

Green Stormwater Infrastructure Design and Maintenance: Replenishing the Urban Landscape

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**Santa Clara Valley
Urban Runoff
Pollution Prevention Program**

Topics Overview

- Definitions
- Stormwater Background
- Stormwater Control Measures
 - Bioretention Focus
 - Larger projects
- Design
- Construction
- Maintenance
- Additional Resources



Definitions

Gray Infrastructure

The historically-used system for conveying stormwater with pipes, catch basins, curbs, gutters, channels, storm drains and other human-made impervious materials that generally do not allow for infiltration or use natural systems such as soils or plants.



Green Stormwater Infrastructure (GSI)

Municipalities are using GSI as a **cost-effective, resilient approach** to managing wet weather impacts that provides many community benefits.

While single-purpose gray stormwater infrastructure is designed to move urban stormwater away from the built environment, GSI reduces and treats stormwater at its source while delivering environmental, social, and economic benefits.



Green Street, Paso Robles

Low Impact Development

LID measures mimic nature, and use plants, soils, and/or pervious surfaces to collect stormwater, allowing it to soak into the ground, and be filtered by soil. This reduces the quantity of water and pollutants flowing into local creeks.

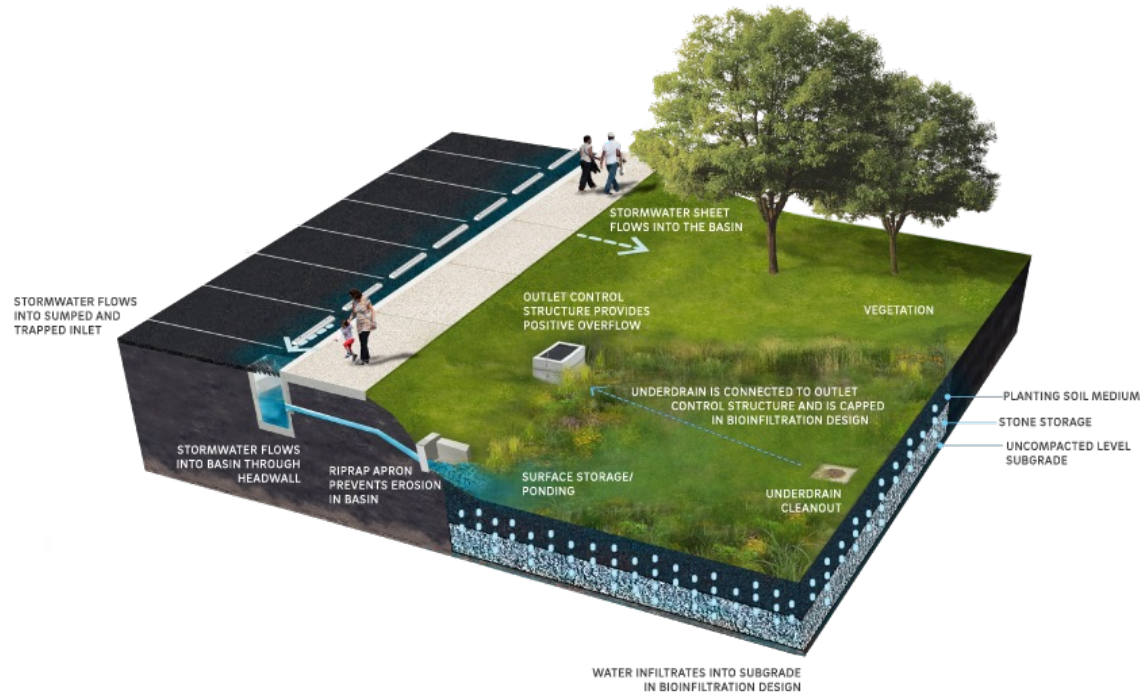
Typically used on parcel-based projects.



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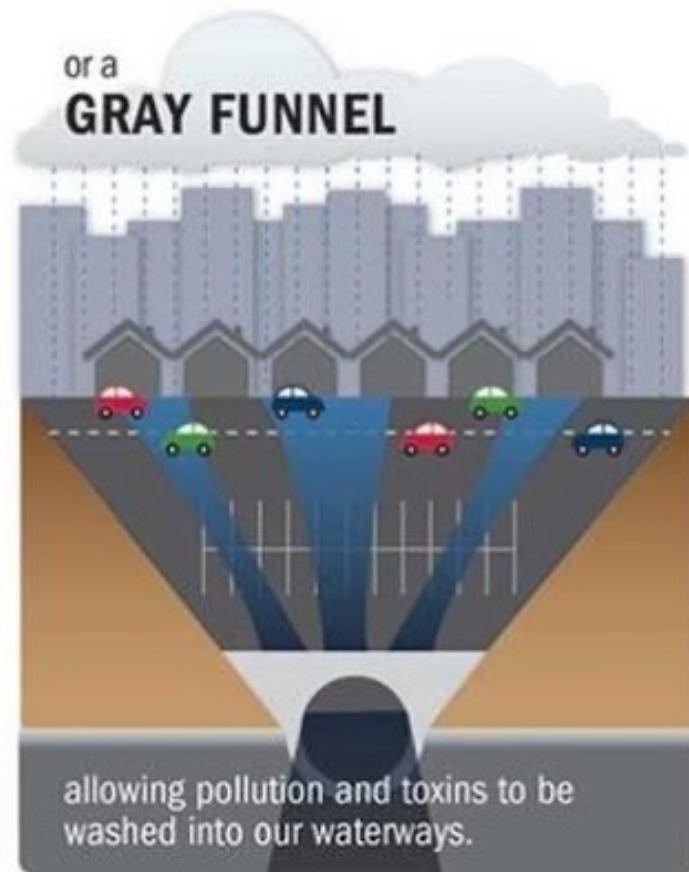
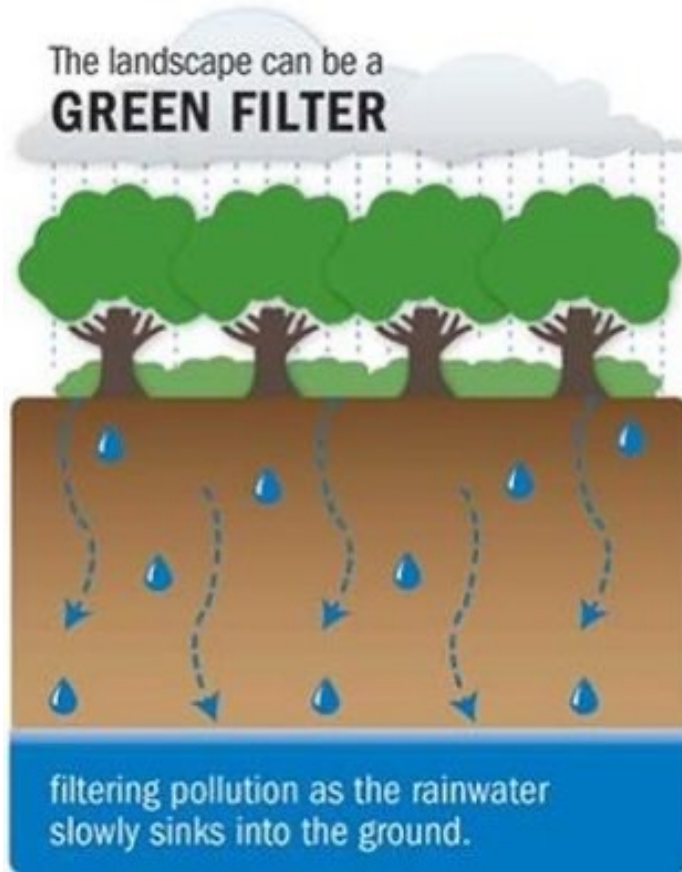
Stormwater Control Measures (SCM)

SCMs use GSI and LID systems that reduce stormwater runoff volume and pollutant loading



Stormwater Background

Why Treat Stormwater?



Stormwater Regulatory Overview



U.S. EPA

Clean Water Act



State Water Resources
Control Board

Issues Statewide Stormwater Permits



Regional Water
Quality
Control Boards

Issue Regional Stormwater Permits
(Region 2 for SF Bay Area)



Municipalities

Implement Local Stormwater Program



WELO and ReScape

The Model Water Efficient Landscape Ordinance (MWELO) and ReScape Regenerative Landscaping Principles provide additional guidance.



Stormwater Control Measure (SCM) Types and Locations

Locations

- Green Streets
 - Roadway projects that incorporate stormwater control measures (SCMs)
- Low Impact Development (LID)
 - Development sites (parcel-based) with SCMs
- Regional Projects
 - Locations with a parcel area greater than 0.25 acres that can capture/treat runoff from off-site as well as on-site areas. Large parcels of open land such as parks are often used for this purpose.

Types

- Bioretention areas
- Rainwater harvesting
- Stormwater planters
- Tree well filters
- Flow-through planters
- Green roofs
- Pervious pavement



Stormwater Control Measure: Bioretention

Bioretention areas, also known as rain gardens, are shallow, vegetated basins that collect and absorb runoff from rooftops, sidewalks, and streets.



San Jose



El Cerrito

Stormwater Control Measure: Green Roof

A green roof intercepts rainwater and cools the building.



San Jose

Stormwater Control Measure: Pervious Pavement

Pervious pavement can infiltrate, treat, and/or store rainwater where it falls. They can be made of pervious concrete, porous asphalt, permeable interlocking pavers or other materials.



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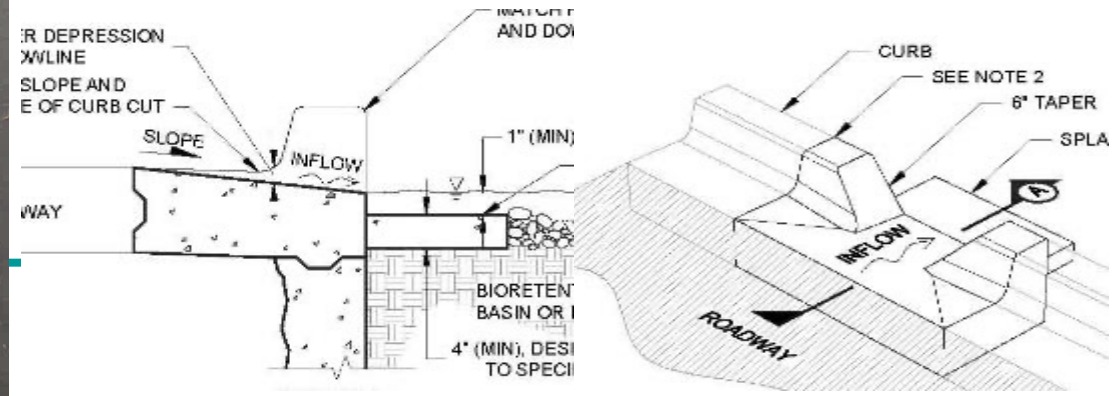
Bioretention Design

Overview



Inlet Design

This photo shows a common issues with water flow and curb cut design. A better design is shown below:



Plant Selection

- Fescues, rushes, sedges, bunch grasses and some flowering plants
- Tough, low-maintenance hardy plants
- Many can survive without irrigation depending on the local climate and some even stay green during a drought
- Do not require frequent trimming when properly placed and designed
- Perennials that do not need to be replanted every year
- California natives or climate appropriate

Plant Selection

Consider:

- Deep rooted plants that help build soil porosity and reach nearby native soils;
- Plant species that will survive both droughts and periodic inundation; and
- Plants that grow well in sandy fast-draining soils.
- Plants native to California
- Non-invasive plants (see Cal-IPC.org)



Penstemon heterophyllus
Foothill Beardtongue

Plant Selection

Stormwater guidelines have plant lists. Bioretention measures are periodically inundated with water so plants that can tolerate those conditions.

Table B-1 Plant List for Stormwater Measures

Emergent Species

<i>Artemisia douglasiana</i>	mugwort
<i>Carex barbarae</i>	Santa Barbara sedge
<i>Carex densa</i>	dense sedge
<i>Carex obnupta</i>	slough sedge
<i>Eleocharis macrostachya</i>	creeping spikerush
<i>Hydrocotyle ranunculoides</i>	marsh pennywort
<i>Juncus balticus</i> †	baltic rush
<i>Juncus bufonius</i>	toad rush
<i>Juncus effusus</i> †	Pacific rush
<i>Juncus leseunii</i>	common rush
<i>Juncus mexicanus</i>	Mexican rush
<i>Juncus patens</i>	blue rush
<i>Juncus xiphioides</i>	iris-leaved rush
<i>Limonium californicum</i>	Marsh rosemary
<i>Phragmites</i> spp.	common reeds
<i>Scirpus actutus</i>	tule
<i>Scirpus americanus</i> †	three square
<i>Scirpus californicus</i> †	california bulrush
<i>Spartina foliosa</i>	California cordgrass
<i>Typha angustifolia</i>	narrowleaf cattail
<i>Typha latifolia</i>	cattail

	Bioretention Area - including linear treatment measure	Flow-Through Planters	Tree Well Filters ²	Vegetated Buffer Strip	Infiltration Trench	Extended Detention Basin - bioretention soil	Extended Detention Basin - non-bioretention soil	Turf Block Pavers	Green Roof - extensive	Green Roof - intensive	California Native	Drought Tolerant
						✓	✓				✓	
		✓			✓	✓		✓	✓	✓	✓	
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Muhlenbergia rigens,
Deergrass

















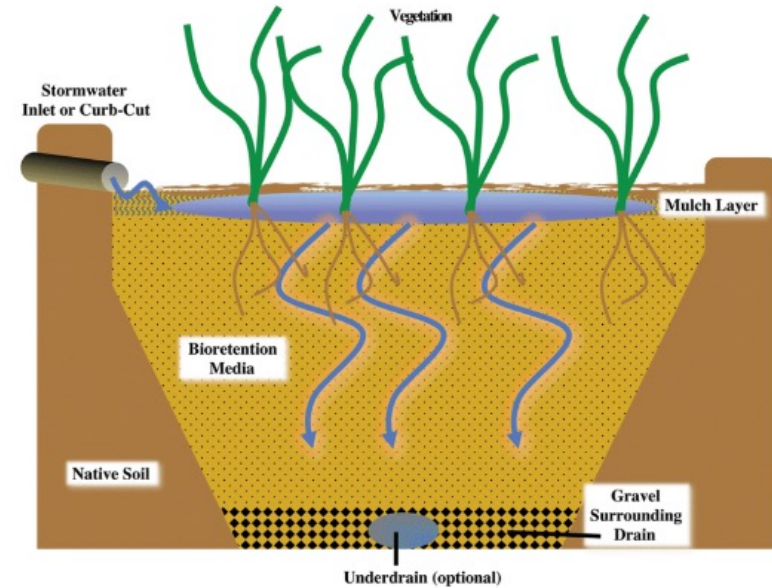






Bioretention Soil Media (BSM)

- Soils for bioretention areas should:
- Be sufficiently permeable to achieve an infiltration rate of at least 5 inches per hour.
- Have sufficient moisture retention to support healthy vegetation.
- Consist of a mixture of fine sand and compost that meets the BASMAA specification:
 - 60%-70% Sand
 - 30%-40% Compost



Mulch Types



- Wood Mulch
 - Uncomposted Wood Mulch
 - Composted Wood Mulch
 - Rock Mulch:
 - Gravel (small)
 - Medium-sized rock
 - Cobble (large)
 - Combination
 - Rock mulch can be used in the flow line with wood mulch on the sloped sides
 - Jute netting can also be used to temporarily hold the mulch in place until plants are established
-

Uncomposted Wood Mulch



Composted Wood Mulch (BWM)



Gravel Rock Mulch (Small)



Medium-sized Rock Mulch and Cobble (Large)



Combination Wood and Rock Mulch Design



rows and
sloped sides,
of rock mulch
and wood
es can be

Mulch Topics

- Purposes of mulch
 - Wood Mulch and Rock Mulch
 - Reduces weed growth
 - Reduces soil erosion (slows the flow)
 - Wood Mulch
 - Conserves water by minimizing soil dehydration
 - Keeps soil cool
 - Adds organic content to the soil
- Depth of mulch
 - 3 inches over bare soil areas is required in California for water-efficient landscaping and conservation
- Best types of mulch?
 - Wood mulch – composted arbor mulch
 - Rock mulch – gravel
- Challenges
 - Wood Mulch
 - Floats
 - Needs replenishing
 - Rock Mulch
 - Makes weeding hard
 - Heats soil
- Worst Types of Mulch?
 - Micro-bark
 - Floats a lot and is all the same size
 - Cobble
 - Heavy to move for weeding
 - Dangerous/vandalism



Composted Wood Mulch Benefits

- The composting process improves mulch in these ways:
 - Inoculates mulch with beneficial organisms - and the soil media, when applied later
 - Holds more water
 - Floats less (heavier and less resinous)
 - Less flammable
 - Reduces pathogens that might be in the mulch like Sudden Oak Death (*Phytophthora ramorum*)
 - Increases SB 1383 procurement credit
 - The Biotreatment Wood Mulch (BWM) Specification can be downloaded from the SCVURPPP website:
 - <https://scvurppp.org/2021/07/01/biotreatment-soil-media-supplier-list/>
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The Bioretention Measure Design Affects the Mulch Choice



Off-line design with trench drains & wood mulch



In-line design with Splash Apron and Cobbles

Bioretention Maintenance

Typical Maintenance Issues

1. Remove trash and sediment
2. Remove weeds
3. Maintain 3" mulch
4. Replace dead or missing plants
5. Look for erosion
6. Check irrigation system
7. Prune plants
8. Remove flow blockages
9. No standing water for more than 2-3 days



GSI Maintenance Field Guide - San José

Plant Density



4 Excellent Condition

- » 100% plant coverage at plant maturity*
- » Plants are appropriately spaced
- » No obstruction of inlets, overflow, or irrigation infrastructure

3 Good Condition

- » At least 90% plant coverage at maturity*
- » Some sporadic bare spots present (0-10%)
- » Most plants are appropriately spaced
- » Partial obstruction of one or more inlet, overflow, or irrigation system

2 Moderate Condition

- » At least 50% plant coverage at maturity*
- » Moderate number of small bare spots with no large, continuous bare spots (10-20%)
- » Significant obstruction of one or more inlets, overflows, or irrigation systems

1 Poor Condition

- » Less than 50% plant coverage at maturity*
- » Significant number of bare spots or large, continuous bare spots (more than 20%)
- » Full obstruction of one or more inlets, overflows, or irrigation systems

*Newly planted systems may not have full coverage, but systems must have full coverage after plant establishment and maturity

Graphic developed by the City of San José, a member of SCVURPPP, with the help of Lotus Water





NO DUMPING!
DRAINS TO BAY





Maintenance Examples from the Field



Maintenance Examples from the Field



Maintenance Examples from the Field



Maintenance Examples from the Field



Maintenance Examples from the Field



Maintenance Examples from the Field



Maintenance Examples from the Field



Maintenance Examples from the Field



Additional Resources

SCVURPPP C.3 Stormwater Handbook (2016)

<https://scvurppp.org/2016/06/20/c-3-stormwater-handbook-june-2016/>

SCVURPPP GSI Handbook (2019)

<https://scvurppp.org/2019/09/01/scvurppp-green-stormwater-infrastructure-handbook/>

City of San José GSI Maintenance Field Guide (2019)

<https://www.sanjoseca.gov/your-government/departments-offices/environmental-services/our-creeks-rivers-bay/green-stormwater-infrastructure>

SCVURPPP GSI Vegetation Guide (Coming in 2023)

Rescape Landscaping Program

<https://www.rescapeca.org/>

Green Gardener Training Program

<https://www.mywatershedwatch.org/residents/green-gardener-program/>

South Bay Green Gardens

<https://www.southbaygreengardens.org/>

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Calandrinia spectabilis
Rock Purslane