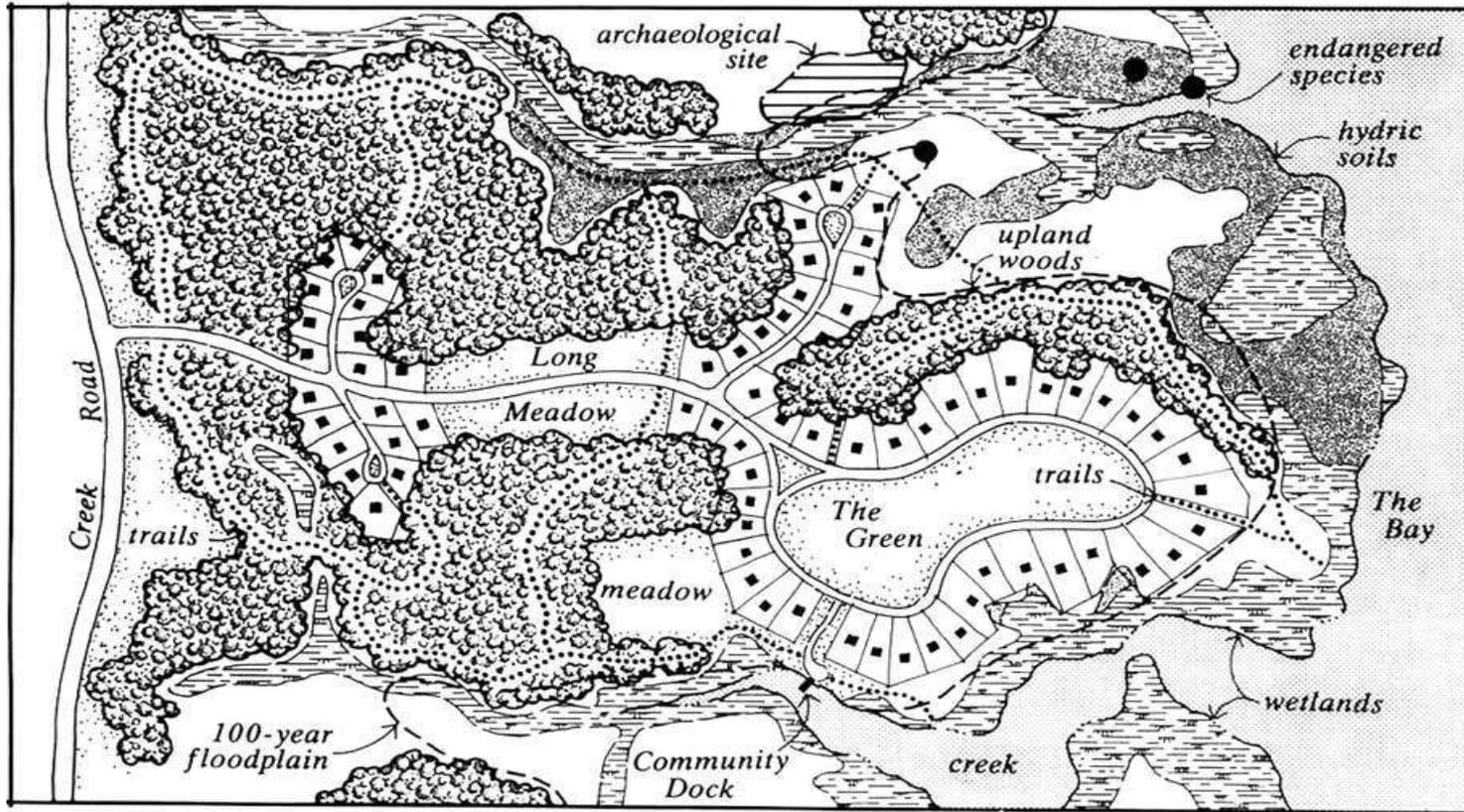
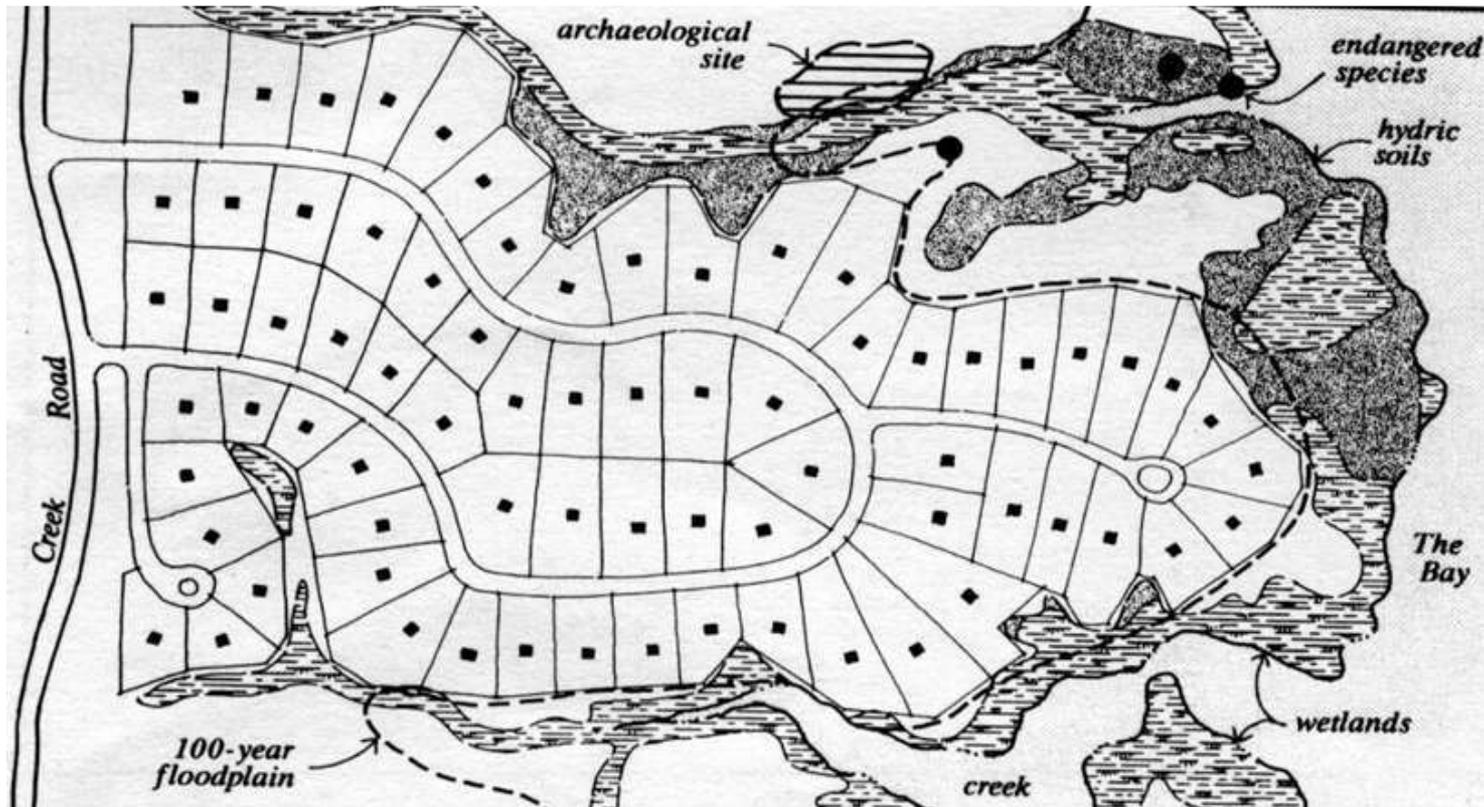


# Draw lot lines



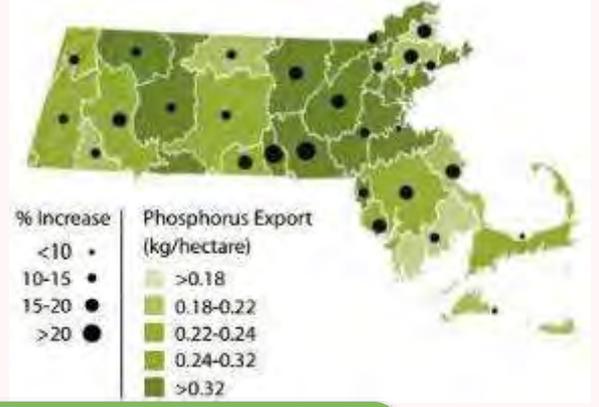
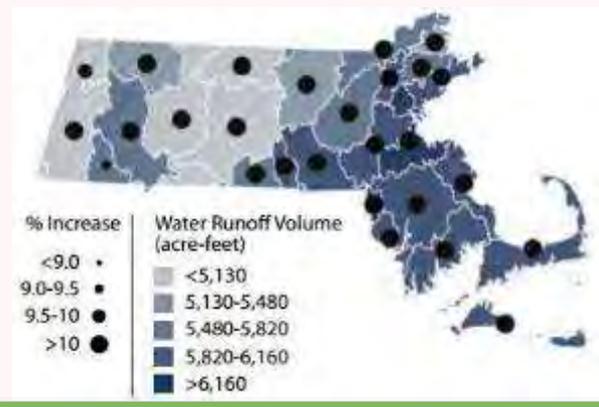
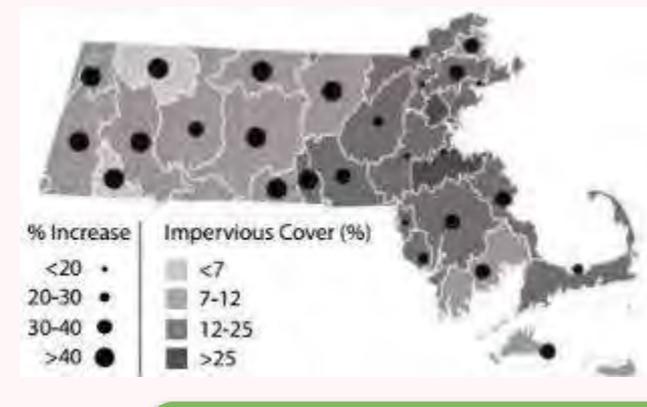
Instead of...



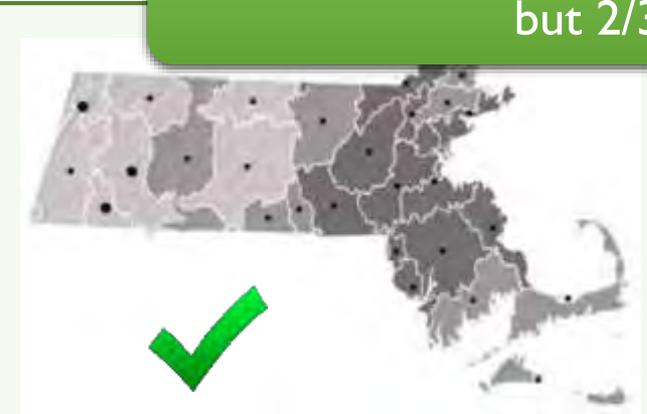
# If we all had OSRD... nutrients, impervious, phosphorus

Source: Harvard Forest *Changes to the Land* 2014

**If we continue to follow growth patterns, in 2060:**



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



# Site-specific solutions via 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

# What does it look like?

## Pinehills – Plymouth, MA<sup>4</sup>

The Pinehills is a 3,174 acre New England village style development in Plymouth, MA that preserved over 2,000 acres. The remaining third of the property is peppered with a variety of homes including townhomes, condos, and single family – all of which are densely developed but in a quaint style that retains New England's classic character by preserving the natural landscape and mature trees surrounding the homes.

Developers also preserved Old Sandwich Road, the oldest unpaved public way in continuous use in the country, and instead created new, narrow roadways that follow the contour of the existing land. They incorporated numerous LID and green infrastructure elements into the built areas, including bioswales and rain gardens to handle on-site stormwater management. Additionally, The Pinehills incorporated 10 miles of walking trails that residents use to reach the mixed-use town center.

The Pinehills

By working with the land, the developers not only saved money on clearing, grading, and piping, but also created over \$1 billion in new assessed property value for the town of Plymouth since 2001 while residents enjoy increased aesthetics, community health, and historic charm.





# What does it look like?



Horsley Witten

## Cottages on Greene – East Greenwich, RI<sup>3</sup>

Walkable, affordable neighborhoods were sparse in East Greenwich and the community had one of the highest housing values in the state, with little developable land available. However, a group of developers took a creative approach and transformed a derelict .85 acre parcel into 15 mixed affordable and market rate homes less than half a mile from the waterfront.

These 2-bedroom, 1,000 ft<sup>2</sup> “cottages” require minimal homeowner maintenance. They are organized around a series of courts that incorporate bioswales, rain gardens, and pervious pavement in the parking lot—features that together manage stormwater on site. By incorporating small bridges across retention ponds, developers brought attention to these LID features. By reducing traditional piping and catch basins, developers also saved nearly 17% on their site design (see chart to the right for details).

<u>Green “LID” Alternative</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
Bioretention	2,215	sf	\$20.00	\$44,300
Bioswale	430	lf	\$15.00	\$6,450
Perforated CPP Underdrain	350	lf	\$15.00	\$5,250
Pavement Section (typ.)	540	sy	\$35.00	\$18,900
Permeable Bituminous Section	450	sy	\$43.75	\$19,688
Drywell	3	each	\$5,000.00	\$15,000
				<b>\$109,588</b>
<u>Conventional Alternative</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
Catch Basin	5	each	\$3,000.00	\$15,000
12” CPP	200	lf	\$30.00	\$6,000
Drain Manhole	4	each	\$4,000.00	\$16,000
Stormceptor Unit	1	each	\$20,000.00	\$20,000
Underground Recharge System	1	each	\$40,000.00	\$40,000
Pavement Section	990	sy	\$35.00	\$34,650
				<b>\$131,650</b>
<b>Green alternative savings =</b>				<b>\$22,063</b>
<i>Horsley Witten Group, Inc.</i>				<b>16.8%</b>

# Options & benefits of LID

Benefit	Reduces Stormwater Runoff				Increases Available Water Supply	Increases Groundwater Recharge	Reduces Salt Use	Reduces Energy Use	Improves Air Quality	Reduces Atmospheric CO <sub>2</sub>	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

# Examples of GI & LID and how to get there

**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



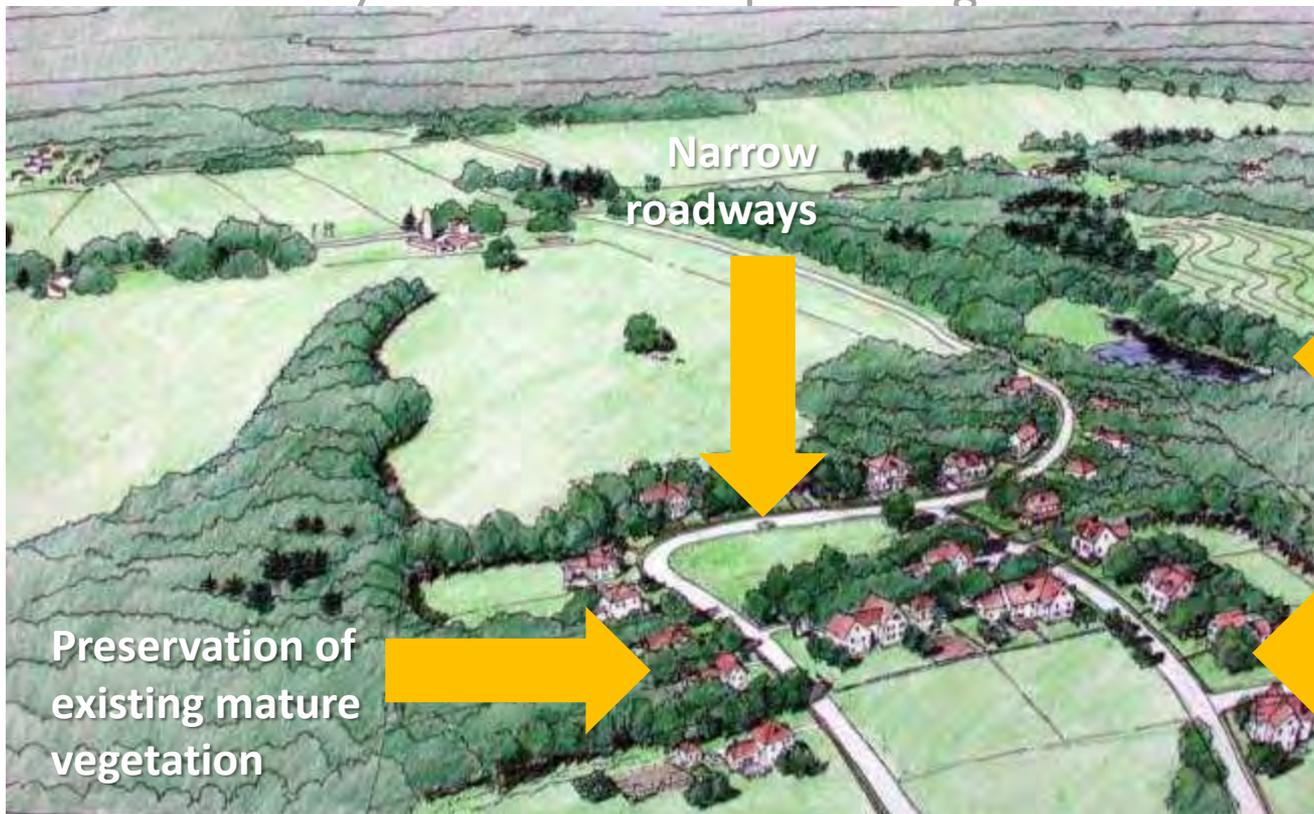
save money

# 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



Narrow  
roadways

Local  
wetlands  
bylaw

OSRD;  
small lot size

Preservation of  
existing mature  
vegetation

# 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



Narrow, curbless roads

Minimum site disturbance;  
preservation of trees



Allow curb cuts for bioretention



# 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



Underground utilities, tree box filters between road and sidewalk

Curb cut for bioswales; vegetation between road and sidewalk



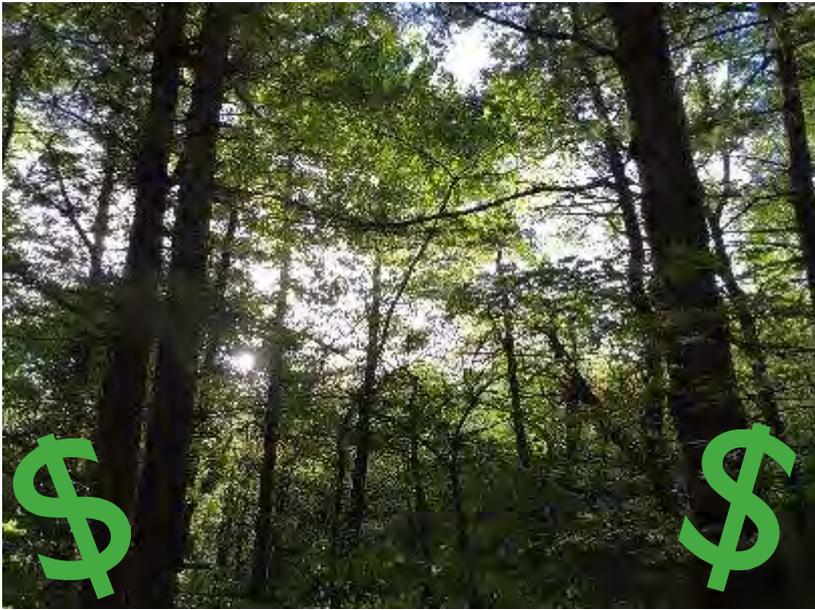
North Street, Pittsfield, MA



# Climate smart is budget smart

## Reduced clearing & grading costs

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



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

# Climate smart is budget smart

## 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*.

# Charles River Natural Valley Storage Area

## US Army Corps of Engineers

### Background

- 1972 study identified development pressure, recommended conservation to reduce flooding

### Project

- 8,095 acres purchased/protected in the mid-upper Charles River watershed

### Cost

- \$8,300,000

### Benefits

- \$11,932,000 in flood protection 1977-2016
- Recreation
- Habitat
- Cleaner water & air



Enhanced Safety



Avoided Costs



Environmental Services

# Watershed protection

## MWRA

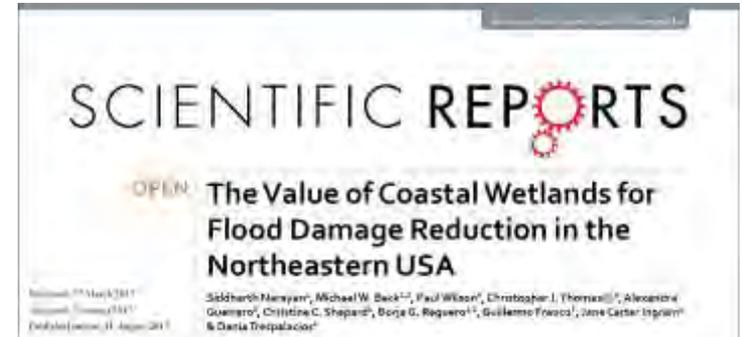
- Quabbin & Wachusett Reservoirs serve 2.5 million
- Over 20 years, Massachusetts Water Resources Authority spent \$130M to protect 22,000 acres of watershed lands
- Avoided ratepayer cost of \$250M on a filtration plant and \$4M/yr in operations



# Return on Investment Studies Northeast US Scientific Reports

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- In Hurricane Sandy, wetlands reduced \$625,000,000 in direct flooding damages in New Jersey
- In New England, wetlands reduce storm damage by approximately 16%



<https://www.nature.com/articles/s41598-017-09269-z>

# Return on Investment Studies in MA

## Trust for Public Land

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- 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**



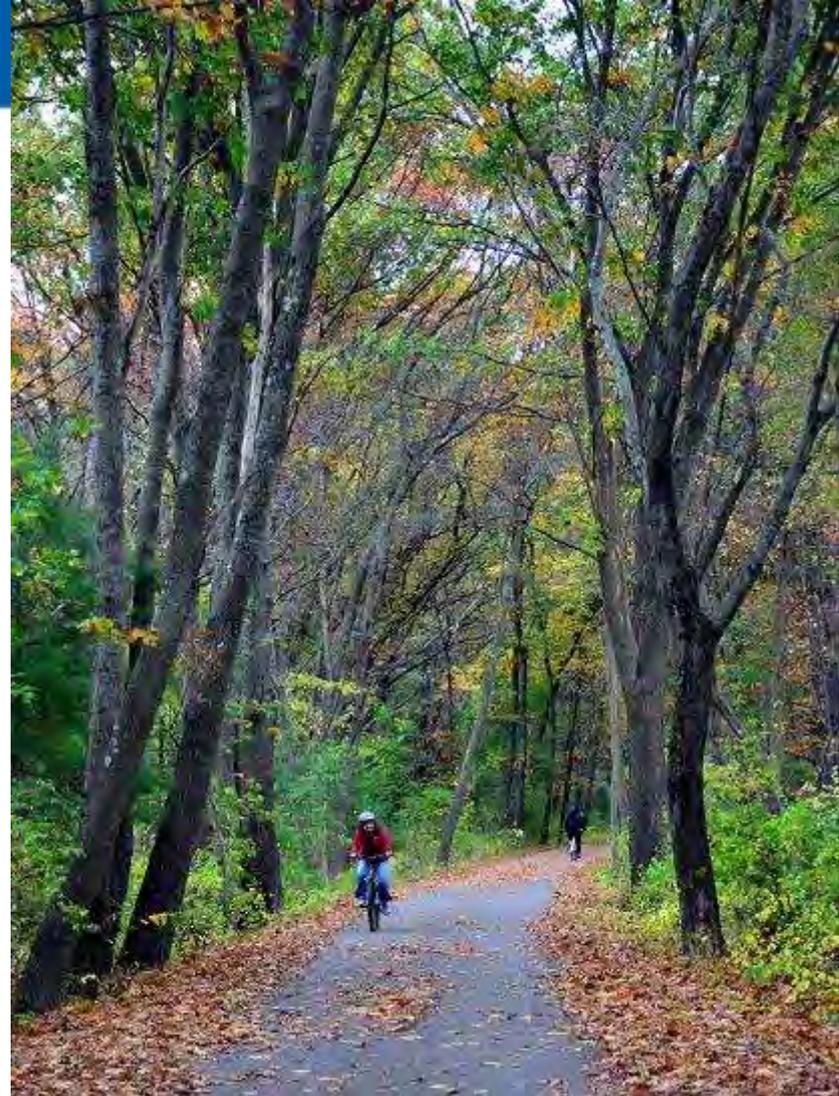
# The power of a bylaw: Westford

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

# Multiple benefits of OSRD

## Environmental

- Water quality, habitat protected
- Improved community resilience



## Social

- Increased recreational opportunities
- Maintain forested, rural character
- Maintain look of established community



## Economic

- Developers spend less on clearing/grading
- Homes sell faster and for 10-30% more
- Community spends less on road maintenance
- Community receives open space for free

# If you forget everything I just said... it's right here.



## Balancing Growth & Character

As our communities grow and develop, it's important to consider the natural and aesthetic value of the landscape. Cutting down forests and substituting expansive lawns without any mature trees sacrifices the classic charm of New England, and reduces our ability to enjoy foliage in the fall, shade in the summer, and privacy, recreation, and walkable neighborhoods all year long.

Conservation design (CD) can offer all of these benefits along with the valuable fire ecosystem services described in Fact Sheet #1 while meeting communities' development needs. Building homes closer together and preserving adjacent land for shared use creates attractive, cohesive communities where neighbors know one another and have recreational and aesthetic benefits right outside their doorstep. CD also improves property values while decreasing building costs and protecting water resources.

## What is Conservation Design?

Conservation design looks at the existing characteristics in a landscape and works to protect the most important aspects during development—whether it's a historic rock wall, a scenic overlook, or a critical habitat area. In these cases, when a developer purchases a land parcel for a subdivision, they typically put at least 50% of the land into permanent protection. Then a land trust, conservation commission, or other relevant group receives the protected land and its benefits without having to purchase the land themselves.

This type of development allows communities to grow while also preserving local natural resources and sense of character—at no additional cost to the community.

This fact sheet reviews how to create a conservation design and explores examples of successes and challenges communities have faced in implementing this type of design.

## What are Green Infrastructure (GI) and Low Impact Development (LID)?

**Green Infrastructure (GI)** includes both natural features such as forests and wetlands as well as engineered landscapes that mimic these natural processes like a rain garden.

**Low Impact Development (LID)** works to preserve the natural landscape and remove impervious surfaces to keep stormwater close to the source and out of a resource rather than a waste product.

Together, LID and GI not only manage stormwater and improve groundwater supplies, but also offer many free ecosystem services including cleaner air and water, flood control, shade and energy savings, recreational opportunities, and enhanced property values and quality of life.

**Preserving our existing GI is our first line of defense against climate impacts** such as increased water frequency and intensities as well as achieving long-term cost savings.



A classic New England village look at the Cottage on Green in East Greenwich, RI



[massaudubon.org/lidfactsheets](http://massaudubon.org/lidfactsheets)

# If you forget everything I just said... it's right here.



## Making Regulations Reflect Priorities

Local conservation lands and green infrastructure are important assets for communities, and include environmental, economic, health, and social benefits.

However, many communities' plans and land-use rules unintentionally encourage sprawling development that comes with many costs. Whether it's an outdated open space plan that doesn't prioritize conservation needs or bylaws that require large lots, wide roads, and big, water-intensive lawns, there are lots of opportunities to revise regulations and guide development in a more sustainable direction.



A planned driveway and mature trees in Plymouth, MA

## Planning Ahead for the Community You Want to Have



Local land-use regulations have the ability to make or break communities' ability to enhance conservation and incorporate LID techniques described in previous fact sheets. You get what you zone for — what will your community look like if fully built-out in accordance with the local rules as they currently stand?

It's important to periodically review and update local plans and rules and determine how they work together, and whether they encourage or discourage smart growth. By analyzing and updating local plans and land-use rules such as zoning, subdivision rules and regulations, site plan review, and stormwater regulations, communities can ensure that development is consistent with local goals and values. This fact sheet will review how to go started and prioritize.

## What are Green Infrastructure (GI) and Low Impact Development (LID)?

**Green Infrastructure (GI)** includes both natural features such as forests and wetlands as well as engineered landscapes that mimic these natural processes like a rain garden.

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<b>MA Open Space Residential Design Best Practices Factors</b>	<b>Conventional</b>	<b>Better</b>	<b>Best Practice</b>
<b>Permit Type</b>	Special Permit	By Right	Mandatory
<b>Land area to which the zoning is applicable</b>	Only a small amount of developable land	Land of particular environmental sensitivity	All developable land zoned residential
<b>Minimum Open Space</b>	50-65%	65-75%	≥ 75%
<b>Yield Calculation</b>	Full plan with full percolation tests	Sketch plan with selected percolation test(s)	By formula
<b>Minimum parcel size</b>	≥ 10 acres	5-10 acres	None
<b>Review Process</b>	No detailed analysis of site characteristics in relation to design	Cluster layout	Flexible "OSRD" 4 Step
<b>Ownership of Open Space</b>	Appropriate to the resources present. For example, agricultural land by the farmer, watershed land by a water dept. or district, habitat land by the conservation commission,		
<b>Dimensional Standards; area, frontage, etc.</b>	Specified, < than for standard subdivision	Formulaic reduction with specified minimums	None set or small minimums
<b>Quality of open space conserved: Specificity of local priorities for natural, cultural, and historic resource conservation</b>	No indication of local conservation priorities, or language that refers only to regulated resource areas.	Lack of specificity regarding local conservation priorities; no map of priority locations	Local priorities clearly and unambiguously stated and mapped for use in site design.
<b>Contiguity of open space; relationship to</b>	No contiguity requirement	Contiguity required within	Contiguity required; adjacent