# Form and Function:

## A Guide to Enhancing Stormwater BMP Aesthetics and Amenity Value

September 2025

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## INTRODUCTION

Stormwater management features, also known as Best Management Practices (BMPs), have been established over recent decades to provide physical and biological treatment of runoff to protect water quality and prevent flooding. In addition to this function, BMPs may also be designed with an aesthetically pleasing form which provides additional community, environmental, and economic benefits.

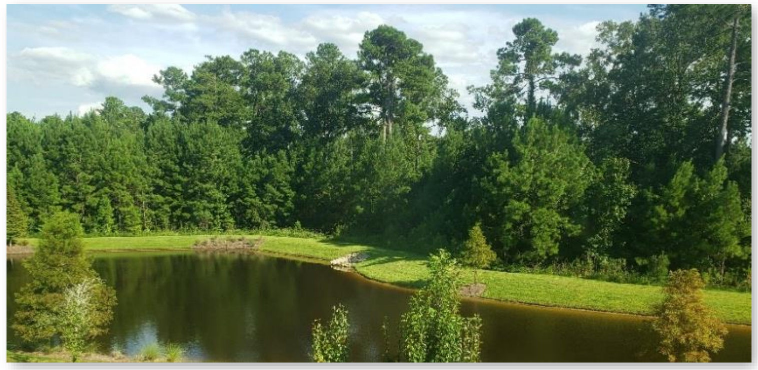

**Figure 1 - Typical wet detention pond in a residential development.**

Traditional development methods aim to move runoff away from buildings to a centralized storage or detention area, such as the wet detention pond in Figure 1. These areas, typically wet or dry detention ponds, may be enhanced to improve BMP aesthetics, making them a community amenity instead of merely a stormwater treatment area. It is also beneficial for aesthetics and water quality to use a variety of BMPs throughout the site and not only one or a few centralized detention ponds. Low Impact Development (LID) BMPs provide localized treatment throughout the site to keep and treat water on site, improving water quality and reducing overall runoff. Many of these LID methods also include native plantings to increase uptake while also being an attractive amenity for people to enjoy. With appropriate landscaping, native vegetation can imitate the natural environment and can better manage runoff (EPA, 2024). Appropriate landscaping can also increase uptake of runoff as well as filter it before it has a chance to leave the site (Morganello & Scaroni, 2016). Figure 2 illustrates these water quality benefits in a properly vegetated BMP.

*"The low-impact development (LID) approach combines a hydrologically functional site design with pollution prevention measures to compensate for land development impacts on hydrology and water quality."* *(DER, 1999)*

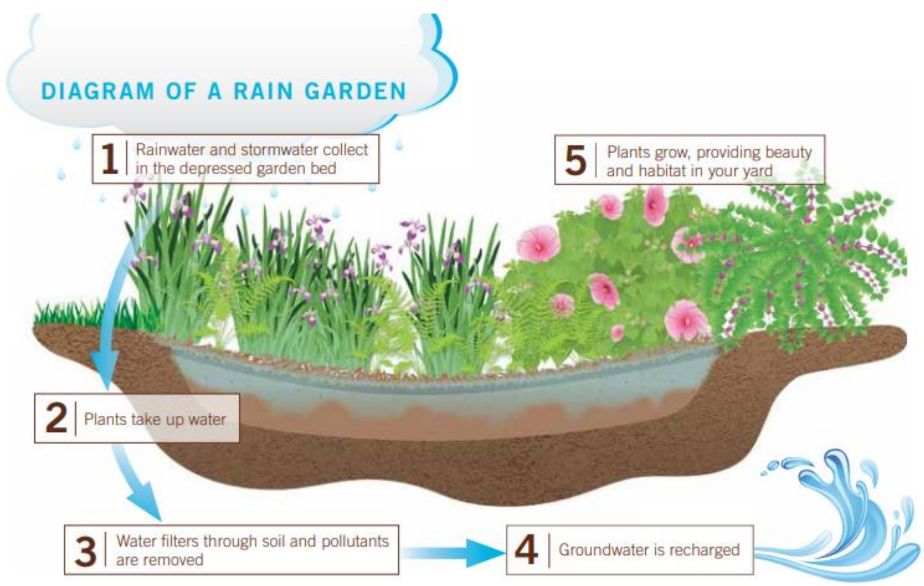


**Figure 2 - Diagram of a rain garden showing how vegetation in a basin can treat runoff (Morganello & Scaroni, 2016)**

## TYPES OF DETENTION PONDS

Wet and dry detention ponds both manage the quantity and quality of stormwater runoff before discharging offsite but do so differently based on the presence or absence of a permanent pool of water. Wet ponds and variations like enhanced wet ponds and constructed wetlands are designed to maintain a permanent pool of water based on the riser structure and local hydrology. Dry ponds do not maintain a permanent pool of water and are designed to fully dewater within a certain amount of time (typically 24 to 72 hours). Wet ponds and dry ponds have different conceptual zones for the purpose of designing and landscaping. Wet ponds potentially have inlets and outlets, forebays, basin pool, and side slopes (Clemson, n.d.). Enhanced wet ponds also designate between the pool, littoral shelves, emergent, riparian, and upland zones (Caflisch, et al., 2024). Constructed wetlands include high and low marsh zones. Dry pond zones include inlets and outlets, the basin bottom, side slopes, and perimeter zones. Employing these zones in stormwater pond design adds visual interest to the practice.

It is valuable to become familiar with local plant species that can inhabit these zones according to their exposure to water in order to design stormwater assets that also serve as a community amenity. Aesthetic vegetation enhancements can also provide water quality benefits by removing pollutants from runoff and providing wildlife and pollinator habitat. Figure 3 shows a wet pond that has been enhanced with zone-appropriate vegetation in the foreground. The background of the photo where turfgrass is planted to the waterline resembles a more conventional wet pond, without the benefits of enhancement. Note that planting trees on a constructed/fill embankment should be discouraged in both wet and dry ponds due to potential for roots to compromise the embankment's structural integrity.

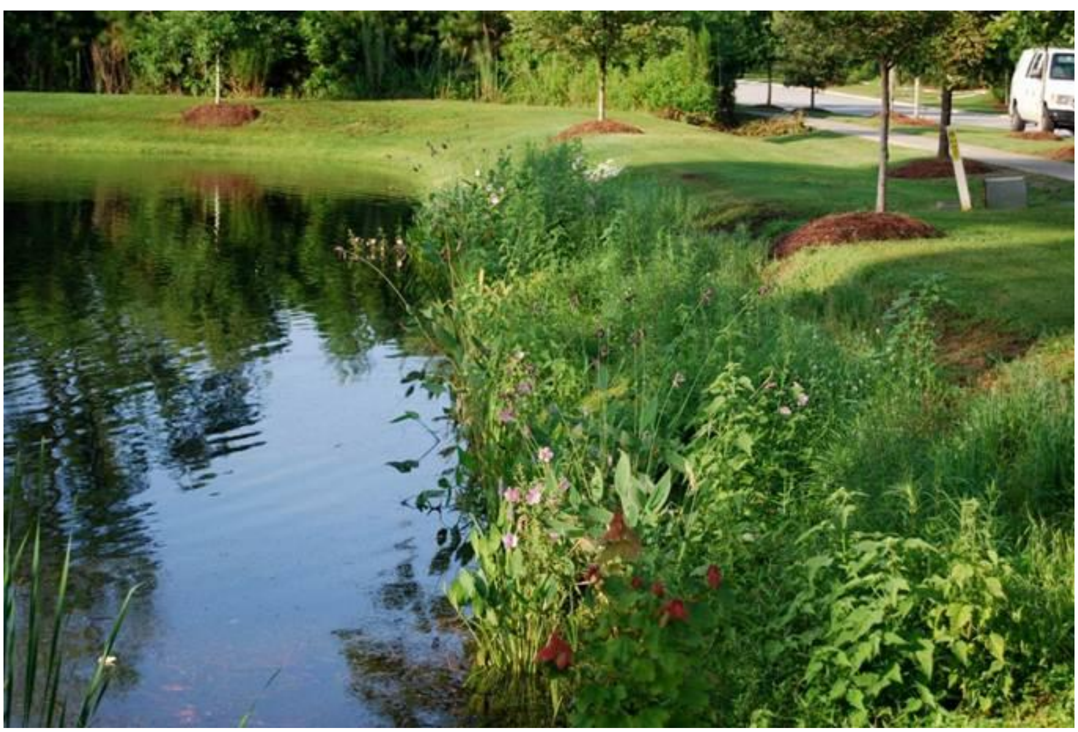

**Figure 3 - Enhanced wet pond featuring a littoral shelf and diverse vegetation (Caflisch, et al., 2024).**

## WET PONDS

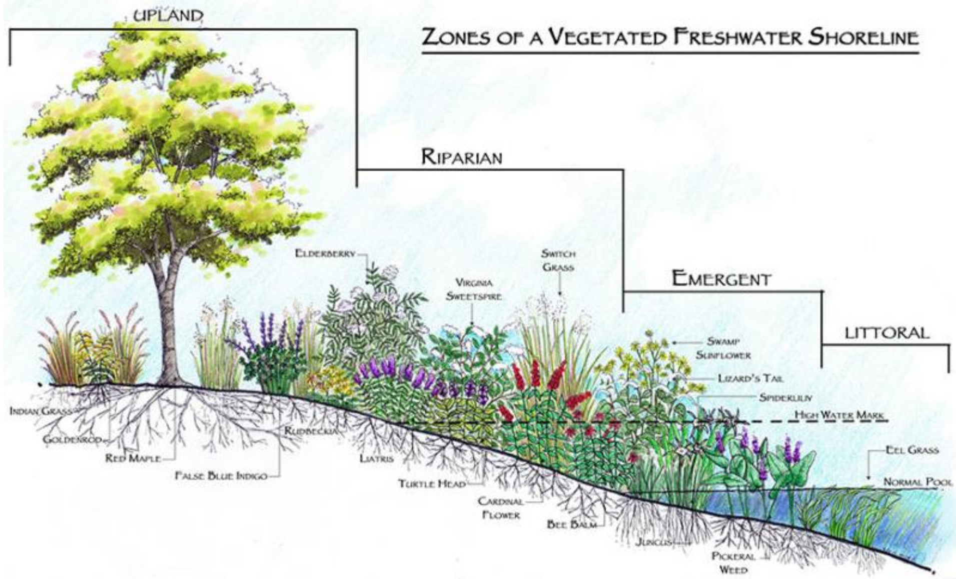


**Figure 4 - Zones of an enhanced wet detention pond (Caflisch, et al., 2024)**

Upland plantings will remain dry and endure little to no submersion. Plants in the riparian and emergent zones must have tolerances to both submersion and dry periods. Littoral shelves (aquatic safety benches) should remain submerged. Planting local vegetation according to time being submerged vs. dry will mimic native ecosystems and create a pleasant and functional pond for all to enjoy. See Figure 4 for an illustration of these zones. It is important to the integrity of the pond embankments to eliminate trees from the slopes or top of constructed embankments or dams. Any trees must be in the upland zone on previously existing/undisturbed soils and not located on fill associated with constructed embankments or dams. Figure 5 shows a typical detail for a wet pond.

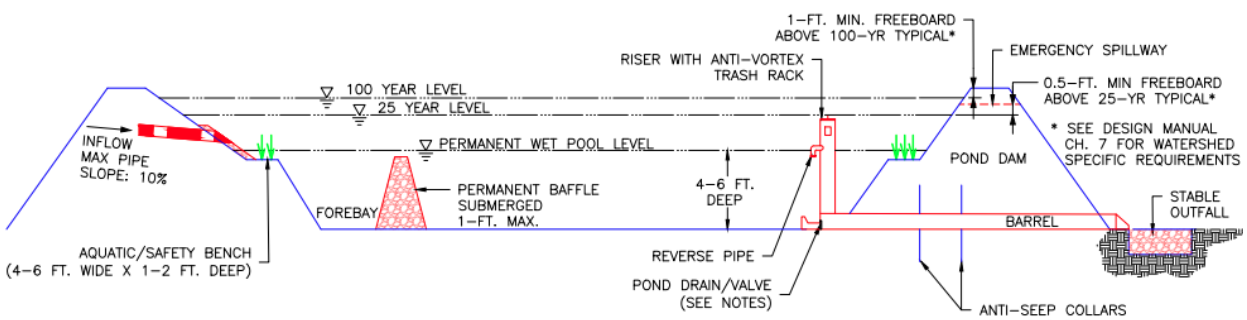


**Figure 5 - Typical wet pond detail. See the Greenville County Design Manual Appendix G for specifications.**

Figure 6 and Figure 7 show a wet detention pond before and after restoration of vegetation to improve water quality and BMP aesthetics. Note that the pond is excavated and trees are acceptable and desirable because they are not located on fill or a constructed embankment or dam. Figure 8 shows a wet detention pond with poor vegetation and bank erosion. In contrast, the pond in Figure 9 has diverse natural vegetation around its banks and a fountain to provide aeration.

Figure 6 - Ponds with sod to the water line often see severe bank erosion and sediment deposition (Iannone, 2019)

Figure 7 - Appropriate planting in each pond zone restores and protects the pond and its banks as well as providing a more beautiful setting for people to enjoy (Iannone, 2019).

**Figure 8 - A lack of vegetation can lead to erosion and poor pond performance**

**Figure 9 - Dense vegetation and the addition of a fountain improve the overall aesthetics and water quality of this pond**

## CONSTRUCTED WETLANDS

Constructed wetlands are a variation of wet ponds that provide filtration and uptake of stormwater and pollutants by wetland plants in strategic zones. They also control the flow of water and offer both retention and extended detention. Constructed wetlands present the potential for a stormwater feature that is aesthetically pleasing and can also support a diverse array of aquatic plant and wildlife species that offer valuable ecosystem services to citizens. Figure 10 shows a typical design schematic of a constructed wetland, including important zones and features.

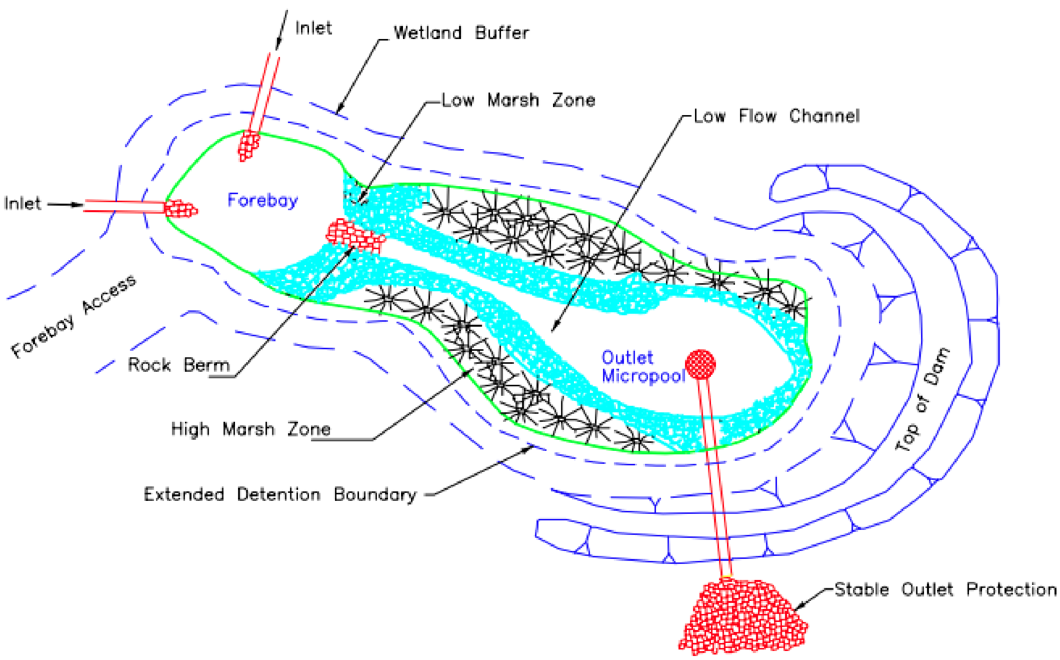


**Figure 10 - Typical constructed wetland detail. See the Greenville County Design Manual Appendix G for more specifications.**

The shallow water zone is between 0 – 18 inches deep and includes high and low marsh zones that encourage emergent plant growth and foster diversity. The high marsh zone, with a target depth of 6-inches deep, should make up roughly one-half of the shallow water zone. The low marsh zone, 6 – 18 inches deep, should make up the other half of the shallow water zone. The deep water zone, 1.5 – 6 feet deep, includes the forebay, low flow channels, and outlet micropool. There may be submerged or floating vegetation in the deep water zone. There are semi-wet zones above the permanent pool that support vegetation that can tolerate dry conditions and be submerged in larger storm events. There should also be a buffer around the wetland for maintenance access to remove sediment from the forebay and harvest wetland plants.

For constructed wetlands to function appropriately and remove pollutants and nutrients, it is important to maintain them to be properly by removing sediment as indicated by the cleanout stake and removal of debris from inlet and outlet structures. Vegetation should be monitored every six months over the first three years to ensure it is well established. Figure 11 shows a newly constructed wetland and the same wetland after two years of proper maintenance during establishment. Place new plants as needed to encourage appropriate growth and remove any vegetation that is not part of the wetland plan. Unwanted vegetation can overtake the wetland and replace wetland plants with invasive growth. Figure 12 is an example of a constructed wetland that needs improvement, and Figure 13 shows a local constructed wetland functioning properly.

**Figure 11 - Monitoring is critical during the years following planting ensure species thrive as designed. Above: initial planting of wetland vegetation. Below: Establishment of vegetation after three years. (Dragonfly Pond Works, 2024)**

**Figure 12 - Invasive cattails and other vegetation have taken over this stormwater wetland (Transform Your Wetland with Invasive Cattail Removal!, 2022)**


**Figure 13 - Well established constructed wetland with diverse vegetation at the Shoeless Joe Jackson Park, Greenville, SC**

## DRY PONDS

Similar to a wet pond, it is essential to consider the moisture tolerances of dry pond plantings. In a dry pond, dry conditions will be present the majority of the time, with short periods of submergence during and after rainfall. Ensure there are no trees planted on slopes or on top of constructed embankments or dams to preserve the embankment integrity. Figure 14 below shows a typical detail for a dry pond.

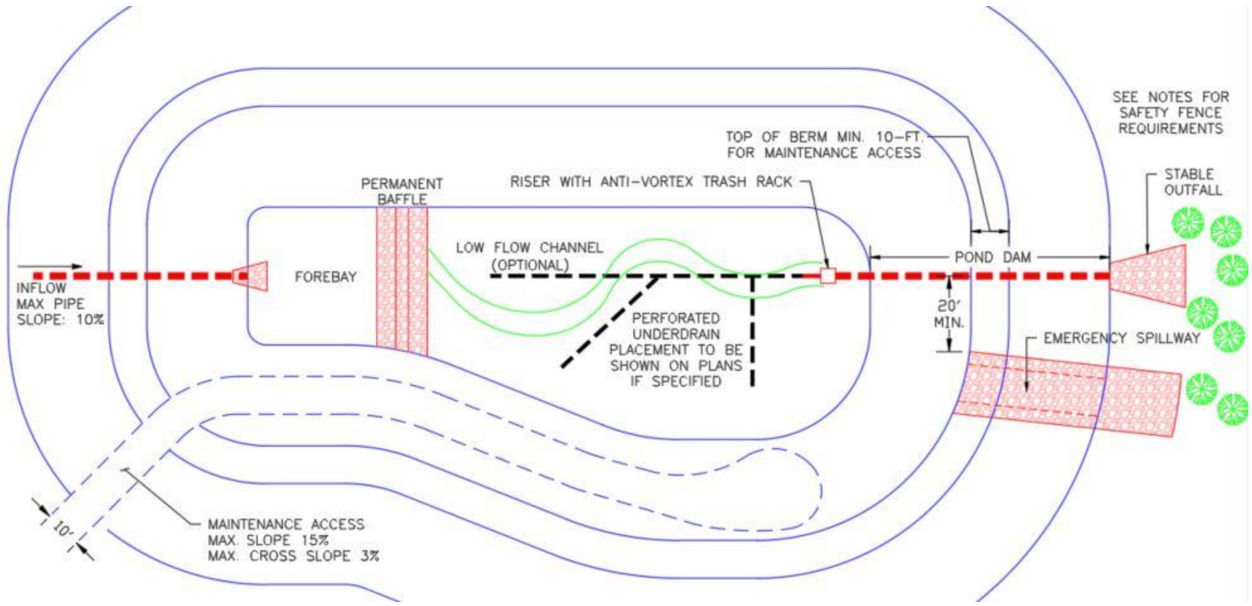


**Figure 14 - Typical dry pond detail. See the Greenville County Design Manual Appendix G for specifications.**

Areas with clayey soils should include a low flow channel so that standing water does not build up in the bottom. This channel should be stabilized with TRM and vegetation and have a meandering flow path, simulating natural streams. Hard armor should be avoided in stabilization efforts. When a hard structure like a retaining wall is necessary, consider natural materials like boulders or gabion baskets of stone instead of concrete or cinder blocks. Stabilization with natural materials and vegetation provides the functionality of filtering slower flows and increasing plant uptake of water, while also adding aesthetic appeal to the dry pond by mimicking nature.

Figure 15 shows a dry pond that has not been properly constructed and maintained, leading to significant bank erosion and loss of storage volume due to sediment accumulation across the basin bottom. Figure 16 shows a well maintained dry pond with a partially vegetated low flow channel. The maintenance of pond is paramount to them functioning properly and remaining an aesthetic amenity.

Figure 17 shows a dry pond that utilizes poured-in-place concrete for the pond walls and bottom. In contrast, Figure 18 shows a dry pond that utilizes gabion baskets of natural stone and robust vegetation for a more natural appearance.

Figure 15 - Lack of vegetation will lead to significant erosion and basin failure (Penna, n.d.)

Figure 16 - A dry pond with a low flow channel, partially vegetated (City of Greeley, CO, n.d.)

Figure 17 - This dry detention pond features concrete walls and a chain link fence, providing function with no attempt at a natural or aesthetically appealing form

Figure 18 - This dry detention pond utilizes gabion baskets of stone and vegetation to present an engineered structure with features that mimic nature

## SITE AESTHETIC ENHANCEMENTS

### POND LOCATION

One of the major goals of beautification is to make an asset such as a stormwater pond appear like it is part of the environment and still have optimal performance to control water quality and quantity. A big component of planning a pond is where it is located, traditionally near a parcel boundary where the property is graded lowest so that it can discharge and not monopolize available land space. There should be available access to all parts of the pond to allow for maintenance activities.

**Figure 19 - Integrating the pond location can enhance the beauty of a development (Solitude Lake Management, 2024)**

To turn the pond into an amenity rather than just a stormwater management asset, it could potentially be designed alongside other amenities (open spaces, clubhouse, etc.) with access available to owners and their users. Features such as picnic areas, boardwalks, and benches can elevate the pond's enjoyment. Using LID (Low Impact Development) principles in conjunction with attractive ponds creates an inviting and functional place that can be enjoyed rather than endured. A permeable paver path leading to an enhanced stormwater pond would be an inviting walk where people can enjoy the landscaping and wildlife. However, designers need to be aware of potential hazards that a stormwater BMP as an amenity may present and plan to mitigate them. Examples include the following:

- The use of gentle side slopes and paths minimizes a fall hazard to anyone walking along the pond and may eliminate the need for installation of a barrier or fence.
- The inclusion of a shallow aquatic bench or littoral zone around the perimeter minimizes the risk if someone were to fall into the pond.
- The creation and implementation of a thoughtful and detailed vegetative maintenance plan prevents spread of invasive or nuisance plant and animal species.

Figure 19 shows bridges as part of a walking path around ponds. This provides a beautiful amenity to the community. Figure 20 and Figure 21 are also examples of well-maintained ponds with features added to increase citizen's enjoyment.

Incorporating visual appeal into the design ensures that the asset can be appreciated by anyone who encounters it, including pedestrians and passers-by. Like any other infrastructure, regular maintenance is essential. This includes weed control, upkeep of landscaping vegetation, removal of accumulated sediment, and necessary repairs. These tasks help preserve both the functionality and the appearance of the pond.

**Figure 20 - Maximize amenities of stormwater management methods (Hilton Head Island, n.d.)**

**Figure 21 - A pleasant path and observation areas further integrates ponds into beautification and enjoyment of citizens (Minnesota Pollution Control Agency, 2024)**

## DESIGN INTEGRATION

Furthering the goal of creating an aesthetically pleasing environment, the design of the pond and landscaping can be made an extension of building architecture. Complimenting the angles, or lack of angles for curvilinear projects, in the building's façade can create a seamless transition from the built environment to one that appears more natural. Stormwater control measures can be integrated into built environments in a way that supports and enhances the overall design, rather than conflicting with it. Strategic use of landscaping and vegetation can also be employed to increase the function of the pond but also can add finishing touches to the look of a building and its surroundings. Figure 22 exemplifies the use of natural materials within an urban stormwater management feature. Additional design features may include permeable pathways for walking, jogging, and running, as well as seating and/or picnic areas. Try to design to avoid fences where possible; however, if they are necessary, select fences that mesh with the overall aesthetic of the project.

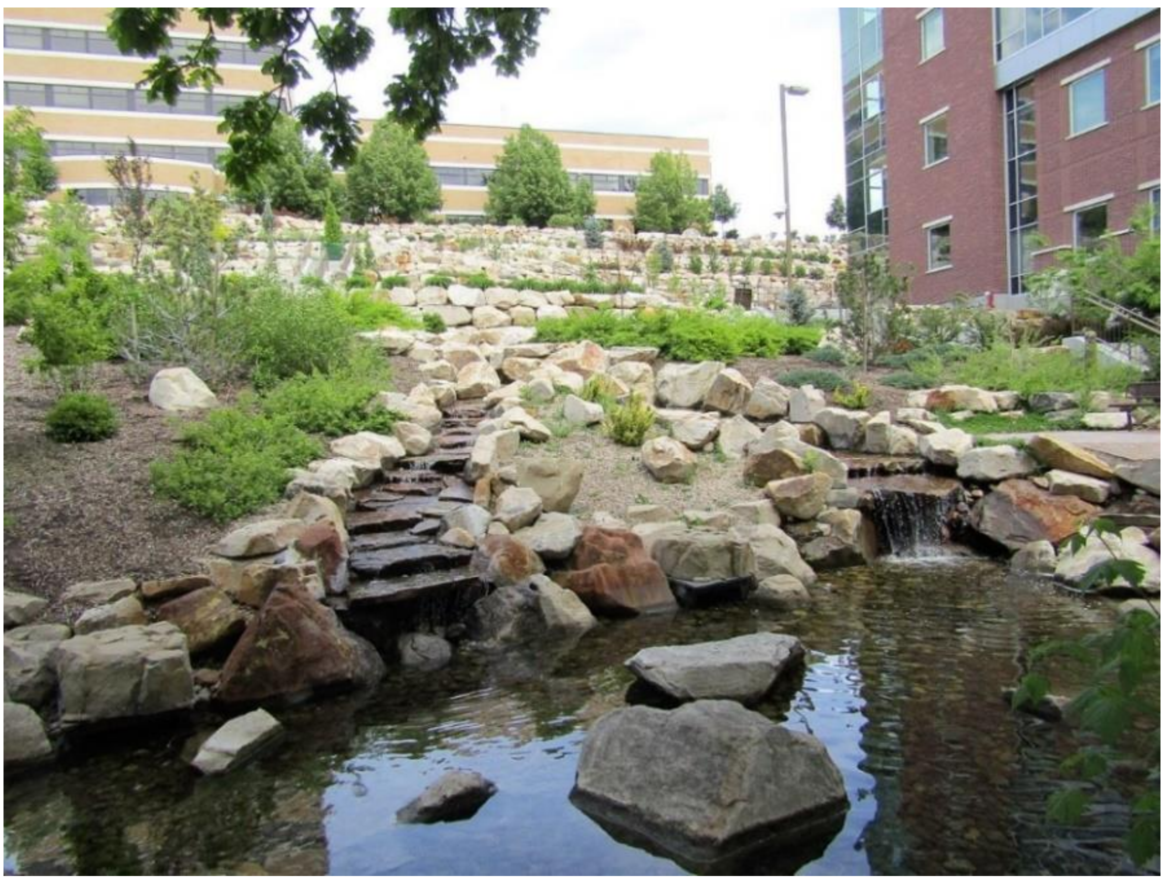

**Figure 22 - Natural materials utilized at the Bertrand F. Harrison Arboretum in Provo, UT. (Photo credit Ben P.L.)**

Retaining walls may be built with natural-appearing materials instead of poured in place concrete walls or cinder blocks. This could include the use of large stones and boulders or gabion baskets filled with smaller stones, as shown in Figure 23, to further enhance the connection with nature. Side slopes can be graded in ways to appear more natural rather than a traditional berm or dike. Small changes in design can have a meaningful effect on the look of the project.

**Figure 23 - Gabion basket retaining walls are striking alternatives to traditional retaining walls (Gabion Basket, n.d.)**

Smaller stormwater features such as the LID features discussed in the following sections can be integrated into areas along roadways, parking lots, and pedestrian walkways.  shows examples of bioretention basins that receive roadway and parking lot runoff through curb cuts or open curb to provide infiltration and water uptake by plants.

**Figure 24 - Left: Roadway and sidewalk runoff enters a bioretention basin through curb cuts (Portland, 2024). Right: Bioretention installed along a parking lot receives runoff as sheet flow (Greenville, SC).**

Figure 25 shows how the shape and design of ponds can be integrated into the surrounding architecture to create an appealing public space with visual continuity between the built and natural environment.


**Figure 25 - These images show how a dry detention pond mirrors architecture at the Denver Art Museum in Denver, Colorado (photo credit: Google Street View/Google Satellite)**

## SAFETY FENCES AND VEGETATIVE BARRIERS

Dry and wet ponds may be constructed without fences or barriers when side slopes are 3H:1V or less steep, adequate maintenance access is provided, and aquatic benches (for wet ponds) are provided. This is strongly preferred and represents best practices for aesthetics and long term function of the pond. Dry ponds and wet ponds with side slopes steeper than 3H:1V and/or inadequate maintenance access provided must provide a safety fence or vegetative barrier no less than four feet tall. Wet ponds which lack an aquatic/safety bench also require a safety fence or vegetative barrier. In situations where a barrier is required, use of vegetative barriers may improve aesthetics over a fence while providing stabilization to the embankment and protecting the public. Figure 26 shows a chain link fence, which is an effective barrier but is not as aesthetically pleasing as the vegetative barrier in Figure 27.

**Figure 26 - Chain link fencing provides a needed safety barrier due to steep slopes, but creates separation rather than connection to the stormwater feature**

**Figure 27 - Vegetative barrier around the top of the dry pond embankment provides a natural option when pond barriers are required for safety**

## LID METHODS

Incorporating decentralized stormwater management strategies beyond large, centralized detention basins can significantly enhance a site's aesthetic appeal and functional value. This may include green stormwater infrastructure (GSI) and low impact development (LID) methods that can be employed in tight spaces and can contribute to the overall function and beauty of a project. Bioretention cells and rain gardens can be integrated into the site to store and treat stormwater close to its source. Pervious paving can be used on paths and in parking areas. Enhanced Dry Swales (Bioswales) can maximize a vegetated space's ability to hold, convey, and filter stormwater runoff and reduce the need for curb and gutter and stormwater pipe. A wide range of stormwater management practices exist outside of traditional detention ponds and designers are encouraged to explore these alternatives to improve site aesthetics. Figure 28 shows bioretention and rain gardens implemented across a site, blending in with the site layout.


**Figure 28 - LID practices provide distributed stormwater treatment across a site in Greenville County**

## BIORETENTION

Bioretention is characterized by a shallow ponding area controlled by a riser structure and the use of a filter media mix and underdrain system along with vegetation to treat the quality of stormwater runoff. The engineered filter media mix provides filtration of runoff, sorption of pollutants, and organic material that supports growth of vegetation. In situ soils are not appropriate filter media. Turf grass may be used in bioretention but adding additional plants may increase water and nutrient uptake while creating an aesthetically appealing space. Figure 29 illustrates an innovative bioretention placement in a narrow, linear space behind residential lots – an effective application for this practice. Figure 30 is a typical detail for bioretention.

**Figure 29 - Bioretention capturing runoff from rear subdivision lots**

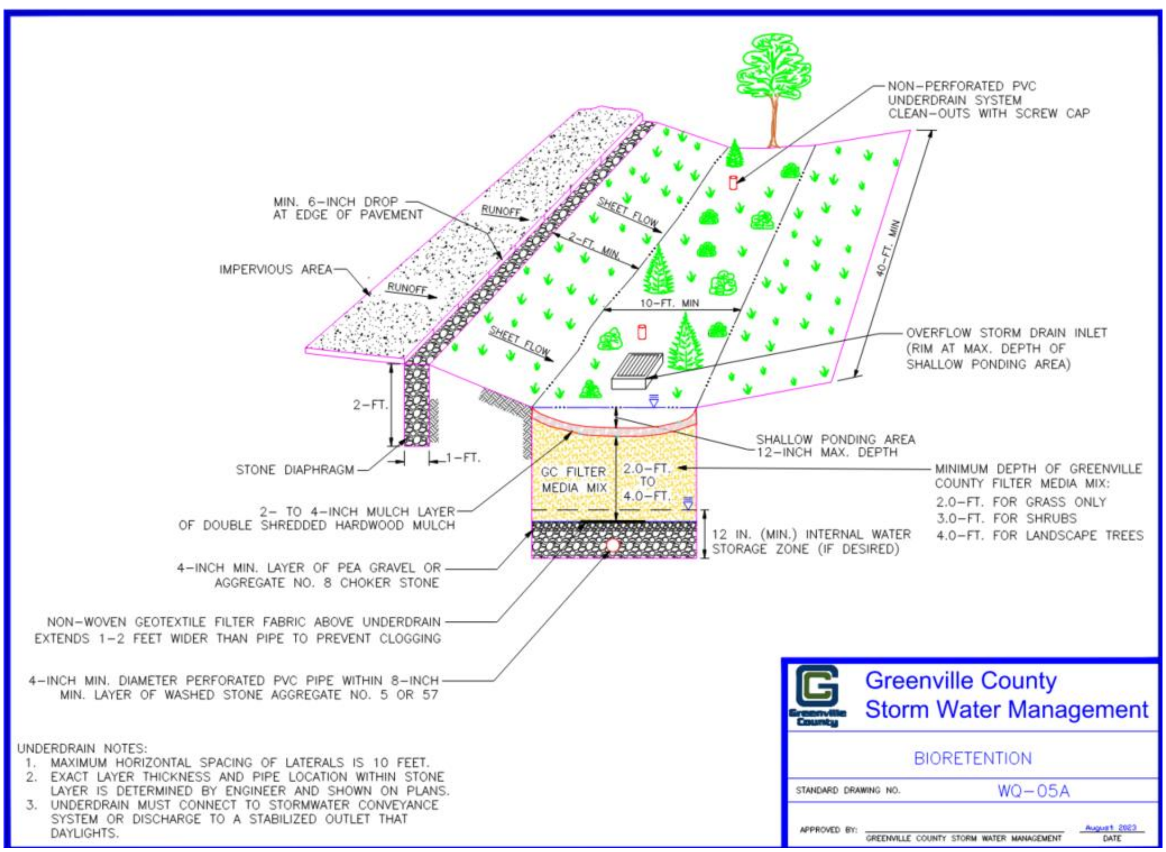


**Figure 30 - Typical Bioretention detail. See the Greenville County Design Manual Appendix G for more specifications.**

## RAIN GARDENS

Rain gardens are similar to bioretention cells in both form and function. However, they are typically smaller in scale and may include a small overflow spillway instead of a riser structure to pass high flows. They treat smaller areas of up to 2,500 square-feet and may be used in tandem with other LID BMPs or larger ponds to further enhance runoff treatment and overall aesthetic appeal of the area. Figure 31 shows a rain garden during a rain event retaining the runoff from the surrounding area. The inflow will infiltrate gradually, reducing the site's runoff volume and pollutants while also providing water and nutrients for the plants in the garden. Figure 32 is a typical detail for a rain garden.

Figure 31 - Rain Garden functioning for retention and later infiltration and filtering (VASWCD, 2024)

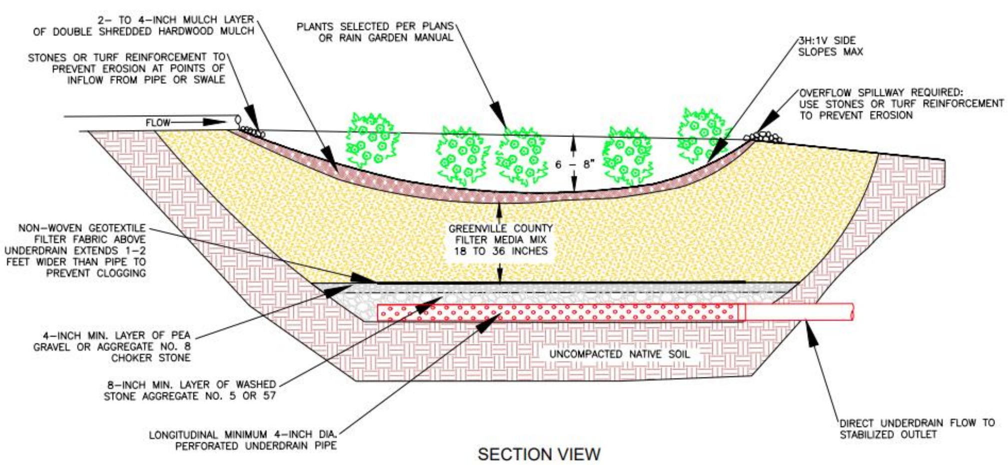


Figure 32 - Typical design of a rain garden. See the Greenville County Design Manual Appendix G for more specifications.

## PERVIOUS PAVEMENT

Pervious pavement combines effective stormwater infiltration with a visually appealing surface, offering both environmental performance and aesthetic enhancement in areas where space and appearance are priorities. There are several types of pervious pavement including geogrids with stone or grass, paver stones with open joints or spaces for stone or grass, and permeable concrete or asphalt. Figure 33 shows several of these options. Always abide by the installation and maintenance instructions from the product manufacturer to ensure optimum performance over the lifetime of the asset. Figure 34 is a typical detail for pervious pavement installations.

**Figure 33 - Examples of pervious pavement including open cell paver stones with soil and grass infill, permeable concrete, and geogrid filled with stone**

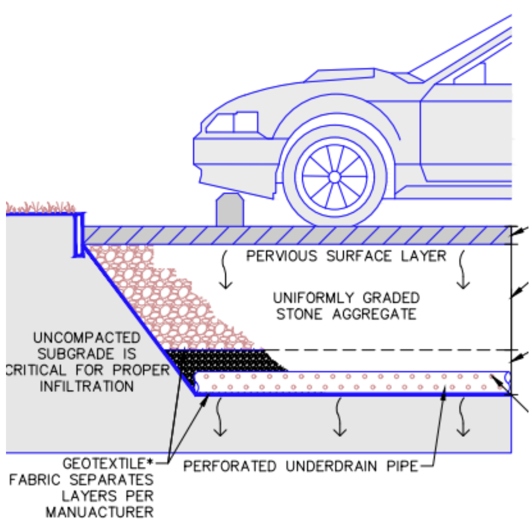


**Figure 34 - Detail for a typical pervious pavement installation. See the Greenville County Design Manual Appendix G for more specifications.**

## ENHANCED DRY SWALE

An enhanced dry swale is a shallow, vegetated channel designed to convey stormwater. The practice relies on check dams to slow water and promote infiltration and may contain an engineered filter media and underdrain system. Using these rather than impervious channels provides water quality improvement within the conveyance and aesthetic enhancement to the landscape. Figure 35 shows a functional and visually attractive enhanced dry swale installed in Greenville County. Figure 36 shows a typical detail for an enhanced dry swale.

Figure 35 - Enhanced dry swale in Greenville County featuring natural stone and vegetation

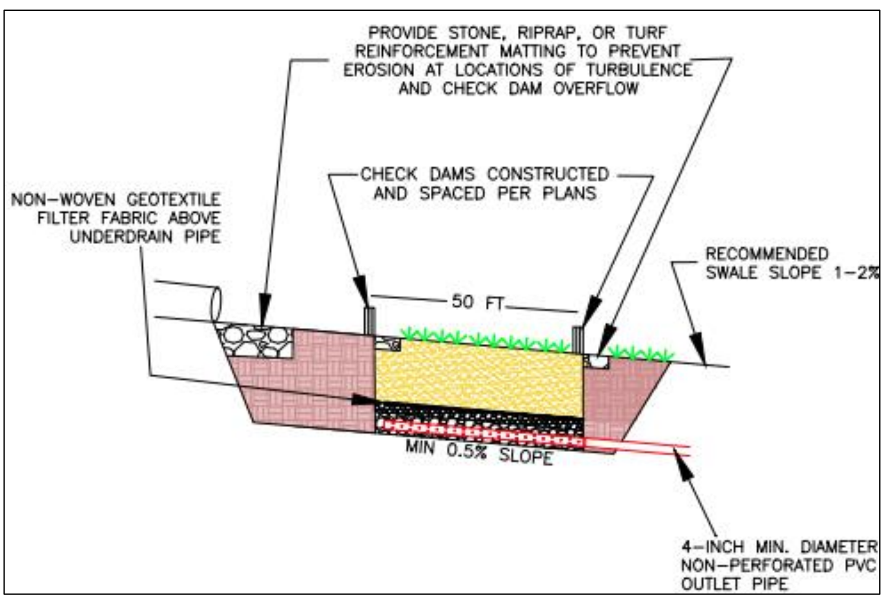


Figure 36 - Detail for Enhanced Dry Swales. See the Greenville County Design Manual for more specifications.

## VEGETATED FILTER STRIPS

Vegetated filter strips (VFS) offer infiltration and filtration of runoff to improve water quality. They are densely vegetated and can be used in a treatment train in conjunction with other BMPs. Figure 37 shows examples of VFS downstream of an outlet pipe at installation and after establishment. Figure 38 shows a typical detail for vegetated filter strips that utilize a concrete level spreader.

**Figure 37 - Above: VFS and level spreader during installation and prior to establishment of vegetation. Left: An established VFS with a well-maintained stand of turfgrass.**

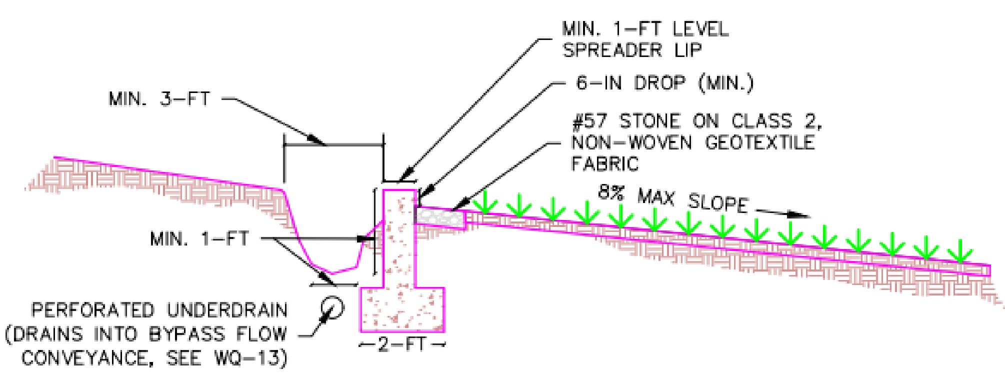


**Figure 38 - Typical VFS and concrete level spreader detail. See the Greenville County Design Manual for more specifications.**

## STEEP SLOPE APPLICATIONS

This section describes how stormwater features can be utilized on steep slopes to both manage runoff and increase the aesthetic and amenity value of an area. Sloped applications often utilize terracing or grade control structures to create flat areas along the slope. Velocity control and erosion protection are key and may require strategic use of hard armoring, retaining walls, or level spreaders. It is also important to select species of vegetation that are deep rooted and well suited to sloped areas with higher velocities. Examples of steep slope applications are below.

### TERRACED DETENTION

On sloped terrain, terraced or stepped detention basins can be used to slow water flow and enhance treatment efficiency while preventing erosion. These basins could be wet or dry detention basins or constructed wetlands, depending on the design, hydrology, and vegetation. These systems must incorporate robust structural elements like retaining walls, check dams, or geotextiles to stabilize the slope and support vegetation. Additionally, selecting native, deep-rooted plants helps anchor the soil and improve water filtration. While more complex than flatland installations, slope-adapted detention basins can effectively manage stormwater and improve water quality in sloped areas. Figure 39 shows constructed pocket wetlands in a park with pedestrian paths and benches to facilitate public use and enjoyment.

**Figure 39 - Pockets of constructed wetlands on steep slopes at the Liupanshui Minghu Wetland Park (Turenscape, n.d.)**

## BIORETENTION

Bioretention areas can also be adapted for steep slopes, though they require careful engineering to ensure structural stability. Incorporating terracing provides level planting beds that slow runoff and promote infiltration. Reinforced embankments, underdrains, and overflow structures are necessary to manage water safely and prevent slope failure. Plant selection should prioritize species with strong root systems to stabilize soil and tolerate variable moisture conditions. Figure 40 shows a bioretention area tailored to a steeply sloped area adjacent to a parking lot.

**Figure 40 - Bioretention with grade control structures on a steep slope (HydroCycle Engineering, PC, n.d.)**

## RAIN GARDENS

Rain gardens can be adapted to steep slopes using the same core strategies outlined for constructed wetlands and bioretention areas – terracing, erosion control, and deep-rooted vegetation. While generally simpler and smaller in scale, rain gardens still require level planting zones and overflow management to function effectively on sloped terrain. Figure 41 displays a rain garden appropriately implemented for a sloped area.

Figure 41 - Rain gardens can be designed to slow and treat runoff flows at the bottom of slopes (Stever, 2016)

## PERVIOUS PAVEMENT

Pervious pavement can be used on steep slopes with similar precautions as the previously discussed systems. Stabilizing and stepping the subgrade, using appropriate aggregate layers to prevent washout, and installing edge restraints to maintain structural integrity are important considerations when proposing pervious pavement on slopes. While the practice allows stormwater to infiltrate directly through the surface, steep slopes may require additional drainage controls to prevent runoff bypass. When properly designed, pervious pavement offers a durable, low-impact solution for managing stormwater and reducing erosion on sloped hardscapes like that shown in Figure 42.

**Figure 42 - Pervious pavement surfaces infiltrate water to reduce flows down sloped areas (TrueGrid, n.d.)**

## REGENERATIVE STORMWATER CONVEYANCE

A regenerative stormwater conveyance (RSC) provides water quality and site aesthetic enhancements in steep slope applications by using grade control structures to create ponding areas overtop a layer of engineered filter media. RSCs are similar to enhanced dry swales, but with added emphasis on velocity control and erosion protection during conveyance of on-line high flows. The RSC shown in Figure 43 utilizes different sizes of stone and vegetation where appropriate to ensure a stable channel and provide a conveyance that appears more natural compared to an impermeable concrete channel or pipe outfall.

**Figure 43 - A regenerative stormwater conveyance in Greenville County provides engineered channel stability while visually resembling a natural streambed**

## VEGETATED FILTER STRIPS

Vegetated filter strips can also be applied to slopes with careful attention to flow control and erosion prevention. Like the systems previously discussed, they benefit from terracing or gentle grading to slow runoff and increase contact time with vegetation. Dense, deep-rooted grasses and groundcovers help stabilize soil and filter pollutants. On steeper slopes, additional measures such as level spreaders or check dams may be needed to distribute flow evenly and prevent channeling. Figure 44 illustrates a vegetated filter strip with terracing to provide water quality benefit and prevent erosion down the slope.

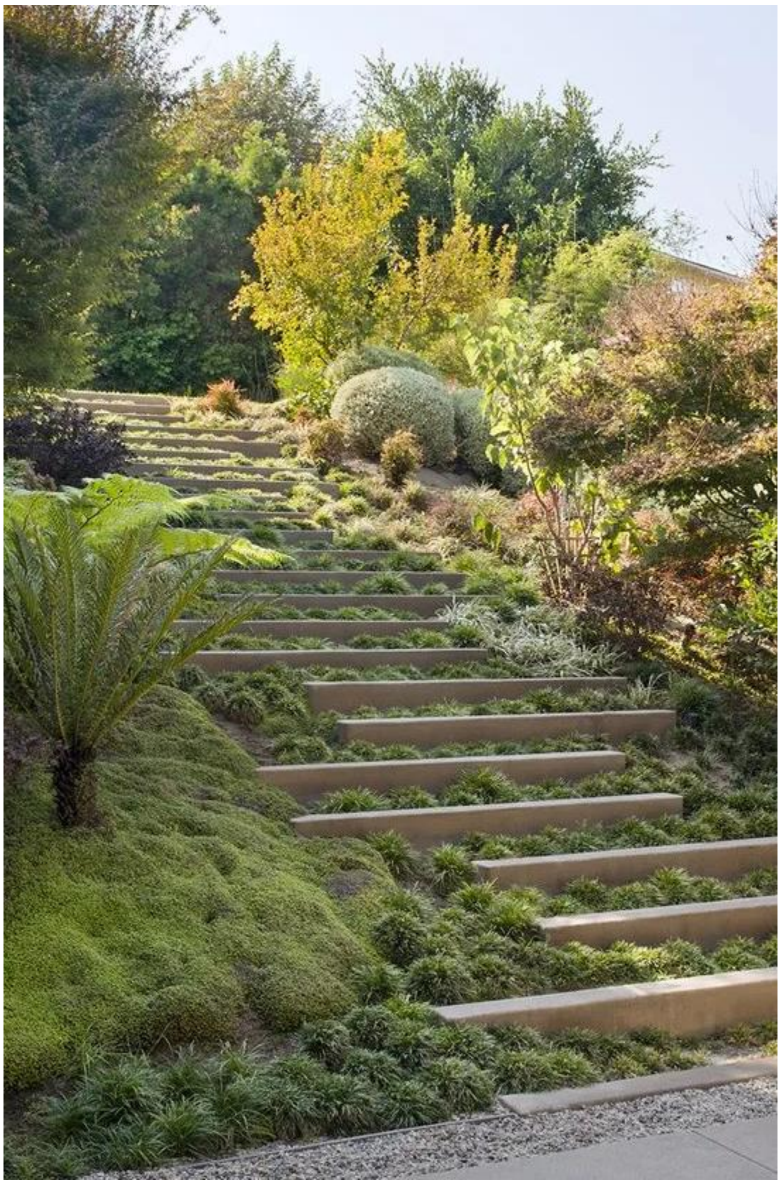

**Figure 44 - Terracing of vegetated filter strips can create flow paths with gentle slope to filter water and improve site aesthetics (Risedorph, 2016)**

## STONE TRENCH LEVEL SPREADER

Level spreaders are a useful tool to create and maintain sheet flow conditions, which are optimal for water quality treatment by LID practices. In sloped applications, level spreaders are necessary to prevent or disrupt concentration of flow across sloped areas. Level spreaders may be constructed out of pour-in-place concrete (as shown in the LID Methods / VFS section) or they may be constructed as a stone trench using natural materials like river rock or other stone. A stone trench level spreader provides improved aesthetic appeal as well as the functional benefits of storage volume within the void space of the stone and increased infiltration. Figure 45 shows two examples of level spreaders in sloped applications. Figure 46 shows a typical design detail for a stone trench level spreader creating sheet flow into a Vegetated Filter Strip.

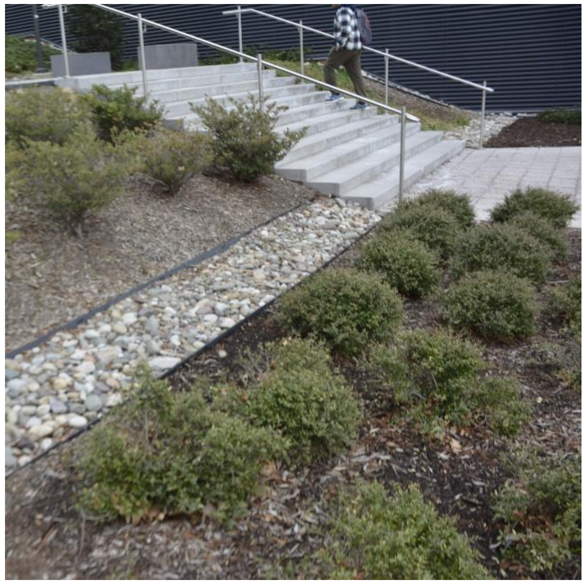

**Figure 45 - Stone trench level spreaders installed at the toe of slope to intercept concentrated flow and create sheet flow conditions through areas with engineered filter media and vegetation**

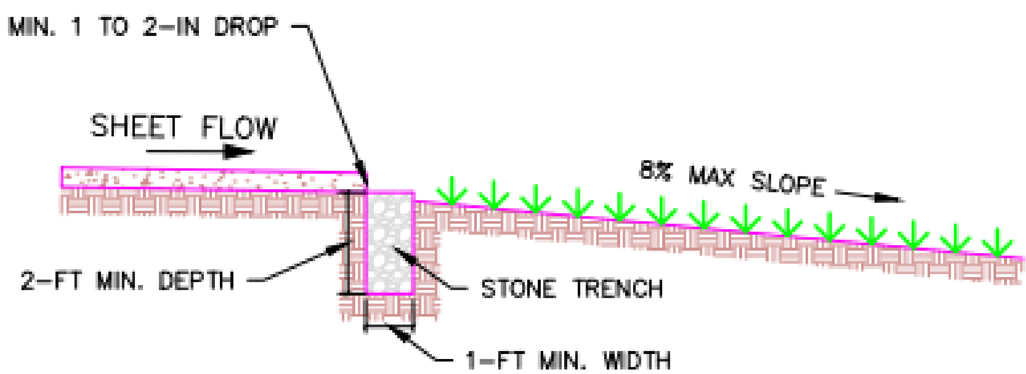


**Figure 46 - Typical VFS and stone trench level spreader detail. See the Greenville County Design Manual for more specifications.**

## CONCLUSIONS

While managing stormwater runoff is primarily a technical feat, it can also present the opportunity to beautify urban and suburban environments. Enhancing ponds with vegetation and natural features not only increases the aesthetics of a place but improves treatment of stormwater runoff. Employing LID methods where feasible creates an aesthetically pleasing landscape that can foster a sense of place for people to experience and enjoy, while also managing and treating stormwater runoff close to its source. The concepts and examples of this document are intended to provide a framework for a shift from traditional stormwater management using only centralized detention BMPs with steep slopes and minimal natural features to an approach of working with nature and creating aesthetically pleasing natural areas that improve water quality and add amenity value to developments.

For more information, see the Greenville County Stormwater Management Design Manual for further technical guidance or contact Greenville County's Land Development Division at:

301 University Ridge, Suite S-3300
Greenville, SC 29601

Phone: 864-467-4610

Website: https://www.greenvillecounty.org/LandDevelopment/

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SOIL AND WATER

## WORKS CITED


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## APPENDIX A: VEGETATION

### BIORETENTION PLANT SPECIES

| Botanical Name | Common Name | Height | Zone* | Light | Description |
|---|---|---|---|---|---|
| **Trees** | | | | | |
| *Aesculus pavia* | Red Buckeye | 10-15 ft. | 2 | Sun/shade | Spring flowers, prefers part shade, may defoliate early in season. |
| *Amelanchier canadensis* | Serviceberry | 12-20 ft. | 2 | Sun/ part shade | Moist to average soils; Tolerates part shade; Multi-stem grey bark, early spring white flowers, early purple berries, red in fall; high wildlife value, fruits for birds. |
| *Betula nigra* | River Birch | 50 ft. | | Sun | Deciduous; Multi-stem upright. |
| *Carpinus caroliniana* | Ironwood/ American Hornbeam | 30 ft. | 1,3 | Sun /shade | Shade tolerant, handles inundation of water, unique silver fluted trunk. |
| *Chionanthus retusus* | Chinese Fringetree | 12-20 ft. | | Sun | Deciduous; Rounded. |
| *Chionanthus virginicus* | Fringe Tree | 12-20 ft. | 2 | Sun/shade | Moist soils; excellent small urban tree; Can be shrubby; fragrant pendulous white spring flowers and gold fall color. |
| *Cornus florida* | Flowering Dogwood | 15-30 ft. | | Sun/shade | Deciduous; Upright. |
| *Fagus grandifolia* | | | | | |
| *Ilex opaca* | American Holly | 15-50 ft. | 1,2 | Sun/shade | Medium drought tolerance; Bioretention soil must be sandy loam - intolerant to coarse soils (loamy sand); Sun to shade evergreen, slow growing, white flowers, red berries. |
| *Magnolia stellata* | Star magnolia | 10-20 ft. | | Sun | Deciduous; Oval to rounded. |
| *Magnolia virginiana* | Sweetbay Magnolia | 15-30 ft. | 3 | Sun/ part shade | Sun to shade semi-evergreen, fragrant flowers, bright red berries, often multi-stem. |
| *Nyssa sylvatica* | Black gum | 30-50 ft. | | Sun/ part shade | Deciduous; Upright/oval. |
| *Quercus bicolor* | Swamp White Oak | 50-60 ft. | | Sun | Deciduous. |
| *Sassafras albidum* | Sassafras | 30-60 ft. | | Sun/ part shade | Deciduous; Upright, open. |
| *Taxodium distichum* | Cascade Falls/ Bald Cypress | <20 ft. | | Sun | Deciduous; Weeping. |
| **Vines** | | | | | |
| *Bignonia capreolata* | Cross Vine | | | Sun | Semi-evergreen; Coarse texture. |
| *Campsis radicans* | Trumpet creeper | | | | |
| *Gelsemium sempervirens* | Carolina Jessamine | 10-20 ft. | | Sun | Evergreen; Fine texture, shiny leaves. |
| *Lonicera sempervirens* | Trumpet Honeysuckle | 15-25 ft. | | Sun | Evergreen/Deciduous; Medium texture. |
| **Shrubs** | | | | | |
| *Abelia x grandiflora* | Glossy abelia | 3-6 ft. | | Sun | Semi-evergreen; Spreading to rounded, arching. |
| *Aucuba japonica* | Japanese aucuba | 6-10 ft. | | Shade | Evergreen; Upright. |
| *Buddleia davidii* | Butterfly Bush | 5-10 ft. | | Sun | Deciduous; Rounded. |
| *Callicarpa americana* | American Beautyberry | 4-8 ft. | 2 | Sun/ shade | Average to droughty soils ; no anaerobic tolerance; Striking purple berries on new growth, yellow fall color, sun to part shade; well-suited for mountains. |
| *Calycanthus floridus* | Sweetshrub/Allspice | 6 ft. | | Shade | Deciduous; Rounded. |
| *Chaenomeles speciosa* | Flowering quince | 6-10 ft. | | Sun | Deciduous; Rounded. |
| *Cornus alba (sericea L.)* | Redtwig dogwood | 3-4 ft. | | | Deciduous; Upright/vertical. |
| *Hamamelis vernalis* | Ozark Witch Hazel | 15-30 ft. | | | Deciduous; Rounded. |
| *Hamamelis virginiana* | Witch Hazel | 15-30 ft. | | Sun/ Part shade | Deciduous; Rounded. |
| *Hibiscus syriacus* | Rose of Sharon | 8-12 ft. | | Sun | Deciduous; Erect shrub/small tree. |
| *Ilex glabra* | Inkberry Holly | 6-8 ft. | 3 | Sun/shade | Very flood tolerant; high anaerobic tolerance. White flowers with black berries. |
| *Ilex verticillata* | Common Winterberry/ Deciduous Holly | 6-10 ft. | 3 | Sun/ part shade | Very flood tolerant intermediate drought resistance; Bioretention soil must be sandy loam - intolerant to coarse soils (loamy sand). White flowers with red berries retained in winter; sun to part shade; well-suited for mountains. |
| *Itea virginica* | Virginia Sweetspire | 3-6 ft. | 3 | Sun/shade | Medium shrub. Fragrant white tassel flowers, deep red or purple fall foliage. Well suited for Piedmont. Prefers moist soils. |
| *Ilex vomitoria* | Dwarf Yaupon/ Yaupon Holly | 8-15 ft. | 1,2 | Sun/ part shade | High drought tolerance, No anaerobic tolerance. Red fruit in fall & winter. Long lasting translucent berries. |
| *Illicium floridanum* | Florida Anise | 6-8 ft. | | Shade | Evergreen; Upright. |
| *Lindera benzoin* | Spicebush | 8 ft. | 3 | Part shade/ shade | Very early chartreuse flowers, fragrant leaves, pale yellow fall color. Suitable for Coast. |
| *Myrica cerifera (evergreen)* | Wax Myrtle | 10-20 ft. | 1,2 | Sun/ part shade | Very flood tolerant; medium drought resistance; medium anaerobic tolerance. Fragrant leaves, berries for candles, can prune as a hedge. |
| *Physocarpus opulifolius* | Common Ninebark | 5-10 ft. | | Sun | Deciduous; Upright. |
| *Rhododendron viscosum* | Swamp Azalea | 6 ft. | | Part shade | Deciduous; Upright and spreading. |
| *Sabal minor* | Dwarf palometto | 10 ft. | | Sun | Evergreen; Upright. |
| *Sambucus canadensis* | Elderberry/Black Lace | 6-8 ft. | | Sun | Deciduous; Leggy, open-purple foliage, flowers, and berries. |
| *Spiraea japonica* | Fortune meadowsweet | 2-3 ft. | | Sun | Deciduous; Mounded. |
| *Spiraea thunbergii* | Thunberg's meadowsweet | 3-5 ft. | | Sun | Deciduous; Rounded. |
| *Viburnum dentatum* | Southern Arrowhead | 6-10 ft. | | Sun | Deciduous; Upright. |

| Botanical Name | Common Name | Height | Zone* | Light | Description |
|---|---|---|---|---|---|
| *Viburnum lantana* | Wayfaringtree virburnum | 10-15 ft. | | Sun | Deciduous; Upright. |
| *Viburnum lantanoides* | Hobblebush | 3-6 ft. | | Sun | Deciduous; Upright. |
| *Viburnum x rhytidophylloides* | Lantanaphyllum Viburnum | 8-10 ft. | | | Semi-evergreen; Upright and spreading. |
| **Perennials** | | | | | |
| *Achillea millefolium* | Common Yarrow | 1-2 ft. | | Sun | Herbaceous; mounded. |
| *Amsonia hubrichtii* | Hubricht's bluestar | | | | |
| *Amsonia tabernaemontana* | Eastern Bluestar | 1-3 ft. | 3 | Sun/ part shade | Wetland plant that is Drought resistant; pale blue tubular flowers. |
| *Aquilegia canadensis* | Columbine | | | | Herbaceous; Tall, shade, and well-drained. |
| *Asclepias incarnata* | Swamp Milkweed | 2-4 ft. | 3 | Sun | Pink rose-purple blooms in mid-summer, attracts butterflies. Thrives in mucky clay soils |
| *Asclepias tuberosa* | Butterfly Milkweed | 2-3 ft. | 1 | Sun/ part shade | Prefers well-drained sandy soils. Tolerates drought. Striking and rugged plant with orange flowers that attract butterflies. Slow to establish and easy to grow from seed. |
| *Aster novae-angliae* | New England Aster | 2-6 ft. | | Sun | Herbaceous; Upright, mounded. |
| *Canna glauca* | Canna Lily | 3-5 ft. | | Sun | Herbaceous |
| *Chelone glabra* | White Turtlehead | 1-4 ft. | 3 | Sun | Snapdragon type white flowers, often lavender tinged. Attracts butterflies and hummingbirds. Suitable for Piedmont. |
| *Chelone lyonii* | Pink Turtlehead | 1-4 ft. | | Sun | Herbaceous; Mounding. |
| *Conoclinium coelestinum* | Blue Mistflower | 1-3 ft. | | Sun | Herbaceous; Rounded. |
| *Epimedium spp.* | Epimedium | 8-10 in. | | Shade | Herbaceous; Spreading mound. |
| *Eutrochium purpureum* | Joe Pye Weed | 3-6 ft. | 3 | Sun | Rapid grower with large pink to purple flowers that attract butterflies. |
| *Helianthus angustifolius* | Swamp Sunflower | 4-7 ft. | 3 | Sun/ part shade | Tall yellow daisy flowers with maroon center. Good seed source for birds. |
| *Hemerocallis sp.* | Daylily | 8-24 in. | | Sun/ Part shade | Herbaceous; Mounding. |
| *Heuchera americana* | American Alumroot | 8-18 in. | | Shade | Herbaceous; Mounding. |
| *Hibiscus coccineus* | Scarlet rosemallow | 4-7 ft. | | Sun | Deciduous; Upright, fine. |
| *Iris cristata* | Crested Iris | 3-6 in. | | Shade | Herbaceous; Upright. |
| *Iris sibirica* | Siberian Iris | 18-24 in. | | | Herbaceous |
| *Iris versicolor* | Harlequin Blueflag | 2 ft. | | Sun | Herbaceous; Upright. |
| *Iris virginica* | Virginia Iris | 18-24 in. | | Sun | Herbaceous; Upright. |
| *Juncus effusus* | Soft rush | 1-3 ft. | | Sun | Evergreen; Vertical. |
| *Kniphofia uvaria* | Redhot Poker | 1.5-4 ft. | | Sun | Herbaceous; Vertical. |
| *Lobelia cardinalis* | Scarlet Lobelia/ Cardinal Flower | 3-5 ft. | 3 | Sun/shade | Drought resistant; Bioretention soil must be sandy loam - intolerant to coarse soils (loamy sand). Brilliant red flower spikes that attract butterflies and hummingbirds. |
| *Lobelia siphilitica* | Great Blue Lobelia | 1-3 ft. | | Part shade/ shade | Herbaceous; Upright. |
| *Mertensia virginica* | Virginia Bluebells | 1 ft. | | Part shade/ shade | Herbaceous; Low mound. |
| *Monarda didyma* | Scarlet beebalm | 2-3 ft. | | | |
| *Penstemon digitalis* | Smooth Penstemon | 2 ft. | | Sun | Herbaceous; Upright. |
| *Phlox divaricata* | Woodland phlox | 10-20 in. | | Part shade/ shade | Herbaceous; Upright. |
| *Physostegia virginiana* | Obedient Plant | 2-3 ft. | | Sun | Herbaceous; Upright and mounded. |
| *Polygonatum biflorum* | Smooth Solomon's Seal | 1-3 ft. | | Shade | Herbaceous; Arching. |
| *Ruellia brittoniana* | Mexican petunia | | | | |
| *Rudbeckia fulgida* | Black-eyed Susan/ Goldstrum | 1-3 ft. | 2 | Sun | Moist to dry soils; showy flowers; other species & cultivars. Self-sows and produces abundant offsets. |
| *Salvia uliginosa* | Bog-Sage | 4-5 ft. | | Sun | Herbaceous; Upright. |
| *Solidago speciosa* | Goldenrod | 2-3 ft. | 3 | Sun | Thin sprays of arching flowering stems occur at the top of sturdy stems.; Other species & cultivars |
| *Tradescantia virginiana* | Virginia spiderwort | 1-2 ft | | Sun/ Part shade | Herbaceous; Mounded. |
| *Verbena bonariensis* | Tall Verbena | 2-4 ft. | | Sun/ Part shade | Herbaceous; Upright and spreading. |
| *Symphyotrichum spp. (Boltonia asteroides)* | Common Aster | 1-3 ft. | | Sun | Herbaceous; Mounded. |
| *Vernonia noveboracensis* | Ironweed | 3-6 ft. | 3 | Sun | Tall red-purple flower clusters late summer & early fall that attract butterflies. Tolerates inundation. |
| *Veronica spicata* | Spiked speedwell | 1-2' | | Sun | Herbaceous; Rounded and upright. |
| **Grasses** | | | | | |
| *Acorus gramineus* | Sweet Flag | 4-8 in. | | Part shade/ shade | Evergreen; Stiff, upright spreading. |
| *Andropogon gerardii* | Big Bluestem | 6-8 ft. | 1,2 | Sun/ part shade | Bunch grass with a blue-green color turning maroon-tan color in fall. Deep roots and drought resistant. Moderately tolerant of acidity and salinity |

| Botanical Name | Common Name | Height | Zone* | Light | Description |
|---|---|---|---|---|---|
| *Calamagrostis x acutiflora* | Feather reed grass | 4-5 ft. | | Sun | Herbaceous; Vertical, tightly clustered. |
| *Carex appalachica* | Appalachian Sedge | 8-12 in. | | | Herbaceous; Dry side. |
| *Carex stricta* | Tussock Sedge | 8-12 in. | | Part shade/ shade | Herbaceous; Upright or slightly arching. |
| *Chasmanthium latifolium* | River Oats | 2-4 ft. | 1,3 | Part shade/ shade | Clump forming. Dangling oats are ornamental and copper in fall. Medium drought and anaerobic tolerance; showy seed clusters, spreads by seed. |
| *Muhlenbergia capillaris* | Muhly Grass/ Mist Grass | 1-3 ft. | 1,3 | Sun | In the fall, creates a stunning pink to lavender floral display. Functions well in meadow gardens. |
| *Panicum virgatum* | Panic Grass/ Switchgrass | 3-6 ft. | 1,3 | Sun/ part shade | Clump forming grass very tolerant of flooding and tolerates dry soils and is drought resistant; fuzzy flower heads. |
| *Pennisetum alopecuroides* | Dwarf Fountain Grass/Cassian | | 2-3 ft. | | Herbaceous |
| *Schizachyrium scoparium* | Little Bluestem | 2-18 ft. | 1,2 | Sun/ part shade | Clump grass that attracts birds and mammals. Blue-green stems that turn mahogany-red with white seed tufts in the fall. Readily reseeds. Suitable for the Coast. |
| *Sorghastrum nutans* | Indian Grass | 3-6 ft. | 1,2 | Sun/shade | Tall, bunching sod-former, with broad blue-green blades and a large, plume-like, soft, golden-brown seed head. Fall color is deep orange to purple. Drought tolerant |
| **Turf Grasses** | | | | | |
| *Cynodon dactylon* | Bermudagrass | | | | |
| *Festuca arundinacea* | Tall Fescue | | | | |
| *Zoysia japonica* | Japanese/Korean Lawngrass | | | | |
| **Ferns** | | | | | |
| *Athyrium filix-femina* | Lady Fern | 1.5-3 ft. | | Shade | Herbaceous; Mounding. |
| *Onoclea sensibilis* | Sensitive Fern | 3-4 ft. | | Part shade/ Shade | Herbaceous; Mounding. |
| *Osmunda cinnamomea* | Cinnamon Fern | 2-4 ft. | 3 | Part shade/ shade | Ideal for moist areas of Bioretention area. Non-flowering plant that reproduces by spores. |
| *Osmunda regalis* | Royal Fern | 2-3 ft. | 3 | Part shade/ shade | Tolerates year-round shallow water. |
| *Polystichum acrostichoides* | Christmas Fern | 18-36 in. | | Part shade/ shade | Herbaceous; Arching. |
| *** = Wetness Zone** | **1** Plants that, once established, withstand drought (3-4 weeks without rainfall); Establishment is 1-2 yrs for trees & shrubs, 1 yr for perennials & grasses<br>**2** Plants that grow best in moist to average soils and only tolerate short periods (1-2 days) of flooding.<br>**3** Plants that tolerate longer periods of flooding (3-5 days), but also grow in moist to average soils. | | | | |

## VEGETATION FOR AQUATIC BENCHES OR LITTORAL SHELVES

| Vegetation Common Name | | |
|---|---|---|
| Alligator Flag | Lance-leaf Arrowhead | Swamp Hibiscus |
| Arrow Arum | Lizard's Tail | Swamp Lily |
| Caric Sedge | Louisiana Iris | Swamp Rose |
| Coastal Spikerush | Pickerelweed | Swamp Sunflower |
| Duck Potato | Pond Cyprus | Sweetflag |
| Flat Sedge | Rice Cutgrass | Switchgrass |
| Giant Bulrush | Soft Rush | Tickseed |
| Golden Canna | Softstem Bulrush | Three-square |
| Green Arum | Southern Blue-Flag Iris | Virginia Chain Fern |
| Jointed Spikerush | Smartweed | Wool Grass |