The Low Impact Development Center, Inc.

- Mission: Stormwater Management Technology
- Pilot Projects, Monitoring, Modeling, Manuals, Training, Education

Balancing Growth and Environmental Integrity

Landscape Designs for Better Water Quality

2003

Low Impact Development (LID)

Stormwater Management

Ecosystem Based Functional Design

"Uniformly Distributed Small-scale Controls"

"Integration of Controls with Sites, Streets and Architecture "

*** Low Cost & Low Impacts ***

Prince George's County, MD

LID National Design Manual 1999

"Centralized versus Decentralized Controls"

LID – Examples of Where and Who

Where

- Chesapeake Bay Watershed
- Great Lakes States
- Puget Sound
- Oregon
- New England
- Florida
- Minnesota
- Pennsylvania
- New Jersey
- Delaware
- North Carolina
- New Zealand
- Australia

Who

- ASCE
- EPA
- NRDC
- NAHB
- Harvard Design School
- Universities
- Watershed Groups
  - Rappahannock
  - Upper Nuse
  - Chagrin
- Professional Groups
- Consultants
- DOT's
- U.S. Congress
- DOD

Defining LID Technology

Major Components

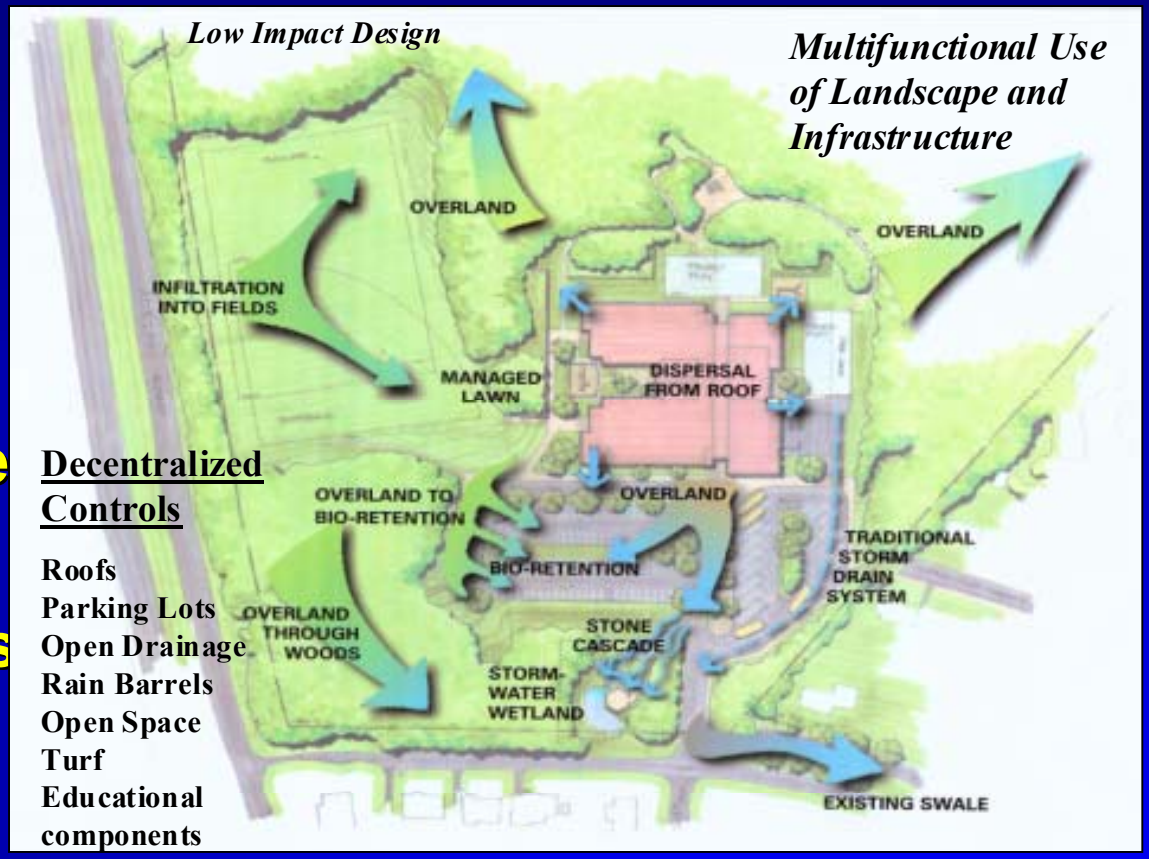
1. Conservation (Watershed and Site Level)
2. Minimization (Site Level)
3. Strategic Timing (Watershed and Site Level)
4. Integrated Management Practices (Site Level)
   Retain / Detain / Filter / Recharge / Use
5. Pollution Prevention
   Traditional Approaches

1. Conserve Natural Areas

- Conservation of drainages, trees & vegetation
- Land use planning
- Watershed planning
- Habitat conservation plans
- Stream & wetland buffers

2. Minimize Impacts

- Minimize clearing
- Minimize grading
- Save A and B soils
- Limit lot disturbance
- * Soil Amendments
- Alternative Surfaces
- Reforestation
- Disconnect
- Reduce pipes, curb and gutters
- Reduce impervious surfaces



3. Maintain Time of Concentration

- Open Drainage
- Use green space
- Flatten slopes
- Disperse drainage
- Lengthen flow paths
- Save headwater areas
- Vegetative swales
- Maintain natural flow paths
- Increase distance from streams
- Maximize sheet flow

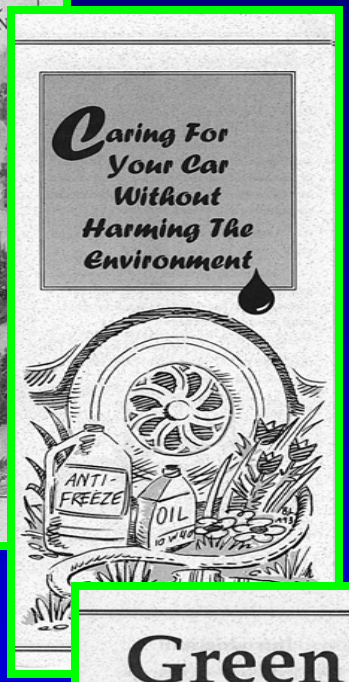
4. Storage, Detention & Filtration
"LID IMP's"

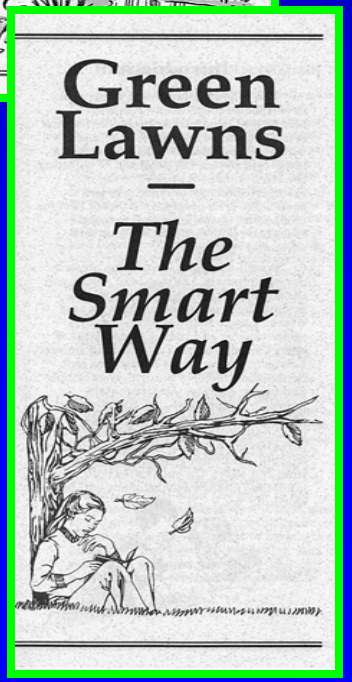
- Uniform Distribution at the Source
  - **Open drainage swales**
  - **Rain Gardens / Bioretention**
  - **Smaller pipes and culverts**
  - **Small inlets**
  - **Depression storage**
  - **Infiltration**
  - **Rooftop storage**
  - **Pipe storage**
  - **Street storage**
  - **Rain Water Use**
  - **Soil Management****

5. Pollution Prevention

30 - 40% Reduction in N&P

Kettering Demonstration Project





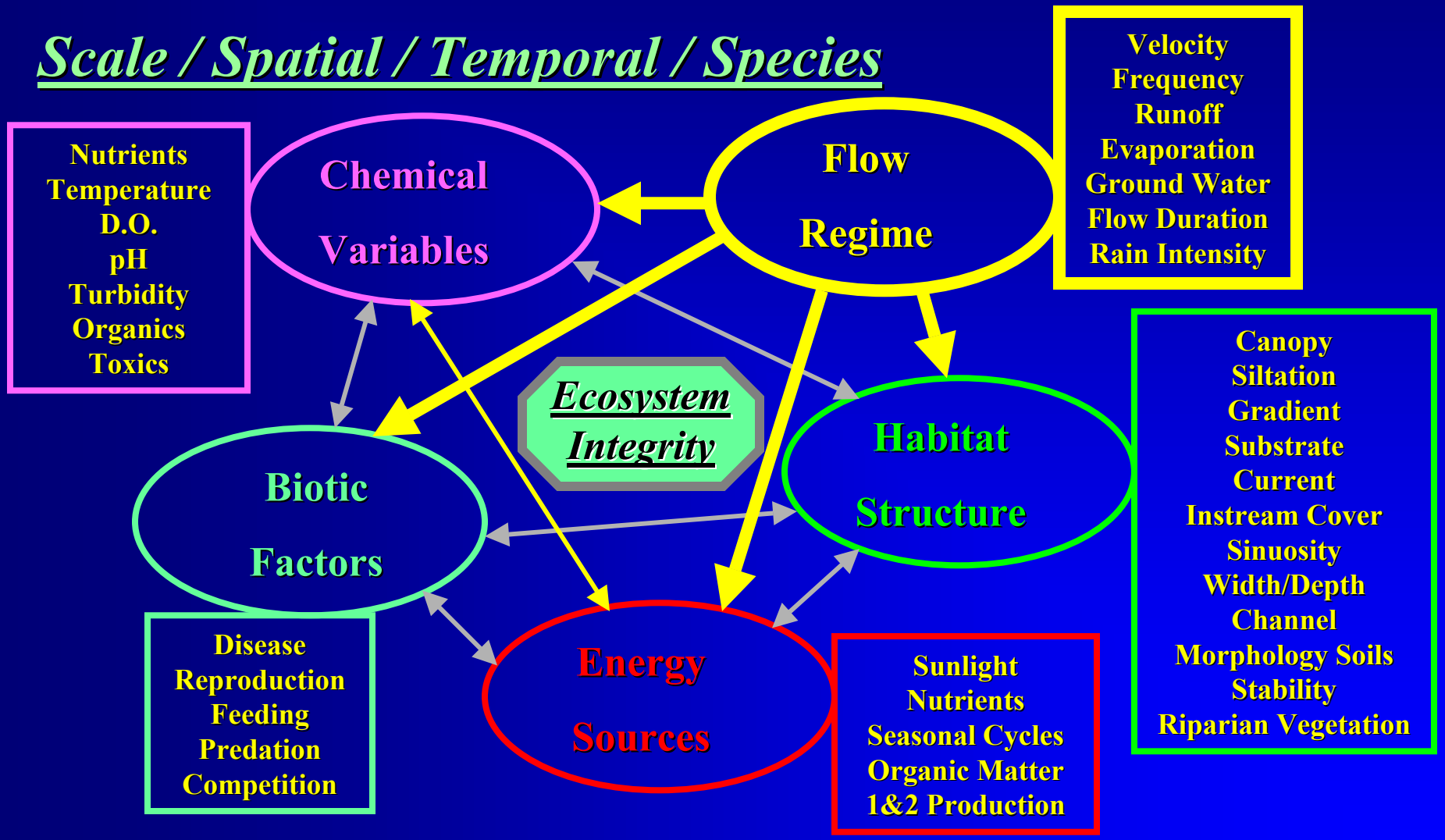
- Maintenance
- Proper use, handling and disposal
  - Individuals
    - Lawn / car / hazardous wastes / reporting / recycling
  - Industry
    - Good house keeping / proper disposal / reuse / spills
  - Business
    - Alternative products / Product liability

Important Concepts

- Terrestrial / aquatic ecosystem linkages
- Ecosystem functions
- Using nature to mitigate its own forces
- Mimic the water balance
- Hydrology as an organizing principle
- Multiple systems
- Volume / Frequency / Timing
- Ecological functions of the built environment

How well do we maintain the ecological integrity (functions) of aquatic systems (small streams)?

Scale / Spatial / Temporal / Species



Key LID Principles

"Volume"

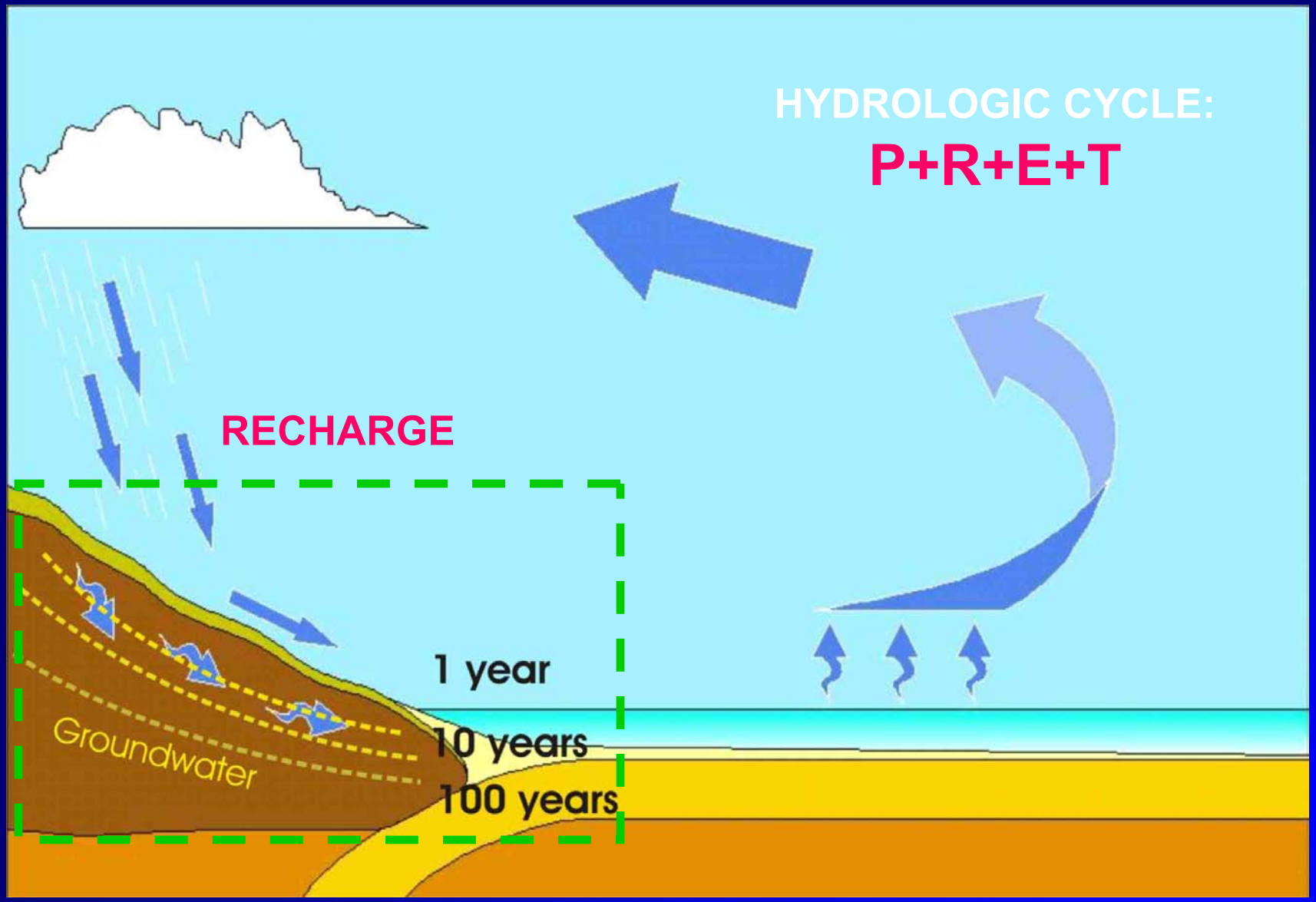
"Hydrology as the Organizing Principle "

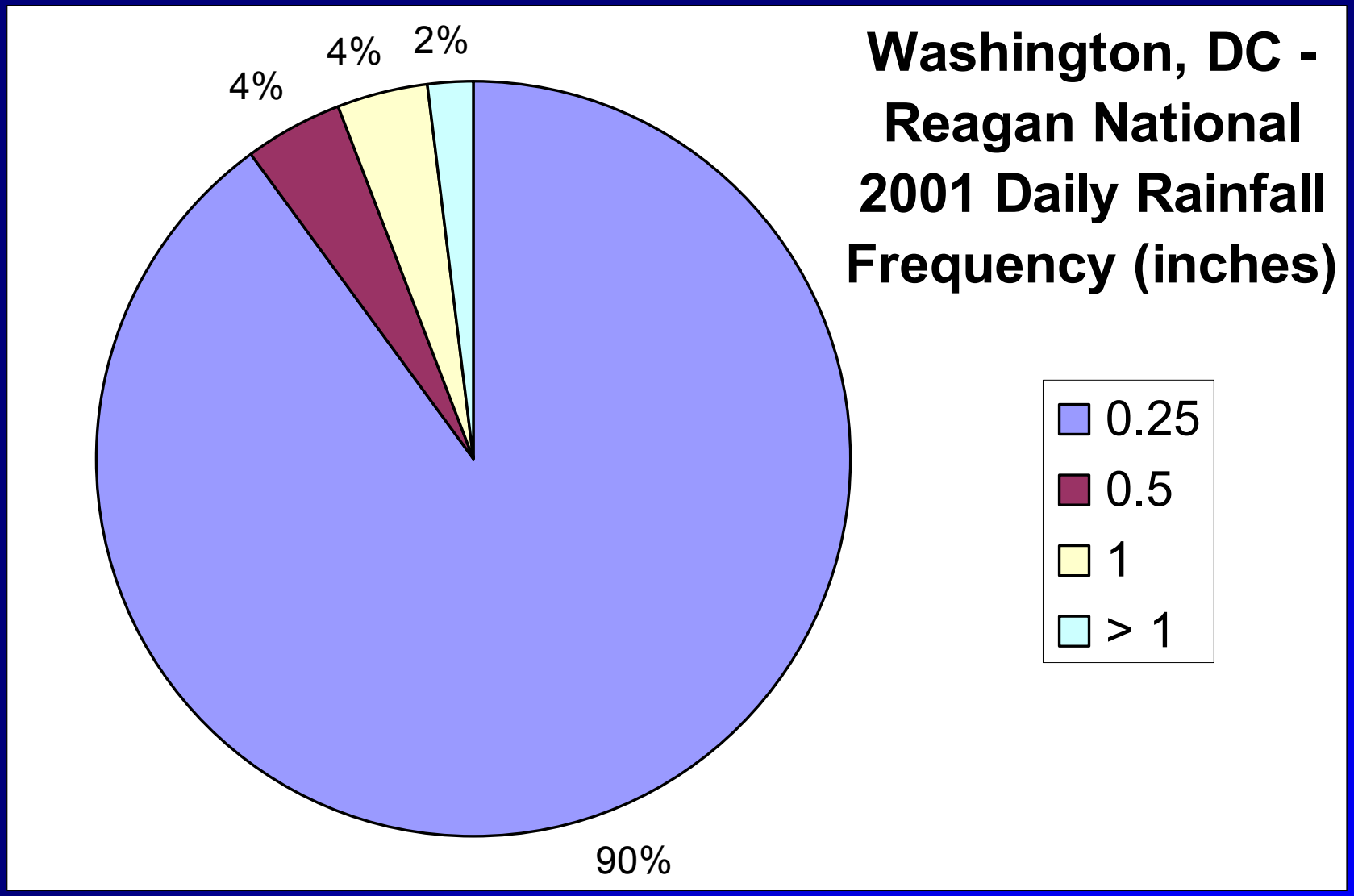
- Unique Watershed Design
  - Match Initial Abstraction Volume
  - Mimic Water Balance
- Uniform Distribution of Small-scale Controls
- Cumulative Impacts of Multiple Systems
  - filter / detain / retain / use / recharge / evaporate
- Decentralized / Disconnection
- Multifunctional Multipurpose Landscaping & Architecture
- Prevention

It's not what but how you do it!

- Hydrologically Functional Designs
- Increasing Assimilative Capacity
- Multifunctional / Beneficial Landscape and Architecture

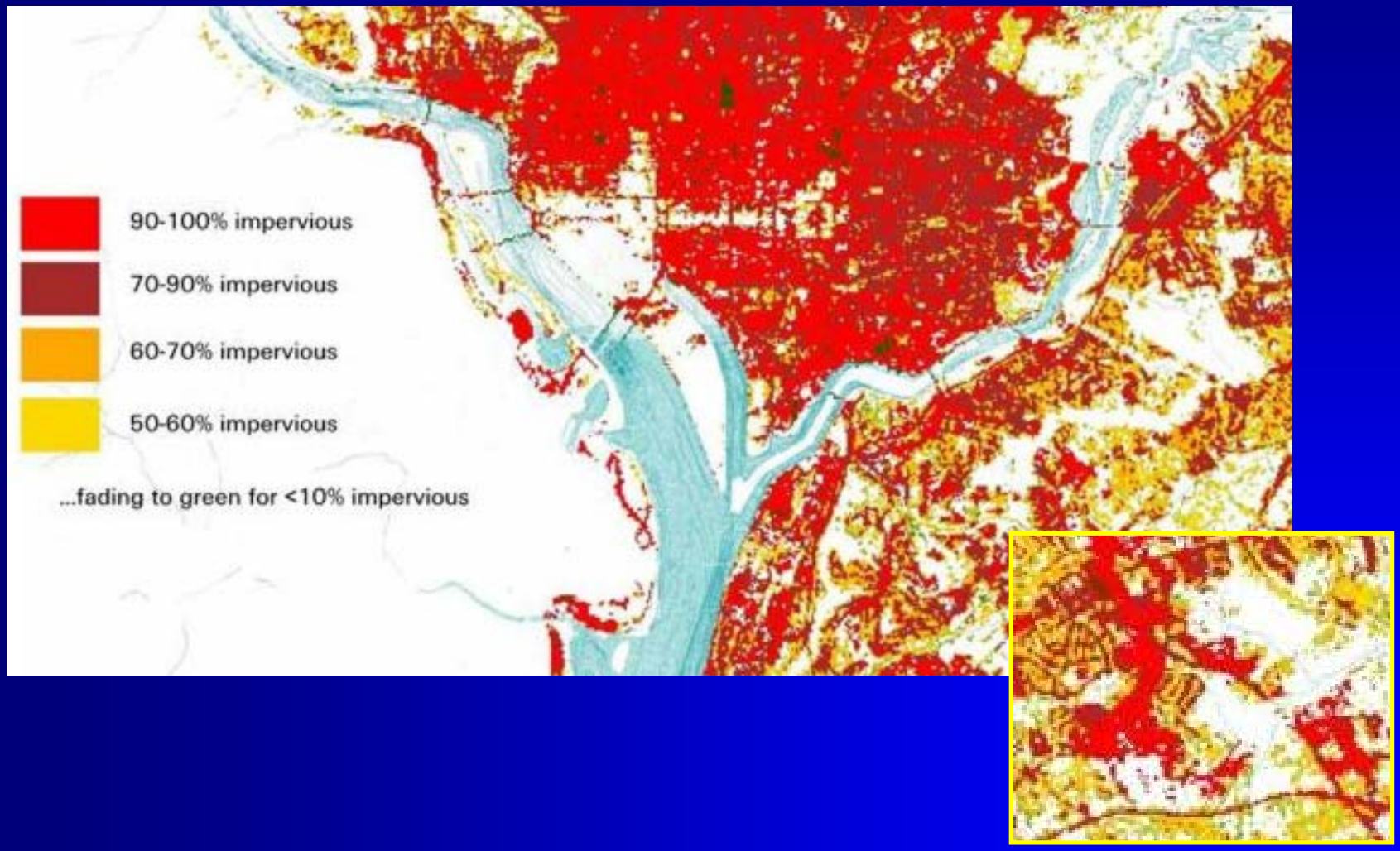
LID Provides Powerful New tools for Urban Stormwater Management





Volume/Frequency

An estimate of imperviousness can be derived directly from the satellite image for developed areas. (Water bodies from the USGS topographic maps are overlaid for orientation, and areas identified as undeveloped in the National Land Cover dataset are left white.)

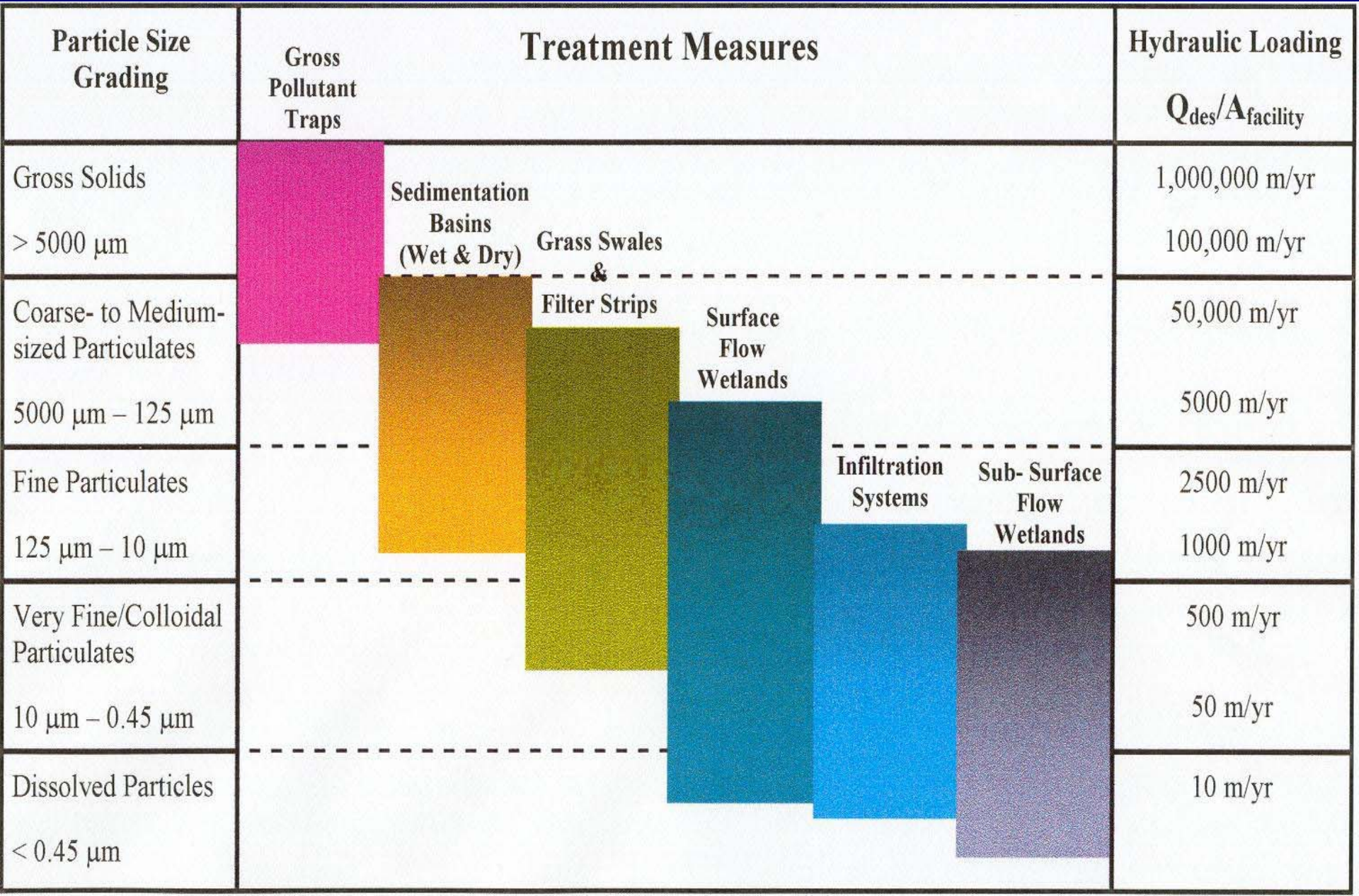


Soil Modific

- Clear Ve
- Remove
- Compac
- Change
- Modify D
- Destroy Biological Activity
- Destroy Soil Structure / Function

Urban Stormwater Art

Multiple Systems to Deal Wide a Range of Problems

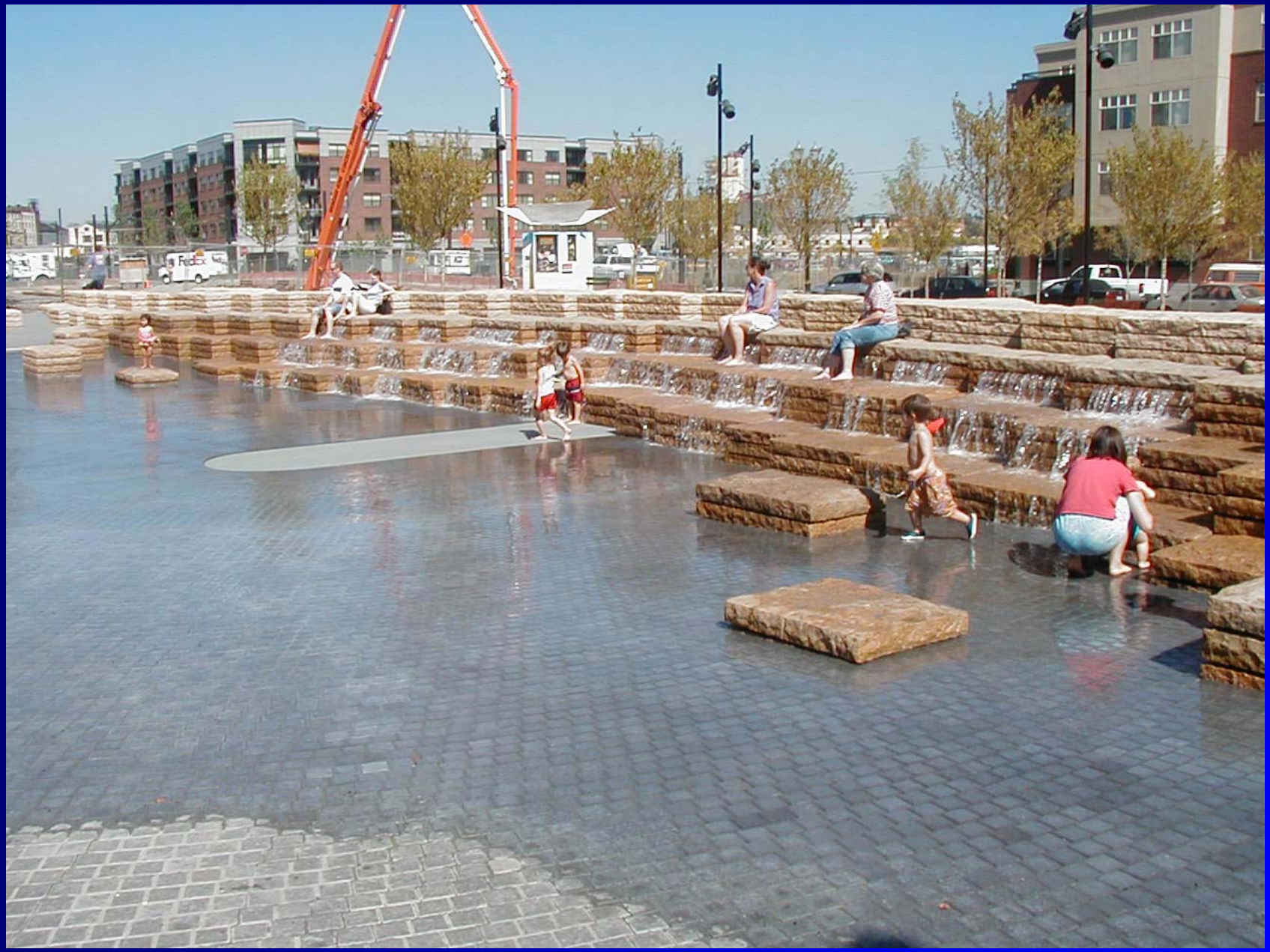


Where's the ~~Beef~~ Buffer?

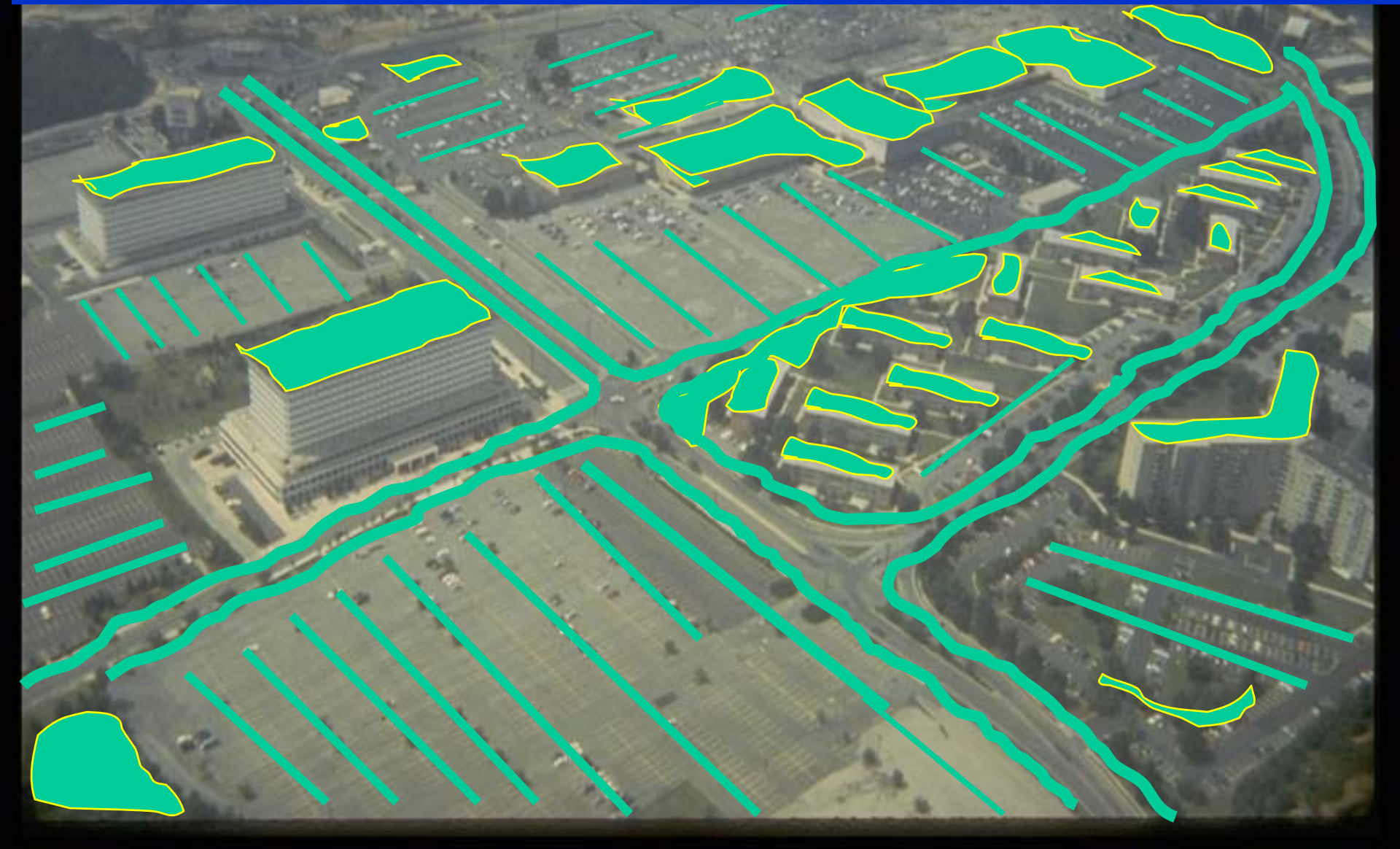
Anacostia Tributary

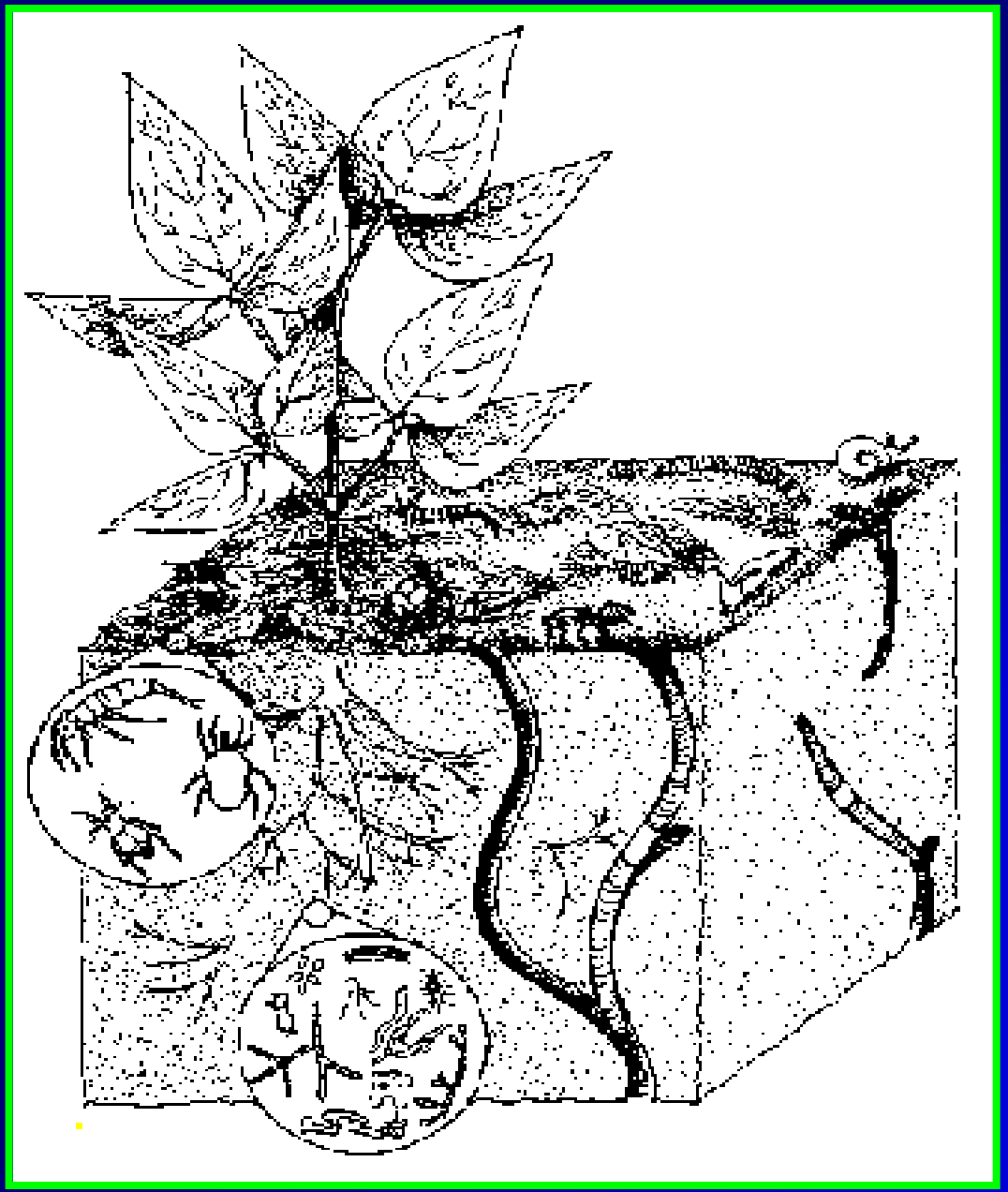
Canadian
TMDL Goose

Engineers Fountain Design



Urban LID -- Rooftop Storage, Bioretention Landscaping, Parking Lot Storage, Longer Flow Paths, Swales, Water Use, Pollution Prevention ……





Bioretention

A Dynamic Living Ecosystem Cycling Nutrients, Chemicals and Organic energy Sources

Plants

Bacteria

Protozoa

Fungus

Worms

Insects

Mammals

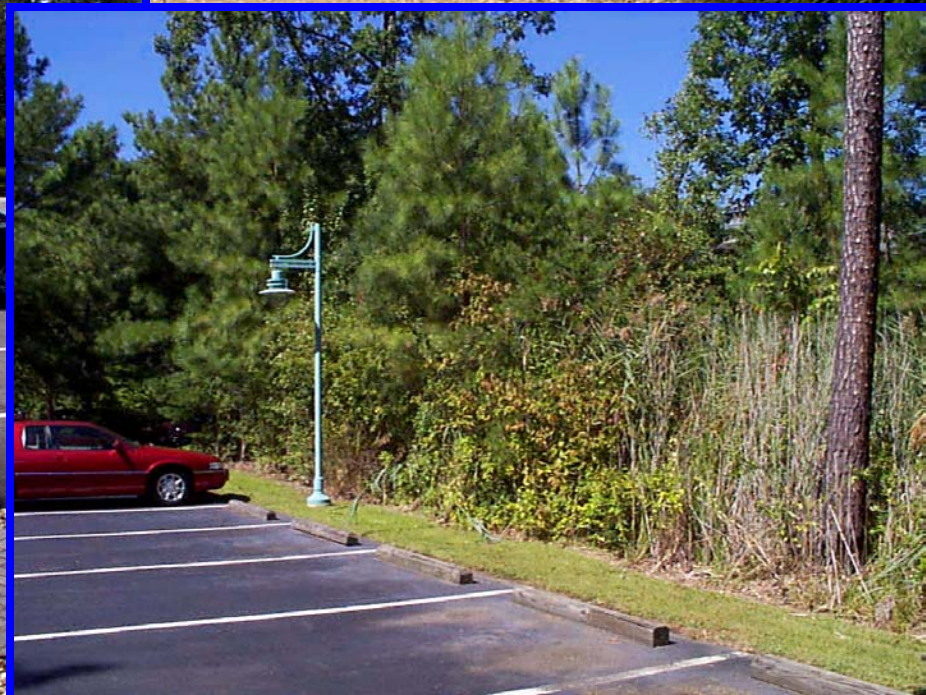
VIEW OF LOT WITH STORAGE AND BIORETENTION

Rain Gardens

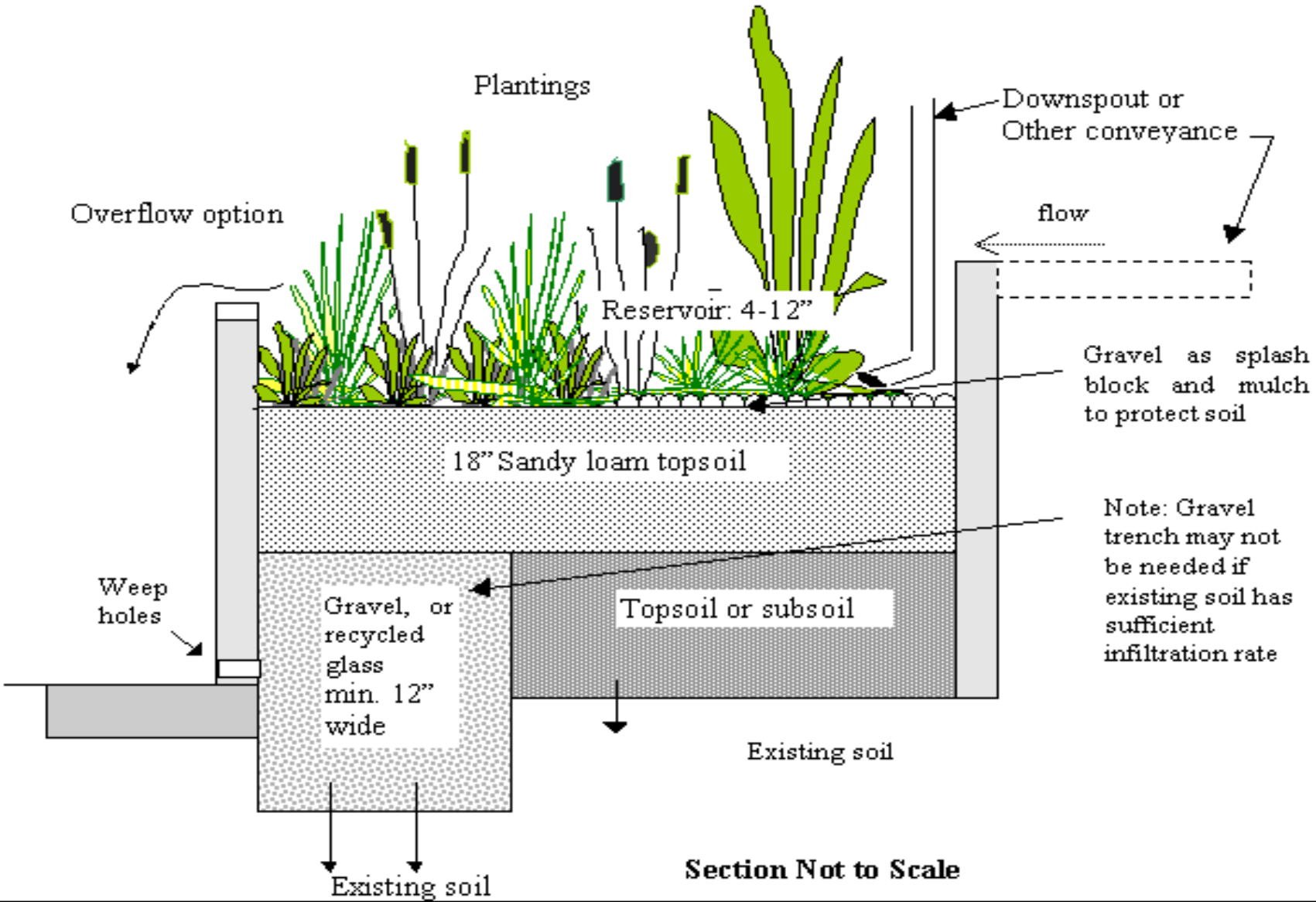
Typical Landscape Maintenance Practices

Rain Gardens


SOLOMON'S
LANDING

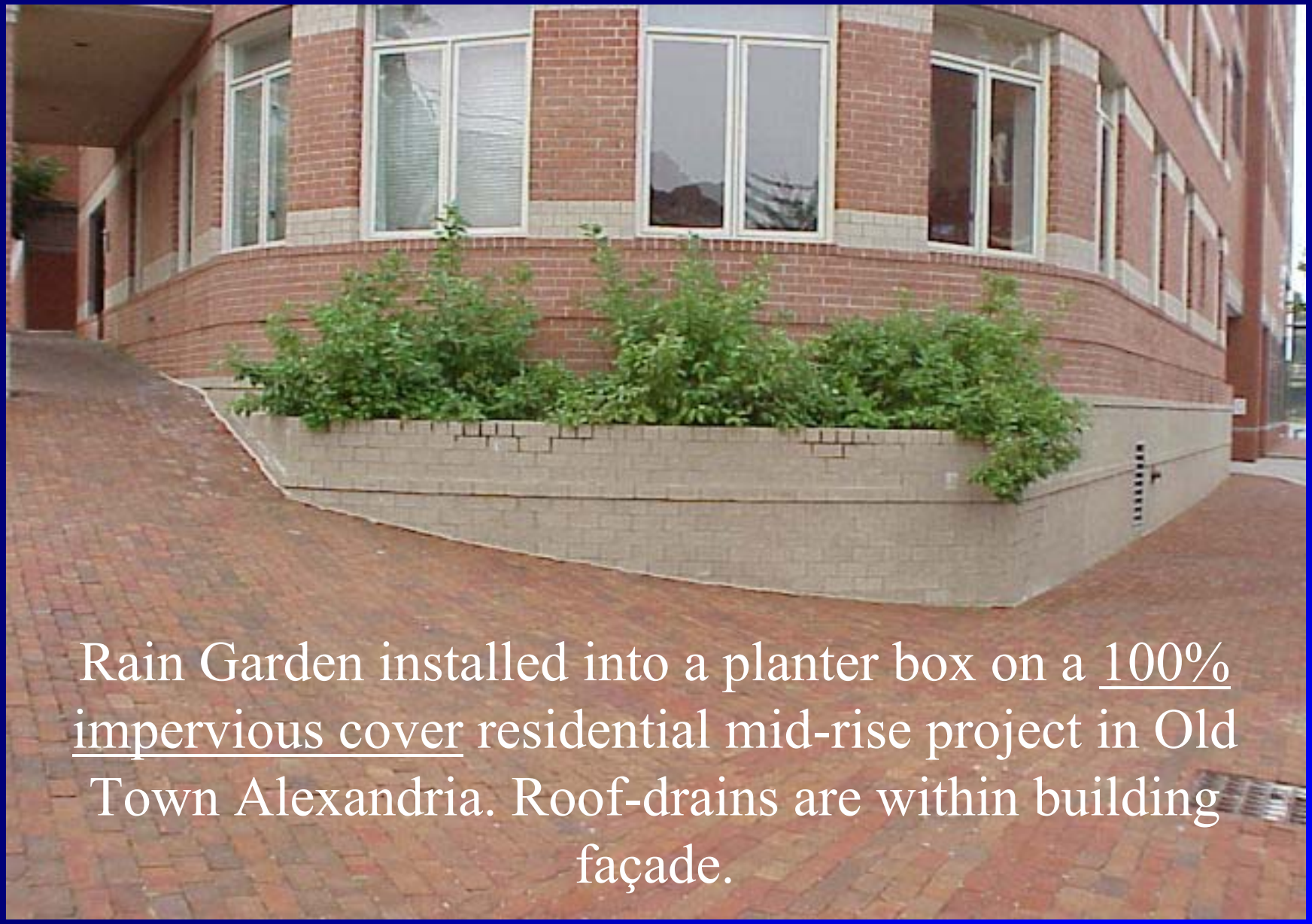


Stormwater Planter AB

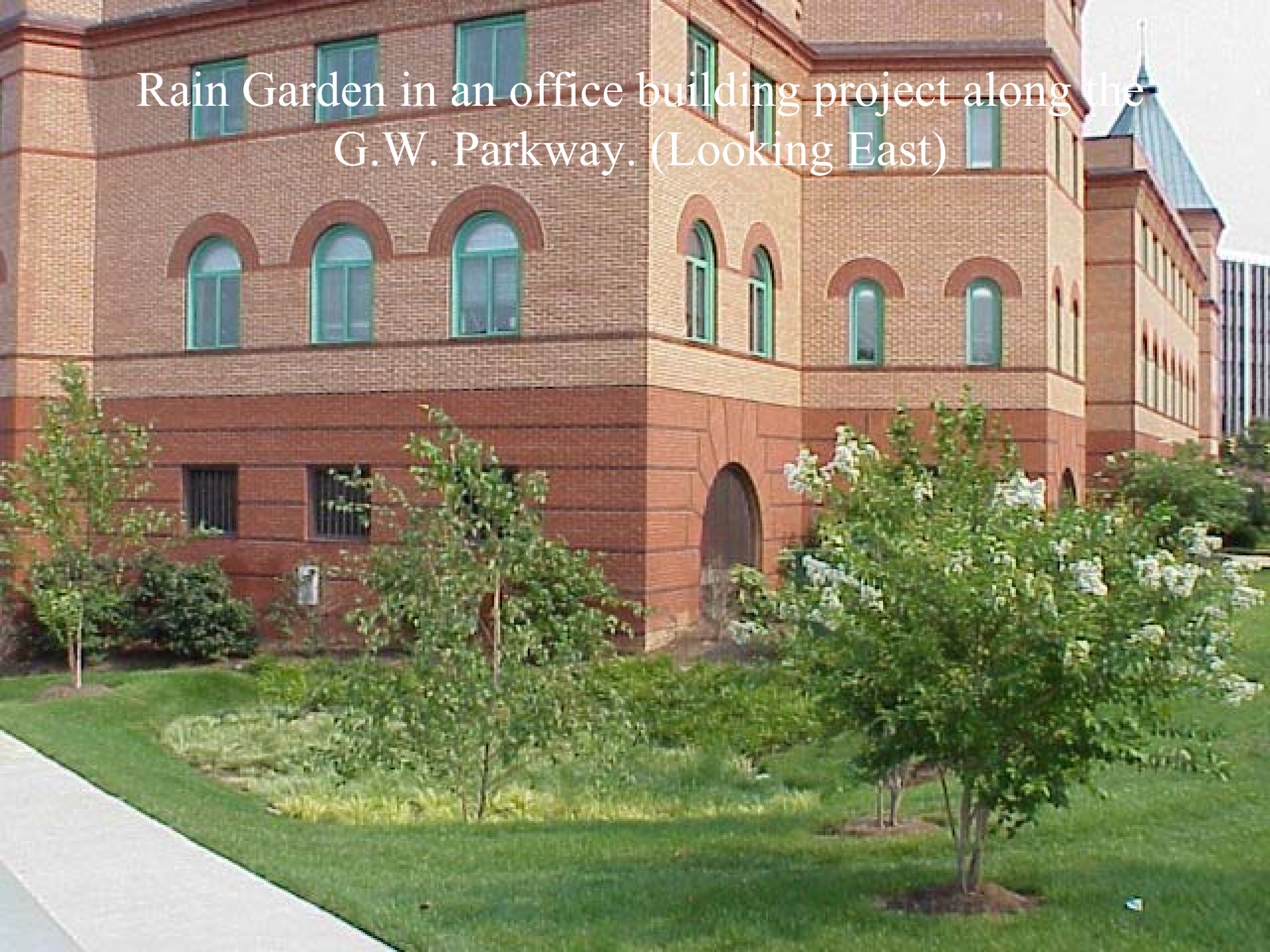


Section Not to Scale

Scuppers into Stormwater Planter



Rain Garden installed into a planter box on a 100% impervious cover residential mid-rise project in Old Town Alexandria. Roof-drains are within building façade.



Rain Garden in an office building project along the G.W. Parkway. (Looking East)

The first Rain Garden in Virginia, located in a turning circle in front of St. Stephens School, Alexandria.


Rain Garden in the inter-space of a high density town house project.
Depressed Curb Inlet.

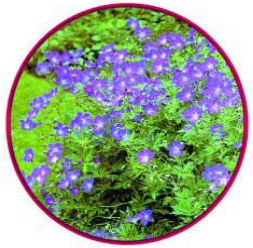
Rain Garden with depressed curb and sidewalk.

The Sunny Border Garden Layout

10 Happy Returns Daylily
(Hemerocallis 'Happy Returns')
Height: 18 inches
Space: 12 inches
Blooms : June to frost

1 Blue Flag Iris
(Iris versicolor)
Height: 2 feet
Space: 1 foot
Blooms: May - June

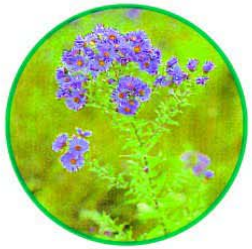
2 Johnson's Blue Geranium
(Geranium x 'Johnson's Blue')
Height: 15-18 inches
Space: 12 inches
Blooms: May to frost

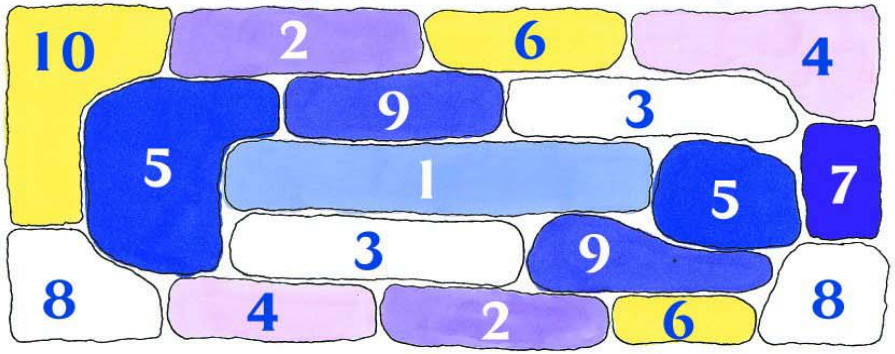


3 White Coneflower
(Echinacea purpurea alba)
Height: 2-3 ft
Space: 18 inches
Blooms: June to frost

Bonestroo Rosene Anderlik & Associates
Engineers & Architects
Garden & Brochure Design

9 New England Aster
(Aster Novae-Angliae)
Height: 4-5 Feet
Space: 2 Feet
Blooms: Midsummer to frost





4 Purple Leaf Sedum
(Sedum x 'Vera Jameson')
Height: 12 inches
Space: 12 inches
Blooms: June to frost

8 Lambs Ears
(Stachys lanata)
Height: 12 inches
Space: 12 inches
Blooms: May to June with interesting foliage all Summer

7 Little Grapette Daylily
(Hemerocallis 'Little Grapette')
Height: 18 inches
Space: 12 inches
Blooms: June to frost

6 Moonbeam Coreopsis
(Coreopsis verticillata 'Moonbeam')
Height: 12 inches
Space: 12 inches
Blooms: All Summer

MAPLEWOOD
Together We Can

5 Great Blue Lobelia
(Lobelia Siphilitica)
Height: 2 feet
Space: 1 foot
Blooms: August - September

Maplewood, Minnesota (Met Council)

Reduced Impervious Area

- 11% less impervious area than standard street improvement

SEA Streets - After Construction
2nd Ave NW - NW 117th St to NW 120th St

LID Center,

Fat Street

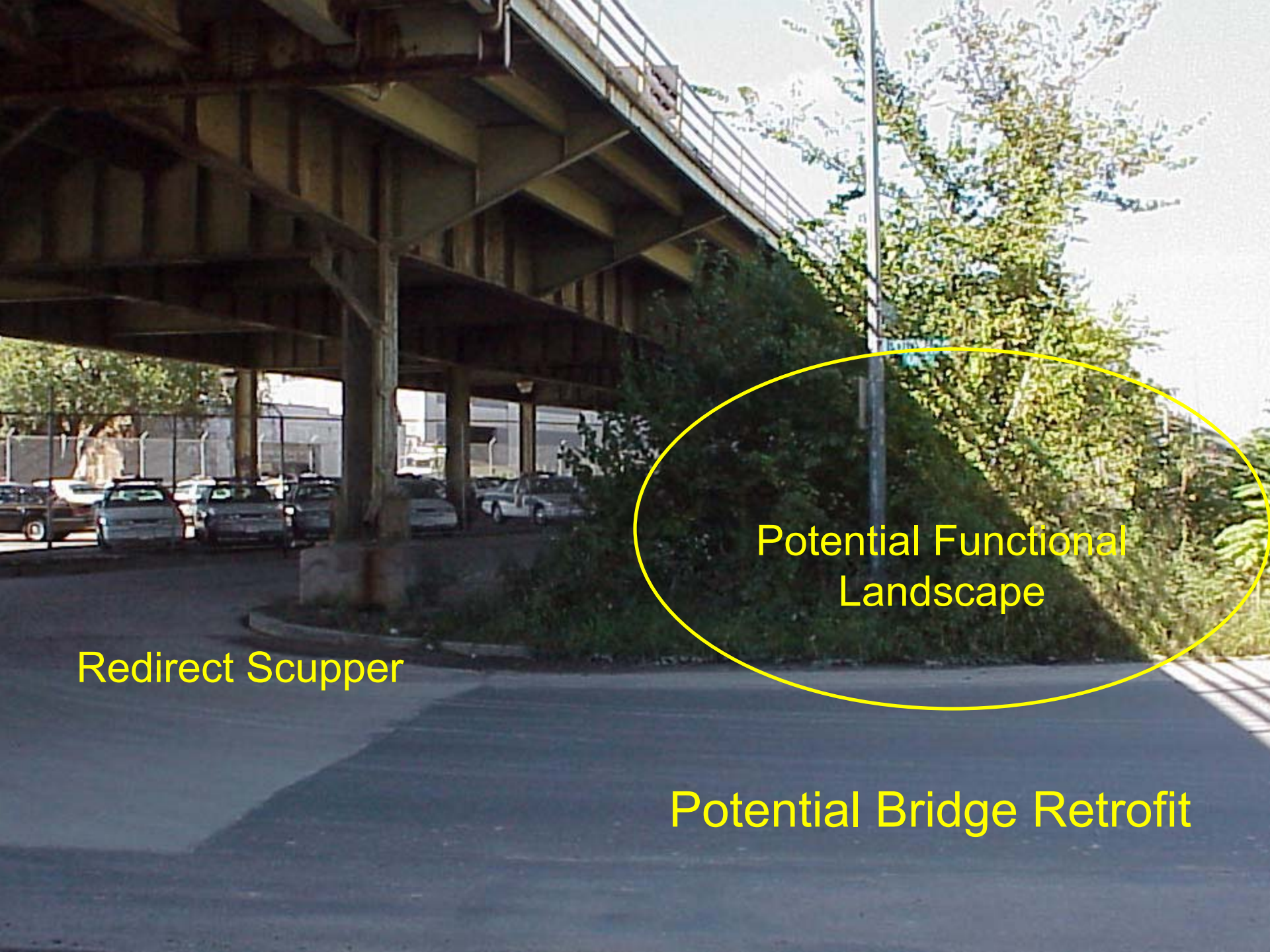
Skinny Street with Fat Person

After Completion - January 2001

SEA Program, City of Seattle

“SEA” Street


Undeveloped Areas

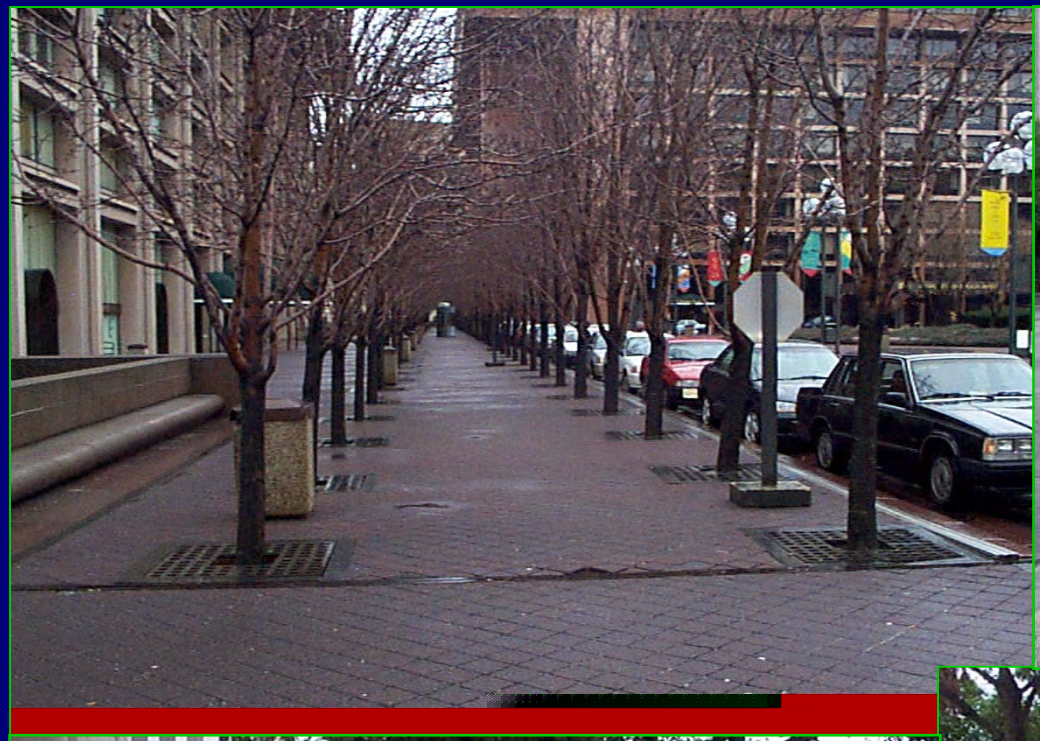

Potential Functional Landscape
Redirect Scupper
Potential Bridge Retrofit

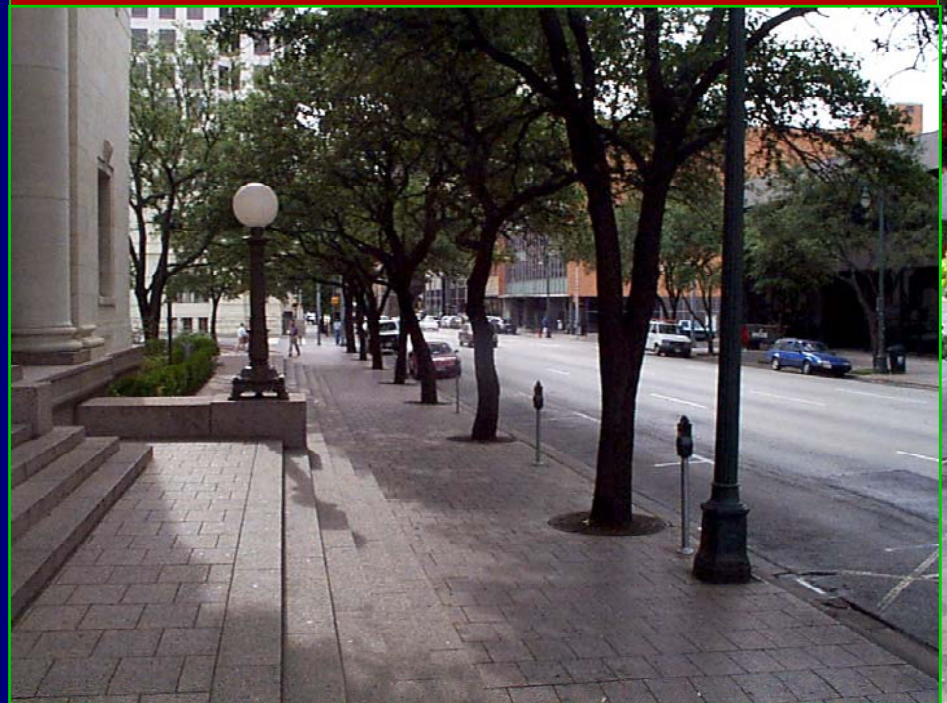
Soil Amendment

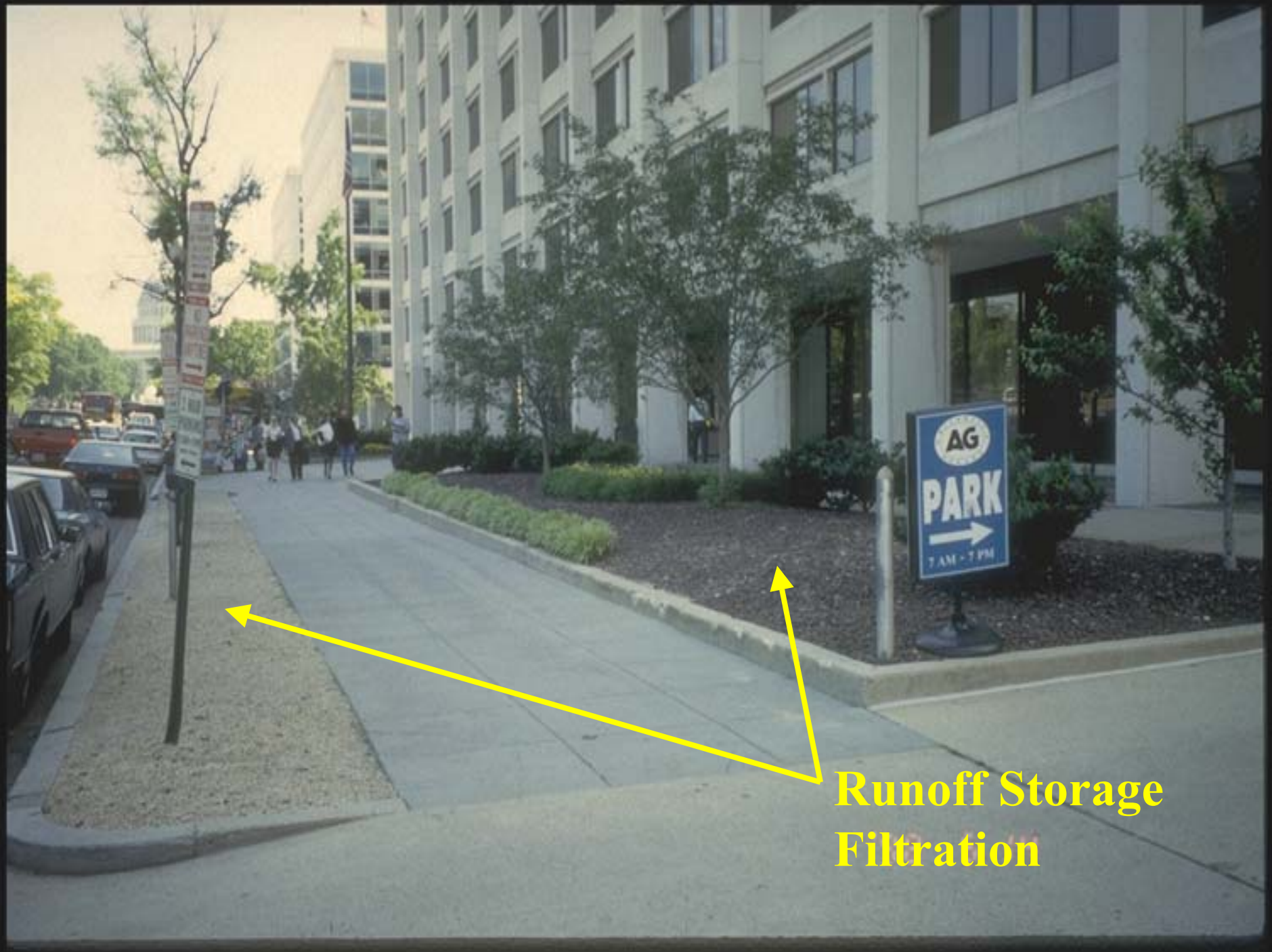
Soil aeration machine

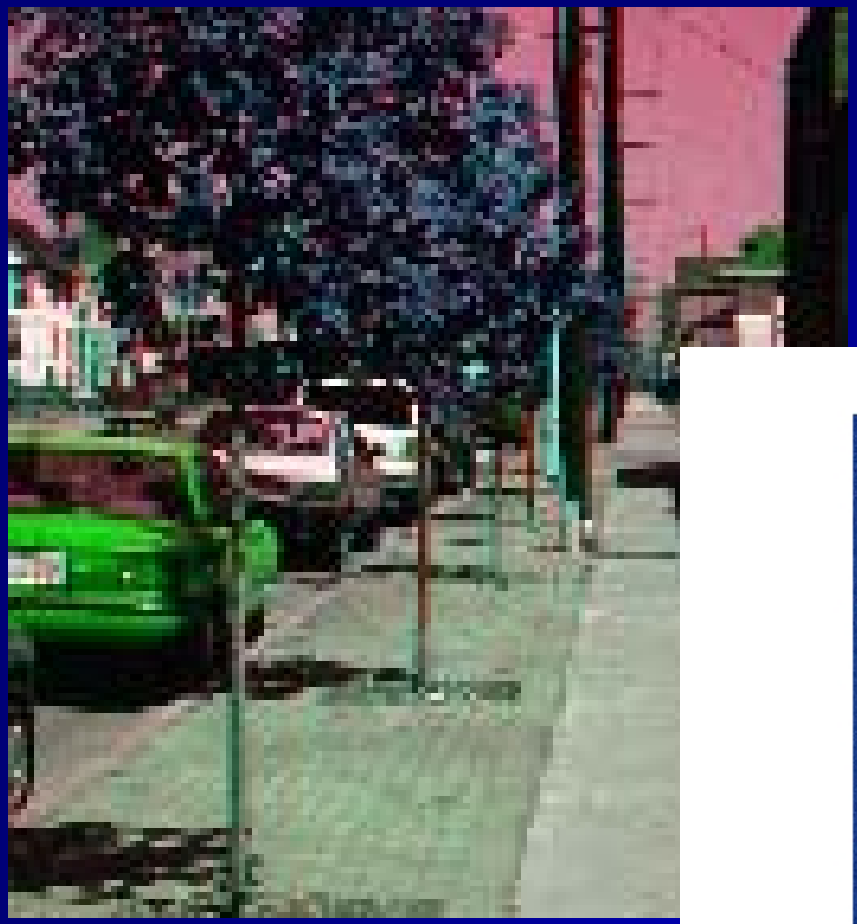
Development at Redmond Ridge, where soils were amended to a depth of 12 inches.

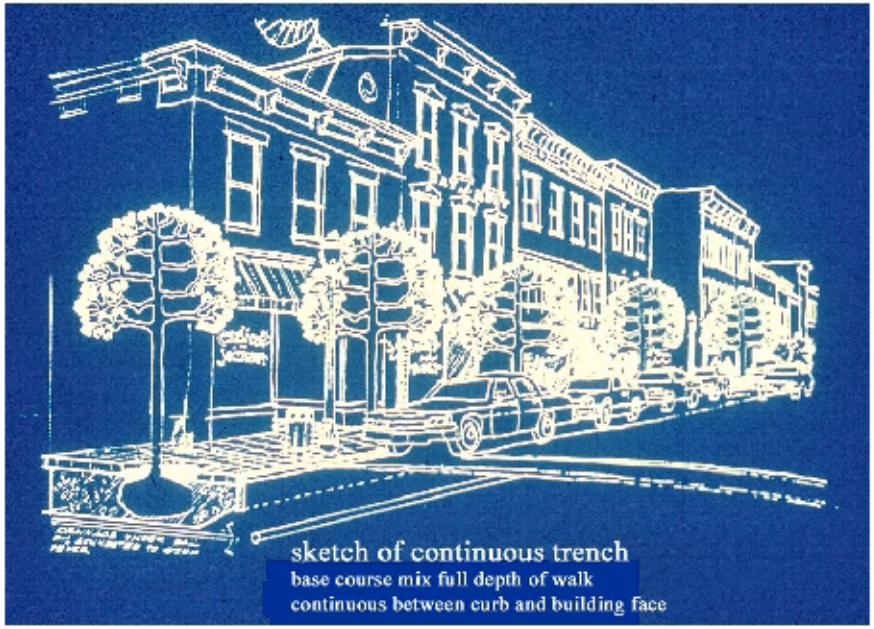

Soil Amendments
Mulch






AG
PARK
7 AM - 7 PM
Runoff Storage
Filtration





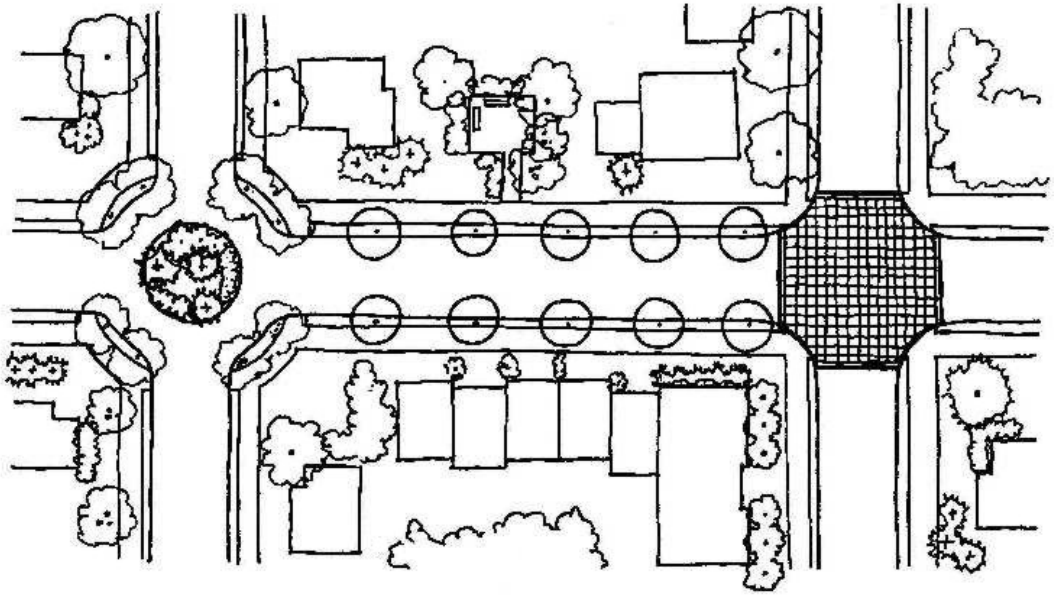
Using space under the sidewalk for root growth is the only place for trees to find adequate soil.

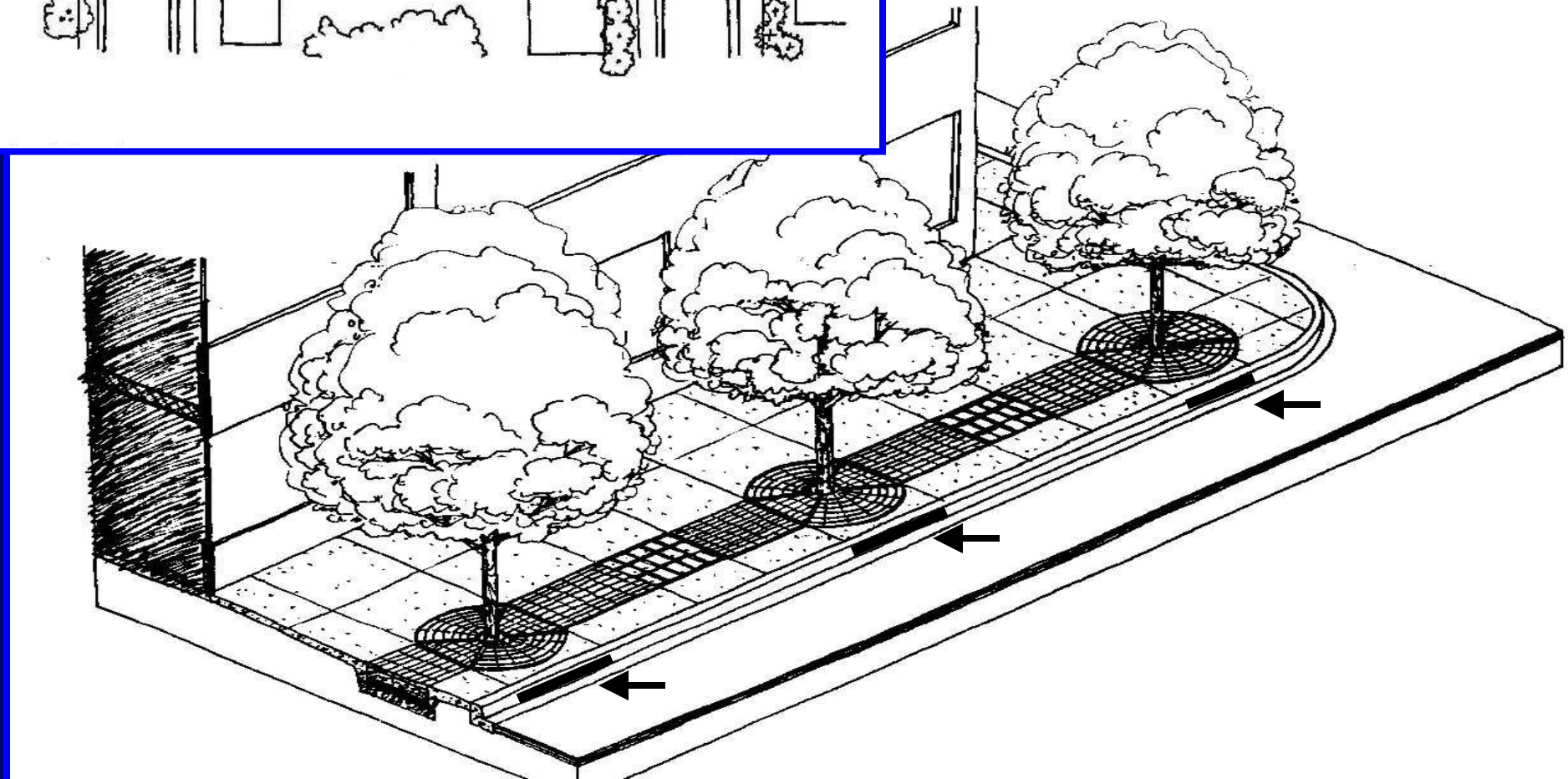
STRUCTURAL STREET TREE SOILS

UHI, 2000

NY State Dept of Transportation installation of CU Structural Soil in Ithaca,, NY 1997. Fifty trees of five species planted into continuous trenches.

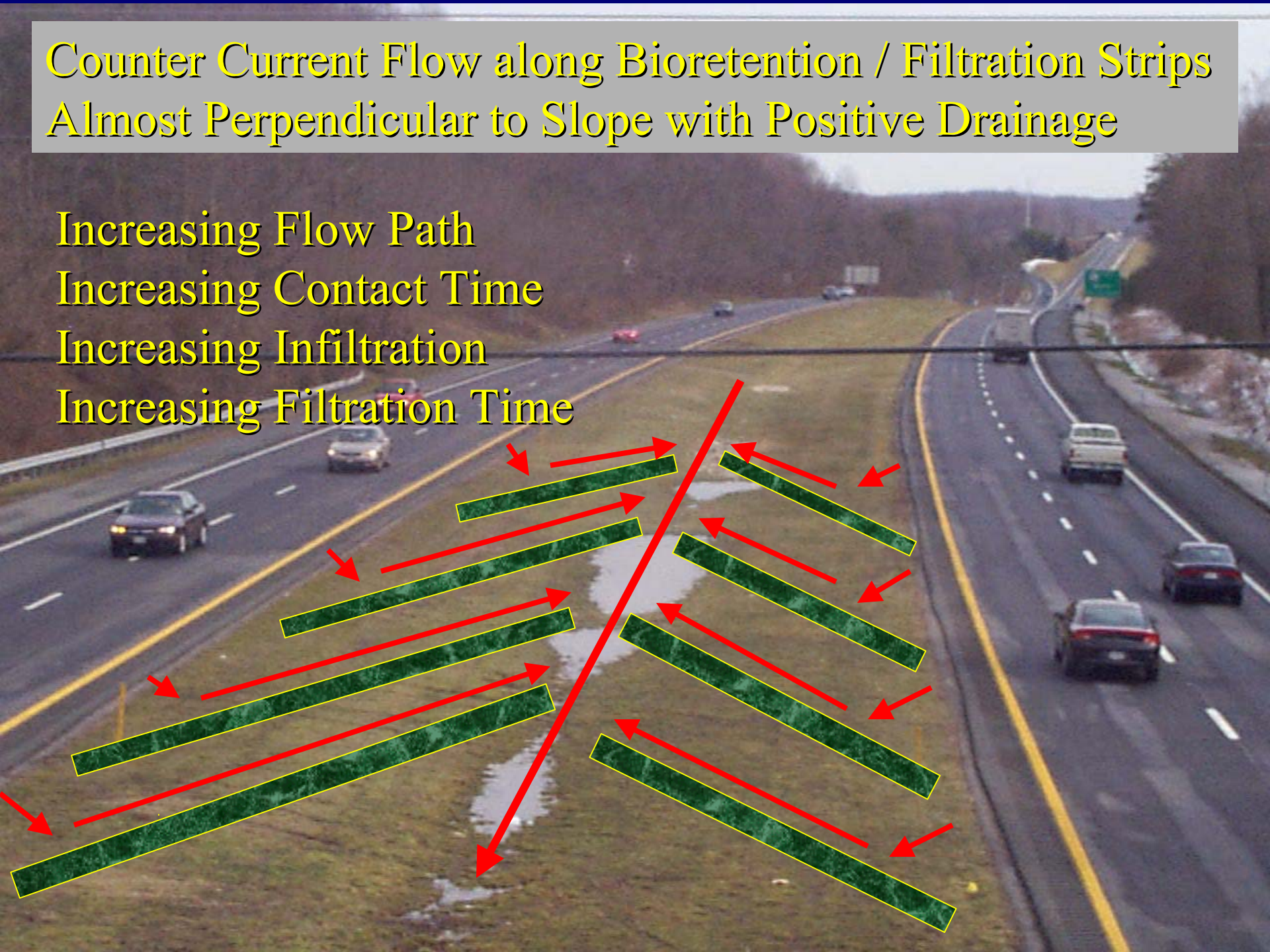
Street Tree / Shrub Filters



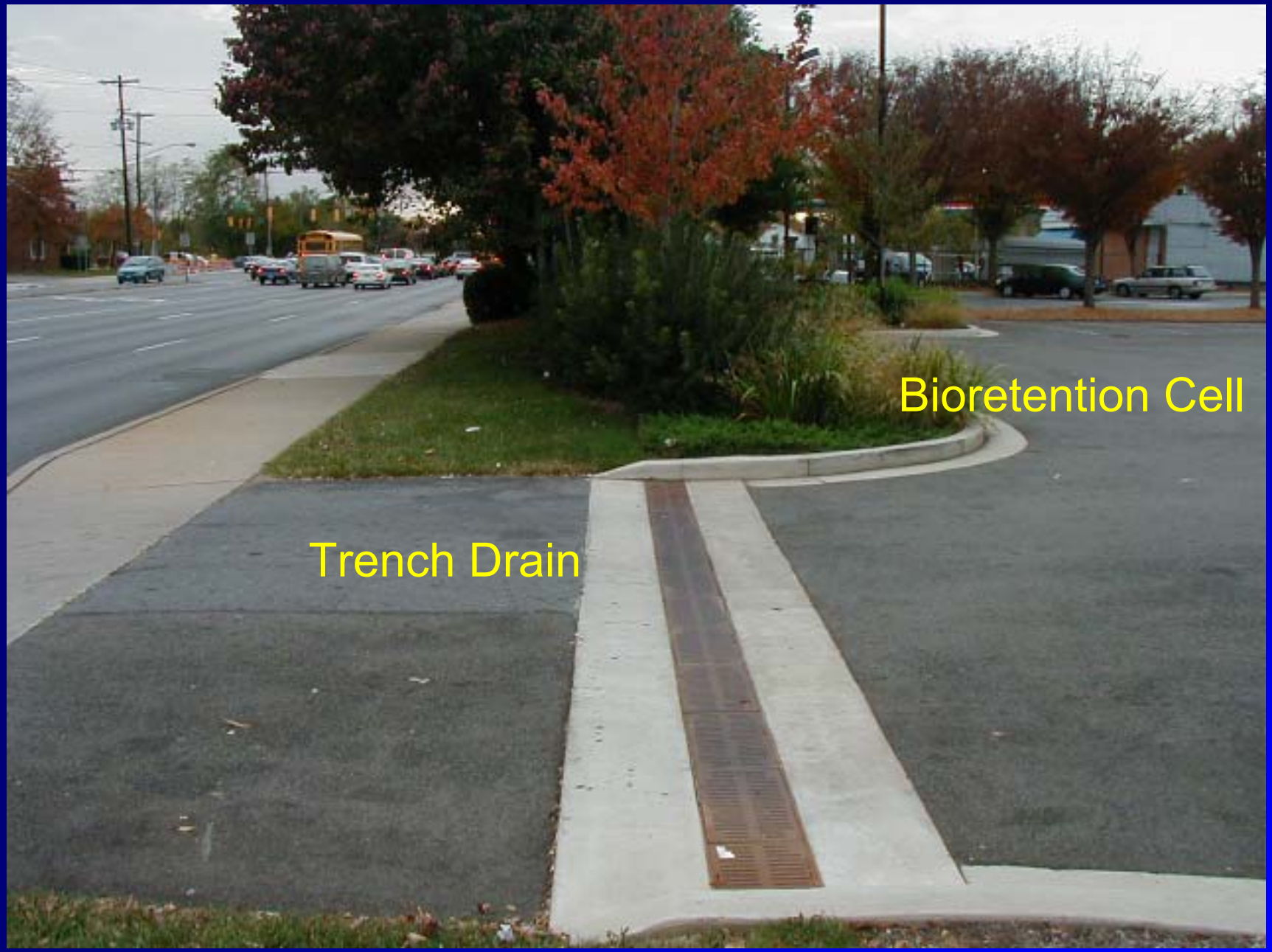



Tree and Shrub
Box

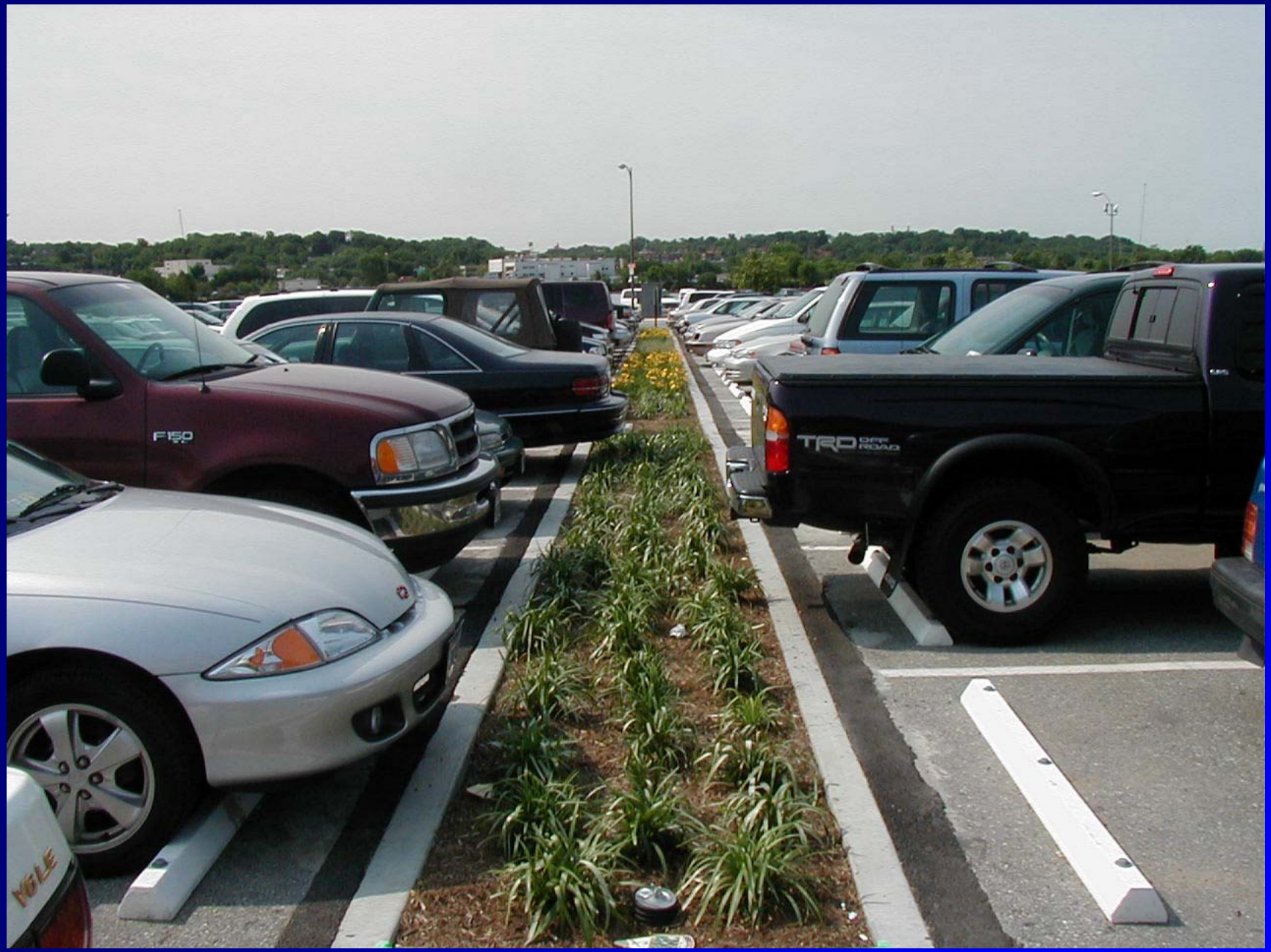
Counter Current Flow along Bioretention / Filtration Strips Almost Perpendicular to Slope with Positive Drainage

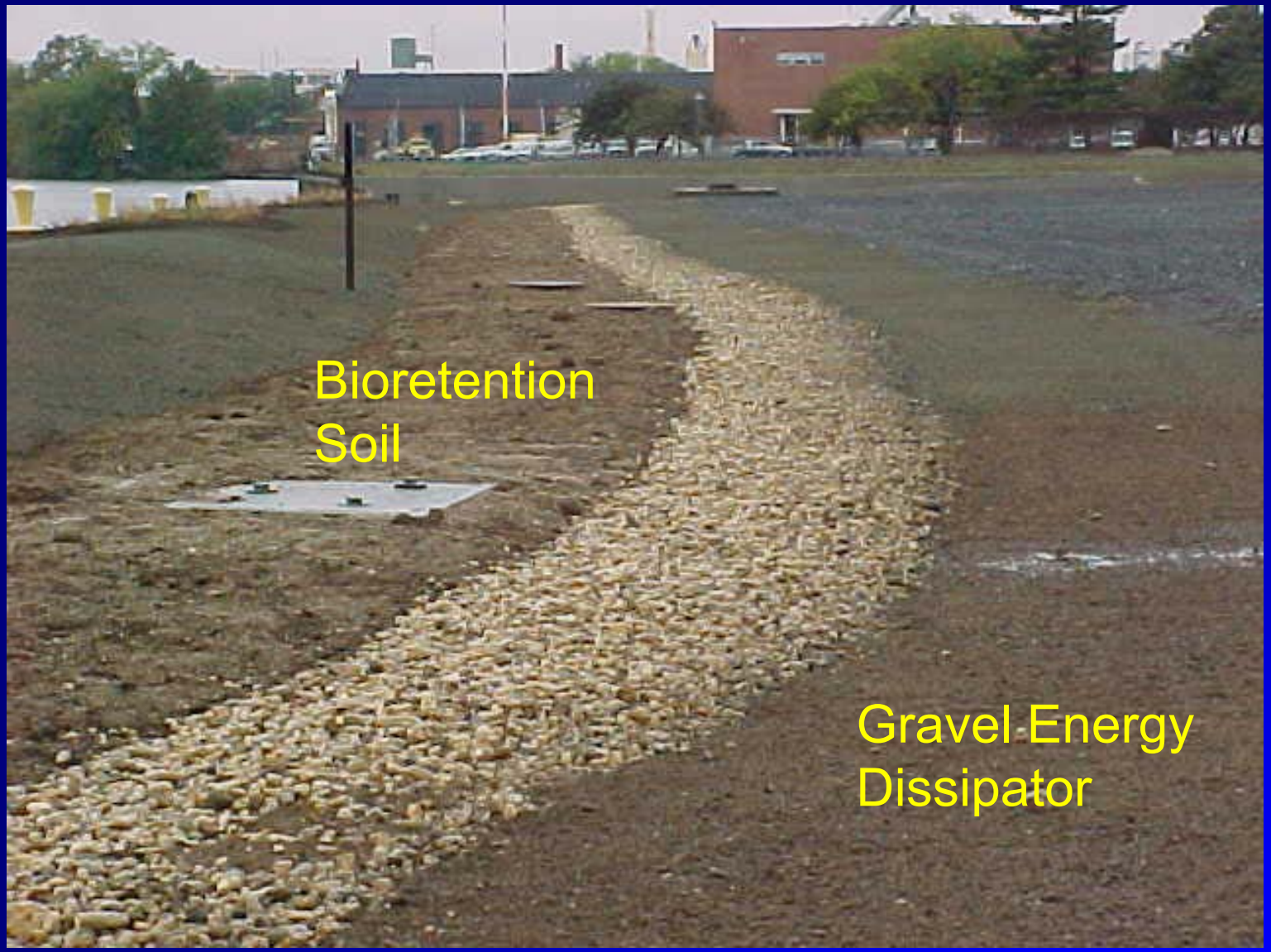


Over 5 miles of Bio-filtration Swale at a large mixed use project.



Entrance to State Highway – Montgomery County





Bioretention Strip Immediately After Construction

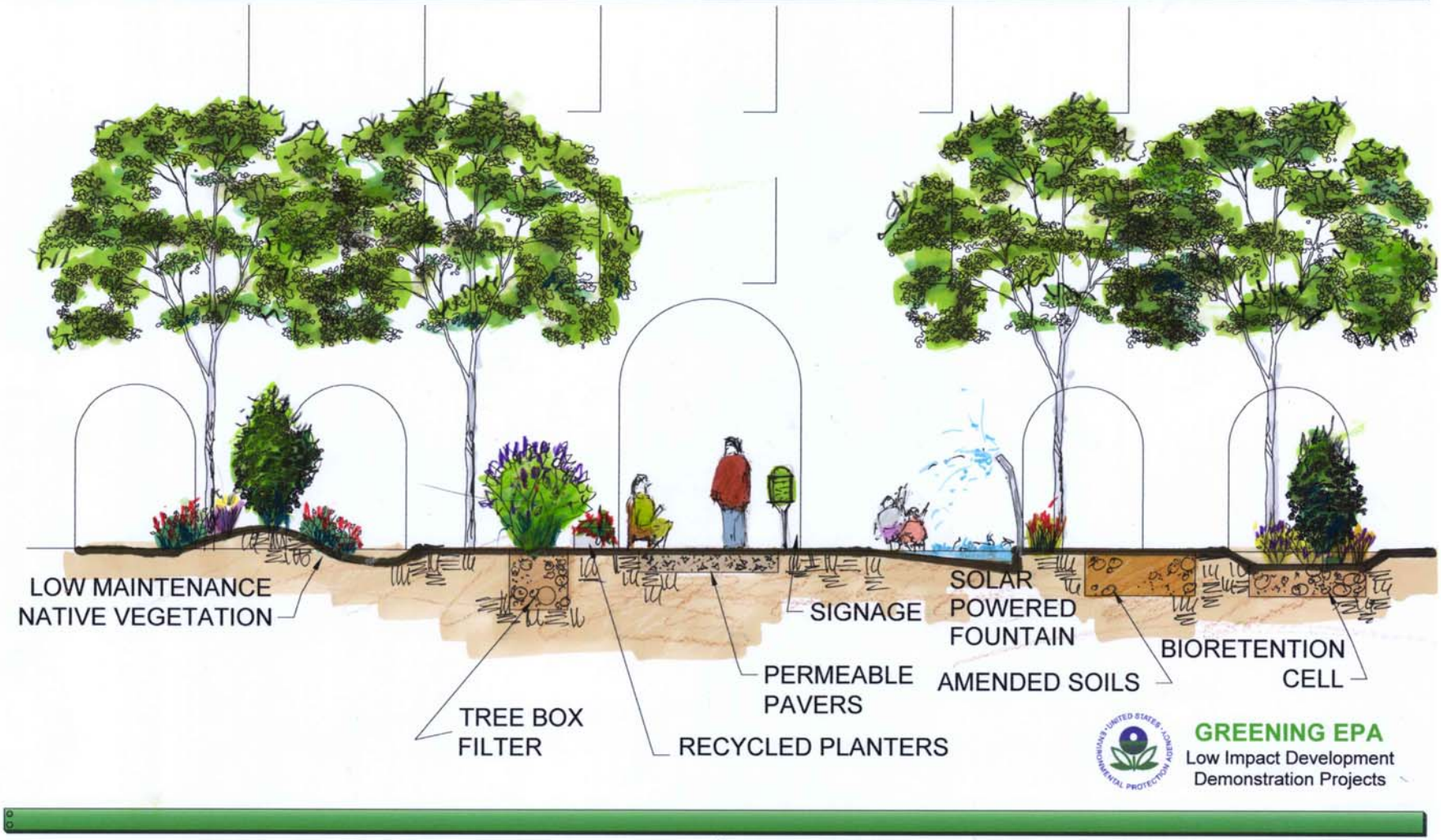
OVERALL CONCEPT PLAN

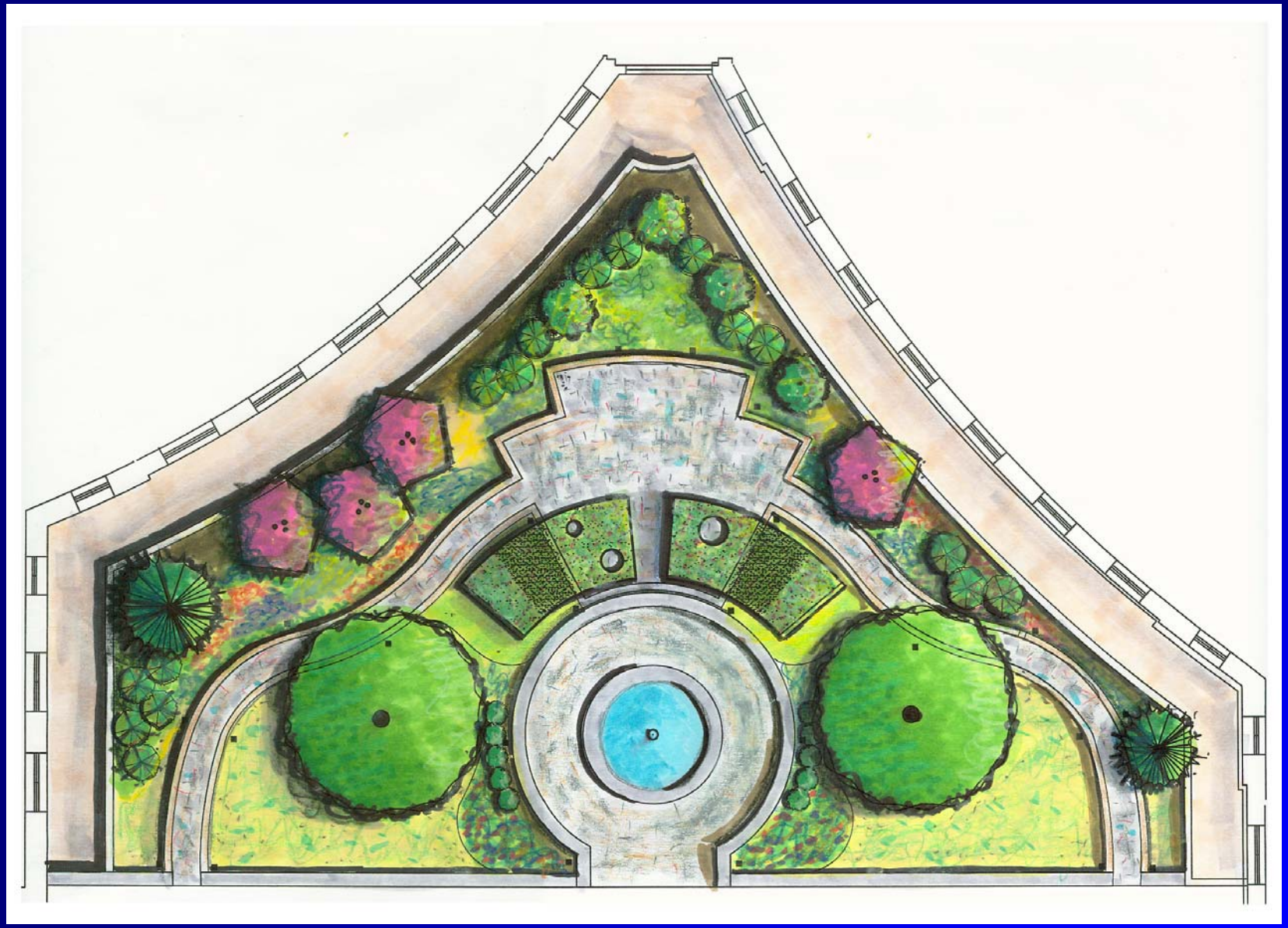
LIST OF POTENTIAL PRACTICES

- BIORETENTION CELLS
- AMENDED SOILS
- STRUCTURAL TREE SOILS
- PERMEABLE PAVERS
- CISTERNS
- LOW MAINTENANCE NATIVE LANDSCAPING
- GREEN ROOF GRIDS
- GREEN ROOFS
- DRIP IRRIGATION
- LANDSCAPE CONTOURING
- SIDEWALK REGRADING
- HIGH EFFICIENCY IRRIGATION
- SOLAR POWERED FOUNTAIN
- INLET INSERTS
- RECYCLED PLANTER BOXES
- RECYCLED BENCHES
- DISCONNECT ROOF LEADERS
- TREE BOX FILTER
- DIVERT STORM DRAINAGE TO LANDSCAPE
- ALTERNATIVE PAVEMENT SURFACES
- EDUCATIONAL SIGNAGE AND EXHIBITS
- MONITORING DEVICES
- STORM DRAIN DIVERSION
- POLLUTION PREVENTION

GREENING EPA
Low Impact Development
Demonstration Projects

FRANKLIN CIRCLE: SECTION VIEW






MAY 29 2001

Increasing Surface Area

Urban Canopy

Weep Wall Filter


NORTHWESTERN HIGH SCHOOL
7000 ADELPHI ROAD

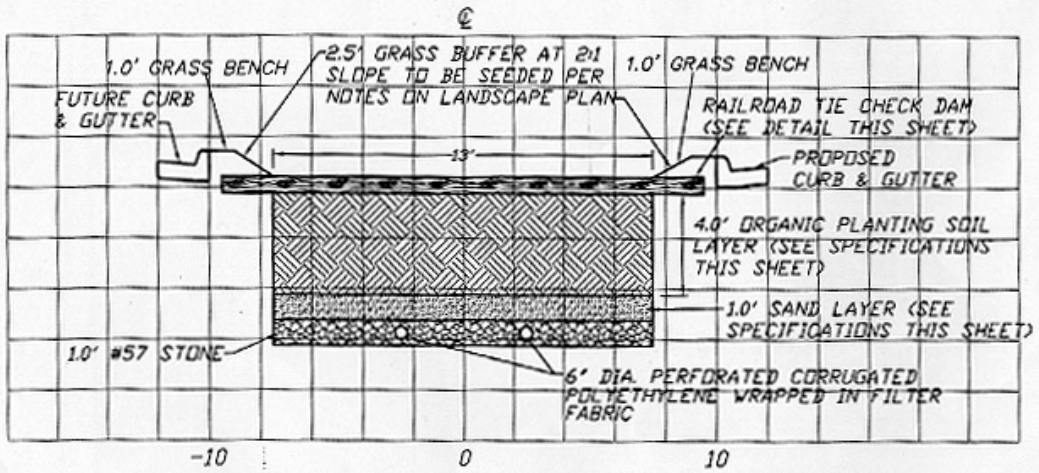
Buckman Heights courtyard with infiltration garden

Plant Density

Plant Location


NOT
TER

UVA Stormwater Group



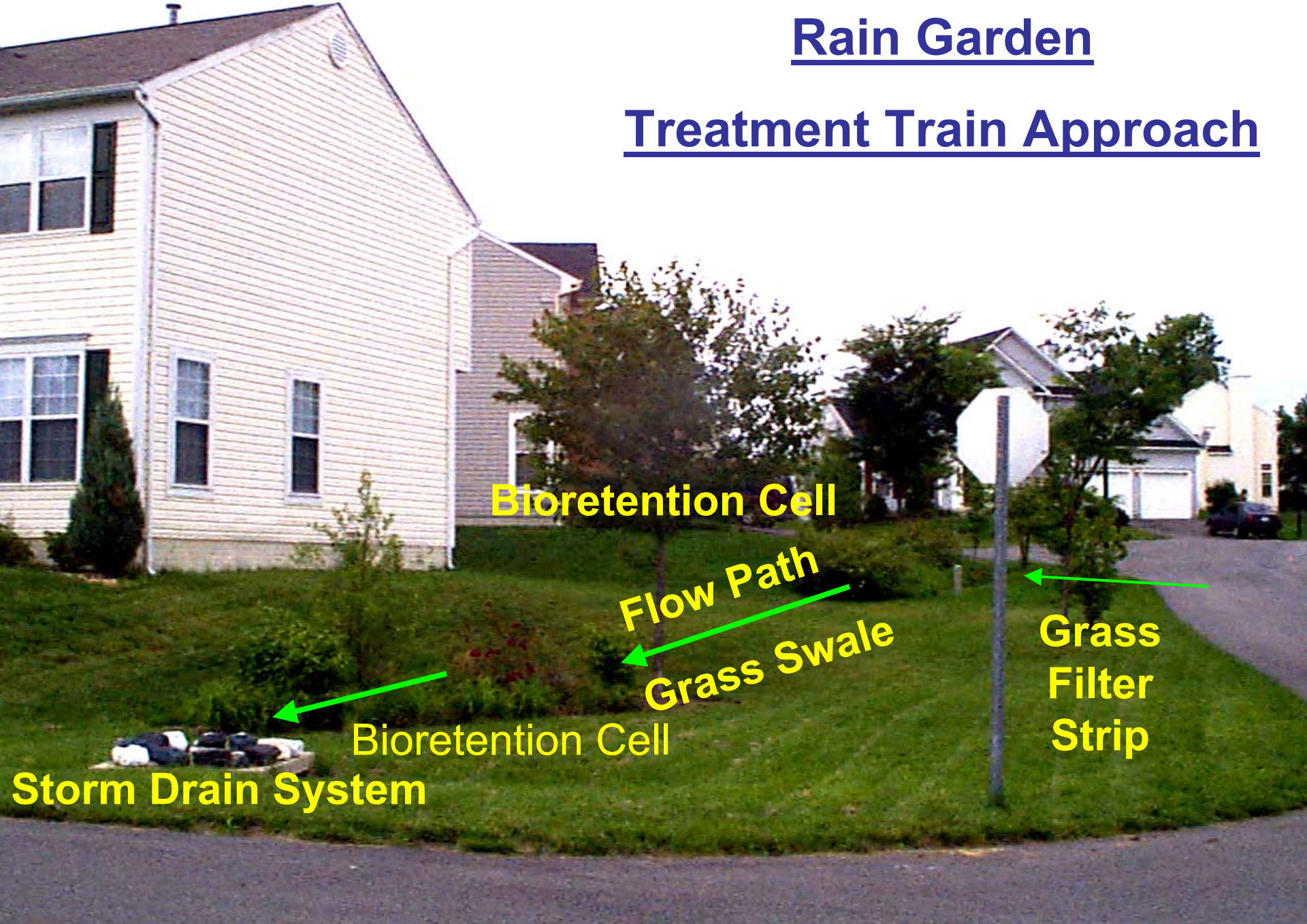
Bioretention

BMP CROSS SECTION (TYPICAL)

Dr. Shaw Yu, Dept. Civil Eng.

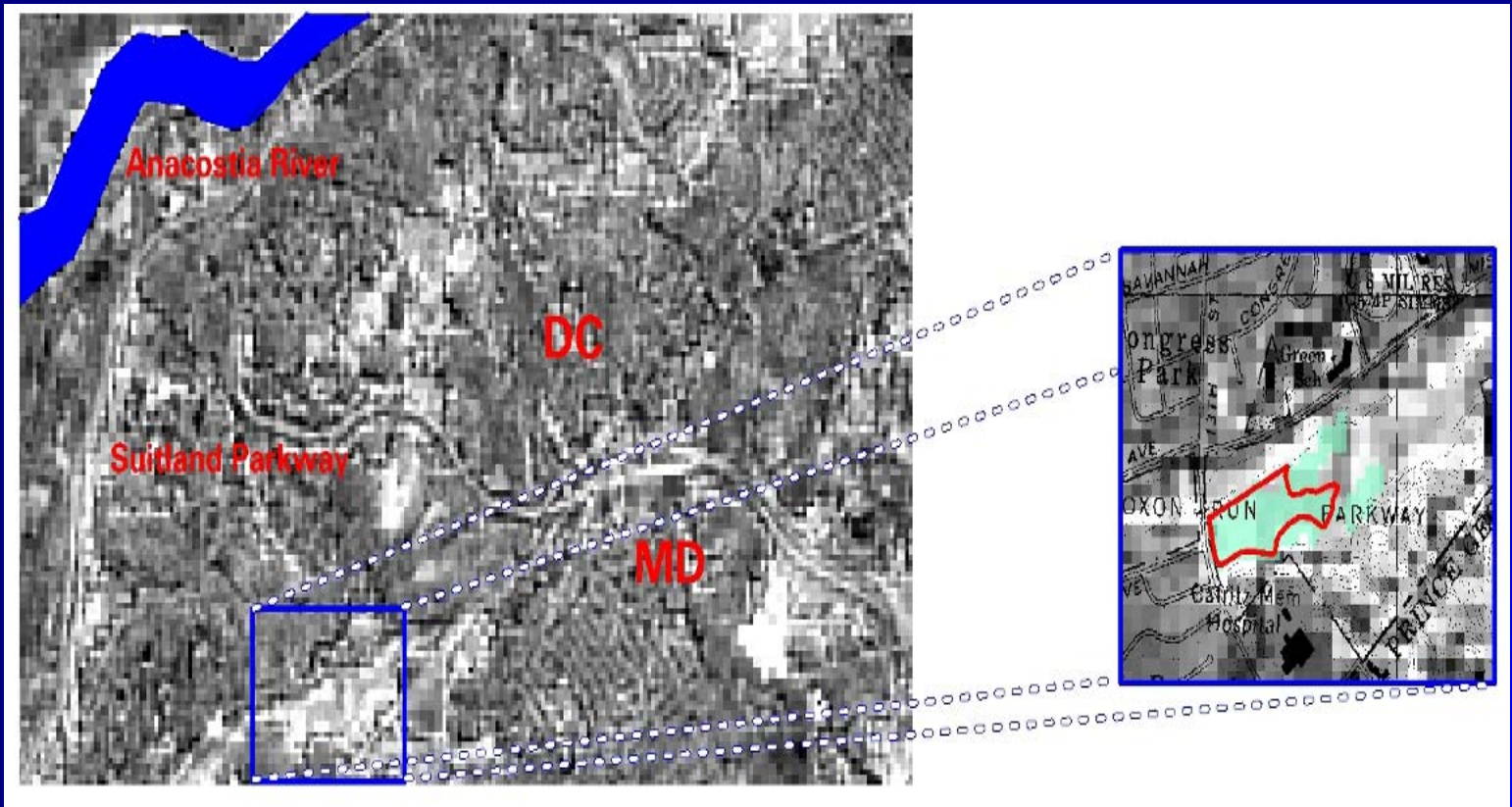
Rain Garden

Treatment Train Approach



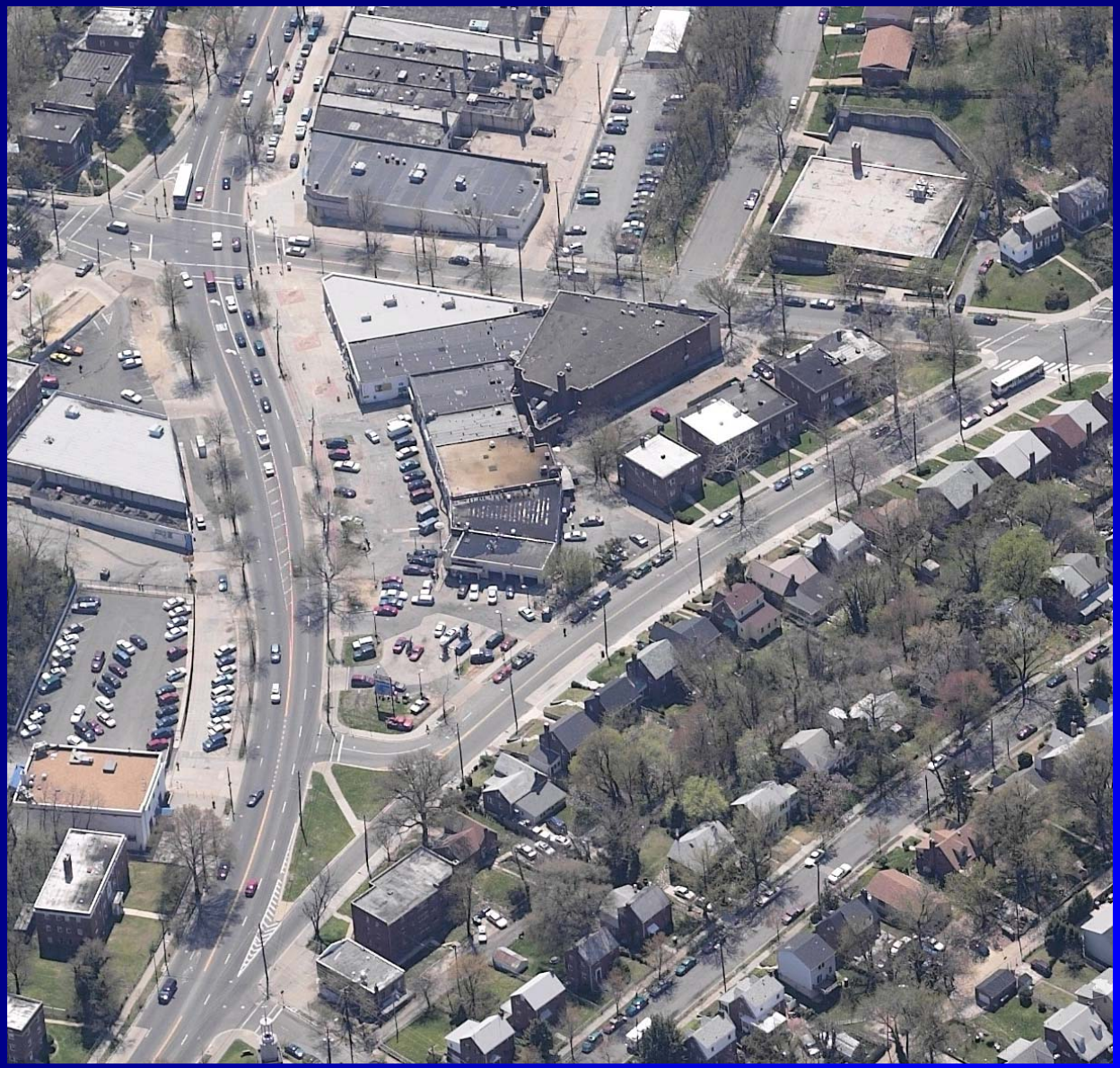

Open Swales
Small Culverts

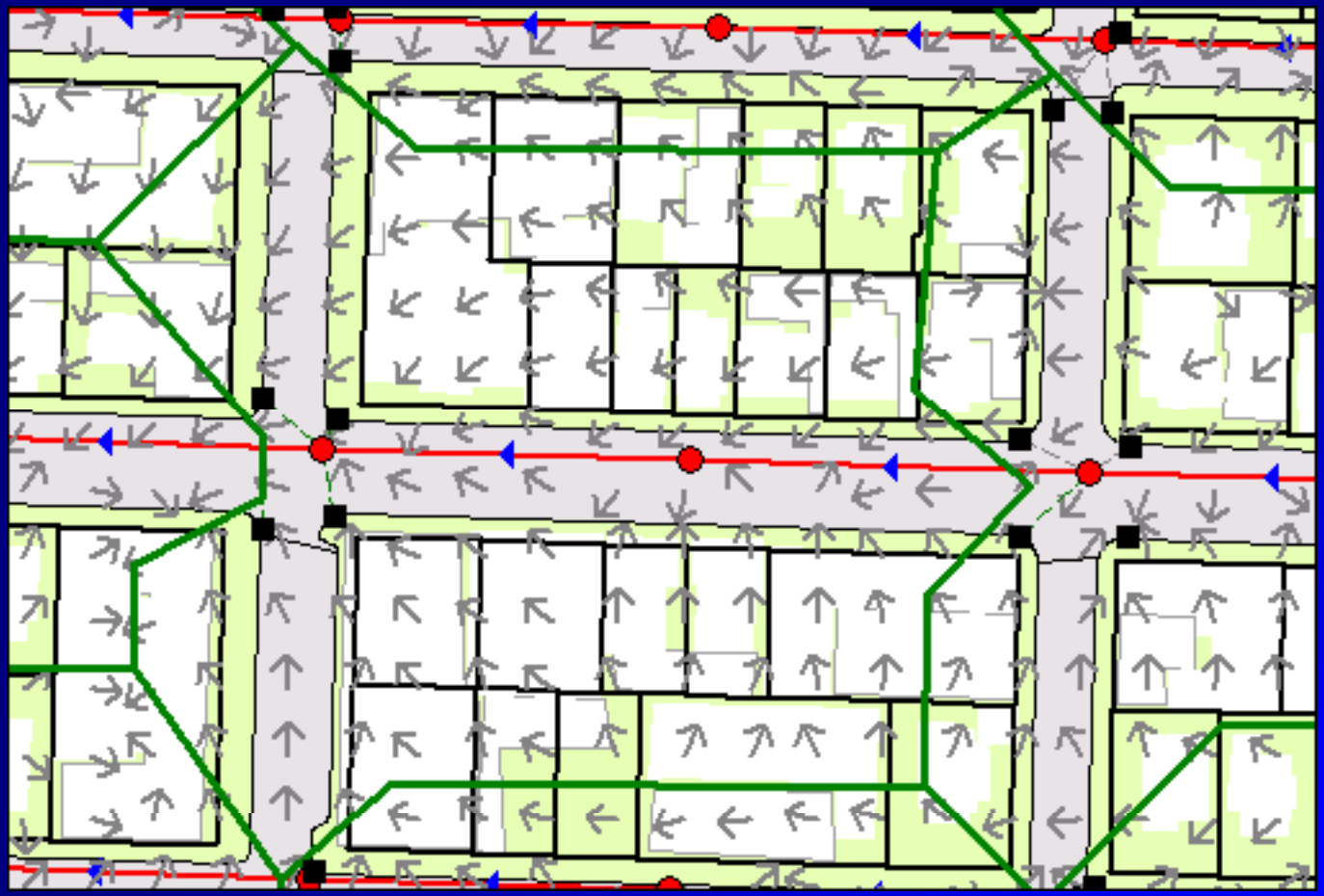
Summerset Subdivision



Soil Moisture Map

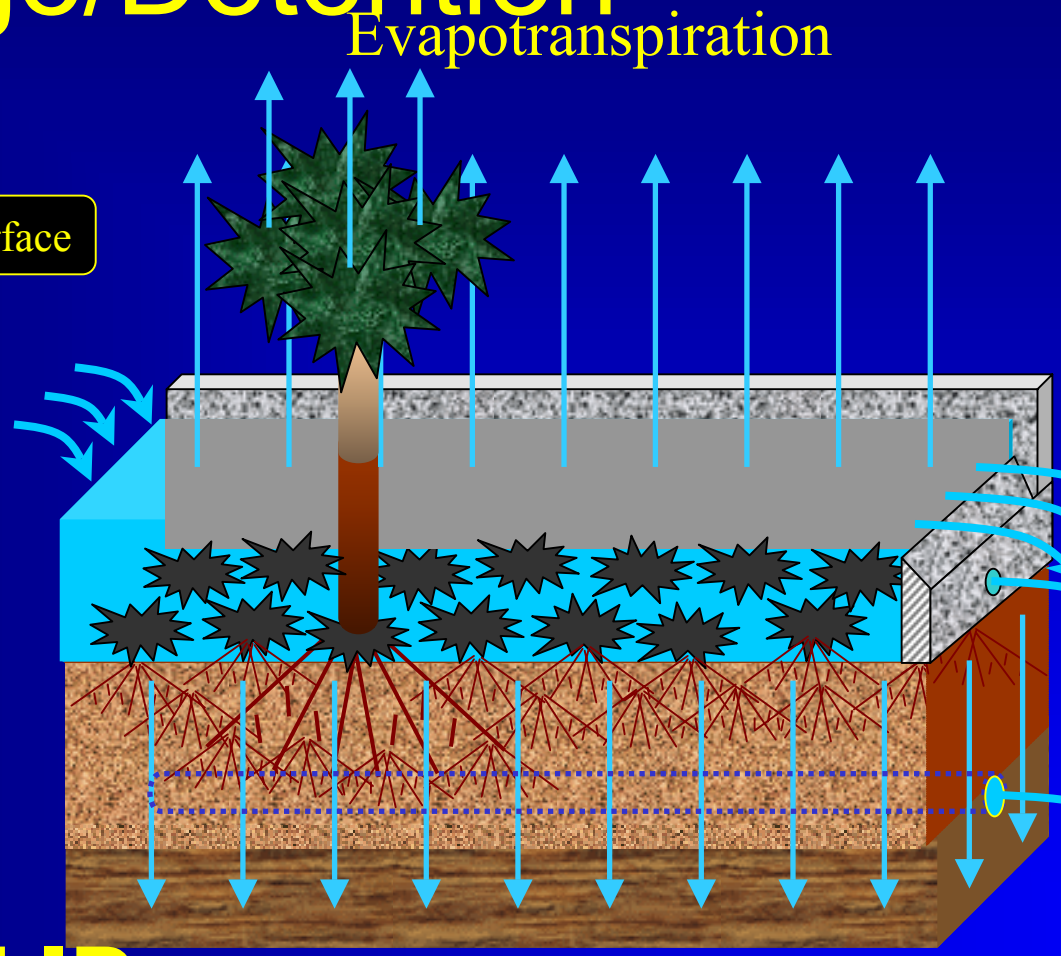
Ground Truthing Image



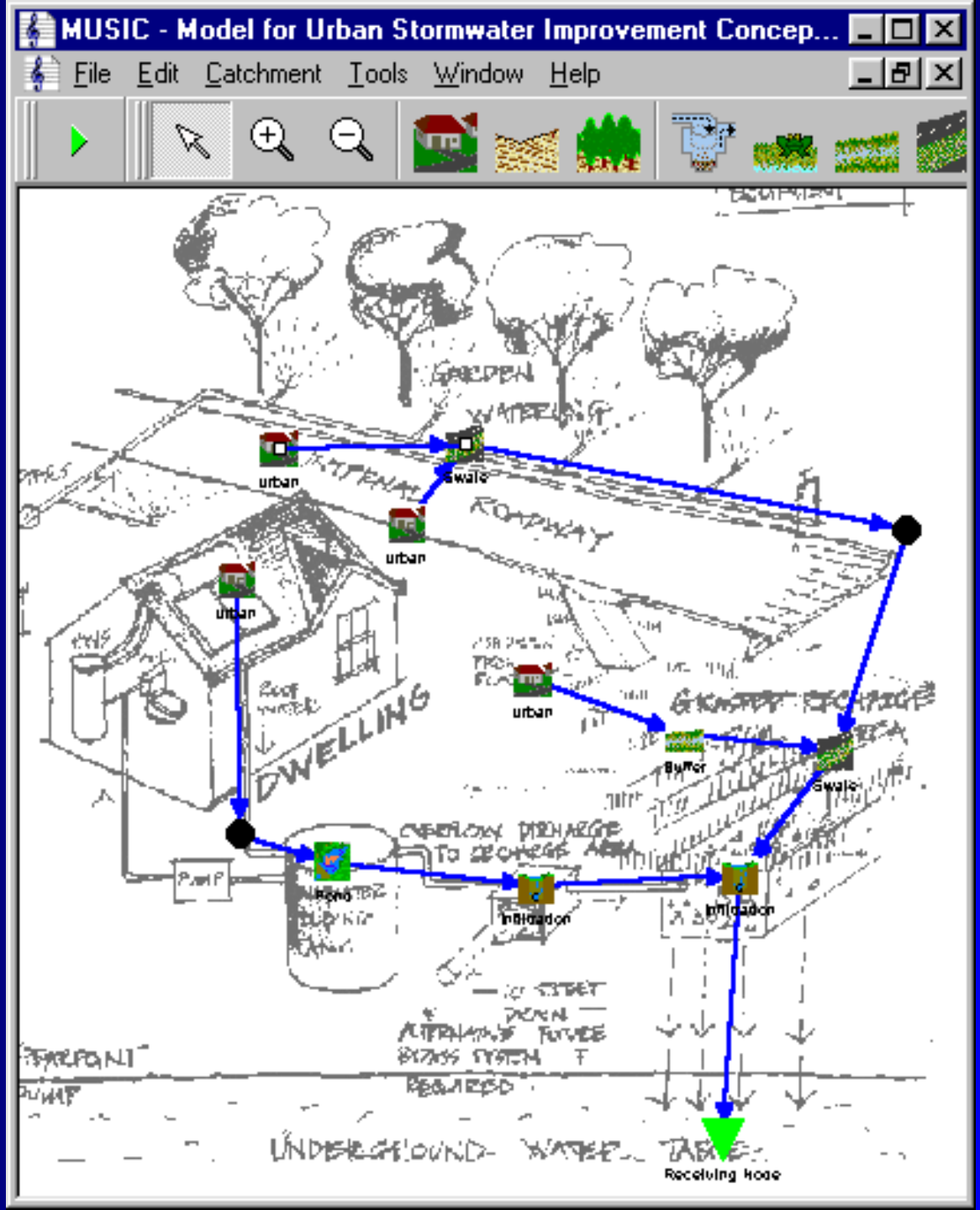


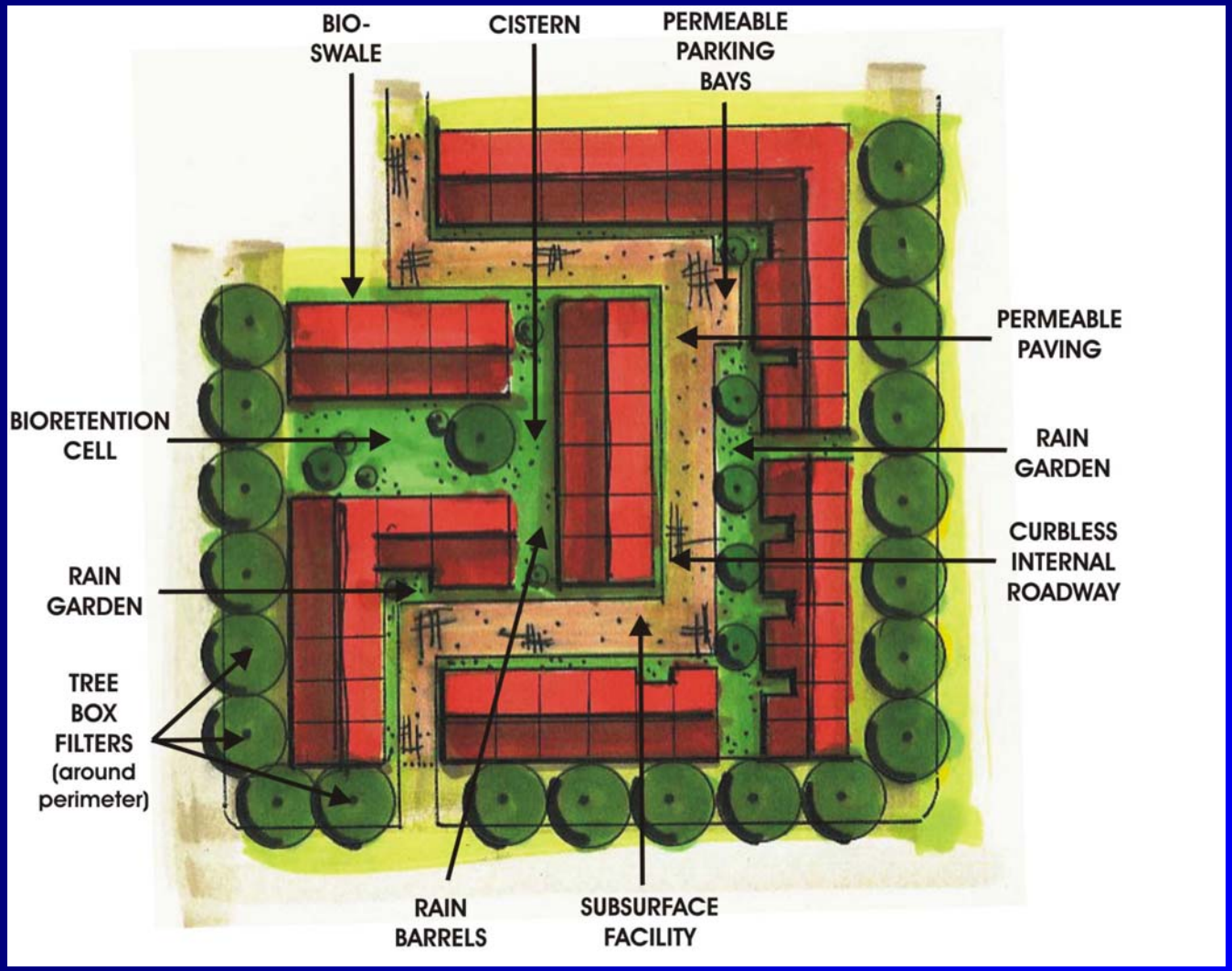
Hoffman and Crawford, 2000

BMP Class A: Storage/Detention



PGDER LID MODEL


MUSIC - Model for Urban Stormwater Improvement Concep...
File Edit Catchment Tools Window Help
urban
Swale
urban
urban
urban
Buffer
Swale
Pond
Infiltration
Infiltration
Receiving Node



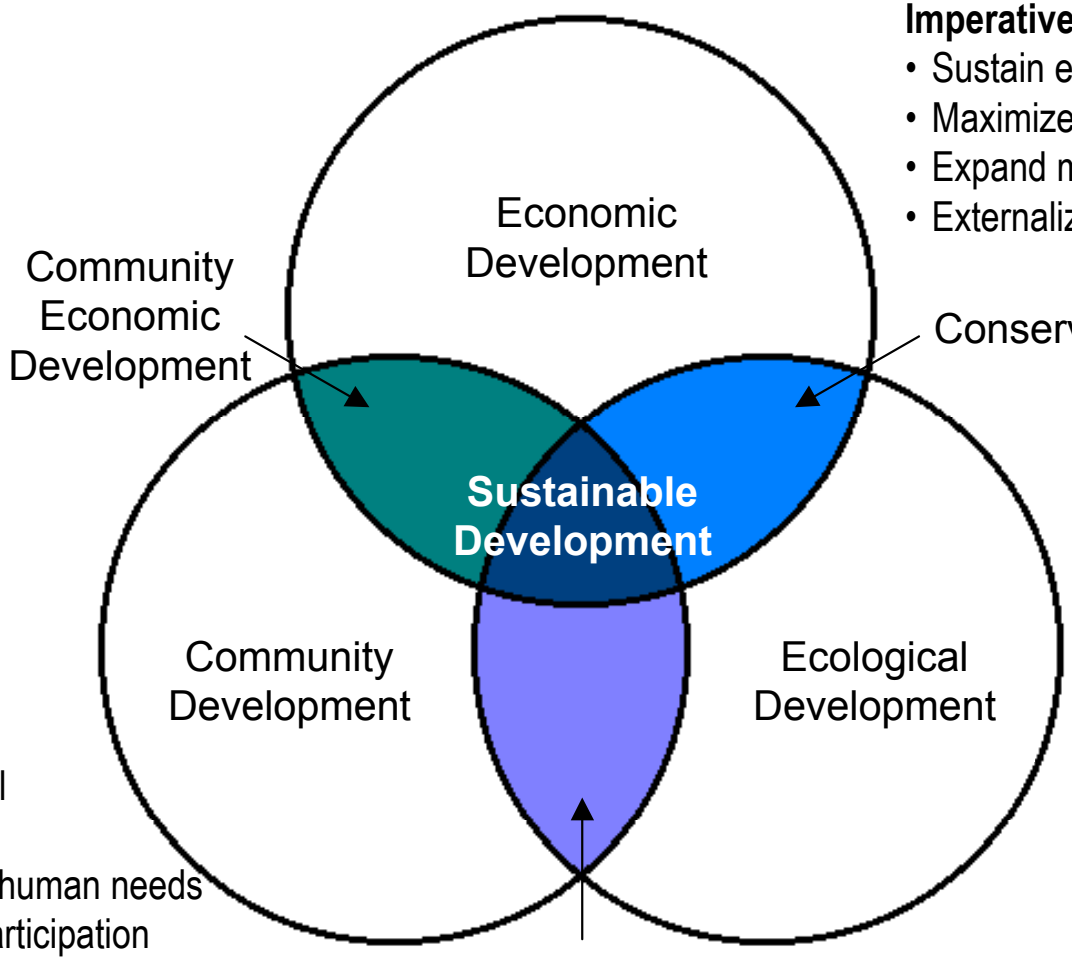
LID Practices (No Limit!)

"Creative Techniques to Treat,Use, Store, Retain, Detain and Recharge"

- Bioretention / Rain Gardens*
- Strategic Grading*
- Site Finger Printing
- Conservation*
- Flatter Wider Swales
- Amended Soils*
- Long Flow Paths
- Tree / Shrub Depression
- Turf Depression
- Landscape Island Storage
- Rooftop Detention /Retention
- Disconnection*
- Parking Lot / Street Storage
- Smaller Culverts, Pipes & Inlets
- Alternative Surfaces
- Reduce Impervious Surface
- Surface Roughness Technology
- Rain Barrels / Cisterns / Water Use*
- Catch Basins / Seepage Pits
- Sidewalk Storage
- Vegetative Swales, Buffers & Strips*
- Infiltration Swales & Trenches
- Eliminate Curb and Gutter
- Shoulder Vegetation
- Maximize Sheet flow
- Maintain Drainage Patterns
- Reforestation……..
- Pollution Prevention……..

New Research Initiatives

- DC LID Master Plan (NFWF Legacy)
- WERF Decentralized
- PG LID Model
- NCHRP/NAS LID for Linear Projects
- Navy ESTCP



Imperatives:
- Sustain economic growth
- Maximize private profit
- Expand markets
- Externalize costs

Imperatives:
- Increase local self-reliance
- Satisfy basic human needs
- Guarantee participation and accountability
- Use appropriate technology

Imperatives:
- Respect carrying capacity
- Conserve and recycle resources
- Reduce waste

Courtesy ICLEI, 1999

Stormwater Management!!!