4.0 Summary of Watershed Restoration Strategies

Watershed restoration strategies to address stormwater problems and to improve water quality were developed for the Sugarland Run and Horsepen Creek watersheds. The strategies recommended in this plan were developed by identifying priority subwatersheds and then identifying candidate restoration projects within them. The top 70 projects were selected for implementation within the next 10 years, and an additional 50 projects were selected for implementation within the next 25 years. A brief description of the methodology used to select priority subwatersheds and candidate restoration projects and the actual prioritization process is provided in this section. Detailed information on this process is provided in Technical Memos 3.2 and 3.4/3.5 found in Appendix B.

This section also includes a description of watershed restoration strategies, along with several examples of the types of projects that have been proposed. The end result of this work can be found in the list of 10-year and 25-year projects provided at the conclusion of this section.

4.1 Priority Subwatershed Identification

Priority subwatersheds and candidate restoration areas were identified based on the results of final subwatershed ranking, priority restoration elements from the Stream Physical Assessment (SPA), problem areas identified during subwatershed characterization and field reconnaissance, and input from the Watershed Advisory Group (WAG). These areas were targeted for implementation of structural Best Management Practices (BMPs), or restoration strategies.

There are also areas within the Sugarland Run and Horsepen Creek watersheds that would benefit from preservation strategies rather than solely restorative strategies. Preservation strategies target the less impacted subwatersheds and key areas such as headwaters to prevent future degradation of the subwatershed and downstream areas. By evaluating subwatershed ranking, results of the pollutant loading model STEPL, and the total impervious area of the subwatershed, priority areas for preservation strategies were identified. These areas were targeted for the implementation of non-structural BMPs.

4.2 Description of Prioritization Process

The prioritization process that was used to select priority subwatersheds, identify candidate restoration projects, and determine final restoration projects consisted of four steps as outlined below. Detailed information and data regarding the prioritization process can be found in Technical Memos 3.4 and 3.5 located in Appendix B.

Step 1: The potential "universe" of structural projects was narrowed down by identifying priority subwatersheds, evaluating candidate restoration projects, soliciting comments from the WAG and determining which projects were viable.

Step 2: The watershed management plan prioritization scheme was used to perform the initial project ranking using the Spreadsheet Tool for Estimating Pollutant Load (STEPL) and watershed indicators for all structural candidate projects within the 0-25-year implementation time frame.

STEPL is a spreadsheet tool that uses simple algorithms to calculate nutrient and sediment loads from various land uses and determines the pollutant load reductions that would occur from implementing various BMPs.

Structural candidate projects were scored from 1 to 5 points, with 5 points representing the highest priority and 1 point representing the lowest priority. The five factors included:

- **Effect on watershed impact indicators (30%)** – Watershed impact indicators provide an overall picture of the condition of the watershed using a variety of quantitative indicators. Candidate projects that have a greater positive effect on the watershed impact indicators are likely to have a greater benefit than projects with a lesser or neutral effect.
- **Effect on source indicators (30%)** – Source indicators provide an overall picture of the stressors within a watershed using a variety of quantitative indicators. Candidate projects that have a greater positive effect on the source indicators are likely to have a greater benefit than projects with a lesser or neutral effect.
- **Location within priority subwatersheds (10%)** – Candidate projects located within poor quality subwatersheds have the potential to provide a greater overall impact than a project located within a high quality subwatershed. Therefore, projects located in poor quality subwatershed received a higher priority and a higher score than projects located in a high quality subwatershed.
- **Sequencing (20%)** – Projects upstream relative to other projects should be completed prior to projects located downstream. Upstream projects will provide protection for future downstream projects and also mitigate sources and stressors that cause cumulative impacts downstream. Therefore, projects in headwater areas were considered the highest priority and received a higher project score.
- **Implementability (10%)** – Less complex projects and projects without land acquisition requirements will be easier to implement and are given higher scores accordingly. Projects that were located on County property or retrofits of County-maintained stormwater facilities were scored higher than projects on private parcels and those with multiple landowners.

Step 3: The proposed 10-year implementation projects were further analyzed and evaluated using both the Storm Water Management Model (SWMM) and the HEC-RAS model. SWMM is a rainfall-runoff simulation model that estimates the quantity and quality of runoff. HEC-RAS is a computer program that models the hydraulics of water flow through watercourses. By utilizing these tools, a determination was made on which projects should be included in the 10-year implementation plan and how they were ranked within it.

Step 4: The final set of recommended projects and final ranking of all projects was determined through close collaboration with the WAG. Project ranking was also adjusted and finalized based on estimated costs and projected benefits of the projects. Projects that had greater projected benefits relative to estimated costs were prioritized. Finally, the ranked structural projects were grouped into the two implementation timeframes - the priority projects within 10 years and the long-term projects within 25 years. Detailed project fact sheets were created for the priority projects and can be found in Section 5.

4.3 Summary of Subwatershed Strategies

Once priority subwatersheds were identified and impairments for each subwatershed were determined, improvement goals and strategies were developed for each priority subwatershed based on the sources of subwatershed impairments. In order to achieve these goals, both structural projects and non-structural practices were developed.

All subwatersheds draining to a planned, un-built regional pond were evaluated for potential restoration alternatives, and the alternatives were categorized as **regional pond alternative strategies**. **Subwatershed improvement strategies** are intended to reduce stormwater impacts for subwatersheds that do not drain to a planned, un-built regional pond. **Stream restoration strategie**s are targeted to improve habitat, to promote stable stream geomorphology, and to reduce in-stream pollutants due to erosion. **Non-structural measures and preservation strategies** can provide significant benefits by improving the water quality of stormwater runoff, by reducing the quantity of stormwater runoff, by improving stream and riparian habitat, and by mitigating the potential impacts of future development. Table 4.1 shows the relationship between the County goals and objectives and the restoration strategies.

Table 4.1
Relationship between County Objectives and Restoration Strategies

	Restoration Strategies			
County Goals & Objectives	**Regional Pond Alternatives**	**Subwatershed Improvements**	**Stream Restoration**	**Non-Structural & Preservation**
Minimize impacts of stormwater runoff on stream hydrology to promote stable stream morphology, protect habitat, and support biota	✘	✘	✘	✘
Minimize flooding to protect property, human health, and safety	✘	✘		
Provide for healthy habitat through protecting, restoring, and maintaining riparian buffers, wetlands, and in stream habitat	✘	✘	✘	✘
Improve and maintain diversity of native plants and animals in the County	✘	✘	✘	✘
Minimize impacts to stream water quality from pollutants in stormwater runoff	✘	✘		✘
Minimize impacts to drinking water sources from pathogens, nutrients, and toxics in stormwater runoff	✘	✘		✘
Minimize impacts to drinking water storage capacity from sediment in stormwater runoff	✘	✘	✘	✘
Encourage the public to participate in watershed stewardship	✘	✘	✘	✘
Coordinate with regional jurisdictions on watershed management and restoration efforts such as Chesapeake Bay initiatives	✘	✘	✘	✘
Improve watershed aesthetics in Fairfax County	✘	✘	✘	✘

The following table includes a summary of project types that may be included for the various improvement goals and strategies.

Table 4.2
Summary of Subwatershed Strategies & Project Types

Strategies	Project Types
Regional Pond Alternatives	Stormwater Pond Retrofits New Stormwater Ponds Low Impact Development Retrofits Culvert Retrofits, including Road Crossing Improvements Outfall Improvements Area-wide Drainage Improvements
Subwatershed Improvements	Stormwater Pond Retrofits New Stormwater Ponds Low Impact Development Retrofits Culvert Retrofits, including Road Crossing Improvements Outfall Improvements Area-wide Drainage Improvements
Stream Restoration	Streambank Stabilization Natural Channel Restoration
Non-Structural Measures and Preservation Strategies	Buffer restoration Rain barrel programs Dumpsite/Obstruction removal Community outreach/Public education Conservation acquisition/easements Street sweeping Storm drain stenciling

Each of the subwatershed strategies are briefly described below along with information on sample project types.

4.3.1 Regional Pond Alternative Strategies

Regional stormwater ponds, which may be very large, can be considered as a watershed management tool. Based on *The Role of Regional Ponds in Fairfax County Stormwater Management (Fairfax County 2003)*, a number of smaller on-site stormwater facilities that perform a similar function to larger regional pond facilities are the preferred approach. All subwatersheds containing a planned, un-built regional pond or draining to a planned, un-built regional pond were evaluated for potential alternatives. Regional pond alternative strategies include:

- Retrofits to existing stormwater ponds
- New stormwater ponds
- Low impact development projects,
- Culvert retrofits
- Outfall improvements
- Area-wide drainage improvements

When more than one project is proposed for a regional pond drainage area, the project group will be considered as a single project in order to emphasize the necessity of implementing the entire group of projects to replace the function of the large regional pond.

The Regional Stormwater Management Plan created by Camp, Dresser and McKee in 1989 proposed a total of 12 regional ponds for Sugarland Run and Horsepen Creek watersheds; five regional ponds were proposed for Sugarland Run and seven regional ponds were proposed for Horsepen Creek. In addition to the 12 regional ponds proposed in the 1989 Regional Stormwater Management Plan, four additional regional ponds were proposed for Sugarland Run and Horsepen Creek Watersheds, three in Sugarland Run and one in Horsepen Creek, for a total of 16 regional ponds proposed for the two watersheds.

Of the eight regional ponds proposed for Sugarland Run watershed, only four have been fully constructed, two are partially funded and unconstructed, and two are not actively funded and not slated for construction. The four unconstructed regional ponds proposed for Sugarland Run (S-01, S-02, S-05, and S-07) were evaluated as described above. Alternative projects are proposed for three out of the four unconstructed regional ponds (S-02, S-05, and S-07). For regional pond S-01, alternatives were considered but no projects were deemed viable due to the lack of good locations for alternative projects. It is proposed that regional pond S-01 be implemented with a limited scope. Detailed descriptions for these projects can be found in Section 5.

Of the eight regional ponds proposed for Horsepen Creek watershed, four have been fully constructed, two are partially funded and unconstructed, and two are inactive, unfunded and unconstructed. The four regional ponds proposed for Horsepen Creek that have not been constructed (H-02, H-07, H-13, and H-16) were evaluated as described above. No alternative projects are proposed for regional pond H-02, because all existing development in the drainage area receives treatment on-site and any future development would also be treated on-site. Implementation of the regional pond was also determined to be undesirable because areas draining to the proposed regional pond are adequately treated and implementation of the regional pond would require a large disturbance to wooded areas and riparian buffers. The best option for the area of this regional pond is to implement non-structural practices that would preserve and protect the forested riparian buffer and ensure that all new development have adequate stormwater controls. Alternative projects are proposed for regional pond H-07 but adequate quantity control could not be obtained through the alternative projects alone. It is proposed that the alternative projects for regional pond H-07 be combined with the construction of a pond at the location of the proposed regional pond that would have a more limited scope. Alternative projects are proposed for proposed regional pond H-13. Proposed regional pond H-16 drains a single 89 acre subwatershed that was determined to be low priority due to good site conditions. An existing wet pond, WP0354, is also located upstream of the proposed location for regional pond H-16 and would treat most of the drainage area to the regional pond. It is proposed that regional pond H-16 remain unconstructed as there is no need for a regional pond at this location. Detailed descriptions of these projects can be found in Section 5.

4.3.2 Subwatershed Improvement Strategies

Subwatershed improvement strategies are intended to reduce stormwater impacts for subwatersheds that do not drain to a planned, un-built regional pond. Project types for subwatershed improvement strategies are the same types of projects recommended for the planned, un-built regional pond drainage areas. However, each individual project will be given its own project identification number and will not be considered as a combined group of projects.

Low impact development (LID) projects may be incorporated into Regional Pond Alternative Strategies and Subwatershed Improvement Strategies. LID projects are Best Management Practices (BMPs) designed to provide water quality and quantity benefits for stormwater management on the site where stormwater is generated. Possible LID projects include:

- Sand Filters and Sand/Peat Filters
- Rain Gardens/Bioretention
- Infiltration Basins/Trenches
- Vegetated Rooftops
- Porous/Permeable Paving
- Underground or Rooftop Storage

4.3.3 Stream Restoration Strategies

Stream restoration strategies are targeted at improving stream and riparian buffer habitat, promoting stable stream geomorphology, and reducing in-stream pollutants due to erosion. Regional pond alternative strategies and subwatershed improvement strategies are critical to the success of stream restoration strategies by improving drainage and reducing peak flows. A major component of stream restoration strategies is identifying and addressing the source of the impairments.

Stream restoration can be accomplished by installing streambank stabilization measures, installing and/or maintaining riparian buffers, or implementing natural channel restoration measures. Structural streambank stabilization measures include riprap or other “hard” engineering stabilization measures such as concrete, sheet piling or gabions. Non-structural streambank stabilization measures, which are preferred, can include the following:

- Cedar tree revetments
- Root wad revetments
- Rock toe revetments
- Live crib walls
- Natural fiber rolls
- Live fascines
- Brush mattresses
- Live stakes

Streambank stabilization projects can be expensive and are more likely to succeed when upstream stormwater problems are addressed prior to the installation of streambank stabilization measures.

4.3.4 Non-Structural Measures and Preservation Strategies

Non-structural projects do not require traditional construction measures to be implemented and may be programmatic in nature. These projects include but are not limited to the following practices:

- Buffer restorations
- Rain barrel programs
- Dumpsite and obstruction removals
- Community outreach and public education
- Land conservation coordination projects
- Inspection and enforcement projects
- Street sweeping programs
- Recommendation of additional studies, surveys and assessments

These projects, in concert with the structural projects, represent a holistic approach to watershed management. Since much of the land area in Fairfax County is privately owned, there is a strong need to work with local communities to promote environmental awareness and recommend projects that can be implemented by residents and other groups.

The fundamental difference between structural and non-structural projects is the ability to predict the result of the project implementation through models. For example, the nitrogen removal of a wet pond may be calculated; however, there is no way to predict the reduction in nitrogen from an outreach campaign on proper fertilizer use. Additionally, these projects and programs should not be confined to any single watershed but could be implemented throughout the County as opportunities occur. Because of these differences, non-structural projects were evaluated and will be implemented using a different process than the structural projects.

There are many advantages of non-structural projects. Some of the key advantages to this projects type are:

- Less costly
- Less disruptive
- Promotes public and community awareness

In general, non-structural projects represent opportunities to proactively pursue stormwater issues that more traditional structural practices cannot address. The use of non-structural practices fulfills Fairfax County's MS4 permit requirements and environmental initiatives. The full potential of these projects will be realized through partnerships with County agencies, residents and other interested parties.

4.4 Project Type Descriptions

A detailed description of the project types included in the WMP and their benefits are provided below.

New Stormwater Ponds and Stormwater Pond Retrofits

Extended Detention (ED) Basin

An extended detention basin is a stormwater management facility that temporarily stores stormwater runoff and discharges it at a slower rate through a hydraulic outlet structure. It is typically dry during non-rainfall periods. The purpose of this BMP is to enhance water quality and decrease downstream flooding and channel erosion. Water quality is enhanced through gravitational settling, though settled pollutants may become re-suspended with frequent high inflow velocities.

Photo 4.1 Extended Detention Basin Full of Stormwater
Source: Virginia Stormwater Management Handbook

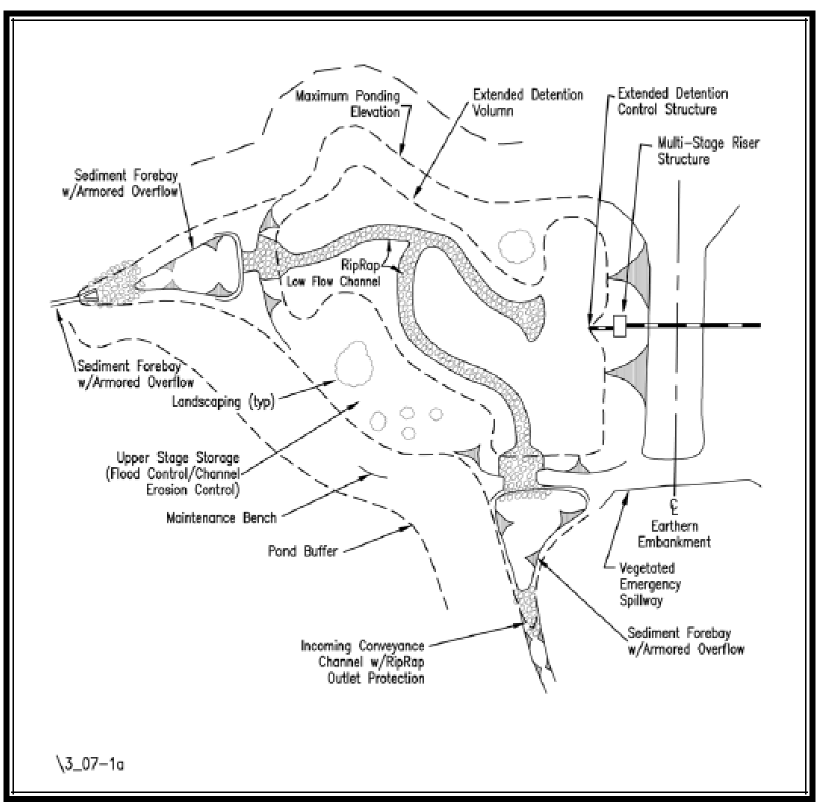

Figure 4.1 Plan View of Extended Detention Basin
Source: Virginia Stormwater Management Handbook

Photo 4.1 shows an extended detention basin full of stormwater runoff. The circuitous path slows stormwater and allows for the settling of sediments.

Figure 4.1 shows a typical plan view of an extended detention basin.

__Enhanced Extended Detention (EED) Basin__

An enhanced extended detention basin has a similar design to an extended detention basin, though it incorporates a shallow marsh along the bottom. The shallow marsh improves water quality through wetland plant uptake, absorption, physical filtration, and decomposition. Wetland vegetation also traps settled pollutants, reducing the re-suspension that can be found in extended detention basins. The purpose of this BMP is to enhance water quality and decrease downstream flooding and channel erosion.

Photo 4.2 Enhanced Extended Detention Basin Full of Stormwater

Source: Virginia Stormwater Management Handbook

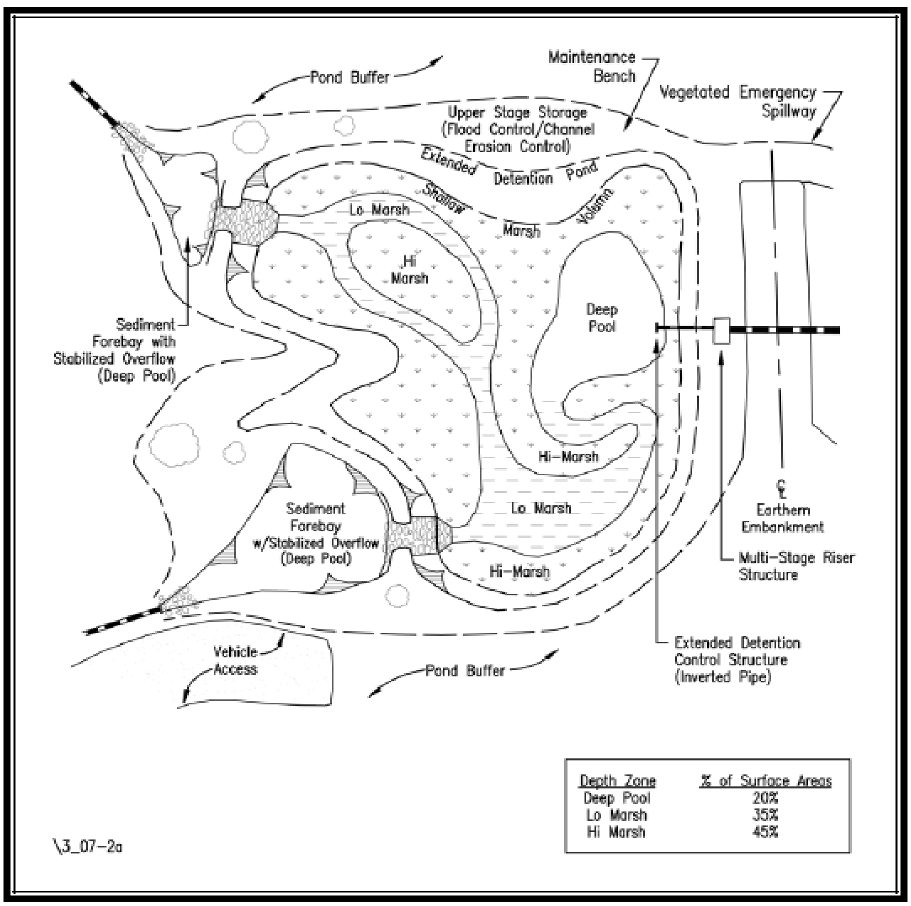

Figure 4.2 Plan view of Enhanced Extended Detention Basin

Source: Virginia Stormwater Management Handbook

Photo 4.2 shows a multi-stage weir principal spillway and deep water pool (18”-48” depth) in an enhanced extended detention basin.

Figure 4.2 shows a plan view of an enhanced extended detention basin.

Retention Basin (Wet Pond)

A retention basin (wet pond) is a stormwater facility that has a permanent pool of water, which means it is normally wet all the time. The purpose of this BMP is to provide storage for stormwater runoff, to alleviate downstream flooding and channel erosion, and to improve water quality. A retention basin may be used to temporarily store stormwater runoff above the permanent pool elevation and release it at lower rates. Water quality can be improved through gravitational settling, biological uptake and decomposition.

Photo 4.3 Retention Basin
Source: Virginia Stormwater Management Handbook

Photo 4.3 shows a typical stormwater retention basin in a residential community. The aquatic bench is important for public safety, the biological health of the facility, and is aesthetically pleasing.

Figure 4.3 shows a typical plan view and section of a retention basin.

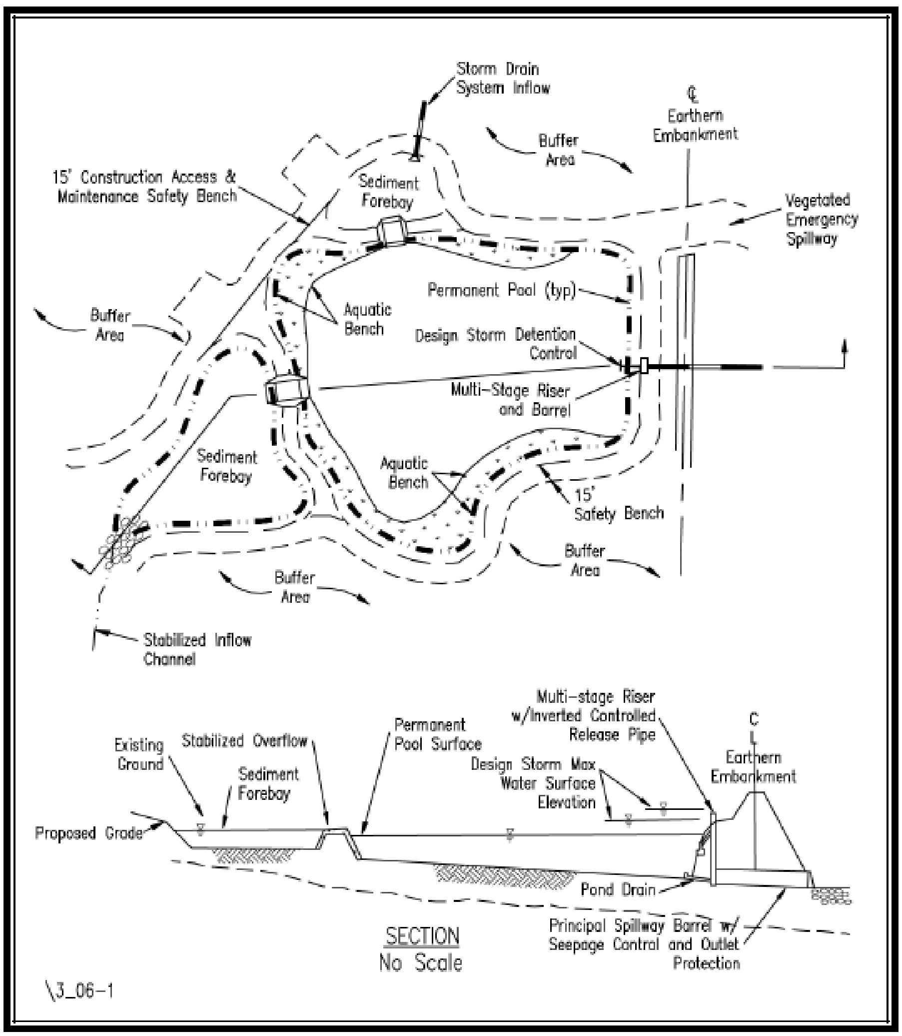

Figure 4.3 Retention Basin – Plan and Section
Source: Virginia Stormwater Management Handbook

Constructed Stormwater Wetlands

Constructed stormwater wetlands are shallow pools that are created to provide growing conditions suitable for both emergent and aquatic vegetation. They are constructed to replicate natural wetland ecosystems. Constructed wetlands are installed to enhance the water quality of stormwater runoff through gravitational settling, nutrient uptake by wetland vegetation, absorption, physical filtration, and biological decomposition.

Photo 4.4 Constructed Stormwater Wetlands
Source: Virginia Stormwater Management Handbook

Photo 4.4 shows a constructed stormwater wetland. The vegetation is protected from waterfowl by a netting system. Figure 4.4 shows a plan view of constructed stormwater wetlands.

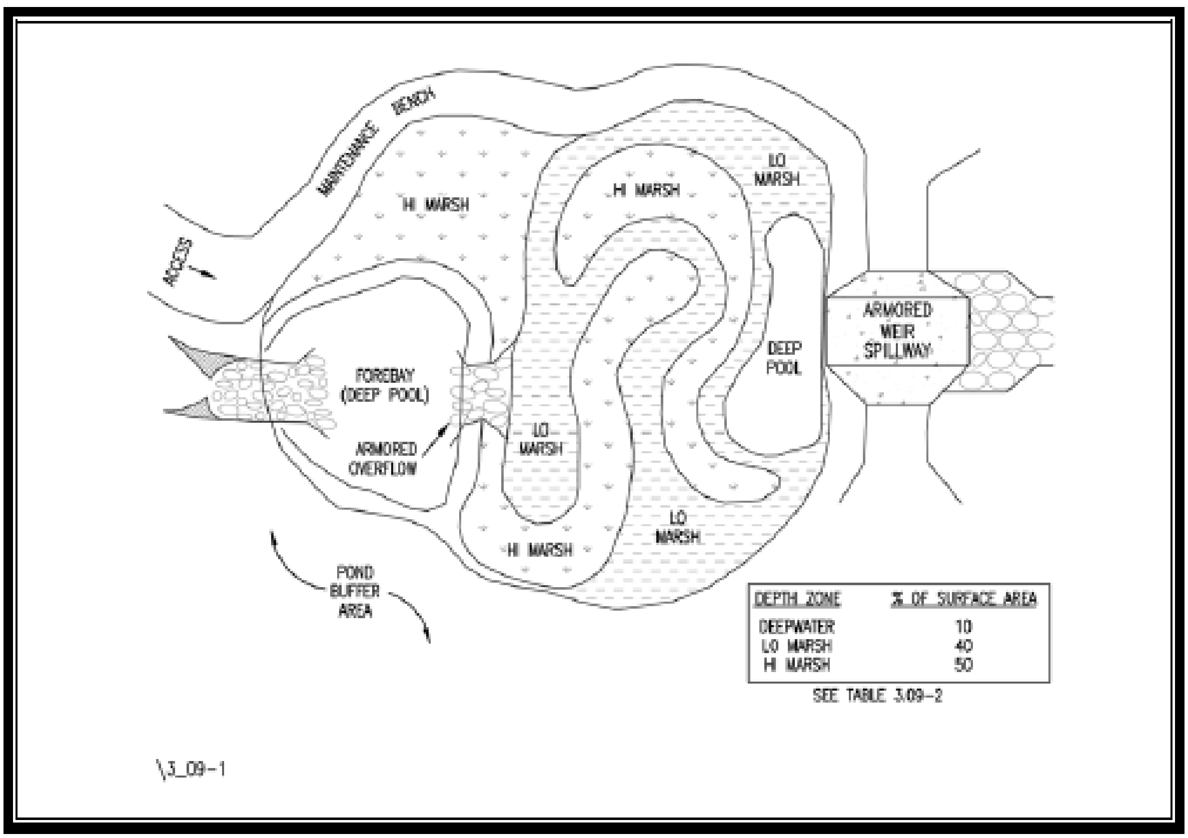

Figure 4.4 Constructed Stormwater Wetlands – Plan
Source: Virginia Stormwater Management Handbook

Culvert Retrofits

A culvert is a conduit through which surface water can flow under or across a road, railway, trail, or embankment. A culvert retrofit involves the replacement or modification of an existing culvert. This can be necessary due to many factors such as a culvert being undersized for the amount of stormwater it carries or if the culvert has been damaged.

Culvert Retrofits with Micro-pools

Culvert retrofits with micro-pools involve the measures stated above plus the addition of shallow depressions that hold stormwater, known as micro-pools. The purpose of this BMP is to slow down stormwater in order to enhance water quality through infiltration, sedimentation, and filtration and to decrease downstream flooding and erosion. Stormwater runoff volumes are decreased through infiltration and by uptake of the plant material. Culvert retrofits with micro-pools improve water quality, reduce stormwater runoffs and peak volumes, increase groundwater recharge, provide wildlife habitat, and are aesthetically pleasing. Figure 4.5 shows a typical plan and profile of a crossing retrofit showing a secondary embankment.

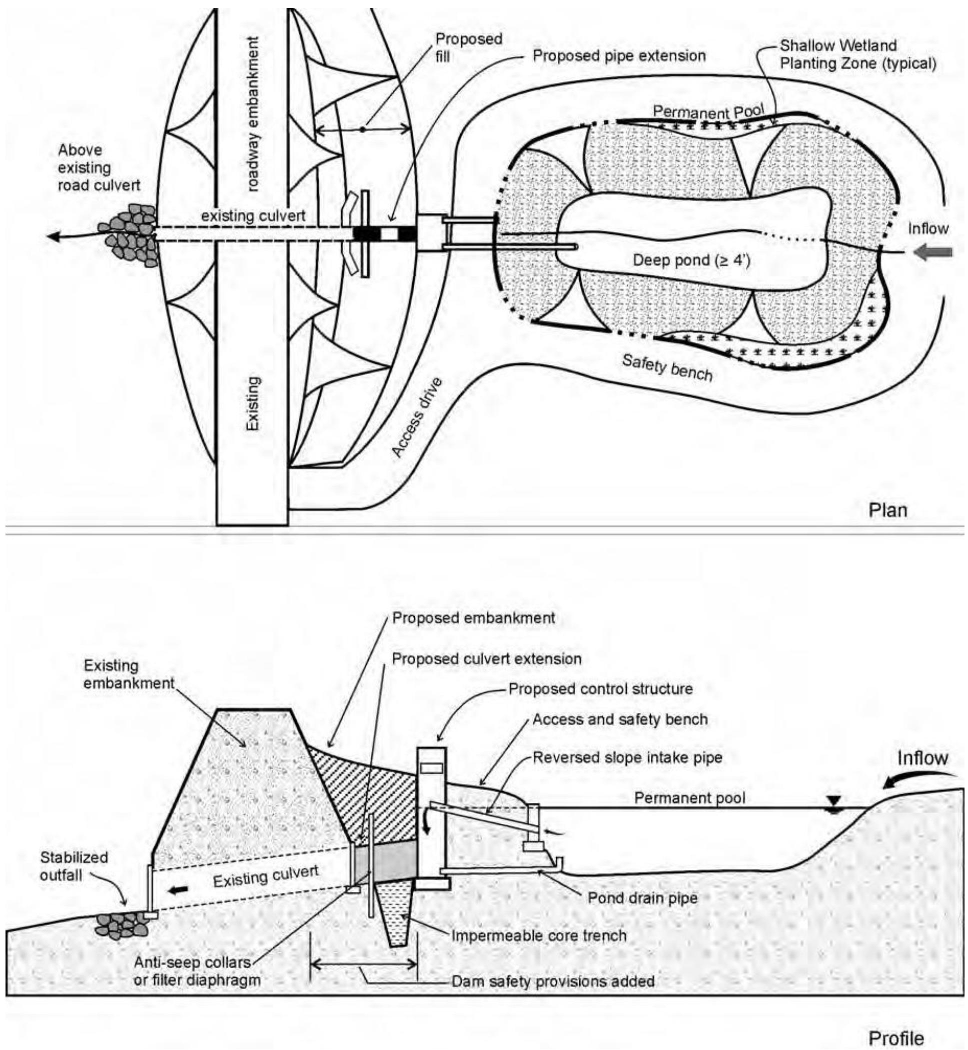

Figure 4.5 Typical Culvert Retrofit with Micro-pool Configuration

Source: Center for Watershed Protection

Best Management Practices/Low Impact Development Retrofits (BMPs/LIDs)

Rain Garden (Bioretention Basin)

Photo 4.5 Rain Garden
Source: Virginia Stormwater Management Handbook

A rain garden (bioretention basin) is a shallow surface depression planted with native vegetation to capture and treat stormwater runoff. The purpose of this BMP is to capture, treat, and infiltrate stormwater. Rain gardens store and infiltrate stormwater runoff, which increases groundwater recharge and may decrease downstream erosion and flooding. Stormwater runoff water quality is improved by filtration through the soil media and biological and biochemical reactions with the soil and around the root zones of plants. Rain gardens improve water quality, reduce stormwater runoff and peak volumes, increase groundwater recharge, provide wildlife habitat and are aesthetically pleasing.

Photo 4.5 shows the application of a rain garden in a multifamily residential area.

Figure 4.6 shows a plan view of a rain garden at the edge of a parking lot with curbing.

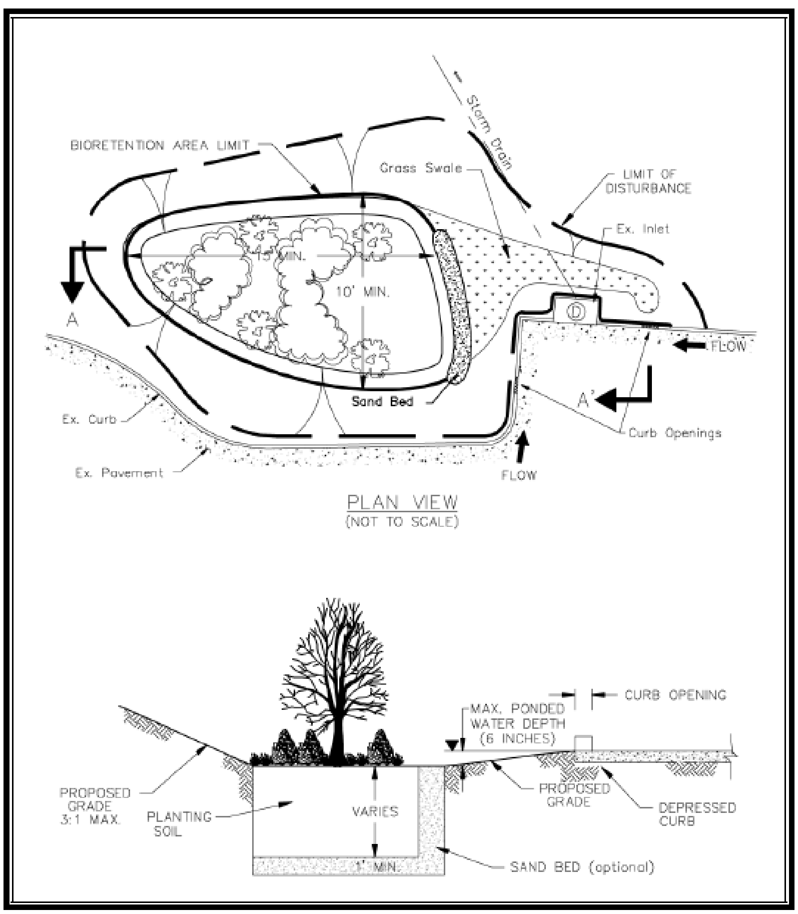

Figure 4.6 Rain Garden at Edge of Parking Lot, Plan View (Source: Virginia Stormwater Management Handbook)

Vegetated/Grassed Swale

A vegetated/grassed swale is a broad and shallow channel vegetated with erosion resistant and flood-tolerant grasses and/or herbaceous vegetation. Sometimes, check dams are placed within the swale to encourage ponding behind them. The purpose of this BMP is to convey and slow down stormwater in order to enhance water quality through sedimentation and filtration. Check dams slow the flow rate and create small, temporary ponding areas. Stormwater runoff volumes may be decreased through infiltration and/or evapo-transpiration and water quality is improved by nutrient uptake of the plant material and settling of soil particles.

Photo 4.6 Grassed Swale with Check Dams
Source: Virginia Stormwater Management Handbook

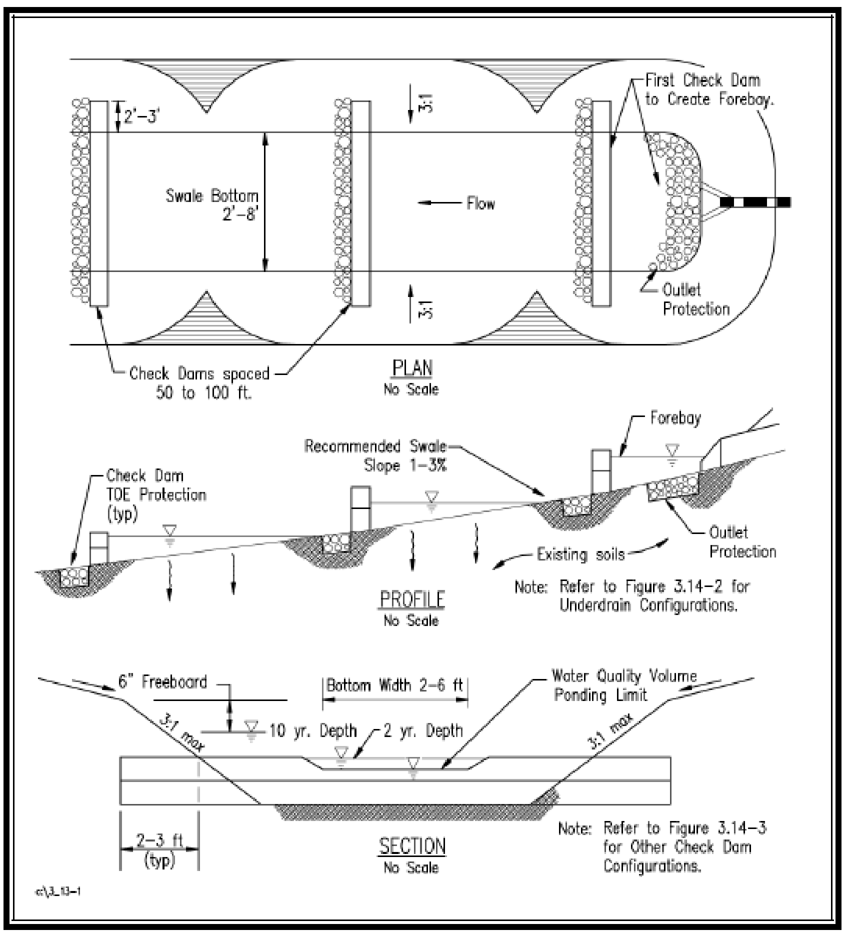

Figure 4.7 Typical Vegetated Swale Configuration
Source: Virginia Stormwater Management Handbook

Photo 4.6 shows a grassed swale with check dams. The area behind the check dams is used for storage of stormwater runoff. The notched center of the check dams allows for safe overflow of stormwater without scouring the sides of the channel.

Figure 4.7 shows a typical vegetated swale configuration.

Water Quality Swale/ Infiltration Trench

A water quality swale is a vegetated/grassed swale that is underlain by an engineered soil mixture designed to promote infiltration. The purpose of this BMP is to convey and slow down stormwater in order to enhance water quality through infiltration, sedimentation, and filtration. Stormwater runoff volumes are decreased through infiltration and water quality is improved by nutrient uptake of the plant material and settling of soil particles. Infiltration trenches may also be designed with a gravel surface.

Photo 4.7 Vegetated Water Quality Swale
Source: F. X. Browne, Inc.

Photo 4.7 shows a vegetated swale connecting a drainage outlet and a stormwater basin. The swale was planted with a combination of native trees, shrubs and herbaceous plants that provide nutrient uptake, habitat for organisms like birds and butterflies, and are aesthetically pleasing.

Figure 4.8 shows a typical water quality swale configuration.

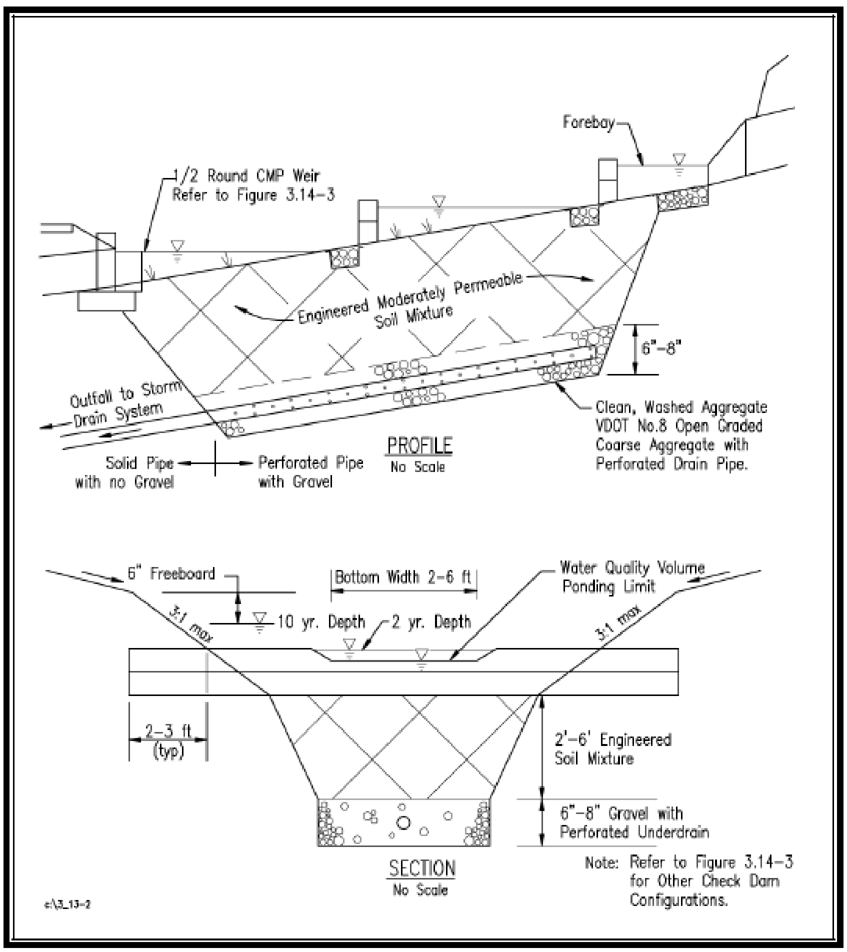

Figure 4.8 Typical Water Quality Swale Configuration
Source: Virginia Stormwater Management Handbook

Green Roof

A green roof is a roof that is covered or partially covered with a waterproof layer, soil media, and vegetation. Extensive green roofs have low-growing, drought-tolerant vegetation (typically sedum species) planted in shallow soil. Intensive green roofs have a thicker layer of soil and can support a wider variety of plant material, including trees. The purpose of a green roof is to reduce stormwater runoff volumes and peak flows, improve water quality, improve air quality, provide insulation for the building, provide habitat for wildlife, and to decrease urban air temperatures. Intensive green roofs typically encourage public access for recreational and aesthetic uses. Figure 4.9 shows a green roof cross section.

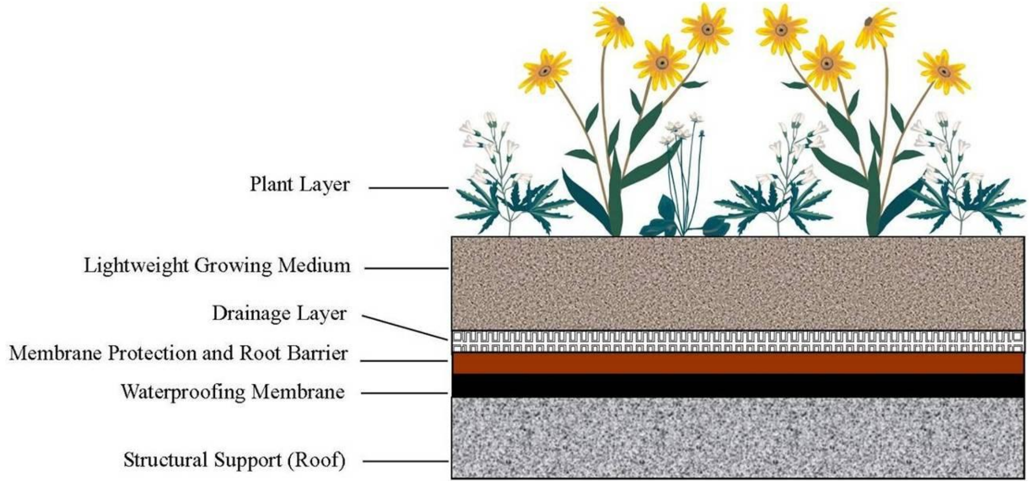

Figure 4.9 Green Roof Cross Section
Source: Virginia Stormwater Management Handbook

Photo 4.8 Before Green Roof

Photo 4.9 After Green Roof

Source: Fairfax County, VA

The photos below show a before and after shot of the Herrity Building parking garage at the Government Center complex in Fairfax County.

The Herrity Building green roof is open to the public and provides an aesthetic green space for workers and those who visit.

Stream Restoration

Photo 4.10 Restored Channel in Snakeden Watershed, Reston, Virginia
Source: Reston Association

A healthy stream is one that is in its natural condition, does not have a disproportionate amount of stormwater runoff contributing to the stream flows, meanders, has a healthy riparian buffer with native vegetation and supports aquatic life. Straightened streams with smoothed channels, typically man-made or altered, have increased velocities which can cause substantial erosion and flooding to downstream areas. The purpose of a stream restoration is to return the stream to its healthy, natural condition. Stream restoration includes many types of improvements such as re-grading stream banks to enhance the floodplain, re-grading the stream to create a meander or step pool system, stabilizing stream banks with "soft" measures, stabilizing stream banks with "hard" measures and building in-stream structures to protect the stream banks and streambed.

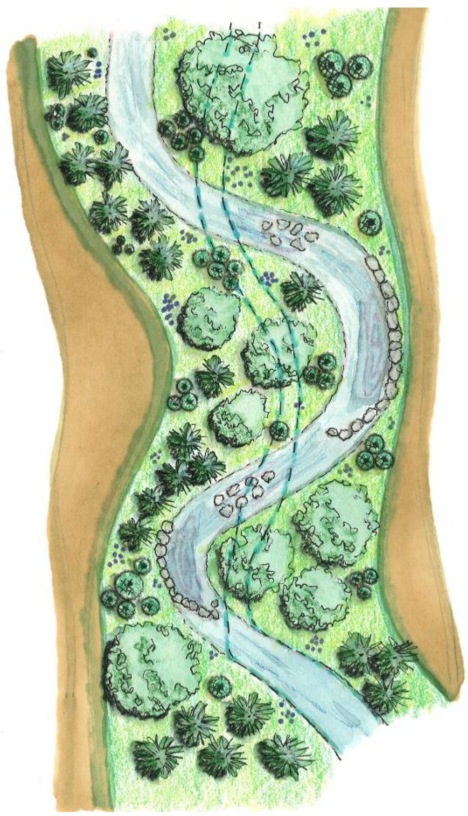

Figure 4.10 Comprehensive Stream Restoration Project
Source: F. X. Browne, Inc.

Stabilizing stream banks with "soft" measures such as vegetation, brush layering and fascines protect stream banks from scour and erosion caused by large velocities. Healthy vegetation will also slow velocities, decrease flows, and provide wildlife habitat. Building in-stream structures such as rock cross vanes and step pools and stabilizing stream banks with "hard" measures like boulder revetments also protect the stream banks from scour and erosion caused by large velocities. Restored streams have reduced soil erosion, reduced stormwater runoffs and peak volumes, provide aquatic habitat, provide recreational activities and are aesthetically pleasing.

In some cases, localized streambank stabilization measures are not sufficient to restore stream channel structure and functions. For severely impaired streams, a more comprehensive restoration project may be warranted that involves reconstructing the channel and/or floodplain. Re-grading of the stream banks or streambed is done to mimic the natural shape and direction of a healthy stream. Re-grading stream banks to connect with the floodplain allows large flows access over the floodplain, which can decrease velocities and volumes. Creating a meander in the stream can slow flows to reduce downstream flooding.

Step Pools

Step pools are rock grade control structures that recreate the natural step-pool channel morphology and gradually lower the elevation of a stream in a series of steps. They are constructed in steeper channels where a fixed bed elevation is required, and are typically used in streams with a slope greater than three percent. They are built in the stream channel and allow for “stepping down” the channel over a series of drops. As water flows over the step, energy is dissipated into the plunge pool. Step pools can connect reaches of different elevations, dissipate the energy of high-velocity flows, and improve aquatic habitat.

Photo 4.11 Step Pool Channel
Source: Arlingtonians for a Clean Environment

Photo 4.11 shoes a close-up of step pools in Donaldson Run in Arlington, VA. Figure 4.11 shows a typical plan and profile for step pool structures.

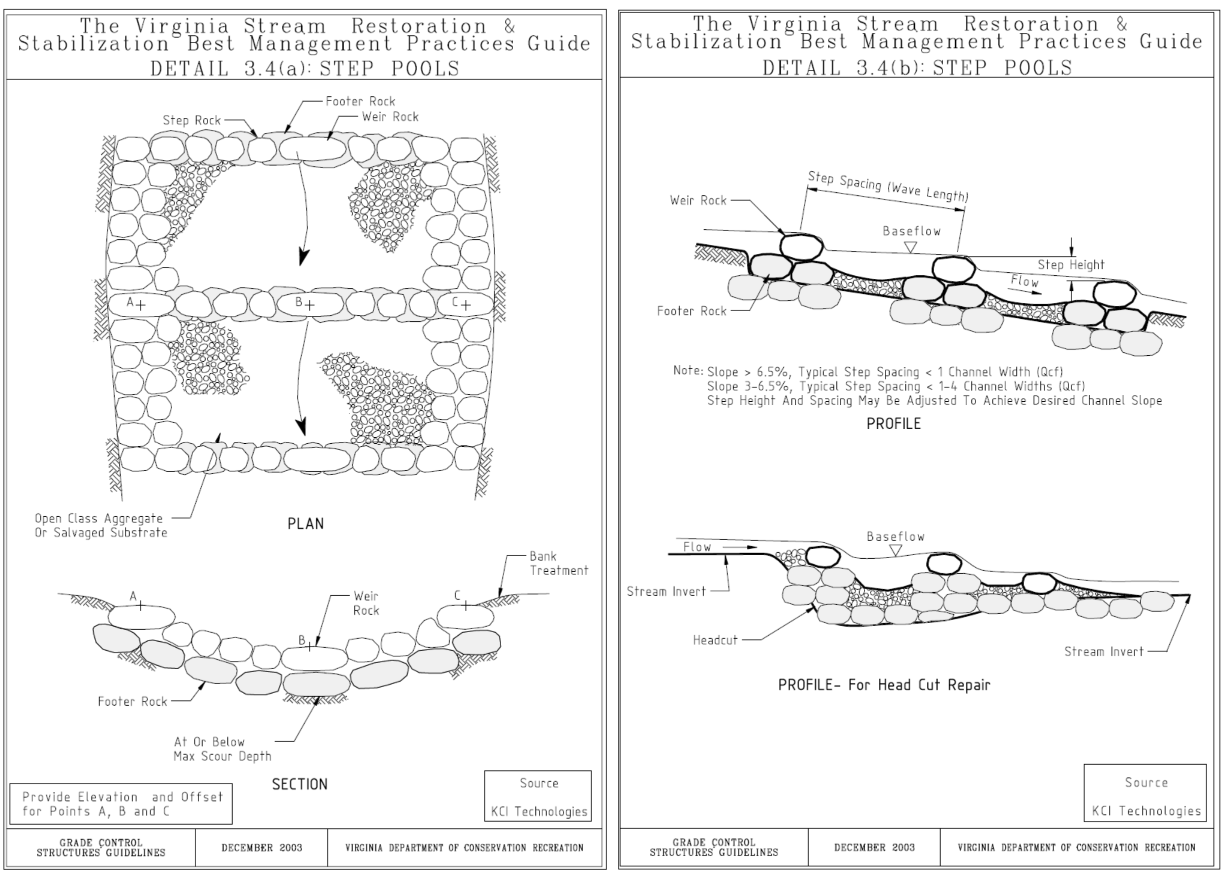

Figure 4.11 Step Pool Plan and Profile
Source: Virginia Stormwater Management Handbook

Rock Vanes

A rock cross vane is an in-stream stone structure that provides grade control and reduces streambank erosion. Rock cross vanes are placed at an angle to direct flow to the center of the stream over the cross vane, capture sediment, and create a scour pool downstream of the structure. They are used to direct flows toward the center of the channel which decreases stress on the stream banks and reduces bank erosion. The narrower flow path and decreased stress on stream banks is also beneficial for protecting bridges and maintaining streambed elevation.

Photo 4.12 Rock Vane in Completed Stream Restoration in Reston, Virginia

Source: Reston Association

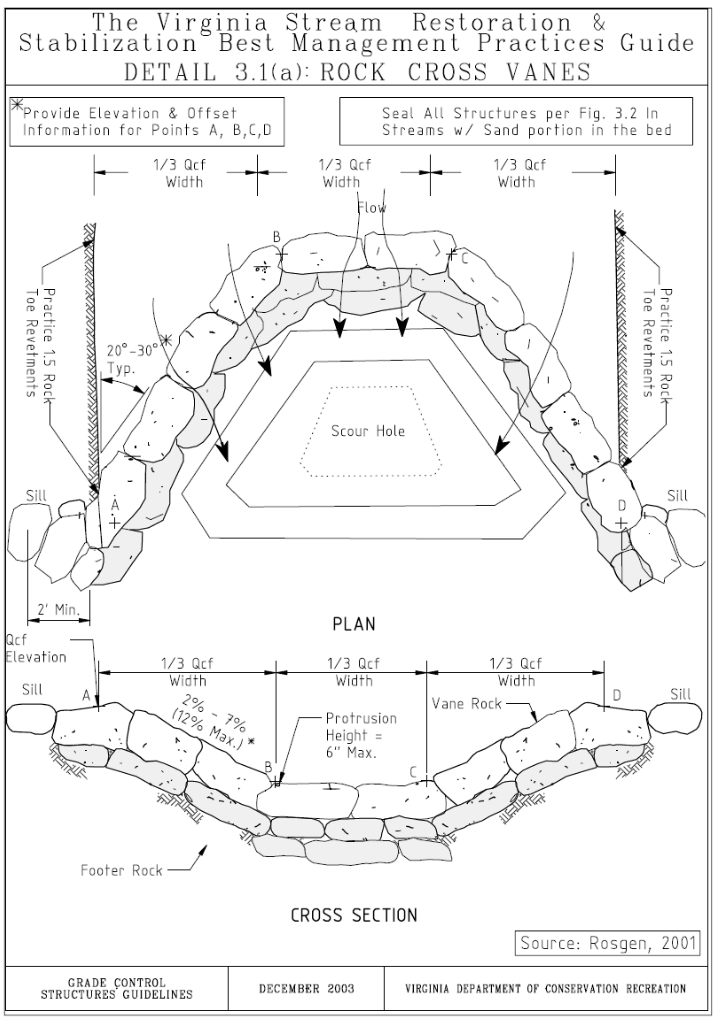

Figure 4.12 Detail Plan Rock Vane

Rock vanes also increase the flow depth downstream from the structure which enhances fish habitat.

Photo 4.12 shows a rock vane structure in a completed stream restoration in the Snakeden Watershed in Reston, Virginia. Figure 4.12 shows a detailed sketch for a typical rock vane.

Boulder Revetments/Boulder Toe

Boulder revetments, also called boulder toe, consists of placing a boulder or boulders in the toe of a streambank to provide rigid toe protection. The "toe" lies at the bottom of the slope and supports the weight of the streambank. Rigid toe protection is used where the lower streambank and toe are subject to erosion and require permanent protection. They can be placed at near vertical slopes, and are a good option for areas that have limited horizontal space. Boulder revetments protect stream banks from heavy flows and prevent erosion at the base of the streambank.

Photo 4.13 Boulder Revetment
Source: Center for Watershed Protection

Photo 4.13 shows a boulder revetment in a completed stream restoration. Figure 4.13 shows a detailed sketch for a typical boulder revetment.

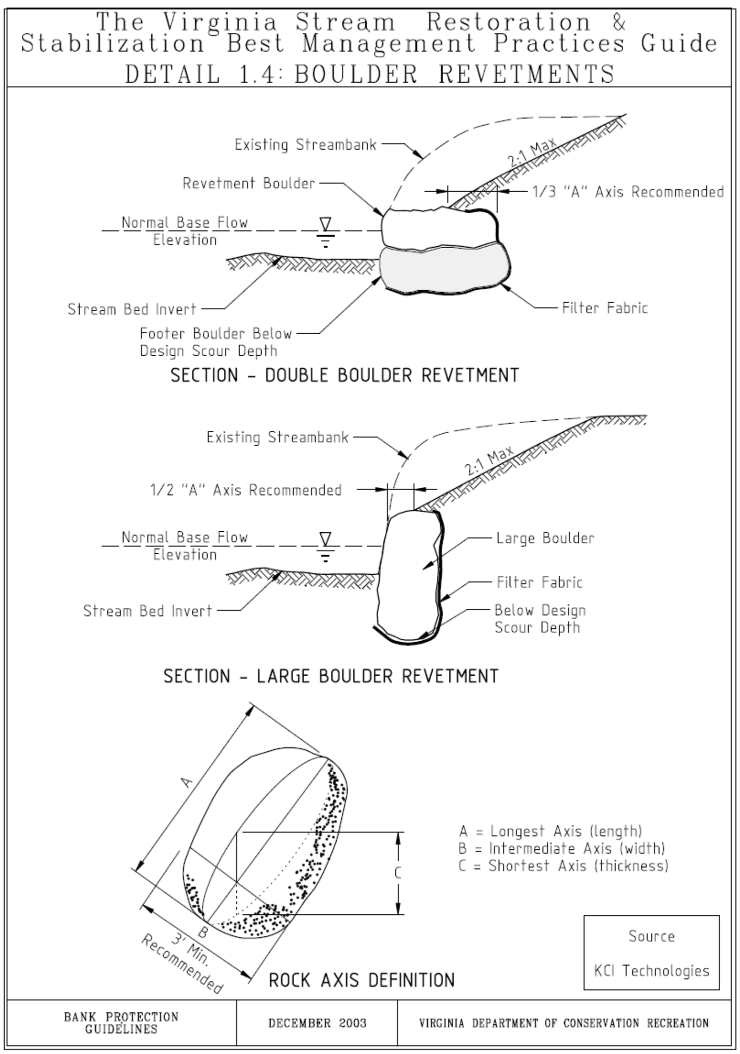

Figure 4.13 Detail Plan Boulder Revetment

Non-Structural

Riparian Buffer Restoration

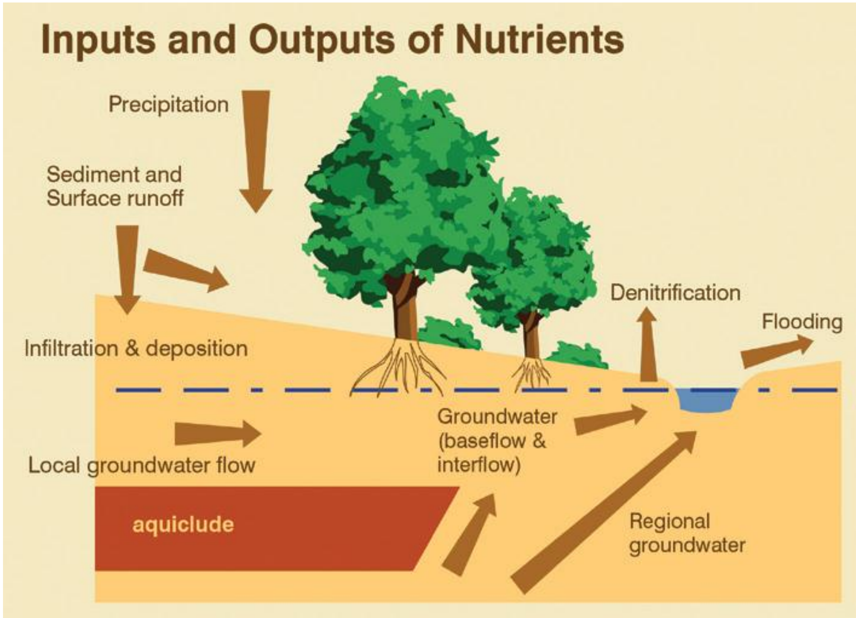

Figure 4.14 Riparian Buffer Nutrient Inputs and Outputs
Source: Virginia Department of Forestry

A riparian buffer is the area adjacent to streams, lakes, ponds and wetlands. This area is extremely important to the health of a water body, as it intercepts, slows, and filters stormwater before it reaches the water. A wooded riparian buffer with a shrub and herbaceous layer is the most effective riparian buffer, while the least effective riparian buffer consists of mowed grass or no vegetation. The wider a riparian buffer is, the better it is for the health of a stream.

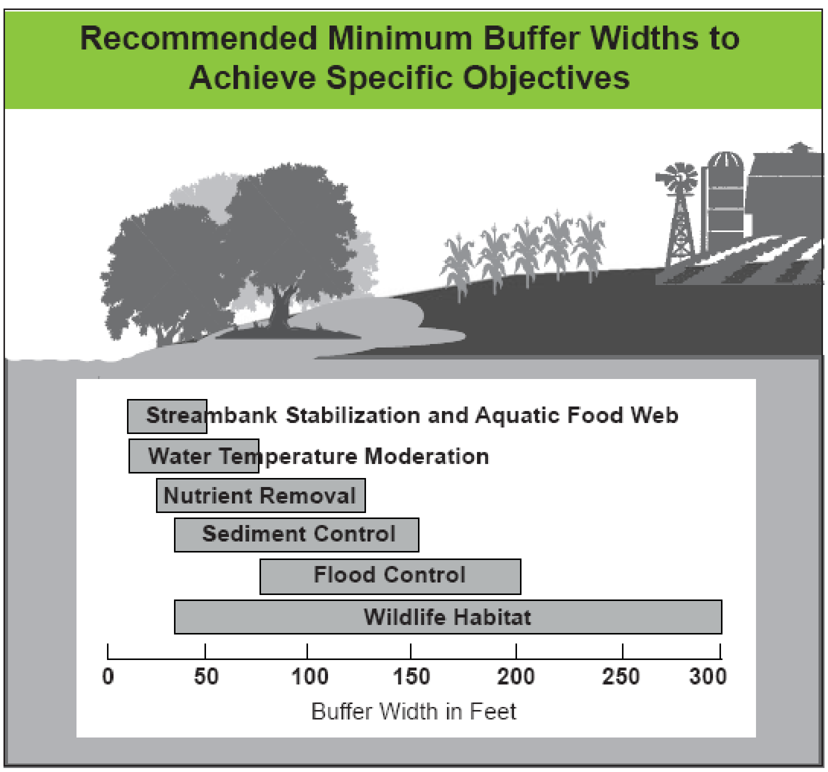

Figure 4.15 Buffer Widths and Objectives
Source: Virginia Department of Forestry

Riparian buffer restoration consists of removing invasive species and/or undesirable vegetation and replanting with native trees, shrubs, and herbaceous species. Among the benefits of these buffers is improved water quality, reduced soil erosion and stormwater runoff and improved wildlife habitat.

Figure 4.14 illustrates the inputs and outputs of nutrients in a riparian buffer.

Figure 4.15 describes the recommended minimum buffer widths to achieve specific objectives.

Targeted Rain Barrel Program

Rain barrels are tanks/containers that collect and store stormwater runoff from a roof by connecting to rain gutters/downspouts. The purpose of a rain barrel is to slow down and capture stormwater runoff to reduce stormwater runoff volumes and peak rates and to decrease flooding and erosion. Utilizing the rainwater for irrigation improves water quality by filtration through the soil and increases groundwater recharge. Utilizing rainwater also reduces the need to use well water or municipal water.

Photo 4.14 shows a typical rain barrel that can be assembled at home or bought from a retail center.

Photo 4.14 Typical Rain Barrel
Source: Northern Virginia Soil and Water Conservation District, Fairfax County, VA

4.5 Overall List of Projects

Map 4.1 shows all structural and non-structural project locations throughout Sugarland Run and Horsepen Creek watersheds as they are distributed within the Dranesville, Hunter Mill and Sully supervisor districts.

Table 4.3 is the Master Project List, which contains all projects, organized by implementation plan and project number. The 10-year implementation projects have associated project fact sheets that are located in Section 5.

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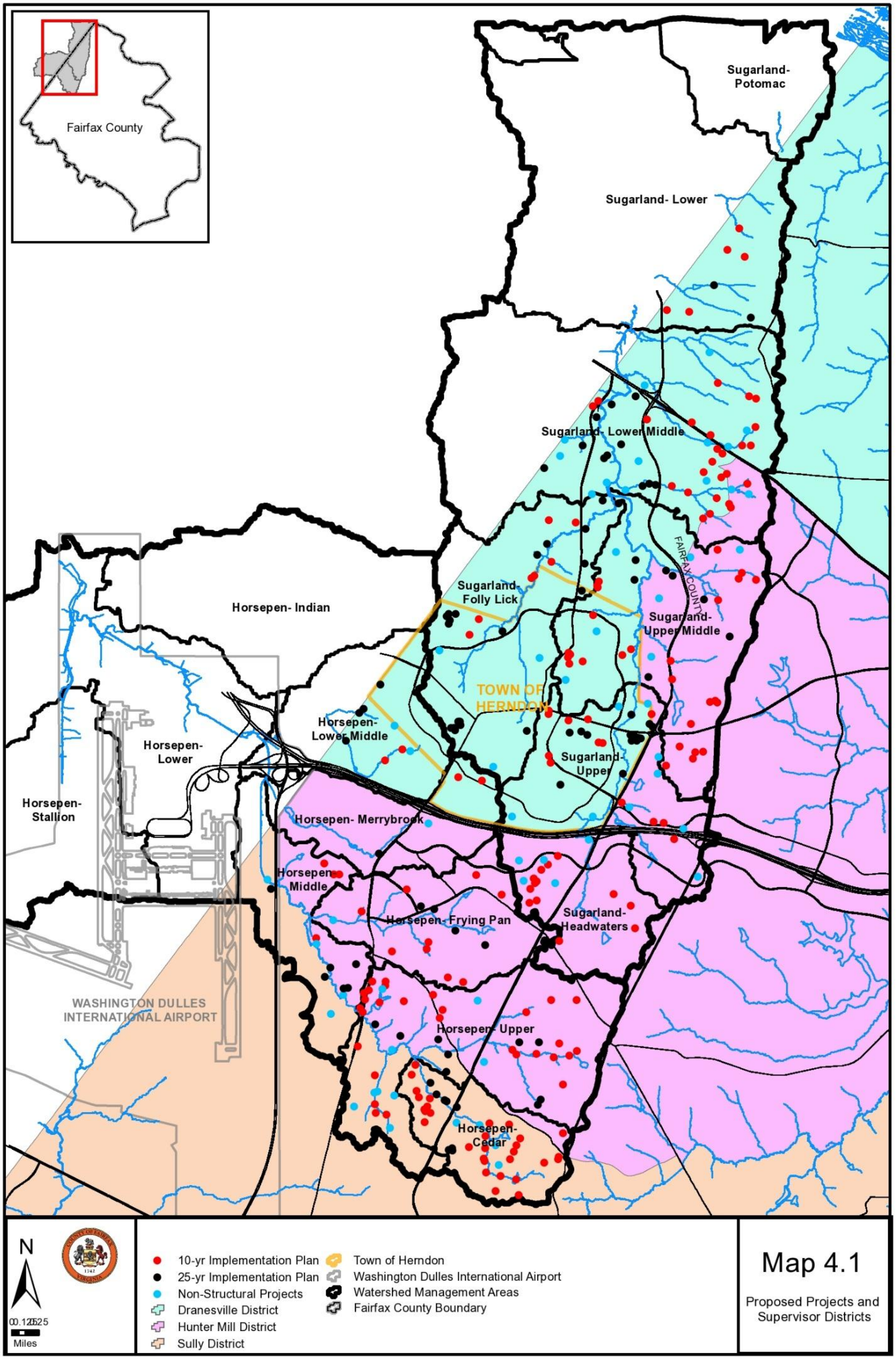

Map 4.1

Proposed Projects and Supervisor Districts

Table 4.3
Master Project List

Priority Structural Projects (10 Year Implementation Plan)

Project #	Project Type	WMA	Location	Watershed Benefit	Land Owner	Cost
HC9007	Regional Pond Alternative Suite	Horsepen - Cedar	Between Ladybank Lane & Mother Well Court	Quality/ Quantity	Park/Private	$790,000
HC9013	Regional Pond Alternative Suite	Horsepen - Cedar	Between Franklin Farm Rd, West Ox Rd & Ashburton Ave	Quality/ Quantity	County/Private	$1,970,000
HC9102	New Stormwater Pond	Horsepen - Middle	Legacy Circle & Sunrise Valley Drive	Quality/ Quantity	Private	$150,000
HC9106	Stormwater Pond Retrofit	Horsepen - Frying Pan	Frying Pan Road & Centreville Road	Quality/ Quantity	State/County/ Private	$310,000
HC9107	New Stormwater Pond	Horsepen - Merrybrook	Palmer Drive & Dogwood Court	Quality/ Quantity	Local	$210,000
HC9108	Stormwater Pond Retrofit	Horsepen - Middle	Near Copper Creek Road & Copper Creek Court	Quantity/ Quality	County/Park	$190,000
HC9109	Stormwater Pond Retrofit	Horsepen - Frying Pan	Between Coppermine Rd, Thomas Jefferson Dr & Masons Ferry Dr	Quality/ Quantity	Private	$400,000
HC9110	New Stormwater Pond	Horsepen - Merrybrook	Herndon Parkway & Campbell Way	Quality/ Quantity	Private	$160,000
HC9114	Stormwater Pond Retrofit	Horsepen - Frying Pan	Fox Mill Road & Cabin Creek Road	Quality/ Quantity	Private	$340,000
HC9116	New Stormwater Pond	Horsepen - Frying Pan	Near Halterbreak Court & Curved Iron Road culs-de sac	Quality	Park	$220,000
HC9118	Stormwater Pond Retrofit	Horsepen - Upper	Between Floris Lane & Merricourt Lane culs-de-sac	Quality/ Quantity	Private	$120,000
HC9119	Stormwater Pond Retrofit	Horsepen - Frying Pan	Colts Brook Drive & Fox Mill Road	Quality/ Quantity	County	$450,000
HC9121	Stormwater Pond Retrofit, BMP/LID	Horsepen - Upper	Centreville Road & Lake Shore Drive	Quality/ Quantity	State/Park/ Private	$590,000
HC9122	Stormwater Pond Retrofit	Horsepen - Upper	Lake Shore Drive & Running Pump Lane	Quality/ Quantity	Private	$70,000
HC9123	Stormwater Pond Retrofit	Horsepen - Upper	Near Point Rider Lane & Equus Court	Quality/ Quantity	County	$150,000
HC9126	Stormwater Pond Retrofit	Horsepen - Upper	Monterey Estates Drive & West Ox Road	Quality/ Quantity	County	$180,000

Table 4.3 Master Project List						
Priority Structural Projects (10 Year Implementation Plan)						
Project #	**Project Type**	**WMA**	**Location**	**Watershed Benefit**	**Land Owner**	**Cost**
HC9127	Stormwater Pond Retrofit	Horsepen - Frying Pan	Near Medow Hall Drive & New Carson Drive	Quality/ Quantity	County/Private	$180,000
HC9128	Stormwater Pond Retrofit	Horsepen - Upper	Korean Orthodox Presbyterian Church, McLearen Road & Centreville Road	Quality/ Quantity	Private	$430,000
HC9129	Stormwater Pond Retrofit, BMP/LID	Horsepen - Upper	West Ox Road & New Parkland Drive	Quality/ Quantity	County/State	$490,000
HC9132	Stormwater Pond Retrofit	Horsepen - Upper	Highland Mews Subdivision, Hutumn Court & Highland Mews Court	Quality/ Quantity	Private	$210,000
HC9133	Stormwater Pond Retrofit, BMP/LID, Stream Restoration	Horsepen - Cedar	Near Glen Taylor Lane & Mother Well Court	Quantity/ Quality	Park/Private	$310,000
HC9134	Stormwater Pond Retrofit, BMP/LID	Horsepen - Upper	Kinross Circle & Scotsmore Way	Quality/ Quantity	Private	$310,000
HC9136	Stormwater Pond Retrofit	Horsepen - Upper	Near Viking Drive & Pinecrest Road	Quality/ Quantity	Private	$150,000
HC9137	Stream Restoration, New Stormwater Pond	Horsepen - Upper	Between Tewksbury Drive & Kettering Drive	Quality	Private	$430,000
HC9140	Stormwater Pond Retrofit	Horsepen - Upper	Huntington Drive cul-de-sac	Quality/ Quantity	Private	$370,000
HC9142	Stormwater Pond Retrofit, New Stormwater Pond	Horsepen - Upper	Quincy Adams Drive & Quincy Adams Court	Quality/ Quantity	Private	$220,000
HC9143	Stormwater Pond Retrofit	Horsepen - Cedar	Off of Ashburton Avenue, near Thistlethorn Drive & Saffron Drive	Quantity/ Quality	County	$310,000
HC9149	New Stormwater Pond	Horsepen - Upper	Chasbarb Terrace & Chasbarb Court	Quality	Private	$270,000
HC9200	Culvert Retrofit, Stream Restoration	Horsepen - Lower Middle	Near Parcher Avenue & Monaghan Drive, next to the Reflection Lake pool	Quality	Private	$1,070,000
HC9201	Stream Restoration	Horsepen - Upper	Between Claxton Drive & Conquest Place culs-de-sac	Quality	Private	$230,000

Table 4.3 Master Project List						
Priority Structural Projects (10 Year Implementation Plan)						
Project #	**Project Type**	**WMA**	**Location**	**Watershed Benefit**	**Land Owner**	**Cost**
HC9202	Stream Restoration	Horsepen - Upper	Between Quincy Adams Court, Viking Court & Prince Harold Court culs-de-sac	Quality	Private	$950,000
HC9500	BMP/LID	Horsepen - Middle	Wellesley Subdivision, Stratford Glen Place	Quality	Private	$250,000
HC9503	BMP/LID	Horsepen - Frying Pan	Frying Pan Park/Kidwell Farm	Quality	Park	$90,000
SU9002	Regional Pond Alternative Suite	Sugarland - Upper Middle	Near Wheile Ave, between Pellow Circle Terrace & Reston Ave	Quality/ Quantity	County/Private	$860,000
SU9005	Regional Pond Alternative Suite	Sugarland - Lower Middle	Near Leesburg Pike, between Rolling Holly Drive & Sugarland Road	Quality	County/ Private	$780,000
SU9007	Regional Pond Alternative Suite	Sugarland - Lower Middle	Between Leesburg Pike, Fairfax County Parkway & Wiehle Avenue	Quality/ Quantity	State/County/ Park/Private	$1,010,000
SU9100	Stormwater Pond Retrofit	Sugarland - Lower	Jackson Tavern Way cul-de-sac	Quality/ Quantity	County	$170,000
SU9101	Stormwater Pond Retrofit	Sugarland - Lower	Near Great Falls Way & Jackson Tavern Way	Quality/ Quantity	County/Private	$390,000
SU9103	Stormwater Pond Retrofit	Sugarland - Lower	Thomas Run Drive	Quality/ Quantity	County/Private	$210,000
SU9106	Stormwater Pond Retrofit, BMP/LID	Sugarland - Lower Middle	Near Tralee Drive & Old Holly Drive	Quality/ Quantity	Private	$400,000
SU9108	Stormwater Pond Retrofit	Sugarland - Lower Middle	Dranesville Road & Woodson Drive	Quality/ Quantity	Private	$210,000
SU9110	Stormwater Pond Retrofit	Sugarland - Lower Middle	Methven Court cul-de-sac	Quality/ Quantity	County	$130,000
SU9117	Stormwater Pond Retrofit	Sugarland - Folly Lick	Dranesville Road & Hiddenbrook Drive	Quality/ Quantity	County/Private	$500,000
SU9123	Stormwater Pond Retrofit	Sugarland - Folly Lick	Near Philmont Drive & Judd Court	Quality/ Quantity	Private	$310,000
SU9129	Stormwater Pond Retrofit	Sugarland - Upper Middle	Near Quail Ridge Court cul-de-sac	Quality	Private	$190,000

Table 4.3
Master Project List

Priority Structural Projects (10 Year Implementation Plan)

Project #	Project Type	WMA	Location	Watershed Benefit	Land Owner	Cost
SU9130	New Stormwater Pond	Sugarland - Upper Middle	Near Jenny Ann Court cul-de-sac	Quality/ Quantity	Private	$150,000
SU9135	Stormwater Pond Retrofit, BMP/LID	Sugarland - Upper Middle	Trinity Presbyterian Church	Quality/ Quantity	Private	$320,000
SU9136	New Stormwater Pond	Sugarland - Upper Middle	Near Queens Row Street & Herndon Parkway	Quality/ Quantity	Private	$110,000
SU9139	Stormwater Pond Retrofit	Sugarland - Upper	Towns at Stuart Pointe Subdivision, Stuart Pointe Lane	Quality/ Quantity	County	$70,000
SU9143	Stormwater Pond Retrofit	Sugarland - Upper	Near Grove Street & Herndon Parkway	Quality/ Quantity	Private	$140,000
SU9144	New Stormwater Pond, BMP/LID	Sugarland - Upper Middle	Bowman Towne Drive & Fountain Drive	Quality/ Quantity	Park/Private	$200,000
SU9146	Stormwater Pond Retrofit, New Stormwater Pond	Sugarland - Upper	Next to St. Timothy's Episcopal Church, Spring Street	Quality/ Quantity	County/Private	$130,000
SU9147	Stormwater Pond Retrofit	Sugarland - Upper	Near Edmund Halley Drive & Sunrise Valley Drive	Quality/ Quantity	Private	$140,000
SU9149	New Stormwater Pond, Stream Restoration, Stormwater Pond Retrofit	Sugarland - Headwaters	Polo Fields Subdivision	Quality/ Quantity	Private	$1,930,000
SU9150	New Stormwater Pond	Sugarland - Headwaters	Near Nutmeg Lane cul-de-sac	Quality/ Quantity	Private	$250,000
SU9201	New Stormwater Pond, Stream Restoration	Sugarland - Folly Lick	Folly Lick stream corridor between Fantasia Drive & Monroe Street	Quality/ Quantity	Park/Private	$910,000
SU9203	Stream Restoration	Sugarland - Upper Middle	Hunters Creek HOA and Runnymede Park	Quality/ Quantity	Local/Private	$290,000
SU9204	Stream Restoration	Sugarland - Folly Lick	Herndon Centennial Park golf course	Quality/ Quantity	Local	$1,880,000
SU9205	Stream Restoration	Sugarland - Upper Middle	Fairfax County Parkway & Walnut Branch Road	Quality/ Quantity	State/Private	$810,000
SU9208	Stream Restoration	Sugarland - Headwaters	Near Sanibel Drive & Tigers Eye Court culs-de-sac	Quality	Private	$1,170,000
SU9209	Stream Restoration	Sugarland - Headwaters	Pinecrest Road & Glade Drive	Quality	State/Private	$290,000
SU9210	Stream Restoration	Sugarland - Headwaters	Fox Mill Road & Keele Drive	Quality	Private	$80,000

Table 4.3 Master Project List						
Priority Structural Projects (10 Year Implementation Plan)						
Project #	**Project Type**	**WMA**	**Location**	**Watershed Benefit**	**Land Owner**	**Cost**
SU9500	BMP/LID	Sugarland - Upper Middle	Herndon High School	Quality	County	$850,000
SU9502	BMP/LID	Sugarland - Upper Middle	Herndon Elementary School	Quality/ Quantity	County	$580,000
SU9504	BMP/LID	Sugarland - Upper Middle	Reston North Park	Quality/ Quantity	Park	$130,000
SU9505	BMP/LID	Sugarland - Upper	Near Elden Street & Van Buren Street	Quality/ Quantity	Private	$380,000
SU9509	BMP/LID	Sugarland - Upper Middle	Trader Joe's	Quality	County/Private	$330,000
SU9512	BMP/LID	Sugarland - Upper Middle	Reston Hospital	Quality	Private	$200,000
SU9514	BMP/LID	Sugarland - Upper	Sunset Hills Road & Fairfax County Parkway	Quality	State/Private	$290,000
SU9515	BMP/LID	Sugarland - Upper	Sunset Hills Road & Town Center Parkway	Quality	Private	$200,000
					Total Cost:	***$29,560,000***

Table 4.3 Master Project List					
Long-term Structural Projects (25 Year Implementation Plan)					
Project #	**Project Type**	**WMA**	**Location**	**Watershed Benefit**	**Land Owner**
HC9100	Stormwater Pond Retrofit	Horsepen - Lower Middle	Rock Hill Road & Turquoise Lane	Quantity/ Quality	Private
HC9101	Stormwater Pond Retrofit	Horsepen - Lower Middle	Near Spring Knoll Drive & Summerset Place	Quantity/ Quality	Private
HC9103	Stormwater Pond Retrofit	Horsepen - Middle	Dulles Int'l Airport, near Sully Rd & electric substation	Quantity/ Quality	Federal
HC9104	New Stormwater Pond	Horsepen - Merrybrook	Centreville Road & McNair Farms Drive	Quality	Private
HC9111	Stormwater Pond Retrofit	Horsepen - Frying Pan	Near Frying Pan Road & Coppermine Road	Quantity/ Quality	County/Park
HC9113	Stormwater Pond Retrofit	Horsepen - Middle	Towerview Road cul-de-sac	Quantity/ Quality	Private
HC9115	Stormwater Pond Retrofit, New Stormwater Pond	Horsepen - Middle	Near Mustang Drive & Maverick Lane	Quantity/ Quality	County/Private
HC9117	Stormwater Pond Retrofit	Horsepen - Frying Pan	Monroe Manor Drive cul-de-sac	Quantity/ Quality	County
HC9124	Stormwater Pond Retrofit	Horsepen - Frying Pan	Near Locksley Court cul-de-sac	Quantity/ Quality	County

Table 4.3 Master Project List					
Long-term Structural Projects (25 Year Implementation Plan)					
Project #	**Project Type**	**WMA**	**Location**	**Watershed Benefit**	**Land Owner**
HC9125	New Stormwater Pond	Horsepen - Upper	Near Spring Chapel Court cul-de-sac	Quality	Park
HC9130	Stormwater Pond Retrofit	Horsepen - Upper	Middleton Farm Subdivision, between Middleton Farm Lane & Blue Holly Lane culs-de-sac	Quality/ Quantity	Park
HC9131	Stormwater Pond Retrofit, Culvert Retrofit	Horsepen - Upper	Near West Ox Road & McLearen Road	Quantity/ Quality	County/Private
HC9135	Stormwater Pond Retrofit	Horsepen - Cedar	Near Emerald Chase Drive & Rover Glen Court	Quantity/ Quality	Private
HC9138	New Stormwater Pond	Horsepen - Cedar	Near Emerald Chase Drive & Ruby Lace Court	Quality	Park
HC9139	New Stormwater Pond	Horsepen - Upper	Near Bradwell Road & Litchfield Drive	Quality	County
HC9146	Stormwater Pond Retrofit, BMP/LID	Horsepen - Cedar	Near Ashburton Avenue & Wheeler Way	Quantity/ Quality	County/Private
HC9148	Stormwater Pond Retrofit, New Stormwater Pond	Horsepen - Upper	Near Glenbrooke Woods Drive cul-de-sac	Quality	Private
HC9302	Area-wide Drainage Improvement	Horsepen - Cedar	Burchlawn Street cul-de-sac	Quality	N/A
HC9400	Culvert Retrofit	Horsepen - Lower Middle	Near Rock Hill Road & Innovation Avenue	Quality	State/Private
HC9401	Culvert Retrofit	Horsepen - Lower Middle	Near Rock Hill Road & Innovation Avenue	Quantity	State
HC9501	BMP/LID	Horsepen - Middle	Along stream corridor between Floris Street & Mountainview Court	Quality	Private
HC9502	BMP/LID	Horsepen - Middle	Floris Elementary School	Quality	Park
HC9505	BMP/LID	Horsepen - Upper	Near Emerald Chase Drive & Lazy Glen Court	Quality	County
SU9001	Regional Pond Alternative Suite	Sugarland - Lower Middle	Near Rowland Drive & Heather Way	Quality	Park/Private
SU9105	Stormwater Pond Retrofit	Sugarland - Lower	Air View Lane	Quantity/ Quality	Private
SU9107	Stormwater Pond Retrofit	Sugarland - Lower Middle	Near Leesburg Pike & Fairfax County Parkway	Quantity/ Quality	County
SU9111	Stormwater Pond Retrofit	Sugarland - Lower Middle	Dranesville Road & Woodson Drive	Quality	State/Park
SU9112	Stormwater Pond Retrofit	Sugarland - Lower Middle	East of Dranesville Road & Butter Churn Drive	Quantity/ Quality	Park
SU9115	Stormwater Pond Retrofit	Sugarland - Lower Middle	Hastings Hunt Section 6 and Jenkins Ridge Subdivisions	Quantity/ Quality	County/Private

Table 4.3 Master Project List					
Long-term Structural Projects (25 Year Implementation Plan)					
Project #	**Project Type**	**WMA**	**Location**	**Watershed Benefit**	**Land Owner**
SU9118	Stormwater Pond Retrofit	Sugarland - Folly Lick	Near stream corridor in Dranesville Estate Section 1 and 2	Quantity/ Quality	County/Park
SU9120	Stormwater Pond Retrofit	Sugarland - Upper Middle	Near Eddyspark Drive & Kingsvale Circle	Quality/ Quantity	County/Private
SU9121	Stormwater Pond Retrofit, New Stormwater Pond	Sugarland - Folly Lick	East of Millikens Bend Road near Millbank Way & Westlodge Court	Quantity/ Quality	Park
SU9122	Stormwater Pond Retrofit	Sugarland - Folly Lick	Baptist Temple of Herndon	Quantity/ Quality	Private
SU9124	Stormwater Pond Retrofit	Sugarland - Upper Middle	Near Rosiers Branch Drive & Heather Down Drive	Quantity/ Quality	County
SU9127	Stormwater Pond Retrofit	Sugarland - Folly Lick	Herndon United Methodist Church	Quantity/ Quality	Private
SU9128	Stormwater Pond Retrofit	Sugarland - Upper Middle	Between the Fawn Ridge Lane culs-de-sac	Quantity/ Quality	County/Private
SU9133	New Stormwater Pond, BMP/LID	Sugarland - Folly Lick	Near Crestview Drive & Bond Street	Quantity/ Quality	Private
SU9137	New Stormwater Pond	Sugarland - Upper Middle	Walnut Branch Road & Purple Sage Court	Quantity/ Quality	Private
SU9140	New Stormwater Pond, Stormwater Pond Retrofit	Sugarland - Upper	Safeway; corner of Post Drive & Grove Street	Quantity/ Quality	Private
SU9141	Stormwater Pond Retrofit	Sugarland - Upper	Substation near Grove Street & Grant Street	Quality/ Quantity	Private
SU9142	Stormwater Pond Retrofit	Sugarland - Folly Lick	Near Spring Street & Wood Street	Quantity/ Quality	Private
SU9200	Stream Restoration	Sugarland - Lower Middle	Near Dranesville Road & Woodson Drive	Quality	State/Park/ Private
SU9202	Stream Restoration	Sugarland - Folly Lick	Near Herndon Parkway & Stevenson Court	Quality	Private
SU9206	Stream Restoration	Sugarland - Upper	Near Herndon Parkway & Tamarack Way	Quality	Private
SU9207	Stream Restoration	Sugarland - Upper	Near Fairfax County Parkway & New Dominion Parkway	Quality	Private
SU9400	Culvert Retrofit	Sugarland - Lower	Near Kentland Drive & Parrish Farm Lane	Quantity/ Quality	State/Private
SU9501	BMP/LID	Sugarland - Upper Middle	Lake Newport Road & North Point Drive	Quality	County/Private
SU9510	BMP/LID	Sugarland - Upper	Near Elden Street & Fairfax County Parkway	Quality	State/Private
SU9511	BMP/LID	Sugarland - Folly Lick	Dulles Park Court & Alabama Drive	Quality	Private
SU9513	BMP/LID	Sugarland - Upper	Near Old Dominion Avenue & Aspen Drive	Quality	Private

Table 4.3 Master Project List Non-Structural Projects					
Project #	**Project Type**	**WMA**	**Location**	**Watershed Benefit**	**Land Owner**
HC9901	Buffer Restoration, Rain Barrel Programs	Horsepen - Cedar	Near Ashburton Avenue & Thistlethorn Drive	Quality/ Quantity	Park/Private
HC9902	Buffer Restoration	Horsepen - Frying Pan	Stream corridors near Copper Bed Road & Copper Hill Road	Quality	County/Park
HC9903	Buffer Restoration, Rain Barrel Programs	Horsepen - Lower Middle	Reflection Lake HOA & Four Season HOA (Herndon)	Quality/ Quantity	Private
HC9904	Conservation Acquisition Project/ Land Conservation Coordination Project	Horsepen - Middle	Stream corridors near Sully Road & Park Center Road	Quality	Federal/County/ Park/Private
HC9905	Conservation Acquisition Project/ Land Conservation Coordination Project, Dumpsite/ Obstruction Removal, Buffer Restoration	Horsepen - Upper	Stream corridors near McLearen Road & Cobra Drive	Quality	County/Park/ Private
HC9906	Rain Barrel Programs	Horsepen - Upper	Chantilly Highlands	Quantity	Private
HC9907	Conservation Acquisition Project/ Land Conservation Coordination Project, Buffer Restoration	Horsepen - Merrybrook	Centreville Road & Woodland Park Road	Quality	County/Private
SU9900	Rain Barrel Programs	Sugarland - Folly Lick	Westfield, Fortnightly Square, Haloyon of Herndon Sect 5, Van Vlecks, Ballou, Saubers, Herndon Station, Herndon Park Station, and Chandon Subdivisions	Quantity	Private
SU9901	Buffer Restoration	Sugarland - Lower Middle	Near Leesburg Pike & Rolling Holly Drive	Quality	State/Park/ Private
SU9902	Rain Barrel Programs	Sugarland - Lower Middle	Sugar Creek Sec. 1, Stuart Hills, Cedar Chase, Oak Creek Estates, Forest Heights Estates, Stoney Creek Woods, Hastings Hunt sec. 6, portion of Jenkins Ridge, Holly Knoll, and Crestbrook Subdivisions	Quantity	Private
SU9903	Conservation Acquisition Project/ Land Conservation Coordination Project	Sugarland - Lower Middle	Stream corridor near Leesburg Pike & Holly Knoll Drive	Quality	County/Private

Table 4.3 Master Project List					
Non-Structural Projects					
Project #	**Project Type**	**WMA**	**Location**	**Watershed Benefit**	**Land Owner**
SU9904	Community Outreach/ Public Education	Sugarland - Lower Middle	Near Heather Way cul-de-sac	N/A	Private
SU9905	Rain Barrel Programs	Sugarland - Upper	Crestview Sec. 1, Runnymede Manor, Stuart Woods, Reston Sec. 49, and Towns at Stuart Pointe Subdivisions	Quantity	Private
SU9906	Buffer Restoration	Sugarland - Upper	Near Fairfax County Parkway & Sunset Hills Road	Quality	County/Private
SU9907	Conservation Acquisition Project/ Land Conservation Coordination Project, Buffer Restoration	Sugarland - Upper	Stream corridors near Herndon Parkway & Fairbrook Drive	Quality	Private
SU9908	Rain Barrel Programs	Sugarland - Upper Middle	Stuart Ridge, Shaker Woods, Shaker Grove, Kingstream, Hunters Creek, Potomac Fairways, Iron Ridge Sec. 2, Graymoor, Chestnut Grove, Old Drainsville Hunt Club, Jeneba Woods, Reston Sec. 49, and Sugar Land Heights Subdivisions	Quantity	Private
SU9909	Rain Barrel Programs	Sugarland - Headwaters	Polo Fields Subdivision	Quantity	Private
SU9910	Buffer Restoration	Sugarland - Headwaters	Fairfax County Parkway & Dulles Access Road	Quality	Private
SU9911	Conservation Acquisition Project/ Land Conservation Coordination Project	Sugarland - Headwaters	Sunrise Valley Wetland Park	Quality	Private

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