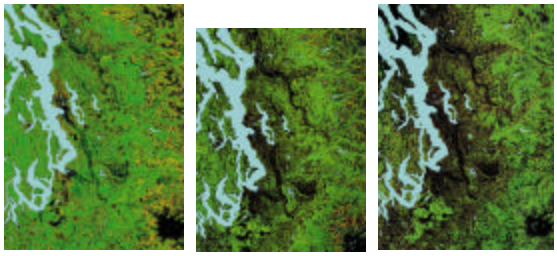
Street Alternatives: Seattle Public Utilities Natural Drainage System Program

Seattle Public Utilities

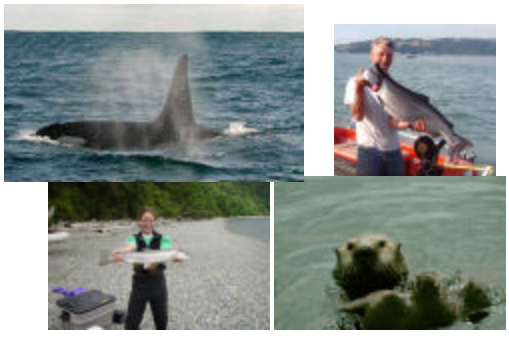
Urbanization of Puget Sound



1972 1986 1996

Applied, Analysis Inc. --- http://www.discover-aai.com/index.htm

Endangered and threatened species of Puget Sound – orca, chinook (steelhead, chum, coho, etc.)



Natural Drainage Systems

Tries to make this… **…function like this.**

Seattle's Natural Drainage System Program

City Right-of-Way

- Residential Neighborhood – NDS Grids
  - –SEA Street Prototype
  - –Cascade Prototype
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- High density Neighborhood– High Point
- Commercial Area – Swale on Yale

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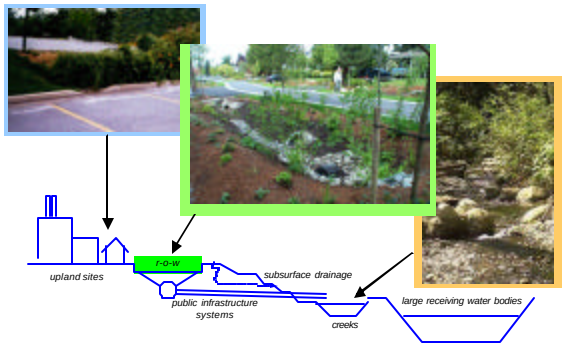
Tracy Tackett, Low Impact Development Program Manager

Opportunities within a watershed



Before After

SEA St: 2nd Ave NW between 117th & 120th Streets, aerial looking nor

Curvilinear Template

Who to Involve

Street Design, Landscape Architects, Other Utilities, …

SEA Street monitoring results for two years:

99%

reduction in total runoff volume

NW110th Carkeek Cascade

Existing Systems

Carkeek **Cascade** at NW 110th

Combined with flow through water quality channel

Different from SEA Street – lots more water, steeper slopes

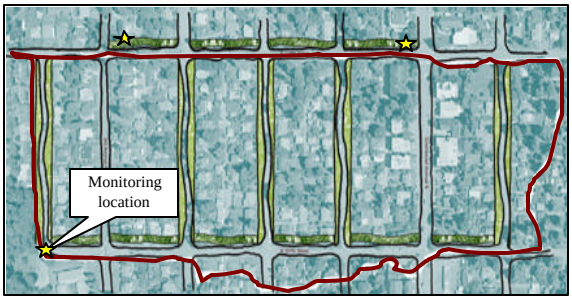
Major Lesson Learned, Street Guidelines

Major Lesson Learned, Soil Wrap Wall specs

Water Quantity and Quality Monitoring by UW (Cameron Chapman) – great performance

Major Lesson Learned, modeling
- Less runoff than anticipated
- Higher average annual infiltration rate

Broadview Green Grid



Sub-basin drainage area = 32 acres

SEA Streets and Cascades

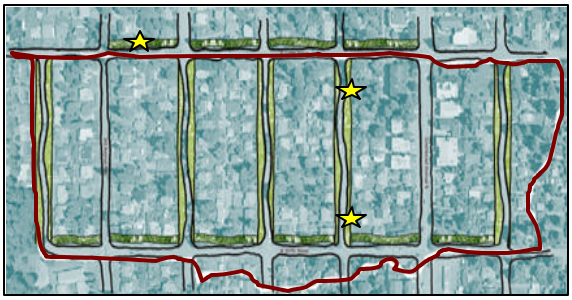
Major Design Change

Major Lesson Learned, Native Soils

Major Lesson Learned, Native Soils

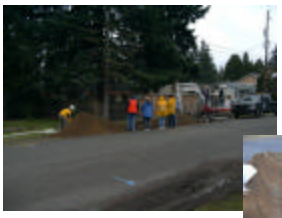
Major Lesson Learned, Native Soils

Major Lesson Learned, Native Soils



Sub-basin drainage area = 32 acres

Native Soil Infiltration Rates



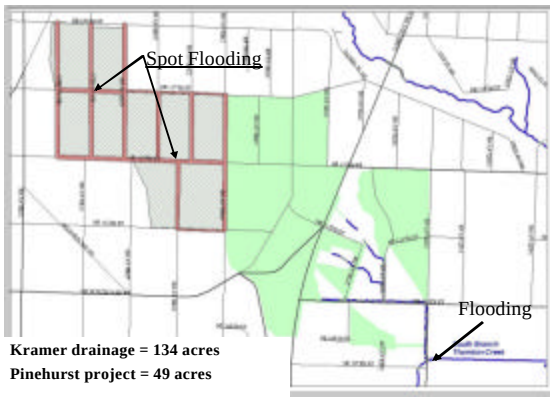
Modified Full Scale Field Testing (PIT)

Field flexibility - Subsurface Pipe

Major Lesson Learned, Bioretention Soils

Major Lesson Learned, need better modeling

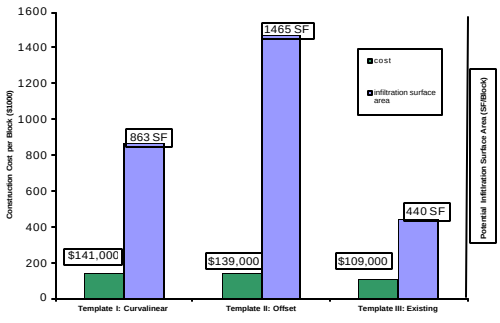
Pinehurst Project Area



- **Kramer drainage = 134 acres**
- **Pinehurst project = 49 acres**

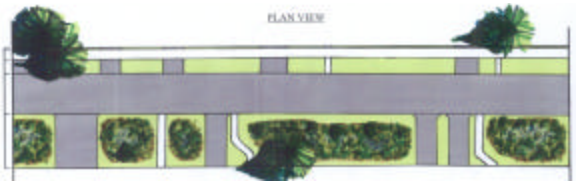
Offset Template

Block Scale Template Cost/Benefit Comparison



Major impact to residents during construction!

Construction Costs



$280,000 for 660’ block

42% Stormwater elements (including soil)

45% Street improvements (road, curb, sidewalk)

13% Landscaping

Note: correlates to approximate $200/ LF for stormwater elements

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More Project Information:

http://www.ci.seattle.wa.us/util/naturalsystems/

Natural System Program

High Priority Watersheds

North:
Piper's Creek Watershed

South:
Longfellow Creek Watershed

Longfellow Creek Watershed

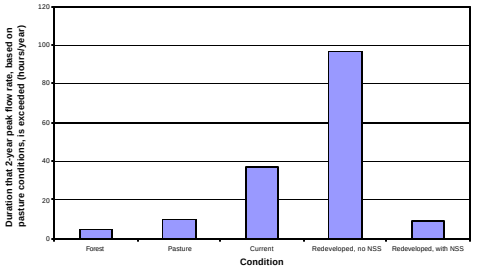
High Point Redevelopment

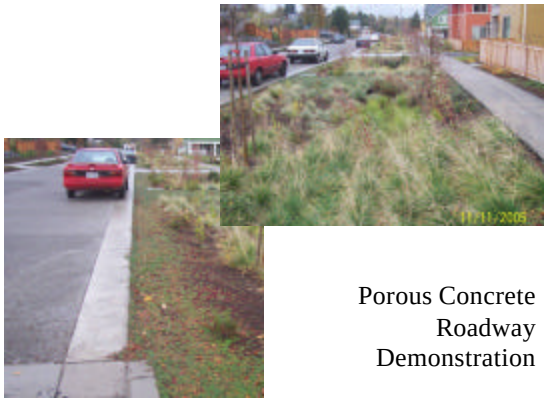
- **130-acre site**
- **new right-of-way**
- **1,600 units**
- **65% impervious area**
- **9% of watershed**

High Point Natural Drainage Strategies
Housing: Block-level Design

High Point Neighborhood

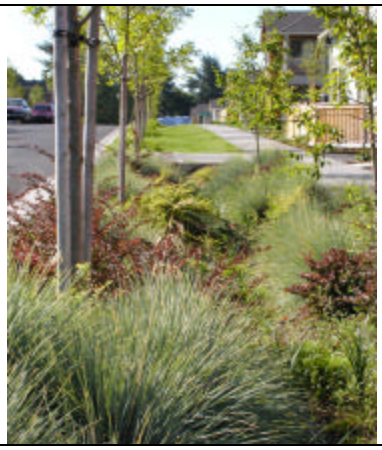
Case Study: High Point Redevelopment, Seattle, WA





Porous Concrete
Roadway
Demonstration

Who to work with – Permitting and enforcement procedures in place prior to construction



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Right-of-Way - Commercial Neighborhood

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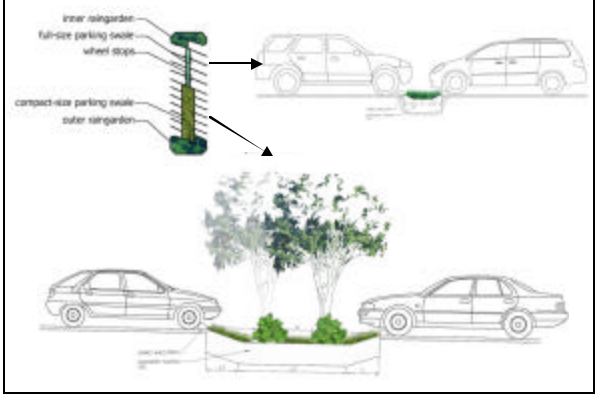
Telescope Swale Details



Private Property: parking lots


Department of Planning and Development

CAH 515

dpd Seattle Permits

Green Parking Lots

WHO SHOULD CONSIDER GREEN PARKING LOTS?

WHAT ARE GREEN PARKING LOTS?

Natural Drainage Landscapes

http://www.ci.seattle.wa.us/dpd/Sustainable_Building

Rainwise Incentives Program

- Rainwater cisterns
- Green roofs
- Biortention
- Bioswales
  - – Peak reduction
  - – Peak and volume reduction
- Compost amended soil
- Porous pavement
- Reduction of impervious surface area

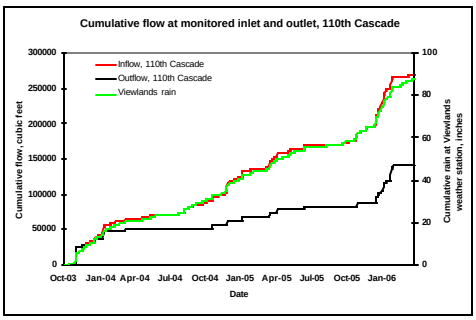
More Project Information:

http://www.ci.seattle.wa.us/util/naturalsystems/

Major Lesson Learned, Stewardship

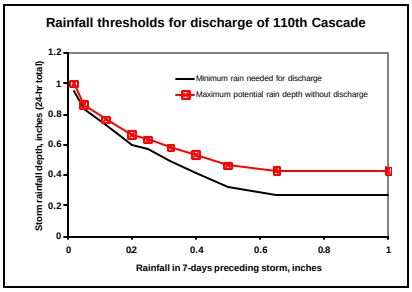
Water Quality Monitoring by UW

Results: runoff retention



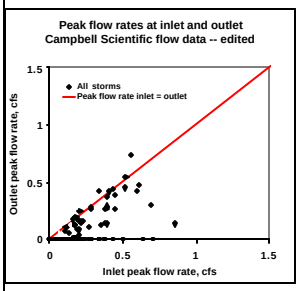
- System retains at least 48% of all inflows

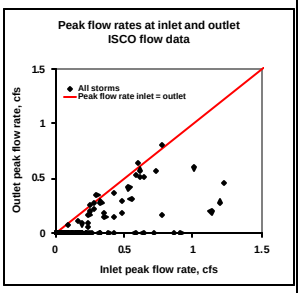
Results: outlet hydrology



- Discharge in only 49 of 235 storms
- Fully retains storms up to 1" in dry conditions
- Fully retains storms up to 0.3" in any condition

Results – peak flow reduction





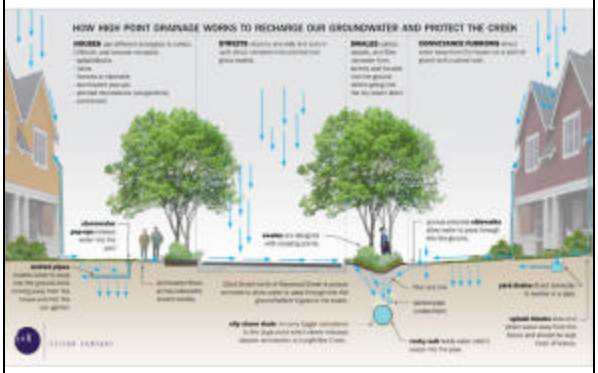
Water Quality Results: Conservative estimates of percent reduction in mass loading

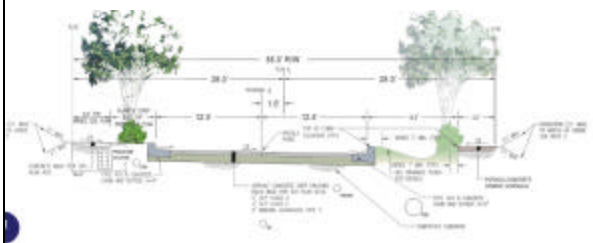
Pollutant	**Method 1**	**Method 2, 3***
TSS	84 (72-92)	89, 86*
TN	63 (53-74)	67
TP	63 (49-74)	73
Copper	83 (77-88)	83
Zinc	76 (46-85)	84
Lead	90 (84-94)	89
Motor oil	92 (86-97)	93

Results: typical outflow quality from 110th Cascade (mg/L)

Pollutant	**Range**
TSS	10 – 40
TN	0.6 – 1.4
TP	0.09 – 0.23
SRP	0.02 – 0.05
Total copper	0.004 – 0.008
Dissolved copper	0.002 – 0.005
Total zinc	0.04 – 0.11
Dissolved zinc	0.02 – 0.06
Total lead	0.002 – 0.007
Dissolved lead	< 0.001
Motor oil	0.11 – 0.33

High Point Neighborhood





Swale Cross Sections

- Vegetated swale
- 10” ponding
- 18” deep

- Grass-lined swale
- 2” ponding
- 8” deep

Porous Concrete Roadway