Going Green with the NYS Stormwater Design Standards

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NYSDEC

Stormwater Discharge Permitting Program

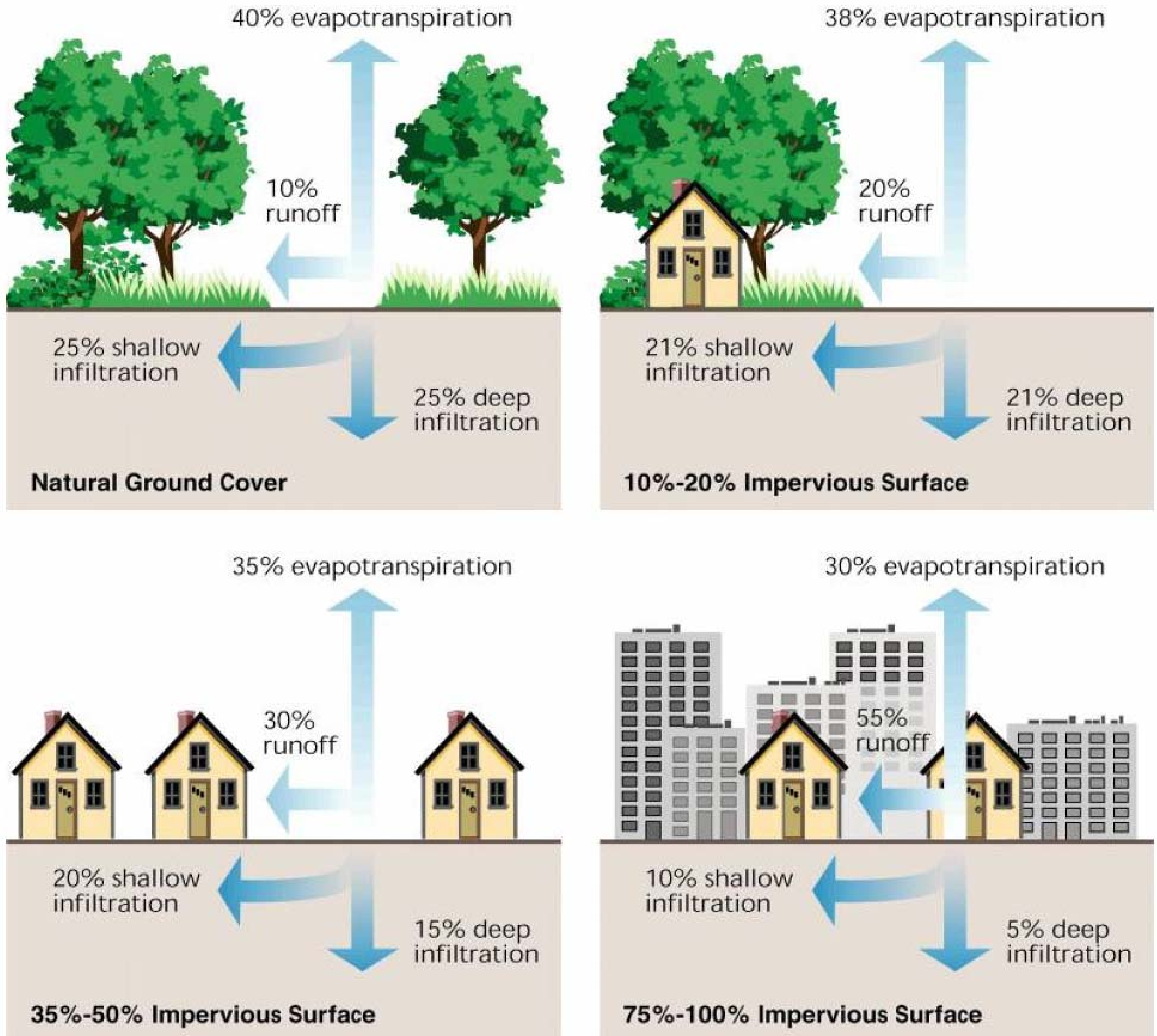
- Construction Activities (GP-0-10-001)
- Municipal Separate Storm Sewer Systems (GP-08-002),
- New Design Standards
  - Runoff Reduction Requirements
  - Green Infrastructure Principles
    - Planning
    - Technique
  - WQ Treatment and Quantity Controls

Background

- EPA's Memo
  - Use of GI in NPDES Permits
- Energy Independence And Security Act
- National Research Council 2008 Study
- NY Public Review Process
  - Permit Updates
  - Design Manual Updates
    - Chapters 3 (Stormwater Management Planning)
    - Chapter 4 (Sizing Criteria)
    - Chapter 5 (Green Infrastructure)
    - Other Chapters
  - 2008 Design Standards
    - Unified Sizing Criteria
      - WQv Capture and Treatment
      - Water Quantity Controls
    - Performance Criteria (80% TSS, 40% P removal)

What needed to Change?

- More than a permit requirement
- A paradigm shift
- Rain is a resource, Not a waste
- Get away from the curb and gutter
- Get away from big basin approach
- Region, Watershed, Neighborhood, Site approach

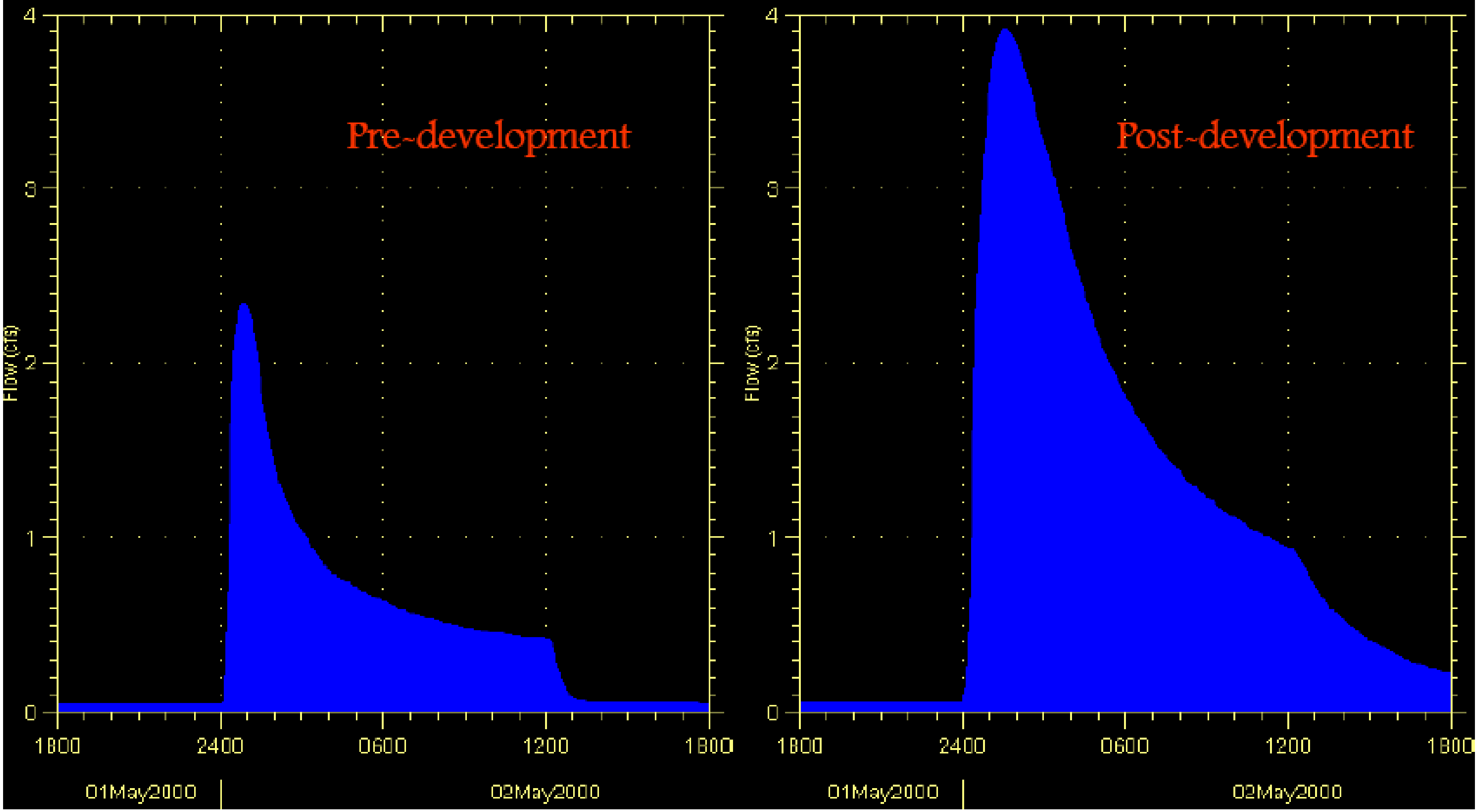

40% evapotranspiration
10% runoff
25% shallow infiltration
25% deep infiltration
Natural Ground Cover
38% evapotranspiration
20% runoff
21% shallow infiltration
21% deep infiltration
10%-20% Impervious Surface
35% evapotranspiration
30% runoff
20% shallow infiltration
15% deep infiltration
35%-50% Impervious Surface
30% evapotranspiration
55% runoff
10% shallow infiltration
5% deep infiltration
75%-100% Impervious Surface

Blakeslee Creek, Michigan

70% increase in peak flow.

170% increase in runoff volume.

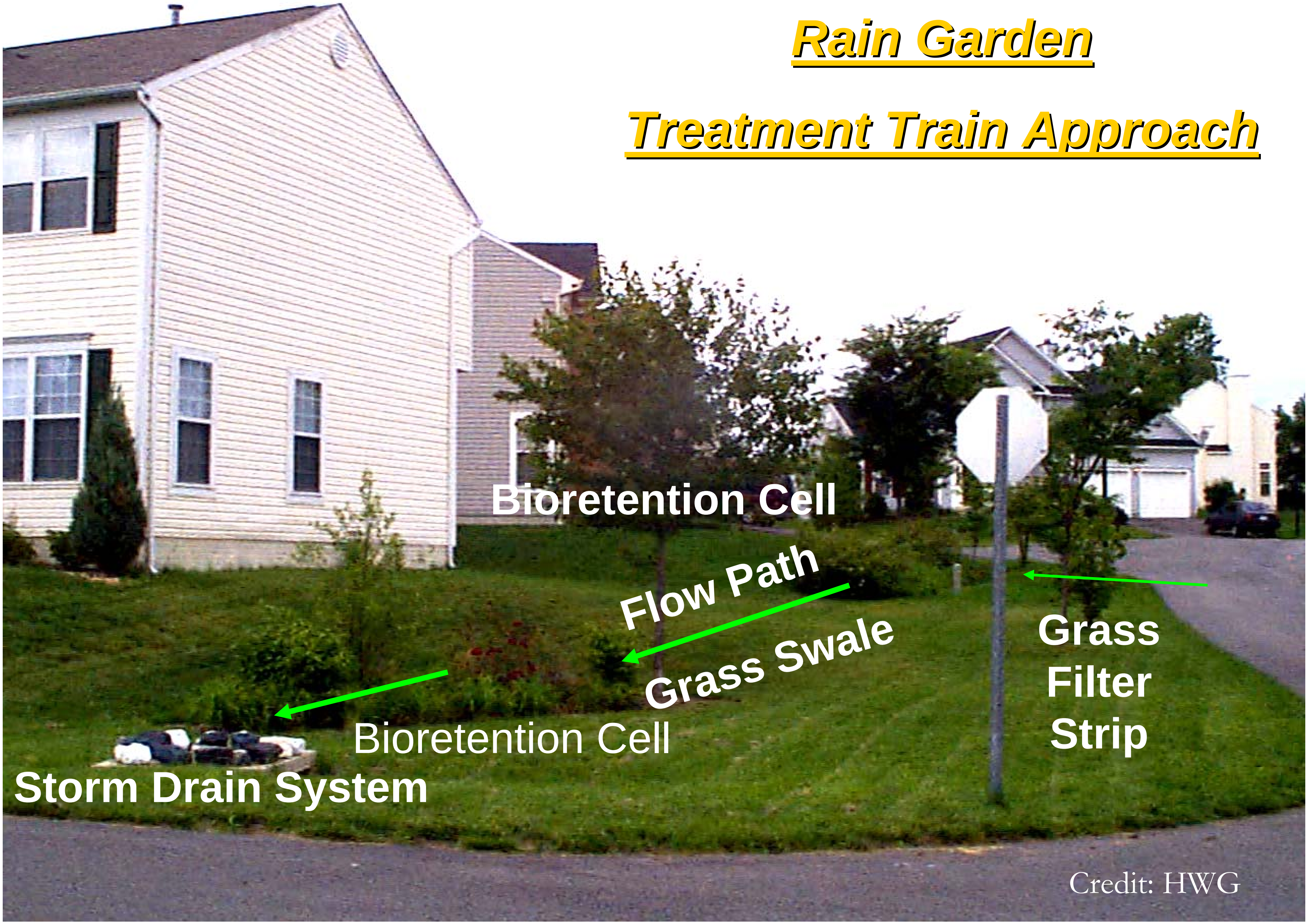
Former instantaneous peak flow now lasts ~4 hours.




Conventional Site Design
Collect
Concentrate
Convey
Centralized
Control
Good Drainage Paradigm
Credit: HWG

Rain Garden

Treatment Train Approach



Green Infrastructure Definition

- In the context of stormwater management, the term green infrastructure includes a wide array of practices at multiple scales to manage and treat stormwater, maintain and restore natural hydrology and ecological function by infiltration, evapotranspiration, capture and reuse of stormwater, and establishment of natural vegetative features.

Updates: The Essence of Green Infrastructure

- Promote Redevelopment Approach
- Plan Based on GI Principles
- Runoff Reduction Sizing Criteria
  - Incorporate green techniques (90% storm)
    - Reduce volume to predevelopment hydrology
      - By area reduction or volume storage
      - Minimum reduction rates based on HSG
    - Treat remaining WQv with standard practice
  - Alternatively mimic pre construction hydrology by continuous simulation modeling

Updates: The Challenges of Green Infrastructure

- Building Codes
- Maintenance Issues
- Traditional methods vs. GI
  - Planning
  - Computation
  - Design
- Public Acceptance

Managing Wet Weather with Green Infrastructure Handbook Series

- Managing Wet Weather with Green Infrastructure Municipal Handbook
  - Action Strategy
  - Funding Options
  - Retrofit Policies
  - Green Streets
  - Rainwater Harvesting Policies
  - Incentive Mechanisms
- Water Quality Scorecard Incorporating Green Infrastructure Practices at the Municipal, Neighborhood, and Site Scales

http://cfpub.epa.gov/npdes/greeninfrastructure/munichandbook.cfm

Chapter 3: Steps of Plan Development

Step 1:
Site Planning
Step 2:
Determine Water Quality Volume
Step 3:
Runoff Reduction by Applying Green Infrastructure Techniques and Standard SMPs with RR
Step 4:
Apply SMPs to remaining WQv
Step 5:
Apply volume & peak rate control

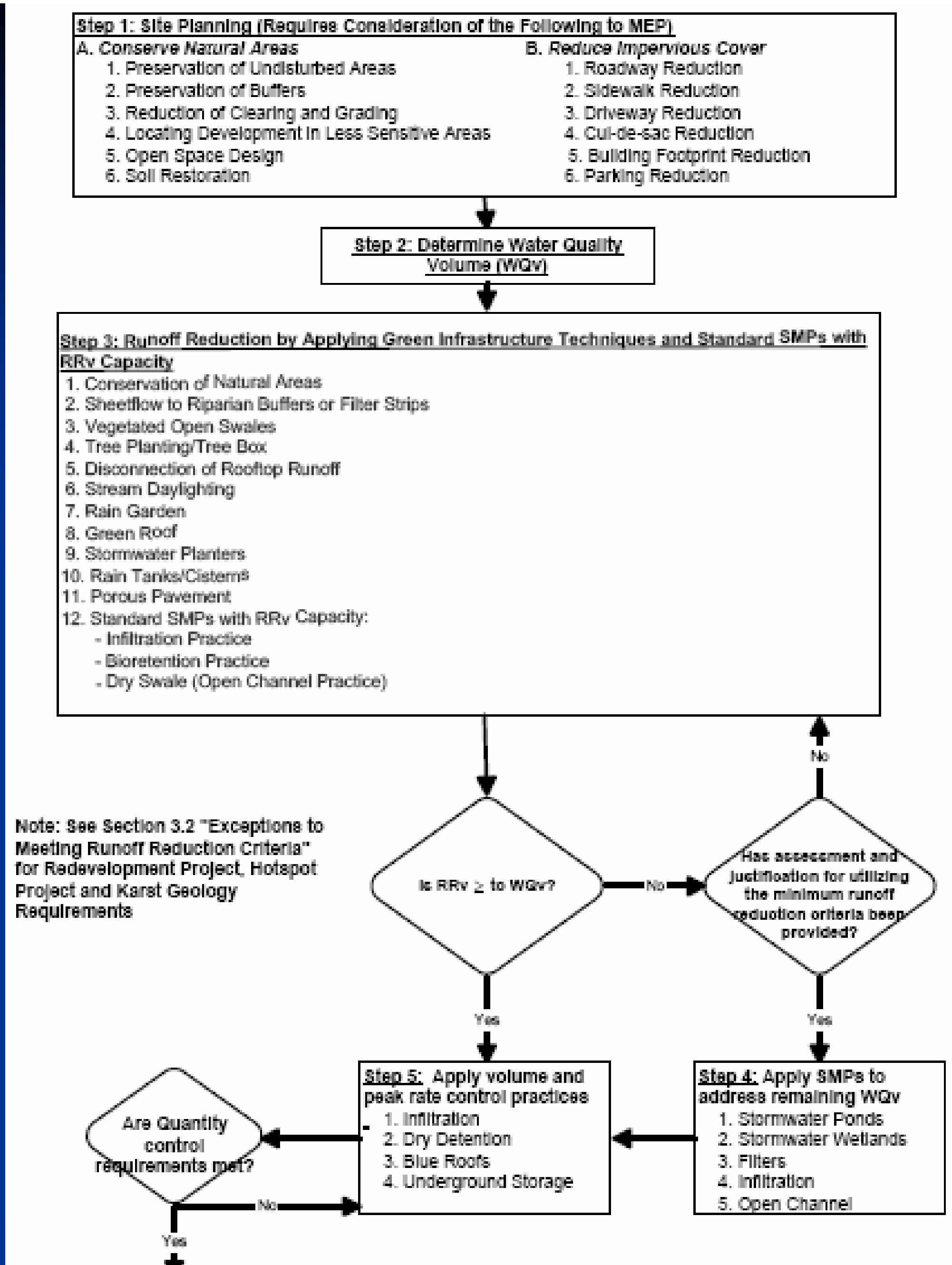


Figure 3.1
Stormwater Site Planning and Practice Selection Flow Chart

Chapter 4
Sizing Criteria

- Sizing Criteria & Alternative Method
- Justifications
- Stream Order
- Precipitation Data
- Hotspot
- Orifice Sizing

Water Quality Volume (WQv)	**90% Rule:** WQ_v(acre-feet) = [(P)(Rv)(A)] /12 Rv = 0.05+0.009(I) I = Impervious Cover (Percent) Minimum Rv = 0.2 if WQv > RRv P(inch) = 90% Rainfall Event Number (See Figure 4.1) A = site area in acres
Runoff Reduction Volume(RRv)	RRv (acre-feet) = Reduction of the total WQv by application of green infrastructure techniques and SMPs to replicate pre-development hydrology. The minimum required RRv is defined as the Specified Reduction Factor (S), provided objective technical justification is documented.
Channel Protection Volume(Cpv)	**Default Criterion:** Cp_v(acre-feet) = 24 hour extended detention of post-developed 1-year, 24-hour storm event; remaining after runoff reduction. Where site conditions allow, Runoff reduction of total CPv , is encouraged
Overbank Flood (Q_p)	Q_p(cfs)=Control the peak discharge from the 10-year storm to 10-year predevelopment rates.
Extreme Storm (Q_f)	Q_f(cfs)=Control the peak discharge from the 100-year storm to 100-year predevelopment rates. Safely pass the 100-year storm event.
Alternative method (WQv):	Design, construct, and maintain systems sized to capture, reduce, reuse, treat, and manage rainfall on-site, and prevent the off-site discharge of the precipitation from all rainfall events less than or equal to the 95th percentile rainfall event, computed by an acceptable continuous simulation model.

Chapter 5

- Avoid the Impact
- Reduce the Impact
- Manage the Impact

Updates: Avoid the Impacts
Preserve Natural Features

- Preservation of Undisturbed Areas
- Preservation of Buffers
- Reduction of Clearing & Grading
- Locate Sites in Less Sensitive Areas
- Soil Restoration

The Integral Component of Retention: Soil Restoration

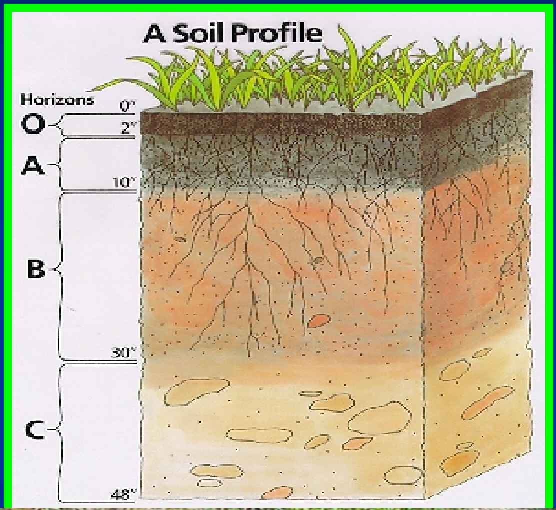
Hydrology - storage /evaporation /recharge/detention

De-compaction

Storing Cycling Nutrients (bacteria / fungi) phosphorous / nitrogen / carbon

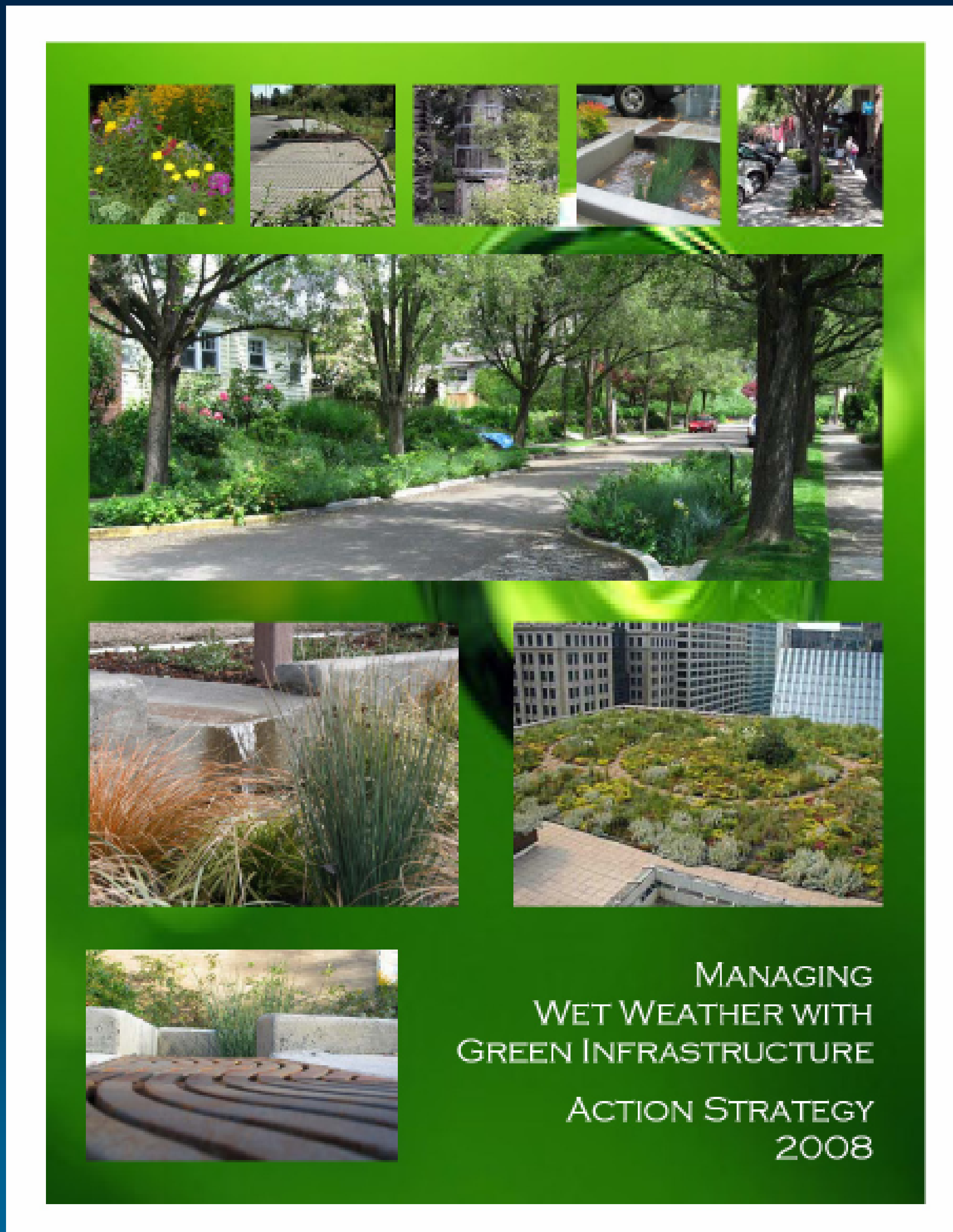
Plant Productivity (vigor)

Water Quality –infiltrate, filter, immobilize & detoxify organic and inorganic materials



Updates: Reduce the Impact
Reduce Impervious Cover

- Design to traffic density
- Minimize roadway
  - lengths & Widths
- Reduce
  - Sidewalk width
  - Cul-de-sac
  - Parking area
  - Footprint
- Shared driveway

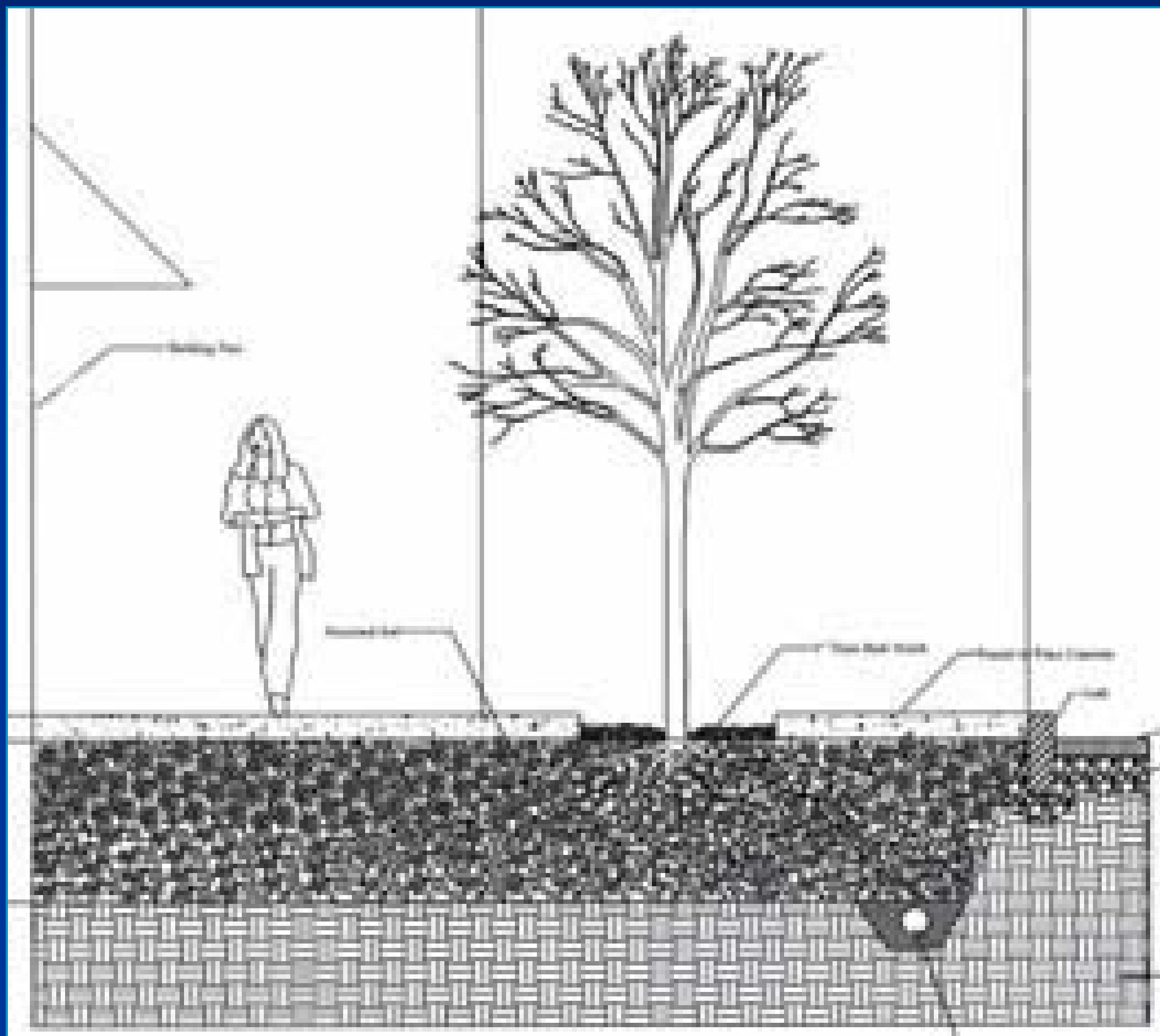


Strategy Categories

- Research
- Outreach & Communication
- Tools
- Clean Water Act Regulatory Support
- Economic Viability & Funding
- Demonstrations & Recognition
- Partnerships & Promotion

Released January 17, 2008

Innovative Approaches



Innovative Approaches

Example of Municipal Codes

Municipality	Document	Section Title	Section #
City of Austin	Standard Specifications and Standard Details	Grass-Lined Swale and Grass- Lined Swale with Stone Center	627S
City of Austin, Engineering Services Division. Standard Specifications and Details Website: http://www.ci.austin.tx.us/sd2/			
City of Seattle	2008 Standard Specifications for Municipal Construction	Natural Drainage Systems	7-21
City of Seattle. Street Edge Alternatives Project http://www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/GreenStormwaterInfrastructure/index.htm			

Municipal Projects in the Right-of-Way

Municipality	Bioretention Type	Document
Maplewood, MN	Rain gardens	*Implementing Rainwater in Urban Stormwater Management*
http://www.ci.maplewood.mn.us/index.asp?Type=B_BASIC&SEC=%7BF2C03470-D6B5-4572-98F0-F79819643C2A%7D		
Portland, OR	Curb extensions Planters Rain gardens	*2006 Stormwater Management Facility Monitoring Report* 12
http://www.portlandonline.com/bes/index.cfm?c=36055		

New York Examples

Municipality	Type	Document
Town of Amherst	Minimum Parking Ratios	Zoning Ordinance
http://www.amherst.ny.us/pdf/planning/compplan/zcrc/p7.pdf		
Towns of - Clinton - Wappinger	-Residential Streets, Parking and Lot Imp. Cover -Conservation of Natural Areas	Recommended Model Development Principles
http://www.dec.ny.gov/docs/remediation_hudson_pdf/hrewbsdclin.pdf http://www.dec.ny.gov/docs/remediation_hudson_pdf/hrewbsdwap.pdf		

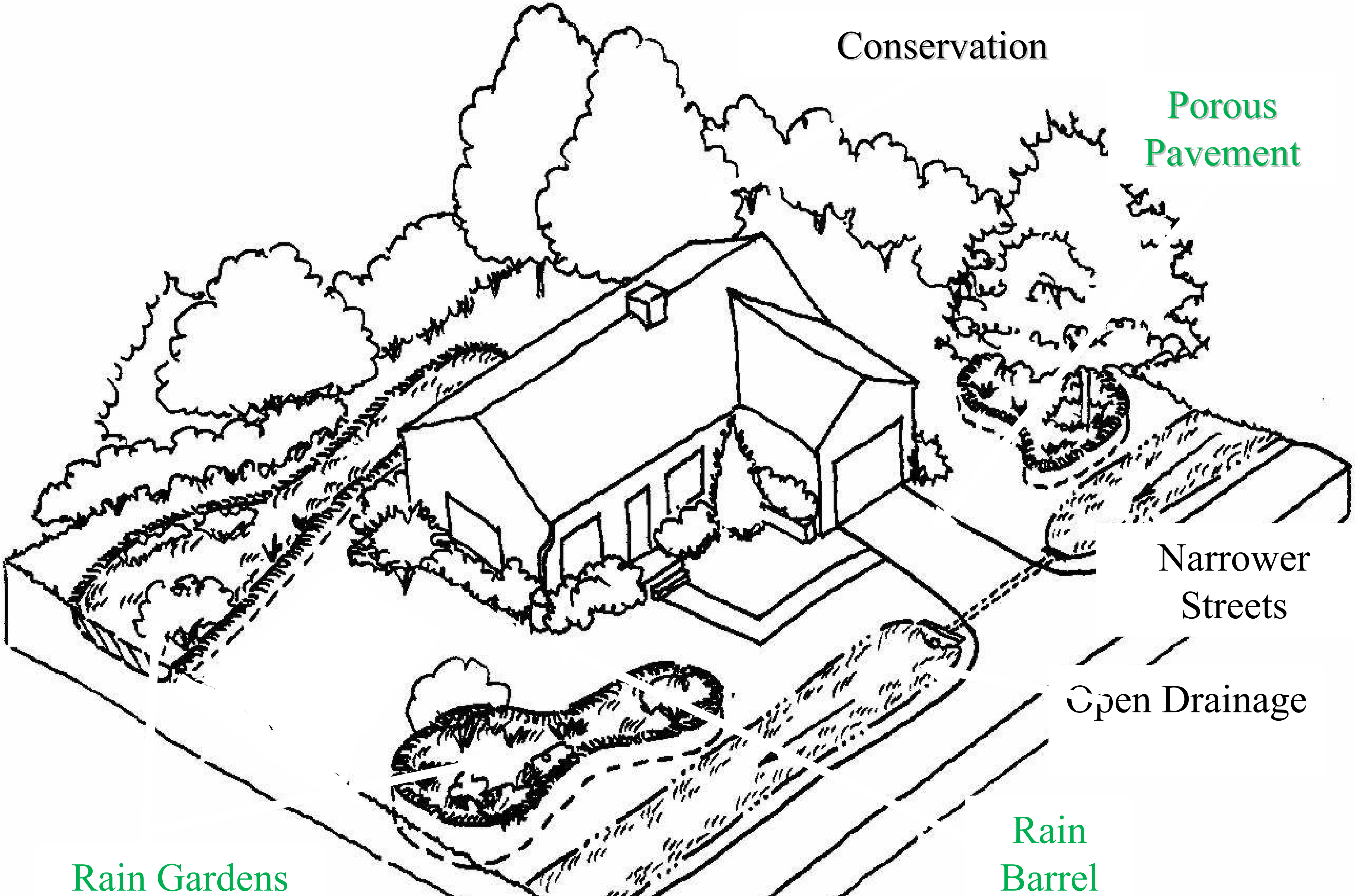
Updates: Manage the Impact
Slow it down, Spread it out, Soak it in

Runoff Reduction (RR) Techniques:

- Conservation of natural areas
- Sheetflow to riparian buffers or filter strips
- Vegetated open swale
- Tree planting / tree box
- Rooftop Runoff disconnection
- Stream daylighting
- Rain garden
- Green roof
- Stormwater planter
- Rain tank/Cistern
- Permeable paving

Updates: Manage the Impact

- Appropriately sizing for contributing drainage area
  - -final grading, flow path, impervious cover disconnection, sub-catchment delineation.
- Soil infiltration testing performed at the proposed practice site
- Adequate separation distance from ground water table
- Reasonable drawdown time
- If other calculation methods are utilized, all the contributing areas and practices must be modeled according to model requirement.
- All green infrastructure practices must be designed for over flow and safe passage of storms greater than the design capacity of the system and conveyed to facilities designed for quantity controls.
- A drainage layer is incorporated in most practices to enhance structural integrity, storage, drainage, and infiltration and may not be neglected.



Provide storage of water quality storm within the watershed

Updates: Manage the Impact

Green infrastructure techniques with storage capacity are sited downstream from the developed areas and sized for contributing areas (pervious and impervious covers), or sized for rainfall by run on.

Green infrastructure techniques without storage capacity that are sited downstream from the developed areas are sized for receiving runoff from a maximum contributing area (pervious and impervious covers).

Areas of green infrastructure techniques that do not receive runoff from developed areas can be subtracted from the contributing area of the downstream SMP for WQv calculation. The Rv of the SMP is calculated based on the pervious and impervious cover of the remaining contributing areas.

Runoff Reduction Technique: Conservation of Natural Areas

Runoff Reduction Technique: Vegetated Buffer/Filter Strips

- Treat & control runoff with:
  - Forested areas
  - Stream buffers
  - Vegetated filter strips

Conservation of Natural Areas

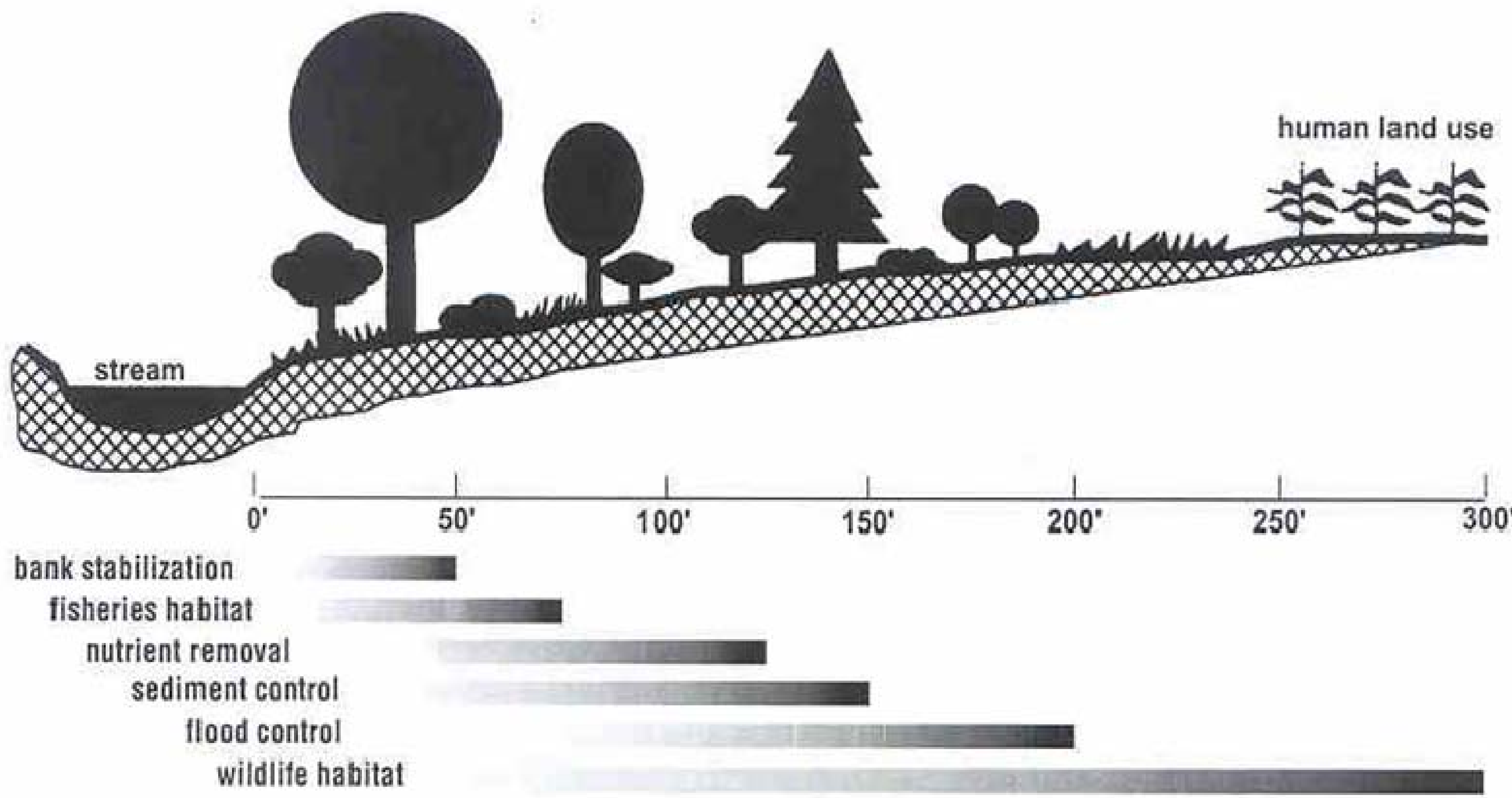
- Delineate on plans / in the field
- Place in permanent conservation Easement:
    - Stream/wetland buffers
    - Undisturbed vegetated or wooded area
- Size by deduction of area from WQv calculation

Vegetated Buffer/Filter Strips

➢Treat & control runoff with:

- Forested areas
- Stream buffers
- Vegetated filter strips

Preservation of Buffers



Runoff Reduction Technique: Rooftop Runoff Disconnection

Open Vegetated Channels

- Convey & treat runoff with:
  - Natural drainage paths
  - Properly designed & constructed channels
- On certain sites use in street right-of-way

Stream Daylighting for Redevelopment

- Increases aesthetics
- Improves water quality
- Prevents flooding – increased storage
- Improves in-stream habitat
- Increases public use
- Increases property values
- Sunlight

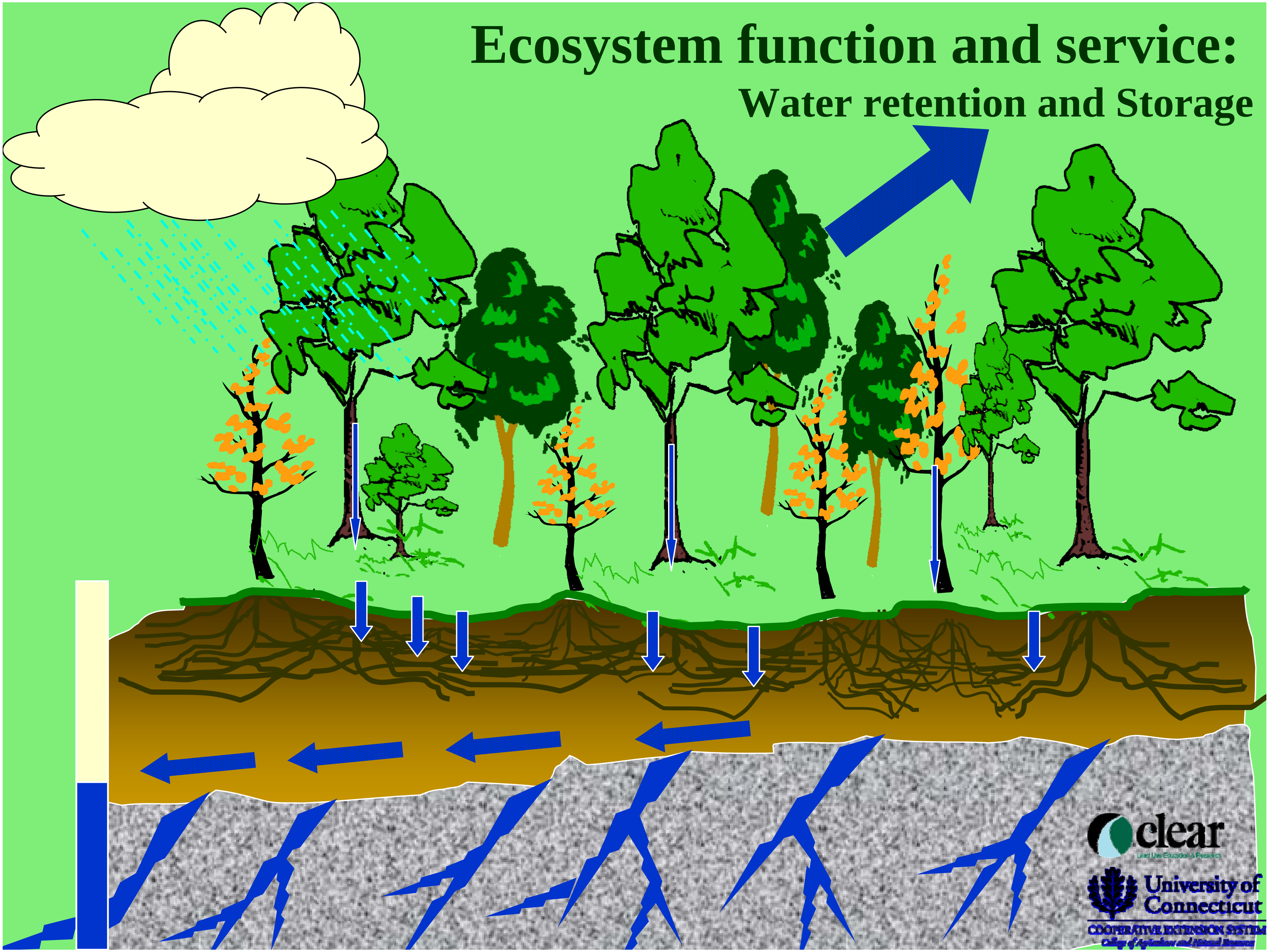
Tree Planting

Plant trees:

- In stormwater management practices (where appropriate)
- In landscape plans
- Revegetate buffer areas . . .

Ecosystem function and service:

Water retention and Storage



Rain Gardens

Rain Gardens

- Applications
  - treats small volumes of runoff using a conditioned planting soil bed and planting materials to filter runoff stored within a shallow depression.
- Limitations
  - Steep slopes
  - Compacted and clay soils
  - Sheet / shallow concentrated flow; roof drain downspout < 1,000 square feet
  - Heavy tree cover or root systems
- Cost estimate $10-12/sf

Rain Gardens
Sizing

$$WQ_V < V_{SM} + V_{DL} + (D_P \times A_{RG})$$

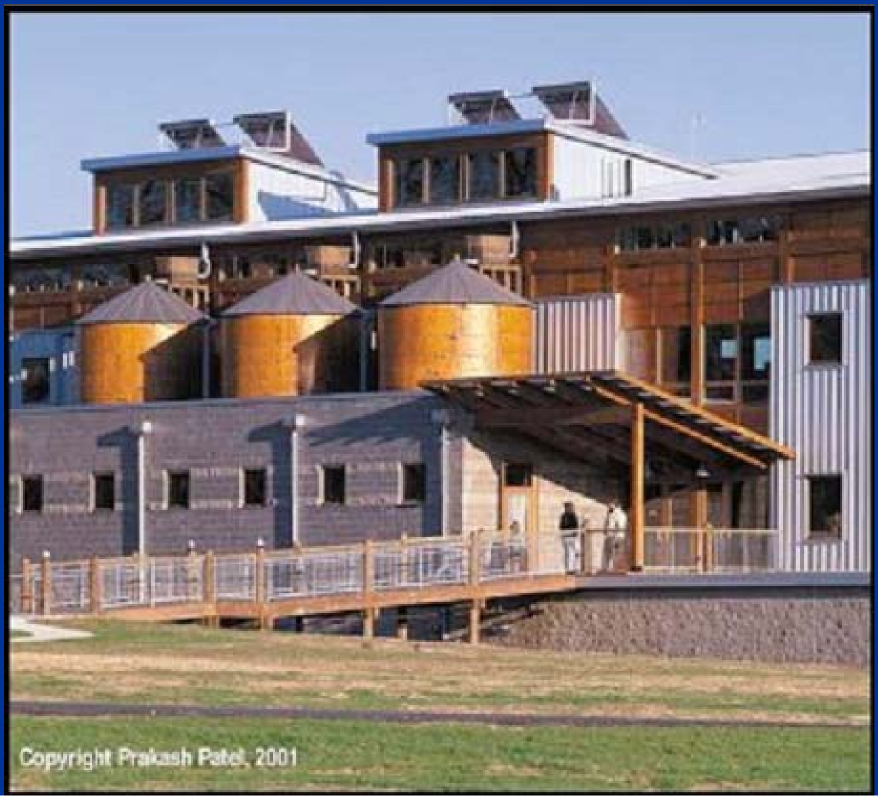
V_{SM} = Volume stored in soil media

V_{DL} = Volume stored in drainage layer

D_P = Depth of ponding layer (6 inch maximum)

A_{RG} = Rain Garden surface Area

Cisterns



Cisterns

- Applications
  - Capture and store stormwater runoff for reuse or irrigation
- Limitations
  - Maintenance
  - Water use management
  - Cold Climate
  - Community Acceptance
- Sizing based on the contributing area:
  - $Vol = WQv * 7.5\ gals/ft^3$
- Cost estimate: $4/gallon

Green Roofs

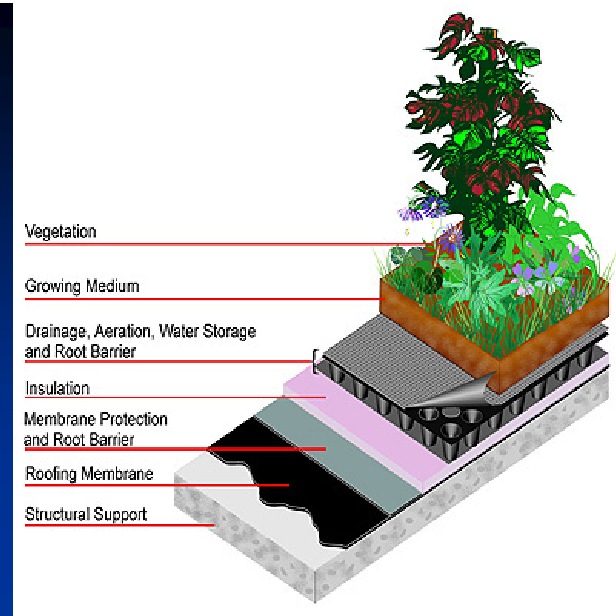
Extensive Green Roof

Intensive Green Roof

Green Roofs

- Applications
  - Reducing total annual runoff volumes
  - Insulation from the heat and cold, energy conservation
  - Reduce the urban heat island effect
  - Creates habitat, aesthetically pleasing
  - Count them pervious area
- Limitations
  - Damage to or failure of waterproofing
  - plant survival
  - Maintenance
- Sizing based on WQv reduction, soil engineering, evapotranspiration

Green Roofs Sizing



$$WQ_v \leq V_{SM} + V_{DL} + (D_P \text{ X } A_{GR})$$

V_{SM} = Volume stored in Soil media

V_{DL} = Volume stored in drainage layer

D_P = Depth of ponding above surface

A_{GR} = Green Roof Surface Area

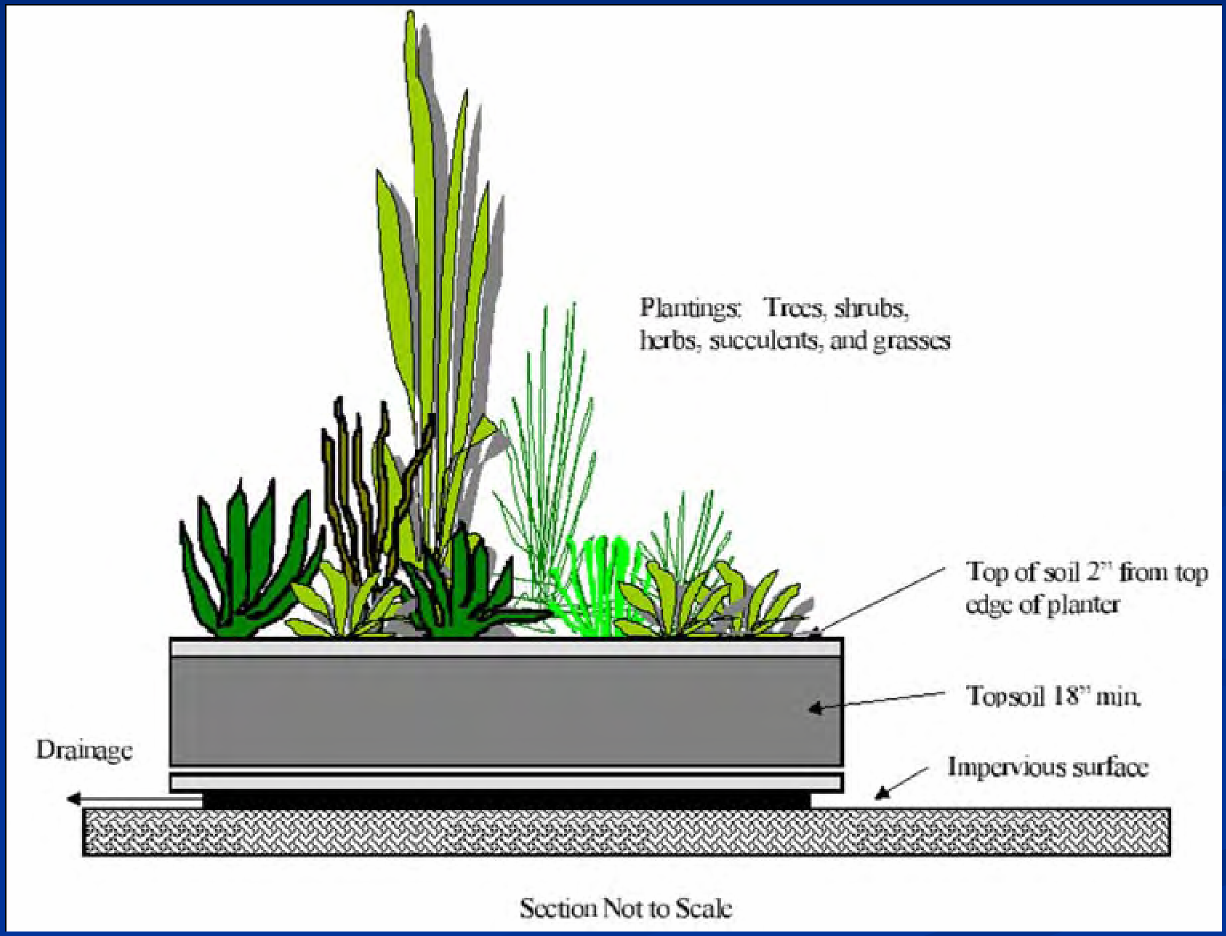
Stormwater Planters

Stormwater Planters

- Applications
  - On-site soils, high GW table not suitable for infiltration
  - Reduction of discharge volume, velocity from impervious areas
  - Aesthetic landscape element and micro-habitat
- Sizing
  - WQv based on surface area, depth of soil medium, hydraulic conductivity

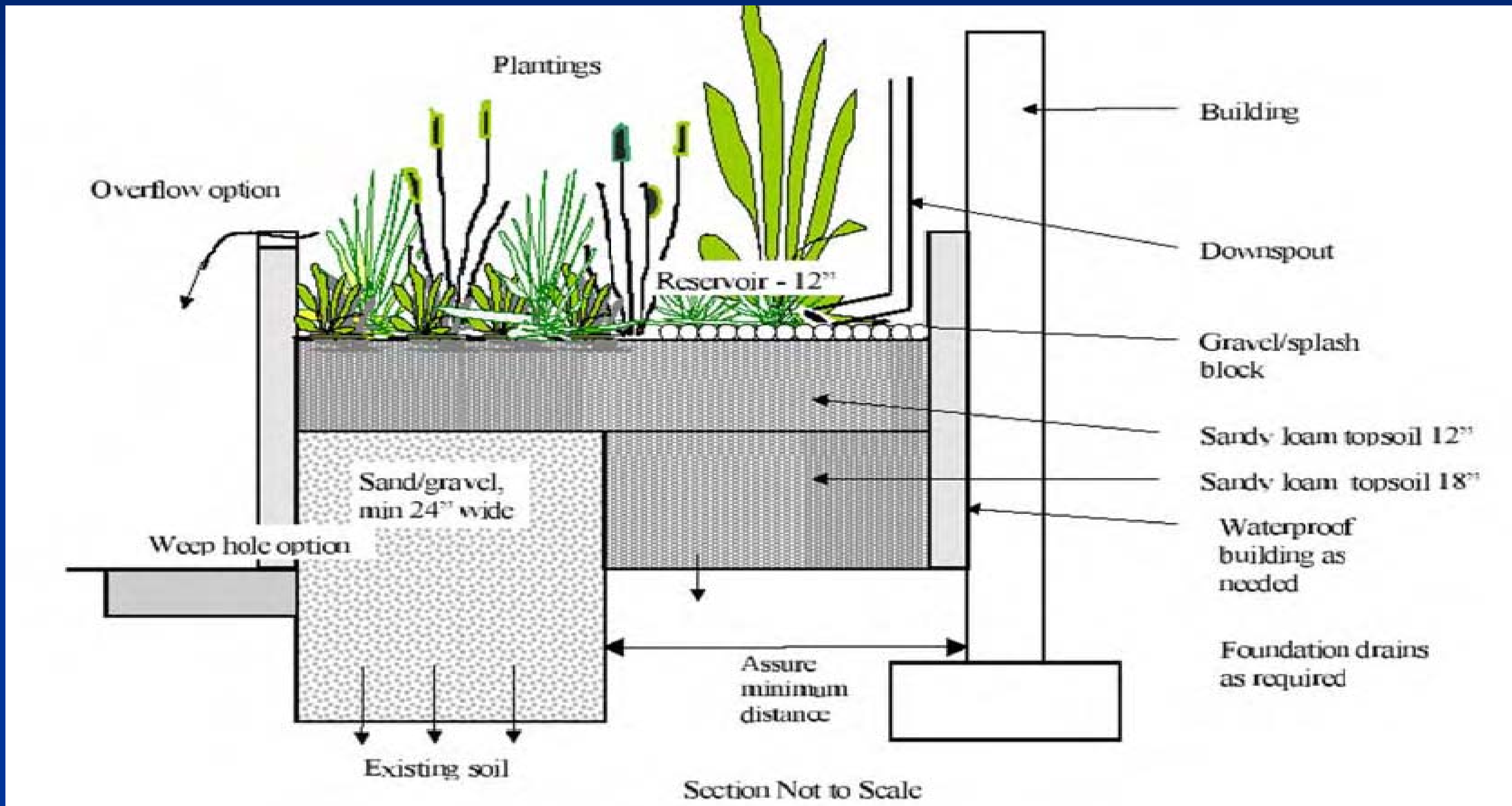
$A_f = WQ_v \times (d_f) / [k \times (h_f + d_f)(t_f)]$

Stormwater Planters



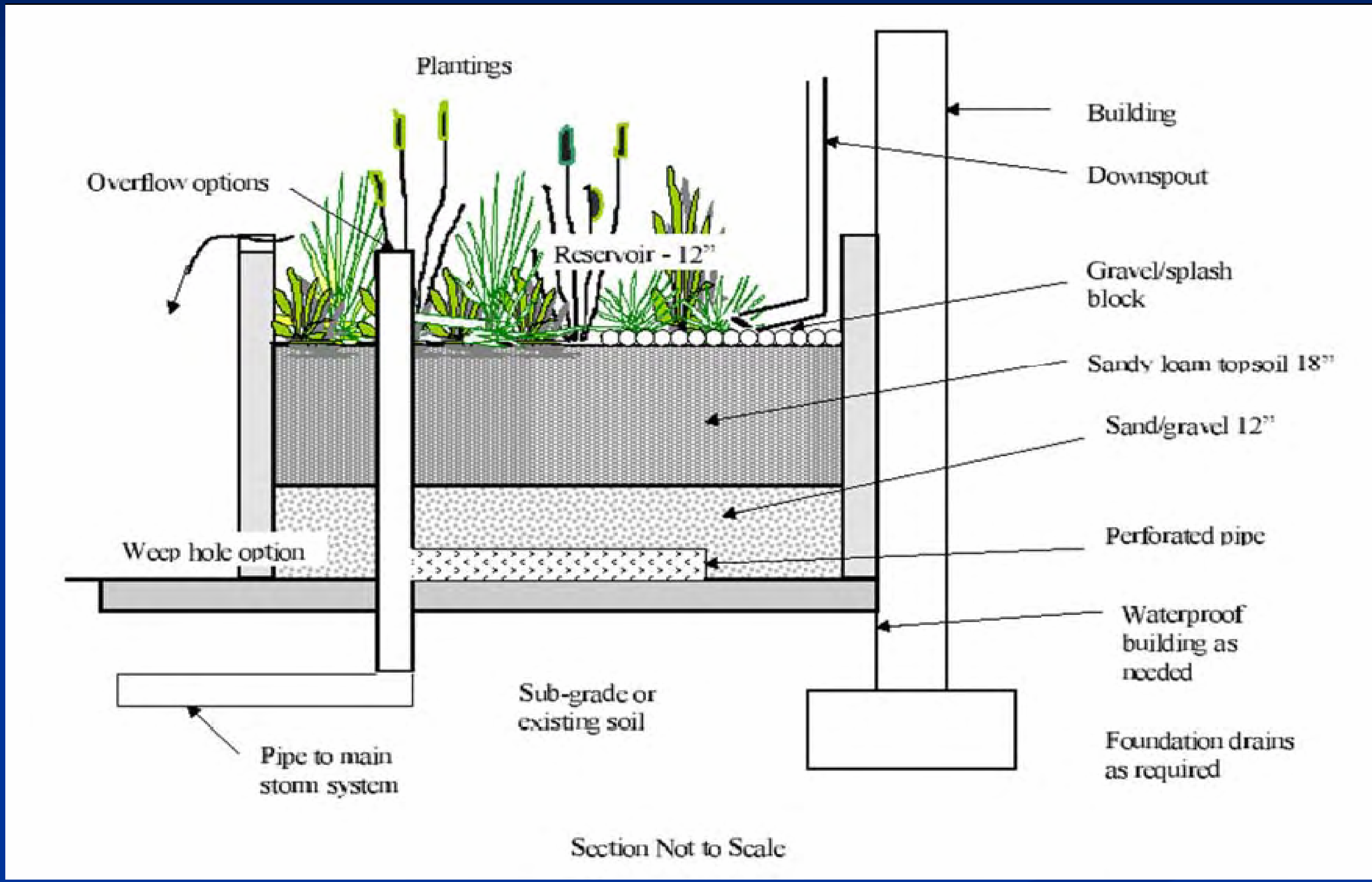
Contained Stormwater Planter

Stormwater Planters



Infiltration Stormwater Planter

Stormwater Planters



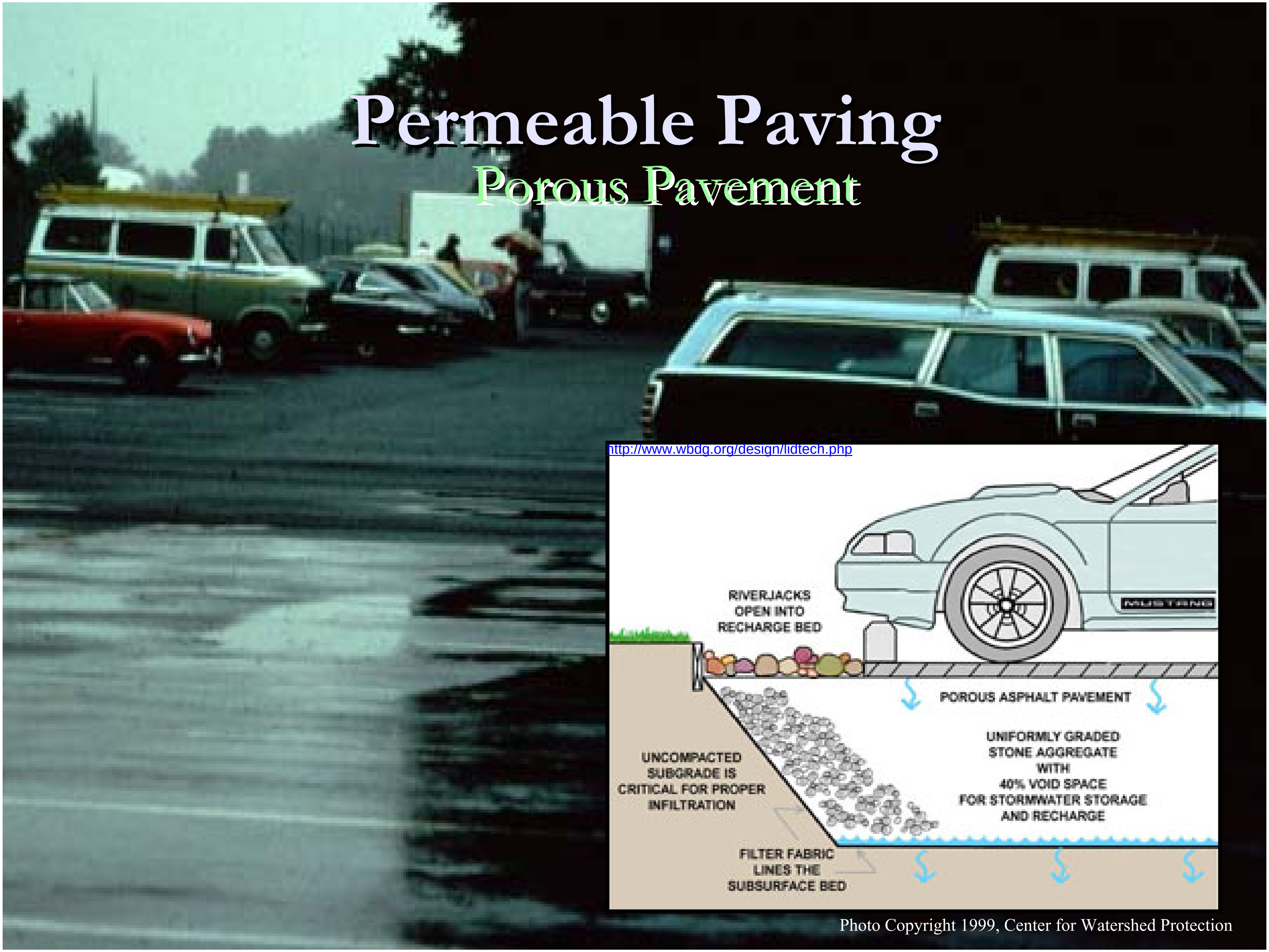
Flow through stormwater planter

Stormwater Planters

- Benefits
  - On-site soils, high GW table not suitable for infiltration
  - Reduction of discharge volume, velocity from impervious areas
  - Aesthetic landscape element and micro-habitat
- Limitations
  - Not designed to treat roadway runoff
  - Overflow needs to be directed to a secondary treatment system or storm drain system.

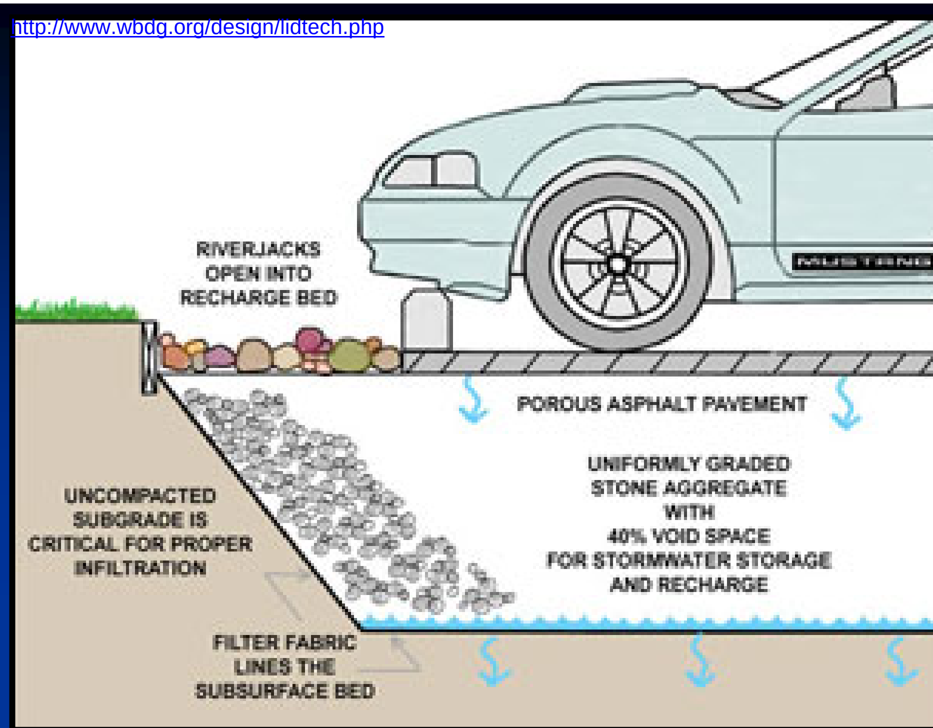
Permeable Paving

Permeable Paving
Porous Pavement



Porous Pavement - Sizing

$$A_p = WQv/n \times d_t$$



Ap = Porous Pavement Surface Area

WQv = Design Volume (cubic feet)

n = porosity of gravel bed/reservoir (0.4)

dt = depth of gravel bed (maximum 4 feet)

Permeable Paving

Permeable Pavers

- Applications
  - low-traffic areas
  - overflow parking
  - Residential single family home
  - GW recharge
- Limitations
  - suitability of the site grades
  - Subsoils
  - Drainage characteristics
  - Groundwater conditions
- Sizing
  - based on surface area

Other Updates

- Chapters 2, 9 and 10
- Additional Practices
  - Removed from Chapter 5
  - Proprietary systems on the web
- Future Updates
  - Bioretention mix
  - Hotspot treatment
  - Schematics
  - Rural projects
  - Maintenance
  - Infiltration testing

Questions?

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