Stormwater or LID bylaw

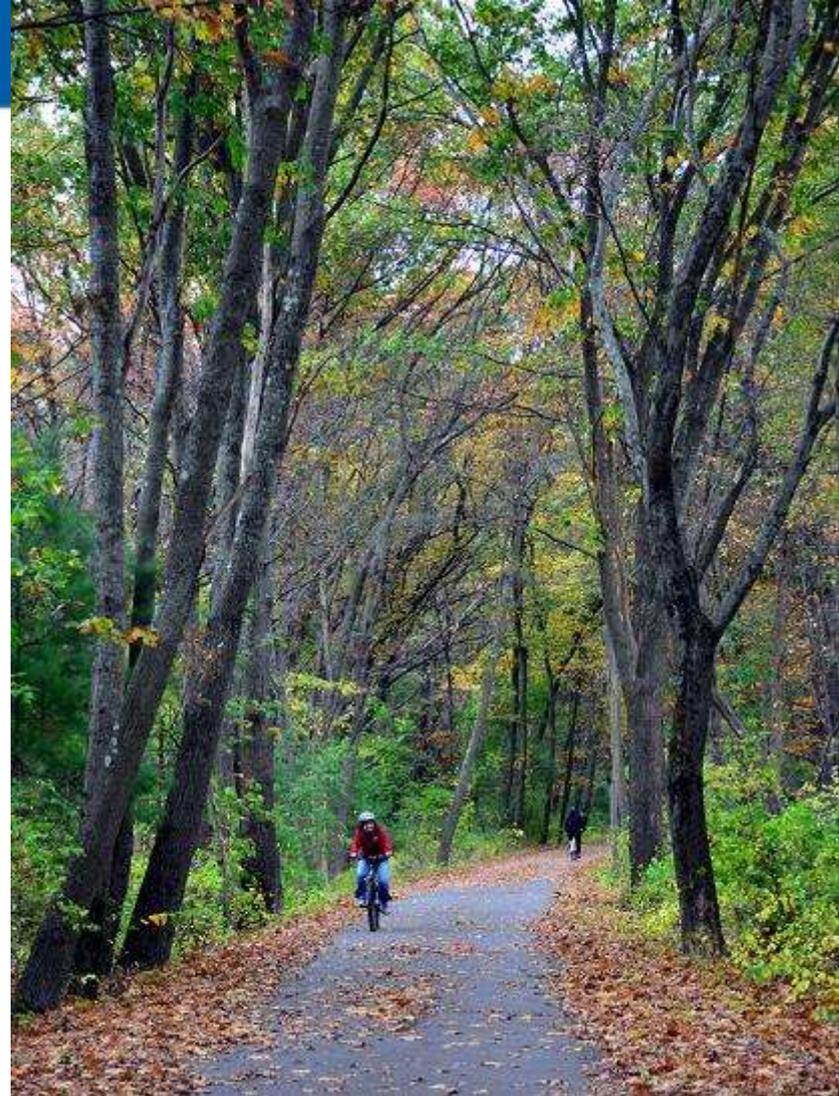
The power of a bylaw: Westford

- Adopted a Conservation Subdivision bylaw in 1978
- Requires developers to submit both conservation and conventional & Planning Board chooses preferred
- 48 developments protected over 1,700 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

More examples of solutions

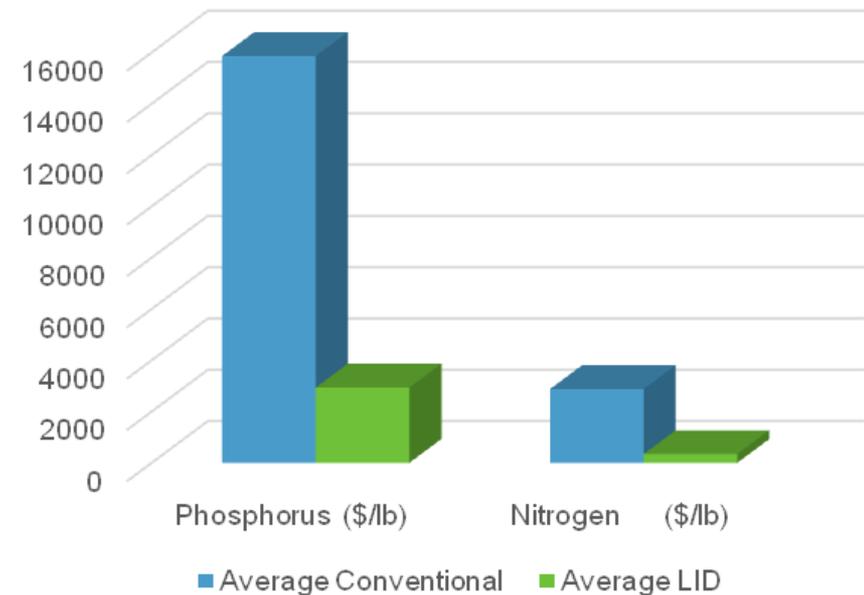
**But first,
any questions
so far?**



Leominster, MA



Comparison of Present Value Costs in Nitrogen and Phosphorus Reduction: LID vs Conventional Detention Systems



Leominster

BMP	% Reduction	0	10	20	30	40	50	60	70	80	90	100	
Hydrodynamic Separator	TSS				35%								
Deep Sump Catch Basin	TSS			25%									
Gravel Wetlands	N								75%				
	P						58%						
Bioretention	N				30-50%								
	P				30-50%								
	TSS										90%		
Infiltration Trench	N					40-70%							
	P					40-70%							
	TSS									80%			

Weir Village Park

- 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

Whittenton Dam Removal

- Partnership worked to remove a failing dam built in 1832
- Threatened safety of downtown Taunton



Whittenton Dam Removal - Benefits

Environmental

- ✓ Fewer algae blooms; improved water quality
- ✓ Improved fish passage and habitat

Community

- ✓ Reduced safety threat
- ✓ Increased local property value
- ✓ Improved recreational opportunities

Economics

- ✓ Cost of removal \$.5M vs. future cost of repair \$1.9M
- ✓ DER study: Each \$1M spent on restoration projects supported 10-13 jobs and \$1.5-\$1.8M in regional economic output



Restoration Improves Stream Continuity and...



Identifying and prioritizing upgrades
can be time consuming...

but many culverts and stream crossings
have already been assessed
and can help prioritize action

Stream Continuity

- North Atlantic Aquatic Connectivity Collaborative (NAACC): StreamContinuity.org
- Find assessed culverts, dams, crossings for fish passage, structural soundness, and best bang for your buck



Take Home Messages

We can't continue on our current, business as usual path.

- You **can take action now** and incorporate these ideas into your everyday work
- **Plan ahead** to encourage the community you want to have



Take Home Messages

- Natural GI provides numerous **free services** and it's easy to find where to conserve
- LID/GI offer **numerous benefits** and are **cost effective**
- **It's been done!** Resources are available.



Funding is Available

State

- MA Clean Water State Revolving Fund Program (CWSRF)
- MA Office of Coastal Zone Management (CZM)
- MA Department of Agricultural Resources (MDAR)
- MA Executive Office of Energy and Environmental Affairs (EEA)
- Mass Environmental Trust (MET)

Federal

- EPA Region I
 - Clean Water Act Section 319 (requires a Watershed Based Plan)

Creating a Watershed Based Plan – the easy way



MASSACHUSETTS
watershed-based plans

<http://prj.geosyntec.com/massDEPWBP>



A Watershed Plan in 3 Easy Steps

1

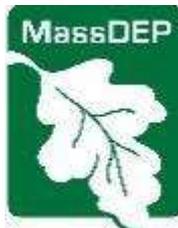
Choose Your Watershed

2

Review Information Sources

3

Develop Your Plan



Resources to Remember

1. Fact Sheets on LID

massaudubon.org/lidcost

2. MAPPR tool

massaudubon.org/mappr

3. EEA Smart Growth Toolkit

http://www.mass.gov/envir/smart_growth_toolkit/



Questions?



Worksheet

Fill out the rest of the columns in your worksheet

- What solutions sound like a good fit for the issues you've identified?
- How feasible are they?
- What next steps do you need to take and what resources or connections will help you achieve success?

We're not done quite yet...

We want to create **lasting partnerships** and continue to help you in the future

Another project is helping **quantify the benefits** of the green infrastructure that Session 3 identified, including creating different “what if” scenarios. Interested? Let us know!

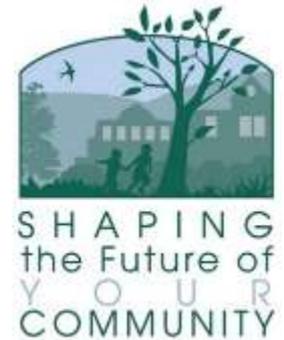


Thank you!

**RTWN is here to offer resources,
host roundtables, and
answer questions – contact us!**



**For more information on Session 4 topics, please visit
www.massaudubon.org/LIDcost**



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The Healthy Communities Project is a partnership among Mass Audubon, Manomet, The Nature Conservancy, the Metropolitan Area Planning Council, and the Southeast Region Planning and Economic Development District. A project of the *Resilient Taunton Watershed Network*, this work is made possible by funding through the Environmental Protection Agency.

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