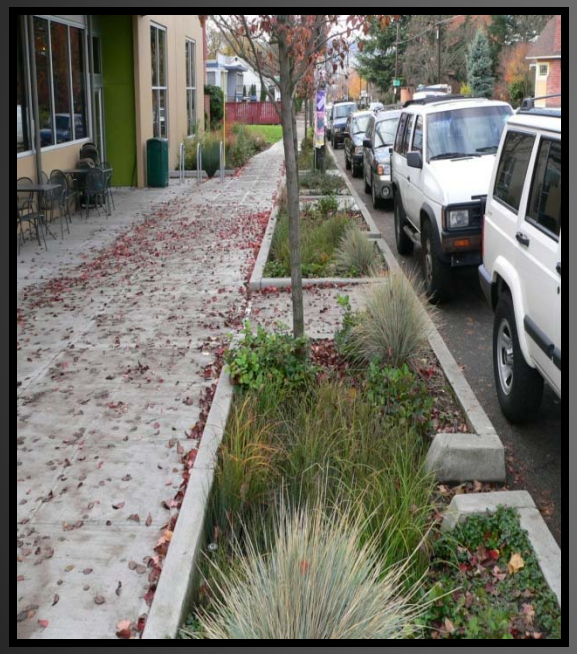
The goal of these workshops is to give designers, builders and managers the technical details necessary to properly design, construct and maintain LID facilities.



- LID research, data, guidelines, specifications, and regulations are evolving rapidly.
- New and evolving bioretention guidelines.
- New resources, including: SWMMWW, 2012 LID Manual, Rain Garden Handbook.

low impact development technical workshop series

WASHINGTON STATE UNIVERSITY EXTENSION

HERRERA

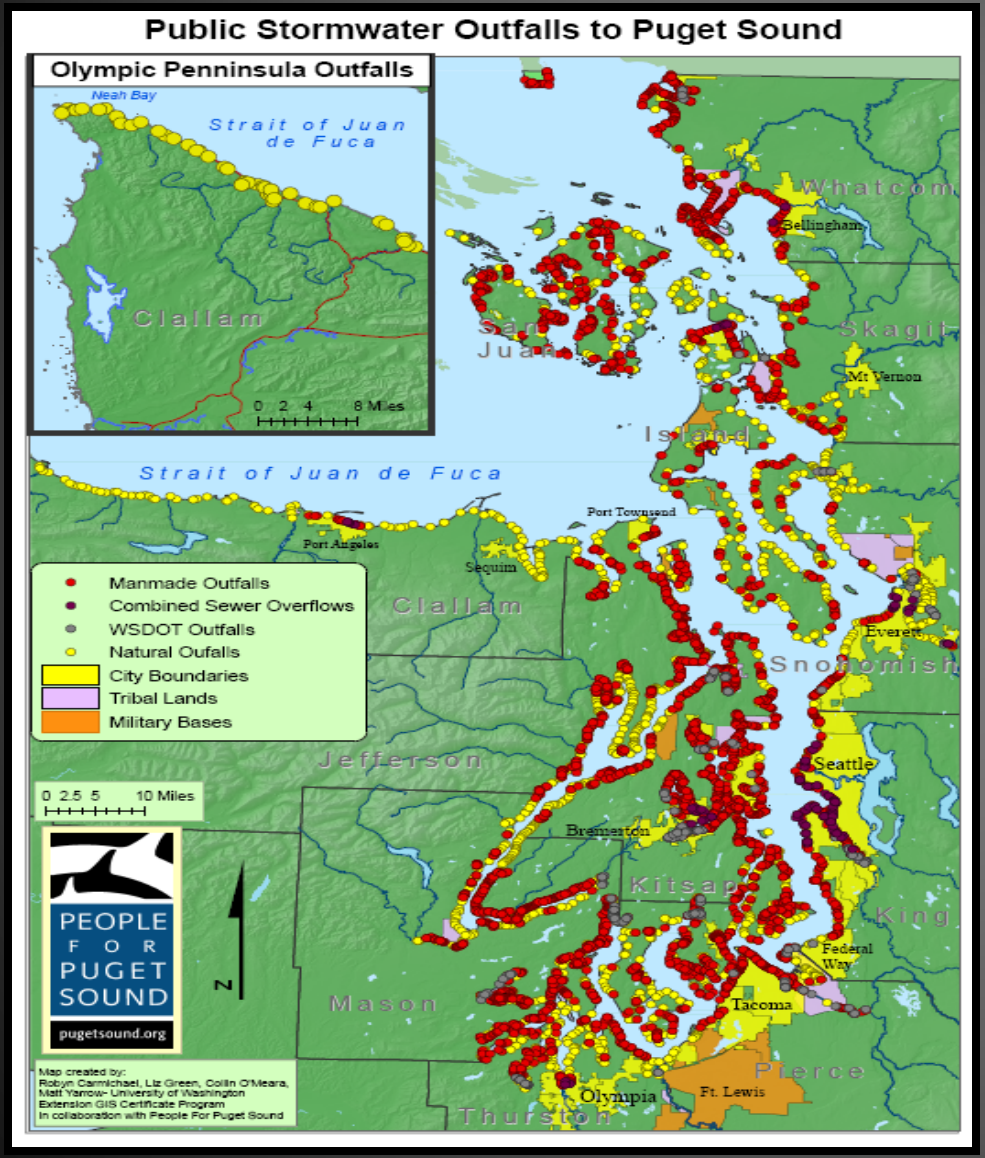
Fundamental questions to consider during the workshops

LID or a distributed approach involves the public in stormwater management. Increased public education and engagement necessary.

LID or distributed approach manages stormwater in smaller contributing areas...this is a fundamental shift in design approach and likely system performance.

Effective application of LID on difficult sites is possible, but site assessment, design and construction precision necessary for success increases significantly.

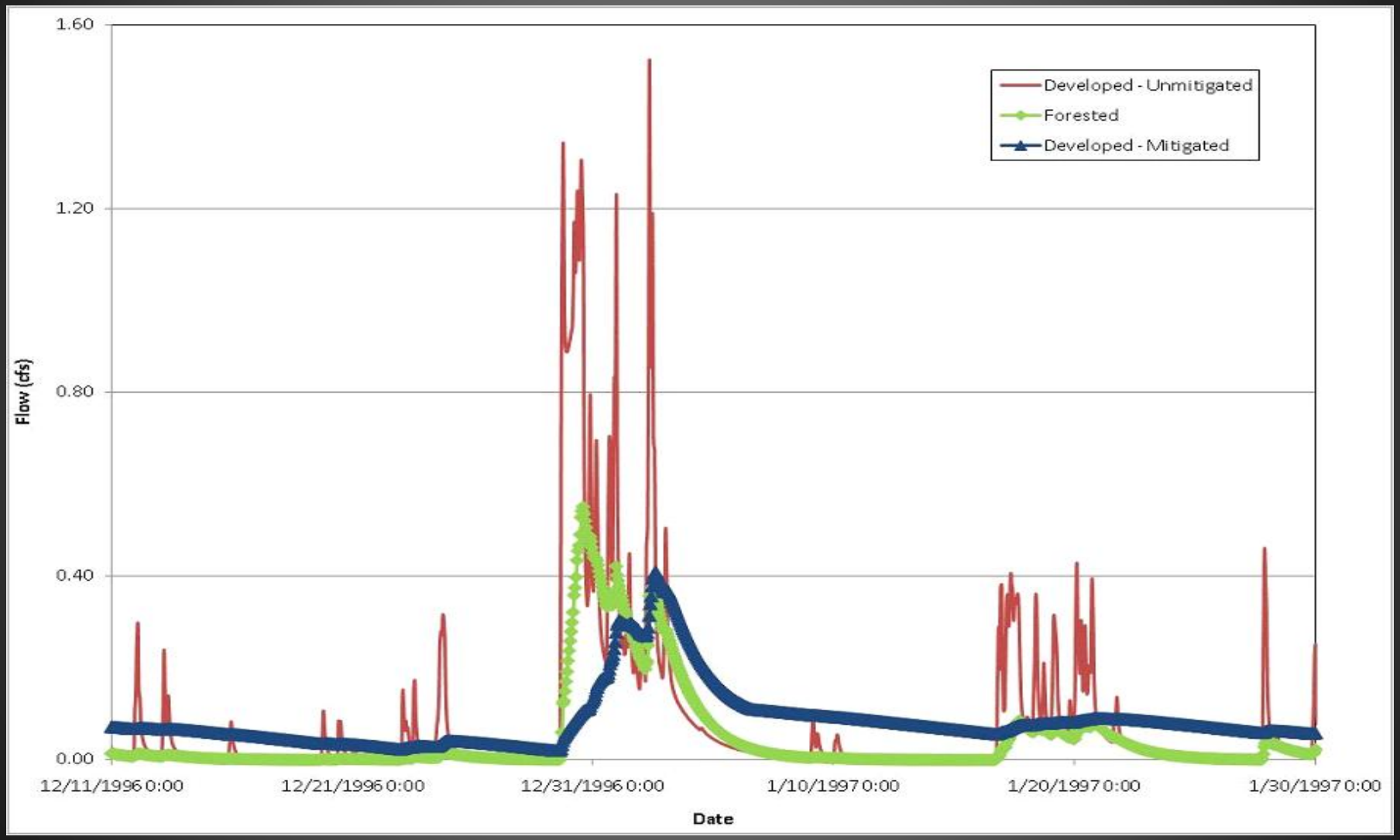
Puget Sound Conditions

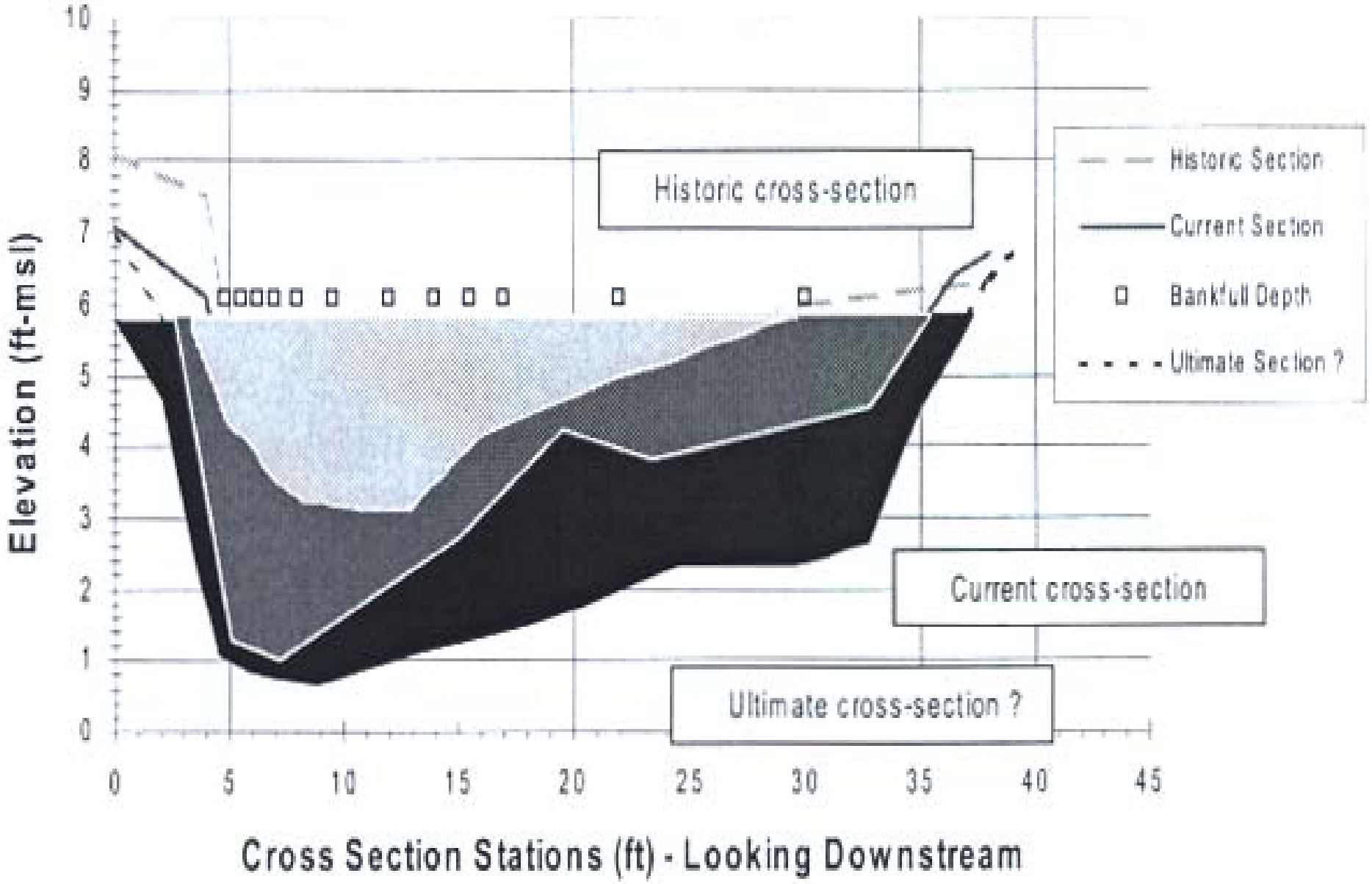


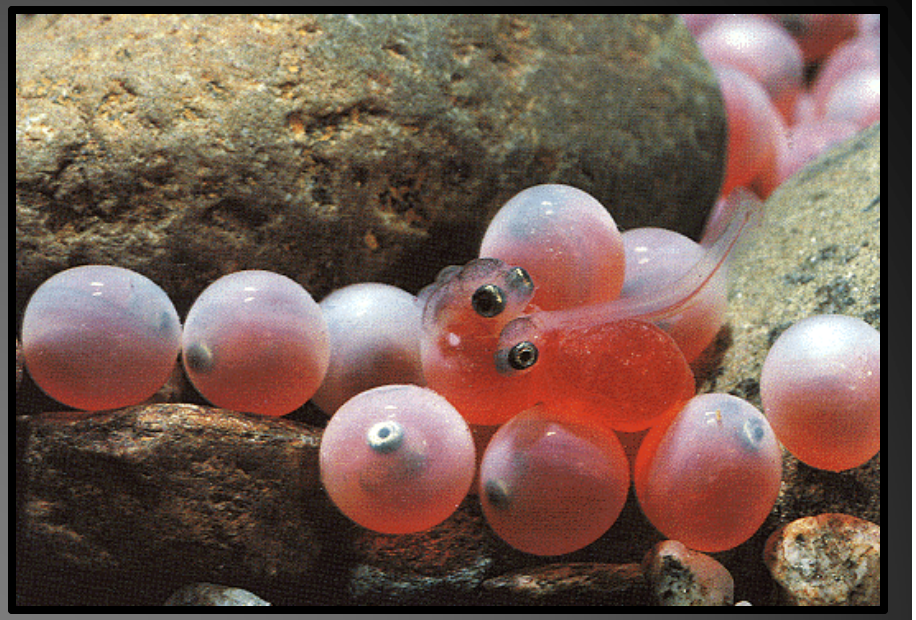
Stormwater outfalls:

- 4,529 manmade.
- 2,123 natural drainages.
- 93 CSO.
- 297 WSDOT.

Peak Flow Control




Elevation (ft-msl)
10
9
8
7
6
5
4
3
2
1
0
0
5
10
15
20
25
30
35
40
45
Cross Section Stations (ft) - Looking Downstream
Historic cross-section
Current cross-section
Ultimate cross-section ?
Historic Section
Current Section
Bankfull Depth
Ultimate Section ?



Incised stream-increased peak flow and flow durations:

- Increased external and channel sediment delivery, and embededness.
- Decreased pools, interstitial oxygen levels and habitat complexity.

Comprehensive Stormwater Management Program

- Land use planning
- Standards equal to Ecology's
- Site plan review
- Construction site inspections
- Maintenance
- Source control
- Illicit discharges & problem response
- Existing problems
- Public education & involvement
- Watershed or basin planning
- Monitoring
- Stable funding
- Low impact development

From Puget Sound Water Quality Management Plan

Low Impact Development Principles and Practices

A land use development strategy that emphasizes protection and use of on-site natural features to manage stormwater.

Integrated engineered, small scale stormwater controls.

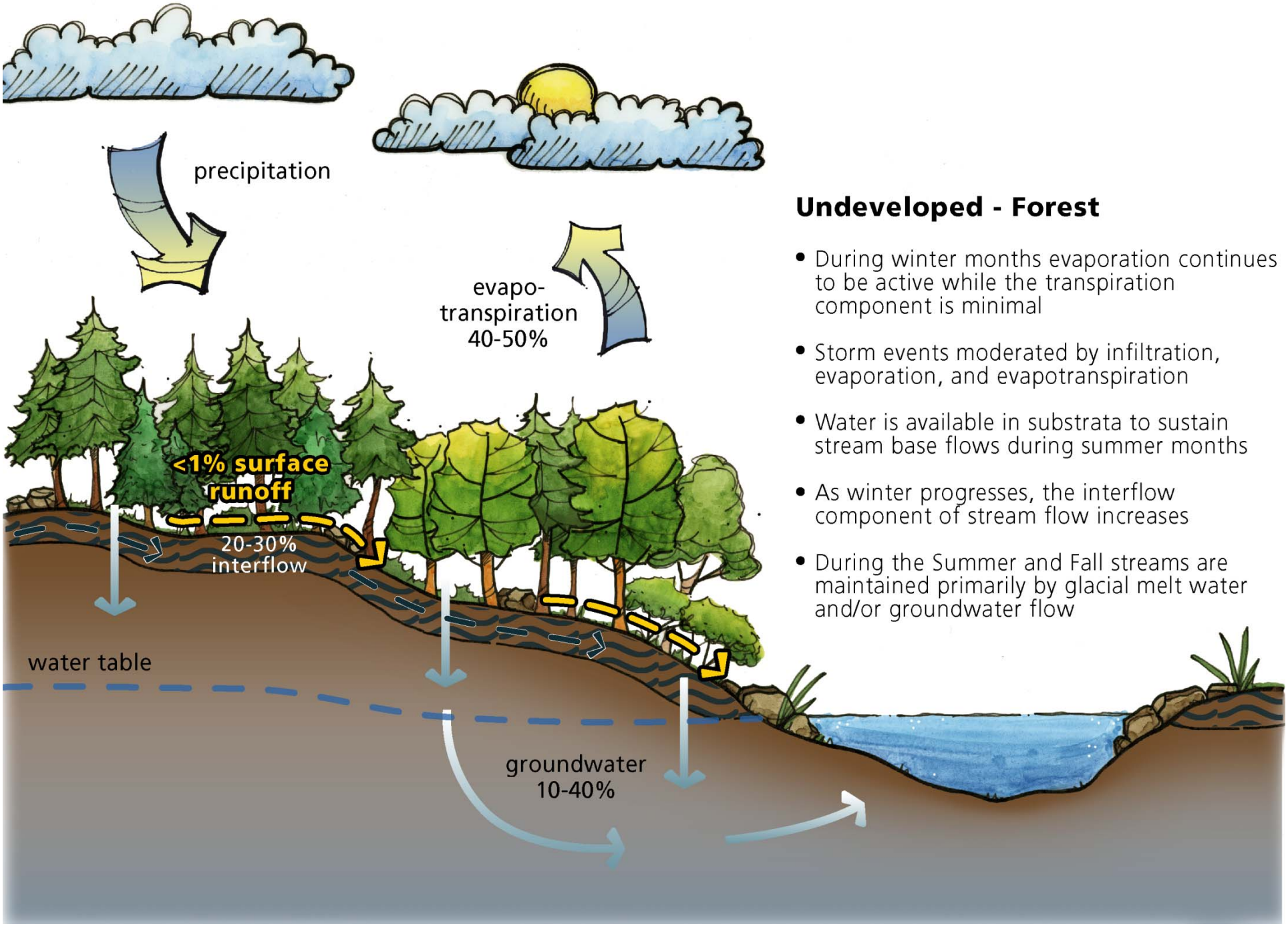
Low Impact Development Principles and Practices

Used at the parcel and subdivision scale: site scale necessary but not sufficient...regional land use planning critical for effective stormwater management.

Primary goals: 1) no measurable impacts to receiving waters; and 2) maintain or more closely approximate pre-development surface flow volumes and durations.

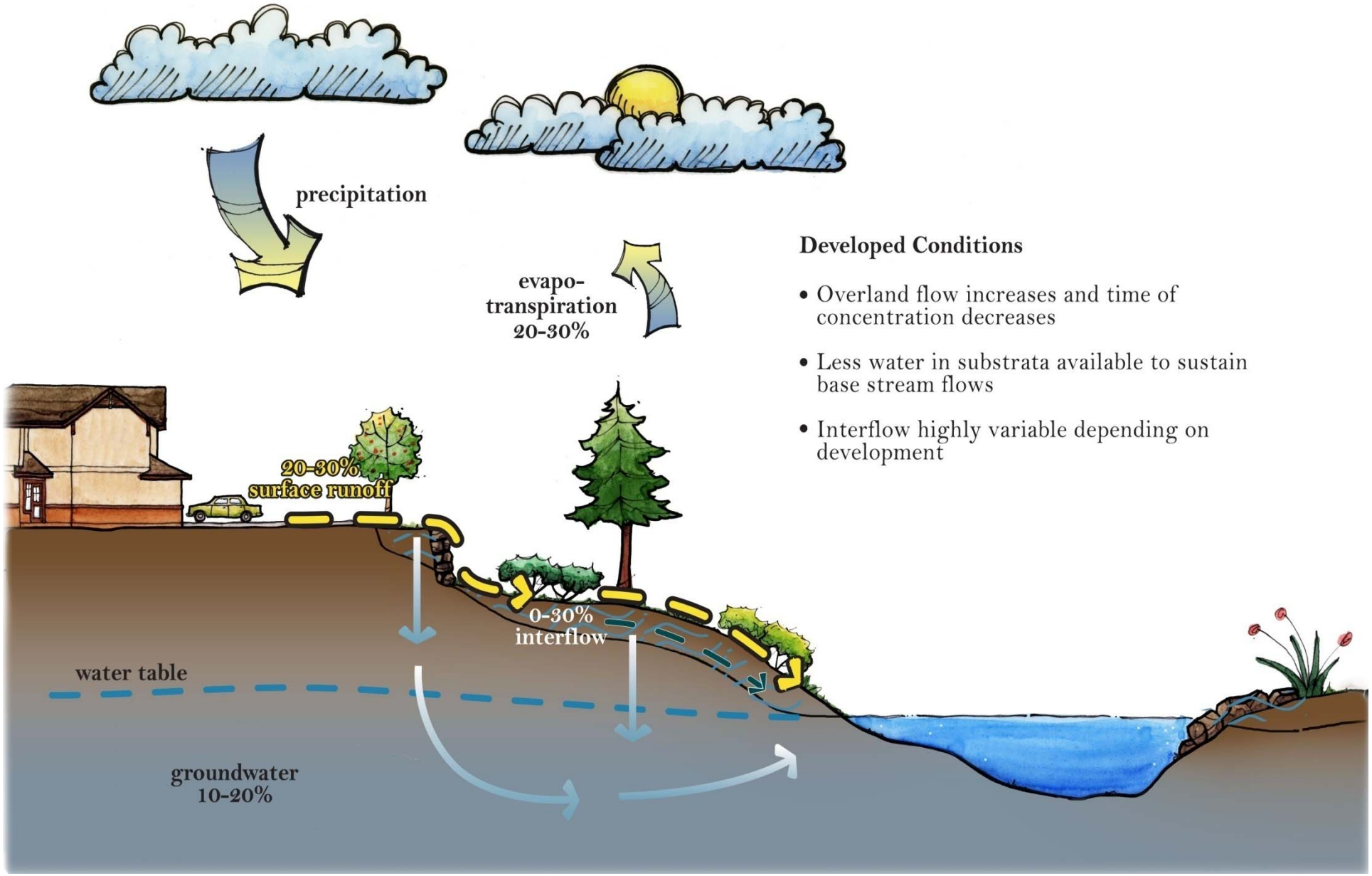
LID Objectives

- Protect and restore native soils/vegetation.
- Reduce the development envelope.
- Reduce impervious surfaces and eliminate effective impervious area.
- Manage stormwater as close to its origin as possible.
- Integrate stormwater controls into the design—create a multifunctional landscape.
- Reduce concentrated surface flow, minimize stormwater contact with impervious surfaces, and increase stormwater contact with soils and vegetation.



Undeveloped - Forest

- During winter months evaporation continues to be active while the transpiration component is minimal
- Storm events moderated by infiltration, evaporation, and evapotranspiration
- Water is available in substrata to sustain stream base flows during summer months
- As winter progresses, the interflow component of stream flow increases
- During the Summer and Fall streams are maintained primarily by glacial melt water and/or groundwater flow



Developed Conditions

- Overland flow increases and time of concentration decreases
- Less water in substrata available to sustain base stream flows
- Interflow highly variable depending on development

Total acres:

23.92

Lots:

103 (4,143 sq ft ave.)

Open space:

15 acres (63%)

Effective impervious area

approaching 0%

AHBL

Pierce County

WASHINGTON STATE UNIVERSITY
EXTENSION


MAY 8 2002


bobcat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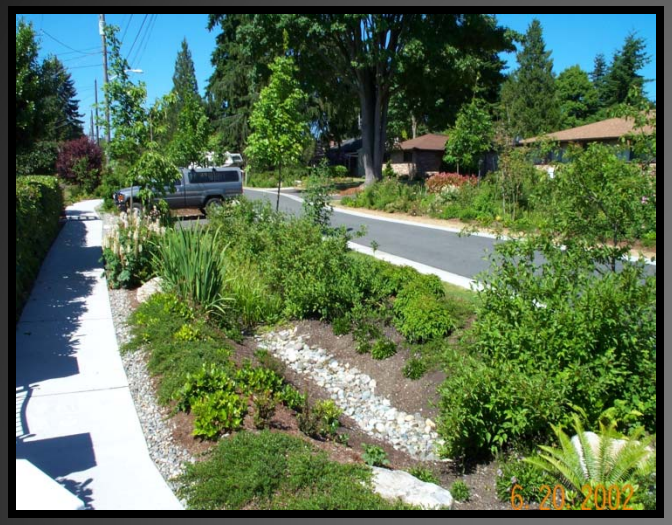
Compost Amended Soils

MANUAL 2002

GUIDELINES & RESOURCES

FOR IMPLEMENTING
SOIL DEPTH & QUALITY
BMP T.5.13 IN WDOE
WESTERN WASHINGTON
STORMWATER MANUAL

Basic Bioretention Application



Shallow landscaped depressions that receive stormwater from small contributing areas.

Soil mixes and plants selected to mimic native conditions.

Small scale, dispersed facilities integrated into the design as a landscape amenity.

Benefits of Bioretention

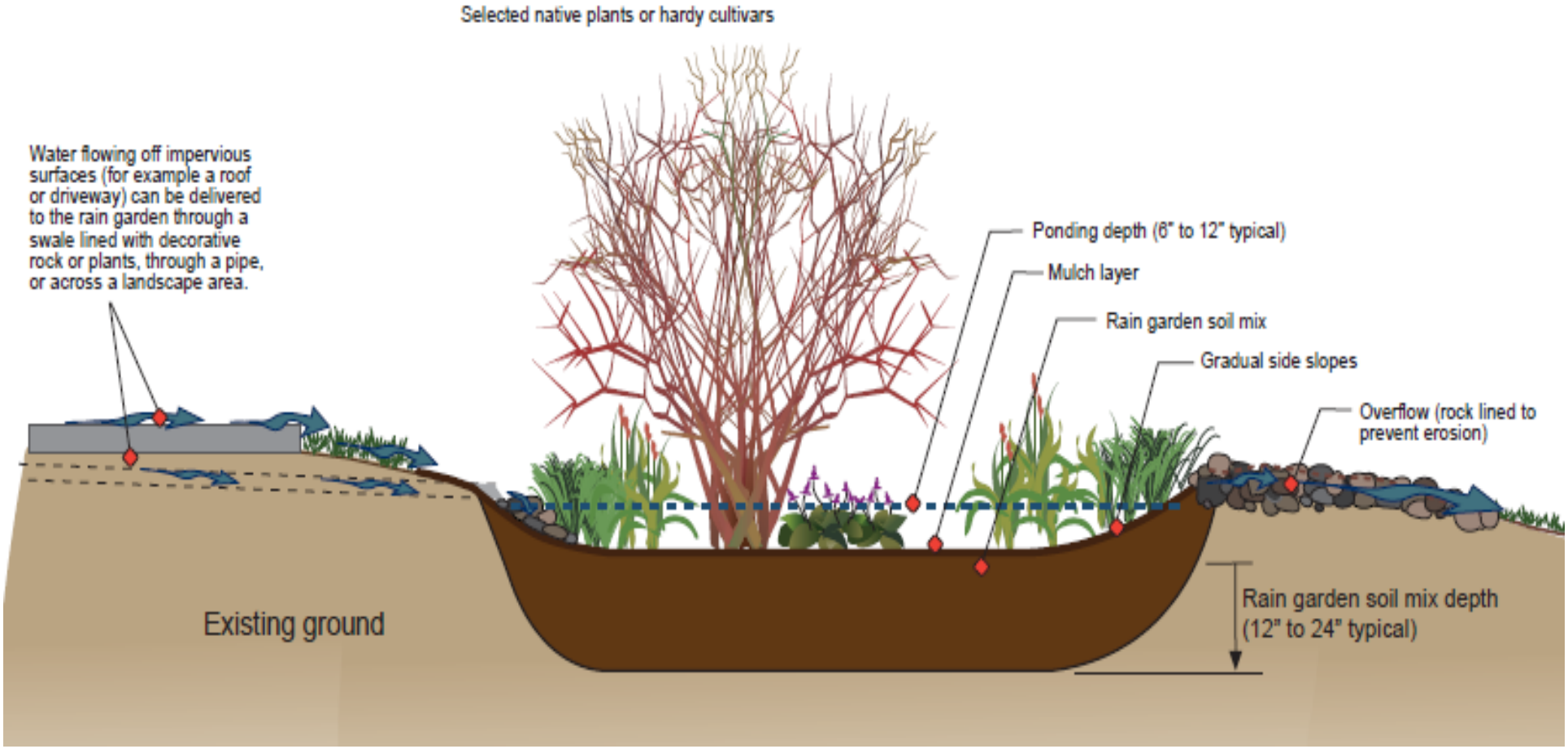
Reduce flooding on neighboring property, overflow in sewers, and erosion in streams by absorbing water from impervious surfaces.

Filter oil and grease from driveways, pesticides and fertilizers from lawns, and other pollutants before they reach the storm drain and eventually streams, wetlands, lakes and marine waters.

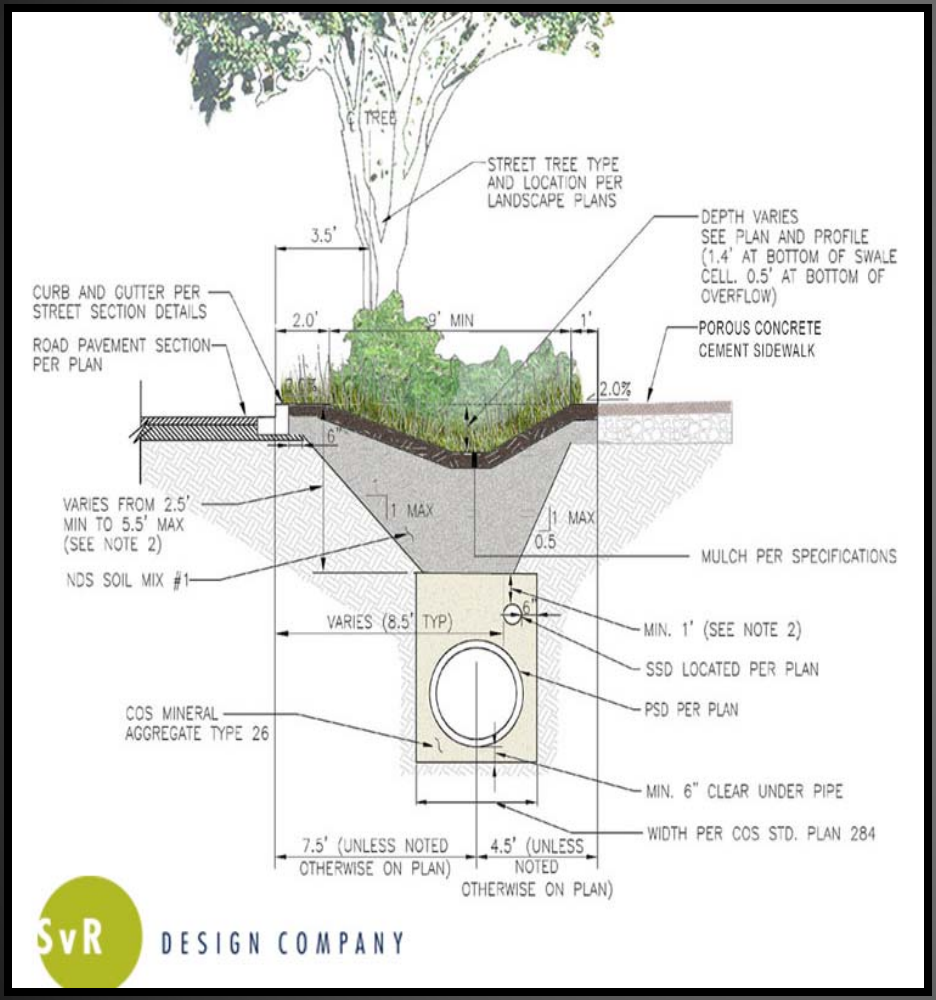
Increase the amount of water that soaks into the ground to recharge local groundwater.

Provide habitat for beneficial insects and birds.

Anatomy of a Rain Garden



Anatomy of Bioretention



Often fitted with various under-drain configurations to manage larger flows in poorer-draining soils or for specific water quality treatment objectives.


GLENCOE ELEMENTARY
RAINGARDEN
ANA691
Rain Garden

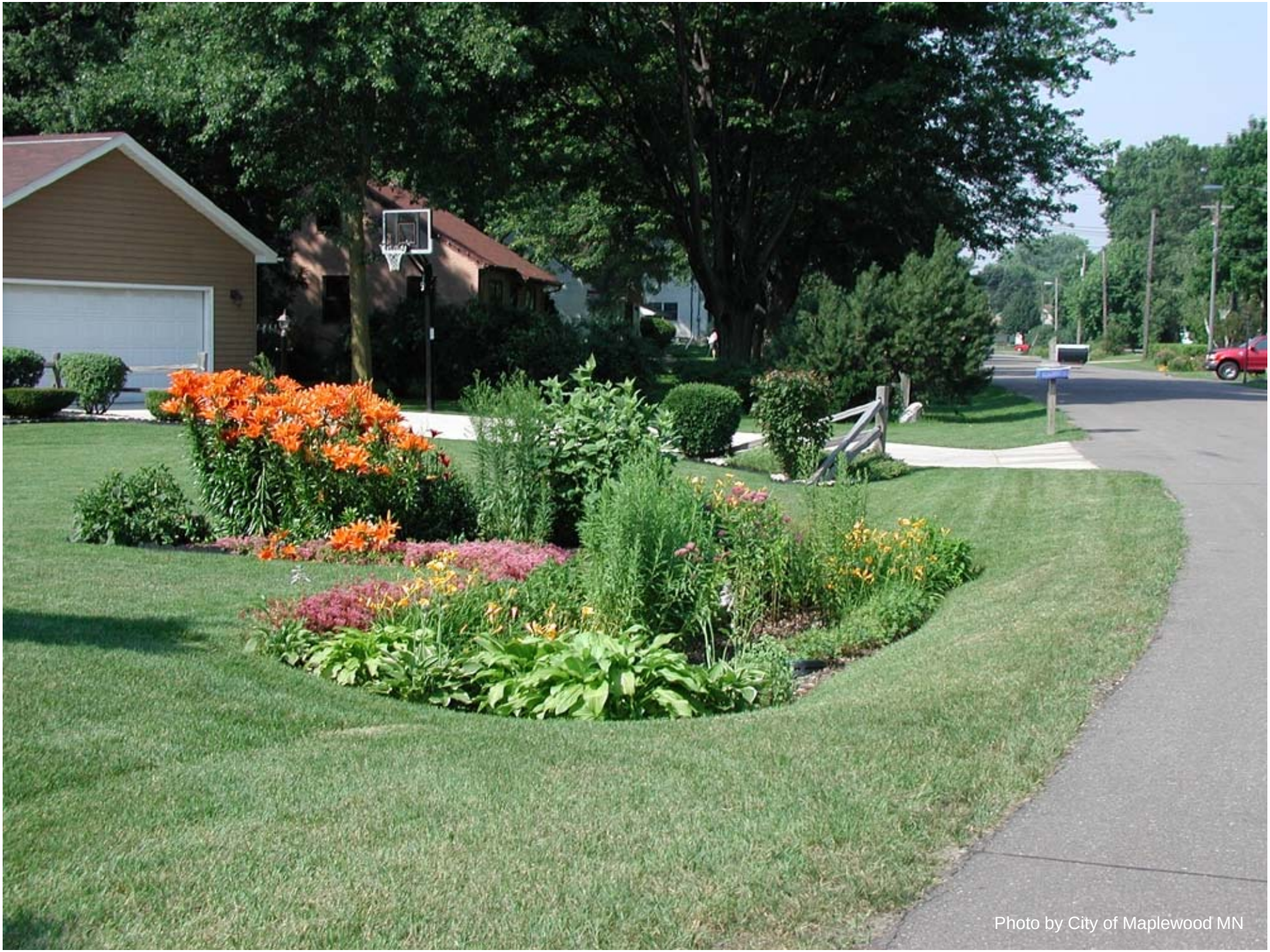


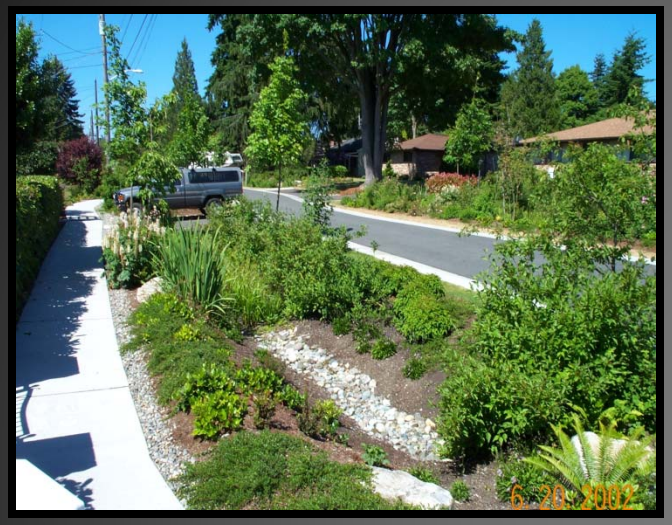
Photo by City of Maplewood MN


Photo by Filterra

Five Critical Design and Construction Factors

- Site assessment.
- Correct design specifications.
- Qualified installers.
- Erosion and sediment control.
- Maintenance.

Application Trends

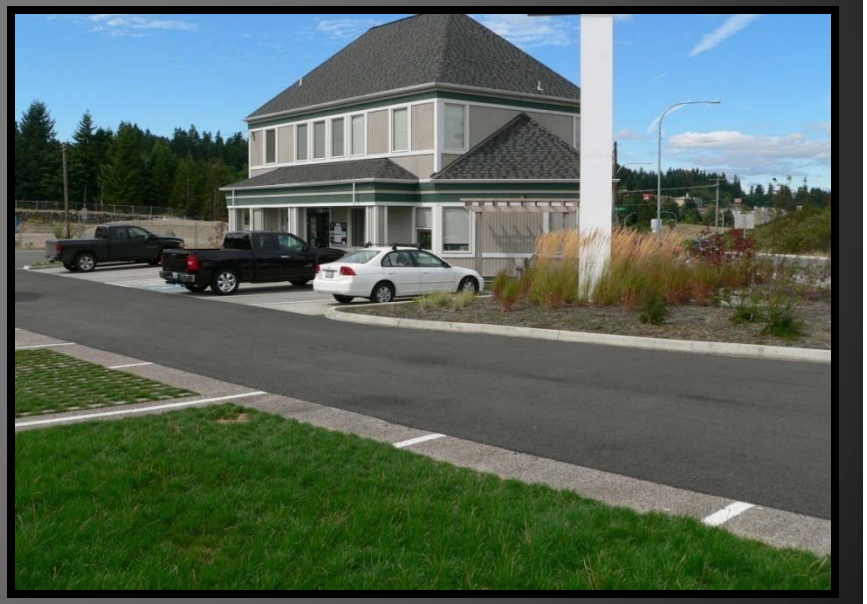


- Bioretention swales adjacent to roads and within right of way.
- Application of bioretention cells on single family lots increasing...in this region and nationally.
- Construction in dense settings requires careful sequencing and TESC.
- Most challenging design elements likely soil media and under-drains.

Application Trends

SEA Street project, 2nd Ave NW, from NW 117th to NW 120th

Hydrologic performance tending to exceed design expectations.



Approximately 98% stormwater volume reduction compared to pre-existing street design.

Myths

- Bioretention is not and effective flow control practice on till.
- Bioretention can not be used for water quality treatment in pollutant hot spots.
- Geotextiles necessary at the soil mix and native soil interface.