Implementing Green Infrastructure: Creative Approaches to Reducing Regulatory and Financial Barriers in Seattle

April Mills
Seattle Public Utilities
Overview

• Funding source
• Partnering
• Interagency coordination
Funding Source
Establishing a Funding Source

- SPU is rate-payer based.
- Scale the drainage rate by the impact of each parcel on the drainage system.
- Offer rate reductions for those parcels that reduce their environmental impact using green infrastructure (SFCP).
### Drainage Rate Structure

**Single-family residential and duplex parcels less than 10,000 SF = Flat rate based on parcel size**

<table>
<thead>
<tr>
<th>Small residential</th>
<th>2011</th>
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<tbody>
<tr>
<td>Under 3000 SF</td>
<td>$134.06</td>
</tr>
<tr>
<td>3000 – 4999 SF</td>
<td>$173.10</td>
</tr>
<tr>
<td>5000 – 6999 SF</td>
<td>$234.94</td>
</tr>
<tr>
<td>7000 – 9999 SF</td>
<td>$298.32</td>
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| Undeveloped (0-15% impervious) | $19.72 |
| Low impact Undeveloped       | $12.35 |
| Light (16-35% impervious)    | $29.62 |
| Low impact Light             | $23.47 |
| Medium (36-65% impervious)   | $42.89 |
| Low impact Medium            | $34.43 |
| Heavy (66-85% impervious)    | $56.57 |
| Very Heavy (86-100% impervious) | $74.49 |
Stormwater Facility Credit Program
Partnering
Partnering

• Rebates
  – RainWise Program

• City requirements
  – Green Factor
  – Stormwater Code

• Public-private partnerships
  – Capital Hill Water Quality Project
  – Highpoint
Seattle Drainage System

- Pink - Creek/Separated Sewers
- Green - Partially Separated Sewers
- Yellow - Combined Sewers
SPU CSO System

- 90 permitted CSO outfalls
  - 37 CSO outfalls do not meet CSO requirements
- 35 CSO storage facilities (8.1 MG)
- 100-200 million gallons CSO discharged annually
- About 200 CSO discharge events annually
- Integration with King County
Using Green Infrastructure for CSO Control
Partnering with the Community: Residential RainWise (2010-2017)
Be RainWise

Rain that falls on our roofs, driveways and other hard surfaces can carry pollutants to our creeks, Lake Washington, and Puget Sound. During big storms, the sheer volume of this “storm water” can flood homes, cause sewer overflows, and erode hillsides and streambanks.

We can all help to slow and clean the rain runoff from our homes with simple projects that are useful and attractive additions to our yards.

Explore

Explore useful solutions for controlling stormwater around your home.

Find

Locate RainWise projects and share your own.

Get Started

Select a contractor to install your project.

Do you live in Ballard?

Find out about financial incentives for stormwater actions.

Contractor Workshops

Business opportunities for Seattle licensed contractors and design professionals. Learn more.

Contractors and Vendors

Want to register as a Rainwise Contractor? Find out more here.

www.rainwise.seattle.gov
Seattle’s Stormwater Code Requires GSI to the MEF
Stormwater Manuals

www.seattle.gov/util/greeninfrastructure
(navigate to Stormwater Code compliance)

- Compost Amended Soil
- Trees
- Bioretention
- Permeable Pavement
- Green Roofs
- Cisterns
- Downspout Dispersion
- Sheet Flow Dispersion
Seattle Green Factor

Improving livability and ecological function through landscaping standards

Phase IV Terry Plaza Looking East
How does the Green Factor work?

- Provides weighted menu, sets minimum score
- Includes green roofs and walls, bioretention, and permeable paving
- Compliance required for permit approval

http://www.seattle.gov/dpd/permits/greenfactor/Overview/
UBC study found that Green Factor, applied over a 9-block area, would result in…

- 13% reduction of stormwater runoff
- 9% reduction of energy demand
- 12% GHG reduction

(Roehr et al, 2008)
Capital Hill Water Quality Project

- Biofiltration treatment of road runoff from Capital Hill to South Lake Union
- WQ treatment for 130 – 190M gallons/yr
Capitol Hill Water Quality Project

KEY DESIGN ELEMENTS

- Swale replaces on-street parking lane
- Swale 10.5’ to 16.5’ wide, 14” to 23” deep
- 26’ wide driving/parking roadway
- Minimum 6’ sidewalks
- Mid-block (~17’ wide) pedestrian crossing
**SWALE DESIGN PARAMETERS:**

- Varying width up to 10’ wide of swale
- 2’ vertical wall on west edge of swale
- 1’ rise and 1’ run stair step on east edge of swale
- 308’ length from inside of swale wall to inside of swale wall
Capitol Hill Water Quality Project
High Point Project
High Point Natural Drainage System

- Housing Authority Project
- 129 acre drainage (8% of Longfellow Creek drainage basin)
- Engineering Diligence
  - Evaluated full SW toolbox
  - Pond plus green infrastructure
**HOW HIGH POINT DRAINAGE WORKS TO RECHARGE OUR GROUNDWATER AND PROTECT THE CREEK**

**HOUSES** use different strategies to collect, infiltrate, and cleanse rainwater.
- splashblocks
- rocks
- furrows or channels
- stormwater pop-ups
- planted depressions (raingardens)
- yard drains

**STREETS** slope to one side and cuts in curb to direct rainwater into planted and grass swales.

**SWALES** collect, absorb, and filter rainwater from streets and houses into the ground before going into the city storm drain.

**CONVEYANCE FURROWS** direct water away from the house via a path of gravel and crushed rock.

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**slotted pipes** enable water to seep into the ground while moving away from the house and into the rain garden.

**stormwater pop-ups** release water into the yard.

**porous concrete sidewalks** allow water to pass through into the ground.

**32nd Street north of Raymond Street** is porous concrete to allow water to pass through into the ground before it goes to the swale.

**city storm drain** to carry bigger rainstorms to the large pond which slowly releases cleaner stormwater to Longfellow Creek.

**yard drains** direct rainwater to swales or a pipe.

**splash blocks** slow and direct water away from the house and should be kept clean of leaves.

**filter soil mix**
- slotted pipe (underdrain)
- rocky soil
- holds water until it seeps into the pipe.
Interagency Coordination
Interagency Coordination

- Cost savings for City if multiple objectives (from multiple departments) achieved in one project
  - Walk/Bike/Ride + CSO mitigation
- Partnering dollars with other agencies set aside to integrate elements from partner agency into lead agency’s project
  - A work in progress with Dept. of Transportation
GSI Siting Considerations

In addition to soil infiltration tests and other technical feasibility variables such as grade and proximity to steep slopes, social/use variables are also critical. For example, siting roadside GSI on streets with less-congested parking, on wider streets, in areas with patches of unnecessary paving, on residential arterials or side streets where traffic calming or Neighborhood Greenways are desired, or adjacent to neighborhood destinations will help achieve multiple benefits and foster support.

Neighborhood Destinations

Streets with Less Parking Congestion

Extra-Wide Streets

Traffic-calming Desired

Oblique Intersections

- 19th NW + NW73rd Looking East
- 19th NW + NW73rd Looking South
- NW 67th St.
- NW 60th St. (parking removed)
- NW 60th St. + Loyal Way
- Sunset Hill Park
- Salmon Bay Park
- Larsens’ Corner Bakery
- Loyal Heights Elementary
- Loyal Heights Play Fields
**Major Opportunities:**
- Inter-neighborhood bicycle connections, especially E-W
- Improved Burke-Gilman Access
- Improved Ballard Bridge Crossing
- Transit Hub Facilities for bike/bus commuters along 15th Ave. NW
- Non-arterial, family-friendly bike routes, intra-neighborhood and inter-neighborhood

**Neighborhood Greenway**

To meet its Bicycle Master Plan targets, Seattle must invite more intra-neighborhood and inter-neighborhood family-friendly, everyday riding.

NW 77th St. has been identified in the Bicycle Master Plan as a critical East-West connector between the Ballard plateau, Greenlake and the UW. Adding bicycle-friendly features, traffic calming strategies and green stormwater infrastructure along this route would create Ballard's first Neighborhood Greenway.
Bus Rapid Transit Planned
15th Ave. NW, 2012

Rapid Ride

D Line
- Buses every 10 minutes
- Easy, fast boarding
- Pay in advance
- Traffic redesigns
- Lights will favor buses
- Sheltered, lit stations
- Real-time bus info
- Stop request signals
- New, low-emission buses

Legend
- RapidRide - D Line
- Other Metro transit service
- Station
- Stop

Major Opportunity:
Bicycle Park + Ride facilities along 15th Ave. NW
Additional Opportunities for Complete Streets Integration

Near-term Transit Improvements

Improved bike-transit integration: Bike + ride facility at major Rapid Ride stations might include bike lockers or dedicated, covered, lit bicycle parking and could also incorporate attractive rain garden demonstrations and/or permeable paving.

Family-Friendly Biking

Improved major connection routes to Burke-Gilman trail. Major entry points to trail could also incorporate GSI demonstrations such as attractive, linear biofiltration swales to cleanse stormwater (lower basin is a separated system).

Improved major arterial crossings at NW 85th St., NW 80th St., NW 65th St., 15th Ave. NW, and 24th Ave. NW could include curb bulb extensions with attractive GSI treatments.

Pedestrian Safety + Amenities

Safe Routes to School programs at Salmon Bay Elementary, Loyal Heights Elementary and Ballard HS could include GSI demonstration sites at or adjacent to each learning institution and/or along walking routes. Pedestrian counts could help identify most heavily-traveled routes. Similar approach could be taken with neighborhood churches and senior housing facilities.
Bulb Extension 60’ ROW

- 6” ponding
- 3’1” side slopes
- 1.5’ flat buffer at sidewalk
- 190 square foot foot bottom area
- 38’ linear feet, including including side slopes

6 additional linear feet would allow for 20’ curbs to curbs

Stormwater/CSO Considerations

- Mitigates whole block to 95% GSI standard

Walk, Bike, Ride, Considerations

- Shortens pedestrian crossing by 7”
- Narrows street/traffic calming
- Improves aesthetic quality and safety of streetscape for pedestrians and bike riders along proposed Neighborhood Greenway route
- Extends existing no-parking zone at intersection by an additional 10’, improving sightlines
- In total, 40’ no parking zone
- Enhances a Safe Routes to School route and a designated recreational walking route

Other Considerations

- Provides “outdoor classroom” opportunity for adjacent elementary school
- Existing code prohibits parking within 30’ of intersection
Achieving Multiple Benefits-
Integrating with Transportation
Stormwater Code Revision Project

Flow Control Standards

Four flow control performance standards

• Wetland Protection Standard
  Protect functions and values

• Pre-developed Forest Standard
  Listed creeks

• Pre-developed Pasture Standard
  All other creeks

• Peak Flow Control Standard
  Public combined sewer, Capacity-constrained systems, Small Lake Basins
Minimum Requirements for Flow Control

- For all parcels:
  - GSI to MEF

- For parcels ≥ 2,000 sf:
  - Creeks, Lakes
  - GSI to MEF

- For parcels ≥ 10,000 sf:
  - Flow Control
  - CSS*

* = Combined Sewer System
Maximum Extent Feasible

“the requirement is to be fully implemented, constrained only by the physical limitations of the site, practical considerations of engineering design, and reasonable considerations of financial costs and environmental impacts.”
GSI to MEF Target

- Single Family Residential – all but 1500 SF new plus replaced impervious surface
- Other – 100% new plus replaced impervious surface
- Incentive – sites with performance standard if achieve 75% control with GSI, done
Feasibility: Practical Considerations of Engineering Design

- Specify: Minimum Requirements—“may be feasible” (Stormwater Manual)
- Specify: Technical Limitations—“not feasible” (Stormwater Manual)
- Eg. Infiltration facilities – steep slopes, contaminated soils, etc
- Specify: Sizing requirements

All information compiled into “GSI to MEF Directors Rule”
Feasibility: Physical Limitations of the Site

Reflects the multiple demands on public space: historical designation, vehicular and pedestrian access, intended use of the right-of-way, urban design elements, etc.
## CSO Control Approaches

<table>
<thead>
<tr>
<th>CSO Control</th>
<th>Cost Range per Gallon</th>
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<tbody>
<tr>
<td>1. System Retrofits</td>
<td>$1 to $2</td>
</tr>
<tr>
<td>2. Green Stormwater Infrastructure</td>
<td>$3 to $22</td>
</tr>
<tr>
<td>3. Infiltration/Inflow</td>
<td>$30 to $32</td>
</tr>
<tr>
<td>4. Flow Transfer</td>
<td>Site Specific</td>
</tr>
<tr>
<td>5. Wet Weather Storage</td>
<td>$12 to $40</td>
</tr>
<tr>
<td>6. Wet Weather Treatment</td>
<td>$8 to $25</td>
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Define Priority Basin(s)

Define Project Goals

Selection of Tools (private and parcel scale alternatives)

Establish Alternatives Suite

Evaluate (performance modeling, cost effectiveness)
The Beginning of GI in Seattle: SEA Street Project

- Achieved 99% reduction in runoff
- Treated local runoff only
- Added formal drainage system and sidewalk
SEA Street Project

Pre-project

Post construction 2001

Ten years later
## Green Stormwater Infrastructure Projects

12 years of Building GSI Experience and Knowledge

<table>
<thead>
<tr>
<th>Project</th>
<th>Project Drainage Area</th>
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<tbody>
<tr>
<td>SEA Street #1</td>
<td>2 acres</td>
</tr>
<tr>
<td>NW 110th Cascade</td>
<td>28 acres</td>
</tr>
<tr>
<td>Broadview Green Grid</td>
<td>32 acres</td>
</tr>
<tr>
<td>Pinehurst Green Grid</td>
<td>49 acres</td>
</tr>
<tr>
<td>High Point</td>
<td>129 acres</td>
</tr>
<tr>
<td></td>
<td>240- acres</td>
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SEA Street #1, Seattle