Stormwater Management Techniques

WMPF LAND USE TRAINING INSTITUTE

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Potential Impacts of New Development

- Urban development can significantly increase stormwater runoff
- Water quality considerations
  - Sediment
  - Nutrients
  - Organic Carbon
  - Bacteria
  - Hydrocarbons
  - Trace Metals
  - Pesticides
  - Chlorides
  - Thermal Impacts
  - Trash & Debris
  - Snowmelt Concentrations
- Diminishing Groundwater Recharge
- Increased flooding

Benefits of Green Infrastructure

- Reduce runoff volume and peak flow
- Slow down the flow to increase time of concentration and promote infiltration and evapotranspiration
- Improve groundwater recharge
- Protect downstream water resources, including wetlands
- Reduce downstream flooding and property damage
- Provide water quality improvements/reduced treatment costs
- Reduce thermal pollution
- Improve wildlife habitat

Green Infrastructure for Stormwater Management

AREA REDUCTION

- Conservation of Natural Areas
- Riparian Buffers/Filter Strips
- Tree planting/Preservation
- Rooftop Disconnection

VOLUME REDUCTION

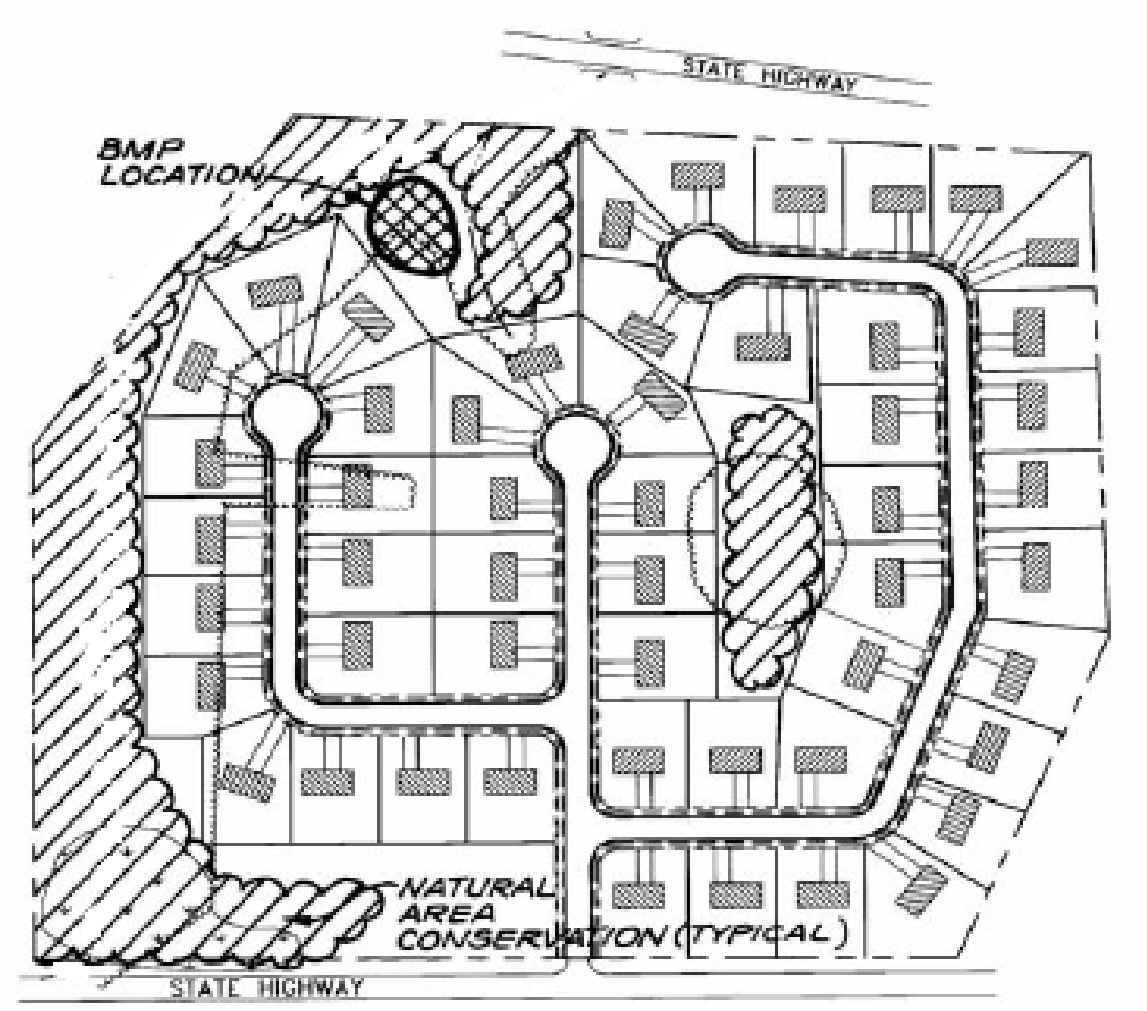
- Infiltration Trench
- Drywell
- Infiltration Basin
- Bioretention
- Dry Swale
- Vegetated Swale
- Green Roof
- Rain Garden
- Planters
- Cisterns/Rain Barrels
- Porous Pavement

STORMWATER MANAGEMENT PRACTICES FOR RUNOFF REDUCTION

Date: 11/11/11

NOTE: This table provides only a general overview of each practice. Reference the New York State Stormwater Design Manual for complete standards, details, specifications, and design variations.

	PRACTICE (Design Manual Page)	LAND USE	CONTRIBUTING DRAINAGE AREA	DESIGN ELEMENTS	SLOPE	SOILS	HEAD	GROUND WATER SEPARATION	ALLOWABLE RUNOFF REDUCTION
Area Reduction	Conservation of Natural Areas (5-47)	Commercial/ Residential	If any contributing area, maximum contributing length = 75-180′ (depending on soil & impervious)	• Minimum size = 10,000 s.f. • Sheet flow inlet	< 8%	Native	—	> 6″	Area and contributing area deducted
	Reparian Buffers/Filter Strips (5-51)	Commercial/ Residential	Maximum contributing length = 75-180′ (depending on soil & impervious) Maximum 5,000 s.f. for filter strip	• Sheet flow inlet or flow dissipation • Minimum width = 50-100′ (Depends on slope)	< 15%	Native	—	> 6″	Area and contributing area deducted
	Tree planting/Preservation (5-64)	Commercial/ Residential	Maximum contributing area = ½ crown diameter or maximum 100 s.f. impervious area/tree	• Minimum 4″ caliper – existing • Minimum 2″ caliper – new deciduous or 6′ high (new conifer)	< 5%	Native/ constructed	—	> 6″	100 s.f./tree
	Rooftop Disconnection (5-69)	Commercial/ Residential No hotspots	Maximum contributing area = 2,000 s.f. Maximum length = 75′	• Flow dissipation required for discharges from > 500 s.f. • Minimum vegetated area width – 50′	< 5%	Native/ constructed	—	> 6″	Impervious area changed to pervious for R_v
Volume Reduction	Infiltration Trench (6-31)	Commercial/ Residential No hotspots	Maximum 5 acres	• 25-100% pre-treatment • Monitoring required • Soil testing required	< 15%	k> 0.5″/hr.	1′	> 3′	90% contributing WQ_v
	Drywell (6-31)	Commercial/ Residential No hotspots	Maximum 1 acre	• Roof top runoff only • Pre-treatment - sump • Soil testing required	< 15%	k> 0.5″/hr.	1′	> 3′	90% contributing WQv
	Infiltration Basin (6-31)	Commercial/ Residential No hotspots	Maximum 10 acres	• 25-100% pre-treatment • Monitoring required • Soil testing required	< 15%	k> 0.5″/hr.	3′	> 3′	90% contributing WQv
	Bioretention (6-44)	Commercial/ Residential	Maximum 5 acres	• Sheet drainage/flow inlet dissipation • Monitoring required • Sized using Darcy's Law	< 6%	Constructed	5′	> 2′	80% contributing WQv for A & B soils, 40% for C & D soils
	Dry Swale (6-59)	Commercial/ Residential/ Highway	Maximum 5 acres	• Non erodible 2-year flows • Check dams if slope is > 2% • Minimum 30-minute retention time • 10% pre-treatment • Maximum depth 18″	< 4%	Constructed	3-5′	> 2′	40% contributing WQv for A & B soils, 20% for C & D soils
	Vegetated Swale (5-58)	Commercial/ Residential/ Highway	Maximum 5 acres	• Peak WQ_v flow < 3cfs • Convey at < 1.0 fps at depth of < 4″ • Minimum length – 100′ • 10 minute retention time	< 0.5% to 4%	Native	1-4′	> 2′	20% contributing WQv for A & B soils, 10% for C & D soils
	Green Roof (5-86)	Commercial	Roof area	• Roof loading 16-200 lb/s.f.	<30%	Constructed	.25′- 2.0′	—	100% contributing WQv
	Rain Garden (5-76)	Residential/ Commercial	Maximum 1,000 s.f.	• Located within 30′ of contributing source • Max. loading ratio of 5:1 (DA to surface area) • Max. ponding depth = 6″	< 6%	Constructed	2-3′	> 2′	100% contributing WQv for A & B soils 40% for C & D soils
	Planters (5-97)	Commercial	< 15,000 s.f.	• Underdrain for "flow through" & C & D soils • Sized using Darcy's Law	—	Constructed	3.5′	> 2′	100% contributing WQv
	Cisterns/Rain Barrels (5-106)	Commercial/ Residential	Roof area	• Require use of collected water • Approximately 625 gal/1,000 s.f. of roof/1″ rain	—	—	—	—	100% contributing WQv
	Porous Pavement (5-114)	Commercial/ Residential No hotspots	Surface area plus small adjacent area	• Requires loading analysis • Sheet flow for contributing area	<5%	Constructed over HSG A, B, or C	2-3′	> 3′	100% contributing WQv

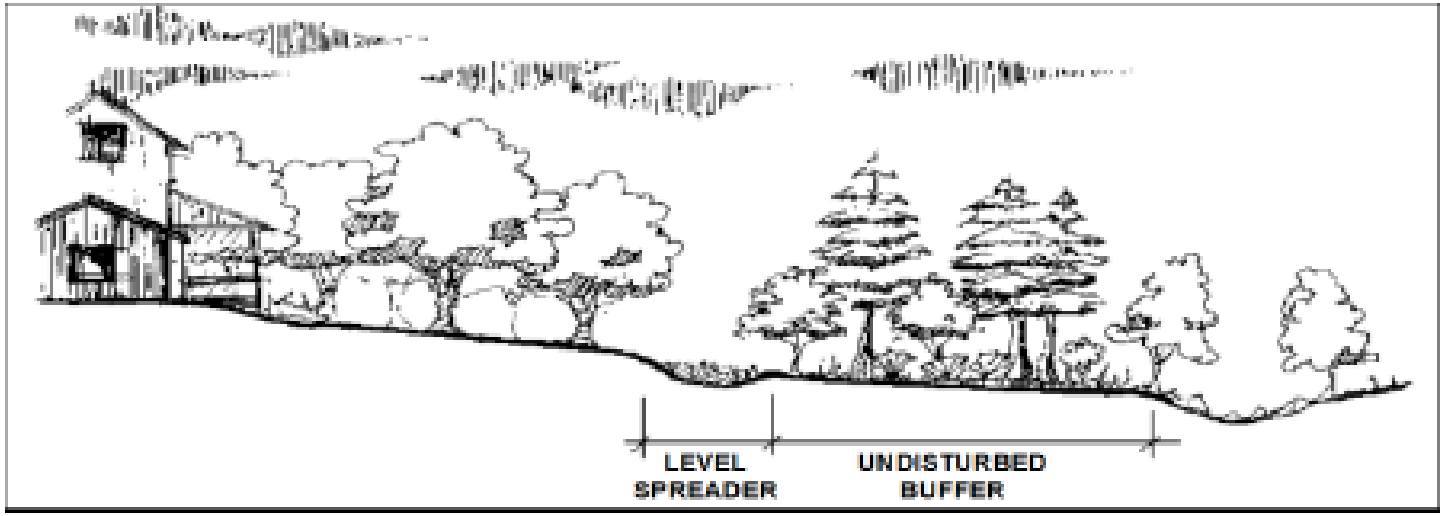


Conservation Easement of Natural Areas

- Forest retention areas, stream and river corridors, wetlands, undisturbed open space
- Provides permanent protection of open space
- Requires establishment of a legal protective easement for water quality credit
- Minimum area of 10,000 square feet for water quality credit

Sheet Flow to Riparian Buffers or Filter Strips

- Vegetated surfaces designed to treat sheet flow from adjacent surfaces and remove pollutants through filtration and infiltration
- Intercept runoff before it becomes concentrated
- Maximum contributing length of 150' (75' for impervious areas)
- Maximum contributing slope is 15%



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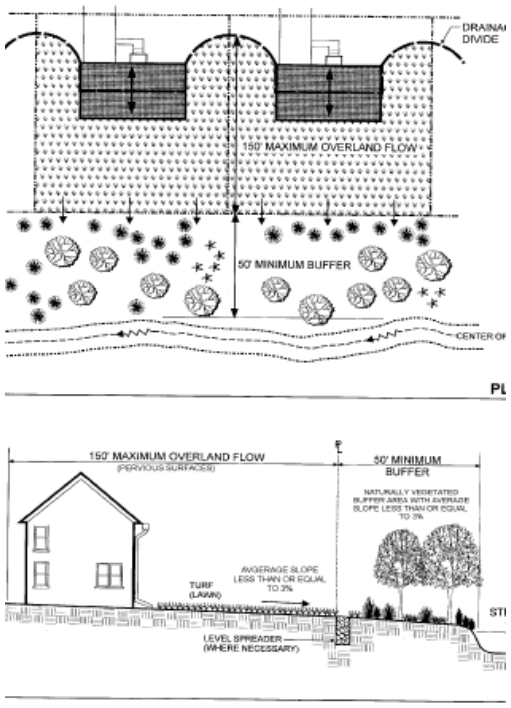
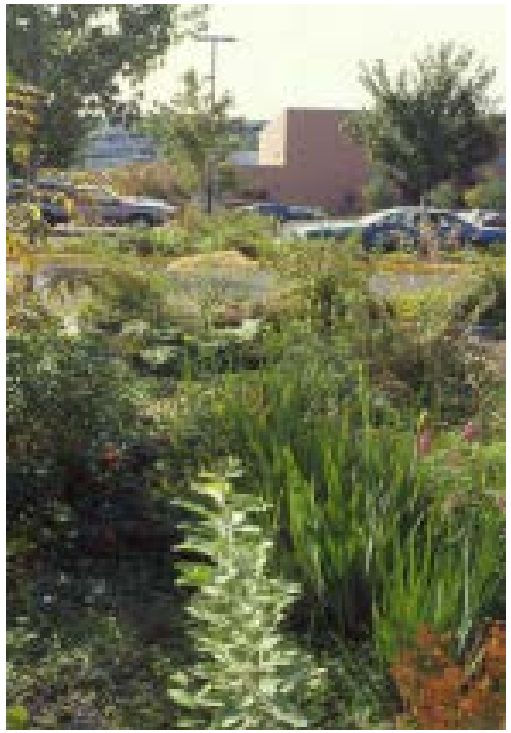
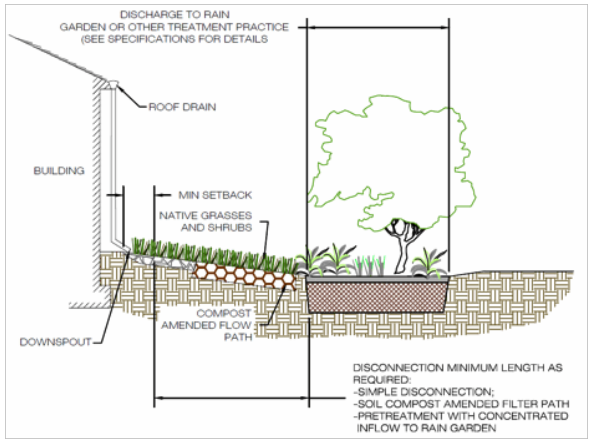
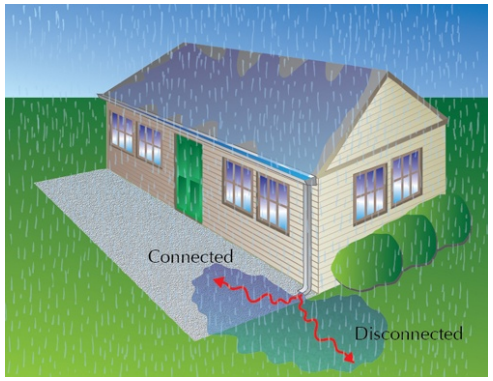




Tree Planting/Preservation

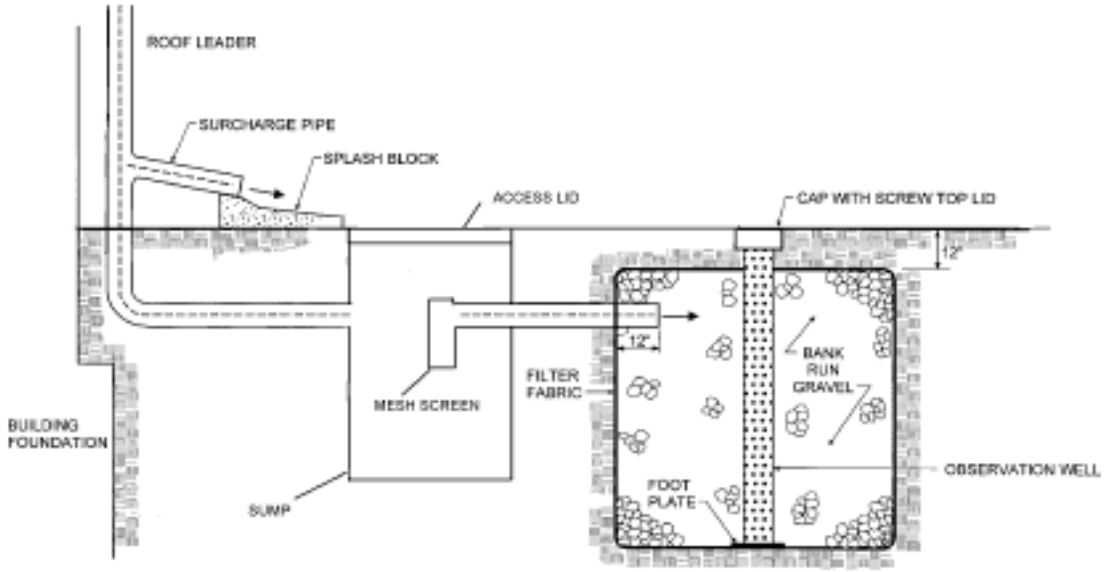
- Reduce stormwater runoff, promote evapotranspiration, increase nutrient uptake, provide shading and thermal reductions, and encourage wildlife habitat
- Can be groupings of trees in landscaped areas or tree pits of individual trees
- Conservation where stands of trees are non-invasive, healthy, and likely to flourish in proposed conditions
- Adequate space provided for each tree to grow
- Soil amendments may be required prior to planting





Rooftop Disconnection

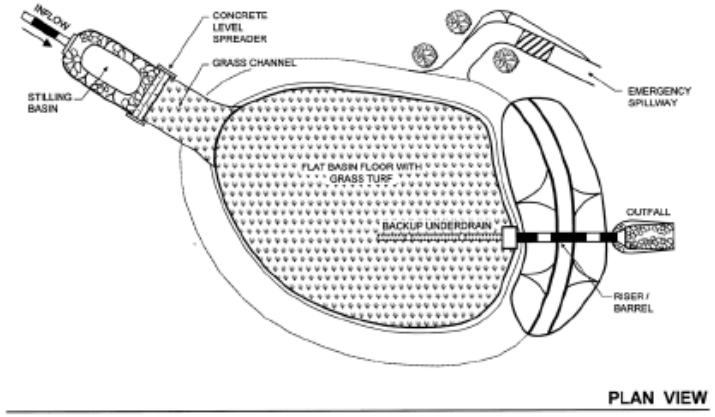
- Direct runoff from residential rooftops to designated pervious areas
- Reduces peak flows, increases water quality
- Only valid for Type A and B soils
- Contributing area is 500 square feet or less
- Downspouts at least 10’ from nearest impervious surface
- Average slopes less than 5 percent

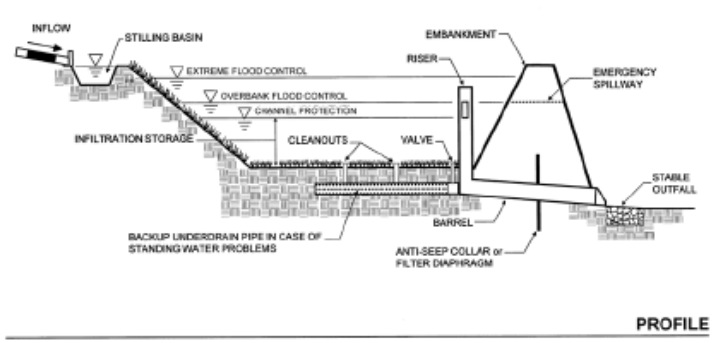


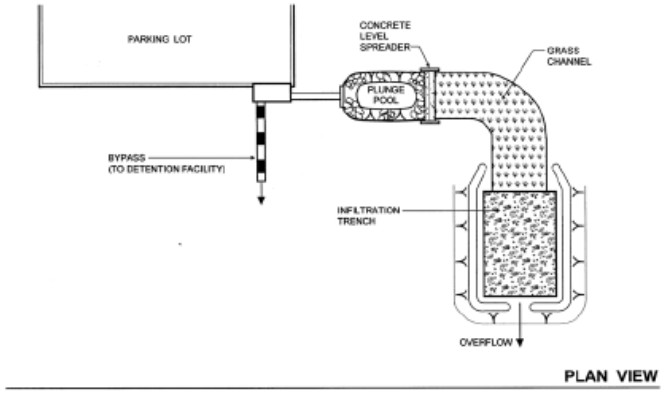
Infiltration Trench / Infiltration Basin / Drywell

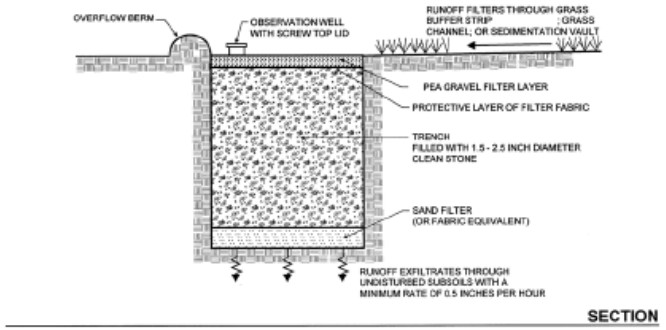
- Require infiltration rate of 0.5 in/hr, three feet separation from groundwater and bedrock
- Slopes less than 15%
- Cannot accept hotspot runoff
- 25' separation from structure (10' for drywells)
- Contributing area less than 5 acres, less than 1 acre for drywells
- Requires pretreatment via sediment basin, sump pit, grass channel, plunge pool etc.
- Should not be constructed until contributing drainage area has been stabilized

Infiltration Trench / Infiltration Basin / Drywell





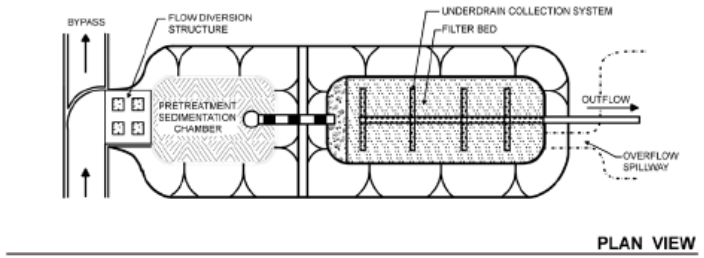


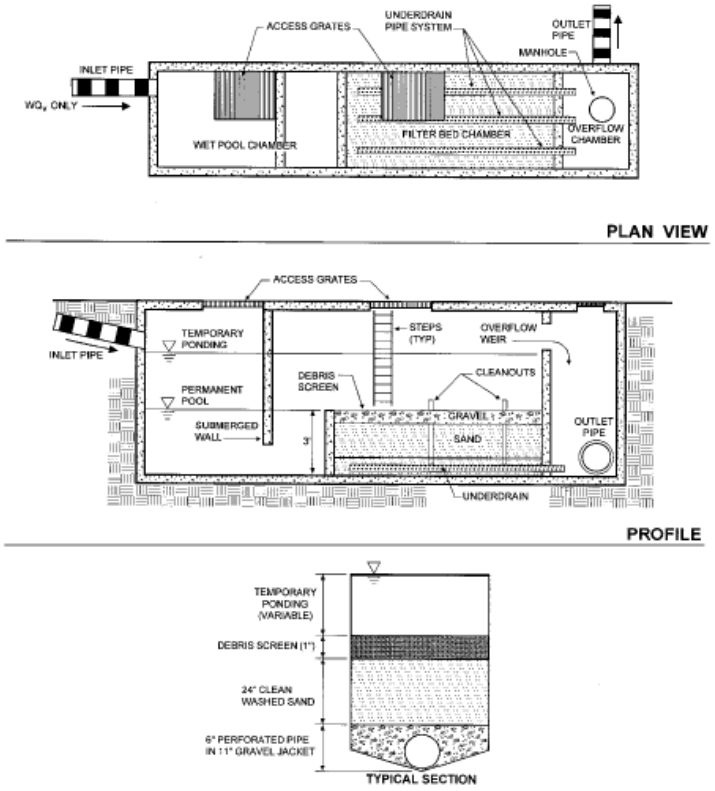


Sand Filters/Bioretention

- Maximum drainage area is 10 acres
- Applied to land with high percentage of impervious surface
- Pretreatment is required
- Landscaping is critical to performance and function of bioretention areas
- A legally binding and enforceable maintenance agreement between owner and local authority
- Cold climate design

Sand Filters/Bioretention





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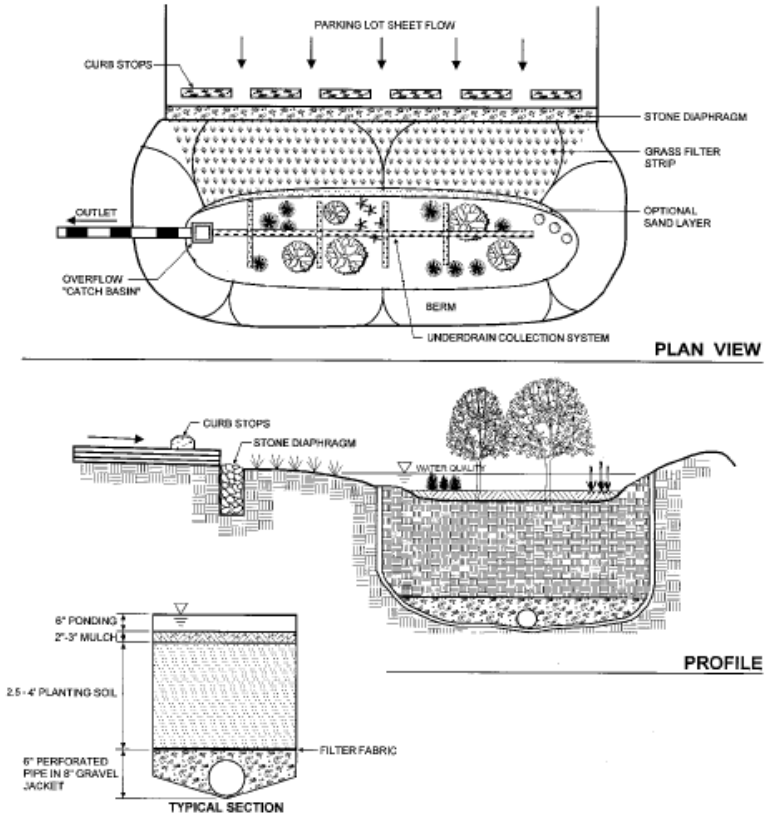
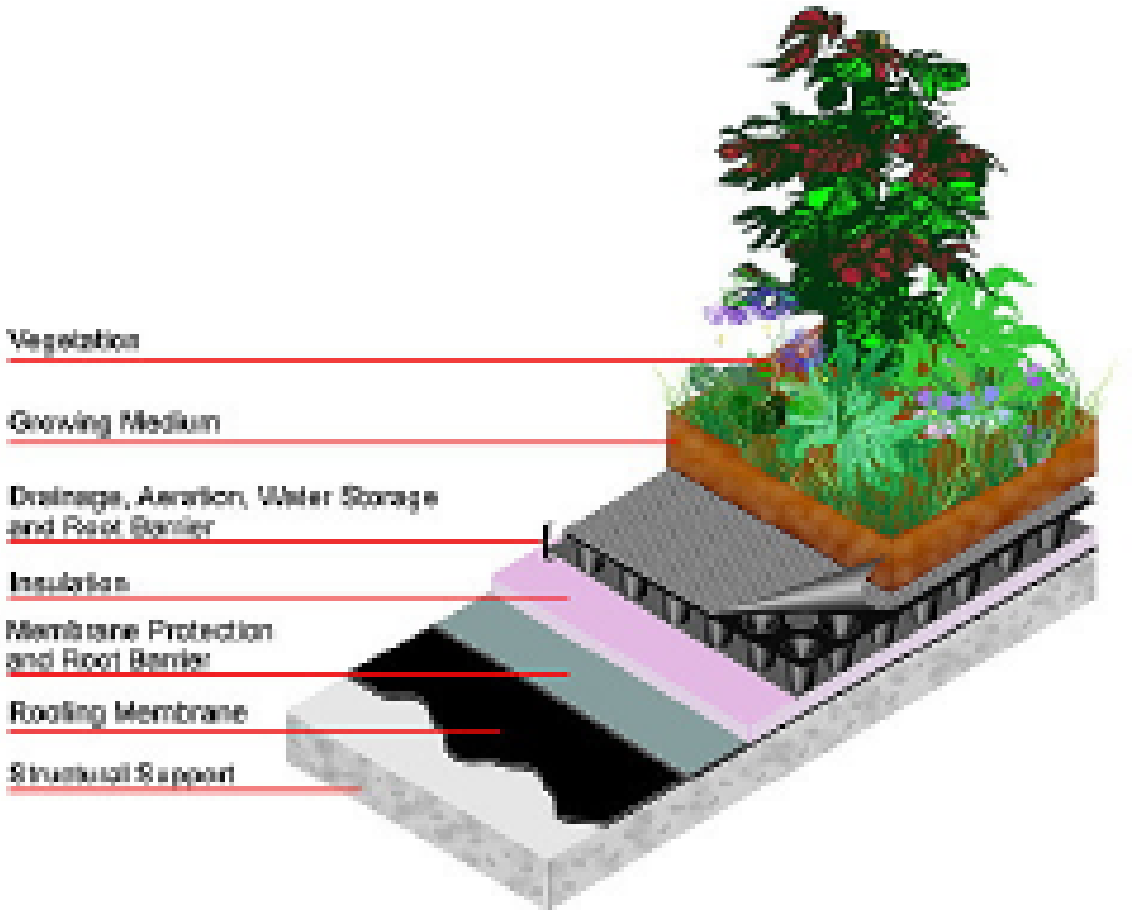


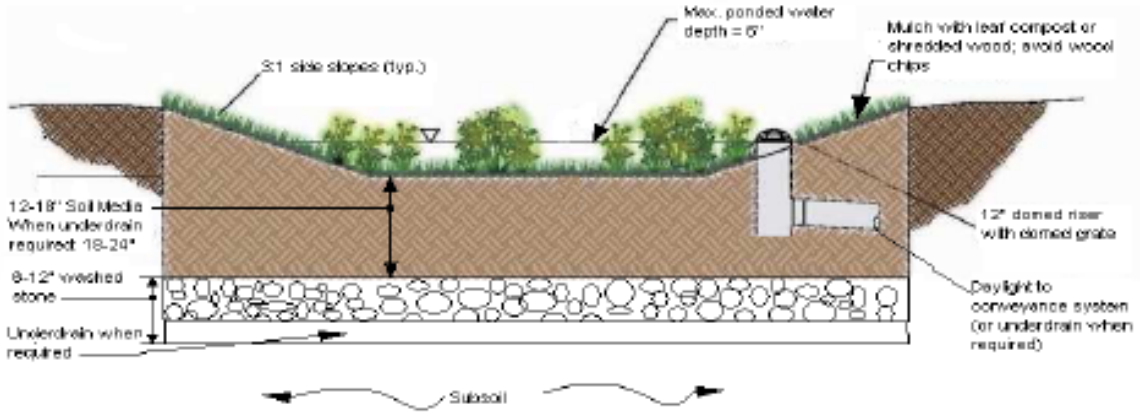
Open Channel Systems (Swales)

- Max slope of 4%
- Dry swales used by roads, highways, residential development, pervious areas
- Wet swales restricted to residential areas
- Design with 3:1 side slopes, for a 10 year storm with 6" freeboard
- Provide checkdams as necessary to slow down flow



Green Roofs

- Layer of vegetation and soil installed on top of a conventional flat or sloped roof
- Can be intensive or extensive
- Can be installed on redevelopments as well as new buildings
- Roof max slope of 30%
- Reduces total annual runoff volumes



Rain Garden

- Used in residential land settings
- Range in 40 to 300 sq. ft. in size
- Pollutant treatment for rooftops and driveways
- Groundwater recharge
- Aesthetically pleasing
- Need flat slopes
- Not to be used for parking lot or roadway runoff
- 1,000 square foot maximum contributing area

Stormwater Planters

- Can be placed above or below ground
- Three types: contained planters, infiltration planters, and flow-through planters
- Suitable for sites with high groundwater tables
- Ideal for treating rooftops and sidewalks
- Requires routine maintenance
- 15,000 square foot maximum contributing area

Cisterns/Rain Barrels

- Capture and store stormwater runoff to be used later for landscaping irrigation
- May be used in most site areas due to minimal site constraints
- Require active management/maintenance

Porous Pavement

- Used for roads, parking, sidewalks, and plaza surfaces
- Formed with larger aggregate and less fines, creating more void spaces
- Permeable pavers include reinforced turf, interlocking concrete modules, and brick pavers
- Provides groundwater recharge, effective pollutant treatment
- Can clog from sand applied for winter traction

Other practices: Underground Storage Hydrodynamic separators