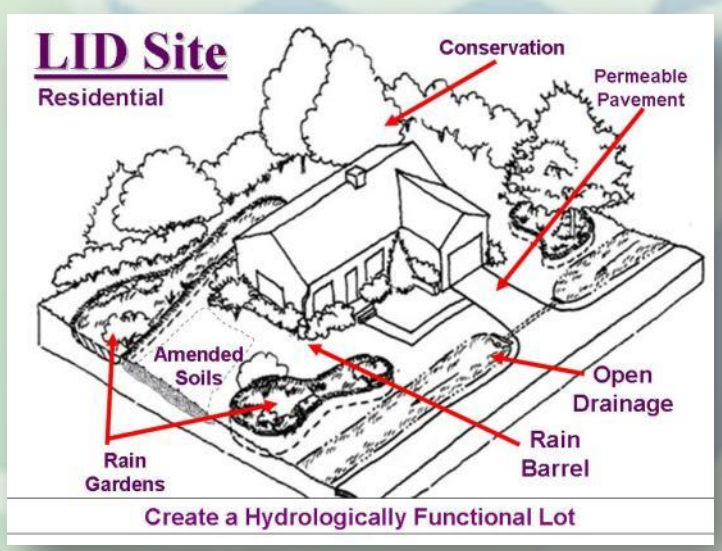
EPA Region 1 MS4 Stormwater General Permits and LID Training Clinic



Fundamentals of LID

Dean College
Franklin, MA
June 3, 2011

Low Impact Development (LID)

Community Planning

LID Site Design

LID BMPs

Larger Conventional BMPs

Receiving Waters

Horsley Witten Group, Inc.

Low Impact Development (LID)

Traditional

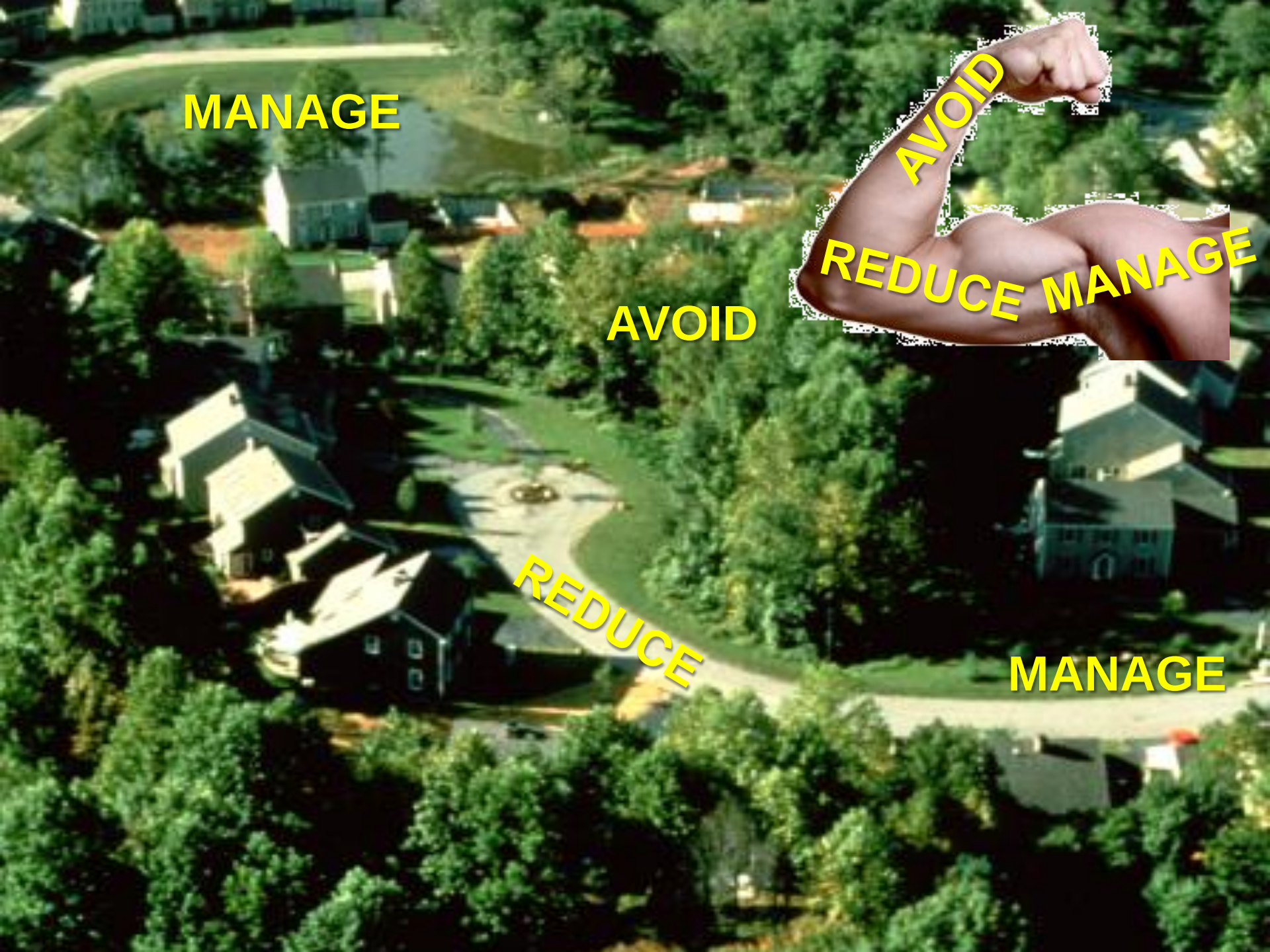
LID

Site Design

BMPs

LID Site Planning and Design Approach

Objective - to provide a process by which LID is considered at an early stage in the planning process to prevent stormwater impacts rather than mitigate them.


MANAGE
AVOID
REDUCE
MANAGE
AVOID
REDUCE MANAGE

LID Site Planning and Design Criteria

A	Protect undisturbed open space;
A	Maximize the protection of natural drainage areas, streams, surface waters, wetlands, and buffers;
A	Minimize land disturbance, locate disturbances in less sensitive areas;
A/R	Minimize the decrease in the "time of concentration" from pre-construction to post-construction;
A/R	Minimize soil compaction;
R	Minimize impervious surfaces;
M	Provide vegetated conveyance and treatment systems;
M	Provide low-maintenance landscaping;
M	Break up or disconnect runoff over impervious surfaces;
M	Provide source controls to prevent / minimize the release of pollutants into stormwater runoff.

Avoid the Impacts
Preservation of Natural Features & Compact Development

- Preservation of undisturbed areas;
- Preservation of buffers, natural drainage systems;
- Reduction of clearing and grading;
- Locating sites in less sensitive areas;
- Compact development; and
- Working with natural conditions (landscape, hydrology, soils)

Open Space Residential Design

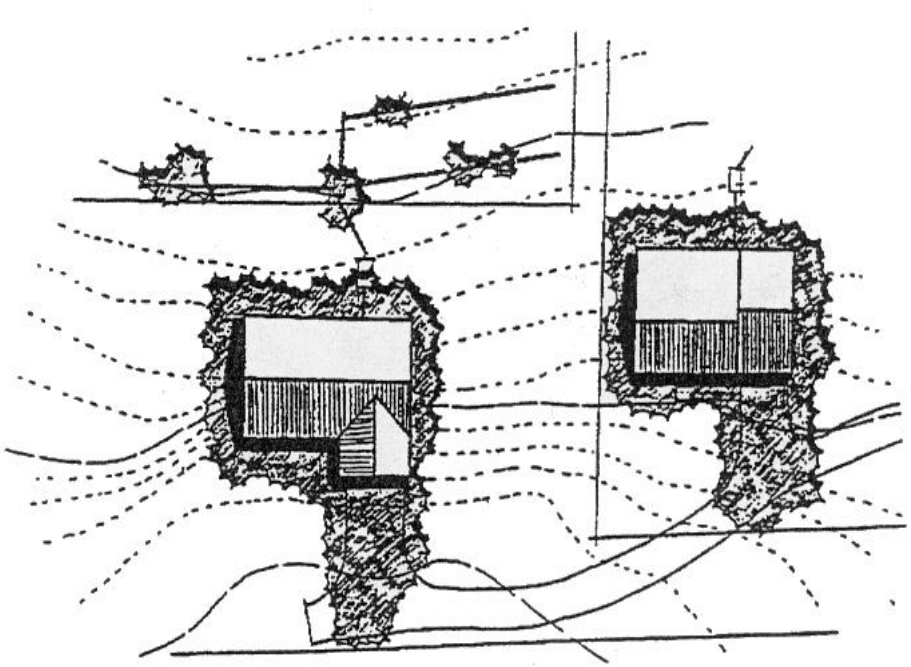
Houses located on "brow" of ridge

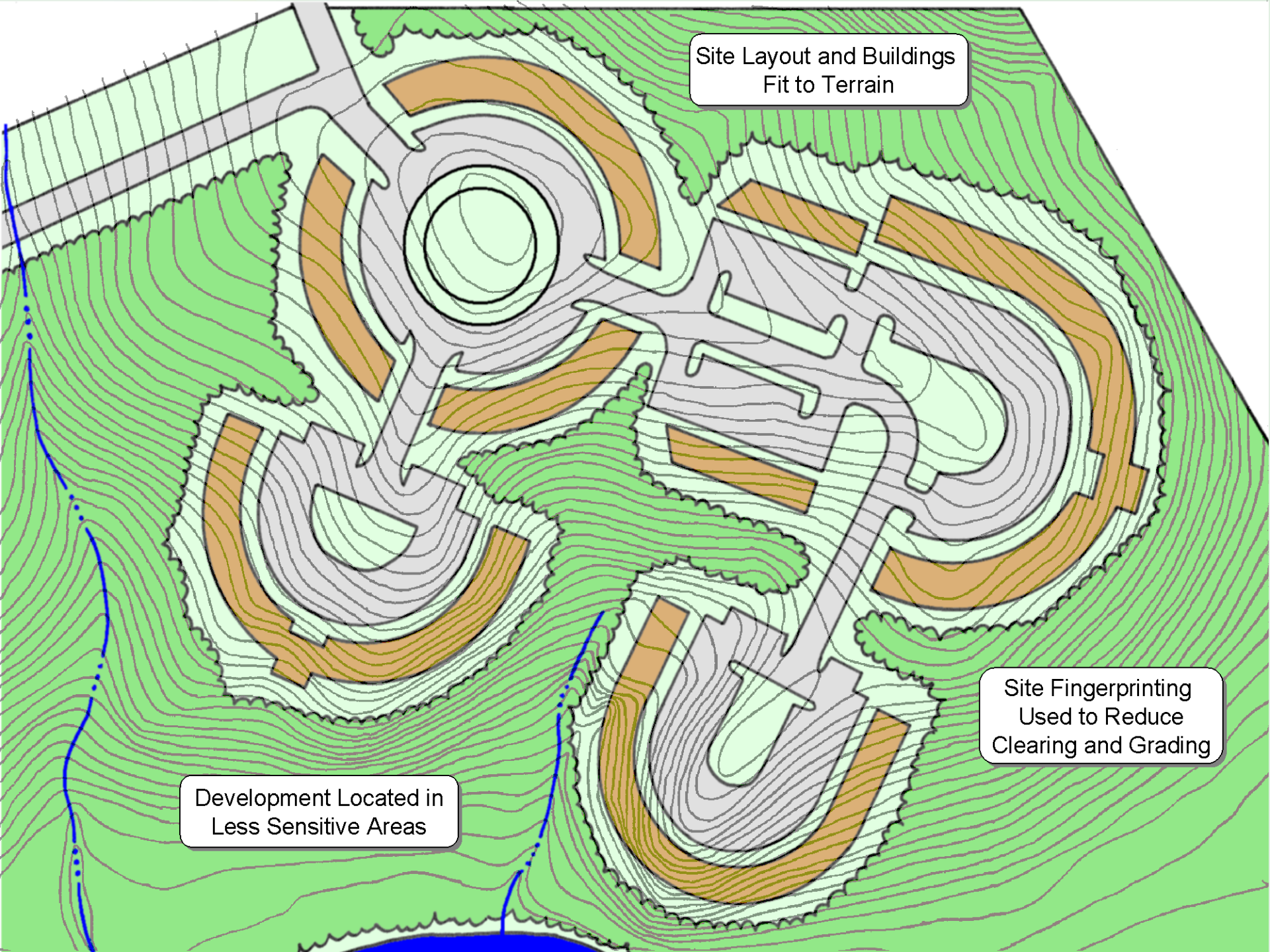
Roads on ridge lines or upland areas

Vegetated drainage swales

Undisturbed vegetation on slopes

Natural drainageways preserved




Site Layout and Buildings Fit to Terrain
Site Fingerprinting Used to Reduce Clearing and Grading
Development Located in Less Sensitive Areas

Buffers and Stormwater

Reduce the Impacts
Reduction of Impervious Cover

- Roadway Reduction;
- Sidewalk Reduction;
- Driveway Reduction;
- Cul-de-sac Reduction;
- Building Footprint Reduction; and
- Parking Reduction.

Street Widths and Lengths


Alternative to street sidewalk

Shared driveways reduce total area


Hammerhead turn-around


Permeable pavers are an alternative


Oversized parking lot with excessive impervious cover

Parking demand ratios dictate parking lot size

Manage the Impacts
Source Controls/Structural Controls

- Disconnection of Impervious surfaces;
- Mitigation of runoff*;
- Stream restoration; and
- Reforestation.

*Practices that rely on natural systems (e.g., bioretention, constructed wetlands, infiltration, filtering)

Rain Gardens

Rain Barrels and Cisterns

Source: http://www.rdrop.com/users/krishna/rainwatr.htm

Green/blue Roofs

Green/blue Roofs

Stream Restoration

Stream Daylighting

Reforestation

Street Trees

New England Examples

- Zero Discharge project in Barnstable, MA;
- LID Retrofit in Plymouth Harbor, MA;
- Pilot installations at Silver Lake in Wilmington, MA
- Costs and Benefits

Lombard Farms
West Barnstable, MA

Site Design

Stormwater Design

DA2

DA1

BIORETENTION AREA 2

Horsley Witten Group, Inc.


Water Street Retrofit
Plymouth, MA
Plymouth
Water Front Park
N Park Ave
S Park Ave
Memorial Dr
Chilton St
Howland Ct
Brewster St
Plymouth
Plymouth Rock

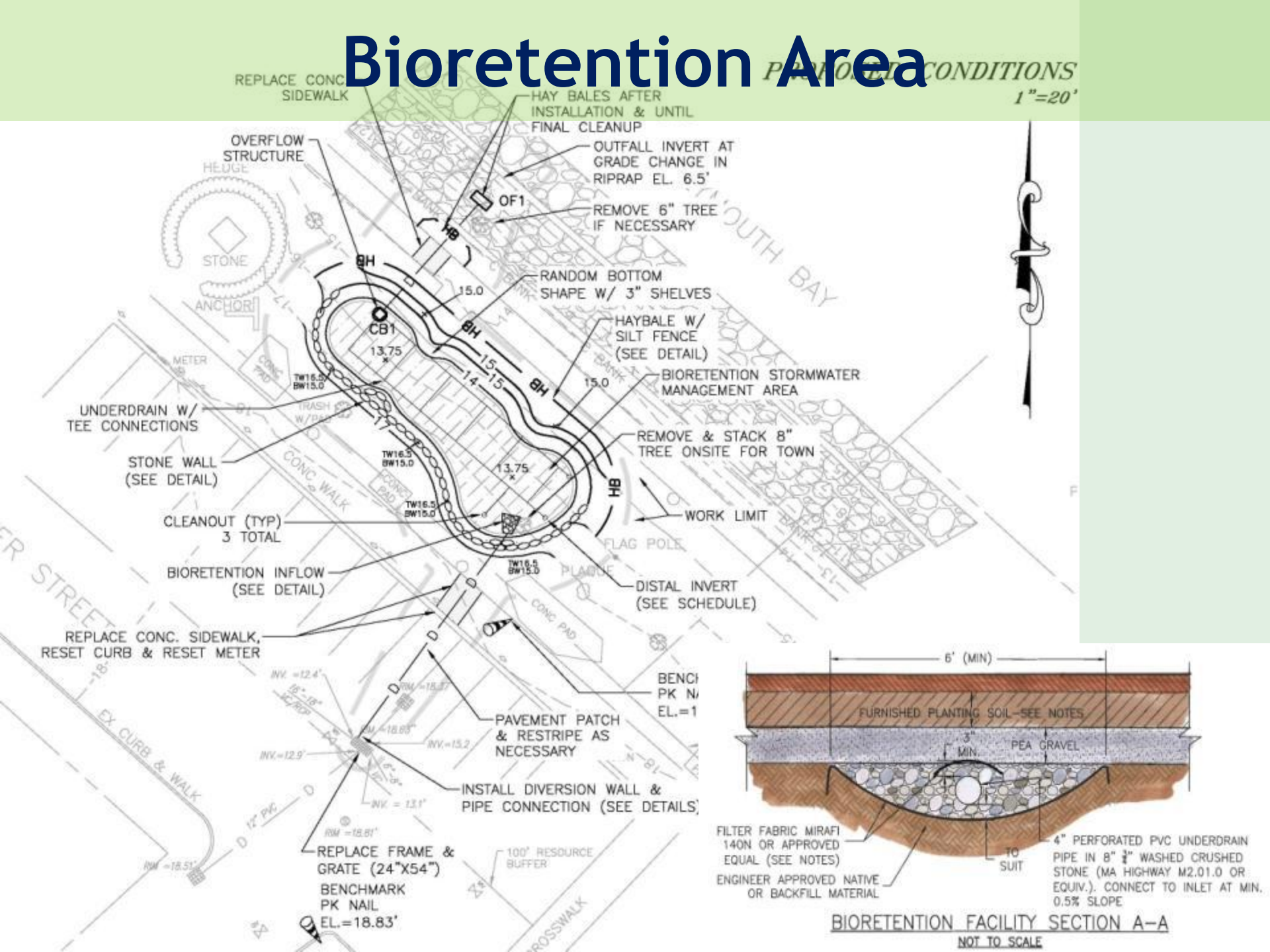
Existing Conditions and Site Constraints

- 4.5 acre drainage area – 33% imperviousness
- Residential & commercial properties
- Heavily trafficked site
- Close proximity to Plymouth Harbor Coastal Bank
- Steep grades and poor soils (Urban Fill)

Stormwater Design Features

- Bioretention facility designed as primary treatment
- 990 square-feet of treatment area
- Sized to treat ½-inch of runoff
- Low flows directed through diversion structure
- High flows bypass bio to prevent scouring & erosion
- Bio designed w/ underdrain system due to poor soils
- Steep grades accommodated w/ boulder wall
- Designed to fit in w/ surrounding landscape

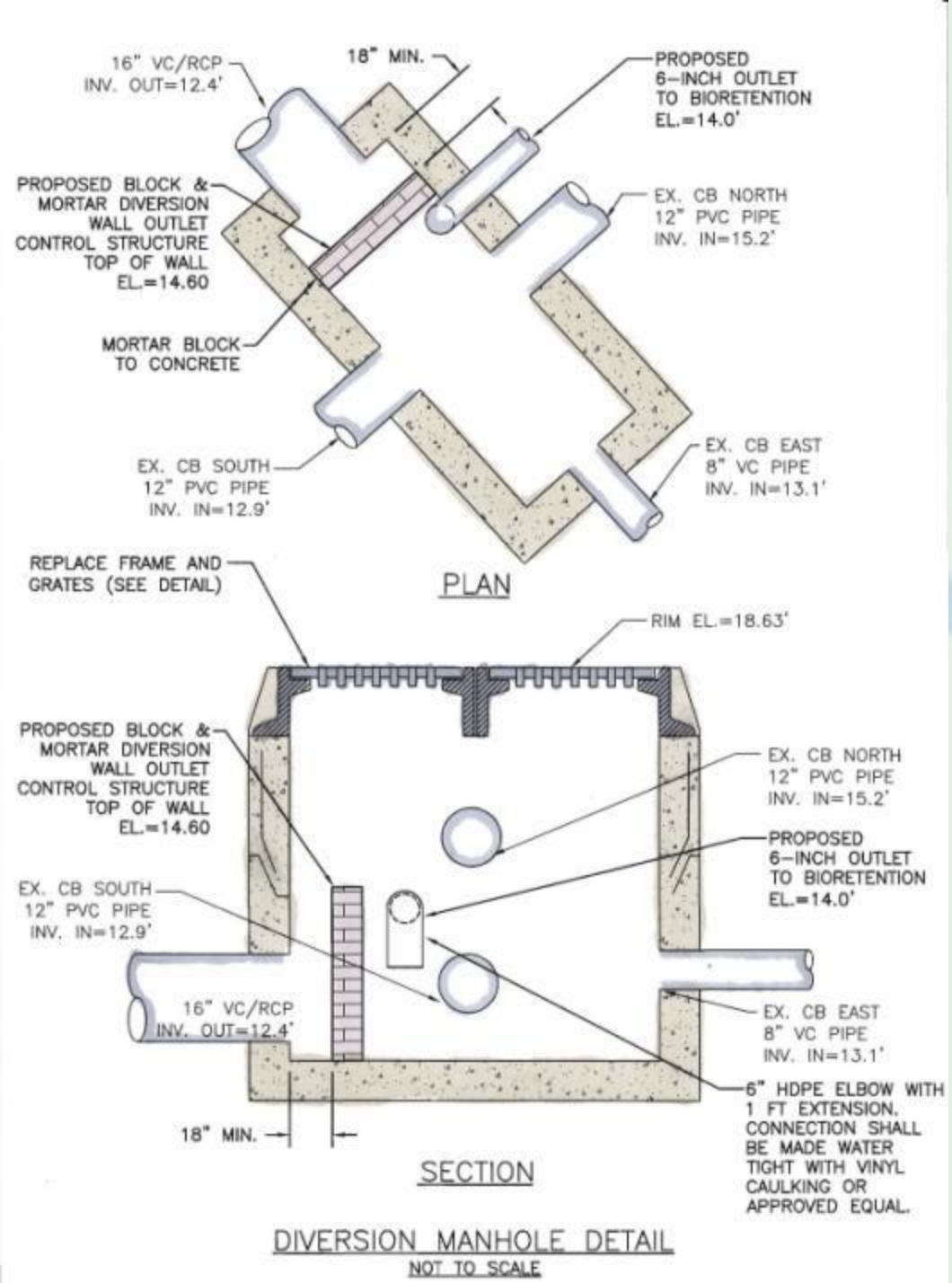
Bioretention Area



BIORETENTION FACILITY SECTION A–A

NOT TO SCALE

Diversion Structure



- Retrofit of existing structure
- ½-inch water quality event directed to bio
- High flows bypass to existing outlet


06/13/2009

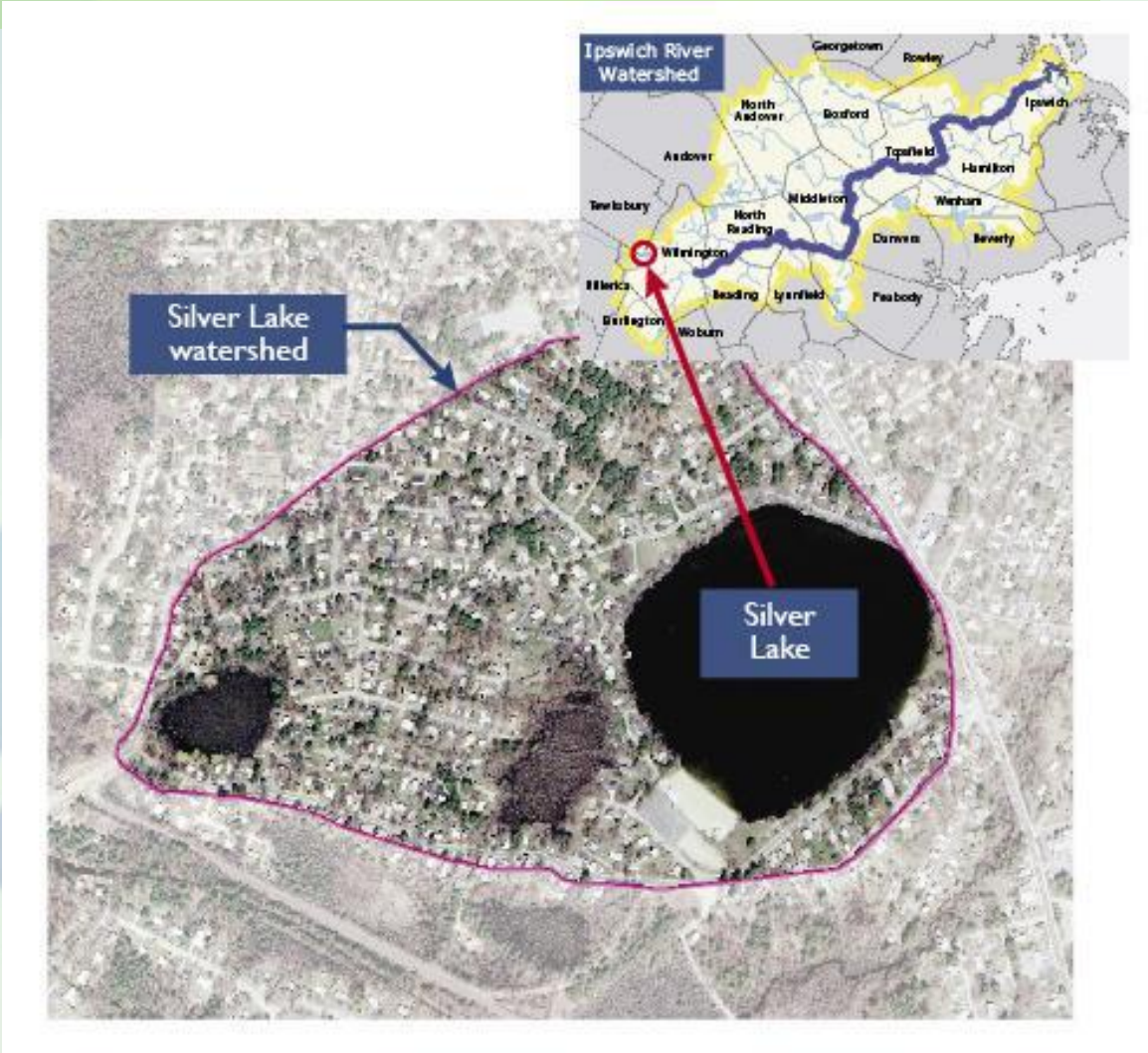
Bioretention Planting Plan

Underdrain and Stone Placement

Filter Media Placement and Bio Plantings

Silver Lake
Wilmington, MA

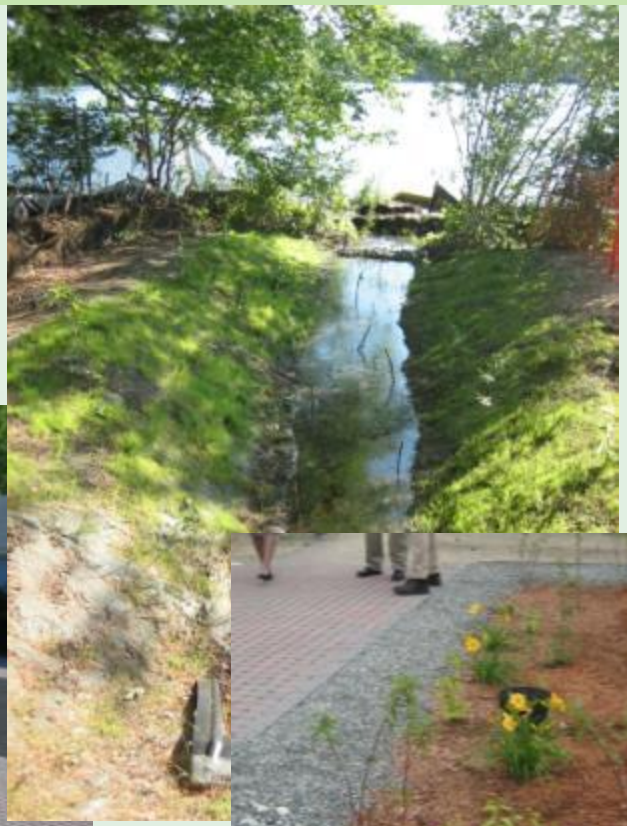
- Silver Lake
  - Watershed Area: 132 acres
  - Pond Area: 28.5 acres
  - Watershed/Lake Ratio = 4.6:1
- Ipswich River Watershed



Horsley Witten Gr

Geosyntec consultants

LID Technologies Demonstrated



Horsley Witten Gr

Geosyntec consultants

Pre-Construction Conditions

Image downloaded from Google Earth™

Geosyntec consultants

Parking Lot Improvements

ec consultants

Test Apparatus

Geosyntec consultants

Infiltration Test Results

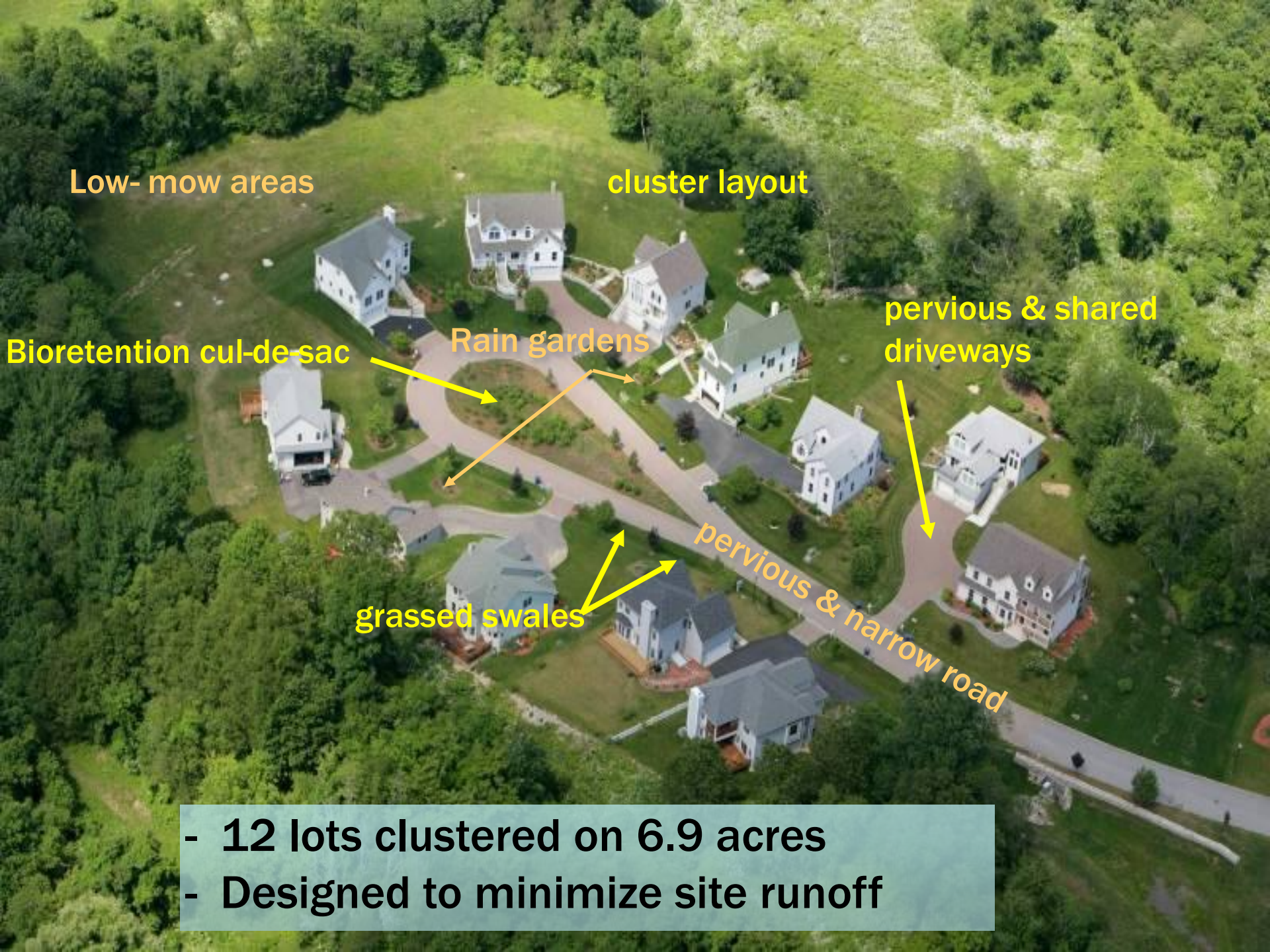
Location	Infiltration Rate (in/hr)
Bioretention Cell 1	22.73
Bioretention Cell 2	21.94
Raingarden	12.38

Note: ASTM D3385-94 provides accurate results for soils with infiltration rates between 0.0014 and 14.17 in/hr.

Geosyntec consultants

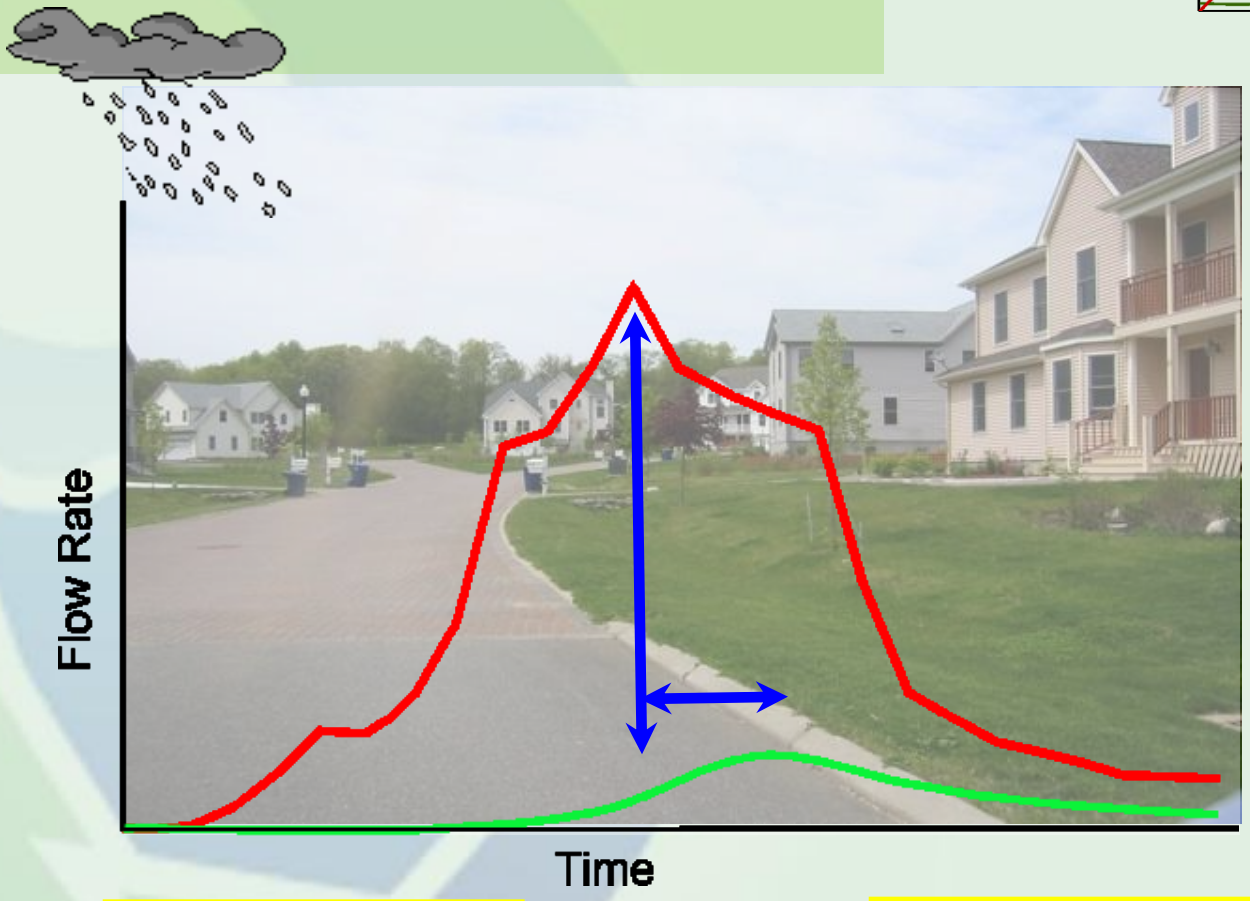
Low Impact Development

Does it really work?



- 12 lots clustered on 6.9 acres
- Designed to minimize site runoff

But Does It Work?



Adapted from J. Clausen, UConn

Some LID Cost Comparisons
(as recently reported in Stormwater Magazine)

Conventional Design Savings

- Mobilization
- Professional services (design and construction observation)
- Detention ponds
- Landscaping
- Paving?
- Maintenance?

LID Design Savings

- Site clearing and grading (earthwork)
- Temporary E&SC
- Drainage infrastructure (pipes and inlets)
- Curbing
- Site stabilization
- Paving?
- Maintenance?

But it really Depends

LID Cost Savings a Function of Design and Expertise

- Is the project a Conservation Development (OSRD) with reduced disturbance?
- How much LID is incorporated (pervious pavers, swales, natural area preservation, etc?
- How complicated are the designs? Is multiple staging required?
- Are there unusual site constraints (slopes, soils, shallow groundwater, etc)?
- Is density going to be affected?
- How much expertise exists in your region?
- How much maintenance is required?
- Are the local codes compatible with LID?