Green Stormwater Infrastructure for New Jersey

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Green Infrastructure (GI or GSI)

...an approach to stormwater management that is cost-effective, sustainable, and environmentally friendly.

Green Infrastructure projects:
- capture,
- filter,
- absorb, and
- reuse

stormwater to maintain or mimic natural systems and treat runoff as a resource.
Impervious Surfaces

More development → More impervious surfaces → More stormwater runoff

10% 20% 30% 55%

More development

More impervious surfaces

More stormwater runoff
Green Infrastructure

Stormwater management practices that protect, restore, and mimic the native hydrologic condition by providing the following functions:

- Infiltration
- Filtration
- Storage
- Evaporation
- Transpiration
Green Infrastructure Practices

Bioretention Systems
- Rain Gardens
- Bioswales
- Stormwater Planters
- Curb Extensions
- Tree Filter Boxes

Permeable Pavements

Rainwater Harvesting
- Rain barrels
- Cisterns

Dry Wells

Rooftop Systems
- Green Roofs
- Blue Roofs
TYPES OF BIORETENTION

**Bioretention Cells**
- Single-family lots
- Commercial areas
- Parking lots

**Rain Gardens**
- Single-family lots
- Small commercial areas

**Bioretention Swales/Bioswales/Vegetated Swales**
- Typically in right-of-way

**Planters & Planter Boxes**
- Highly urban areas
- Right-of-way and adjacent to buildings

**Vegetated Curb Extensions**
- Bioretention incorporated into right-of-way in urban and suburban areas
Rain Gardens

NATIVE PLANTS
A rain garden is planted with a variety of grasses, wildflowers, and woody plants that are adapted to the soil, precipitation, climate, and other site conditions.

DRAINAGE AREA
This is the area of impervious surface that drains stormwater runoff to the rain garden.

BERM
The berm is constructed as a barrier to control, slow down, and contain stormwater.

PONDING AREA
The ponding area is the lowest, deepest visible area of the garden. When designed correctly, this area should drain within 24 hours.

INLET
This is the area where stormwater enters. The inlet is often lined with stone to slow water flow and prevent erosion.

CURB CUT
This curb cut and concrete flow pad are designed to help redirect stormwater runoff to the rain garden system and out of the storm drain.
Rain Garden Cross-Section
Lots of Rain Gardens
Bioswale

**NATIVE PLANTS**
A bioswale is planted with a variety of grasses, wildflowers, and woody plants that are adapted to the soil, precipitation, climate, and other site conditions. The vegetation helps filter stormwater runoff as it moves through the system.

**CONVEYANCE**
Unlike other systems, the bioswale is designed to move water through a vegetative channel as it slowly infiltrates into the ground.

**SLOPE**
The slope is designed at a maximum of 3:1. These slopes often require erosion control materials for stabilization.

**INFLOW**
This is the area where stormwater enters.
**Stormwater Planters**

**Native Plants**
A stormwater planter is planted with a variety of grasses, wildflowers, and woody plants that are adapted to the soil, precipitation, climate, and other site conditions.

**Curb Cut**
This curb cut and concrete flow pad are designed to help redirect stormwater runoff to the rain garden system and out of the storm drain.

**Concrete Wall**
Concrete walls are installed to match the existing curb. These walls create the frame for the stormwater planter and continue to function as a curb.

**Inlet**
This is the area where stormwater enters. The inlet is often lined with stone to slow water flow and prevent erosion.

**Subgrade**
Stormwater planter systems are unique because of their subgrade structure. This structure is layered with bioretention media, choker course, compact aggregate, and soil separation fabric.
Stormwater Planter Cross-section
Curb Extensions
Permeable Pavement

**POROUS ASPHALT**
It is common to design porous asphalt in the parking stalls of a parking lot. This saves money and reduces wear.

**UNDERDRAIN**
Systems with low infiltration rates due to soil composition are often designed with an underdrain system to discharge the water.

**ASPHALT**
This system is often designed with conventional asphalt in areas of high traffic to prevent any damage to the system.

**DRAINAGE AREA**
The drainage area of the porous asphalt system is the conventional asphalt cartway and the porous asphalt in the parking spaces. Runoff from the conventional asphalt flows into the porous asphalt parking spaces.

**SUBGRADE**
Porous pavements are unique because of their subgrade structure. This structure includes a layer of choker course, filter course, and soil.
Permeable Pavements

• Underlying stone reservoir
• Porous asphalt and pervious concrete are manufactured without "fine" materials to allow infiltration
• Grass pavers are concrete interlocking blocks with open areas to allow grass to grow
• Permeable pavers systems are concrete pavers with infiltration between the spaces of the pavers
• Ideal application for porous pavement is to treat a low traffic or overflow parking area
ADVANTAGES

• Manage stormwater runoff
• Minimize site disturbance
• Promote groundwater recharge
• Low life cycle costs, alternative to costly traditional stormwater management methods
• Mitigation of urban heat island effect
• Contaminant removal as water moves through layers of system

COMPONENTS

Design Guidelines for Porous Asphalt with Subsurface Infiltration

- Riverjacks open into recharge bed
- Porous asphalt pavement
- Uniformly graded stone aggregate with 40% void space for stormwater storage and recharge
- Uncompacted subgrade is critical for proper infiltration
- Filter fabric lines the subsurface bed
Porous Asphalt
Grass Pavers
Rainwater Harvesting Systems

DRAINAGE AREA
This is the area of impervious surface that is captured in the rainwater harvesting system. In this case, it is a structure rooftop.

FIRST FLUSH DIVERTER
This mechanism is installed to by-pass the first several gallons of runoff which tend to be the dirtiest water before it enters the tank.

GUTTER
This captures runoff from the rooftop and carries it to the rainwater harvesting system.

CISTERN TANK
This tank is designed in different sizes to accommodate the runoff from a designated drainage area.

SPIGOT
A spigot is installed near the base of the cistern tank to allow water to be removed for use without an electronic pump system.

OVERFLOW
This mechanism is designed to act as a discharge for the water when the cistern is full or when it is winterized.

SEDIMENT
Sediment and other pollutants that enter the tank will settle to the bottom.
Cisterns
Dry Wells
Infiltration Trench

- Trench
- Water floods the trench then enters pipe and flows away
- Perforated Pipe
- Gravel Encase Pipe
- Gravel
Rooftop Practices – Green Roof
Types of Green Roofs

Extensive

Intensive
Types of Green Roofs

**Extensive**
- Soil depth up to 6 inches
- Lightweight
- Limited plant species options
- Lower maintenance, nutrient, and irrigation requirements

**Intensive**
- Soil depth typically 6 inches or greater
- Heavier weight load on roof
- Many more plant options, including trees and shrubs
- Requires irrigation, fertilization, and maintenance
Rooftop Practices – Blue Roof

- Gravel: Optional alternative for securing roof
- Aluminum Tray: Mobility and minimal maintenance
- Geotextile: Moderate flow rate
- Corrugated Plastic: Creates flat surface
- Roof Membrane
- Insulation
- Roof Deck
Stormwater Wetlands
Small-Scale Infiltration Systems

Surface Infiltration Basin – Plan View

- Conduit Outlet Protection for Non-erosive Inflow
- 3:1 Maximum Side Slope for Earthen Embankments
- Sand, Minimum Depth = 6 in., Min. Tested Permeability = 20 inches/hour
- Filter Fabric (Sides only)
- Optional Berm for Directing Overflow

NOTE: ➔ = Direction of Runoff

Not to Scale
Surface Infiltration Basin – Profile View

- Inflow
- 2 ft. Maximum Runoff Depth
- Sand, Minimum Depth = 6 in., Min. Tested Permeability = 20 inches/hour
- Overflow
- Filter Fabric (Sides only)
- 2 ft. Minimum Separation from SHWT
- Uncompacted Subsoil
- Design Storm Outflow
- Seasonal High Water Table (SHWT)

NOTE: = Direction of Runoff

Not to Scale
Small-Scale Sand Filter

Profile View – Sand Filter Basics

Inflow

Pretreatment Zone

Optional Perforated Riser

Treatment Zone

Optional Turf and Topsoil Layer

Overflow

Outlet Control w/ Maintenance Access

Stone Choker Course

Sand Bed

SHWT

Underlying Soils

NOTE:

= Direction of Runoff

Not to Scale
Profile View – Sand Filter with Underdrain

Inflow → Pretreatment Zone → Treatment Zone → Overflow

- Stone Choker Course
- Sand Bed
- Perforated Underdrain
- Gravel Layer
- Filter Fabric
- Underlying Soils
- SHWT

NOTE:
→ = Direction of Runoff

Not to Scale
Plan View – Sand Filter with Underdrain

Inflow  Pretreatment Zone  Treatment Zone  Overflow

Gravel Layer  Perforated Underdrain

Filter Fabric

NOTE:
= Direction of Runoff
Surface Vegetation, Topsoil, Sand Layer & Stone Choker Course Not Shown

Not to Scale
March 2021 – Major Development will mostly use these GI Practices

- Pervious Paving Systems
- Small-Scale Bioretention Systems
- Small-Scale Infiltration Basins
- Small-Scale Sand Filters

To satisfy groundwater recharge, stormwater quantity, and stormwater quality requirements.

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