

Saving Land, Water, and Money



conserve



restore



protect



save money

March 2017

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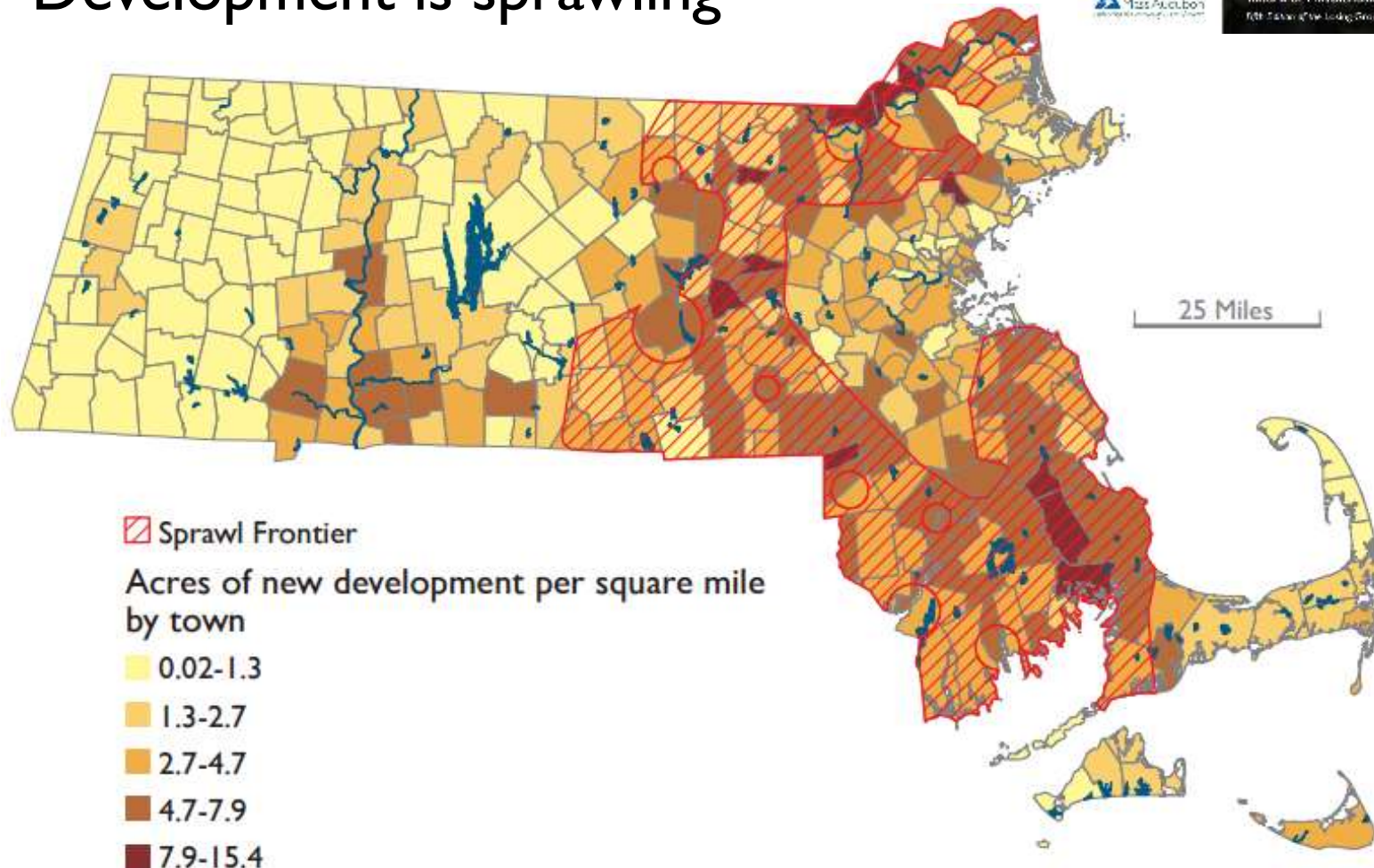
Scott Horsley shorsley@horsleywitten.com

What's the Problem?

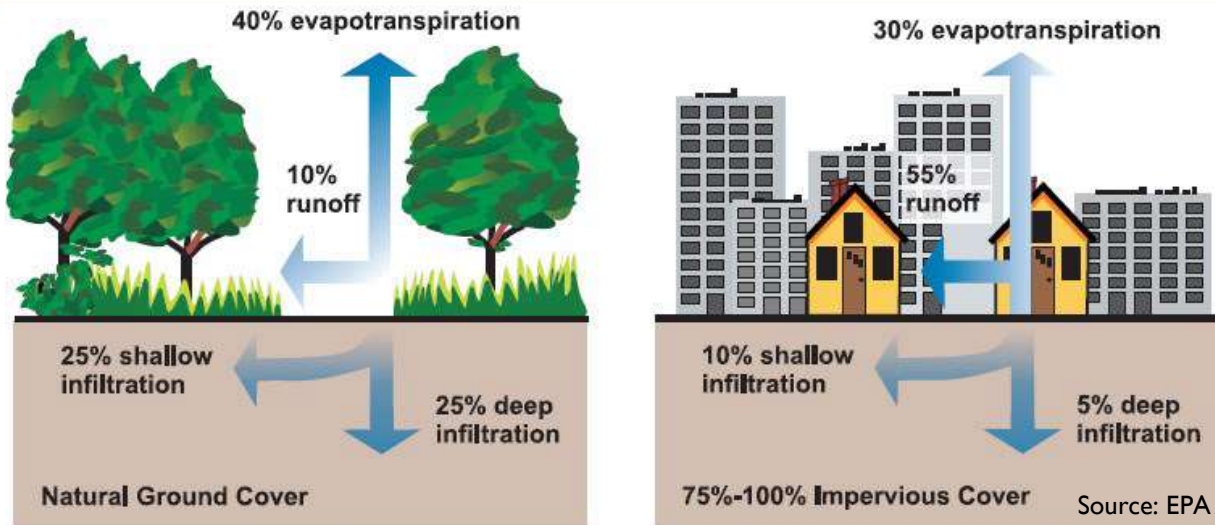
Development is sprawling



Mass Audubon
www.massaudubon.org



What's the problem?



Impervious
surface



Runoff



Impacts: dry rivers, flooding, algae blooms



We need to change course

Traditional development

Impervious surfaces

Thirsty Lawns

Stormwater runoff

Groundwater depletion

Water quality impairment

Infrastructure impacts

Financial and regulatory burdens



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. ”

- EPA



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

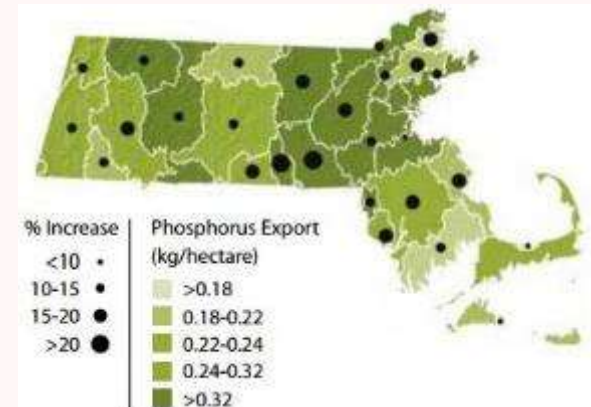
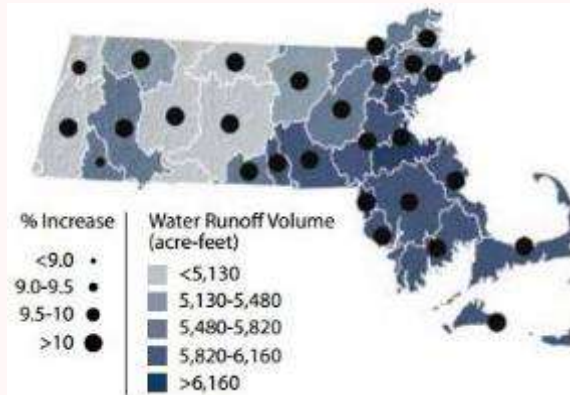


make
sure
water that
falls in our
communities
stays in our
communities

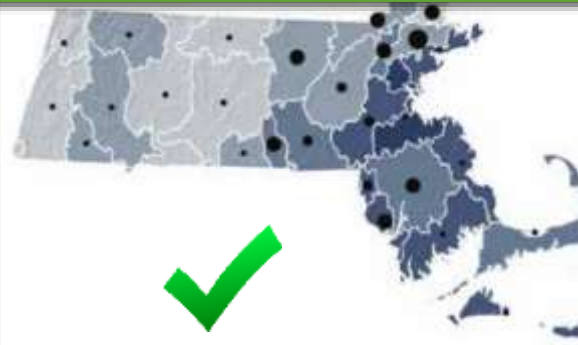
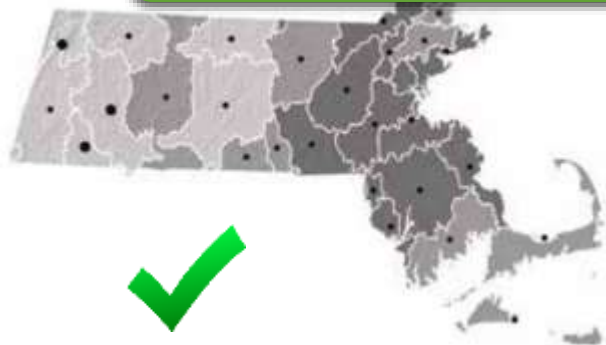
The Value of Green: Impervious, Runoff, Nutrients

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

Sustainable
development



Increased
infiltration



Reduced
runoff & more
groundwater



Improved
water quality



















Intact
infrastructure



Regulations met
Money saved



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

Source: Center for Neighborhood Technology's The Value of Green Infrastructure

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

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Integrate LID and green infrastructure designs into current development projects

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Integrate

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Restore

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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 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.

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*.

Floods, Droughts, and You

You can help!

- ✓ Educating community members, homeowners, and local officials
- ✓ Use of native plants and storm-water management through LID where possible
- ✓ Requesting that developers consider LID in projects during the public comment process

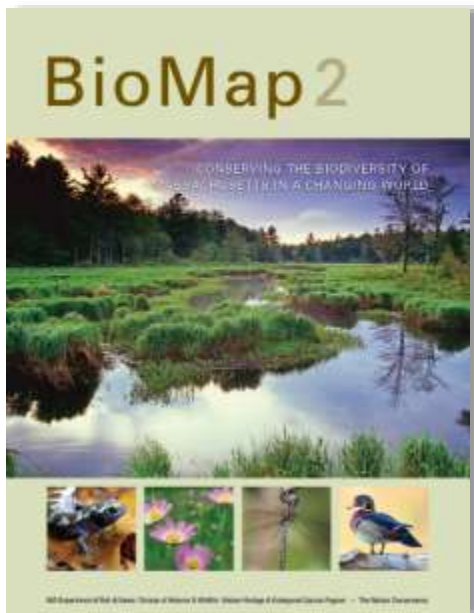


Where to protect?

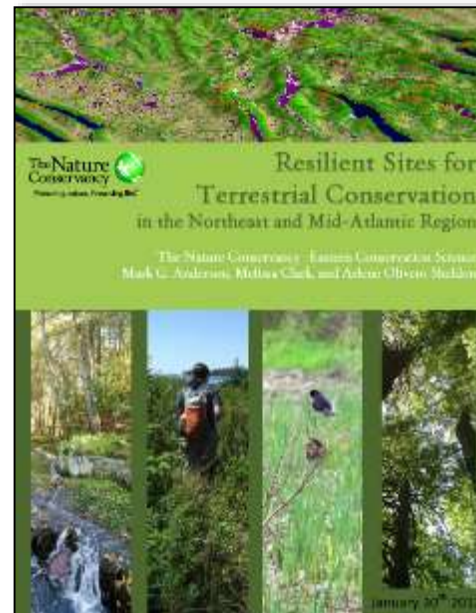
Resilient places



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 Regions and DFW Districts*

2

Choose model

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

3

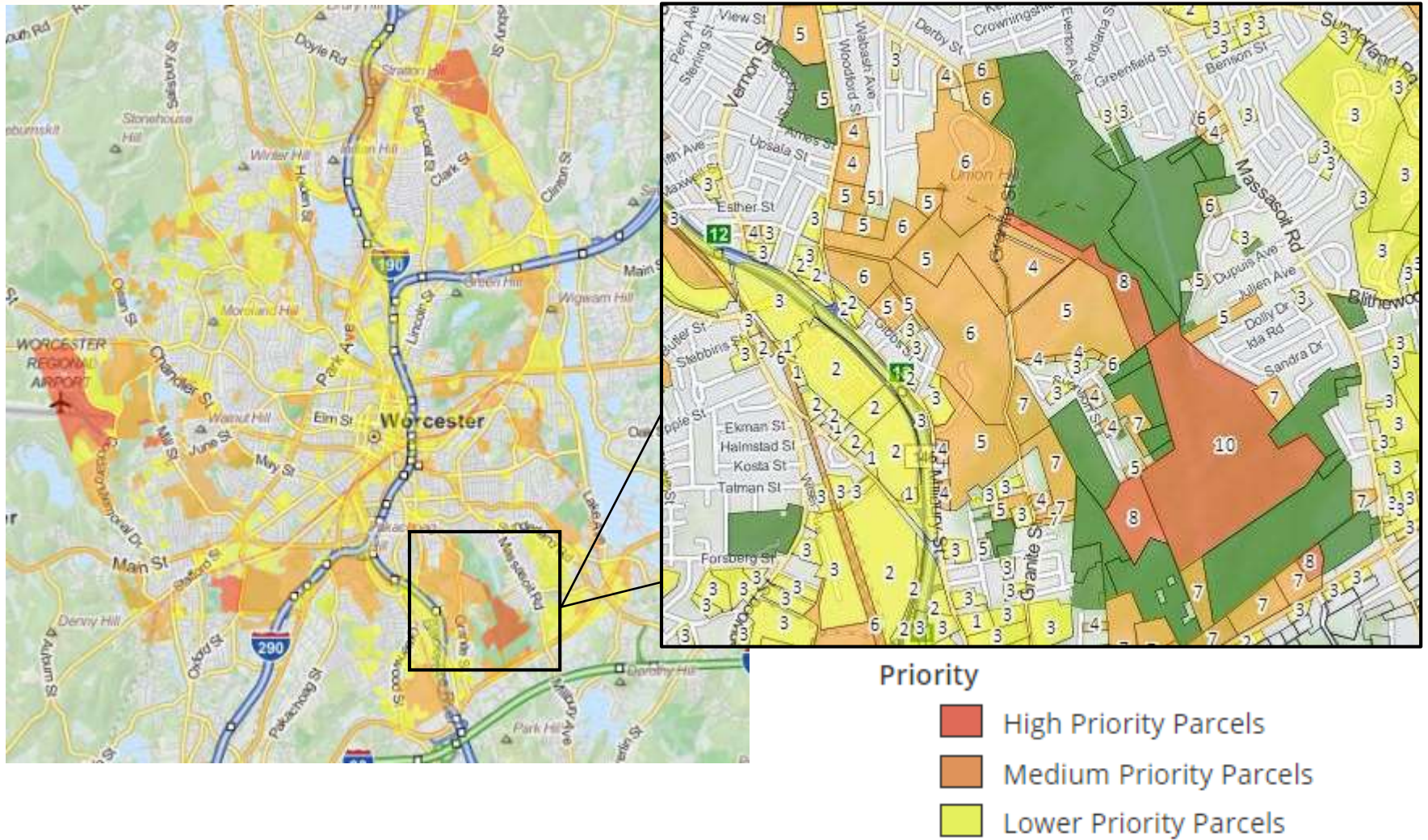
Run & Review Results

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

Coming soon: *Prime Farmland, Surface Water Protection Zones, and Wellhead Protection Areas*

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

massaudubon.org/mapppr



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



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

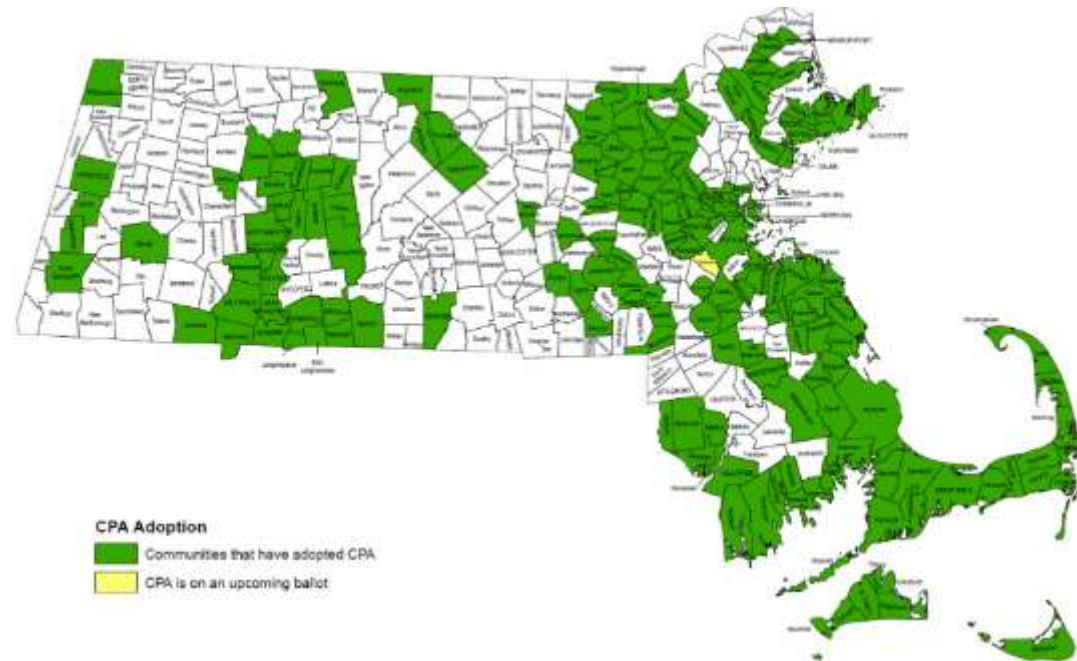
- A state law enabling cities and towns to create a dedicated fund to
 - Preserve open space
 - Preserve historical resources
 - Create community housing
 - Create outdoor public recreation areas
- 0.5-2.0% on local property tax bill



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

Cottages on Greene: East Greenwich, RI





Cottages on Greene



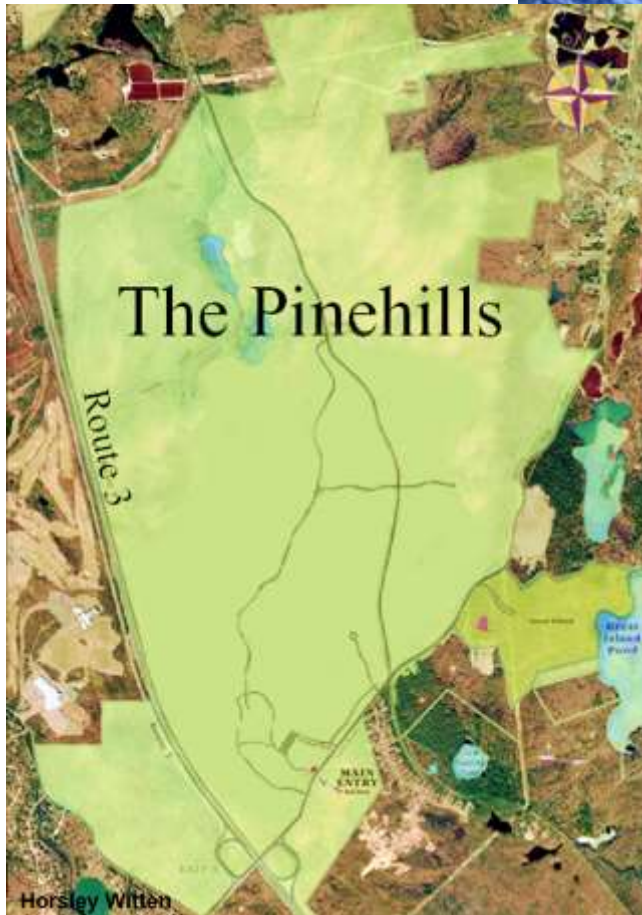
Cottages on Greene

[illegible]

* Preliminary estimate – site design was revised.

****“Apples to apples” starting with a compact site.**

Pinehills: Plymouth, MA



Preserved Historic Sandwich Road

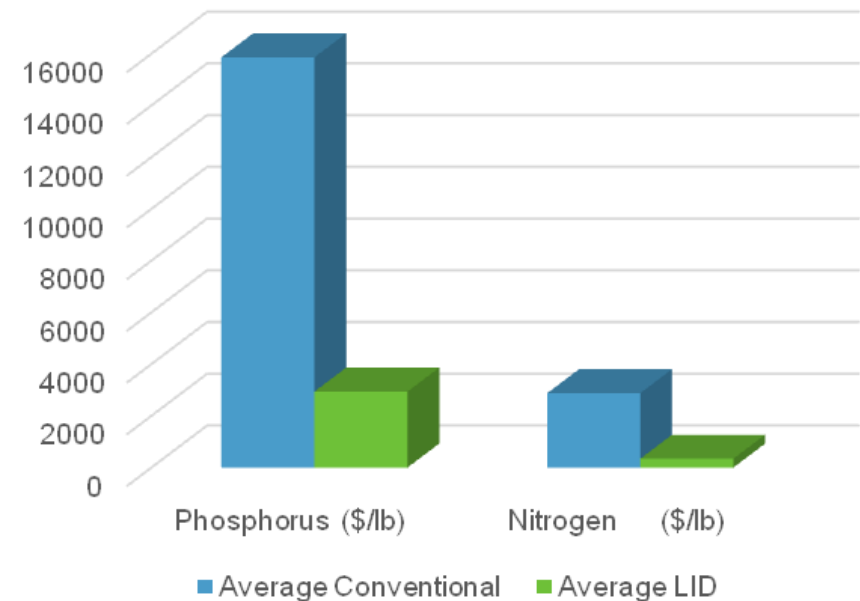
Pinehills



Leominster, MA

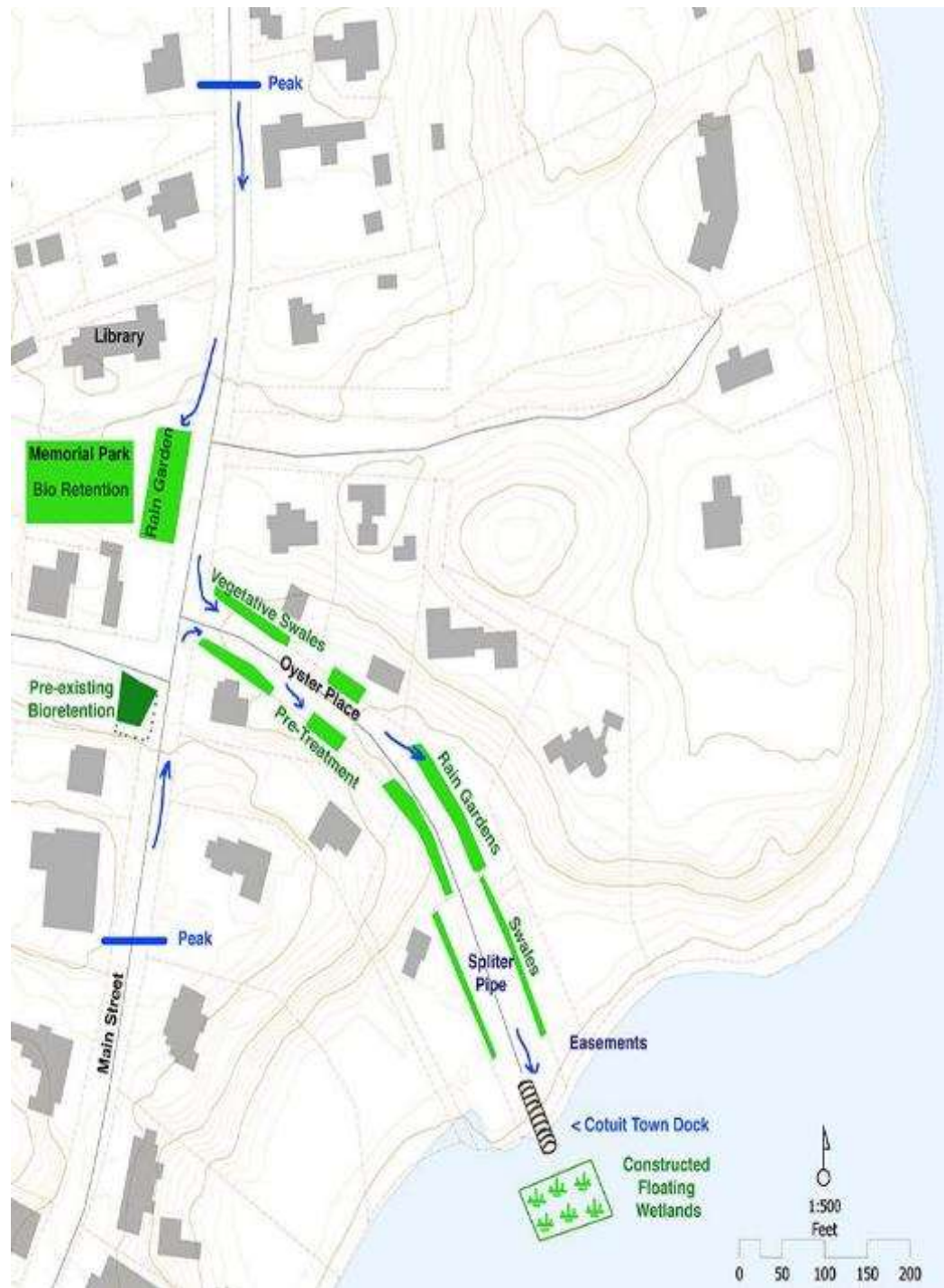


Comparison of Present Value Costs in Nitrogen and Phosphorus Reduction: LID vs Conventional Detention Systems



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%		





to illustration

Cotuit Town Dock Swales ~ Mary Kocol





STORMWATER TREATMENT SYSTEM

-
- ① Stormwater inflow from parking lot.
 - ② Stormwater distributed through rain garden via a subsurface perforated pipe.
 - ③ Stormwater infiltrates downward to underlying groundwater from distribution pipe.
 - ④ Groundwater moves towards bay at approximately 1 foot/day.
 - ⑤ Groundwater pumped with solar-powered water pump and is distributed back to rain garden via subsurface drip irrigation for additional treatment.

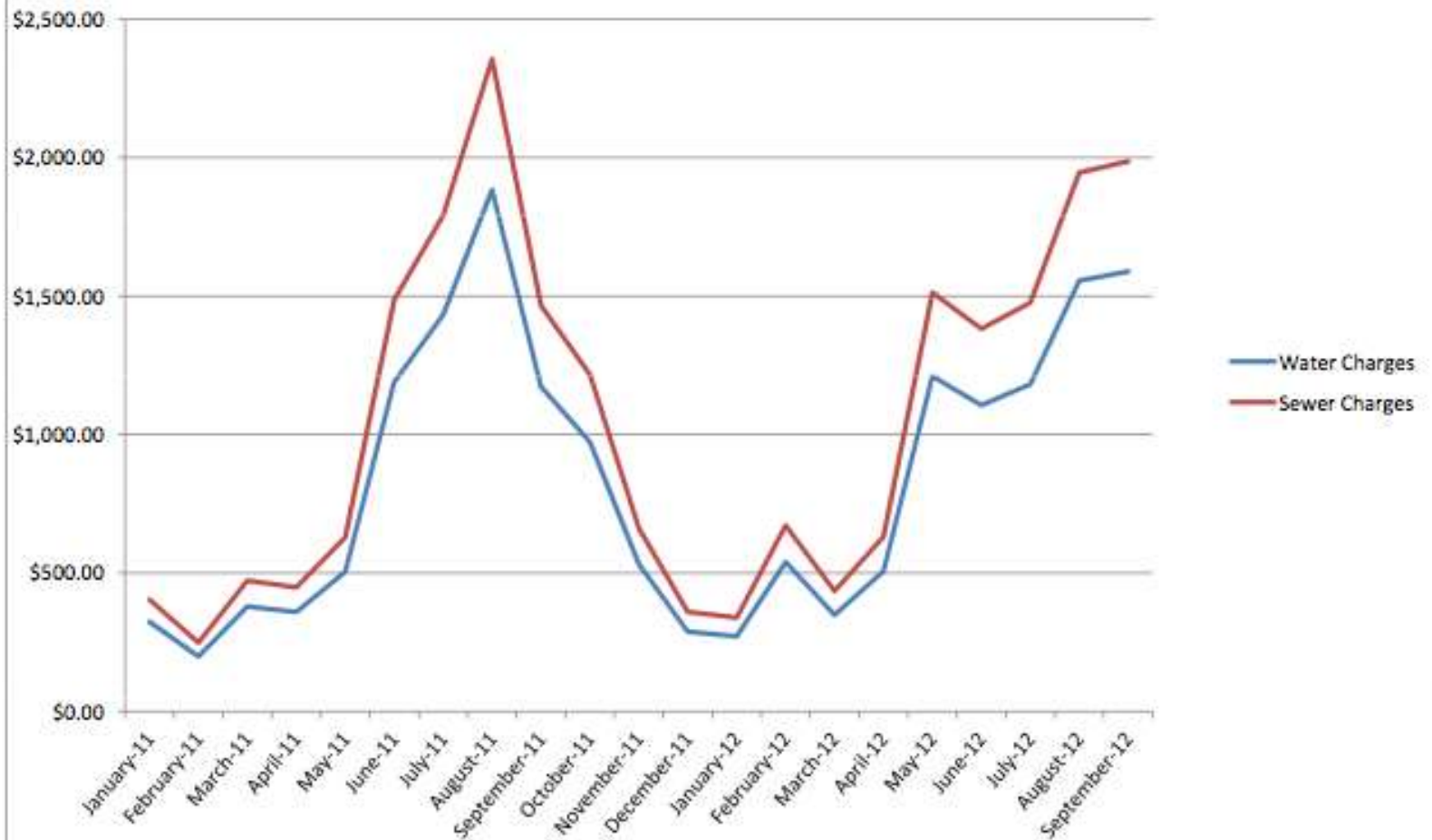
Drip Irrigation

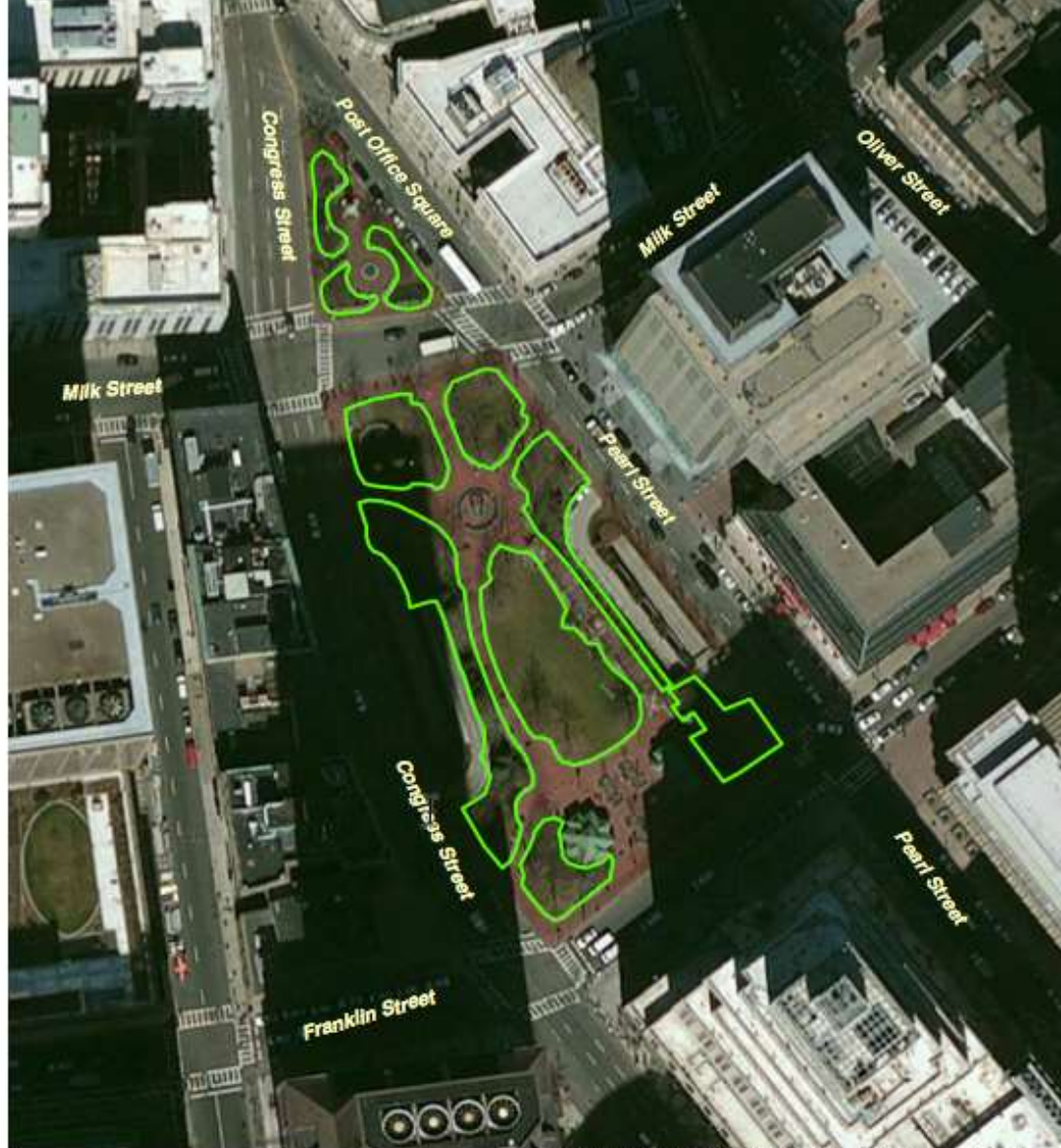
Water Table

Solar-Powered Water Pump



Figure 1: Post Office Square Park and Garage Monthly Water and Sewer





Path: H:\Proposals\Client Name\Friends of Post Office Square\GIS\PostOfficeSq.mxd

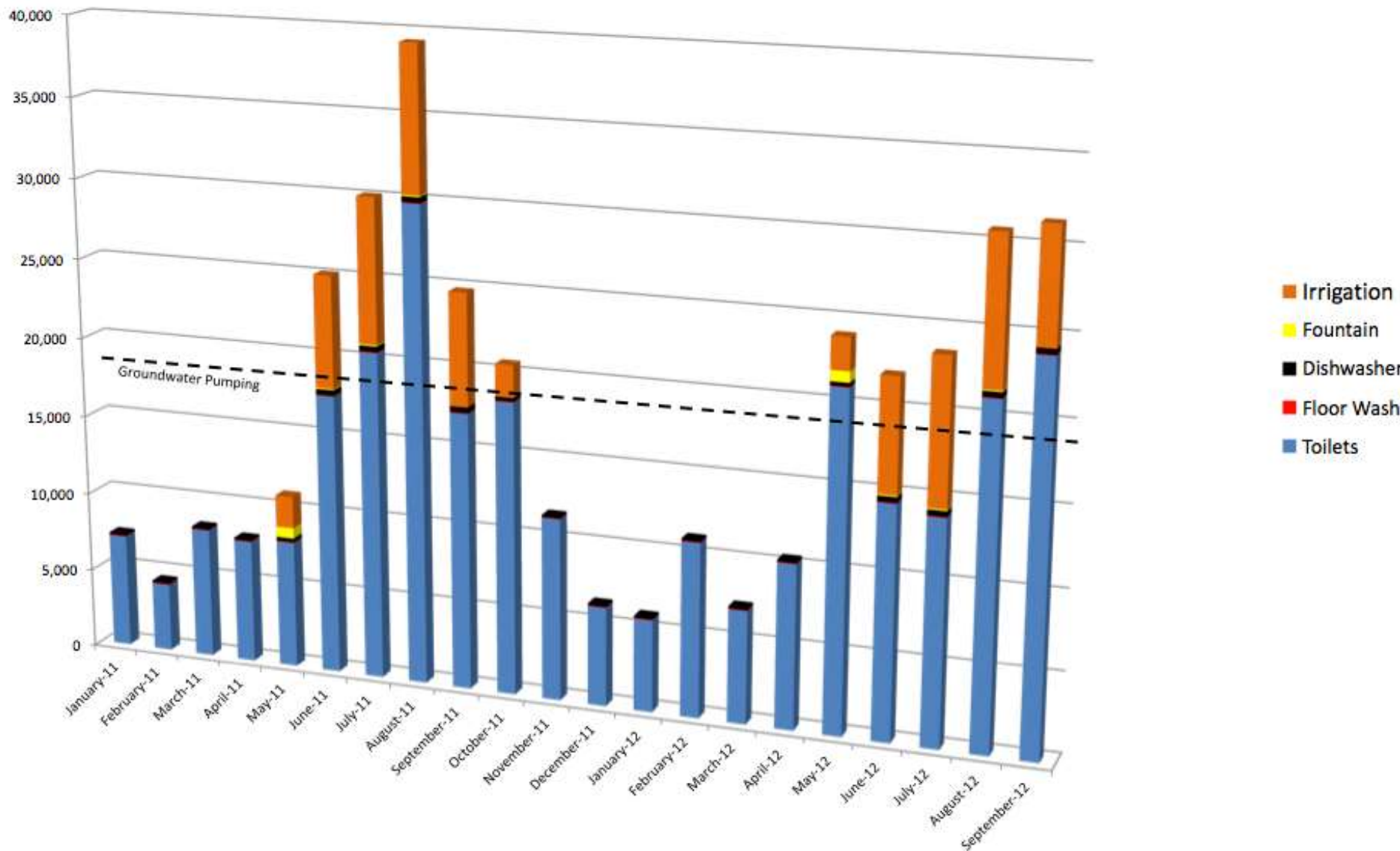
*Bing Imagery, ESRI 2010

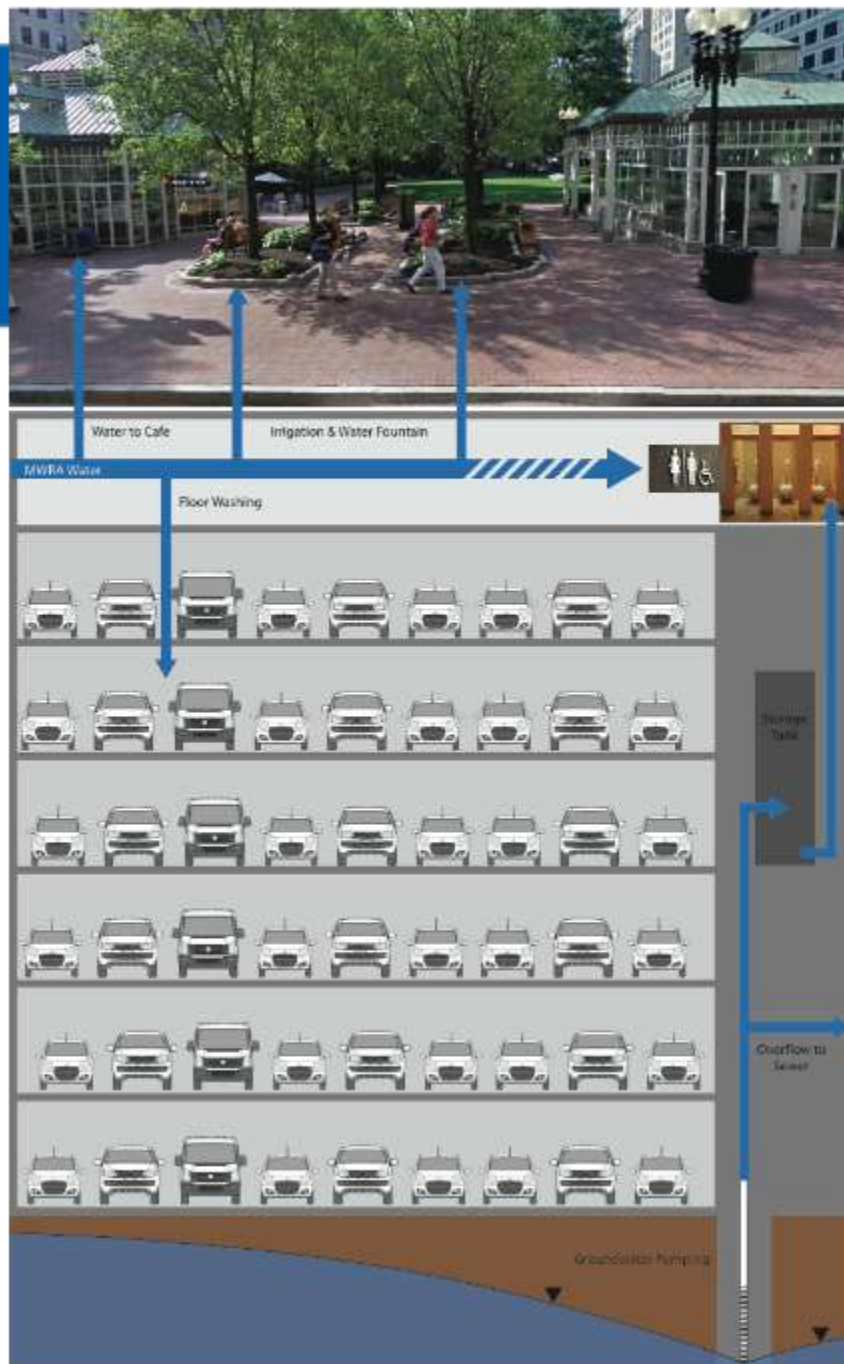
Legend

Horsley Witten Group



Figure 3: Summary of Water Usage at Post Office Square (Cubic Feet/Month)





Permeable Pavement

- Higher initial cost (\$12/sf vs \$5-7/sf)
- Reduces the amount of land needed for stormwater management
- Can infiltrate as much as 70-80% of annual rainfall
- Reduced flood risk may increase property value by 2-5%
- Can reduce salt use by as much as 75%



Rain Barrels and Cisterns

Runoff Reduction & Water Conservation

- Downspouts directed to tanks or barrels
- 1" rainstorm generates 623 gallons stormwater per 1,000 sf of roof
- Storage: 50 – 10,000 gallons
- Excess diverted to drywell or rain garden
- Landscaping, car washing, other non-potable uses



Bioretention

- \$300-500/year in labor for maintenance (varies by size of swale)
- 70% TSS removal credit with adequate pretreatment



Source: Larry Gavin



Rain Garden

- \$2-12/ft² installed
- \$200/year in labor for maintenance
- Reduces runoff by 90%
- Reduces N, P, metals, and TSS by 65-90%



Green Roofs

- Reduced flooding of and damage to urban streets
- Interior heating and cooling benefits of 10 degrees or more
- Carbon sequestration & air purification
- Recreational amenity
- Improved aesthetics



Green Roofs

- Reduces runoff by 30-86%
- Extended roof life, estimated at 40 years
- Payback of 6.2 years

Over a 50-year period

- Installation, replacement and maintenance cost: \$18/sf
- Stormwater and energy benefit: \$19/sf
- Benefits to the community savings: \$38/sf



U.S. General Services Administration Study:
Green Roof Cost Benefit Analysis

Resources to Remember

1. Fact Sheets on LID

massaudubon.org/lidcost

2. MAPPR tool

massaudubon.org/mappr

3. Other Resources available at

massaudubon.org/shapingthefuture



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 community
- **Work together** 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.



Thank you!

For more information, please visit
www.massaudubon.org/LIDcost

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