Stormwater Retention Best Management Practices

"2nd Wave" BMPs
First wave stormwater management BMPs dealt with preventing the type of pollution that contaminates runoff. These BMPs did not affect the traditional collection and conveyance system of stormwater management. Second wave BMPs involve planning and design that reduce runoff and manage stormwater as a resource.

"At the Source" Vs "End of Pipe" Solutions
Traditional stormwater management involves "end of the pipe" design. In this process, stormwater picks up ever increasing amounts of pollutants, greater volume and speed of flow. This "end of pipe" solution results in large volumes of fast moving, contaminated water being discharged through small channels or pipes into the nearest receiving waters (streams, lakes, or oceans).

"At the source" design strives to allow stormwater to remain onsite by infiltrating permeable surfaces. By treating rain water as a resource and allowing it to infiltrate the soil, this strategy greatly reduces the volume, flow and toxicity of any remaining water that does enter the "end of pipe" system.

Conveyance Vs Infiltration Strategies
The conveyance approach to stormwater management seeks to "get rid of the water." This system collects and concentrates runoff through a network of impervious gutters, structures, and underground pipes. A conveyance system must be continually increased in size as it reaches its final outfall because of the constant addition of tributary storm drain systems. Because of its impervious nature, pollutants in the water become more concentrated. When it reaches its outfall, large volumes of highly polluted water are emptied, untreated, into natural water bodies, impairing water quality and reducing beneficial uses.

The infiltration approach to stormwater management seeks to emulate and preserve the natural hydrologic cycle. This system seeks to move stormwater slowly over large permeable surfaces to allow it to percolate into the ground. These permeable surfaces can double as recreational areas during dry weather. Because these systems allow stormwater to infiltrate the soil, overall runoff volumes are reduced and groundwater supplies are more quickly replenished. The slow, natural infiltration process enables the soil to naturally mitigate many of the pollutants found in stormwater. In addition, as it takes longer for water to enter and make its way through the traditional storm drain system, it reduces the speed, volume and pollutant load of the remaining water when it reaches the outfall.

Think Small—80% of Runoff Comes from Small Storms of .5" to 1.25" of Rain
Our current storm drain systems are sized to accommodate the flows from the largest storm cycles. However, 80% of runoff is generated from storms producing only .5" to 1.25" of rain. Infiltration-based stormwater systems are ideal for these smaller, more frequent events. Infiltration systems can incorporate overflow design components that direct the flows from the infrequent, larger storm events to the current "end of pipe" system.

Site Design Considerations
In order to maximize the effectiveness of infiltration type storm water systems, and to minimize the runoff of rain water, the following site design considerations must be kept in mind.

A. Define development envelope & protected areas — Protect existing site features (trees, creeks, and slopes), keep development compact to minimize environmental impact and reduce costs, and retain desirable landscape features.

B. Minimize directly connected impervious areas — Avoid the design of impermeable areas that are directly linked to the storm drain system. Design impermeable areas to drain to permeable soil, shallow retention basins, or soil depressions that can hold the first 1/3" to 1" of rain.

C. Maximize permeability — Maximize the use of landscaped areas or permeable surfacing materials.

D. Maximize choices for mobility — Incorporate design elements that encourage pedestrian use and support existing mass transit options.

E. Use drainage as a design element — Design for the use of water as a site amenity. Properly designed retention or wet ponds can be used as a component of the drainage system while creating a valuable and sought after development amenity.

Stormwater Impact and Regulatory Requirements

The runoff caused by storms is the single largest source of non-point water pollution in the US. Past pollution prevention educational efforts have focused on businesses and the public. While these activities remain important, a new area of stormwater pollution prevention is emerging: designing new developments to allow for the retention and infiltration of stormwater runoff.

The Los Angeles Regional Water Quality Control Board recently passed the Standard Urban Stormwater Mitigation Plan (SUSMP) regulation which requires all new developments built in the Los Angeles area to be designed to treat or retain onsite the first 3/4" of rain that falls in a 24-hour period.

Through the implementation of some new design approaches and the use, where possible, of permeable paving materials, the quantity of stormwater runoff and its resulting quality can be improved. And the new SUSMP regulations can be met.

Viewing rain water as a resource to be captured and conserved rather than a nuisance to be channeled offsite, may require a fundamental change in our thought processes. However, the resulting savings in immediate and long term costs plus the environmental benefit to the Southern California coastal areas are worth the effort.

Information Resources

City of Santa Monica Watershed Management Program
(310) 458-8223 / www.sustainablesm.org

County of Los Angeles Stormwater Program
(888) CLEANLA / dpw.co.la.ca.us/epd/#stormwater

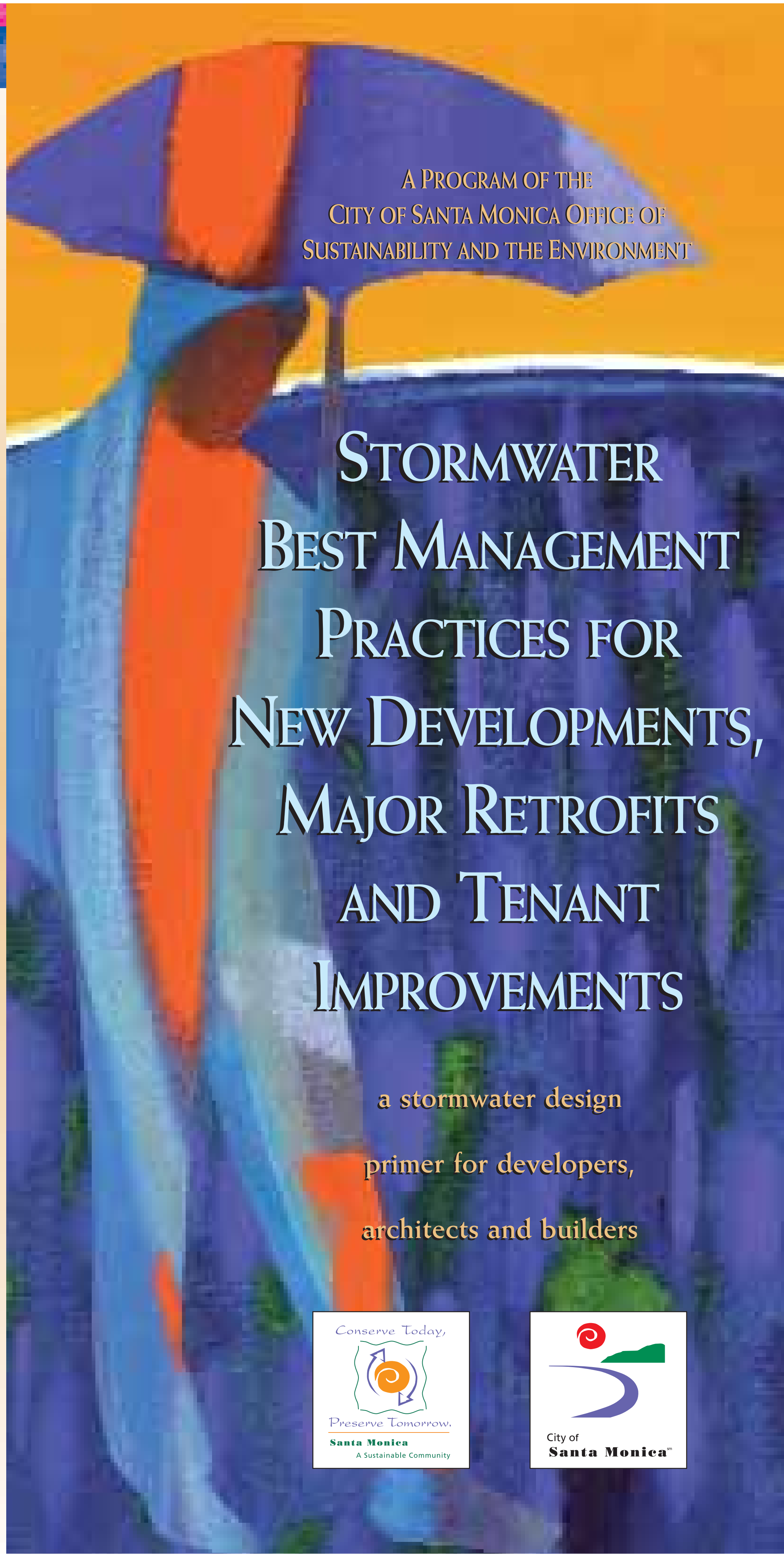
Los Angeles Regional Water Quality Control Board
(213) 576-6600 / www.swrcb.ca.gov/rwqcb4

The Santa Monica Bay Restoration Commission
(213) 576-6615 / www.smbay.org

Illustrations courtesy of "Start at the Source" Bay Area Stormwater Management Agencies Association

Santa Monica BAY Restoration Commission

Brochure originally produced through funding from the Public Involvement and Education Fund of the Santa Monica Bay Restoration Commission and by KJ Services Environmental Consulting



A Program of the City of Santa Monica Office of Sustainability and the Environment

Stormwater Best Management Practices for New Developments, Major Retrofits and Tenant Improvements

a stormwater design primer for developers, architects and builders

Conserve Today, Preserve Tomorrow. Santa Monica A Sustainable Community

City of Santa Monica

Stormwater Design Best Management Practices for Residential, Commercial, and Governmental Developments

A — Permeable Pavements

Permeable pavements are designed to allow for the infiltration of stormwater while still providing a load-bearing surface. While maintaining a surface suitable for walking and driving, permeable pavements contain sufficient void space to allow water to infiltrate into the underlying soil.

Types of Permeable Pavement:

1. Pervious asphalt and concrete.
2. Unit pavers on sand.
3. Granular materials such as gravel, cobbles, and wood mulch.

B — Street Design

Streets (including gutters and sidewalks) account for up to 70% of all the impervious area in a community, having a great impact on stormwater quality. As currently designed most streets are directly connected to an underground conveyance system.

Stormwater quality is improved through the following design options:

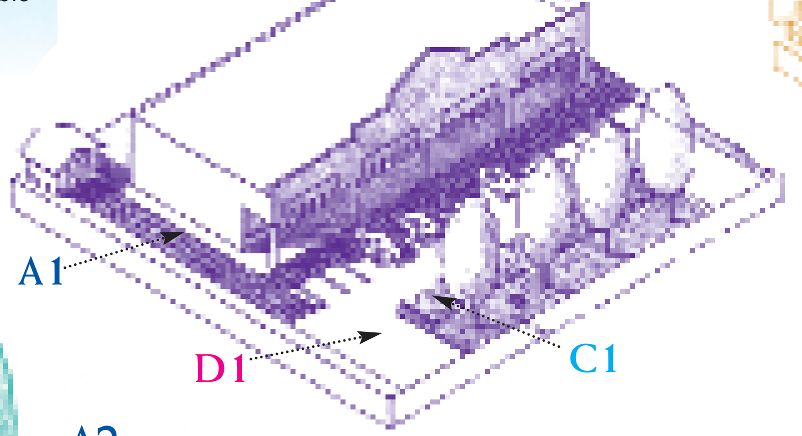
1. Reduced street width.
2. Limited on-street parking.
3. Reduced sidewalk width and placement.
4. Landscaped parkways.
5. Swale drainage systems.
6. Concave medians.
7. Cul-de-sac planting.

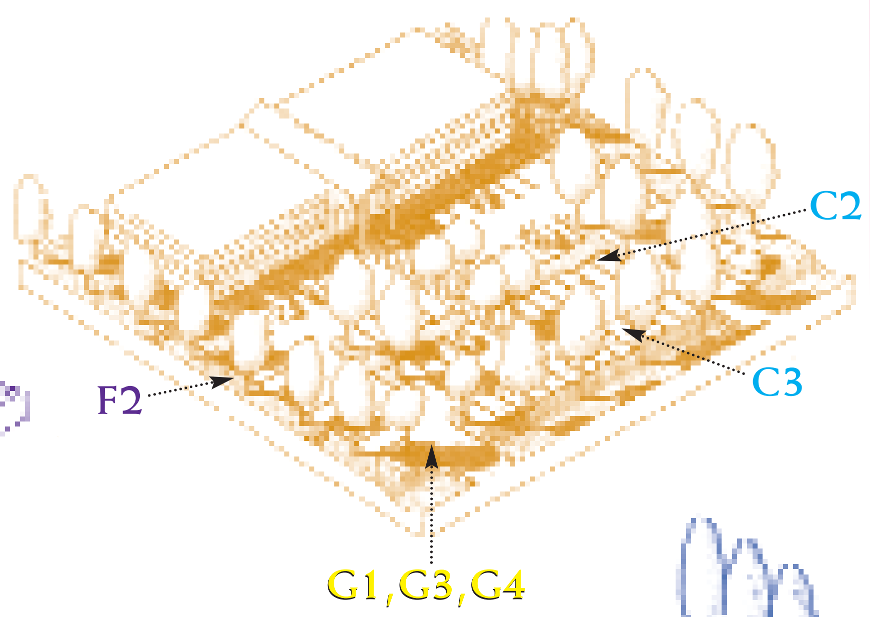
C — Parking Lots

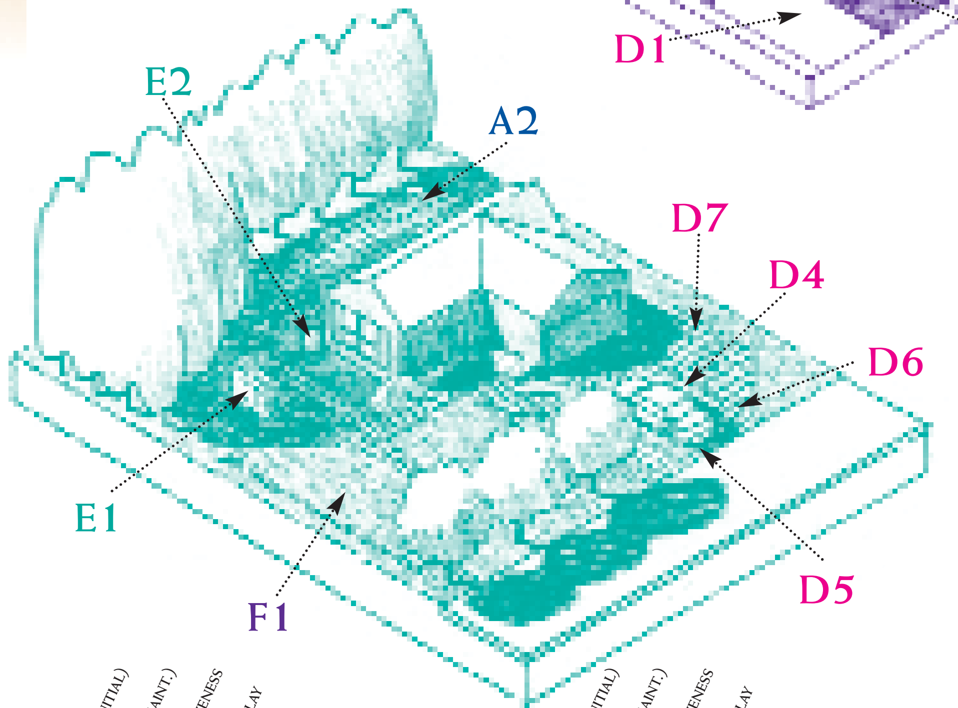
In a typical parking lot, including aisles, curbs, and driveways, 400 square feet is allocated per vehicle (100 cars ≈ 1 acre). All this paved area has an adverse impact on stormwater.

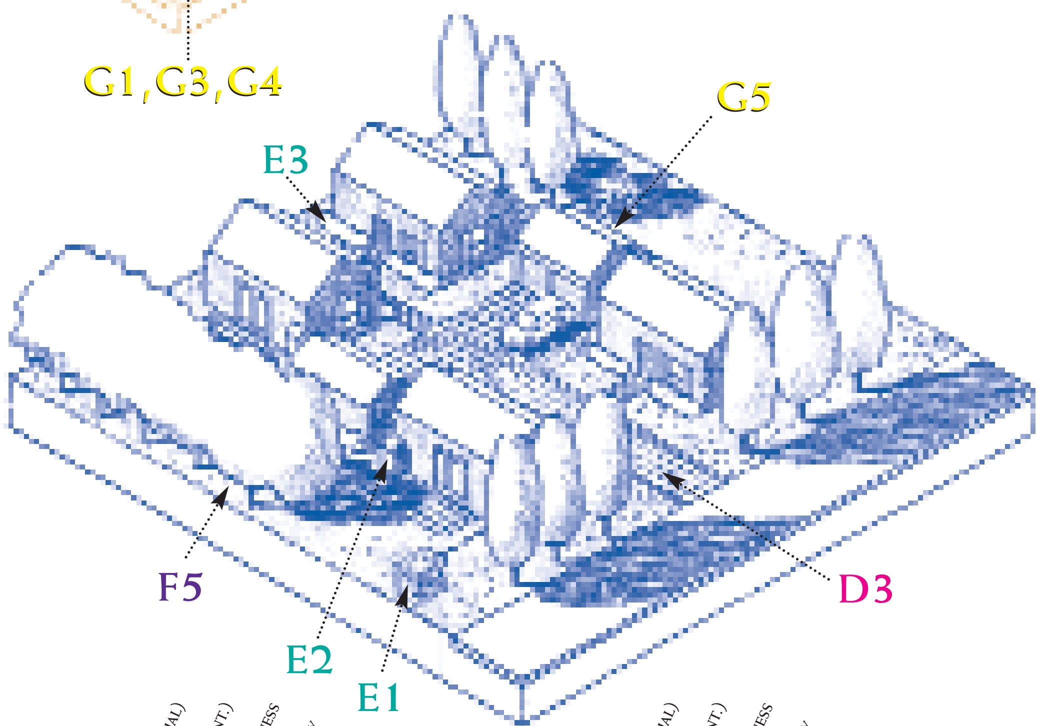
Ideas to help reduce this stormwater impact include:

1. Non-Permeable/Permeable combo parking lots.
2. Parking groves.
3. Permeable pavement parking.









D — Driveways

Driveways can be designed to minimize their impact on stormwater through the creative use of permeable pavements and grading for drainage to landscaped areas.

1. Driveways designed to drain to permeable areas.
2. Crushed aggregate driveways.
3. Unit pavers on sand.
4. Turf block driveways.
5. Paving under wheels only.
6. Flared driveway aprons for 2 or 3 car garages.
7. Temporary RV parking on turf block.

E — Building Design Features

Certain building design features, that can be incorporated into a variety of developments, effectively allow for the retention and infiltration of stormwater.

1. Infiltration Pit.
2. Cistern.
3. Foundation planting.

F — Landscaping

The proper use of landscaping, site grading and surface water amenities, such as wet ponds and constructed wetlands, allow for the efficient infiltration of stormwater into underlying soils.

1. Concave lawn areas.
2. Vegetated swales.
3. Dry ponds.
4. Wet ponds.
5. Climate-appropriate plant selection to maximize infiltration and minimize water use.

G — Manufactured Treatment Devices

Where stormwater cannot be treated by onsite infiltration, devices should be used to clean or filter stormwater before it reaches the existing underground conveyance system.

1. Catch basin or inlet inserts/filters.
2. Oil/Water separators.
3. Media filters.
4. Screening-separation devices.
5. Downspout filters.

Legend: Least ○ ◗ ● Most

BMPs Design Details Matrix

This matrix summarizes their initial construction cost, maintenance cost, relative effectiveness at meeting stormwater quality goals, and their suitability for use in expansive, clay soils. Conventional approaches are also evaluated for comparison.

Permeable Pavements	Cost (Initial)	Cost (Maint.)	Effectiveness	OK in Clay
Conventional Asphalt/Concrete	◗	○	○	●
Pervious Concrete	●	●	●	○
Porous Asphalt	●	●	●	○
Turf Block	◗	●	●	◗
Brick	●	◗	◗	◗
Natural Stone	●	◗	◗	◗
Concrete Unit Pavers	●	◗	◗	◗
Crushed Aggregate	○	◗	●	●
Cobbles	○	◗	◗	●

Streets	Cost (Initial)	Cost (Maint.)	Effectiveness	OK in Clay
Conventional Street Standards	●	○	○	●
Access Street: Urban Neo-Traditional Standard	○	○	●	●
Access Street: Rural Standard	○	◗	●	●
Urban Curb/Swale System	◗	◗	●	◗
Rural Swale System	○	◗	●	◗
Dual Drainage System	●	●	●	●
Concave Median	○	○	●	◗
Cul-de-sac	○	○	●	◗

Parking Lots	Cost (Initial)	Cost (Maint.)	Effectiveness	OK in Clay
Conventional Parking Lot	◗	◗	○	●
Combo Parking Lots	○	◗	●	●
Parking Grove	◗	○	●	●
Permeable Pavement Parking	○	◗	●	●

Driveways	Cost (Initial)	Cost (Maint.)	Effectiveness	OK in Clay
Conventional Driveway	○	◗	○	●
Not Directly-Connected Impervious Driveway	○	○	●	◗
Crushed Aggregate	○	◗	●	●
Unit Pavers On Sand	●	◗	◗	◗
Paving Only Under Wheels	○	◗	●	●
Flared Driveways	○	○	●	●
Temporary Parking	○	◗	●	●

Buildings	Cost (Initial)	Cost (Maint.)	Effectiveness	OK in Clay
Conventional Pipe System	●	◗	○	●
Infiltration Pit	○	◗	●	◗
Cistern	●	◗	◗	●
Foundation Planting	○	○	●	◗

Landscape	Cost (Initial)	Cost (Maint.)	Effectiveness	OK in Clay
Conventional Pipe System	●	◗	○	●
Grass/Vegetated Swales	○	◗	●	●
Extended Detention (Dry) Ponds	○	◗	●	●
Wet Ponds	○	●	●	●
Plant Species Selection for Infiltration Areas	○	◗	●	●
Landscape Maintenance for Stormwater Systems	◗	◗	●	●