Low Impact Development

"The LID Picture and How to Make it Happen"

October 22, 2003

Environmentally and Economically Sustainable Technology

Water Resources – Why LID?

- Water Supply
- Wastewater
- Stormwater
  - Flood Control
  - Ecological Health
  - Human Use
  - Regulations

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"

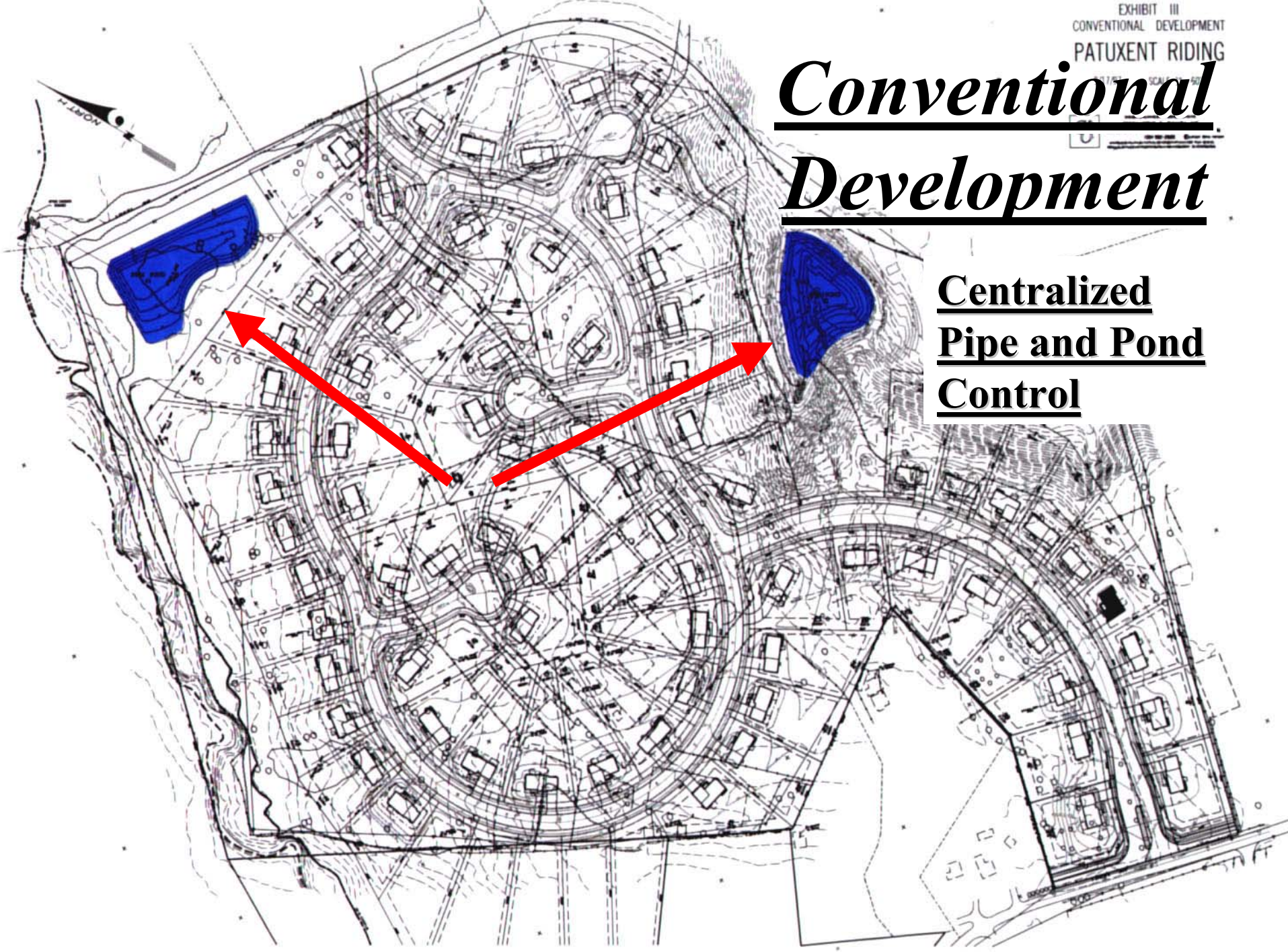
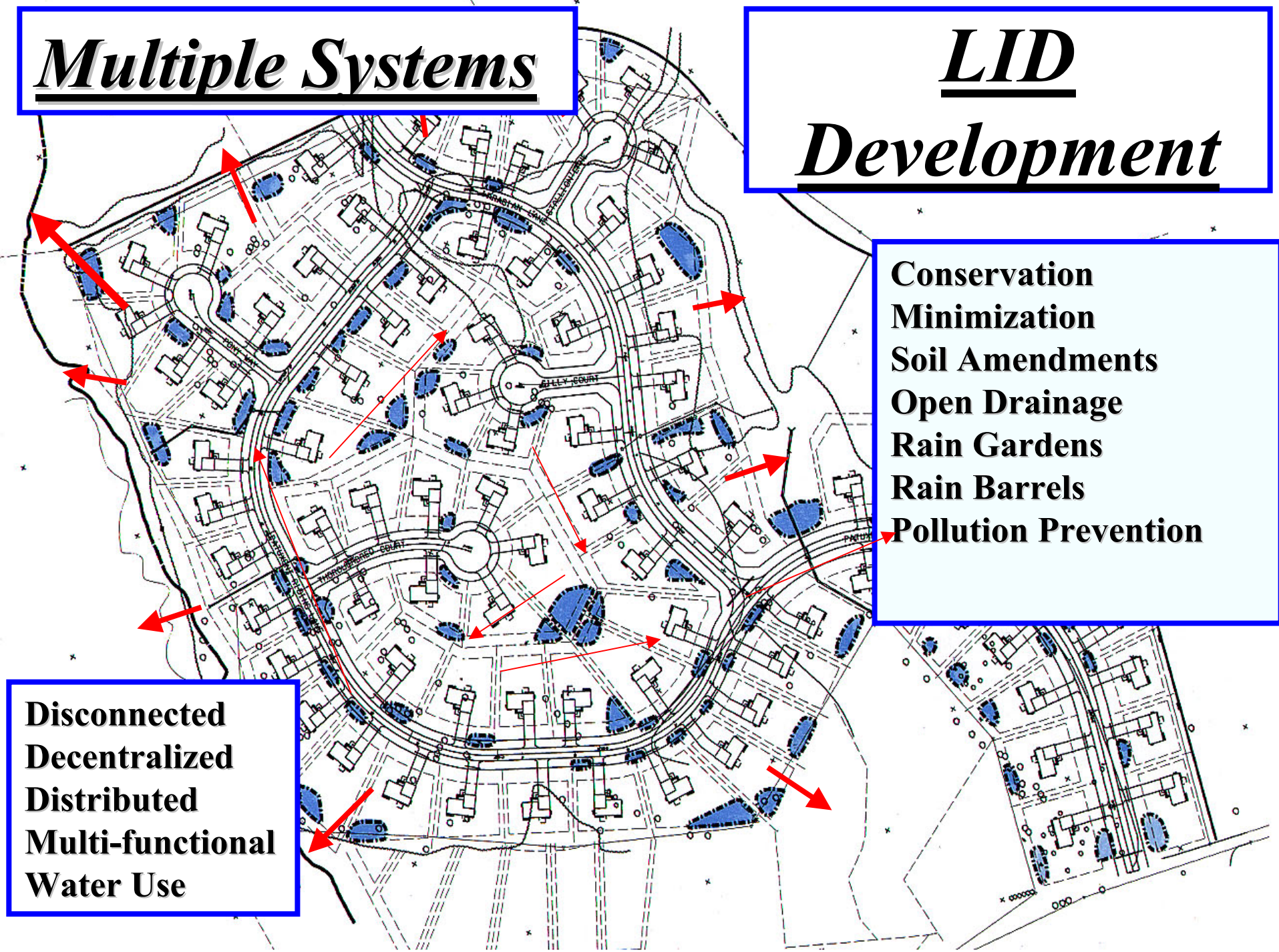


EXHIBIT III
CONVENTIONAL DEVELOPMENT
PATUXENT RIDING
NORTH
Conventional Development
Centralized Pipe and Pond Control

Multiple Systems

LID Development



Conservation
Minimization
Soil Amendments
Open Drainage
Rain Gardens
Rain Barrels
Pollution Prevention

Disconnected
Decentralized
Distributed
Multi-functional
Water Use


Conventional


Low Impact
'96 8


Good Drainage


Functional Lanscape Design

LID – Examples of Where and Who

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

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

Emerging Technology Debate

Centralized

Versus

Decentralized Controls

Important Concepts

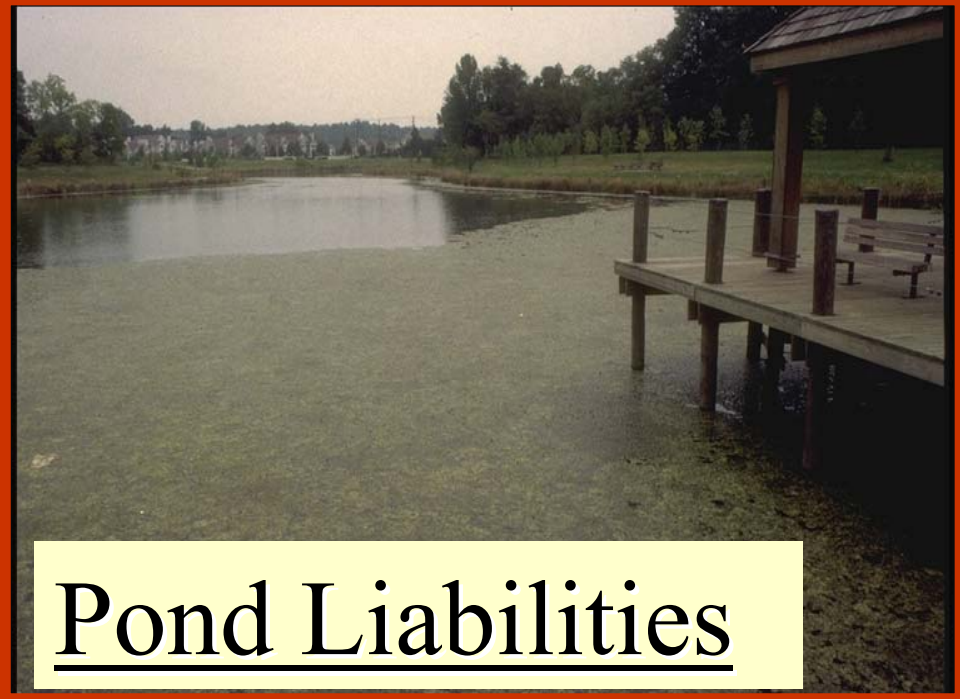
- Terrestrial / aquatic ecosystem linkages
- Ecosystem Functions
- Using Nature to Mitigate Its Own Forces
- Mimic the water balance
- Hydrology as an organizing principle
- Multiple Systems
- Volume / Frequency / Timing
- Ecological functions of the built environment

Paradigms Shifts

- Watersheds to **Ecosystems**
- Flow Centric to **Volume Centric**
- Centralized Control to **Decentralized Control**
- Uni-functional to **Multifunctional**
- Impact Reduction to **Functional Restoration**
- Good Drainage to **Functional Drainage**
- One Size Fits All to **Unique Ecosystem Design**

Limitations of Conventional Stormwater Approaches

- Economics
  - Cost of Maintaining a Growing / Aging Infrastructure
- New Objectives (Public Health / Ecological)
  - Source Water, CSO's, Living Resources / Streams
  - Regulations
    - NPDES / TMDL's / ESA



Limitations

- Safety / Health
- Inspection / Maintenance
- Inefficient Pollutant Removal
- Temp / Sediment / Frequency / Volume

Limitations of Conventional Stormwater Approaches

- Technology Gaps
  - Cumulative impacts
  - Not an anti-degradation strategy
  - Allows hydrodynamic modifications
  - Allows continued stream degradation
  - Limited use for urban retrofit
  - Unsustainable maintenance burdens


Issues
West Nile Virus
Safety
Maintenance

Your understanding of the state of technology is key to:

- Setting Goals
- Prioritizing protection / restoration strategies
- Determining cost of protection programs
- Promoting / discouraging development

"Technology can be Apolitical"

LID Basics

Principles
and
Practices

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

How Does LID Maintain or Restore The Hydrologic Regime?

- **Creative ways to:**
  - **Maintain / Restore Storage Volume**
    - **interception, depression, channel**
  - **Maintain / Restore Infiltration Volume**
  - **Maintain / Restore Evaporation Volume**
  - **Maintain / Restore Runoff Volume**
  - **Maintain Flow Paths**
- **Engineer a site to mimic the natural water cycle functions / relationships**

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

Defining LID Technology

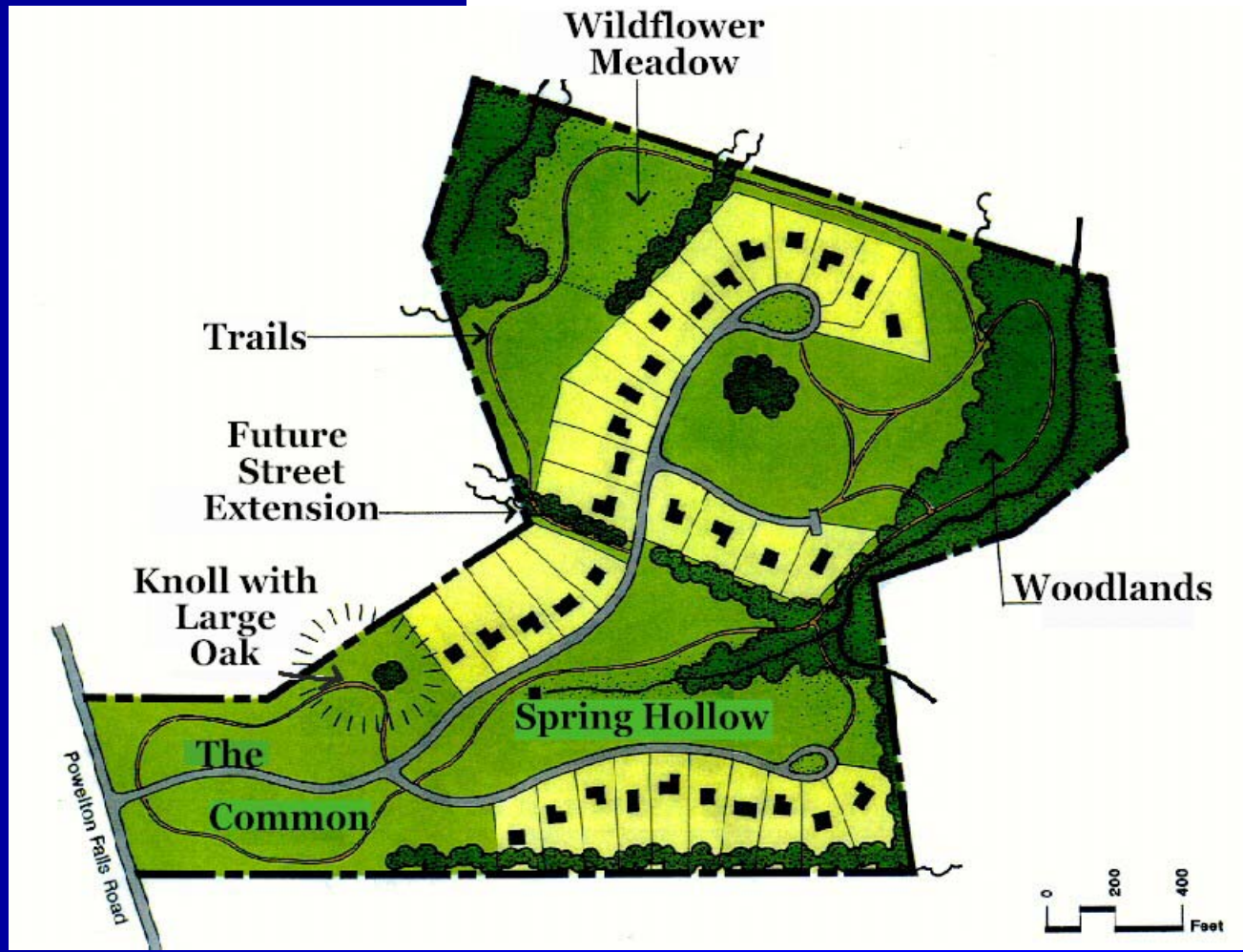
Major Components

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. Conservation Plans / Regulations

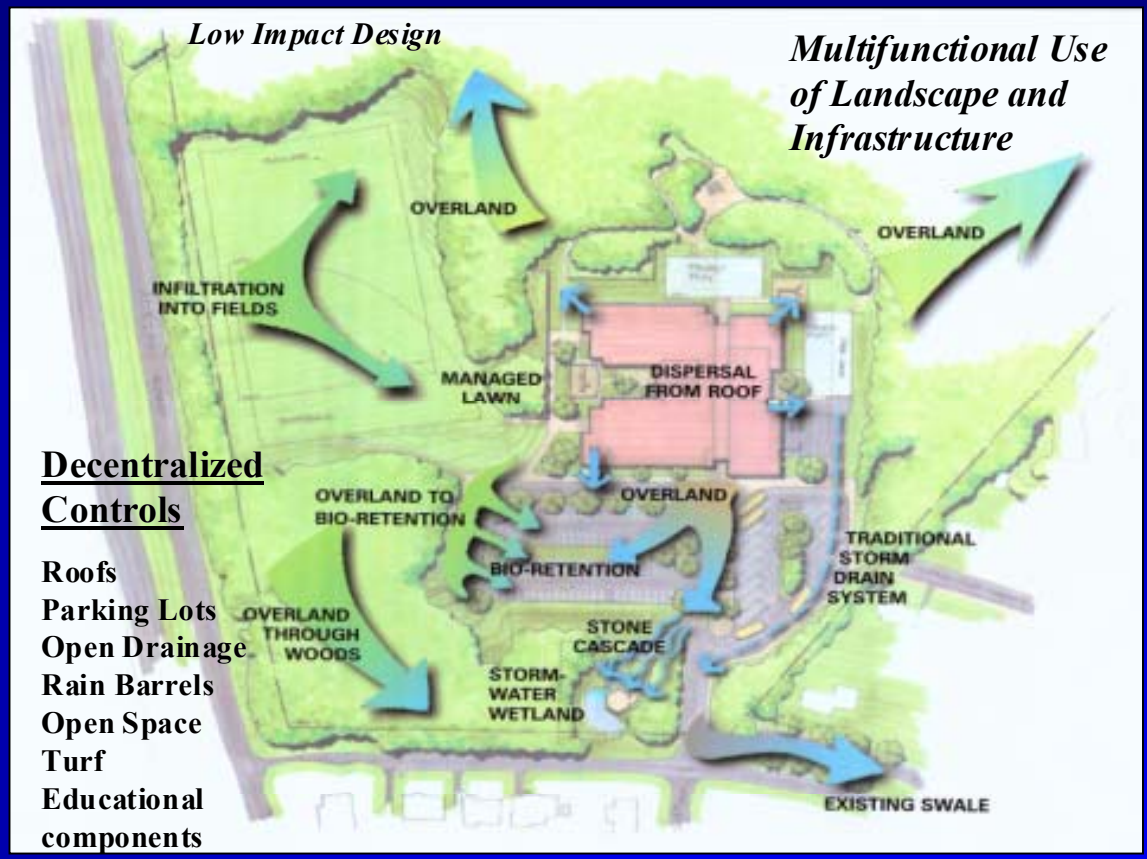
- **Local Watershed and Conservation Plans**
  - Forest (Contiguous and Interior Habitat)
  - Streams (Corridors)
  - Wetlands
  - Habitats
  - Step Slopes
  - Buffers
  - Critical Areas
  - Parks
  - Scenic Areas
  - Trails
  - Shorelines
  - Difficult Soils
  - Ag Lands
  - Minerals

Large and Small Scale



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

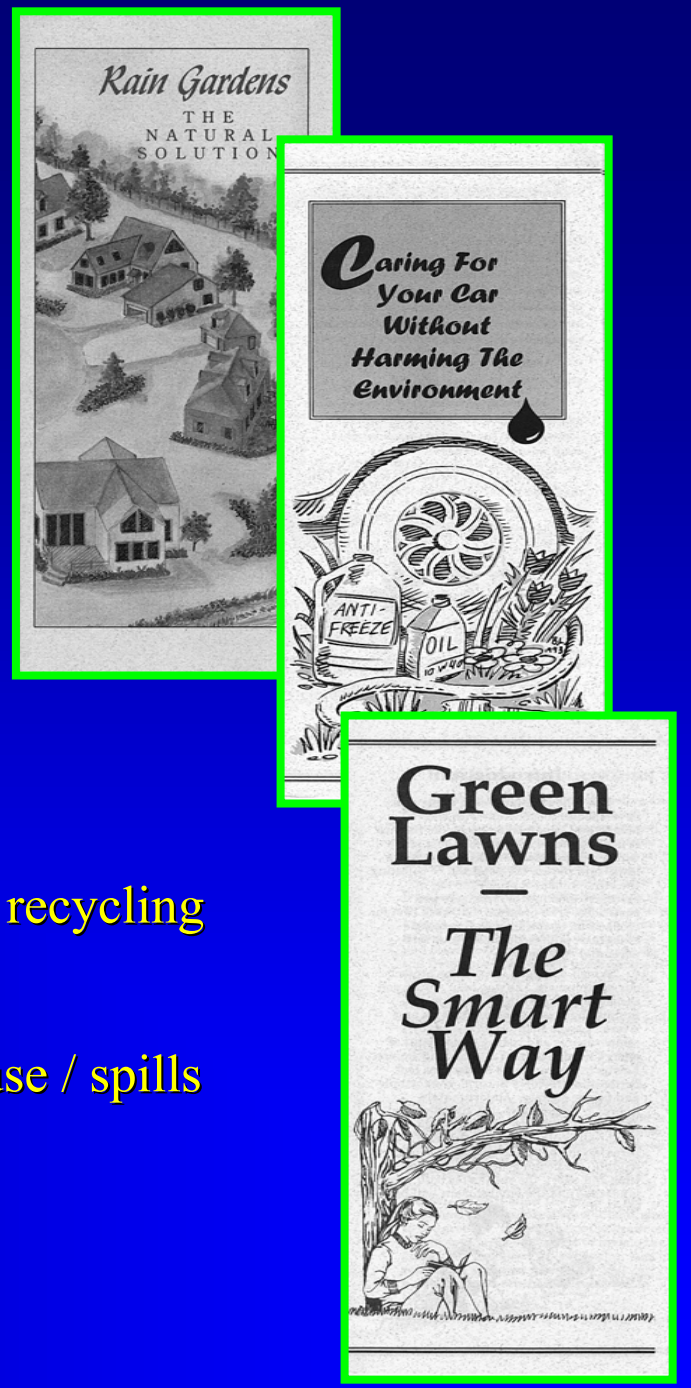
4. Storage, Detention & Filtration
"LID IMP's"

- 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

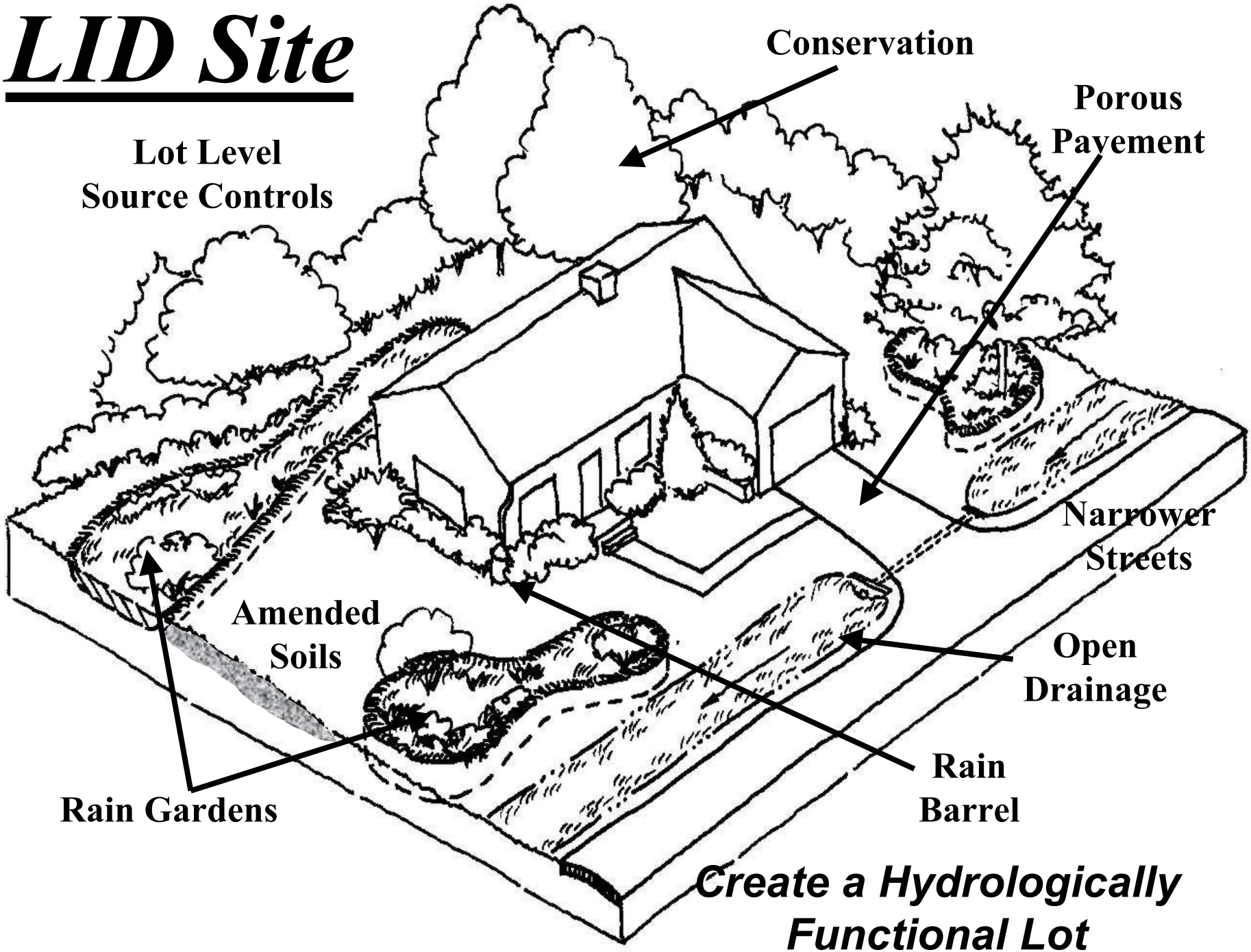
30 - 40% Reduction in N&P

Kettering Demonstration Project



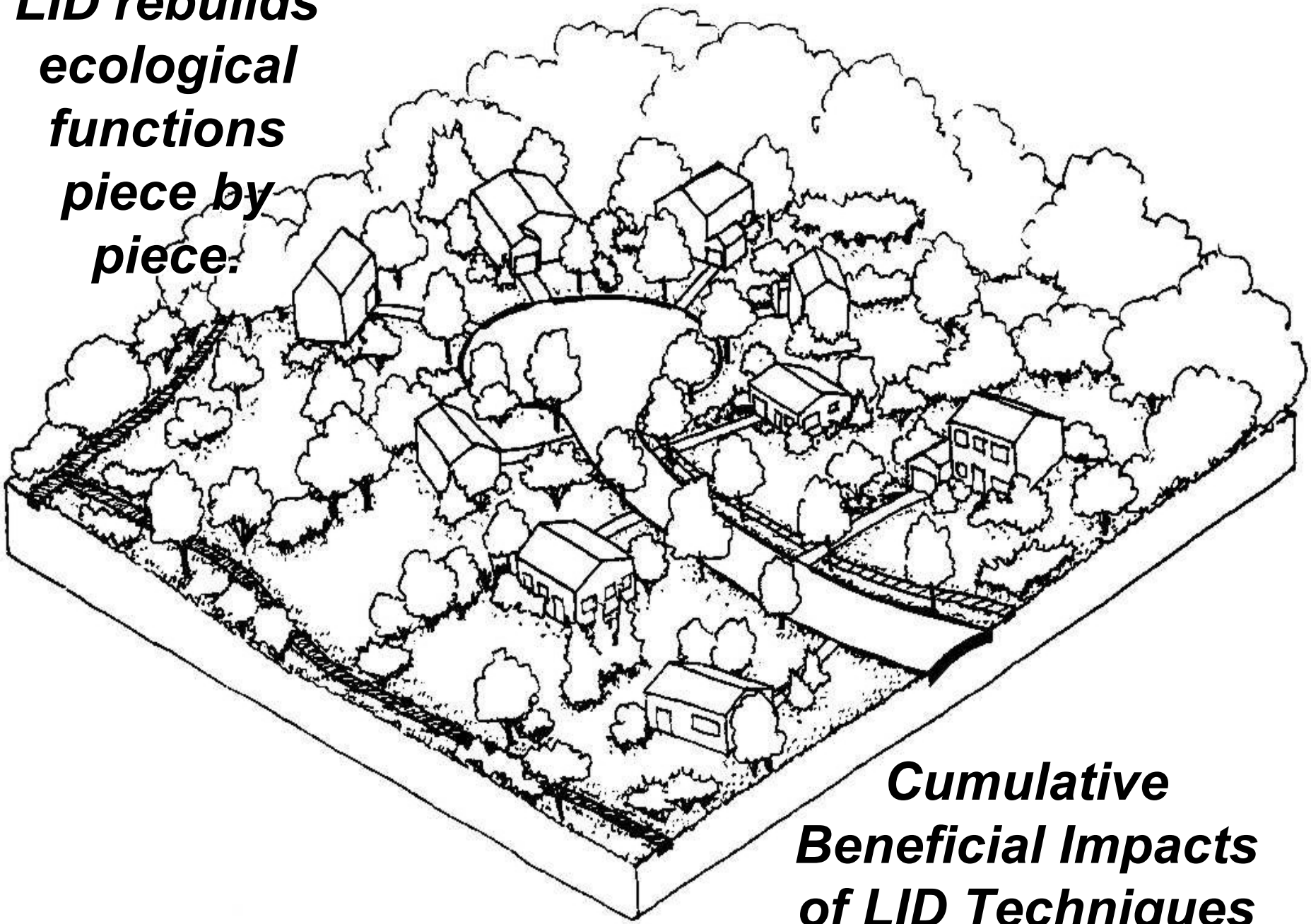
- Maintenance
- Proper use, handling and disposal
  - Individuals
    - Lawn / car / hazardous wastes / reporting / recycling
  - Industry
    - Good house keeping / proper disposal / reuse / spills
  - Business
    - Alternative products / Product liability

LID Site



Create a Hydrologically Functional Lot

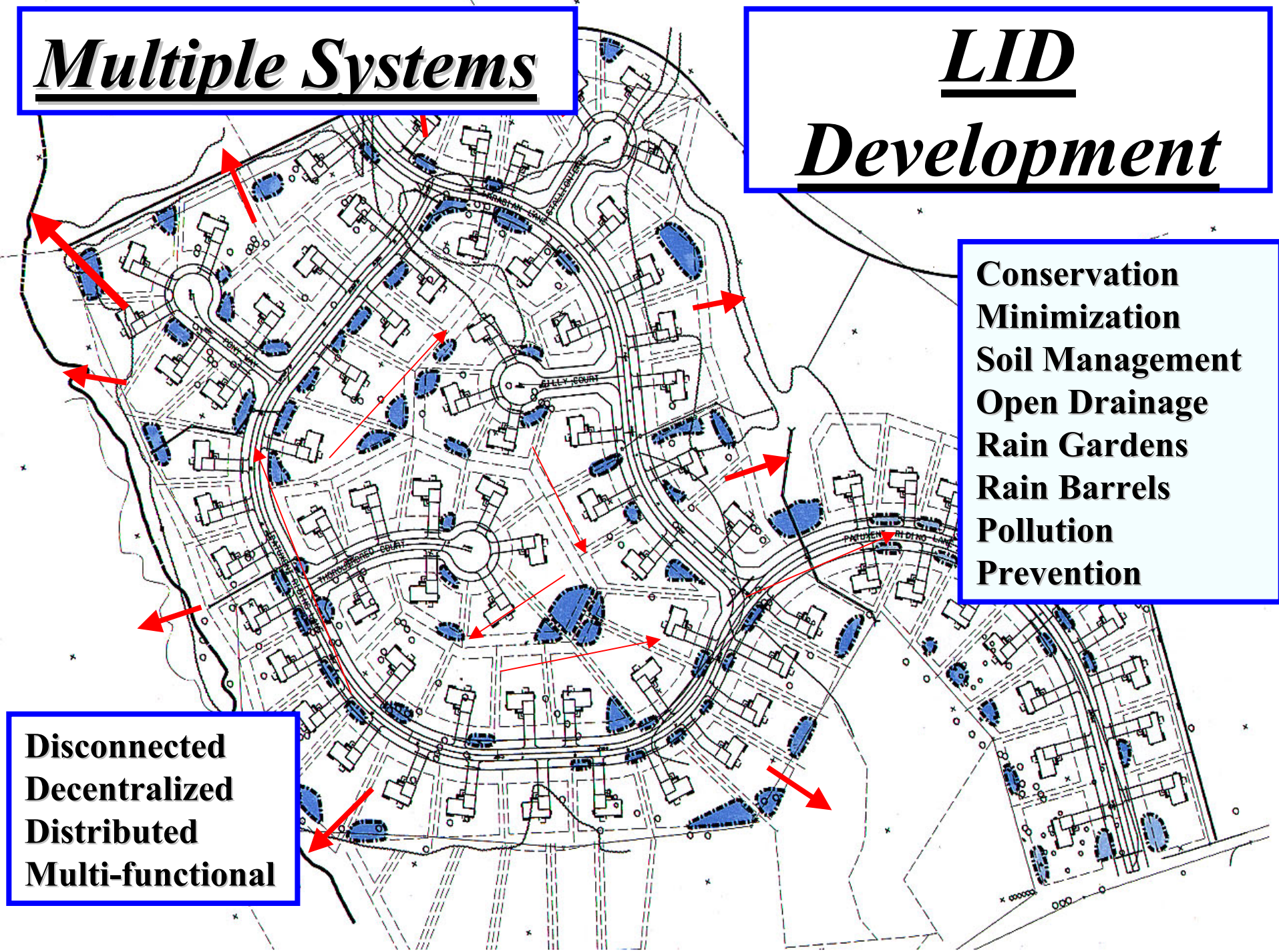
LID rebuilds ecological functions piece by piece.



Cumulative Beneficial Impacts of LID Techniques

Multiple Systems

LID Development



Conservation
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Pollution
Prevention

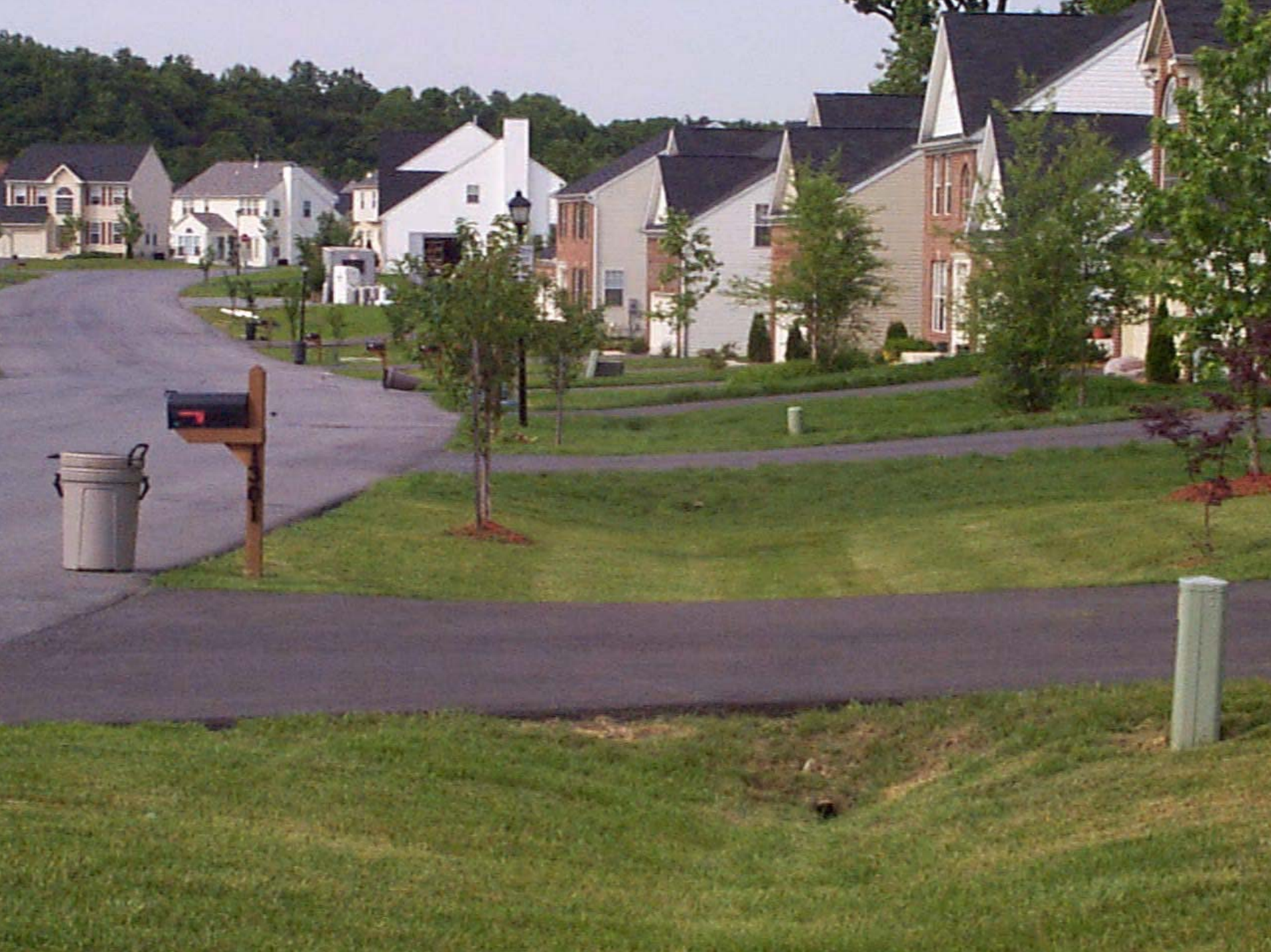
Disconnected
Decentralized
Distributed
Multi-functional

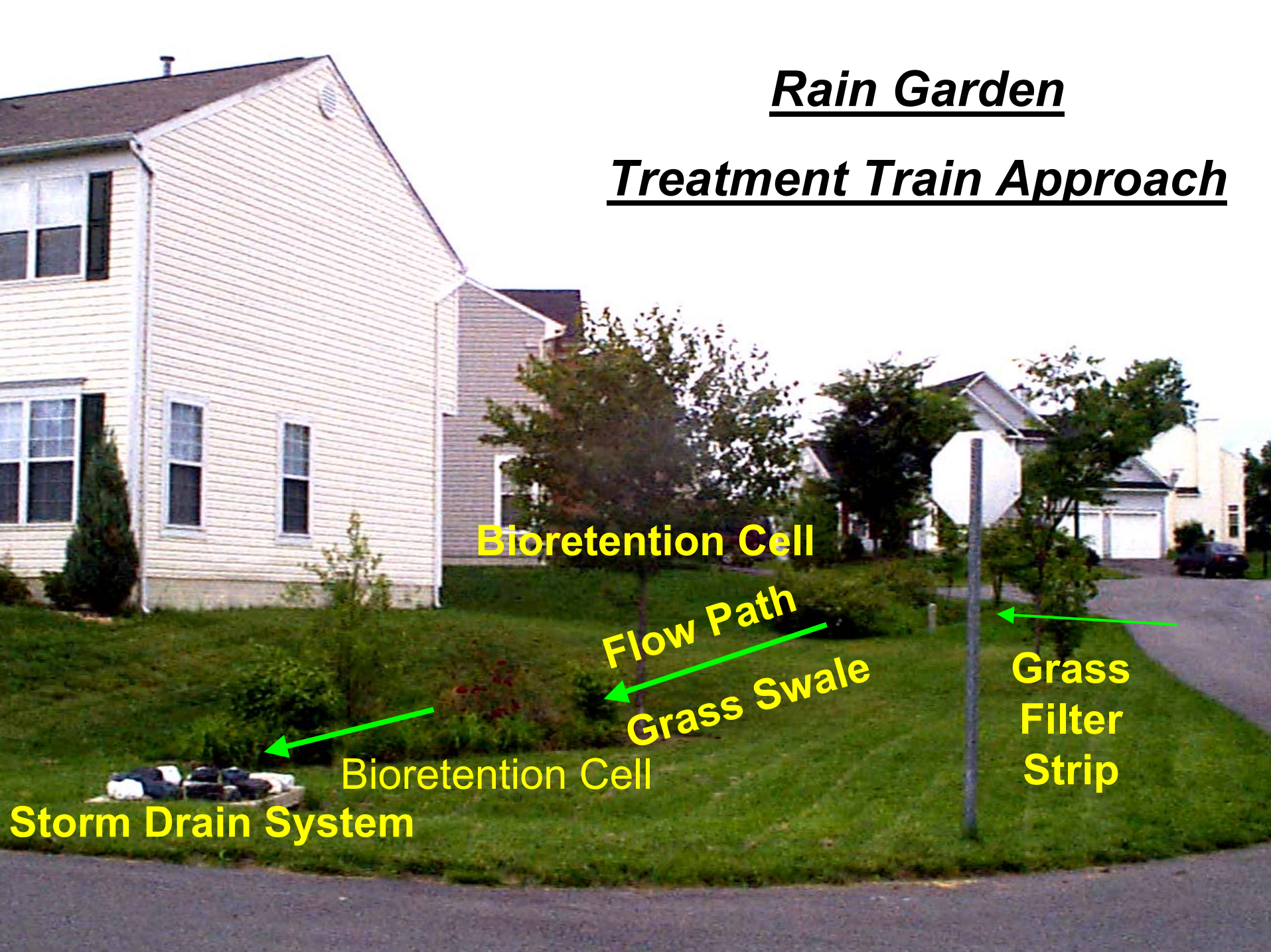
Construction Cost Comparison

	Conventional	Low Impact
Grading/Roads	**$569,698**	**$426,575**
Storm Drains	**$225,721**	**$132,558**
SWM Pond/Fees	**$260,858**	**$ 10,530**
Bioretention/Micro	**—**	**$175,000**
Total	$1,086,277	$744,663
Unit Cost	$14,679	$9,193
Lot Yield	74	81

Rain Gardens

Typical Landscape Maintenance Practices

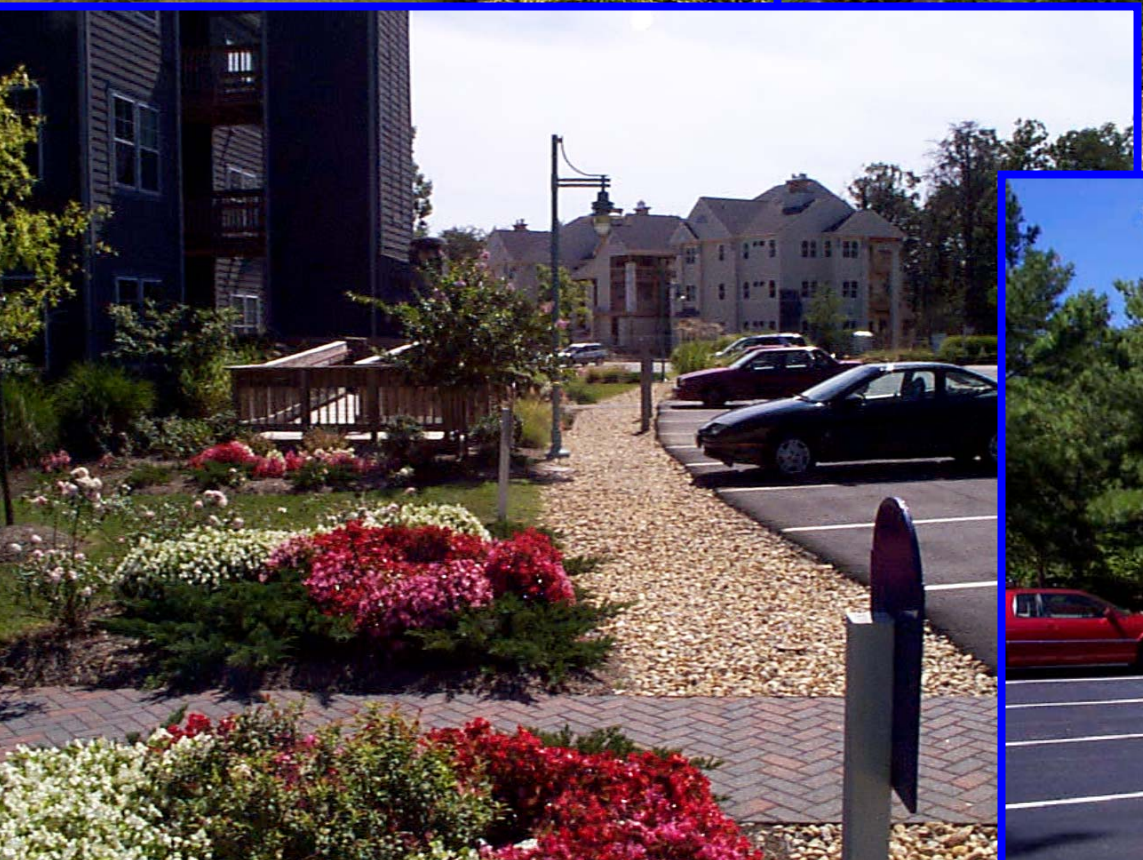


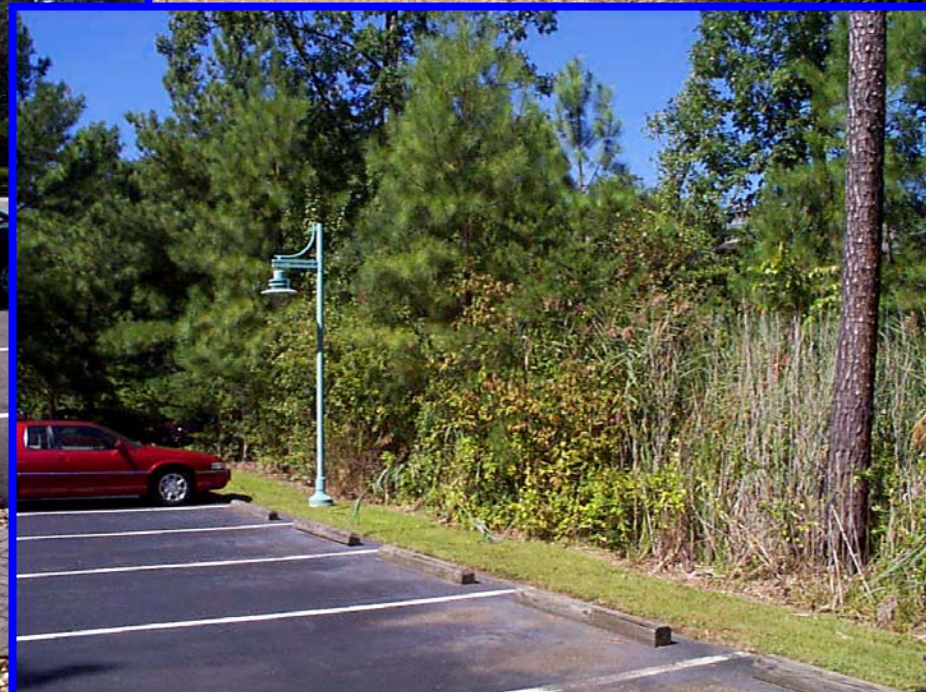

Rain Garden
Treatment Train Approach
Bioretention Cell
Flow Path
Grass Swale
Grass
Filter
Strip
Bioretention Cell
Storm Drain System


SPEED LIMIT
25

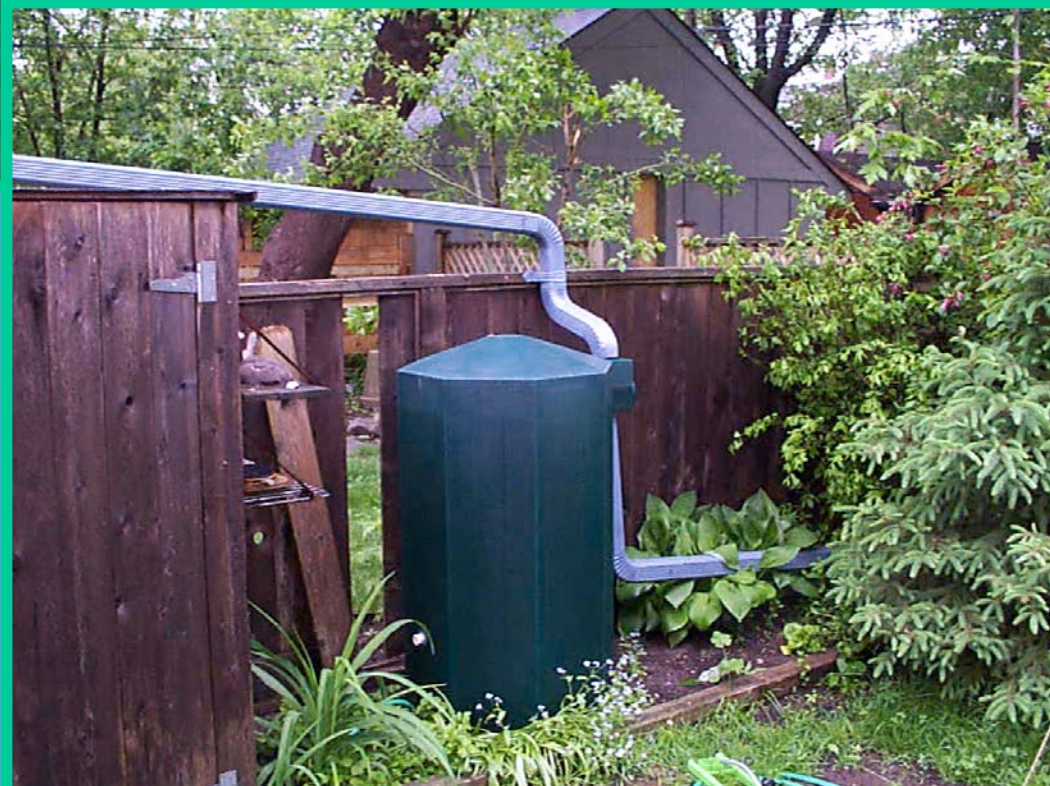
VIEW OF LOT WITH STORAGE AND BIORETENTION


SOLOMON'S
LANDING





Total Water Management



Runoff Use

Consumption Reduction

Save $100 / yr.


Caring For Your Car Without Harming The Environment
ANTI-FREEZE
OIL
Rain Gardens
THE NATURAL SOLUTION
Green Lawns
—
The Smart Way
pollution prevention
it's everyone's business


ANTIFREEZE


LITTER

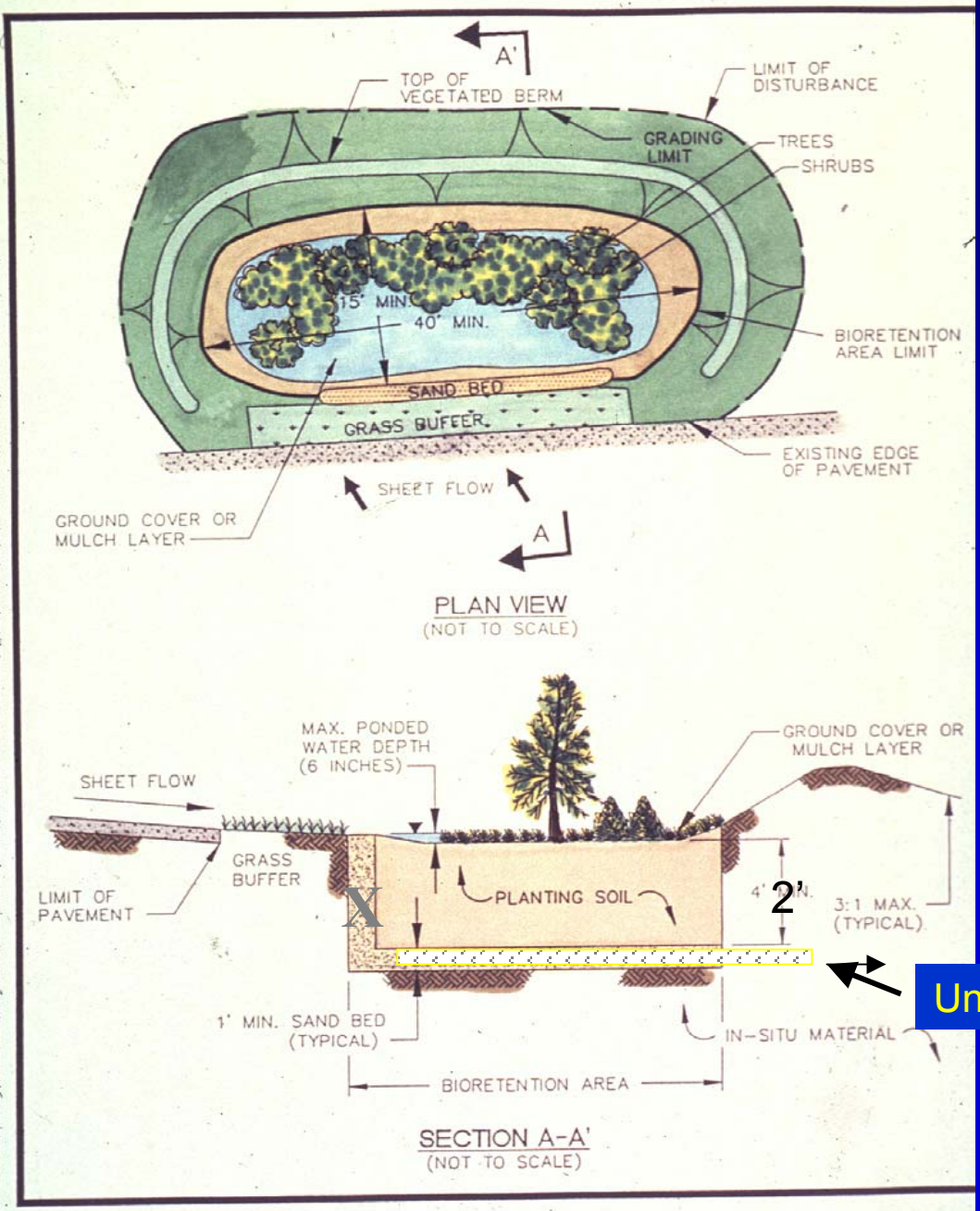

Corbis.com

What is Bioretention?

"Filtering stormwater runoff through a terrestrial aerobic (upland) plant / soil / microbe complex to remove pollutants through a variety of physical, chemical and biological processes."

The word "bioretention" was derived from the fact that the biomass of the plant / microbe (flora and fauna) complex retains or uptakes many of the pollutants of concern such as N, P and heavy metals.

It is the optimization and combination of bioretention, biodegradation, physical and chemical that makes this system the most efficient of all BMP's



PARKING EDGE AND PERIMETER WITHOUT CURB

Bioretention

- Shallow Ponding - 4" to 6"
- Soil Depth 2' - 2.5'
- Sandy Top Soil
  - 65% Sand
  - 20% Sandy Loam
  - 15% Compost
- Under Drain System
- Plant Selection

Under Drain

Aesthetic Value / Habitat Value

Property Value / Low Cost

Low Maintenance

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……..

Low-Impact Development Hydrologic Analysis and Design

- Based on NRCS technology, can be applied nationally
- Analysis components use same methods as NRCS
- Designed to meet both storm water quality and quantity requirements


Urban Development
Washington D.C.
Potomac River
Anacostia River

LID Urban Retrofit

"First Define Your Goals!"

Water Quality

Water Supply

Fisheries

Recreational Use

ESA

CSO

Flood Control

Urban LID Lot Level Control Opportunities

- Roofs
- Buildings
- Down Spouts
- Yards
- Sidewalks
- Parking Lots
- Landscape Areas
- Open space
- Amended Soils

Multifunctional Infrastructure

Retention

Detention

Filtration

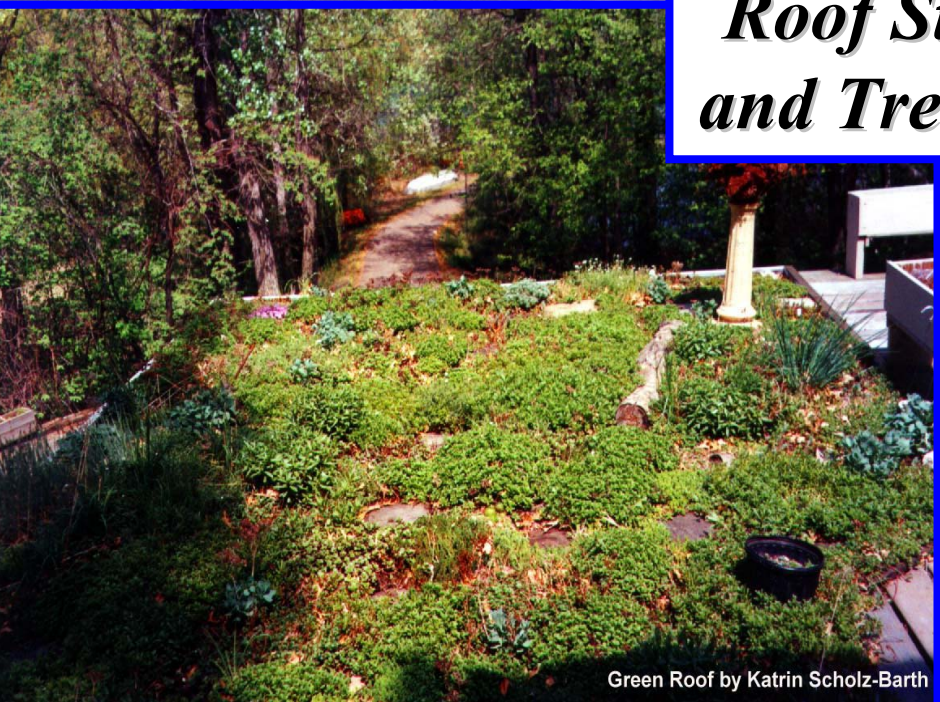
Infiltration

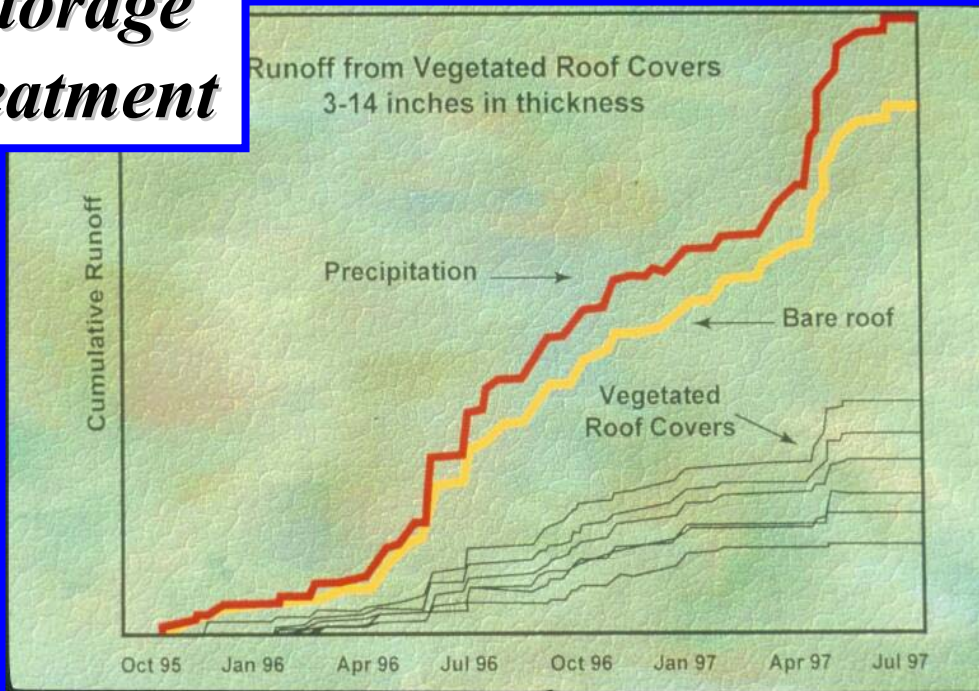
Timing

Water Use

Prevention

Roof Storage and Treatment

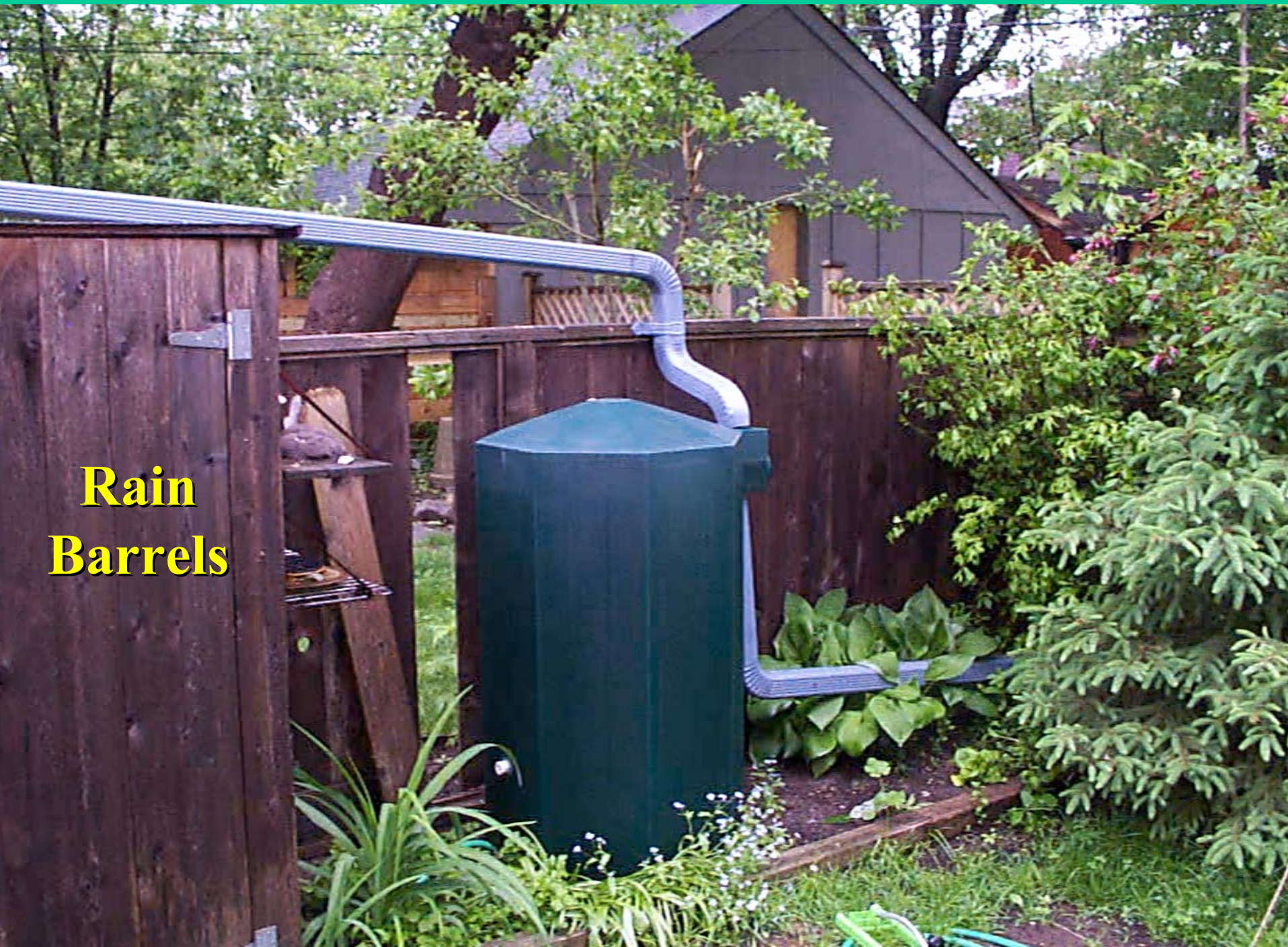





MAY 29 2001

Buildings Design

Downspouts Disconnect / Water Use


Rain
Barrels

Increasing Surface Area

Urban Canopy

Weep Wall Filter

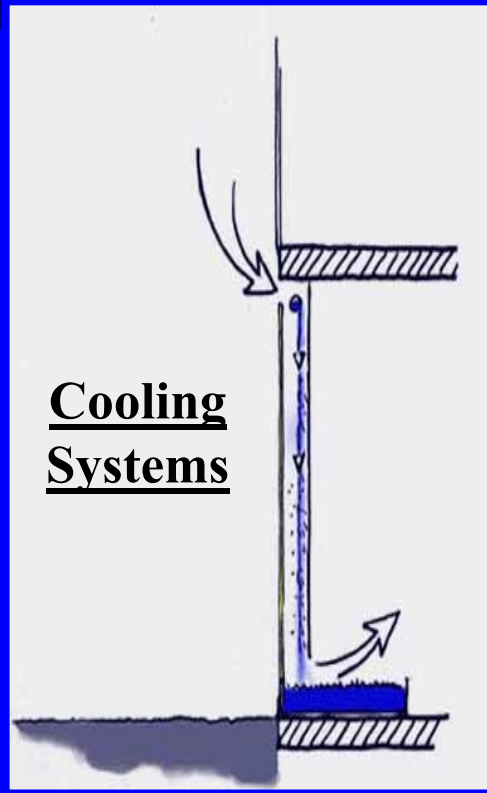

NORTHWESTERN HIGH SCHOOL
7000 ADELPHI ROAD

Buckman Heights courtyard with infiltration garden


Rain Gardens
MAY 21 2001


Tree Shrub Box

Runoff Use / Filter



Herbert Dreiseitl - ww.dreiseitl.de

Runoff Use

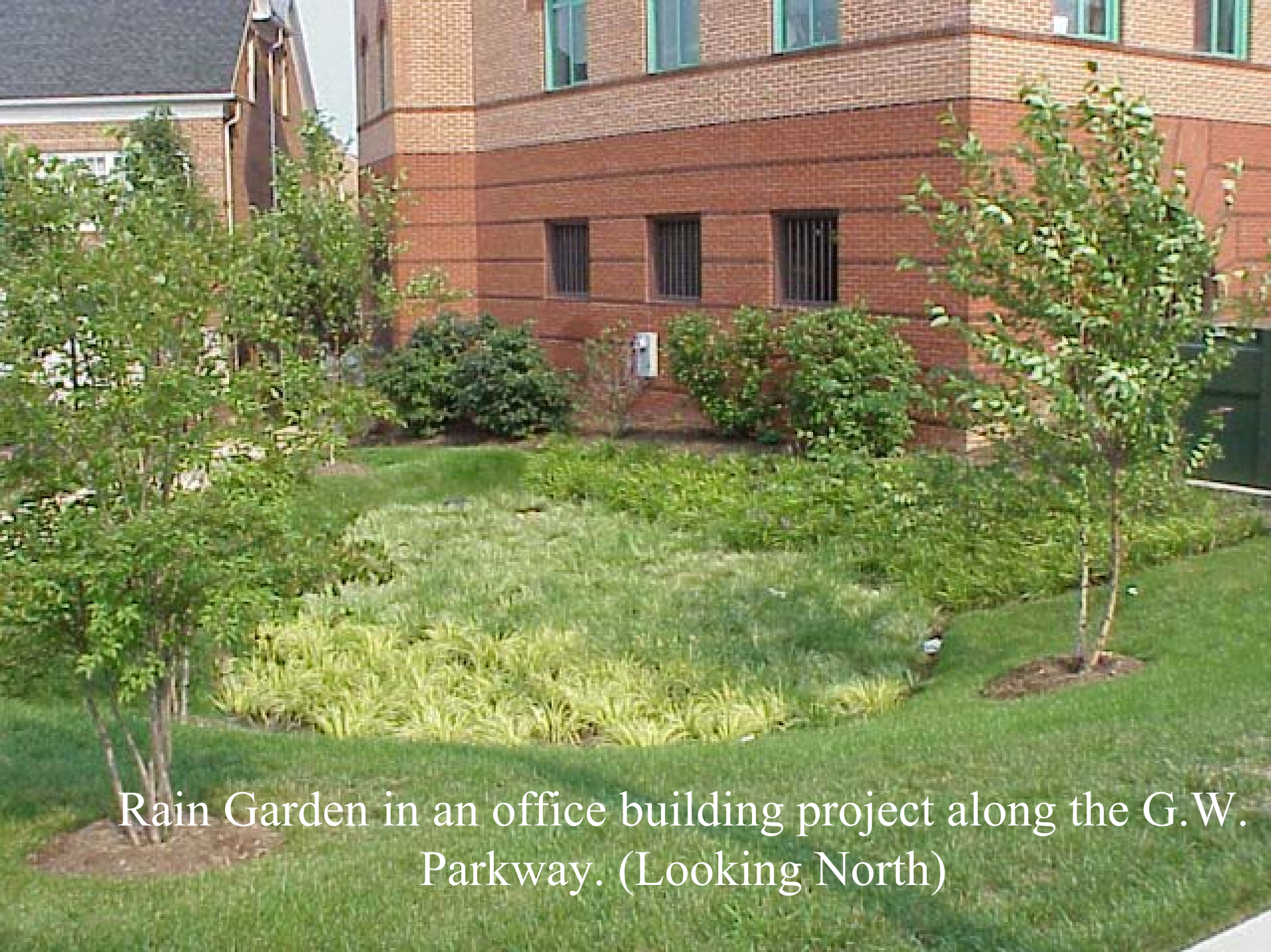
Possibilities & Opportunities

Virginia

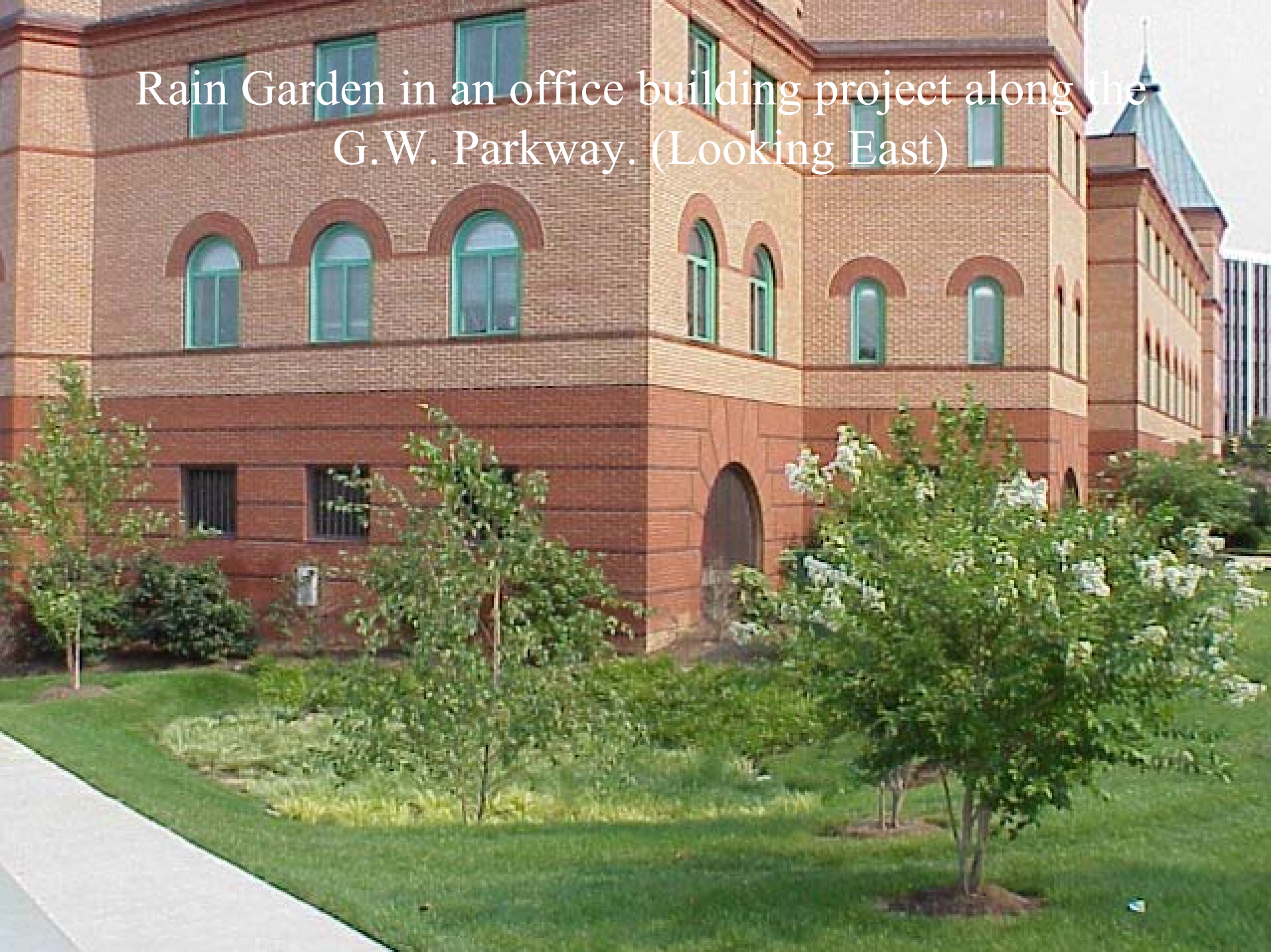
Examples of Bioretetnion and Rain Gardens DEQ / DCR

Larry Gavan


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

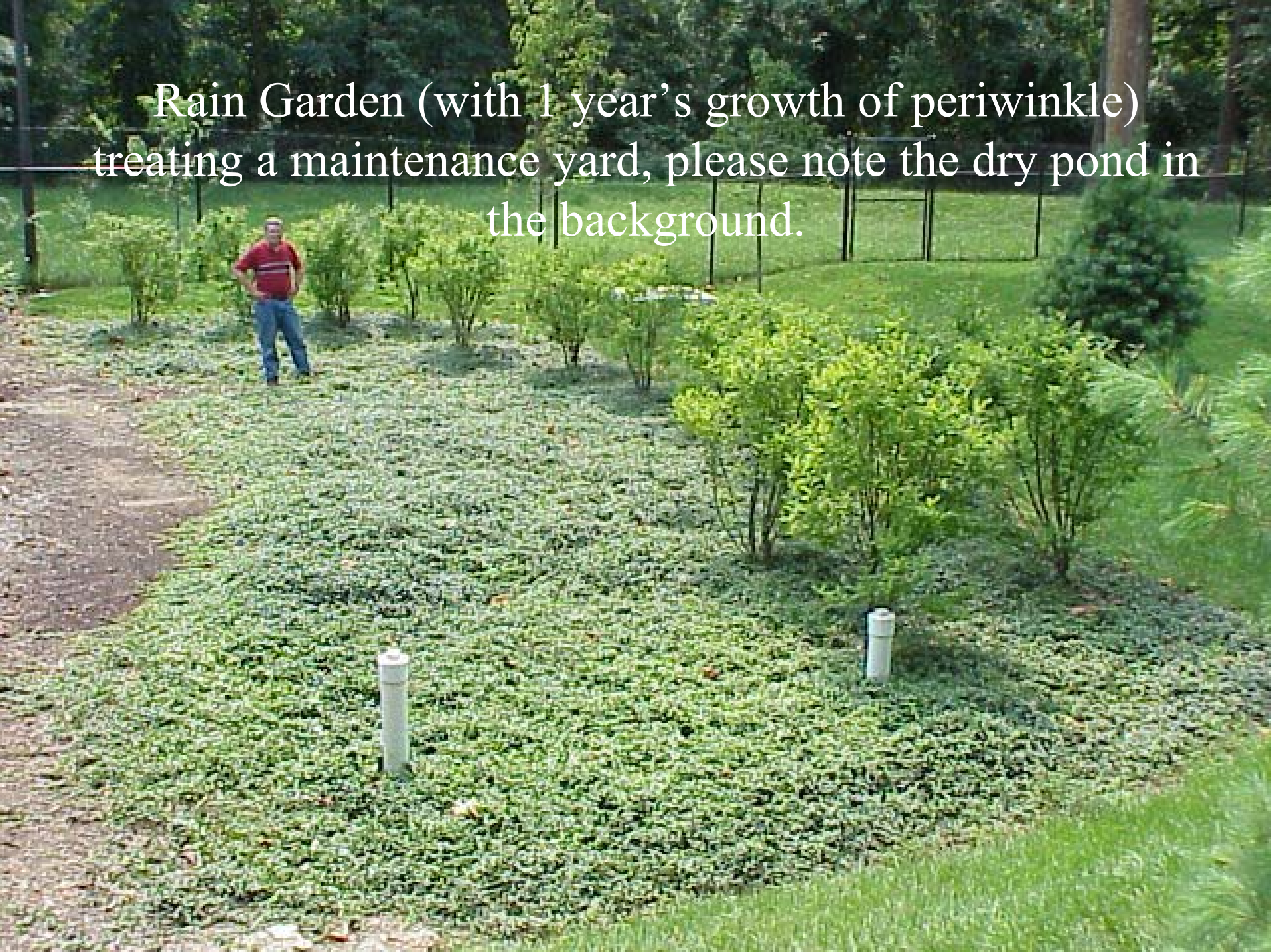


Rain Garden in an office building project along the G.W. Parkway. (Looking North)


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

Rain Garden in a median strip of a townhouse project just inside the beltway. Please note the depressed curb and grate inlet structure,

Rain Garden on a commercial project with turf grass near I-395 and Edsall Road.


Rain Garden (with 1 year's growth of periwinkle) treating a maintenance yard, please note the dry pond in the background.

Rain Garden (in use) in the front yard of a town house project.

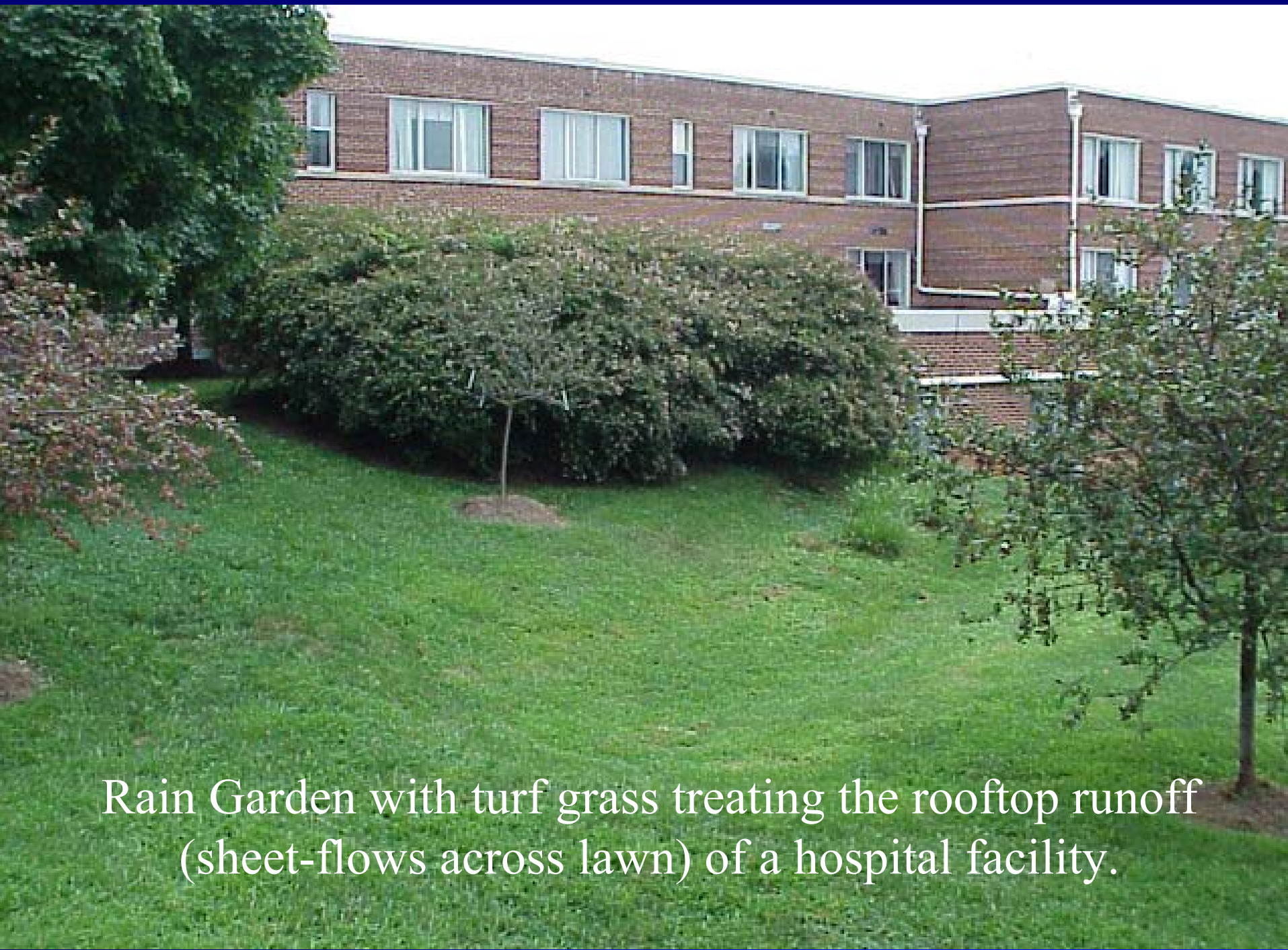
Grassed Swale leading to a Rain Garden in a commercial project.

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

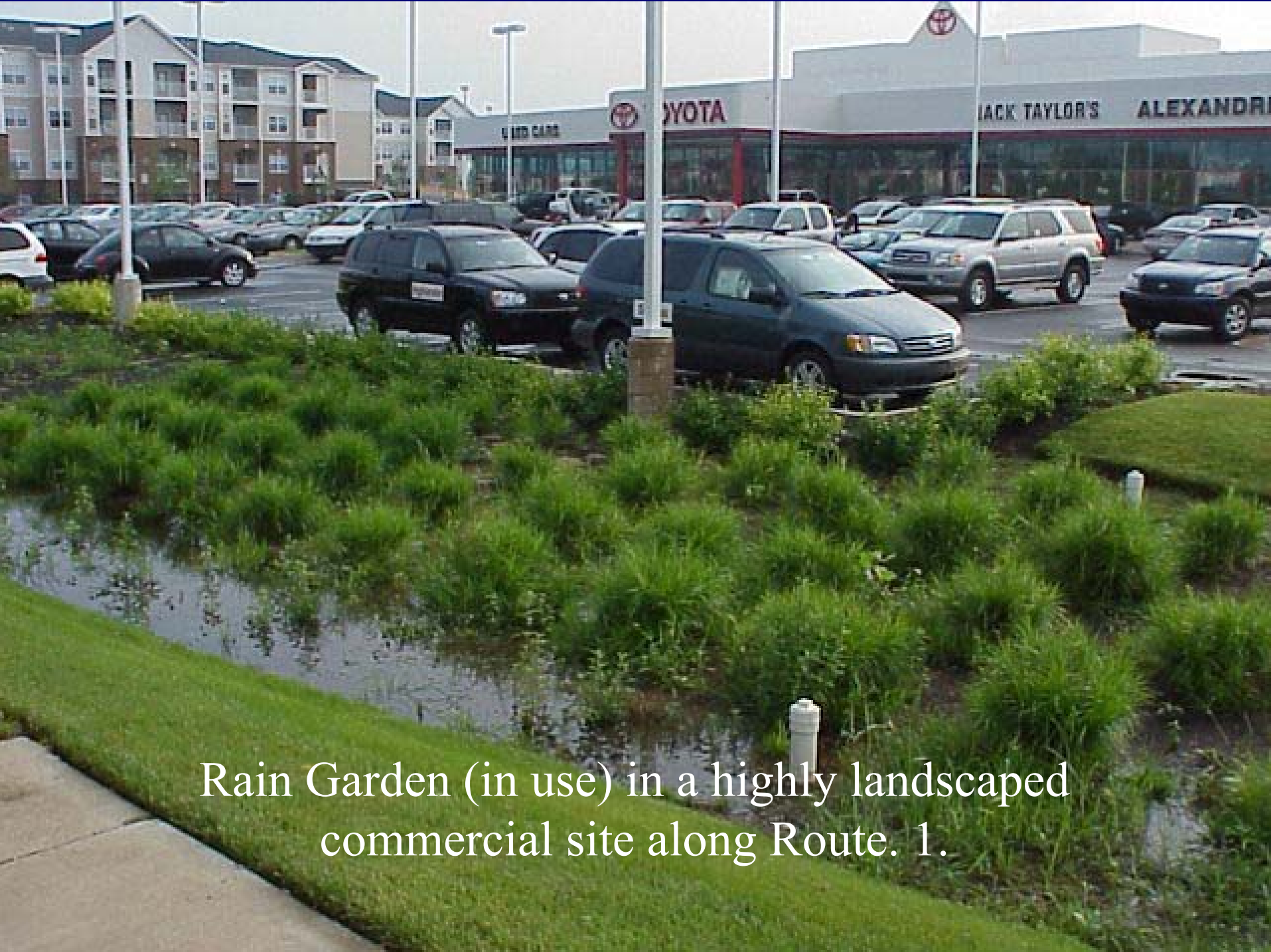
St. Stephens Rain Garden- 5 years later.

Rain Garden with turf grass alongside a parking lot in a highly urbanized area with an overflow device in the background.

Rain Garden (in use) located in the entrance median to a town house Project.



Rain Garden with turf grass treating the rooftop runoff (sheet-flows across lawn) of a hospital facility.



Rain Garden (in use) in a highly landscaped commercial site along Route. 1.


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

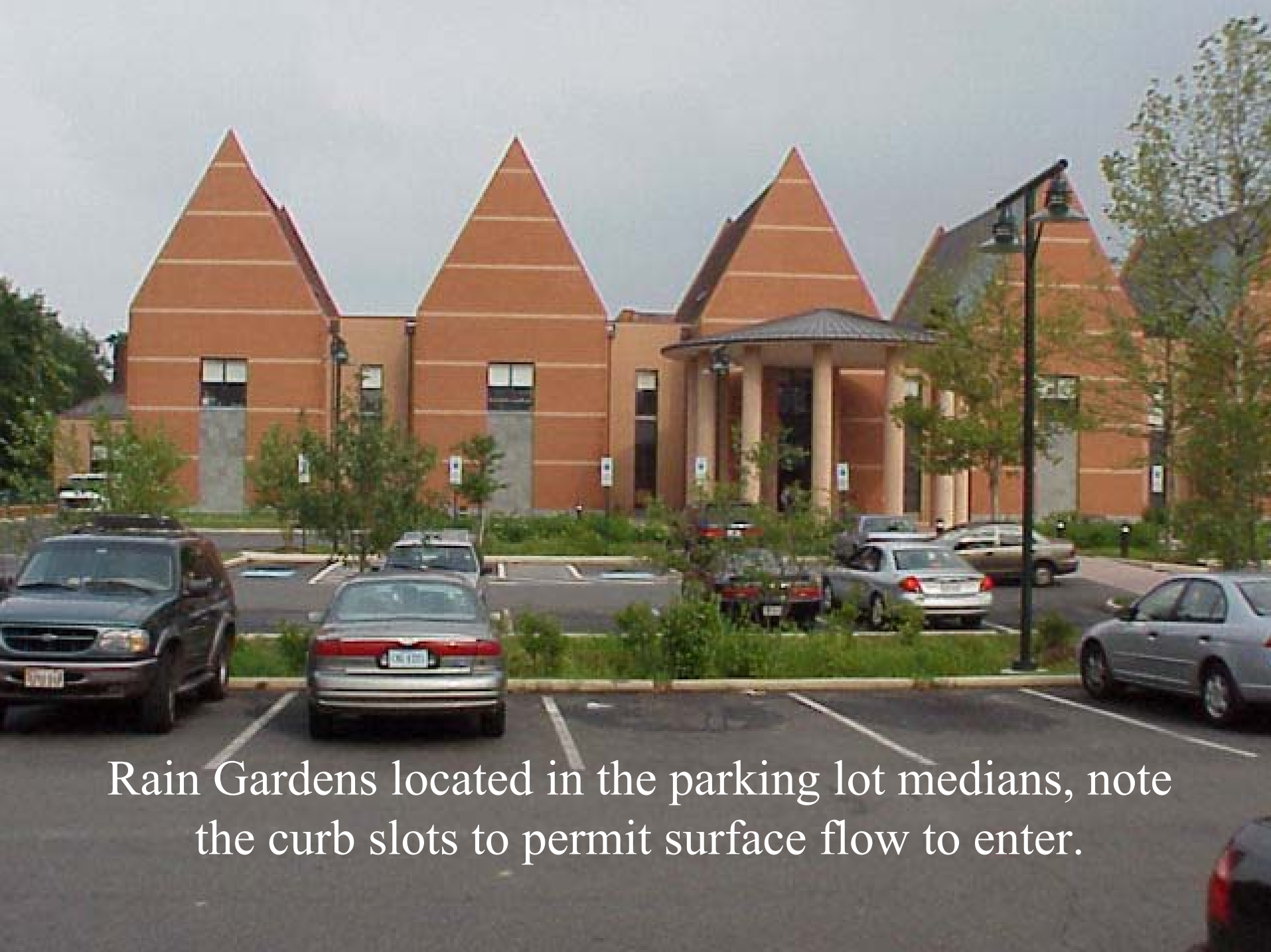
Rain Garden with trees, shrubs, inlet pipe and overflow device in a residential project.

Rain Garden with depressed curb and sidewalk.

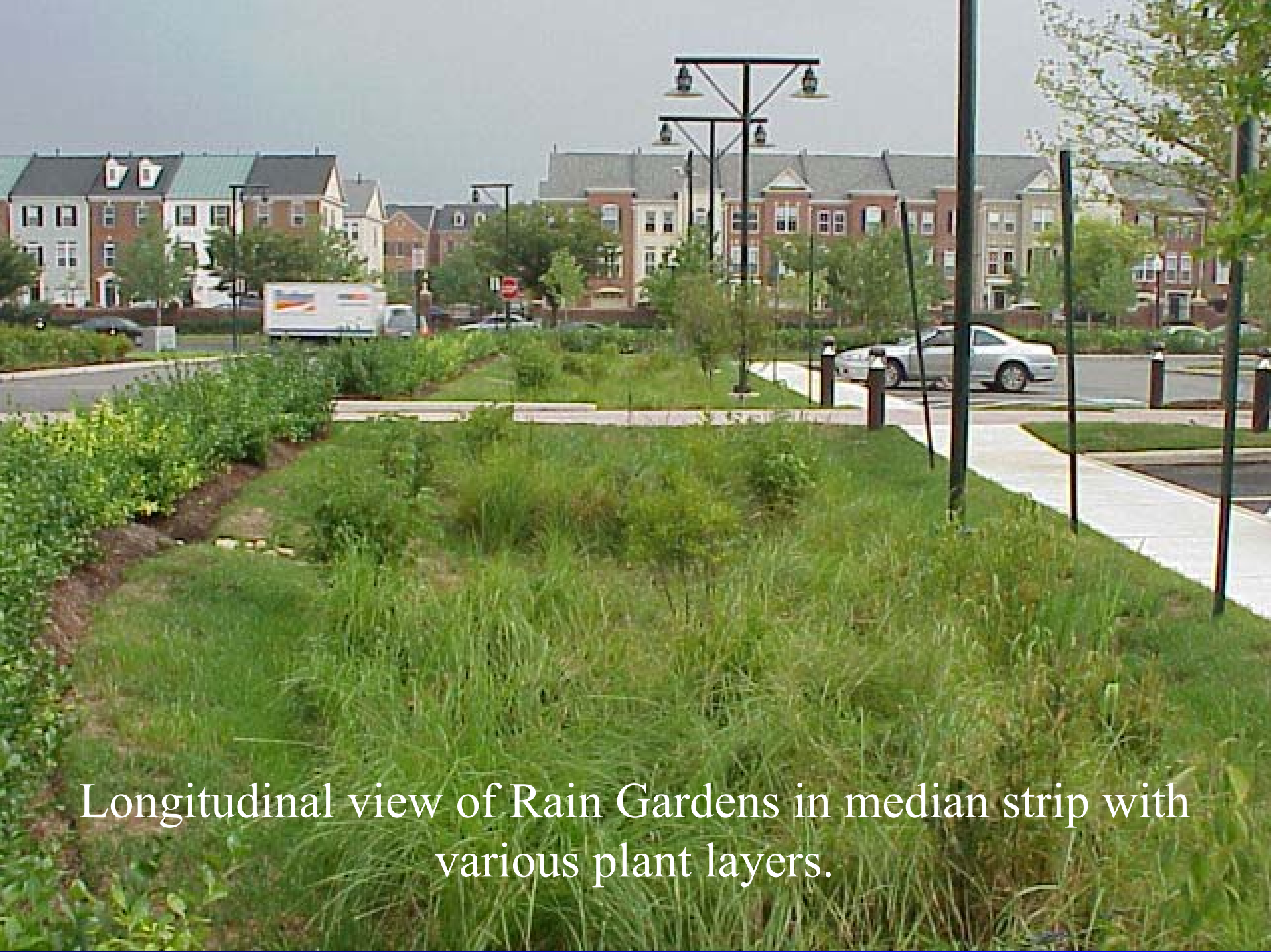
Over 5 miles of Bio-filtration Swale at a large mixed use project.

Rain Garden with mixed plant layers treating a residential parking lot along a street-front.

Rain Gardens used through-out the Alexandria Central Library to treat all impervious runoff



Rain Gardens located in the parking lot medians, note the curb slots to permit surface flow to enter.



Longitudinal view of Rain Gardens in median strip with various plant layers.


Rain Garden longitudinal view showing overflow device.

Longitudinal view of Rain Gardens showing use of curb and grated inlets

Future: Make Low Impact Development a mainstream approach for land development in Virginia.


STOP