### Saving Land, Water, and Money with smart land use solutions



### Framingham Public Library July 19, 2016

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### **Special thanks to**

### American Planning Association, MA Chapter





\*\*Please see Stefanie for CM Credit Sign In\*\*

### Foundation for MetroWest



# 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 & recreating natural landscape features and minimizing imperviousness to create site drainage that treats stormwater as a resource rather than a waste product.





### What's The Problem?





### Get it in the Ground

Flooding

**Quality** 



Droughts

Eutrophication

### **Climate Change**

### rising temps & more frequent intense storms

more & longer summer droughts

more heavy precipitation

### We Need to Change Course



## 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**



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



Conserve the natural green infrastructure already providing free ecosystem services Incorporate LID and green infrastructure design into development Restore the resiliency of urban landscapes through LID in redevelopment





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 Restore the resiliency of urban landscapes through LID in redevelopment









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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
- Public Health
- Air Quality
- Water Quality & Quantity

- Recreation
- Quality of Life
- Property Value
- Carbon Sequestration

MA forests provide over **\$3.8 billion** each year in free ecosystem services



## The Value of Green: Reduced Paving Costs

Traditional paving costs \$5-7/ft<sup>2</sup>. Reducing just a short, two-mile road from 28' to 20' equates to a savings of \$422,400 - \$591,360.

That's *half a million dollars saved* by reducing a short stretch of pavement by just four feet per lane!

When the entire road is shortened for a condensed subdivision instead of sprawling development, that savings grows 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 that preserve 50% of land save \$200,000-300,000, while maintaining the same amount of development.



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

### But where to conserve?





Patterns of development and their impact on the nature of Massachusetts 10th Sahan of the Losing Ground Series ·\*\* A.1

Planning for Resilience

Planning for the Future



of the remaining unprotected land is of high conservation value. (BioMap 2)

As development pressures increase, we can plan our land use for both a strong economy and a safe, healthy environment.

As of 2013. over half of the land in Massachusetts had not yet been protected or developed.





The rate of development plummeted during the recent Great Recession. Lately, however, new housing permits are on the rise.



# MAPPR

### www.massaudubon.org/mappr

Protecting the Nature of Massachusetts

AA	Enter a Search Term	

Mapping And Prioritizing Parcels for Resilience 

 GET OUTDOORS
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 OUR CONSERVATION WORK
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 If Image: I

#### OUR CONSERVATION WORK

Wildlife Research & Conservation

Land Conservation

**Ecological Management** 

#### Education & Community Outreach

Sustainable Planning & Development

Losing Ground Report

Shaping the Future of Your Community Program

Preservation & Development Toolkit

Guidebook to Involvement in Your Community

Cost Effective Low Impact Development (LID)

MAPPR Project

Schools

Partners

**Visitor Experience** 

#### Mapping & Prioritizing Parcels for Resilience Project



Mass Audubon, in partnership with The Nature Conservancy and LandVest, developed Mapping and Prioritizing Parcels for Resilience (MAPPR) to allow Massachusetts conservationists to rapidly identify specific parcels that, if protected, could contribute the most to achieving land protection goals.

While land trusts, towns, and agencies have long relied on a wide range of maps and data sets to identify priority areas for land protection to meet their goals, MAPPR takes advantage of newly available digital parcel data to identify specific land protection opportunities. MAPPR also helps land trusts, towns, and agencies to easily define and refine their priorities, discover new opportunities, and extract the data necessary to take the next steps in land protection.

#### Support for MAPPR



MAPPR Tool

Resources

#### Questions

For more information: MAPPR@massaudubon.org

#### Project Partners





# Step I: Choose a study area: town, county, watershed

#### MAPPR Tool

Mapping and Prioritizing Parcels for Resilience (MAPPR) allows land conservationists to identify the parcels within an area of interest that are the highest priorities for protection based on habitat quality, climate change resilience, and other metrics such as parcel size and adjacency to existing protected parcels. Analyses are based on open space data and assessor parcel data available through MassGIS as of April 2015. As a result, ownership information and protection status may be inaccurate for some parcels. Check with your town assessor for the most up-to-date information. Please email any comments to mappr@massaudubon.org.

Ref Layer 🕥

Instructions show

Examples show Study Area 🕥

#### None selected - select one now.

#### Pre-calculated Models 🛞

- Balanced Model
- Resilience Model
- Aquatic Model
- Biological Model

#### Assign Model Values 🕥

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	BioMap2 Priority Natural Communities				
	BioMap2 Forest Cores				
	BioMap2 Vernal Pool Cores				
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	BioMap2 Aquatic Cores				
	BioMap2 Species of Conservation Concern				
Bi	oMap2 Critical Natural Landscape				
	BioMap2 Landscape Blocks				
	BioMap2 Coastal Adaptation				
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# Step 2: Choose a precalculated model

#### MAPPR Tool

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Instructions show

#### Examples show

#### Study Area 🕥

None selected - select one now.

#### Pre-calculated Models 🔞

- Balanced Model
- Resilience Model
- Aquatic Model
- Biological Model

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Adjacent to Protection Under-represented Settings

#### Filter by Parcel Size 👔

select min parcel size 🔻

Filter by Block Size (Unprotected Acres) 👔



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#### Misc. Controls 🔘

- Show parcel priority ranks
- Show parcel export IDs
- Hide parcel labels
- Parcel priority rank colors
- Mass GIS Open Space Layer
- Blocks of Contiguous Parcels

#### Map Type Selector 💿

Street Map
 Satellite

#### Run Model 🤉

#### Pre-calculated Models 💿

- Balanced Model
- Resilience Model
- Aquatic Model
- Biological Model

# Step 2: Or choose your own adventure

#### MAPPR Tool

Mapping and Prioritizing Parcels for Resilience (MAPPR) allows land conservationists to identify the parcels within an area of interest that are the highest priorities for protection based on habitat quality, climate change resilience, and other metrics such as parcel size and adjacency to existing protected parcels. Analyses are based on open space data and assessor parcel data available through MassGiS as of April 2015. As a result, ownership information and protection status may be inaccurate for some parcels. Check with your town assessor for the most up-to-date information. Please email any comments to mappr@massaudubon.org.

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Examples show

#### Study Area 🕥

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- Resilience Model
- Aquatic Model
- Biological Model

#### Assign Model Values 💿

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#### Filter by Block Size (Unprotected Acres) 💿

select min block size 🔹

#### Constrain Model Only Adjacent to Protection 🕥

#### Misc. Controls 💿

- Show parcel priority ranks
- Show parcel export IDs
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- Parcel priority rank colors
- Mass GIS Open Space Layer
- Blocks of Contiguous Parcels

#### Map Type Selector 🛞

- Street Map
   Satellite
- Run Model 🔉

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	BioMap2 Critical Natural Landscape	
	BioMap2 Landscape Blocks	
	BioMap2 Coastal Adaptation	
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# **Step 3: Run Model**

#### MAPPR Tool

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#### Examples show

#### Study Area 🕥

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- Resilience Model
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Parcel Size

- Block Size
- Adjacent to Protection
- Under-represented Settings

#### Filter by Parcel Size 📦

select min parcel size 👎

#### Filter by Block Size (Unprotected Acres) 📦

select min block size 🔹

#### Constrain Model Only Adjacent to Protection 💿

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- Blocks of Contiguous Parcels

#### Map Type Selector 👔

Street Map Controlling





# The different models: Princeton



#### Priority



Medium Priority Parcels Lower Priority Parcels

### **Additional considerations**

#### MAPPR Tool

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Under-represented Settings				

### Nature does it best

### "LID employs principles such as preserving & recreating natural landscape features"



## 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



# 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

# Framingham Planning and Dept. Public Works

Amanda Loomis, Town Planner aloomis@framinghamma.gov

Kerry Reed, Stormwater Engineer kr@framinghamma.gov

### Master Land Use Plan

- 1988 -> 2012/2014
- Serves as policy guide and a framework for future land use and development/redevelop ment.
- Incorporation of BMP and LID







c. Encouraging Low Impact Development (LID) and techniques for reducing runoff and heat island effects;

#### Task 4 - Best Management Practices:

Incorporate Low Impact Development [LID] Techniques and Complete Streets features into town-wide design standards to reduce the impact of the Town's roadways and provide access for all roadway users.

#### 5.2.1.3 Build Green

Include requirements for green infrastructure in the land use regulations:

 a. Incorporate Low Impact Design (LID) standards into subdivision and site plan regulations;

#### 5.2.2.2 Reinforce Low Impact Development (LID) Program Standards

Provide additional standards beyond State Best Management Practices (BMP) in the Subdivision Rules and Regulations:

- a. Add program goals for LID;
- b. Expand grading design recommendations; and

c. Update annual rainfall data and design software programs for calculating stormwater events.

# No one size fits all...



# Cluster By-Laws as an Alternative to Conventional Subdivisions

Neighborhood Cluster Development

**Open Space Cluster Development** 

### **Agricultural Preservation Development**

Decrease development foot print = increase in vegetation Stormwater Drainage System / Low Impact Development Techniques - achieve sustainability objectives.



## Recodification of the Zoning By-Law

### **Site Plan Review**

- Urban Design Objectives
- •BMP, LID, Energy
- •Water & Sewer Service Infrastructure
- Environmental Impact
   Report







### Off-Street Parking Regulations

- Methods to reduce parking space requirements = decrease in pervious pavement
- LID and BMPs
- Landbanking
- Pocket Parks
- Pervious Pavement for overflow
- Increased number of trees




# **Next Steps**

- Corporate Mixed-use By-law
- Recodification: Land Disturbance and Stormwater Management By-Law
- Subdivision Rules & Regulations





## Green Infrastructure & Low-Impact Development



## How Devens promotes smart land use/water management



Neil Angus, AICP CEP, LEED AP BD+C, ND Environmental Planner Devens Enterprise Commission neilangus@devensec.com

## **Devens Overview**

- 35 miles outside Boston
- 4400 ac. former base
- Superfund Site
- 1993 Sustainable redev.
- LID as 1 tool to meet SD goal
- MassDev. Landowner
- DEC Regulatory Authority
- One-Stop Unified Permitting



#### **Balance Eco., Env., Social Amenities:**

- 90 businesses, ~400 res. & ~5,000 jobs
- Growing residential population
  - New and expanding town center
  - 1,100+ ac. Protected open space
- Parker Charter School
- Guild of St. Agnes, Transitions, Veterans Housing, Shriver Job Corps
- Work and Play....Live?

## How Devens has facilitated GI and LID?

- Strong leadership (local gov't)
- Communication/Partnerships
- Build on Progressive Strategy :
  - Education
  - Incentives
  - Regulations (audit/amend)
  - Guidelines



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Regulating LID and GI: Site Plan (974 CMR 3.04) www.devensec.com/devserv.html

- Tree Preservation, Steep slope Requirements
- Limit Construction Impact Zones
- Penalty for removal of trees to be preserved
- Native Landscaping requirements
- Functional landscaping reconnecting ecosystems
- Green Roof & Green Wall Regs
- Parking maximums

## **BMS 89 ac. Campus:**

- Tree preservation (habitat)
- Reduced parking footprint (UHI)
- LID drainage (SWM)
- Green Roof and Green Wall (SWM, EE)
- Green Building (WE, EE, IAQ, GHG red.)

New CMB

New BDB

Existing

Lab/Office

Parking Garage

(2 additional stories)

<u>CELECCECCE</u>

## **BMS expansion:**

- Green roofs
- White roofs

A Bar

• Green walls (SWM, AQ, Viewshed)



## **Regulating LID and GI:** Stormwater (974 CMR 4.08):

Stormwater requirements - replicate natural conditions (90% on-site):

- Decentralized systems no macrodetention basins (local recharge/preserve valuable land)
- LID as a tool to meet infiltration requirements
- Require all projects to comply with MA DEP SWM Standards regardless of WPA (design standards, LTMP)



sign concept for bio-retention swale with double row of trees (See 4.5 Stormwater Management)



## Stormwater cont...

LID standards and specifications :

- Biofiltration basins as preferred method (reduce curbing, piping, structures) edge of pavement and low flow channel;
- Vegetated Roofs and walls (subtract from impervious calculations)
- Permeable Paving (Porous asphalt, paving stones and pervious concrete - DEP & UNH)
- Reinforced Turf (overflow pkg. and emergency access)



Drought-tolerant grass seed mix

Molded plastic cellular open-grid turf reinforcement (minimum 90% open cells) filled with growing/drainage medium - sandy loam (50% sand). Overfill cells to accommodate for setting and to ensure full coverage.

Compacted sandy gravel road base 6-12 inches (depth varies based on infiltration design requirements)

- Compacted subgrade

Safely replenish local aquifers, preserve land, promote GI

## **US Fish and Wildlife Visitor Contact Station**

Facility

- Showcase for SD & LID:
- LID stormwater and roofs
- Porous pavement, reinforced turf
- •Composting toilets
- Material Reuse recl.barn siding
- Education kiosk
- Trail connections (ONWR & Devens)
- Nashua River access
- It can be done and is being done!

## Regulating LID and GI: Subdivision (974 CMR 2.07) www.devensec.com/devserv.html

- Complete Streets Standards (street trees, LID drainage, reduced pavement widths, ped scale design)
  - Additional street types (neighborhood, parkway more green, less grey)
  - Traffic calming measures (chicanes, bump-outs additional LID planting opps. within grey infrastructure)

## **New Grant Road Neighborhood Redevelopment**

- Neighborhood scale designed for people first!
- Healthy/active socially engaging neighborhood -sidewalks, community gardens and active parks -bikeways, traffic calming
- Bump-outs, street trees
  - GI Adds to community character
  - Lot-level LID (pervious pavers, reinforced turf)

## **Regulating LID and GI:** Rainwater Harvesting (974 CMR 4.00 & 8.00)

- Required for comm/ind. irrigation
  Inexpensive supply of water
  Preserves drinking water supplies
  Requires little treatment for non-potable reuse (\$\$) (toilet flushing/irrigation)
  Reduces SW runoff, NPS pollution & erosion
- •Reduces peak summer demand
- •Easy to install/screen
- •Plan early in design





ATTON ROAD



## **Rainwater Harvesting Case Study – 85 Patton Rd.:** N.E. Recovery Center **Proposed Irrigated Area** Devens, MA 102,000 s.f. landscape Porous Pavement area: ~30,000 sf 102,000 sq. ft. Irrigated Landscape 60,000 sq. ft. Turf 30,000 sq. fl. Mixed 42,455 sq. ft. Contributing 12,000 sq. fl. Shrubs Roof Drainage Area **Rainwater Harvesting** Storage Tank Varied in ETHOS:

20,000 Gallons Currently Proposed



## **Payback Analysis**

L la D

Cost of Domestic Water = \$9.65 per 1,000 Gallons (Water plus Sewer: No Irrigation Meter Allowed)

Annual Stormwater Contribution to Irrigation Demand	
5,000	32%
10,000	47%
15,000	56%
20,000	62%
25,000	67%
30,000	70%
35,000	73%

Kels IL

Number of Years to Payback Harvesting System vs. Domestic	
5,000	13.49
10,000	11.90
15,000	11.85
20,000	12.21
25,000	12.63
30,000	13.23
35,000	13.81

## **Little Leaf Farms**

- ~110,000 sq.ft. greenhouse (Phase 1)
- Hydroponic baby green lettuce production
- Rainwater harvesting (80% of water demand)
- Automated process, pesticide-free
- Locally sourced/farm to table same day.







# Education & Awareness Seeing is Believing: CASE STUDIES

(yes, it really works...and in most cases better than traditional!)

## LID Case Study: 27 Jackson Road

- MWCC 300+ spaces
- Proper design and construction key to durability





## LID Peer to Peer: 155 Jackson Road

- 70+ spaces
- Same developer as MWCC
- Connected developer with DPW & other developers on "how to's"



## **LID** alternatives

• Underground infiltration system alternatives for constrained sites

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## **Sustainable Housing Pilot:**

- Showcase sustainable/affordable const. (\$225-\$350K)
- Cluster/OS, smart loc.
- LID components [reduced pavement, porous walkways, roof runoff infiltration (no gutters) and rain gardens]



## Lot Level LID strategies:

- No gutters
- Pervious walkways
- Rain gardens
- Reduced lawn areas
- Street trees
- GI & UHI reduction

# Other Ed./ Awareness Strategies:

- Value of trees (GI)
- Street tree inventory and replacement program







#### Triple Bottom-Line Benefits of Street Trees in Devens

#### 1. ECONOMIC:

Increased property value: realitor estimates of tree-lined streets vs. comparable non-tree-lined streets have shown anywhere between 5-16% increase in home/business value. People prefer tree-lined streets! Reduced Energy Casts: streets and parking lats can increase local temperatures which can significantly impact energy casts to homeowners and consumer. The shade provided from street trees, can reduce energy bills for a howehold by as much as 10%.

Return on Investment for a planting cost of \$250-600, a single street tree returns over \$90,000 of direct benefits (not including costhetic social and environmental) in the lifetime of the tree. Extended povement life: the shade of street trees reduces daily heating and cooling (expansion/ contraction) of asphalt (gray infrastructure) and can extend the life of povement up to 60% longer. This translates into a significant cost reduction for maintaining street systems.

Energy: Biomass from trees is a potential source of renewable energy for /Aunicipalities.

#### 2. ENVIRONMENTAL:

**Gray infrastructure to Green infrastructure:** The leaves, branches and trunks of street trees (green infrastructure) can capture up to 30% of a typical rainfall event through absorption and evaporation. The nost systems can absorb up to another 30%, resulting in reduced stamwater nunoff and potential flooding. This also result in less man-made drainage infrastructure (acids basin, piping, detention pond). **Climente Change Mitigetion:** leaves absorb harmful pollutants like carbon dioxide (CO<sub>2</sub>) carbon monoxide (CO<sub>2</sub>) valiable organic ampaunds (VOC) nitrogen oxides (NOx) and particulate matter (PM) such as durit, dust and soot. Street trees absorb harmful pollutants than more distant trees, converting those harmful gases back into axygen and other useful and natural gases.

Air Quelity: shading provided by trees can reduce local temperatures by up to 15°F, which helps reduce the arction of ground-level across — a major contributor to smag & respiratory problems in kids & adults. **Habitat:** street trees provide a canopy, root structure and setting for important insect & backerial life below the surface. Above the surface, they provide biomax, writenth and habitat for birds. &other wildlife.

#### 3. SOCIAL:

**Public Sefety:** street trees help reduce solar glare and define the roadside edge and their canopy over provides shading and separation from the road that can help protect pedestrians, guide matarists movements and help them better assess their speed. These attributes lead many motorists to exercise greater caution, resulting in reduced speeds (by as much as 15mph) as well as fewer accidents on streets lined with trees.

Public Health: trees reduce UV exposure for pedestrians and have a natural calming effect which can help reduce "road rage", local arms and vandalism, surface improving the safety of streets and neighborhoods. Visual access to trees has also been shown to have a rehabilitating impact on our recovery from illness.

Noise Reduction: slower vehicle speeds as a result of street trees can reduce engine and tire noise. Their leafy vegetation can also absorb a great deal of noise in neighborhoods.

Assthetics: trees provide a general softening of the urban environment and also provide a screen for utility poles, light poles, on street and off-street parking and other features that create visual pollution. The aesthetica of tree lined streets and green spaces have been shown to have positive psychological benefits induding lower rates of stress, blood pressure and mental illness.

#### Tree Removal/Replacement in Devens:

For all of the above reasons, the Devens Enterprise Commission (DEC) regulates tree removal. Residents/ business owners should contact the DEC **prior** to removing trees from their property. For a list of noninvasive street tree species recommendations, visit your devenues com/rules-regu/decregr/307.html

MassDevelopment, in conjunction with the DEC, has also conducted a street tree inventory in an effort to better care for and manage street trees within Devens. Annual assessment, trimming and replacement will help ensure street trees continue to thrike within Devens and benefit everyone's triple bottom-line!



Facts and Figures from the USDA Forest Service http://www.is.fed.un/uci/ For more information, contact the DEC Enterprise Commission at 978.772.8831



# **Promoting LID** as a climate adaptation/resiliency strategy:

- Flexibility/durability for changing conditions
- Local GW recharge/decentralized systems
- Reduced flooding
- UHI mitigation (better AQ &WQ)
- GHG reduction
- Building energy efficiency



# Policies and Guidelines:

## Make it even easier to do the right thing!

- Green Roof and Green Wall policy
- Green Roof Inspection Report
- Green Infrastructure Guidelines

http://www.devensec.com/planning-docs.html



## **Green Infrastructure Guidelines:**

- Emphasizing how GI & LID meets multiple reg. requirements
- Mapping of where GI connections are needed most
- Appendices with examples, resources
- Helping to Achieve multiple Plan objectives (Land use, conservation, recreation, sustainability)







## Guidelines:



.

## **Incentivizing LID & Water Efficiency in Devens**

#### • COST:

- Cheaper upfront infrastructure costs offsetting longterm maintenance costs
- Not out of sight, out of mind
- Supply/demand. Efficiency now less susceptible to fluctuating prices (peak water)



## **Incentivizing LID & Water Efficiency in Devens**

- GB Incentive Program: LEED<sup>®</sup> certification = 15% fee refund
- SWM credit green roofs
- USGBC LEED Credit templates
- Need to do more on reuse/reclamation







## **Keys to LID and GI Implementation:**

- Reduce barriers (reg. audit)
- Building consensus: education/awareness (case studies; fact sheets)
- Seeing is believing: showing how it can and is being done
- <u>Balance</u> of regulations and incentives that facilitate smart, efficient, healthy development
- Guidelines and developer assistance to help do the right thing
- Market transformation (increased awareness = increased demand)



## LID Resources

- MA DEP Stormwater Handbook: <u>http://www.mass.gov/eea/agencies/massdep/water/regulations/massachusetts-</u> <u>stormwater-handbook.html</u>
- EPA LID Fact Sheets: <u>http://water.epa.gov/polwaste/green/index.cfm</u>
- MA Smart Growth/Smart Energy Toolkit <u>http://www.mass.gov/envir/smart\_growth\_toolkit/pages/mod-lid.html</u>
- UNH Stormwater Center
   <u>http://www.unh.edu/unhsc/</u>
- EPA Municipal Rainwater Harvesting Guidelines <u>http://www.slideshare.net/K9T/t3j419</u>



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**Devens Enterprise Commission** 

www.devensec.com
### **Technical Assistance**

- Meeting with municipal staff and public officials
- Answering questions & sharing resources
- Bylaw analysis review of local land use regs compared to best practices
- Final report for each community



# **Take Home Messages**

- Natural GI provides numerous free services
- LID/GI offer numerous
  benefits including quality of life, economic, and environmental
- LID/GI are **cost effective** techniques
- It's been done! Resources are available.



## **Take Home Messages**

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

- Conservation design, narrow streets, & LID drainage need to be the preferred, easy-to-permit option
- Do **your** bylaws encourage sustainable development?



### Thank you!

### For more information...

Visit www.massaudubon.org/LIDcost

Contact scovino@massaudubon.org



