City of Richmond
Chesapeake Bay Preservation Program

Public Information Manual

Department of Public Utilities
Water Resources Division
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Purpose/Organization

The purpose of this manual is to guide both property owners and City administrative personnel through the land development review process within designated preservation areas where proposed development could potentially affect the Chesapeake Bay.

This manual also establishes procedures and requirements necessary for implementation of the program with a level of specificity beyond what is described in the ordinance. While the ordinance adopted by Richmond City Council meet the minimal requirements of the Chesapeake Bay Preservation Act and the Chesapeake Bay Preservation Area Designation and Management Regulations, this Public Information Manual expands upon the City's ordinance and provides both guidance and specific techniques to provide flexibility, yet ensure compliance with both the letter and intent of the State and City requirements.

The manual is organized into four chapters:

1. **Introduction and Program Overview**
   This section will be used by the applicant to understand the relationship of Chesapeake Bay Preservation Act goals and objectives established by the City's program and to help determine its applicability to a specific project. A flow diagram of the Chesapeake Bay Preservation Program review process (Figure 1, page 12)

2. **Chesapeake Bay Site Plan submission/review procedures**
   Once an applicant determines that a project is subject to Chesapeake Bay Site Plan review, this section will provide the detailed procedures to follow, including a checklist of Site Plan requirements.

3. **Performance Criteria**
   The applicant must comply with performance criteria outlined in this section when preparing a Chesapeake Bay Site Plan.

4. **Program Mechanics**
   The appendices include a checklist, maintenance agreements and additional information which is helpful in addressing program requirements.

Chapter I - Introduction and Program Overview

The Virginia Chesapeake Bay Preservation Act

Purpose of the Chesapeake Bay Preservation Act

In 1989 the Virginia General Assembly enacted the Chesapeake Bay Preservation Act (the "Act") (Chapter 14, Title 180 of the Code of Virginia) for the express purpose. . .

> *"to protect and improve the water quality of the Chesapeake Bay, its tributaries, and other state waters by minimizing the effects of human activity upon these waters and implementing the Act, which provides for the definition and protection of certain lands called Chesapeake Bay Preservation Areas, which if improperly used or developed may result in substantial damage to the water quality of the Chesapeake Bay and its tributaries."*

The Act has matured through time into a cooperative state-local program that states:

> *"Healthy state and local economies and a healthy Chesapeake Bay are integrally related; balanced economic development and water quality protection are not mutually exclusive. The protection of the public interest in the Chesapeake Bay, its tributaries, and other state waters and the promotion of the general welfare of the people of the Commonwealth require that (i) the counties, cities, and towns of Tidewater Virginia incorporate general water quality protection measures into their comprehensive plans, zoning ordinances, and subdivision ordinances; (ii) the counties, cities, and towns of Tidewater Virginia establish programs, in accordance with criteria established by the Commonwealth, that define and protect certain lands, hereinafter called Chesapeake Bay Preservation Areas, which if improperly developed may result in substantial damage to the water quality of the Chesapeake Bay and its tributaries;."*

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The Chesapeake Bay Preservation Area Designation and Management Regulations promulgated in October 1989 and revised in 2013 by the State Water Control Board, establish criteria to be used by counties, cities and towns in determining the extent of Chesapeake Bay Preservation Areas within their jurisdictions, and for *"granting, denying, or modifying requests*

to rezone, subdivide, or to use and develop land in [such designated] areas". The regulations set forth guidelines for local governments to implement the Act through their comprehensive plans, zoning ordinances and subdivision ordinances to protect the quality of state waters.

City of Richmond Chesapeake Bay Program Overview

In response to the adoption by the Commonwealth of Virginia of the Chesapeake Bay Preservation Act and Regulations, the City has adopted a program which both meets the objectives of the Act and Regulations and addresses the complexities of an urban environment. The objective of the program as outlined in the ordinance adopted by the City of Richmond in implementing the Act and the Regulations is to "*prevent a net increase in nonpoint source pollution from new development and development on previously developed land...”* The City is an urban community within which approximately 85 percent of the land area is currently developed. Richmond also has an urbanized waterfront, and yet, it has developed over the past 200 years in a manner which has retained much of the scenic qualities and natural features of the James River and its tributaries.

Sec. 14-262(a)

Devising achievable means to ensure improved water quality is a challenge for urban areas, particularly with the focus of the Act on rural and suburban conditions and mechanisms for the protection of water quality through the appropriate development of land from a natural to a built environment. The City of Richmond is an urban environment with conditions such as structured stormwater drainage systems, large amounts of impervious cover, artificially enhanced green space, man-made tributary streams, and other elements not specifically addressed or provided for in the Act.

City of Richmond Ordinance -- Chapter 14, Article IV Chesapeake Bay Preservation Areas

The City’s program consists of (1) Chapter 14 (Floodplain Management) of the Code of the City of Richmond, 2017, as amended (referred to as "Ordinance"), (2) preservation area designations shown as a layer in the City's Geographic Information System (GIS) mapping system, (3) and a written set of administrative guidelines, policies, and procedures, contained herein. This manual provides a program overview within the context of implementation, concentrating on procedures and reasonable results rather than on the details of how the program was developed. The program is administered by an appointee of the Director of Public Utilities, referred to as the Program

Program Administrator

Administrator. The Program Administrator may be consulted for additional information not contained in this manual.

Chesapeake Bay Preservation Areas

In implementing the requirements of the Act and Regulations, the City of Richmond has designated and mapped Chesapeake Bay Preservation Areas that cover approximately thirty five percent (35%) of the City's land area. The three types of areas designated are: Resource Protection Areas, Resource Management Areas, and Intensely Developed Areas.

Sec. 14-231(b)
Resource Protection Area (RPA):
(1) tidal wetlands
(2) non-tidal wetlands connected by surface flow to water bodies with perennial flow
(3) tidal shores
(4) other lands considered necessary to protect state waters
(5) buffer of 100 feet landward of water bodies with perennial flow and any of the above.

Resource Protection Area (RPA). This area is designated in accordance with the provisions of Section 14-231 of the Ordinance and include *"lands adjacent to water bodies with perennial flow that have an intrinsic water quality value due to the ecological and biological processes they perform or lands that are sensitive to impacts which may cause significant degradation to the quality of state waters."* In delineating the RPA the City has included: (1) tidal wetlands; (2) non-tidal wetlands connected by surface flow and contiguous to tidal wetlands or water bodies with perennial flow; (3) tidal shores; (4) other lands considered by the City to be necessary to protect the quality of State waters; and (5) buffer areas 100 feet in width landward of, and adjacent to, those components listed in items (1) through (4) above. The land area within the designated RPA makes up approximately three percent (3%) of the City's land area.

Sec. 14-264(a)
Permitted uses in the RPA:
(1) water-dependent development
(2) redevelopment
(3) development or redevelopment within an IDA
(4) established new use
(5) road or driveway crossings
(6) flood control and stormwater management facilities

Land within the RPA may be developed only if the proposed use is water-dependent; constitutes a redevelopment project or is located within an Intensely Developed Area (IDA); or is a management facility satisfying specific conditions of the ordinance; and the proposed use complies with performance criteria established by the Ordinance.

Sec. 14-233(a)
Intensely Developed Areas (IDA) as overlay to RPA-
(1) Downtown Richmond
(2) Port of Richmond

Intensely Developed Areas (IDA). Designated as an overlay to the Resource Protection Area, this category includes *"areas of existing development and infill sites where little of the natural environment remains."* The City's program limits IDA designation to the downtown area and the Port of Richmond property as the only areas where further non-water dependent waterfront development should occur**.**

Resource Management Area (RMA). This area consists of the land area contained within the limits of the 100-year floodplain, non-tidal wetlands that are not included in the RPA, a 500-foot wide setback from the landward edge of the RPA, and a 600 foot buffer from the landward edge of a stream or where water body is not determined. Development within the RMA is to be regulated in accordance with the Performance Criteria (see page 19) in order to lessen negative impacts to water quality and retain the functional value of the RPA. The land area within the designated RMA constitutes approximately sixteen percent (16%) of the City's land area.

Sec. 14-232(b)
Resource Management Area (RMA):
(1) 100-year floodplain
(2) highly erodible soils
(3) highly permeable soils
(4) non-tidal wetlands, not included in the RPA
(5) 500 foot buffer from the edge of any RPA or 600 feet from the landward edge of a stream or water body where perenniality has not been determined.
(6) other lands considered by the City to be necessary to protect the quality of State waters.

The areas designated RPA, IDA or RMA are shown on the Chesapeake Bay Preservation Areas Map, consisting of a layer in the City's GIS mapping system, and adopted as such by City Council.

Chapter II - The Chesapeake Bay Site Plan submission and review process

In addition to the customary permitting process of the City (basic requirements shown in Figure 1, page 12), the Chesapeake Bay site planning process will add one layer of coordinated site plan review for any development of land determined to be within a designated RPA, IDA or RMA (also referred to collectively as Chesapeake Bay Preservation Areas). The following 7 steps describe the process and requirements for preparation and submission of the required Chesapeake Bay Site Plan. This process is also summarized in the flow diagram, Figure 1 on page 12.

Step 1: Determination of a site's location in relation to Chesapeake Bay Preservation Areas

See the Code of Ordinances City of Richmond, Virginia for specifics on when these permits are required

Any application for one of the following -

- **Preliminary Subdivision Plat**
- **Plan of Development**
- **Land Disturbing Permit**
- **Richmond Stormwater Management Permit**
- **Application for Relief of Requirements of the Chesapeake Bay Program**

- will initiate a separate determination by the Program Administrator of the site's location in relationship to designated preservation areas. The location determination will be made by the Program Administrator based on the examination of Chesapeake Bay Preservation Area maps or other City maps, as necessary. Additionally, the Program Administrator has the authority to request additional information from the applicant to make this determination. In accordance with Sections14-231 and 14-232 of the Ordinance, site specific boundaries of the RPA and RMA shall be established by the Program Administrator during the Chesapeake Bay Site Plan review process. The applicant may be required to supply additional technical and field data to assist the Program Administrator in the determination of site specific boundaries.

In the case of an application for a special use permit, plan of development, a community plan or a rezoning/conditional rezoning, the Program Administrator shall inform the applicant of potential impact to a Preservation Area. For these applications, a Chesapeake Bay Site Plan may not be required.

If a site is determined to be within a preservation area, the Program Administrator will request the submission of a Chesapeake Bay Site Plan (see Appendix A for Checklist of Submission Items). If a site is determined to be within a preservation area, the site's location within a particular watershed will also be determined at this step of the process.

Sec. 14-181 (definitions)

Step 2: Determine development, redevelopment, or exempt activity

A project which requires any one of the permits or approvals listed in Step 1 will be classified as either development or redevelopment. Development is defined in Sec. 14-181 of the Ordinance as "*land disturbance and the resulting landform associated with the construction of residential, commercial, industrial, institutional, recreation, transportation or utility facilities or structures or the clearing of land for non-agricultural or non-silvicultural purposes."* Redevelopment is defined as *"the process of developing land that is or has been previously developed."*

In accordance with Sec. 14-292 of the Ordinance, certain types of development may be exempt from the requirements of the ordinance. These uses may include: public utilities, railroads, public roads and facilities, and water, sewer, natural gas, and

underground telecommunication lines.

Only a limited number of uses are permitted within Resource Protection Areas (RPA's). These include: water dependent uses (such as marinas), redevelopment, and specific exempt uses. If that portion of the RPA is also classified as an IDA, additional uses are also permitted.

Step 3: Submission of Chesapeake Bay Site Plan:

"A Chesapeake Bay Site Plan shall be required from any land disturbance, development, or redevelopment within a designated Chesapeake Bay Preservation Area"
Sec. 14-263(10)

The submission of a Chesapeake Bay Site Plan is required by Ordinance Section 14-263(10) for approval of any development or activity in a RMA or RPA. A Chesapeake Bay Site Plan also incorporates much of what is required by the other land permitting processes. The relationship between Chesapeake Bay Site Plan submission items and those required for other related City permits are shown on Figure 1, on page 12.

The submission and review of a Chesapeake Bay Site plan will meet the requirement of "Plan of Development review" described in the Ordinance. The Chesapeake Bay Site Plan is the one document that best enables the Program Administrator to evaluate the conditions on the site to be developed and determine if the requirements of the program are being met. The following list outlines the requirements for a Chesapeake Bay Site Plan:

A. Site Plan

A site plan showing the following on multiple plan sheets or a single plan sheet for smaller, residential projects

- Existing physical site characteristics**,** including the location of all Chesapeake Bay Preservation Area components
- Proposed improvements and/or any impervious cover
- Erosion and Sediment Control Plan
- Landscape Mitigation Plan

B. Checklist Items

A complete checklist of items required on a Chesapeake Bay Site Plan is provided in Appendix A. All of the indicated items should be shown on the site plan, and a copy of the checklist submitted with the plan.

C. Copies of wetlands permits

Wetlands permits required by law, i.e. Army Corps of Engineers permits, which are required for a host of activities affecting wetlands, shore-lines and navigable waters.

Evidence of a determination that wetlands permits are not required may also be required by the Program Administrator.

D. Water Quality Impact Assessment (WQIA)

Sec. 14-264(1)(b) Water Quality Impact Assessment required for Development in RPA and in an RMA if determined necessary by the Program Administrator

In addition to the basic Chesapeake Bay Site Plan submission items, any development in a Resource Protection Area or in a Resource Management Area if determined necessary by the Program Administrator, will require additional information in the form of a *Water Quality Impact Assessment* concentrating on hydrological system impacts. The Program Administrator may request a Water Quality Impact Assessment in a Resource Management Area.

Sec. 14-264(6)(a)

As described in the Ordinance, the purpose of a Water Quality Impact Assessment is to: "*identify the impacts of proposed development on water quality and lands in the resource protection areas consistent with the goals and objectives of the Act, this article, and the city's programs, and to determine specific measures for mitigation of those impacts***"**

Using plan sheet #5 (see description under Checklist, Appendix A), the WQIA must demonstrate the absence of significant adverse impacts of nonpoint source pollution (NPS) on topography, soils, environmentally sensitive areas, hydrology and the quality of State waters and mitigation of any unavoidable adverse impacts.

Step 4: Determine stormwater management requirements for proposed project

Sec. 14-330

Stormwater management requirements for a development will vary dependent upon several factors; whether the project is considered "New Development" or "Redevelopment", the project site area, the land disturbance within the site area, and the amount of impervious, managed turf, or open space cover within the project area. The City of Richmond reviews stormwater management strategies utilizing the approach described in the current version of the *Virginia Stormwater Management Handbook (VSMH).*

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Compliance with the most current water quality design criteria set out in the *VSMH* shall be determined utilizing the Virginia Runoff Reduction Method or equivalent methodology that is approved by the Department of Environmental Equality (DEQ).

For projects that are considered New Development, use the most current version of DEQ's Virginia Runoff Reduction Method (VRRM) New Development Spreadsheet.

Sec. 14-181(Definitions)
Development means land disturbance and the resulting landform associated with the construction of residential, commercial, industrial, institutional, recreation, transportation or utility facilities or structures or the clearing of land for non-agricultural or non-silvicultural purposes.

For projects that are considered Redevelopment, use the most current version of DEQ's Virginia Runoff Reduction Method (VRRM) Redevelopment Spreadsheet.

Redevelopment means the process of developing land that is or has been previously developed.

The standard VRRM Spreadsheets for calculating the required water quality removals can be found at the Virginia Stormwater BMP Clearinghouse-Virginia Runoff Reduction Method (VRRM) website: http://www.vwrrc.vt.edu/swc/Virginia%20Runoff%20Reduction%20Method.html

These calculations should be used when determining the required pollutant removal for a particular project. The website also includes guidance on the VRRM equations and spreadsheet usage.

Compliance with the most current water quantity design criteria set out in the *VSMH* shall be determined utilizing energy balance or appropriate methodology depending on the outfall conditions of the project. This includes compliance with Erosion and Sediment Control Regulations minimum standard 19.

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9VAC25-840-40

Step 5: Develop improvement options to meet calculated NPS pollutant removal requirements

The amount of NPS pollutant removal required resulting from either a new development or redevelopment project will dictate the level of stormwater management improvements to be required. In accordance with the Ordinance**,** effective stormwater management can be achieved through three options, the most common of which is the implementation of what are referred to as Best Management Practices (BMPs).

Sec. 14-323

A Best Management Practice is defined as *"schedules of activities, prohibitions of practices (including both structural and nonstructural practices), maintenance procedures, and other management practices to prevent or reduce the pollution of surface water and groundwater systems from the impacts of land-disturbing activities."*

Water quality goals in terms of the required pollutant removal are determined for both new development and redevelopment projects under Step 4. The Ordinance specifies that effective stormwater management requirements may be achieved for sites through one of the following options:

Sec. 14-263(7)(a)(1-3)

A. Compliance with a locally adopted regional stormwater management program that meets the conditions described in the Ordinance.

B. Compliance with a site-specific VPDES permit issued by the Commonwealth of Virginia, provided that the City specifically determines that the permit requires measures that collectively achieve water quality protection equivalent to that required by the Ordinance.

C. Incorporation of Best Management Practices (BMPs) that meet water quality protection as described in the Ordinance. Examples of different types of BMPs which may be considered by the Administrator to achieve NPS pollution reduction from the site include a combination of structural and nonstructural BMPs.

Selection of the appropriate BMP for a particular site will primarily be guided by performance criteria discussed in the current version of the *Virginia Stormwater Management Handbook*. All approvable BMPs may be found at the Virginia Stormwater BMP Clearinghouse – Virginia Approved

Stormwater BMP Standards and Specifications website:
http://www.vwrrc.vt.edu/swc/StandardsSpecs.html

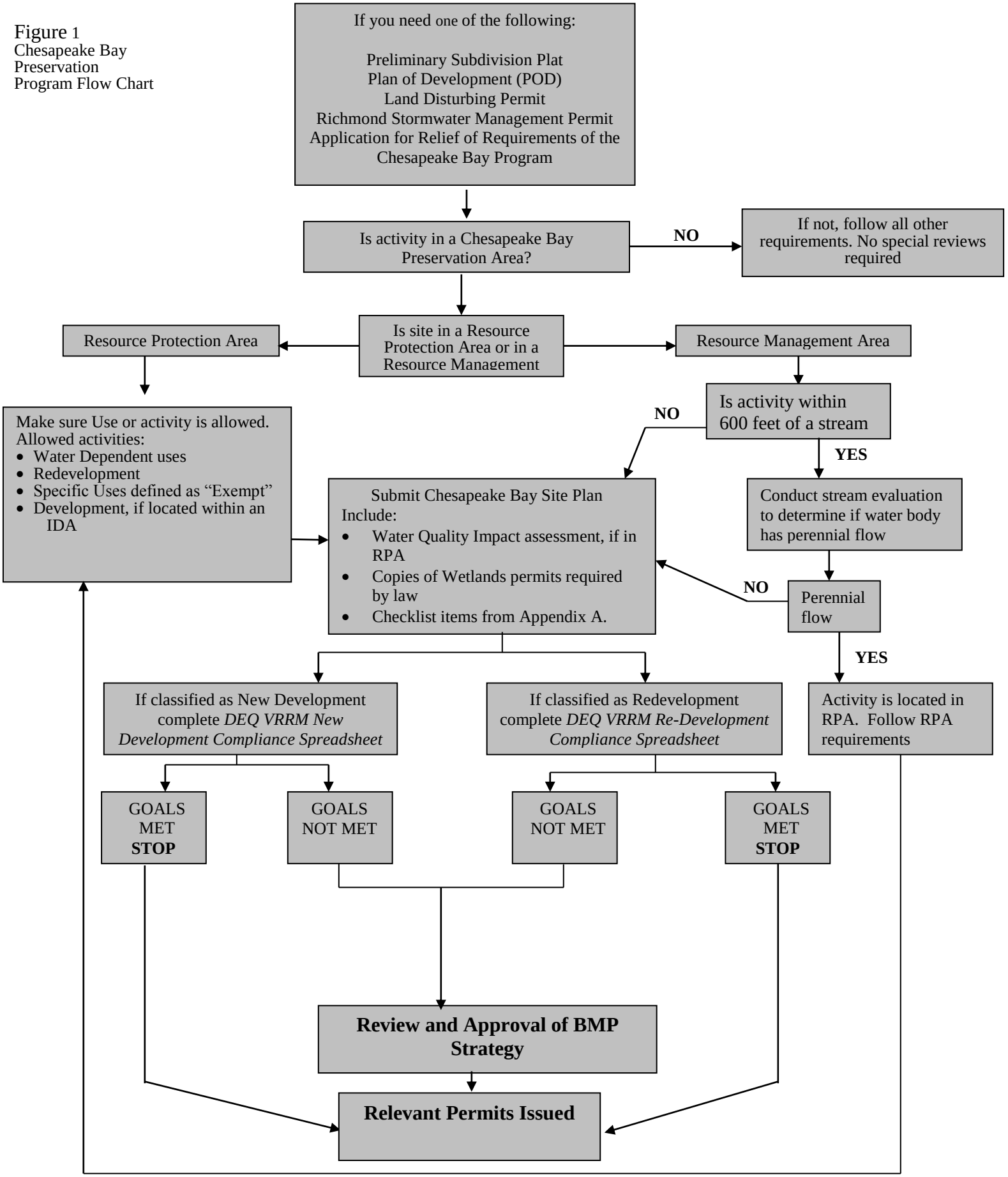
Step 6: Maintenance of Best Management Practice improvements

Sec. 14-263(3)
General Performance Criteria

Sec. 14-331
Long-term maintenance of permanent stormwater facilities

In compliance with Sec. 14-263(3) of the Ordinance, the applicant will be required to enter into a maintenance agreement (See Appendix B) with the City when Best Management Practices, which require periodic maintenance, are installed to meet the performance criteria outlined by the following section. The agreement outlines appropriate responsibilities for the long-term maintenance of the facility and includes general specifications for construction. Such an agreement will be recorded with the deed on the property as a matter of general public record, not as a deed restriction, and as such will transfer with the property as it is sold.

Figure 1
Chesapeake Bay Preservation Program Flow Chart



Step 7: Adjustments to the program requirements

The following opportunities exist for the revision of program requirements as they pertain to a specific site:

A. Establishment of site specific boundaries

In accordance with the Chesapeake Bay Preservation Act and Regulations, the City used the best available mapping resources to determine approximate boundaries of the Resource Protection Area and the Resource Management Area. These boundaries are shown on the Chesapeake Bay Preservation Areas layer of the City's GIS mapping system.

The applicant may be in a position to provide more detailed information and additional technical data that provides greater accuracy than the City's mapping, particularly when applied to the individual site. Upon submission of technical and field data which is acceptable to the Program Administrator, site specific boundaries shall be established for the RPA and RMA. (See Step 1**,** page 5)**.**

Sec. 14-231; Sec. 14-232 Establishment of site-specific boundaries of the RPA and the RMA

As the Program Administrator becomes aware of RPA or RMA features, they will be identified on the appropriate layer in the City's GIS mapping system and identified as "determined eligible, but not adopted." The Program Administrator will treat these areas as Chesapeake Bay Preservation Areas (or excluded from) until such time as City Council formally amends the map.

B. Waiver for nonconforming use

For structures in existence prior to November 11, 1991, and which have been determined by the Program Administrator to not conform to the current requirements of this Division, the Administrator may waive the requirements of the Ordinance, provided that:

- There will be no net increase in nonpoint source pollutant load;
- Any development or land disturbance exceeding an area of 2,500 square feet complies with all erosion and sediment control requirements.

"Request for Exception" Form is used for requesting both exceptions and waivers for nonconforming uses.

The reconstruction of existing structures destroyed by casualty loss within Chesapeake Bay Preservation areas is permitted providing that they are not otherwise restricted by City ordinance.

Property owners requesting waivers for nonconforming structures or uses should complete the "Application for

Relief from Requirements of the Chesapeake Bay preservation Program" form located in Appendix B. All applications must be submitted with a WQIA, Chesapeake Bay site plan, and a landscape mitigation plan.

C. Exemptions to Program Requirements

Sec. 14-292 (b) Exemptions

Certain public utilities, railroads, public roads, and facilities are exempt from the requirements of this program. All such construction, installations operation and maintenance must however meet the requirements of: (1) regulations promulgated and ordinances enacted pursuant to the Erosion and Sediment Control Law and the Stormwater Management Act, or (2) an erosion and sediment control plan and stormwater management plan approved by the City or State, where required; or (3) Local water quality protection criteria at least as stringent as the above State requirements will be deemed compliant. Exemptions for public roads is further conditioned on the optimization of the road alignment and design to prevent or minimize encroachment in the RPA and adverse effects on water quality, and otherwise meet the definition of public roads.

Construction, installation, and maintenance of underground utilities are exempt provided that:

- They are located to the maximum degree possible outside RPA's;
- No more land is disturbed than is necessary for the utility installation;
- It is done in compliance with all applicable state and federal permits and designed and conducted in a manner that protects water quality;
- Land disturbance in excess of 2,500 square feet Complies with all City erosion and sediment control requirements.

Upon reviewing the Chesapeake Bay Site Plan, the Program Administrator will determine if the use or any features of the use meet the conditions required for an exemption and may require the completion of an application for an exemption. The Program Administrator will note on the approved Chesapeake Bay Site Plan those features or activities that are exempt, and will condition any other permit approvals to ensure that all applicable code requirements are met and any other conditions he/she determines necessary to protect water quality.

D. Exceptions

Sec. 14-292 (c) Exceptions

Property owners may find in rare circumstance that a desired use or development of a property that is otherwise in conformance with all other City and State requirements cannot meet all requirements of this program. To accommodate these situations, the City's ordinance allows the property owner to apply for an exception to the program requirements.

Specific conditions must be met in order for exceptions to be granted.

Request for exceptions to the program requirements may be granted by the Program Administrator or in certain situations only by the City Planning Commission, following adequate public notice and a public hearing. Exceptions to the criteria outlined in the Ordinance may be granted by the Administrator or City Planning Commission if the following conditions are met:

Conditions for Exceptions Sec. 14-292(c)(1)

1. The degree of the exception requested is the minimum necessary to afford relief;
2. Granting the exception will not confer upon the applicant any special privileges denied to other property owners subject to the requirements and are similarly situated;
3. The exception is in harmony with the purpose and intent of the Chesapeake Bay Preservation Act, and is not of substantial detriment to water quality;
4. The exception request is not based upon conditions or circumstances that are self-created or self-imposed;
5. Reasonable and appropriate conditions are imposed, as warranted, that will prevent the allowed activity from causing a degradation of water quality;
6. Reasonable and appropriate conditions upon any other findings, as appropriate and required by the City, are met.

Property owners requesting exceptions will need to submit a "Request for Exception" as provided in Appendix B. All applications must be submitted with a WQIA, Chesapeake Bay site plan, landscape mitigation plan and required fee.

Requests for exceptions in CBPA's are submitted to the Program Administrator. Upon reviewing the application package for completeness, the Program Administrator will determine if the exception can be approved administratively, or must be approved by the City Planning Commission.

Exceptions to the general performance criteria in Section 14-263 of the Ordinance may be approved by the Program Administrator. Exceptions to the development criteria for

Resource Protection Areas in Section 14-264 may only be approved by the City Planning Commission.

For exceptions to be considered by the City Planning Commission the following process will apply:

- Submission and review of application
- Scheduling of City Planning Commission meeting date
- Notice by US mail to abutting property owners (including those across the street) no less than 5 days and not more than 21 days prior to the City Planning Commission meeting. The notice will specify the time and place of the hearing.
- The City Planning Commission will conduct a public hearing before voting on the requested exception. The decision of the City Planning Commission is final.
- The Planning Commission can take any of the following actions on the request: approve as submitted, deny, or approve with conditions.
- The City Planning Commission may not send an exception request to a consent agenda.
- If the exception request is approved, Planning Commission must recommend landscape mitigation in accordance with the Riparian Buffers Modification & Mitigation Guidance Manual.
- Upon approval by the City Planning Commission, the Administrator will approve the Chesapeake Bay Site Plan.

E. Permitted Encroachments into the RPA buffer

The Program Administrator can approve development proposals that would result in the encroachment into the RPA buffer area when the application of the buffer area would otherwise render a lot unbuildable. This authority can be applied to lots or parcels recorded prior to October 1, 1989 and also for certain lots recorded between October 1, 1989 and March 1, 2002.

Encroachments into the buffer must also meet the following criteria:

Sec. 14-264(4)

1. The encroachment is the minimum necessary to achieve a reasonable buildable area for a principal structure and necessary utilities.
2. Where practical, a vegetated area that will maximize water quality protection, mitigate the effects of the buffer encroachment, and is equal to the area of encroachment into the buffer area shall be established elsewhere on the lot or parcel.
3. The encroachment does not extend “seaward” into the

buffer area by more than 50 feet.

For lots or parcels recorded between October 1, 1989 and March 1, 2002, the following additional criteria for encroachments must be met:

1. The lot or parcel was created as a result of a legal process conducted in conformity with the City's subdivision ordinance.
2. Conditions or mitigation measures imposed through a previously approved exception.
3. If the use of BMP's was previously required, the BMP shall be evaluated to determine if it continued to function effectively and if necessary the BMP shall be reestablished or repaired and maintained as required.

Property owners meeting the criteria described above may request authorization for the encroachment by completing the application for an "Exception to the Requirements of the Chesapeake Bay Preservation Program" provided in Appendix B. Such encroachments can be approved by the Program Administrator and require neither City Planning Commission approval nor public notice. All applications must be submitted with a WQIA, Chesapeake Bay site plan, and landscape mitigation plan prior to administrative approval.

Revisions to approved plan

Any revisions to an approved plan will require review and approval by the Program Administrator.

Appeals of Decisions of the Program Administrator

Sec. 14-294

Any applicant who is aggrieved by any action of the City in disapproving a request for use or development within a Chesapeake Bay Preservation Area as described on the submitted Chesapeake Bay Site Plan shall have the right to file an appeal of such action with the Director. Such appeal must be filed within 30 days from the date of the action appealed and must be accompanied by a fee of as set forth in Appendix A of the City Code to be paid into the City treasury.

The Director will schedule a hearing on the appeal within 15 days of receipt of the appeal.

Procedures for Review of Chesapeake Bay Site Plans

Sec. 14-293

The Program Administrator shall review the Site Plan and associated materials submitted by the applicant in relation to the performance criteria outlined by this manual and the ordinance and the elements required for a Chesapeake Bay Site Plan as outlined in Appendix A. The Program Administrator will have 45 days from the receipt of the plan and all requested documentation, or revisions thereof, to approve or reject the plan submission. No action by the Program Administrator within 45 days shall constitute approval.

Chapter III - Performance Criteria

Section 14-263 and 14-264 of the City's Ordinance provides a concise list of performance criteria with which all development within the designated preservation areas must comply. Expansion and interpretation of these criteria forms the basis for the following guidelines to be followed when preparing a Chesapeake Bay Site Plan:

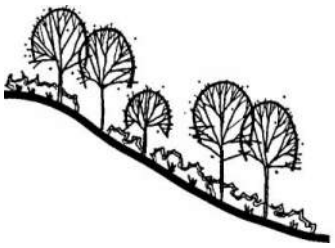
A. Define the limits of land disturbance

Basic site planning considerations to reduce the amount and degree of land disturbance:

No more land shall be disturbed than is necessary for the proposed use
Sec. 14-263(1)

1. Define the buildable area

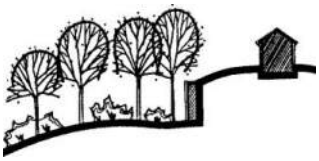
The buildable area is the portion of the parcel which can be devoted to buildings and structures. All area excluding property setbacks, buffers, wetlands, preservation areas, etc. are considered buildable area. The buildable area must be shown on the Chesapeake Bay site plan.



Work with existing topography

2. Work with the existing topography

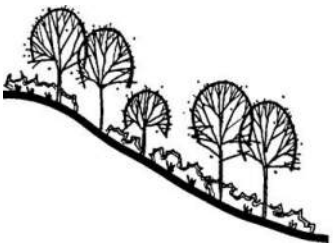
The existing topographic conditions of the site will aid substantially in the placement of uses and features on a site. For example, when laying out a subdivision, new streets should follow the natural contours whenever possible. In other types of development, buildings should be sited to take advantage of the natural topography. Large industrial buildings should be built only where the land is flat enough (3-5% slope) to permit construction with minimal grading. Likewise, large parking lots should be reserved for the flatter areas of a site. In areas where the topography becomes steeper (15% or greater), building sizes should be minimized, tucking smaller structures into the topography and terracing the slope to accommodate separate buildings.



Limit grading operations

3. All efforts should be made to limit grading operations

Retaining walls can be used in order to maintain more closely the conditions of existing grades, thus protecting more vegetation and minimizing disruptive grading activity. Terracing of buildings down steeper slopes will have the same effect. This is achieved by splitting floor levels with access from opposite sides of the building at existing grade, minimizing the amount



Preserve existing vegetation

of grading and land disturbance.

4. **Existing vegetation, especially on steep slopes, should be preserved**
   (See Preservation of existing vegetation, page 20).

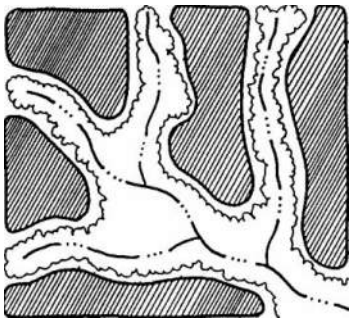
5. **Limits of clearing** should be clearly marked in the field as well as on plans so that equipment operators do not disturb vegetation to be preserved. Clearing limits should remain 10' from the RPA line to create a buffer as a best practice.

6. **Development should take place in staged increments** whenever possible, thereby reducing the period of time that soil is exposed and diminishing the possibility of serious damage by erosion.

7. **Temporary vegetation** shall be applied within 7 days to areas: (a) at final grade, or (b) which will be inactive for longer than 14 days.

Development shall minimize impervious cover consistent with the proposed use or development Sec. 14-263(5)

8. **Define a reasonable building "envelope"** by concentrating the building and its support facilities within as small an area as possible and avoiding any natural or environmentally sensitive areas. The Chesapeake Bay Preservation program requires that impervious cover be minimized, defining impervious cover as *"a surface composed of any material that significantly impedes or prevents the natural infiltration of water into the soil."* This definition includes parking areas, driveways, sidewalks and patios, among other uses. The building envelope, and consequently impervious cover, can be minimized via careful site design and layout. Design techniques which are effective in integrating the natural and the built environment include efficient layout of parking areas, minimizing the size and extent of driveways and designing multi-story buildings or parking decks where appropriate.



Development zones

9. **Development should be concentrated in upland zones,** as a general rule, leaving steeper slopes, lowlands and natural drainage systems undisturbed. Environmentally sensitive areas—wetlands, 100-year floodplains, slopes exceeding fifteen percent (15%), forested areas, wildlife habitats, and natural drainage ways—should be avoided.

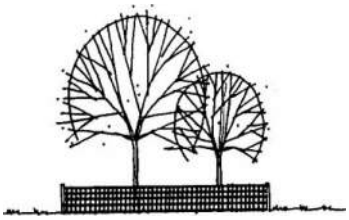
B. Preserve existing vegetation

Indigenous vegetation shall be preserved to the maximum extent practical consistent with the use or development proposed. Indigenous vegetation may be replaced with other vegetation that is equally effective in retarding runoff, preventing erosion and filtering nonpoint source pollution. Sec. 14-263(3)

Existing vegetation is to be preserved and a buffer established wherever possible when it does not exist. The following provisions describe methods to be used when protecting existing vegetation. Should it be necessary to remove vegetation, such vegetation shall be replaced with plant material deemed by the Program Administrator to be equally effective in retarding runoff, preventing erosion and filtering NPS pollution.

1. Define existing vegetation, especially tree groupings or individual trees for preservation in the field and on the site plan.

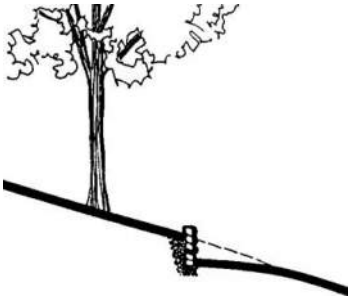
All trees to be retained within the limits of disturbance shall be field marked, root pruned and protected by physical devices installed prior to clearing or grading to ensure protection. Protection measures shall remain in place until construction is complete. Considerations for preservation:



Tree protection

- All tree elements include tops, trunks and roots.
- Devices such as fencing shall be installed along the limits of clearing before clearing, construction work or movement of machinery occurs within 50 feet of the protected areas.
- Heavy equipment, vehicular traffic, stockpiling of materials, or deposition of sediment will not be permitted within the drip line of trees to be retained.
- Trees to be removed shall not be felled, pushed or pulled onto trees being retained.
- No toxic materials--such as paint, acid, nails, gypsum board, wire, chemicals, fuels and lubricants--shall be stored or disposed of within 100 feet of the protected vegetation areas.
- Controlled fires shall not be permitted within 100 feet of the protected areas.

2. Protection measures to employ when lowering the grade:



Lowering the grade

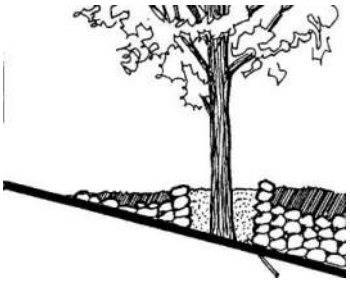
- Grade cuts of 3-inches or more within the drip line of the retained vegetation which, in the determination of the Program Administrator, are harmful to trees shall be reduced or

eliminated by construction of a tree wall within two (2) weeks of the grading work.

- Tree roots exposed and/or damaged when excavating shall be trimmed cleanly and covered temporarily with moist peat moss, burlap, or other material to keep them from drying out.
- Backfill shall consist of topsoil to retain moisture and aid root development; fertilizer should be mixed with soil.
- Retaining walls shall be constructed in accordance with the Virginia Uniform Statewide Building Code, including drain holes as appropriate.

3. Protection measures to employ when raising the grade:

- Fill of three inches or more within the drip line of a retained tree may necessitate a tree well.
- The tree well shall be constructed to allow for tree trunk diameter growth, allowing adequate growth clearance for a younger tree.
- The well shall be constructed of large stones, brick, building tile, concrete blocks or cinder blocks and should be built high enough to extend above the level of the proposed fill.
- One or more drain lines shall begin at the lowest point inside the well and extend down and outward from the tree trunk.
- A layer of stone shall be placed under the tree from the well to at least the drip line; this layer will vary in depth according to the depth of the fill.
- To prevent accumulation of leaves and debris, the area between the trunk and the well wall may either be covered by an iron grate or filled with crushed charcoal and sand.



Raising the grade

C. Reduce impervious cover

Sec. 14-263(5)

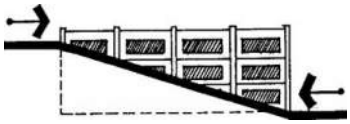
"Impervious cover" is defined as *"a surface composed of any material that significantly impedes or prevents natural infiltration of water into the soil. Impervious surfaces include, but are not limited to roofs, buildings, streets,*

parking areas, and any concrete, asphalt or compacted gravel surface." (Sec. 14-181).

Zoning requirements specify by district certain lot coverage standards, as well as open space ratios, floor-area ratios, building setbacks, height restrictions and off-street parking requirements which, together will dictate a maximum building envelope. Many different options for the arrangement of buildings and supporting space (i.e. parking, open space) may exist depending on the size and configuration of the site and proposed use(s). The mapping of natural features and limits of disturbance developed through the Chesapeake Bay site planning process should work in tandem with the identification of the maximum building envelope for a particular site to ultimately limit the impervious surface.

Specific site planning guidelines to consider which will aid in the reduction of impervious surface on the site include the following:

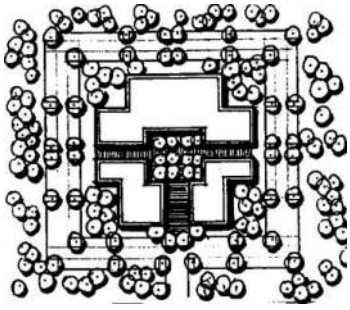
1. **Recognition of open space in site plan**
   Through an efficient site layout, efforts should be made to achieve the correct allowable proportion of building square footage while satisfying the parking requirements and retaining a reasonable proportion of the site in open space; this proportion will vary from a high of 75 percent in the less dense residential subdivisions to almost 0 in the highly developed city center. Bonus provisions in the Zoning Ordinance allow for additional floor area in a building if lot coverage is reduced in the B-4 District.



Parking Structure

2. **Parking structure options**
   Structured parking to replace surface lots should be considered. Additionally, the Zoning Ordinance provides for bonuses allowing for additional floor area in the B-4 District when enclosed parking is provided within a main building.

3. **Arrangement of buildings**
   Buildings should be clustered in groups instead of being spread over the entire site; such clustering can reduce the amount of grading, impervious surface, and allow for efficient treatment of parking.



Layout plan

4. **Parking lot layout**
   Parking lots should always be arranged with double-loaded aisles if possible. The most efficient layout of

parking is with stalls at 90 degrees to the collector aisles. Pavement techniques which promote infiltration are encouraged for any parking areas or other low traffic driveways. This could be porous paving materials, paving stones or other techniques. Any such application must be approved by the Program Administrator.

D. Comply with erosion and sediment control regulations

"Any land disturbing activity that exceeds an area of 2,500 square feet … shall comply with the requirements of the City's erosion and sediment control ordinance" Sec. 14-263(6)

An erosion and sediment control plan is a document which describes the potential for erosion and sediment problems on a site during construction and explains and illustrates the measures which are to be taken to control the problems. Important considerations when developing such an element of the site plan include:

1. **The potential for soil erosion** should be an ongoing consideration when deciding upon the layout of buildings, parking lots, roads and other facilities.

2. **The size of the site, topography, and soil type** will largely dictate the complexity of the plan; plans will be more involved for large sites having steeper slopes and highly erodible soils.

3. **"Rules of thumb" in selecting vegetation** to aid in reducing soil erosion (See the publication *Riparian Buffers Modification and Mitigation Guidance Manual* published by the Department of Conservation and Recreation, Division of Chesapeake Bay Local Assistance for planting guidance. A suggested Plant List, from that document is reprinted in Appendix C:

   - Appropriateness for the time of year, soil conditions of the site and environmental conditions of the area
   - Resistance to heat, cold, insects and diseases
   - Potential for rapid growth
   - Capacity for compact growth
   - Potential for nitrogen fixation
   - Maintenance requirements
   - Drought resistance
   - Indigenous vegetation

4. **Use of mulch**
(i.e. straw, wood chips, asphalt emulsions, jute netting) is one of the most effective temporary erosion control measures because it holds seed and fertilizer in place, retains soil moisture and helps to maintain temperatures conducive to germination.

5. **Surface roughening of a graded slope**
by the vertical movement of a cleated bulldozer creates horizontal grooves that spread the runoff and slows its movement, thereby aiding in erosion control.

6. **Existing BMP facilities on site should be protected**
from the addition of sediment from construction activity. Filters placed around inlet drains or constructed as berms on slopes will protect the drains from infiltration by coarser sediment.

7. **Establishment and maintenance of vegetation**
along stream banks should be a first consideration to control erosion. Existing stream channel erosion will occur when increased demands are placed by increased urban runoff. When upstream runoff cannot be held to pre-development levels, a protective layer of rip-rap along the banks may prove effective. If the slopes are too steep or the stream is swift moving, more rigid structures made of concrete or metal may be necessary.

E. Comply with stormwater quality and quantity requirements ***Sec. 14-263(7)***

For both new developments with low imperviousness and redevelopment sites not served by existing BMPs, construction of a BMP will most likely be needed to accomplish the reduction in NPS pollutants. For the calculations of required pollutant removal and design of BMPs, refer to the current version of the *Virginia Stormwater Management Handbook* available through the Department of Environmental Quality and the Virginia Stormwater BMP Clearinghouse website (http://www.vwrrc.vt.edu/swc/StandardsSpecs.html).

The standard calculation spreadsheets for calculating the required water quality removals can be found at the Virginia Stormwater BMP Clearinghouse-Virginia Runoff Reduction Method (VRRM) website: http://www.vwrrc.vt.edu/swc/Virginia%20Runoff%20R

eduction%20Method.html

These calculations should be used when determining the required pollutant removal for a particular project. The website includes guidance on the VRRM equations and spreadsheet usage.

A few of the basic guidelines from these documents are as follows:

1. **Provide channel and flood protection**
   Potential downstream impacts of proposed development should be recognized and planned for. As part of the Richmond Stormwater Management Permit process (Sec 14-324), the City requires that sufficient engineering calculations be performed to address channel and flood protection for all storm water conveyance systems as specified within the City's Ordinance.

2. **Provide moderate pollutant removal capability**
   By increasing the volume of runoff that has been effectively treated or by adding design features, removal rates may be enhanced. For purposes of the Act and the City's Ordinance, phosphorous is the "keystone" pollutant which is to be measured for reduction through the calculation procedures. A keystone pollutant shares the general characteristics of most other pollutants. By removing or reducing the keystone pollutant, other important pollutants which have a negative effect on the Bay will also be removed.

Keystone pollutant - phosphorous

3. **BMP selection**
   Per the *Virginia Stormwater Management Handbook (VSMH)*, there are several factors to consider when selecting a BMP. These factors include land use, physical feasibility, climate conditions, critical watershed resources, design requirement capability, pollutant removal capability, community and environmental factors, regulatory restrictions and setbacks, and spatial factors. Refer to the *VSMH* for a thorough discussion of BMP selection and several matrix tables to assist in selecting the best BMP for a particular site.

   The Virginia Stormwater BMP Clearinghouse Design Standards and Specifications also includes a thorough discussion of the siting and design considerations for each BMP. The Virginia Stormwater BMP Clearinghouse Standards and Specifications are available at:

http://www.vwrrc.vt.edu/swc/StandardsSpecs.html

4. **Cost effectiveness**
   Due to the wide range of costs for constructing BMPs, costs should be a consideration along with other site development costs; the designer should perform cost analyses to determine ultimate expense to be passed on to the end users of the development.

5. **Long-term maintenance of permanent BMPs**
   The Ordinance requires a Stormwater Utility Maintenance Agreement (SUMA) for all stormwater management facilities, including BMPs and other techniques specified to manage quality and quantity runoff for their full lifespan. The execution of a maintenance agreement (see Appendix B) is between the owner and the City to ensure continued viability of the BMP constructed. Such agreement provides for a vesting of responsibility for ongoing maintenance: how and when specified maintenance will be performed, who will pay for the routine and non-routine tasks, and who will inspect and how regularly inspections will be made. Maintenance requirements and related costs can largely be pre-determined at the design stage; this should be built into the design process.

6. **Develop BMPs which have a neutral impact on the site and its surroundings**
   Consideration should be given to the aesthetic impact of a BMP on the environment (see related discussion on pages 19-22). If an existing BMP is utilized to reduce the transport of pollutants from the site, the following information shall be provided:

   - An "as-built" design of the existing BMP;
   - Calculations showing that the existing BMP will accommodate the increased NPS load and/or proposed BMP design improvements required to provide adequate pollutant removal;
   - A maintenance inspection report; inspection to be made during wet weather;
   - A maintenance agreement.

   A variety of urban BMPs have been developed and refined over the years to mitigate the adverse impacts associated with development. Five types of structural BMPs commonly used are:

(1) extended dry ponds,
(2) wet ponds,
(3) infiltration trenches and basins, and
(4) grassed swales with check dams.
(5) manufactured structures.

Design guidelines for sizing and constructing these structures are outlined in the Virginia Stormwater BMP Clearinghouse. If BMPs not listed in Virginia BMP Clearinghouse are used, the applicant agrees to not seek credits toward their stormwater utility fees and maintain their BMP in perpetuity.

Appendix A:

Department of Public Utilities
730 East Broad Street-8th
Richmond, Virginia 23219
804 646-6440/ (fax) 804 646-2870

CHECKLIST FOR CHESAPEAKE BAY

Chesapeake Bay Site Plan - Requirements and Submission Checklist

Address of Project:_____

Application/Permit Number:_____

IMPORTANT: This checklist is to be completed by the plan preparer and submitted with the permit application package; in time, submittals will be rejected without it. All items must be fully addressed and indicated so by checking the box for that item or entering a comment as to why it has not been addressed (upon review, the plan reviewer may still require the item to be addressed). The comments "N/A" or "not applicable" are not acceptable responses.

Note that plan sheets may be combined as long as all required information is legible.

A. Submission

□ Provide 4 copies of all plan sheets

□ All plan sheets must be certified by the appropriate professional

B. Basic information required to appear on each sheet:

□ Name of project, developer, preparer of plan (Name, address, phone, fax, and email.)

□ Engineer/Architect's stamp (seal).

□ North arrow

□ Scale (suitable scale for base/plan information)

□ Plan date/revision dates

□ Property lines with dimensions and bearings taken from deed or survey

□ Limits of Chesapeake Bay Preservation Areas

□ Area of site

□ Vicinity map (to show location of site in relation to nearby landmarks)

C. Existing physical site characteristics *(sheet #1)*

- Existing topography, depending on the scale of the base sheet, contour intervals should be no greater than 5-feet; intervals of 2-feet or 1-foot are desirable.
- Location of Mean High Water Line (MHWL) of the shores on which the site is located as determined by the best available information acceptable to the Program Administrator. If such line is not within the confines of the property, a locator map at a scale of 1"=200' shall be required to show its proximity to the site.
- Limits of 100-year floodplain, taken from the latest edition of the Flood Insurance Rate Maps of the City (available from the Division of Permits and Engineering Services) or other available sources and site specific studies.
- Location and boundaries of tidal and non-tidal wetlands, as delineated on the National Wetland Inventory (NWI) Maps prepared by the U.S. Department of the Interior (available from the Program Administrator). In cases of either direct or indirect impact on NWI identified wetlands, the Program Administrator may require a delineation of wetlands to be performed by a technical professional acceptable to the Administrator in the field by type, following the classification system found in the *Classification of Wetlands and Deep Water Habitats of the United States*, U.S. Department of the Interior, Fish and Wildlife Service.
- Limits of the boundary line for the established buffers for the RPA and/or RMA.
- Location of all significant plant material, including all trees on site six inches or greater in diameter at breast height; groupings of trees or significant vegetation may be outlined.
- Physical features, including streets, alleys (including all improved and unimproved rights-of-way), parking areas and existing site improvements to remain, such as structures and their use, parking areas, driveways and all areas of impervious cover.
- Existing utilities, including storm sewer, curb and gutter, sewer (including existing septic drainfields), water, electrical, gas, and easements or other improved or unimproved rights-of-way for utilities.
- Land uses immediately adjacent to the site.

D. Proposed improvements *(sheet #2)*

- Areas of proposed impervious surface, including:
- Streets, alleys, easements or other rights-of-way, including proposed improvements to existing rights-of-way
- New sidewalks, curbs and gutters, driveways and access, loading and other paved areas, including location and materials to be used.
- Proposed structures, including building footprint, dimensions, and use.
- The location of any sewage disposal system or reserve drainfields.

E. Preliminary grading plan and/or cross-section drawings (if necessary to evaluate site drainage and conservation of natural features).

F. Limits of the proposed area of disturbance based on all anticipated improvements, including buildings, driveways, parking spaces, utilities, etc.

G. Proposed location and basic layout of planned structural Best Management Practice (BMP) facilities.

H. Additional supporting information including calculations shown in a table format on plan sheet #2

- Total gross square footage area
- Total land area covered by buildings
- Amount of open space on site
- Amount of paved or graveled area (impervious surface) on the site (acreage and percent of site coverage)
- Number of parking spaces
- Number of residential units of each type
- Pre and Post-development runoff rate from 2 and 10 design year storms
- Pollutant load calculations (Refer to the Virginia BMP Clearinghouse - Virginia Runoff Reduction Method (VRRM) website for VRRM Compliance spreadsheets and VRRM Guidance Document - http://www.vwrrc.vt.edu/swc/Virginia%20Runoff%20Reduction%20Method.html)
- BMP design calculations (See VA Stormwater Management Handbook)

I. Erosion and Sediment Control Plan *(sheet #3)*

Requirements in accordance with Chapters 3, through 6 of the *Virginia Erosion and Sediment Control Handbook*:

- Erosion and Sediment Control Checklist with required E & S plans as per the Virginia Erosion & Sediment Control Handbook, 1992 Third Ed.
- Detailed narrative and notes on all E & S measures used including but not limited to any stream crossings or wetland disturbance.
- Assessment of existing shoreline conditions and a determination of required erosion control measures.
- Directional arrows of drainage flow to the planned sediment control measures (if applicable).
- Existing and proposed grades.
- Existing natural and/or developed features on site or directly adjacent to the site.
- Pre- and post-development drainage (including off-site) for all permanent and temporary sediment control measures for the 10-year storm.
- 100-year floodplain under proposed channel conditions.
- Means proposed to preserve any existing vegetation during construction and retention as part of completed project in accordance with guidelines established in the following section (see Performance Criteria, page 19).
- Phasing and sequencing of development, and provisions for handling surface water throughout the stages of development.

J. Landscape Plan *(sheet #4)*

- Major landscaping features, including existing vegetation, to be retained.
- Clear delineation of all trees proposed for removal.
- Description of plant species to be disturbed or removed.
- Treatment of the RPA buffer, indicating proposed landscaping and vegetation to be retained by type and quantity.
- Replanting schedule for trees and other significant vegetation removed for construction, including list of trees and plants to be used.
- Demonstration that the design will preserve to the greatest extent possible any significant trees and vegetation on site and provide maximum erosion control and overland flow benefits.
- Demonstration that indigenous plants (See Plant List, Appendix C) are to be used to the greatest extent possible.

K. Narrative

- Accompanying sheets 1 through 4 shall be a narrative that describes the following:
- A description of the impact the development will have on existing vegetation
- A description, including location and design, of all measures to be taken to meet the performance criteria outlined in the ordinance

L. Water Quality Impact Assessment (WQIA) (sheet #5)

- Required for all development proposed in an RPA or any other area warranted as determined by the Program Administrator. The WQIA consists of the following elements in addition to information contained on previous sheets:

- **Hydrological element**
- Describe existing topography, soils, hydrology and geology of the site and immediately adjacent lands.
- Describe impacts of the proposed development on topography, soils, hydrology and geology on site and adjacent lands.

In addition to the information shown on the CBSP, the WQIA plan sheet must show:

1. Disturbance/destruction of wetlands and justification for such action;
2. Disruption/reduction in supply of water to wetlands, streams, lakes, rivers or other water bodies;
3. Disruption to existing hydrology, including wetland and stream circulation patterns;
4. Source, location and description of proposed fill material;
5. Location of dredge material and location of dumping area for such material;
6. Location of, and impacts on, shellfish beds, submerged aquatic vegetation, and fish spawning areas;

- Provide evidence of required permits in addition to wetlands permits from all applicable agencies necessary to develop the project.
- Describe proposed mitigation measures for the potential hydrological impacts. Potential mitigation measures include:
  1. Proposed erosion and sediment control concepts which may include minimizing the extent of the cleared area, perimeter controls, reduction of runoff velocities, measures to stabilize disturbed areas, schedule and personnel for site inspection;
  2. Proposed stormwater management system;
  3. Creation of wetlands to replace those lost;
  4. Minimizing cut and fill.

□ **Landscape Element**

□ The standard requirements of the Landscape Plan (sheet #4), satisfy this section. At the discretion of the Program Administrator, the applicant may be required to provide additional information, particularly in support of significant mitigation requirements for a project that disturbs more than 50,000 square feet of area.

□ **Wastewater Element**

□ Include calculations and locations of anticipated changes which affect existing septic drainfield or wastewater irrigation areas;

□ Provide justification for sewer line locations in environmentally sensitive areas and describe construction techniques and standards;

□ Discuss any proposed on-site collection and treatment systems, their treatment levels and impacts on receiving water courses.

□ Describe the potential impacts of any proposed wastewater systems, including the proposed mitigative measures for these impacts.

M. Additional documentation that must be provided

□ A copy of any stream perennial flow determination

□ A copy of any US Army Corps of Engineer wetland delineation approval

□ A copy of all required Federal permits

□ A copy of all State permits

Signature of preparer:_____
Date of signature:_____
Preparer's professional seal:

Appendix B: Forms and Instructions

BMP Stormwater Utility Maintenance Agreement (SUMA)

SUMA Plat – Sample Attachment A

Application Instructions for Exceptions, Waivers, Exemptions, and Buffer Encroachments

Application for Relief from Requirements of the Chesapeake Bay Preservation Program Exceptions, Waivers, Exemptions, and Buffer Encroachments

AFTER
RECORDING RETURN TO:
City of Richmond, Department of Public Utilities
Water Resources Division
730 E. Broad Street, 8th Floor
Richmond, Virginia 23219

CITY OF RICHMOND, VIRGINIA
TAX MAP NO: _____

STORMWATER UTILITY MAINTENANCE AGREEMENT

THIS STORMWATER UTILITY MAINTENANCE AGREEMENT (this "Agreement") is made this _____ day of _____, 20___ by and between _____, (the "Owner") and the CITY OF RICHMOND, a municipal corporation organized under the laws of the Commonwealth of Virginia (the "City").

RECITALS

WHEREAS, the Owner holds fee simple title to certain real property situated in the City of Richmond, Virginia, designated as Tax Parcel No. _____ and being a portion of the same real estate conveyed to the Owner by deed recorded in the Clerk's office of the Circuit Court of the City of Richmond, Virginia, as Instrument No. _____, or in Deed Book ____ at page ____ (the "Property"); and

WHEREAS, the Owner has submitted to the City, and the City has approved, a plat showing the location of, and the City's route of access to, one or more stormwater management facilities and associated appurtenances (the "Facilities") on the Property intended to manage the quality and quantity of stormwater runoff from the Property, which plat is entitled _____, prepared by _____, dated _____ and marked as "Attachment A," attached hereto and incorporated herein; and

WHEREAS, the Facilities are described as follows:
_____
_____; and

WHEREAS, pursuant to Sections 14-331 and 14-332 of the 2015 Richmond City Code (the "Code"), the Owner must sign and record in the local land records an instrument to run with the land that, i) obligates the Owner and any future owner of the Facilities to inspect and maintain the Facilities for their full lifespan, and ii) provides the City with a route of access to the Facilities through the Property for purposes of inspection and, when the City deems it necessary and convenient, maintenance of the Facilities; and

WHEREAS, the City and the Owner intend for this Agreement to serve as the instrument described in the previous paragraph.

AGREEMENT

NOW, THEREFORE, in accordance with the rights and obligations described in the Richmond Stormwater Management Program, set forth in Chapter 14, Article V of the Code, the parties agree as follows:

1. **Recitals.** The foregoing Recitals are true and correct and are incorporated herein by reference.

2. **Inspection and Maintenance of Facilities by the Owner**. The Owner agrees to regularly maintain and inspect the Facilities to ensure the Facilities function at design capacity ("Good Working Order") throughout their expected lifespan, as determined by the City's Department of Public Utilities (the "Department"). The Owner shall inspect the Facilities at least once every three (3) years, and the Owner's maintenance of the Facilities must, at minimum, be in accordance with guidance provided in the latest edition of the "Virginia Stormwater Management Handbook" and at the Virginia Stormwater BMP Clearinghouse website.

3. **Submission of Inspection and Maintenance Reports.** The Owner agrees to submit an inspection and maintenance report to the Department, on a form to be provided by the City, within thirty (30) days following any inspection or maintenance of the Facilities by the Owner.

4. **Inspection and Maintenance of Facilities by the City.** Pursuant to Section 14-332 of the Code, the City has the right to access the Property from time to time to inspect the Facilities to ensure they are in Good Working Order. In the event the Facilities are not in Good Working Order, the City will provide the Owner with written notice of corrective action needed to restore Good Working Order ("Corrective Action Notice"). Upon failure by the Owner to take such corrective action within thirty (30) days following receipt of a Corrective Action Notice, the City may take whatever steps it deems necessary to restore the Facilities to Good Working Order. The Owner expressly understands and agrees the City is under no obligation to maintain or repair the Facilities, and in no event will this Agreement be construed to impose any such obligation on the City.

5. **Response to Facilities Emergency.** In the event of an emergency involving the Facilities, as determined by the Department in its sole discretion, the City will have the right, but not an obligation, to take whatever steps it deems necessary to abate the emergency condition. Before, or in place of, exercising such right, the City may to instruct the Owner by telephone or email to abate the emergency condition within a specified period of time.

6. **Reimbursement of the City's Expenditures; No Cost to the City.** In the event the City performs work or expends any funds to maintain or repair the Facilities or to respond to an emergency related thereto, including, but not limited to, performance of labor and purchase of equipment, supplies and materials, the Owner agrees to reimburse the City in full within sixty (60) days after the City provides written notice to the Owner of all compensation due. In no event will the City pay any compensation to the Owner relating to the City's exercise of its rights set forth in this Agreement.

7. **Indemnification.**

a. The Owner hereby agrees to indemnify, defend and hold the City harmless from and against any and all actual, threatened, or alleged claims, liabilities, penalties, fines, costs, losses, damages, causes of action, judgments, and administrative actions, including without limitation attorney's fees and court costs, resulting either directly or indirectly from the acts or omissions of the City and its officers, employees, agents and contractors in the performance of activities on the Property permitted by this Agreement.

b. The City, in its performance of activities on the Property permitted by this Agreement, shall not be liable for any personal injury or property damage to the Owner, its employees, contractors, agents, invitees or licensees, irrespective of how such injury or damage may be caused.

c. No causes of action of, or defenses of, or claims of the Owner against the City shall derogate from or in any way invalidate, offset, or prevent the enforcement of the indemnification owed by the Owner to the City under this section 7, and such enforcement may proceed whether or not caused or contributed to by any negligence or act or omission of the City and notwithstanding any fault or uncured default of the City under this Agreement.

d. None of the provisions within the paragraphs of this section 7 may be construed as a waiver of the sovereign immunity granted to the City by the Commonwealth of Virginia Constitution, statutes and case law to the extent that it applies.

e. Every provision within the paragraphs of this section 7 shall survive the expiration or termination of this Agreement.

8. **Notices.** Notices under this Agreement shall be in a signed writing and shall be considered given when mailed by certified mail return receipt requested or hand delivered to the other party at the following addresses stated in this Section 8.

Any signed written notice to the Owner shall be sent to:

_____

_____

_____

_____

_____

Any signed written notice to the City shall be sent to:

City of Richmond, Department of Public Utilities
Water Resources Division
730 East Broad Street, 8th Floor
Richmond, Virginia 23219

with a copy of the signed written notice sent to:

City of Richmond, Office of the City Attorney
900 East Broad Street, 4th Floor
Richmond, Virginia 23219

Either party may change any of its contact and address information given above by giving notice in writing stating its new address to the other party.

9. **Waiver.** The failure of the City to insist upon the strict performance of any provision of this Agreement shall not be deemed to be a waiver of the right to insist upon strict performance of such provision or of any other provision of this Agreement at any time. Waiver of any breach of this agreement shall not constitute waiver of a subsequent breach.

10. **Enforcement.** Pursuant to Section 14-331(a)(5) of the Code, this Agreement shall be enforceable by all appropriate governmental parties.

11. **Agreement to Run with Land.** This Agreement shall run with the land and be binding upon the Owner's heirs, successors and assigns in title.

12. **Authorization.** The individual executing this Agreement on behalf of the Owner represents that he or she is duly authorized to bind the Owner to the terms and provisions of this Agreement.

SIGNATURE ON FOLLOWING PAGE

IN WITNESS WHEREOF, the Owner has hereunto affixed their signature as of the day and year first hereinabove written.

Owner

BY:_____

NAME:_____

TITLE:_____

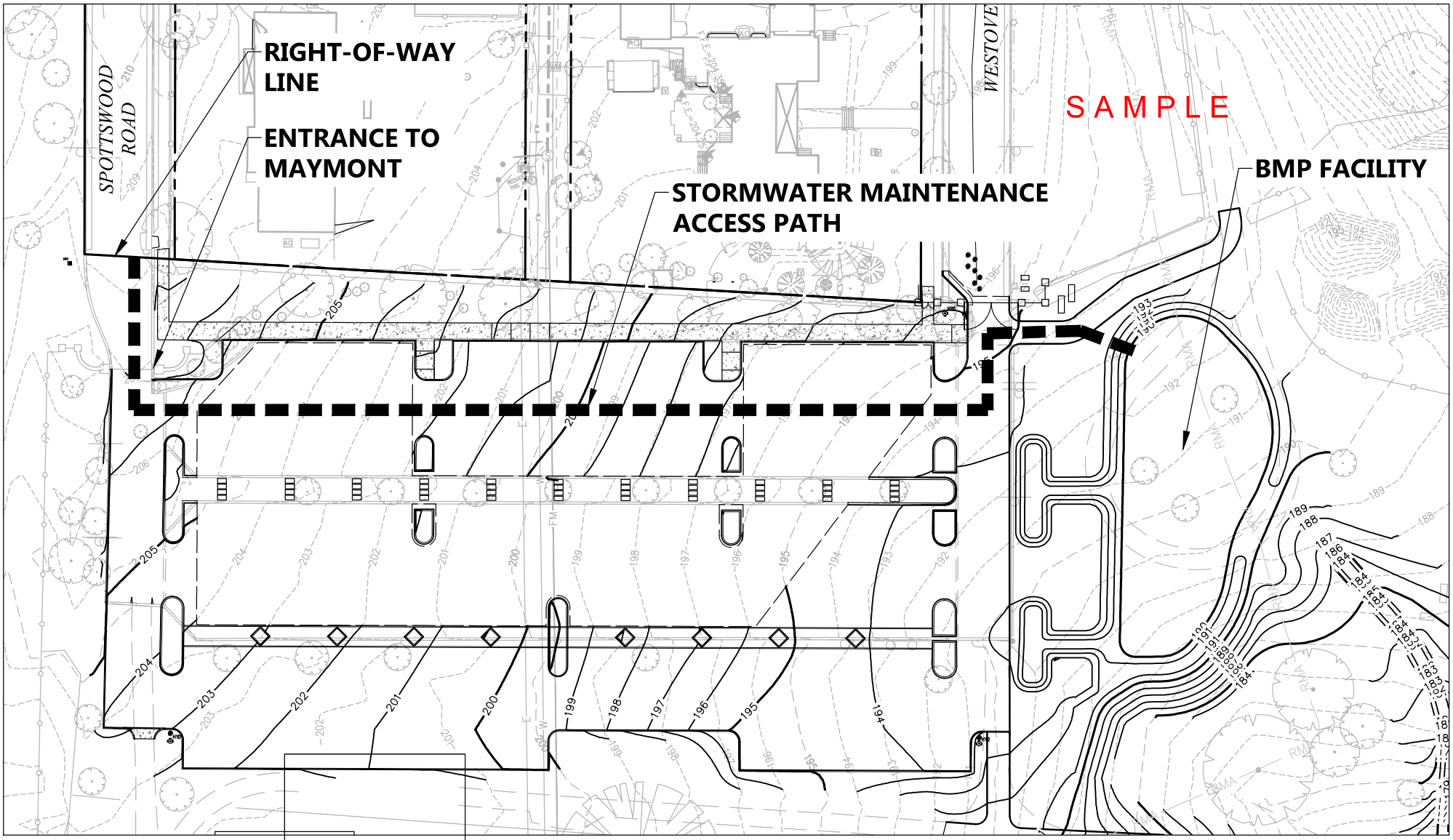
COMMONWEALTH OF VIRGINIA
CITY/COUNTY OF _____, to-wit:

I, _____, Notary Public in and for the City/County and State aforesaid, do hereby certify that _____, whose name is signed to the foregoing agreement, bearing date_____ day of _____, 20___, personally appeared before me in my City/County and State aforesaid and acknowledged the same to be their act and deed.

Given under my hand this _____day of _____, 20____.

_____
Notary Public

Notary Registration Number:
My commission expires: _____



Stormwater Management Access Exhibit

Attachment A

CHESAPEAKE BAY PRESERVATION PROGRAM

Application Instructions

EXCEPTIONS, WAIVERS, EXEMPTIONS AND BUFFER ENCROACHMENTS

PURPOSE

The Chesapeake Bay Preservation Program as defined in city code Chapter 14, Article IV, implements the requirements of the Virginia Chesapeake Bay Preservation Act and the Chesapeake Bay Preservation Area Designation and Management Regulations. As an element of the program, there are four opportunities for property owners to seek partial relief from specific requirements of the requirements. Some of this relief can be provided administratively by the City's Program Administrator; other relief can only be granted by the City Planning Commission, following public notice and a pubic hearing. Property owners requesting relief from requirements of the program must complete the application form for "Relief from Requirements of the Chesapeake Bay Preservation Program." In consultation with the program Administrator, the most appropriate avenue of relief can be determined.

EXCEPTIONS TO THE PROGRAM REQUIREMENTS

When the application of the Chesapeake Bay Preservation Area Ordinance to a lot or parcel located within a Chesapeake Bay Preservation Area would unreasonably restrict the utilization of the property under its current zoning, a CBPA **Exception** can be requested. Submission of the Exception Application is required for approval of any activity or use in the Resource Protection Area not specifically permitted by ordinance. Activities include grading, filling, building, paving, removal of vegetation, and any other disturbances.

Exceptions to the program requirements can only be granted by the City Planning Commission. There are no specific deadlines for the filing of an application for an exception. In general, however, the staff review and public notice period mandated by the City Code combine to result in an approval process of approximately 30 to 60 days. The City Planning Commission considers approval of Chesapeake Bay Program Exceptions at its regular meetings on the first and third Monday of each month. Incomplete submissions or major changes to the plans during the review process may cause delays in this schedule.

WAIVERS FOR NONCONFORMING USES

Under specific circumstances, for structures that existed prior to November 11, 1991, the City's Chesapeake Bay Program Administrator may waive the requirements of the ordinance. There is no fee to request a waiver, nor are there specific deadlines for the application or review process.

EXEMPTIONS TO PROGRAM REQUIREMENTS

Specific uses and development processes are identified in the Ordinance as exempt from the requirements of the program. Property owners should complete the "Relief from Requirements of the Chesapeake Bay Preservation Program" form in order to provide documentation of the necessity of the uses in the locations identified on the submitted plans. Exemptions are granted by the Program Administrator and do not require additional approval or review.

ENROACHMENTS

Encroachments into the Resource Protection Area buffer may be approved by the Program Administrator, for lots recorded prior to the effective date of the program, provided they meet the conditions described in Section 14-264(4) of the Richmond City Code

FILING

Applications for all forms of relief are filed with the:

Department of Public Utilities
Water Resources Division
730 East Broad Street, 8th Floor
Richmond, Virginia 23219
Phone: (804) 646-7586 Fax: (804) 646-2870
Attn: Chesapeake Bay Program Administrator

Requests for Exceptions will be forwarded to the Secretary to the City Planning Commission to schedule a hearing and provide public notice.

DEADLINES

There are no specific deadlines for the filing of an application. Applications for **Exceptions** must be approved by the City Planning Commission, which requires public notice, generally resulting in an approval process of approximately 30 to 60 days. All other requested forms of relief are generally responded to within 15 days upon receipt of a completed application.

PRE-APPLICATION CONFERENCE

Applicants **must** schedule a pre-application conference with the Program Administrator or his/her designee prior to submittal to review the request and other permitting issues that may be involved. **Staff may reject any request without a pre-application conference.** Staff will review submitted applications to ensure all required materials and information are provided. If the application is not acceptable, the required information must be provided prior to formal staff review.

SUBMITTAL REQUIREMENTS

Applications must include the following elements: **1**) completed request form; **2**) Chesapeake Bay Site Plan; **3**) Chesapeake Bay Water Quality Impact assessment.

Applications for **Exceptions** will be forwarded to the City Planning Commission for their consideration and available for public review.

1) **Application Form:**
   The application form for relief from the Requirements of the Chesapeake Bay Preservation Program is available in the Bureau of Permits and Inspections and from the City's web site at www.richmondgov.com. It must be signed by all the owners of the property. If a legal representative signs for a property owner, a copy of the executed power of attorney is required.

2) **Chesapeake Bay Site Plan**
   Applicants should submit four (4) copies of a Chesapeake Bay Site Plan with all required elements as described in the *City of Richmond Chesapeake Bay Preservation Program Public Information Manual* and any additional information required by the Program Administrator. Depending on the type of relief requested, additional documentation as described in the Public Information Manual may also be required.

3) **Chesapeake Bay Water Quality Impact Assessment**
   As part of the Chesapeake Bay Site Plan, the submission of a Water Quality Impact Assessment is required. The submission requirements are described in the *City of Richmond Chesapeake Bay Preservation Program Public Information Manual* which may be supplemented by any other information determined necessary by the Program Administrator for evaluation of the Application.

CITY PLANNING COMMISSION APPROVAL PROCESS for requests for exceptions

Exceptions to the Chesapeake Bay Program requirements can only be approved by the City Planning Commission. Scheduling of the hearing by the Planning Commission will be undertaken by the Planning Commission Secretary. Prior to consideration by the Planning Commission, notice of the hearing is posted on the property and is advertised in a daily newspaper, and mailed to nearby property owners. The Planning Commission will receive a report from the staff and conduct a public- hearing prior to considering and voting on the request. The decision of the City Planning Commission is final.

APPLICATION
FOR RELIEF FROM REQUIREMENTS OF THE CHESPEAKE BAY PRESERVATION PROGRAM
EXCEPTIONS, WAIVERS, EXEMPTIONS AND BUFFER ENCROACHMENTS

To:

Department of Public Utilities
Water Resources Division
730 East Broad Street, 8th Floor
Richmond, Virginia 23219
Phone (804) 646-7586 Fax (804) 646-2870

Date:_____

Type of Relief Requested (check one)

☐ Exception ☐ Waiver ☐ Encroachment ☐ Exemption

Please attach required documents.

Property Address(es):_____

Tax Parcel No(s):_____

Brief Description of Exception: _____

_____

_____

Applicant/Contact Person:_____

Mailing Address:_____

_____Telephone: (_____)_____Fax: (_____)_____

Email address: _____

Property Owner:_____

Mailing Address:_____

_____Telephone: (_____)_____Fax: (_____)_____

Property Owner's Signature:_____

The signatures of all owners of the property are required. Please attach additional sheets as required. If a legal representative signs for a property owner, please attach an executed power of attorney.

Project Information (check appropriate boxes)

Current Use of Property (check one)–

- ☐ Vacant Land to be developed
- ☐ Single Family Residential
- ☐ Other: _____
- ☐ Commercial/Office/Industrial
- ☐ Parking or other paved surface
- ☐ Multi-family residential

Subdivision Name, Lot and Section Number: _____

Lot was last recorded:

- ☐ Prior to October 1989
- ☐ Between October 1989 and February 2002
- ☐ After February 2002

Area of Property (square footage)

Within RPA: _____ Outside RPA: _____ Total: _____

Activity requiring relief is located in (check all that apply)

- ☐ Resource Protection Area Buffer land ward 50 feet
- ☐ Resource Protection Area Buffer seaward 50 feet
- ☐ Slopes greater than ___ percent
- ☐ Wetlands
- ☐ Resource Management Area

Activity requiring relief involves (check all that apply)

- ☐ Construction of New principal structure
- ☐ Accessory (detached) structure
- ☐ Addition to principal structure
- ☐ Parking area, or driveway, or roadway
- ☐ Paved pathways
- ☐ Tree/vegetation removal
- ☐ Utilities
- ☐ Other: _____

Total square footage of RPA impacted: _____

Are there any additional approvals or permits from local, state, or federal agencies required for any portion of this project (zoning variances, wetland permits, etc)?

- ☐ No
- ☐ Yes, Please describe: _____

Description of the Activity and reason for the request:

For **Exceptions**, Please complete the following

APPLICANT'S JUSTIFICATION FOR THE REQUESTED EXCEPTION

In accordance with Section 14-292(c) (1) of the Richmond City code, an exception cannot be granted unless specific findings are made. Please describe how the particular CBPA exception request would meet these six findings:

1. The requested exception to the criteria is the minimum necessary to afford relief;
2. Granting the exception will not confer upon the applicant any special privileges that are denied by the ordinance to other property owners who are subject to its provisions and who are similarly situated;
3. The exception request is in harmony with the purpose and intent of the Ordinance and is not of substantial detriment to water quality;
4. The exception request is not based upon conditions or circumstances that are self-created or self-imposed;
5. Reasonable and appropriate conditions are imposed, as warranted, to prevent the proposed activity from causing degradation of water quality;
6. Other findings and conditions, required by the City have been met.

For **EXCEPTIONS** and **ENROACHMENTS**, please complete the following.

Describe all mitigation measures, including BMPs and vegetation enhancement*,

_____

_____

_____

_____

_____

_____

_____

_____

- Note: all vegetation enhancement should be in accordance with the Riparian Buffers Modification and Mitigation Manual available at http://www.deq.virginia.gov/Portals/0/DEQ/Water/Publications/RiparianBufferManual.pdf

---

Do not mark below this line

Approvals

Program Administrator_____ Date_____

City Planning Commission_____ Date_____

Comments:_____
_____
_____
_____
_____

Appendix C:

List of Plants Recommended for Riparian Buffers
and Vegetative Replacement Standards

Reprinted from
Riparian Buffers Modification and Mitigation Guidance Manual,
Chesapeake Bay Local Assistance Department,
September 2003.

Recommended Plant List for Bioretention Facilities
Fairfax County, Virginia

Reprinted from
Recommended Plant List for Bioretention Facilities,
Fairfax County Public Works and Environmental Services,
February 2007.

PLANT LISTS

These lists are suggestions for recommended plants and are not to be construed as exclusive lists. There are many other suitable plants for riparian buffer planting. These lists are a place to start.

MEDIUM TO LARGE DECIDUOUS CANOPY TREES	SMALL CANOPY/UNDERSTORY TREES
Red maple - Acer rubrum Acer saccharum - Silver maple Betula lenta - Black birch River birch - Betula nigm Shagbark hickory - Carya ovata Mockernut hickory - Caiya tomentosa Hackberry - Celtis occidentalis Washington hawthorn - Craetagus phaenopynitm Persimmon - Diospyros virginiana American Beech - Fagus grandifoha White ash - Fraxinus americana Green ash - Fraxinus pennsylvanica Water locust - Gleditsia aquatica Black walnut - Juglans nigm Sweetgum - Liquidamber sfracitlua Tulip poplar - Liriodendron tulipifera Water tupelo – Nyssa aquatica Black gum - Nyssa sylvatica Sourwood - Oxydendron arboreum Sycamore - Platanus occidentalis Cottonwood poplar – Populus deltoids Swamp cottonwood - Populus heterophylla Black cheny - Prunis serotina Swamp white oak - Quercus bicolor Shingle oak - Quercus imbricata Laurel oak - Quercus laurifolia Overcup oak - Quercus lyrata Swamp chestnut oak - Quercus michauxii Water oak - Quercus nigra Pin oak - Quercus palustris Willow oak - Quercus phellos Shumard oak - Quercus shumardii Swamp willow, Black willow - Salix nigra Weeping willow - Salix babylonica American basswood - Tilia Americana	Red buckeye - Aesculus pavia Smooth alder - Alnus serrulata Serviceberry - Amelanchier canadensis Devil's walkingstick - Aralia spinosa Pawpaw - Asimia triloba American hornbeam- Carpinus caroliniana Sugar hackbeny - Celtis laevigata Redbud, Judas tree - Cercis canadensis Fringetree - Chionanthus virginicus Dogwood - Cornus florida Cockspur hawthorn - Crataegus crus-galli Green hawthorn - Cmtaegus viridis Parsley hawthorne - Crataegus marshalli Swamp cyrilla - Cyrilla racemosa Two-winged Silverbell - Halesia diptera American holly flex opaca Possumhaw - Ilex deciduas Spicebush - Lindera benzom Sweetbay Magnolia - Magnolia virginiana Eastern hophornbeam - Ostrya virginiana Sourwood - Oxydendron arboreum Elderberry - Sambucus canadensisSassafras - Sassafras albidum Sparkleberry - Vaccinium arboreum Nannyberry - Viburnum lentago

EVERGREEN TREES

American holly – llex opaca
Eastern red cedar – Juniperus virginiana
Southern magnolia – Magnolia gmndiflom
Shortleaf pine – Pinus echinata
Pitch pine – Pinus rigida
Eastern white pine – Pinus strobus
Loblolly pine – Pinus taeda
Virginia pine - Pinus virginiana
Darlington oak Quercus laurifolia Darlingtonia
Live oak – Quercus virginiana

EVERGREEN SHRUBS

Inkberry holly - hex glabra
Common juniper Juniperus communis
Shore juniper - Juniperus conferta
Southern wax myrtle – Myrica cerifera
Bayberry – Myrica pennsylvanica
Swamp azalea – Rhododendrona viscosum
Farklebeny – Vaccinium arboreum

LARGE SHRUBS

Alder - Alnus sernilata
False indigo - Amorpha fruiticosa
Red chokeberry – Aroma arbutifolia
American beautybeny – Calicarpa americana
Eastern sweetshmb – Calycanthus floridus
Buttonbush – Cephalanthus occidentalis
Silky dogwood - Cornus amonum
Greystem dogwood – Cornus racemosa
Red twig dogwood Cornus stolomfera
Witch hazel - Harnmamelis virginiana
Wild hydrangea - Hydrangea arborescens
Oakleaf hydrangea – Hydrangea quercifolia
Winterberry holly – flex verticilata
Yaupon holly – flex vomitoria
Virginia sweetspire Itea virginica
Fetterbush/Sweetbells Leucothoe racemosa
Fetterbush – Lyonia lucida
Male-berry - Lyonia ligustrina
Southern wax myrtle Myrica cerifera
Bayberry – Myrica pennsylvanica
Common ninebark – Physocarpus opulifolius
Choke cherry - Pmnus virigniana
Swamp azalea – Rhododendrona viscosum
Smooth sumac – Rhus glabra
Allegheny blackberry – Rubus allegheniensis
Pussy willow – Salix discolor
Silky willow – Salix sericea
Elderberry – Sambucus canadensms
American snowbeil – Styrax atnerieanus
Highbush blueberry - Vaccinium corybosum
Arrowwood viburnum – Viburnum dentatum
Swamphaw Viburnum - Viburnum nudum
Blackhaw viburnum - Vibtumim pmnifolium

SMALL SHRUBS

Obovate serviceberry - Amelanchier obovalis
Black chokecherry - Aroma melanocarpa
Sweet pepperbush - Clethra alnifolia
Sweet fern - Comptonia peregrina
Strawberry bush - Euonymus americanus
Fothergilla - Fothergilla gardenii
Black huckleberry - Gaylussacia baccata
Dangleberry - Gaylussacia frondosa
Wild hydrangea - Hydrangea arborescens
Oakleaf hydrangea - Hydrangea quercifolia
Mountain laurel - Kiiimia latifolia
Staggerbush - Lyonia mariana
Scrubby cinquefoil - Potentilla fruticosa
Beach plum - Prunus maritime
Sand blackberry - Rubus cuneifolius
Bankers willow - Salix cottettii
White meadowsweet - Spiraea alba
Meadowsweet - Spiraea latifolia
Steeplebush - Spiraea tomentosa
Common snowbeny -
Coralberry - Symphocarpos orbiculatus
Lowbush blueberry - Vaccinium angustifolium
Maple-leaved viburnum - Vaccimum acerifolium
Adam's needle - Yucca fllamentosa

NATIVE GRASSES

Big Bluestem – Andropogon gerardi
Broomsedge – Andropogon virglnicus
lindian woodoats Chasmanthmum latifolium
Coastal panic grass – Panicum amarum
Switch grass – Panicum virgatum
Little bluestem – Schizachyrium scoparium
Indian grass – Sorghastrum nutans
Easternn gama grass – Tripsacum dactyloides

HERBACEOUS PLANTS

Black-eyed Susan – Rudbeckia fimlgida
Cardinal Flower – Lobelia cardinalis
Coralbells – Heuchera Americana
Creeping Phlox – Phlox stolonifera
Crested Iris – Iris cristata
Foamflower – Tiarella cordifolia

Goldenrod – Solidago Canadensis
Great Blue Lobelia – Lobelia siphilitica
Green and Gold - Crysogonum virginianum
Ironweed – Vernonia noveboracensis
Jack-in-the-Pulpit - Arisaema triphyllum
Joe-Pye Weed – Eupatorium purpureum
Mayapple – Podophyllurn peltatum
Mistflower – Eupatorium coelestinum
Mouse-ear Coreopsis – Coreopsis auriculata
New York Aster - Aster novi-belgii
Pink Turtlehead – Chelone lyonii
Purple Coneflower – Echinacea purpurea
Small Solomon's Seal – Polygonatum biflorum
Swamp Milkweed - Asclepias incarnata
Sweet Flag - Acorns americanus
Tall Gayfeather – Liatris scanos
Three-toothed Cinquefoil – Potentilla tridentata
Tickseed – Coreopsis grandiflora
Virginia Bluebells – Metensia virginica
Virginia Blue flag - his virginica
Wild Columbine - Aquilegia Canadensts
Woodland Phlox - Phlox divaricata

SHADE TOLERANT PLANTS	**PART SUN** (semi-shade intolerant)
Trees	**Trees**
Red maple	Silver maple
Sugar maple	Sweet birch
Serviceberry, Shadbush	Bitternut hickory
Pawpaw	Shagbark hickory
Yellow birch	Hackberry
Hornbeam	Tulip poplar
American beech	Easter white pine
White ash	Sycamore
Sweetbay magnolia	White oak
Hop hornbeam	Swamp white oak
American basswood	Chestnut oak
Canada hemlock	Willow oak
	Northern red oak
	Slippery elm
Small Trees & Shrubs	**Small Trees & Shrubs**
Dogwood	Red chokeberry
Redbud	Black choke berry
Fringetree	Black huckleberry
Sweet pepperbush	Winterberry
Gray dogwood	Swamp azalea
American hazelnut	Meadowsweet
Witchhazel	Nannyberry
Inkberry	Smooth alder
Mountain laurel	Pinxterbloom azalea
Spicebush	
Staghorn sumac	
Elderberry	
Highbush blueberry	
Witherod	
Southern arrowwood	
Highbush cranberry	
Virginia sweetspire	

FULL SUN (Shade intolerant)

Trees
Persimmon
Black ash
Red ash
Honey-locust
Kentucky coffee-tree
Black walnut
Sweet gum
Black gum
Eastern cottonwood
Black cherry
Pin oak
Black willow
Sassafras

Small Trees & Shrubs
Groundsel bush
Buttonbush
Silky dogwood
Red-osier dogwood
Bayberry
Wax myrtle
Ninebark
Rosebay rhododendron
Blackhaw viburnum

FLOOD TOLERANT

Trees
Red maple
Shadbush
Yellow birch
Black Ash
Red ash
Sweet gum
Sweetbay magnolia
Eastern cottonwood
Swamp white oak
Willow oak
Black willow
Slippery elm

Small Trees & Shrubs
Smooth alder
Red chokeberry
Black chokeberry
Groundsel bush
Buttonbush
Silky Dogwood
Red-osier dogwood
Inkberry
Winterberry
Bayberry
Ninebark
Rosebay rhododendron
Swamp azalea
Swamp rose
Meadowsweet
Highbush blueberry
Witherod
Southern arrowwood
Northern arrowwood
Highbush cranberry

SEMI-FLOOD TOLERANT
(good for wet sites)

Trees
Atlantic white cedar
Allegheny servicebeny
Bald cypress
Black gum
Bitternut hickory
Eldebeny
Grey birch
Green ash
Hackberry
Persimmon
White ash
Honey-locust
Kentucky coffee-tree
Black walnut
Tulip poplar
Black gum
Sycamore
Northern red oak
River birch

Shrubs
Serviceberry
Fringe tree
American hazelnut
Black huckleberry
Grey dogwood
Spicebush
Witchhazel
Mountain laurel
Staghorn sumac
Nannybeny viburnum
Blackhaw viburnum

SALT TOLERANT SPECIES

Trees
Serviceberry, Shadblow
Groundsel tree
Hackberry
American holly
Eastern red cedar
Sweetbay magnolia
Black gum
Pitch pine
Elderberry

Shrubs
Bearberry
Red cokeberry
Black chokeberry
Buttonbush
Sweet pepperbush
Inkberry
Spicebush
Southern wax myrtle
Bayberry
High tide bush
Beach plum
Winged sumac
Smooth sumac
Staghorn sumac
Rugosa rose
Arrowwood viburnum
Blackhaw viburnum
Highbush bluebeny

Recommended Plant List for Bioretention Facilities
Fairfax County, Virginia

February 1, 2007

RECOMMENDED PLANT LIST FOR BIORETENTION FACILITIES – Fairfax County, Virginia

The following list of plants for bioretention facilities was developed by staff from the Department of Public Works and Environmental Services (Urban Forest Management Division and Storm Water Planning Division) in cooperation with staff from the Northern Virginia Soil and Water Conservation District and the Fairfax County Park Authority. It is a "recommended" list of plants for use in bioretention facilities. The list is not exhaustive and is intended to give the designer a palette of plant materials to choose from. Other species may be used, and the acceptability of proposed plant materials is subject to review and approval by the Director. This plant list may be updated periodically to reflect other species that have been shown to perform well in bioretention facilities. Design guidelines for bioretention facilities can be found in the Public Facilities Manual § 6-1307.

KEY:

- **Light:** The amount of sunlight a plant requires is defined as:
  - Full sun ☼, the site is in direct sunlight for at least six hours daily during the growing season.
  - Partial shade ◑, the site receives approximately three to six hours of direct sunlight or lightly filtered light throughout the day.
  - Shade ✹, the site receives less than three hours of direct sunlight or heavily dappled light throughout the day.
- **Moisture:** The amount of soil moisture a plant requires is defined as:
  - Dry (D), areas where water does not remain after a rain; supplemental watering will not be needed, except under the most extreme drought conditions. Plants with the Dry designation can be considered drought tolerant.
  - Moist (M), areas where the soil is damp, and may be occasionally saturated.
  - Wet (W), areas where the soil is saturated for much of the growing season, except in droughts. Many of the plants designated for wet areas tolerate specific ranges of water depths.
- **Salinity:** A plant's tolerance to salinity is defined as:
  - None (N)
  - Low (L)
  - Medium (M)
  - High (H)
- **Browse:** A plant's palatability to animal browsing (in particular deer browsing) is defined as:
  - Low (L)
  - Medium (M)
  - High (H)

SOURCES:

For a list of sources see the notes at the end of this document.

If you have any questions about this list or suggestions for changes, please contact the Urban Forest Management Division at 703-324-1770.

RECOMMENDED PLANT LIST FOR BIORETENTION FACILITIES – Fairfax County, Virginia

Botanical Name **Common Name** **(* = native to Virginia)**	**Time of Bloom and other Characteristics**	**Conditions**	**Mature Size** **Height** **Spread**
Grasses/Sedges/Rushes			
Andropogon gerardii Big bluestem *	August – September. A warm season bunchgrass with yellow flowers; blue green blades turn tawny in fall. Often stays erect until spring.	Light: ☼ ◑ Moisture: D M W Salinity: M Browse: H	H 36” – 72” S 24” – 30”
Andropogon virginicus Broomsedge bluestem *	August – November. A warm season bunchgrass with reddish brown flowers; turns straw colored in fall. Often stays erect until spring. Suited to infertile soil and drought tolerant.	Light: ☼ Moisture: D M W Salinity: L Browse: L	H 36” – 72” S 24” – 30”
Carex crinita Fringed sedge *	June – August. Inconspicuous flowers on long, drooping “fringed” female inflorescences; attracts songbirds and waterfowl.	Light: ☼ ◑ Moisture: M W Salinity: N Browse:	H 24” – 48” S 18” – 36”
Carex lurida Shallow sedge *	June – October. Inconspicuous flowers; upright, cylindrical female inflorescences typically 2-4 per plant; attracts songbirds and waterfowl.	Light: ☼ ◑ Moisture: M W Salinity: N Browse:	H 24” – 48” S 18” – 36”
Carex stricta Tussock sedge *	May – August. Inconspicuous flowers: upright, narrow female inflorescences; attracts songbirds; tolerates periodic drought and flooding; grows in clumps or tussocks.	Light: ☼ ◑ Moisture: M W Salinity: N Browse:	H 24” – 48” S 24” – 48”
Chasmanthium latifolium River oats *	July – September. Attractive flat, drooping seed heads change from green in summer to bronze in fall and persist through winter; attracts songbirds; will naturalize and can be aggressive; can be used as a groundcover.	Light: ☼ ◑ Moisture: D M Salinity: N Browse: H	H 24” – 48” S 24” – 36”
Dichanthelium clandestinum Deer-tongue *	May – October. Perennial warm-season bunchgrass with green flowers; drought tolerant; used to re-vegetate disturbed areas with infertile soils.	Light: ☼ ◑ Moisture: D M W Salinity: L Browse: H	H 18” – 24” S 12” – 24”

RECOMMENDED PLANT LIST FOR BIORETENTION FACILITIES – Fairfax County, Virginia

Botanical Name **Common Name** **(* = native to Virginia)**	**Time of Bloom and other Characteristics**	**Conditions**	**Mature Size** **Height** **Spread**
Elymus hystrix Bottlebrush grass *	June– August. Perennial grass with few, wide flat leaves and loosely flowered spikes; prefers part shade and rich woods.	Light: ☼ ◑ ✹ Moisture: M Salinity: Browse:	H 12” – 24” S 10” – 12”
Elymus riparius Riverbank wild rye *	July– September. Perennial grass with arching wheat/rye like spikes of yellow flowers; good for stream bank conditions; tolerates wide range of conditions.	Light: ☼ ◑ ✹ Moisture: D M W Salinity: L Browse:	H 12” – 36” S 12” – 24”
Elymus virginicus Virginia wild rye *	June – October. Perennial cool-season bunchgrass with arching wheat/rye like spikes of yellow flowers; tolerates a wide range of soil conditions.	Light: ◑ ✹ Moisture: D M Salinity: N Browse: M	H 18” – 36” S 12” – 24”
Eragrostis spectabilis Purple lovegrass *	July – October. Perennial warm-season bunchgrass with delicate bronze-red inflorescences; green foliage turns bronze-red in fall; very drought tolerant, will not do well in frequently saturated soils.	Light: ☼ Moisture: D M Salinity: N Browse: M	H 10” – 12”” S 12” – 18”
Festuca rubra Red fescue *	May – July. Perennial bunchgrass; can be used as a cool-season turf grass, prefers part shade.	Light: ☼ ◑ Moisture: D M W Salinity: M Browse: M	H 12” – 18” S 10” – 12”
Juncus tenuis Slender rush *	May – September. Inconspicuous green flowers; slender wiry stems; can be used as a groundcover or for erosion control; tolerates inundation.	Light: ☼ ◑ Moisture: M W Salinity: L Browse: L	H 6” – 24” S 6” – 12”
Juncus effusus Soft rush *	June – September. Greenish brown flowers; slender stems; can be used as a groundcover or for erosion control; grows in clumps; tolerates inundation.	Light: ☼ ◑ Moisture: M W Salinity: L Browse: L	H 12” – 48” S 12” – 24”
Leersia oryzoides Rice cutgrass*	June – October. Perennial grass with rough edged blades; forms dense stands; good for stabilization and erosion control; drought and inundation tolerance; high wildlife value.	Light: ☼ ◑ Moisture: M W Salinity: N Browse: H	H 24” – 60” S 24” – 36”

RECOMMENDED PLANT LIST FOR BIORETENTION FACILITIES – Fairfax County, Virginia

Botanical Name **Common Name** **(* = native to Virginia)**	**Time of Bloom and other Characteristics**	**Conditions**	**Mature Size** **Height** **Spread**
Panicum virgatum Switch grass *	July – February. Pink-tinged panicles are attractive and persist into winter; clumping warm-season grass; important winter food and cover source for birds and mammals; good for erosion control. Should mainly be used within the coastal plain, east of I-395.	Light: ☼ ◑ Moisture: D M W Salinity: M Browse: M	H 36” – 60” S 24” – 36”
Schizachyrium scoparium Little bluestem *	August – October. Purplish-bronze inflorescences; blue-green foliage turns bronze-orange in fall; useful for erosion control; highly drought tolerant; also tolerates flooding; will tolerate some shade.	Light: ☼ Moisture: D Salinity: N Browse: M	H 24” – 48” S 12” – 24”
Sorghastrum nutans Indian grass *	August – September. Tall clump grass with golden brown plume like flowers; adapted to dry or wet sites; nutritious seed heads for wildlife; grows rapidly.	Light: ☼ ◑ Moisture: D M Salinity: M Browse: M	H 30” – 72” S 12” – 24”
Tridens flavus Purpletop tridens *	August – November. Perennial, yellow-green native grass with a reddish-purple inflorescence; highly drought tolerant; host plant for the Crossline Skipper butterfly.	Light: ☼ Moisture: D M Salinity: N Browse: H	H 24” – 60” S 18” – 30”
Perennials/Ground Covers			
Aquilegia canadensis Red columbine *	April – May. Drooping, bell-like red and yellow flowers attract hummingbirds and butterflies; blue-green foliage; tolerates moist or dry sites; will naturalize; prefers shade.	Light: ☼ ◑ ✹ Moisture: D M Salinity: Browse: L	H 24” – 36” S 12” – 18”
Aruncus dioicus (sylvester) Goatsbeard *	May – July. Many small creamy white to yellow flowers, prefers moist well drained loamy soil.	Light: ☼ ◑ Moisture: M Salinity: Browse:	H 36” – 72” S 24” – 48”
Asarum canadense Canadian wild ginger *	April – May. Semi-evergreen spreads rapidly; can be used as a ground cover; small purple/brown flowers hide under leaves; prefers shade.	Light: ◑ ✹ Moisture: M Salinity: Browse:	H 4” – 6” S 6” – 24”+

RECOMMENDED PLANT LIST FOR BIORETENTION FACILITIES – Fairfax County, Virginia

Botanical Name **Common Name** **(* = native to Virginia)**	**Time of Bloom and other Characteristics**	**Conditions**	**Mature Size** **Height** **Spread**
Asclepias incarnata Swamp milkweed *	May – June. Showy reddish-pink blooms in midsummer; butterfly nectar plant; monarch butterfly host plant; can tolerate drought.	Light: ☼ ◑ Moisture: M W Salinity: N Browse:	H 24” – 48” S 18” – 24”
Asclepias tuberosa Butterflyweed *	May – July. Showy orange blooms, butterfly nectar plant; monarch butterfly host plant; does well in poor, dry soils; will naturalize.	Light: ☼ ◑ Moisture: D M Salinity: N Browse:	H 12” – 36” S 18” – 24”
Aster (Eurybia) divaricatus White wood aster *	July – October. Good for dry shade or moist woods; white flowers attract butterflies; attractive massed at woodland edge; delicate sprawling form; can be used as a groundcover.	Light: ◑ ✹ Moisture: D M Salinity: Browse: L	H 12” – 36” S 18” – 24”
Aster (S*ymphyotrichum) laevis* Smooth or blue bird aster *	August – October. Showy pale lavender-blue flowers with yellow centers in loose clusters; attracts butterflies.	Light: ☼ ◑ Moisture: D M Salinity: Browse: L	H 24” – 42” S 18” – 24”
Aster (S*ymphyotrichum) lateriflorus* Calico aster *	September – October. White or pale purple flowers in small heads; loose branching habit.	Light: ☼ ◑ Moisture: M Salinity: Browse: L	H 12” – 48” S 12” – 18”
Aster (S*ymphyotrichum) novae-angliae* New England Aster *	August – October. Showy bright violet ray flowers surround yellow centers; pubescent leaves and stems; attracts butterflies; will tolerate drought and periodic flooding.	Light: ☼ ◑ Moisture: M W Salinity: Browse: L	H 12” – 60” S 24” – 30”
Aster (S*ymphyotrichum) novi-belgii* New York aster *	July – October. Showy blue-violet flowers with yellow centers attract butterflies; smooth leaves and stems.	Light: ☼ ◑ Moisture: M W Salinity: Browse: L	H 36” – 48” S 24” – 36”

RECOMMENDED PLANT LIST FOR BIORETENTION FACILITIES – Fairfax County, Virginia

Botanical Name **Common Name** **(* = native to Virginia)**	**Time of Bloom and other Characteristics**	**Conditions**	**Mature Size** **Height** **Spread**
Aster (Doellingeria) umbellatus Parasol whitetop	July – October. White or violet tinged daisy-like flowers grow in flat-topped clusters.	Light: ◑ ✹ Moisture: M W Salinity: Browse: L	H 12” – 36” S 18” – 24”
Bidens cernua Nodding beggarticks *	August – October. Yellow flowers; annual; tolerates wide range of soil types; seeds feed songbirds and waterfowl.	Light: ☼ ◑ Moisture: W Salinity: N Browse: L	H 24” – 42” S 24” – 48”+
Chelone glabra White turtlehead *	July – October. White, snapdragon-like flowers attract hummingbirds and butterflies; host plant for Baltimore checkerspot butterfly.	Light: ☼ ◑ Moisture: M W Salinity: Browse:	H 24” – 36” S 12” – 18”
Chrysogonum virginianum Green and gold *	March – June. Showy, bright yellow, star-shaped flowers; attractive, versatile groundcover; will naturalize; prefers shade.	Light: ☼ ◑ ✹ Moisture: D M Salinity: Browse:	H 4” – 8”” S 12” – 18”
Cimicifuga racemosa Black snakeroot *	June – September. Flowers are white upright spikelets; appropriate for naturalized areas; attracts butterflies.	Light: ◑ ✹ Moisture: M Salinity: Browse:	H 36” – 72” S 24” – 30”
Coreopsis verticillata Threadleaf coreopsis *	June – October. Yellow daisy-like flowers attract butterflies; can be used as a groundcover.	Light: ☼ ◑ Moisture: D M Salinity: Browse:	H 12” – 36” S 18” – 24”
Eupatorium coelestinum Blue mist flower *	July – October. Blue-violet, tuft-like flower clusters attract butterflies; will naturalize.	Light: ☼ ◑ ✹ Moisture: D M W Salinity: N Browse:	H 24” – 36” S 24” – 36”
Eupatorium fistulosum Joe pye weed *	July – October. Large terminal panicles of dusky pink-purple flowers attract butterflies and songbirds; seed heads persist into winter; will naturalize.	Light: ☼ ◑ Moisture: D M W Salinity: Browse:	H 18” – 60” S 24” – 48”

RECOMMENDED PLANT LIST FOR BIORETENTION FACILITIES – Fairfax County, Virginia

Botanical Name **Common Name** **(* = native to Virginia)**	**Time of Bloom and other Characteristics**	**Conditions**	**Mature Size** **Height** **Spread**
Eupatorium perfoliatum Common boneset *	July – October. Flat-topped clusters of tiny, white, tuft-like flowers attract butterflies; all parts of this plant are toxic.	Light: ☼ ◑ Moisture: M W Salinity: Browse:	H 36” – 48” S 24” – 36”
Eupatorium (Ageratina) rugosum White snakeroot *	July – October. Bright, white flowers are tiny and tuft-like; attracts butterflies; will naturalize.	Light: ☼ ◑ ✹ Moisture: D M Salinity: Browse:	H 48” – 60” S 24” – 30”
Geranium maculatum Spotted geranium *	April – July. Delicate lavender or pink blooms attract butterflies and beneficial insects; long-bloom period; will naturalize; very adaptable; can be used as a ground cover.	Light: ☼ ◑ Moisture: D M Salinity: Browse:	H 18” – 24” S 12” – 18”+
Helenium autumnale Common sneezeweed *	July – November. Bright yellow, daisy-like flowers with a yellow-green domed central disk; attracts butterflies; intolerant of dry soils.	Light: ☼ ◑ Moisture: M W Salinity: N Browse: L	H 36” – 60” S 36” – 48”
Helianthus decapetalus Ten-petaled or thin-leaved sunflower *	July – October. Daisy-like flowers are yellow with a brown central disk; attracts butterflies and songbirds; moderate drought tolerance.	Light: ☼ ◑ Moisture: M Salinity: Browse:	H 36” – 60” S 36” – 48”
Heuchera americana American alumroot *	April – June. Tiny greenish-white to pale lavender bell-like flowers borne on stalks above heart-shaped foliage; long bloom time; semi evergreen; can be used as a groundcover; prefers shade and rich woods.	Light: ☼ ◑ ✹ Moisture: D M Salinity: Browse:	H 12” – 18” S 10” – 14”
Hibiscus laevis (militaris) Halberd-leaf rose mallow *	August – September. Large white to purple flowers with maroon centers; multi-stemmed; not drought tolerant; attracts butterflies.	Light: ☼ ◑ Moisture: M W Salinity: N Browse: L	H 48” – 72” S 36” – 48”

RECOMMENDED PLANT LIST FOR BIORETENTION FACILITIES – Fairfax County, Virginia

Botanical Name **Common Name** **(* = native to Virginia)**	**Time of Bloom and other Characteristics**	**Conditions**	**Mature Size** **Height** **Spread**
Hibiscus moscheutos Crimson-eyed rose mallow *	July – September. Large white, pink or rose blooms with crimson centers; multi-stemmed; grey-green foliage; not drought tolerant; attracts butterflies.	Light : ☼ Moisture: M W Salinity: L Browse: L	H 36” – 84” S 36” – 48”
Iris versicolor Harlequin blue flag *	May – July. Showy blue to violet-blue flowers on straight stems; tolerates inundation to 6 inches.	Light: ☼ ◑ Moisture: W Salinity: M Browse:	H 24” – 36” S 36” – 60”+
Liatris pilosa Grass-leaf blazingstar *	August – October. Striking spikes of red-purple flowers and delicate green foliage; attracts butterflies and songbirds; moderate drought tolerance.	Light: ☼ ◑ Moisture: D M Salinity: L Browse:	H 12” – 54” S 12” – 24”
Liatris squarrosa Plains blazingstar *	July – September. Small multiple spikes of rose flowers and delicate green foliage; attracts butterflies and songbirds.	Light: ☼ ◑ Moisture: M Salinity: Browse:	H 6” – 30” S 6” – 24”
Lobelia cardinalis Cardinal flower *	July – October. Brilliant scarlet red flowers arranged along tall stems attract hummingbirds and butterflies; biennial; will naturalize; long bloom period.	Light: ☼ ◑ Moisture: M W Salinity: N Browse: M	H 24” – 48” S 12” – 24”
Lobelia siphilitica Great blue lobelia *	August – October. Blue-violet flowers clustered on tall stems attract hummingbirds and butterflies; long bloom time; will naturalize.	Light: ☼ ◑ ✹ Moisture: M W Salinity: Browse:	H 12” – 48” S 12” – 18”
Mentha arvensis Wild mint *	July – September. Lavender to white flowers cluster at the stem; edible herb; low drought tolerance.	Light: ☼ ◑ Moisture: M W Salinity: N Browse: L	H 18” – 30” S 24” – 36”
Mertensia virginica Virginia bluebells *	March – June. Bell-shaped pink to blue flowers; color depends on soil acidity; dormant in summer.	Light: ◑ ✹ Moisture: M W Salinity: N Browse: M	H 12” – 24” S 10” – 12”

RECOMMENDED PLANT LIST FOR BIORETENTION FACILITIES – Fairfax County, Virginia

Botanical Name **Common Name** **(* = native to Virginia)**	**Time of Bloom and other Characteristics**	**Conditions**	**Mature Size** **Height** **Spread**
Monarda didyma Scarlet beebalm *	July – September. Vibrant red flowers attract bees, butterflies and hummingbirds; will naturalize; leaves are fragrant.	Light: ☼ ◑ Moisture: M W Salinity: Browse:	H 24” – 54” S 18” – 36”
Myosotis laxa Smaller forget-me-not *	May – July. Tiny light blue flowers with yellow centers. Will die back in dry summers and come back in the winter.	Light: ◑ Moisture: W Salinity: Browse:	H 3” – 6” S 6” – 8”
Oenothera fruticosa Narrow-leaved sundrops *	May – September. Yellow flowers; attracts hummingbirds and songbirds; long bloom period.	Light: ☼ ◑ Moisture: D M Salinity: H Browse:	H 12” – 36” S 12” – 24”
Onoclea sensibilis Sensitive fern *	Dark brown fertile fronds; will naturalize in wet areas; can be used as a ground cover; needs consistent moisture.	Light: ☼ ◑ ✹ Moisture: M W Salinity: Browse:	H 12” – 36” S 24” – 48”
Penstemon digitalis Talus slope penstemon *	June – August. White flowers attract hummingbirds and butterflies; clump-forming; will naturalize; drought tolerant.	Light : ☼ ◑ Moisture: D M Salinity: M Browse: M	H 24” – 48” S 12” – 36”
Phlox divaricata Woodland phlox*	April – June. Blue, lavender and white aromatic showy flowers; dormant in summer; attracts butterflies; evergreen; frequently cultivated.	Light : ◑ ✹ Moisture: M Salinity: Browse:	H 12” – 18” S 12” – 18”
Phlox stolonifera Creeping phlox*	April – June. Rose, violet or blue flowers; attracts butterflies; evergreen; can be used as a groundcover; will naturalize.	Light : ☼ ◑ ✹ Moisture: D M Salinity: Browse:	H 6” – 12” S 12” – 18”
Physostegia virginiana Obedient plant *	June – September. Showy spires of pink or white flowers; attracts butterflies; will naturalize rapidly and can escape cultivation.	Light: ☼ ◑ Moisture: D M Salinity: Browse:	H 24” – 48” S 18” – 36”

RECOMMENDED PLANT LIST FOR BIORETENTION FACILITIES – Fairfax County, Virginia

Botanical Name **Common Name** **(* = native to Virginia)**	**Time of Bloom and other Characteristics**	**Conditions**	**Mature Size** **Height** **Spread**
Rudbeckia fulgida Early coneflower *	July – October. Yellow-orange flowers with black centers attract butterflies; provides food and cover for songbirds; will naturalize.	Light: ☼ ◑ Moisture: D M Salinity: Browse:	H 18” – 36” S 18” – 24”
Rudbeckia hirta Black-eyed susan *	June – October. Yellow flowers with black centers attract butterflies; provides food and cover for songbirds; will naturalize and can be invasive.	Light: ☼ ◑ Moisture: D M Salinity: N Browse: L	H 12” – 36” S 12” – 24”
Rudbeckia laciniata Cutleaf coneflower *	June – October. Yellow flowers with green centers attract butterflies; provides food and cover for songbirds; will naturalize.	Light: ☼ ◑ ✹ Moisture: M W Salinity: N Browse: H	H 48” – 96” S 24” – 48”
Sedum ternatum Woodland stonecrop *	April – June. Greenish-white, star-shaped flowers; evergreen; can be used as a groundcover.	Light: ◑ Moisture: M Salinity: Browse:	H 3” – 6” S 6” – 12”
Senecio (Packera) aureus Golden ragwort *	April – August. Yellow, daisy-like flowers attract butterflies; will naturalize and can spread aggressively.	Light: ☼ ◑ ✹ Moisture: M W Salinity: N Browse: M	H 12 – 36” S 12” – 24”
Solidago rugosa Wrinkleleaf goldenrod *	August – November. Tough plant that colonizes easily; yellow flowers; medium drought tolerance.	Light: ☼ ◑ Moisture: D M W Salinity: N Browse: L	H 12” – 24” S 12” – 36”+
Tiarella cordifolia Heartleaf foamflower *	April – July. Attractive, white spike flowers; long blooming, spreads rapidly.	Light: ☼ ◑ ✹ Moisture: M Salinity: Browse:	H 6” – 12” S 6” – 12”
Tradescantia virginiana Common Virginia spiderwort *	April – July. Grass-like foliage and deep blue-purple showy flowers; medium drought tolerance.	Light: ☼ ◑ Moisture: M Salinity: N Browse: L	H 12” – 24” S 18” – 24”+

RECOMMENDED PLANT LIST FOR BIORETENTION FACILITIES – Fairfax County, Virginia

Botanical Name **Common Name** **(* = native to Virginia)**	**Time of Bloom and other Characteristics**	**Conditions**	**Mature Size** **Height** **Spread**
Verbena hastata var. hastata Swamp verbena*	June – October. Pencil-like spikes of small blue or purple flowers that bloom a few at a time; swamps, meadows and roadside ditches.	Light: ☼ ◑ Moisture: M W Salinity: Browse:	H 24" – 60" S 18" – 30"
Vernonia noveboracensis New York ironweed *	August – Oct. Spreading, tall upright wildflower with a brilliant purple flower; grows in wet meadows.	Light: ☼ Moisture: M W Salinity: N Browse: M	H 48" – 72" S 24" – 36"
Shrubs/Small trees			
Alnus serrulata Smooth alder *	March – April. Purple/brown, catkins and small cones; yellow and red foliage in the fall; forms thickets along watercourses and tolerates flooding; fixes nitrogen; high wildlife value.	Light: ☼ ◑ ✹ Moisture: M W Salinity: N Browse: M	H 6' – 25' S 10' – 15'
Aronia (Photinia) arbutifolia Red chokeberry *	April – June. Deciduous shrub with white flowers, developing red berries; has medium tolerance for flooding; can be pruned as a hedge; red fall foliage.	Light: ☼ ◑ Moisture: D M W Salinity: L Browse: L	H 6' – 10' S 3' – 5'(10')
Aronia (Photinia) melanocarpa Black chokeberry *	April – May. White flowers that develop into black berries in September/November; can be pruned as a hedge; more drought tolerant then red chokeberry.	Light: ☼ ◑ Moisture: D M W Salinity: N Browse: L	H 5' – 8' S 5' – 10'
Aronia prunifolia (Photinia floribunda) Purple chokeberry *	July – August. White flowers and purple/black berries that ripen in October/December; prefers wetter sites.	Light: ☼ ◑ Moisture: M W Salinity: Browse:	H 5' – 12' S 6' – 8'
Callicarpa americana American beautyberry *	June – August. Lavender pink flowers on new wood; tolerates heavy pruning; lavender berries are persistent during winter and food source for birds; high wildlife value; high drought tolerance.	Light: ☼ ◑ Moisture: D M W Salinity: N Browse: H	H 4' – 8' S 4' – 8'

RECOMMENDED PLANT LIST FOR BIORETENTION FACILITIES – Fairfax County, Virginia

Botanical Name **Common Name** **(* = native to Virginia)**	**Time of Bloom and other Characteristics**	**Conditions**	**Mature Size** **Height** **Spread**
Ceanothus americanus New Jersey tea *	May – September. White flowers and brown seeds; tolerates moisture for short periods; fixes nitrogen; drought tolerant; attracts butterflies.	Light: ☼ ◑ Moisture: D Salinity: M Browse: M	H up to 3' S up to 3'
Cephalanthus occidentalis Common buttonbush *	July – August. Creamy white fragrant ball-shaped flowers; brown ball-like fruits in September through January; drought tolerant, but also tolerates flooding to 36".	Light: ☼ ◑ Moisture: M W Salinity: L Browse:	H 3' – 10'(20') S 3' – 10'
Clethra alnifolia Coastal sweet pepperbush *	July – August. Very fragrant white or pink flowers; butterfly nectar plant; brown capsules; tolerates some flooding by slightly saline water. Occurrence in Fairfax mostly confined to coastal plain east of I-395.	Light: ☼ ◑ Moisture: M W Salinity: L Browse: M	H 4' – 10' S 4' – 8'
Cornus amomum Silky dogwood*	May – June. White flowers with blue berries ripening in August; high wildlife value.	Light: ☼ ◑ Moisture: M W Salinity: N Browse: L	H 6' – 10' S 6' – 10'
Cornus sericea (stolonifera) Redosier dogwood (NE native)	May – July. White flowers, white berries; red twigs (with white pith) and red/maroon fall color; excellent bank stabilizing shrub, sprouts easily from twigs; high wildlife value.	Light: ☼ ◑ Moisture: M Salinity: L Browse: H	H 7' – 9' S 8' – 10'
Gaylussacia baccata Black huckleberry *	May – June. Reddish white flowers; black, bluish seedy berries in the fall; fruit edible; high wildlife value.	Light: ◑ ✹ Moisture: D M Salinity: N Browse: M	H 1' – 3' S 2' – 4'
Hydrangea arborescens Wild hydrangea *	June – August. White flowers on new wood; flowers dry to a tan color and persist; leaves poisonous to humans.	Light: ◑ ✹ Moisture: M W Salinity: Browse:	H 3' – 6' S 4' – 8'

RECOMMENDED PLANT LIST FOR BIORETENTION FACILITIES – Fairfax County, Virginia

Botanical Name **Common Name** **(* = native to Virginia)**	**Time of Bloom and other Characteristics**	**Conditions**	**Mature Size** **Height** **Spread**
Hypericum densiflorum Bushy St. John's wort *	July – September. Yellow, flat topped clusters of flowers; tolerates a variety of moisture conditions.	Light: ☼ ◑ Moisture: D M W Salinity: N Browse:	H 4' – 6' S 3' – 4'
Ilex glabra Inkberry holly *	May – June. Greenish white flowers and black berries in the fall that persist through the winter; male and female flowers on separate plants; high wildlife value; tolerates some flooding.	Light: ☼ ◑ Moisture: M Salinity: M Browse: L	H 6' – 8' S 8' – 10'
Ilex verticillata Winterberry holly *	June – July. Greenish white flowers; red berries in the fall, persistent though the winter; food source for birds; high wildlife value; need male plant to pollinate female in order to bear berries.	Light: ☼ ◑ Moisture: M W Salinity: N Browse: L	H 6' – 10' S 6' – 8'
Itea virginica Virginia sweetspire *	June – July. White flowers with fruit capsules on stalks; plant will sucker and form thickets; tolerates flooding to 6 inches;	Light: ☼ ◑ ✹ Moisture: M W Salinity: N Browse: H	H 3' – 8' S 5' – 10+
Iva frutescens High-tide bush (Jesuit's bark) *	August – October. Greenish white flowers; similar to *Baccharis halimifolia*, but with opposite leaves; tolerates high salinity; grows in brackish and salt marshes. Use in coastal plain east of I-395 only.	Light: ☼ Moisture: M W Salinity: H Browse: L	H 4' – 10' S 6' – 12'
Kalmia latifolia Mountain laurel *	May – July. Showy white to pink purple flowers; shrub of woods, fields, ridge tops, slopes and swamps; performs best in cool locations; evergreen foliage.	Light: ☼ ◑ ✹ Moisture: D M W Salinity: N Browse: L	H 5' – 12' S 5' – 12'
Leucothoe racemosa Fetterbush, swamp sweetbells, gray swamp doghobble *	May – June. White to pinkish bell-shaped flowers borne in dense one-sided clusters; suckering plant that forms thickets; mostly present in coastal plain east of I-395.	Light: ◑ ✹ Moisture: M W Salinity: Browse:	H 4' – 6' S 4' – 6'+

RECOMMENDED PLANT LIST FOR BIORETENTION FACILITIES – Fairfax County, Virginia

Botanical Name **Common Name** **(* = native to Virginia)**	**Time of Bloom and other Characteristics**	**Conditions**	**Mature Size** **Height** **Spread**
Lindera benzoin Northern spicebush *	March – May. Early, small yellow flowers; bright red berries are favored by many birds; stem and leaves very fragrant when crushed; yellow fall color; high wildlife value; butterfly host plant.	Light: ☼ ◑ ✹ Moisture: D M W Salinity: N Browse: M	H 6' – 12' S 6' – 12'
Lyonia ligustrina Maleberry *	May – July. White, globe-shaped clusters of flowers; berry-like capsules persist through winter; evergreen leaves turn orange and red in fall.	Light: ◑ ✹ Moisture: M Salinity: N Browse: L	H 6' - 12' S 10' – 20'
Myrica (Morella) cerifera Small wax myrtle *	March – June. Yellowish-green flowers, bluish-white berries; very fragrant spicy scent, used for candles; waxy evergreen leaves. Use in coastal plain east of I-395 only.	Light: ☼ ◑ Moisture: D M W Salinity: M Browse: L	H 8' – 12' S 8' – 12'
Physocarpus opulifolius Common eastern ninebark *	May – July. White to pink flowers; orange to red capsule; yellow to purple fall color; exfoliating bark adds winter interest; drought tolerant and adaptable.	Light: ☼ ◑ Moisture: M W Salinity: Browse:	H 6' – 10' S 6' – 10'
Rhododendron periclymenoides Pinxterbloom azalea *	April – May. Pink, purple or white flowers. Tolerates thin soils; susceptible to disease and insects.	Light: ☼ ◑ ✹ Moisture: D M Salinity: N Browse: L	H 3' – 10' S 6' – 12'
Rhododendron viscosum Swamp azalea *	May – August. White or pink flowers and brown capsules; fall color yellow, orange to purple; needs acid soil; drought tolerant.	Light: ☼ ◑ Moisture: M W Salinity: N Browse: L	H 3' – 8' S 3' – 8'
Rhus aromatica Fragrant sumac *	March – May. Greenish yellow flowers, dark wine red berry; red fall color; fuzzy edible berry clusters and aromatic leaves; male and female separate plants; high wildlife value.	Light: ☼ ◑ Moisture: D Salinity: Browse:	H 5' – 6' S 6' – 10'
Rhus copallina Shining or winged sumac *	July – September. Greenish yellow flowers, red berry; red fall color; forms large colonies; winter food for wildlife.	Light: ☼ ◑ Moisture: D Salinity: N Browse: L	H 20' – 35' S 10 – 15'

RECOMMENDED PLANT LIST FOR BIORETENTION FACILITIES – Fairfax County, Virginia

Botanical Name **Common Name** **(* = native to Virginia)**	**Time of Bloom and other Characteristics**	**Conditions**	**Mature Size** **Height** **Spread**
Rhus glabra Smooth sumac *	June – July. Greenish flowers, red fuzzy berry clusters; very drought resistant; male and female may be on separate plants; high wildlife value.	Light: ☼ Moisture: D M Salinity: N Browse: L	H 10' – 15' S 10' – 15'
Rosa carolina Pasture rose *	May – June. White to pale pink flowers, red berry-like hips August – March; hips are edible; has thorns.	Light: ☼ ◑ Moisture: D M Salinity: M Browse: M	H 3' – 5' S 6' – 10'
Rosa palustris Swamp rose *	June – August. Pink flowers, red berry-like hips in July-March; hips are edible; has thorns; tolerates flooding; spreads.	Light: ☼ ◑ ✹ Moisture: M W Salinity: N Browse: L	H 6' – 8' S 3' – 4'
Salix sericea Silky willow*	April – May. Small greenish yellow flowers, will tolerate flooding; high wildlife value.	Light: ☼ ◑ Moisture: M W Salinity: N Browse: M	H 10' – 12' S 8' – 12'
Sambucus canadensis Common elderberry *	June – July. Showy white, fragrant flower clusters; blue-black berries August – September; berries are edible; high wildlife value.	Light: ☼ ◑ Moisture: M W Salinity: N Browse: M	H 6' – 12' S 6' – 12'
Spirea alba Narrow-leaved meadowsweet*	June – September. White cone-shaped flower clusters attract butterflies; needs moist soil.	Light: ☼ Moisture: M Salinity: N Browse: L	H 3' – 4' S 3' – 4'
Spirea latifolia Broad-leaved meadowsweet*	June – September. White or pinkish cone-shaped flower clusters attract butterflies; twigs more purplish red then previous species.	Light: ☼ Moisture: M Salinity: N Browse: L	H 3' – 4' S 3' – 4'
Vaccinium angustifolium Lowbush blueberry *	May – June. Tiny white-pink flowers; edible blue-black berries in July-August; red fall color; can be used as a ground cover; good wildlife plant.	Light: ☼ ◑ Moisture: D M Salinity: N Browse: H	H 1' – 2' S 2' – 3'

RECOMMENDED PLANT LIST FOR BIORETENTION FACILITIES – Fairfax County, Virginia

Botanical Name **Common Name** **(* = native to Virginia)**	**Time of Bloom and other Characteristics**	**Conditions**	**Mature Size** **Height** **Spread**
Vaccinium corymbosum Highbush blueberry *	April – June. Tiny white-pink urn-shaped flowers; edible blue-black berries in July-August; yellow to red fall color; commonly cultivated.	Light: ☼ ◑ ✹ Moisture: D M W Salinity: H Browse: M	H 6' – 12' S 6' – 12'
Vaccinium stamineum Deerberry *	April – June. Tiny white-purple flowers; blue-black berries in September – October; berries are edible but sour.	Light: ☼ ◑ Moisture: D M Salinity: N Browse: M	H 3' – 16' S 6' – 12'
Viburnum acerifolium Mapleleaf viburnum *	June. Flat-topped flower clusters are cream to pink; blue-black berries in August – December; tolerates dryness and shade; suckers; orange-purple fall color.	Light: ☼ ◑ ✹ Moisture: D M Salinity: N Browse: M	H 3' – 6' S 3' – 4'
Viburnum dentatum Southern arrowwood *	May – June. White flat-topped flower clusters; blue-black berries September – November; reddish-purple fall color; good winter structure; attracts butterflies and birds.	Light: ☼ ◑ Moisture: D M W Salinity: Browse:	H 6' – 10' S 4' – 8'
Viburnum nudum Smooth witherod viburnum *	June – July. White or cream flowers in flat-toped clusters; berries in September – October appear red then change to blue and finally, black; red-purple fall color; good wildlife plant.	Light: ☼ ◑ ✹ Moisture: D M W Salinity: N Browse: H	H 6' – 18' S 4' – 12'
Viburnum prunifolium Blackhaw viburnum *	April – May. White flowers in flat-topped clusters; July – November blue-black berries; red-purple fall color.	Light: ☼ ◑ ✹ Moisture: D M W Salinity: N Browse: M	H 12' – 16' S 8' – 12'
Trees			
Acer rubrum Red maple *	March – April. Shallow root system; high wildlife value; attractive red flowers and fruit; tolerates moist or dry sites; red/yellow/orange fall color.	Light: ☼ ◑ Moisture: D M W Salinity: L Browse: M	H 60' – 90' S 50' – 75'

RECOMMENDED PLANT LIST FOR BIORETENTION FACILITIES – Fairfax County, Virginia

Botanical Name **Common Name** **(* = native to Virginia)**	**Time of Bloom and other Characteristics**	**Conditions**	**Mature Size** **Height** **Spread**
Amelanchier arborea Downy serviceberry*	March – May. White flowers and red to dark purple fleshy fruit. Used by 58 wildlife species; 35 bird species; important early summer food; edible to people.	Light: ◑ ✹ Moisture: D M Salinity: N Browse: M	H 15' – 25' S 15' – 20'
Amelanchier canadensis Canadian serviceberrry *	April – May. Single or multi-stem; shallow roots, high wildlife value; 4 season interest: white flowers, edible fruit, orange to red fall color; smooth grey bark.	Light: ◑ ✹ Moisture: M W Salinity: N Browse: H	H 35' – 50' S 20' – 25'
Asimina triloba Paw paw *	April – June. Unusual maroon flower; very large leaves; edible yellow fruits relished by wildlife; yellow fall color; moist soil.	Light: ☼ ◑ Moisture: M Salinity: N Browse: L	H 20' – 35' S 20' – 30'
Betula nigra River birch *	April – May. Tolerates wet feet, but is also drought tolerant; interesting catkins; beautiful peeling bark; yellow fall color; high wildlife value; good bank stabilizer; usually disease-free unless old or damaged.	Light: ☼ ◑ Moisture: M W Salinity: N Browse: M	H 50' – 75' S 35' – 50'
Carpinus caroliniana American hornbeam *	April – May. Tolerates sun if soil is moist; tolerates irregular inundation; unique fluted silver-gray bark; yellow, red, or orange fall color; high wildlife value; small slow-growing short-lived understory tree.	Light: ◑ ✹ Moisture: M Salinity: N Browse: L	H 35' – 50' S 30' – 40'
Carya cordiformis Bitternut hickory *	April – May. Grows in dry, moist, or wet soil; yellow fall color; good food source for birds and mammals; strong wood; resistant to wind throw; dense root system with a pronounced taproot.	Light: ☼ Moisture: M W Salinity: N Browse: L	H 60' – 100' S 40' – 60'
Celtis occidentalis Common hackberry *	April – May. Tolerates dry sites and irregular flooding; good food source for birds and mammals; especially important for winter food; host for 7 butterfly species; only host for rare hackberry butterfly; tolerates road salt; yellow fall color; good for bank stabilization.	Light: ☼ ◑ ✹ Moisture: D M W Salinity: N Browse: M	H 40' – 60' S 40' – 60'

RECOMMENDED PLANT LIST FOR BIORETENTION FACILITIES – Fairfax County, Virginia

Botanical Name **Common Name** **(* = native to Virginia)**	**Time of Bloom and other Characteristics**	**Conditions**	**Mature Size** **Height** **Spread**
Cercis canadensis Eastern redbud *	April – May. Tolerates sun if soil is moist; tolerates irregular inundation; flowers pink to lavender prior to emergence of leaves; new leaves reddish; yellow fall color; high wildlife value.	Light: ☼ ◑ ✹ Moisture: D M Salinity: N Browse: L	H 20' – 30' S 20' – 30'
Chamaecyparis thyoides Atlantic white cedar*	March – April. Aromatic evergreen tree with small acute, scale like leaves; bluish cone like fruit; shallow root system makes trees susceptible to wind throw on permanently saturated sites.	Light: ◑ ✹ Moisture: M W Salinity: N Browse: L	H 40' – 50' S 10' – 20'
Chionanthus virginicus White fringetree *	May – June. Clumping or single-stemmed; white, pendulous, fragrant flowers; gold fall color; birds eat fruits; tolerates drought and irregular inundation.	Light: ☼ ◑ ✹ Moisture: D M Salinity: N Browse: M	H 20' – 35' S 15' – 20'
Diospyros virginiana *Common persimmon**	June. Greenish yellow to cream flowers with golden yellow to orange (when ripe) edible fruit in fall; fruit eaten by wide range of wildlife.	Light: ☼ ◑ Moisture: D M Salinity: N Browse: L	H 35' – 50' S 25' – 35'
Fraxinus pennsylvanica Green ash *	April – May. Tolerates drought as well as infrequent flooding; loose purplish flower clusters; male and female flowers on separate plants; yellow to orange fall color; good bank stabilizer.	Light: ☼ ◑ Moisture: D M W Salinity: N Browse: M	H 50' – 70' S 35' – 50'
Hamamelis virginiana American witchhazel *	September – December. Small tree or large shrub. Tolerates irregular flooding or dry sites; yellow fragrant strap-like flowers in fall and early winter; medicinal use.	Light: ◑ ✹ Moisture: D M Salinity: N Browse: L	H 15' – 25' S 15' – 20'
Ilex opaca American holly *	May – June. Evergreen; need both male and female to produce red berries (dioecious); moist to well-drained sandy soil; creamy white flowers; high wildlife value.	Light: ☼ ◑ ✹ Moisture: M Salinity: L Browse: L	H 30' – 50' S 15' – 30'

RECOMMENDED PLANT LIST FOR BIORETENTION FACILITIES – Fairfax County, Virginia

Botanical Name **Common Name** **(* = native to Virginia)**	**Time of Bloom and other Characteristics**	**Conditions**	**Mature Size** **Height** **Spread**
Juniperus virginiana Eastern redcedar *	March – April. Evergreen; tolerates dry or moist sites and a broad range of habitats; red purple flowers; pale green to dark blue cone/like berries consumed by more then 50 varieties of birds.	Light: ☼ Moisture: D M Salinity: L Browse: L	H 35' – 50' S 20' – 35'
Liquidambar styraciflua Sweetgum *	April – May. Tolerates wet soils and a wide range of conditions. Star shaped leaves have spectacular yellow and red fall color; brown capsules contain seeds; eaten by birds and mammals.	Light: ☼ ◑ Moisture: M W Salinity: N Browse: M	H 60' – 100' S 40' – 60'
Liriodendron tulipifera Tulip poplar *	June. Greenish-yellow tulip-like flowers, producing abundant nectar much used by bees; very fast growing tree; seeds eaten by squirrels and a few song birds.	Light: ☼ ◑ Moisture: M Salinity: L Browse: L	H 70' – 100' S 35' – 50'
Magnolia virginiana Sweetbay magnolia *	May – June. Large white to yellow fragrant flowers; small multi-stem tree; red berries; semi-evergreen; wildlife value; will tolerate wet soils.	Light: ☼ ◑ ✹ Moisture: M W Salinity: Browse:	H 15' – 40' S 15' – 25'
Nyssa sylvatica Black gum *	April – June. Greenish white small flowers; tolerates seasonal flooding or dry, rocky uplands; nectar source for honeybees; blue/black berries taken by birds; brilliant scarlet fall color.	Light: ☼ ◑ Moisture: D M W Salinity: L Browse: M	H 30' – 75' S 20' – 50'
Platanus occidentalis American sycamore *	April – June. Tolerates intermittent inundation; white and brown peeling bark; leafs out in late spring; tan/brown balls for fruit; good bank stabilizer; finches eat seeds; nesting cavities.	Light: ☼ ◑ Moisture: M W Salinity: N Browse: L	H 75' – 100' S 75' – 100'
Populus deltoides Eastern cottonwood *	March – April. Tolerates occasional inundation; fast growing; short-lived; golden yellow fall color; can become weedy or invasive; subject to wind and ice damage; shallow root system.	Light: ☼ Moisture: M W Salinity: L Browse: M	H 75' – 100' S 50' – 80'

RECOMMENDED PLANT LIST FOR BIORETENTION FACILITIES – Fairfax County, Virginia

Botanical Name **Common Name** **(* = native to Virginia)**	**Time of Bloom and other Characteristics**	**Conditions**	**Mature Size** **Height** **Spread**
Quercus bicolor Swamp white oak *	May – June. Tolerates seasonal flooding or upland site as well as soil compaction; acorns much prized by wildlife; yellow and sometimes red/purple fall color; shallow root system.	Light: ☼ ◑ Moisture: M W Salinity: L Browse: M	H 60' – 100' S 50' – 75'
Quercus michauxii Swamp chestnut oak *	May. Larval plant for Juvenal's dusky wing butterfly; shallow root system; acorns have high wildlife value; allelopathic (exudes plant growth inhibitors) to understory plants.	Light: ☼ Moisture: M W Salinity: N Browse: M	H 50' – 80' S 75' – 100'
Quercus palustris Northern pin oak *	April – May. Fast-growing large tree; high wildlife value; red fall color; leaves sometimes persist into winter; tolerates seasonal flooding but not consistently wet sites; needs acid soils.	Light: ☼ Moisture: M W Salinity: N Browse: L	H 50' – 80' S 35' – 75'
Quercus phellos Willow oak *	February – May. Fast growing, long lived, large tree; willow like foliage; shallow root system; high wildlife value; red fall color; tolerates seasonal flooding and drought; prefers acidic soil; transplants easily.	Light: ☼ ◑ Moisture: D M W Salinity: N Browse: H	H 80' – 100' S 40' – 75'
Salix nigra Black willow	March – April. Small yellow/green flowers borne in catkins; narrow lance shaped leaves; dense shallow root system excellent for stabilizing eroding land; prefers wet soil; roots sucker readily.	Light: ☼ ◑ Moisture: M W Salinity: N Browse: L	H 35' – 50' S 20' – 35'
Taxodium distichum Bald cypress *	March – April. Deciduous, large, slow growing, long lived conifer; prefers wet sites, but once established also drought tolerant; ducks and marsh birds eat seeds and foliage; buttressed trunk; "knees" grow above water from roots.	Light: ☼ ◑ Moisture: W Salinity: N Browse: L	H 75' – 100' S 25' – 35'
Thuja occidentalis Arborvitae *	May. Dense single stem tree; evergreen; shallow root system; white tailed deer will browse during severe winters; grows on wet and dry sites.	Light: ☼ Moisture: D M W Salinity: N Browse: M	H 50' – 75' S 35' – 50'

RECOMMENDED PLANT LIST FOR BIORETENTION FACILITIES – Fairfax County, Virginia

NOTES:

1. Adapted from Prince George's County, Maryland Bioretention Manual - Bioretention Plant List, updated February 2001.
2. Information was supplemented by the online PLANTS National Database of the Natural Resources Conservation Service, United States Department of Agriculture.
3. Further information was obtained from the following sources:
   - *Native Plants for Wildlife Habitat and Conservation Landscaping: Chesapeake Bay Watershed*. Slattery, Britt E., Kathryn Reshetiloff, and Susan M. Zwicker, Annapolis, MD: U.S. Fish & Wildlife Service, Chesapeake Bay Field Office, 2003
   - *Manual of Woody Landscape Plants: Their Identification Ornamental Characteristics, Culture, Propagation and Uses*. Dirr, Michael A., Champaign, IL: Stipes Publishing L.L.C., 1998.
   - *Native Trees, Shrubs, and Vines for Urban and Rural America.* Hightshoe, Gary L., New York: John Wiley & Sons, Inc., 1988.
   - *Botanica's Annuals & Perennials.* Anna Cheifetz et al, eds., San Diego, CA: Laurel Glen Publishing, 1999.
   - *Perennials: The Definitive Reference.* Roger Phillips & Martyn Rix, Buffalo, NY: Firefly Books Inc., 2002.
   - *A – Z Encyclopedia of Garden Plants.* Christopher Brickell and H. Marc Cathey eds., New York, NY: DK Publishing, Inc., 2004.
   - *Rain gardens: A landscape tool to improve water quality.* Stephanie Keys Golden and Dr. Judith Okay, Charlottesville, VA: Virginia Department of Forestry, 2005

Appendix D: Stream Determination Resources

Included in this appendix are the protocols and checklists for stream determination methods in both Fairfax County, Virginia and the state of North Carolina. Both methods have been approved by the Department of Environmental Quality and for use in the City of Richmond.

Perennial Stream Field Identification Protocol
May 2003

This protocol defines procedures for making field determinations between perennial and intermittent streams. The protocol was developed to support fieldwork for the Fairfax County stream-mapping project. Several existing protocols were used to develop this protocol including:

- Virginia Chesapeake Bay Local Assistant Department's (CBLAD) "Very Rough Draft Guidance for Making Perennial vs. Intermittent Stream Determinations." December 2000.
- North Carolina Division of Water Quality's "Perennial Stream Reconnaissance Protocols" January 2000. Version 2.0. (http://h2o.enr.state.nc.us/ncwetlands/strmfrm.html)
- Williamsburg Environmental Group, Inc. "Qualitative Field Procedures for Perennial Stream Determinations." [unpublished manuscript] Corresponding Author: D.A. DeBerry.
- U.S. Corps of Engineers Branch Guidance Letter No 95-01: Identification of Intermittent versus Ephemeral Streams – Not Ditches. October 1994.

The determination between a perennial and intermittent stream is based on the combination of hydrological, physical and biological characteristics of the stream. Field indicators of these characteristics are classed as primary or secondary and ranked using a weighted, four-tiered scoring system similar to the current system developed by the North Carolina Division of Water Quality (NCDWQ). As discussed below, a stream reach is classified as perennial based on the overall score as well as supporting information such as long term flow monitoring, presence of certain aquatic organisms, or historic information.

DEFINITIONS

Perennial Stream – A body of water flowing in a natural or man-made channel year-round, except during periods of drought. The term "water body with perennial flow" includes perennial streams, estuaries, and tidal embayments. Lakes and ponds that form the source of a perennial stream, or through which the perennial stream flows, are a part of the perennial stream. Generally, the water table is located above the streambed for most of the year and groundwater is the primary source for stream flow. In the absence of pollution or other manmade disturbances, a perennial stream is capable of supporting aquatic life.

Intermittent Stream – A body of water flowing in a natural or man-made channel that contains water for only part of the year. During the dry season and periods of drought, these streams will not exhibit flow. Geomorphological characteristics are not well defined and are often inconspicuous. In the absence of external limiting factors (pollution, thermal modifications, etc), biology is scarce and adapted to the wet and dry conditions of the fluctuating water level.

DATA REVIEW

The following information should be reviewed prior to conducting a field reconnaissance.

- Existing Fairfax County GIS data layers for the generation of 1:250 scale field maps showing project area.
- USGS 7.5-minute quadrangle maps and current USDA Fairfax County Soil Survey.
- County aerial photographs.

- Current weather conditions including date of last rainfall and drought condition using the following sources of data:
  - ✓ Fairfax County-Department of Public Works and Environmental Services currently maintains 10 rain gauge stations within the County (see Appendix A for relative locations).
  - ✓ Dulles airport http://weather.noaa.gov/weather/current/KIAD.html
  - ✓ Regan National Airport http://weather.noaa.gov/weather/current/KDCA.html
  - ✓ Virginia State Climatology Office http://climate.virginia.edu/
  - ✓ Virginia DCR Drought Monitor: http://www.deq.state.va.us/info/drought.html
  - ✓ U.S. Drought Monitor http://www.drought.unl.edu/dm/index.html
  - ✓ The National Weather Service http://205.156.54.206/er/lwx/index.htm

FIELD RECONNAISSANCE

General Procedures

- The field protocol was developed for use throughout the year, with an expected amount of redundancy to account for seasonal variation. March through May represents the optimum time period to observe key biological species and normal flow conditions. The dry season (July through September) represents the ideal time to observe stream flow. Streams that contain flow during the dry period are likely to be perennial assuming normal precipitation conditions. However, the final determination of perenniality should be based on an evaluation of the hydrological, physical, and biological field indicators defined below.

- Preliminary stream reaches should be identified on the generated maps prior to field observations. The maps should include all pertinent GIS data layers including streams, roads, building footprints, parcels, parking lots, RPAs, topography, stormwater structures, sanitary sewer structures, etc.. By studying the maps before field investigations, more information can be ascertained about land uses and landscape characteristics in contributing drainage areas, as well as access issues and sampling logistics.

- Field reconnaissance should begin within the existing RPA or from the upstream point of flow to confirm the presence of a perennial stream. Proceed to a point where there is a significant change in the hydrological, geomorphological, or biological conditions of the stream. For example, a confluence with a flowing tributary. Document grade controls and headcuts on the 1:250-scale field map and on the field data sheet. Also document on the maps where flow begins and whether it is from a groundwater seep/spring or outfall. These features along with site scores and other reach characteristics will ultimately be used to determine the break point between perennial and intermittent stream reaches. It has been observed that flow may stop at a point and begin again some distance downstream. Therefore, reconnaissance should continue until obvious intermittent or ephemeral stream characteristics are noted (lack of strong evidence of continuous drainage channel, dry channel, etc.). After walking upstream and documenting the aforementioned features, investigators should then have a good idea where individual stream

***Figure 1**: Example of a headcut where perennial stream flow begins.*

reach breaks lie. At this point sampling reaches may be established and subsequent data sheets filled out.

- Complete a data sheet for each catchment. Determinations are made on a representative stream reach by examining at least 200 feet and not a single point. A reach should have similar physical characteristics and may be bounded by an upstream and downstream tributary, grade control, other physical feature (headcut, pipe, etc), or an obvious change in channel characteristic (sinuosity, slope, etc). The upper limits of a reach will define the upper limits of a perennial stream. Document the location of the reach and site ID on the field map and data sheet. See Appendix B for a list of feature and reach codes.

Equipment

- Camera
- 16 inch Oakfield probe or Dutch Auger
- Sharpshooter spade
- D-frame dip net/white sorting tray (optional, but may be necessary in Coastal Plains)
- Polarized sunglasses (optional)
- Munsell Soil Color Charts
- GIS-generated site maps (approximately 1 inch = 250 feet)
- Virginia Save Our Streams Benthic Macroinvertebrate Field Sheets: *http://www.sosva.com/download_the_field_sheets_for_th.htm*
- Vegetation Field Guides (Examples):
  Harlow, William M. *Trees of the Eastern and Central United States and Canada.* New York: Dover Publications, Inc., 1942.
  Hurley, Linda M. *Field Guide to the Submerged Aquatic Vegetation of Chesapeake Bay.* U.S. Fish and Wildlife Service, 1992.
  Magee, Dennis W. *Freshwater Wetlands, A Guide to Common Indicator Plants of the Northeast.* Amherst: The University of Massachusetts Press, 1981.
  Newcomb, Lawrence. *Newcomb's Wildflower Guide.* Boston: Little, Brown and Company, 1977.
  Petrides, George A. *Peterson Field Guides Series-A Field Guide to Trees and Shrubs, Northeastern and north-central United States and southeastern and south-central Canada.* Boston: Houghton Mifflin Company, 1958.
  Tiner, Ralph W. *Field Guide to Nontidal Wetland Identification.* Cooperative Publication. Annapolis: Maryland Department of Natural Resources; Newton Corner: U.S. Fish and Wildlife Service, 1998.

FIELD INDICATORS

When assessing the field indicators, in addition to the individual descriptions given below, the amount of time and effort involved in locating and identifying the features described must be factored into each ranking. Use the following time/effort guidelines in conjunction with the detailed ranking parameters for each indicator in assessing the strong, moderate, weak or absent description and assigning the associated scores. *Note*: "strong" does not always mean a strong indication of perenniality. Some indicators, such as leaflitter in streambed, will receive a score of zero for "strong".

Strong - Found easily and consistently throughout the reach.
Moderate - Found with little difficulty but not consistently throughout the reach.
Weak - Takes 10 or more minutes of extensive searching to find.
Absent - Indicator is not present.

Streamflow and Hydrology

1. **Presence or absence of flowing water, >48 hours since last rainfall:** Preferably, flow observations should be taken at least 48 hours after the last rainfall. Local weather data and drought information should be reviewed before evaluating flow conditions. See Data Review section, above, for weather data sources.

   Perennial streams will have water in their channels year-round in the absence of drought conditions. If a stream exhibits flowing water in the height of the dry season (mid-summer through early fall), then it probably conveys water perennially. On the other hand, a stream that does not exhibit flow during periods of increased rainfall would indicate an intermittent or ephemeral flow. Flow is more readily observed in the riffles and very shallow, higher-velocity areas of the stream. Dropping a floating object on the water surface will aid in determining if flow is present.

   Strong - Flow is highly evident throughout the reach. Moving water is easily seen in riffles and runs.
   Moderate - Moving water is easily seen in riffle areas but not as evident throughout the runs.
   Weak - Flow is barely discernable in areas of greatest gradient change (i.e. riffles) or floating object is necessary to observe flow.
   Absent - Water present but there is no flow; dry channel with or without standing pools.

2. **Presence of high groundwater table or seeps and springs:** Groundwater Table: The presence of a high groundwater table or discharge (i.e. seeps or springs) indicates a relatively reliable source of water to a nearby stream. Indicators of a high groundwater table include visual observation of inundation or soil saturation in the floodplain. Indicators of a high water table can be observed by digging a hole in the adjacent floodplain approximately two feet away from the streambed. The presence of water seeping into the hole (usually a slow process) or the presence of hydric soils indicates the presence of a high groundwater table. Use the *Munsell Soil Color Charts* book to determine the chroma of the soil matrix/mottles in the hole. Low chroma soils or mottled soils are good indicators of a high groundwater table*. Hydric soils in the sides of a channel or headcut are also indicators of groundwater discharge. High groundwater tables are commonly found in the Coastal Plain as well as portion of the Triassic Basin within areas with low relief. Seeps: Seeps have water dripping or slowly flowing out from the ground or from the side of a hill or incised stream bank. Springs: Look for "mushy" or very wet, and black decomposing leaf litter nearby in small depressions or natural drainage ways. Springs and seeps often are present at grade controls and headcuts. The presence of this indicator suggests that the stream is continually being recharged by a groundwater source unless during a period of drought. Score this category based on the abundance of these features observed within the reach.

   Strong - Spring, seep or groundwater table is readily observable throughout reach.
   Moderate - Springs, seeps or groundwater table are present, but not abundant throughout reach.
   Weak - Indicators are present, but require considerable time to locate.
   Absent - No springs or seeps present and no indication of a high groundwater table.

*For more information on chroma and redox-morphic features, see following geomorphology section.

3. **Leaflitter in streambed:** Are leaves (freshly fallen or older leaves that may be "blackish" in color and/or partially decomposed) accumulating in the streambed? Perennial streams (with deciduous riparian vegetation) should continuously transport plant material through the channel. Leaves and lighter debris will predominate throughout the length of non-perennial stream channels, whereas there will be little to no leaves present in the stronger flowing areas (riffles) with small accumulations on the upstream side of obstructions. This indicator may be hindered during autumn sampling in

between rain events. This is a secondary hydrologic indicator. *Note the reversal of score on the data sheet.*

Strong - Abundant amount of leaf litter is present throughout the length of the stream.
Moderate - Leaf litter is present throughout most of the stream's reach with some accumulation beginning on the upstream side of obstructions and in pools.
Weak - Leaf litter is present and is mostly located in small packs along the upstream side of obstructions and accumulated in pools.
Absent - Leaf litter is not present in the fast moving areas of the reach but there may be some present in the pools.

4. **Drift lines or wrack lines:** Twigs, sticks, logs, leaves, trash, plastics, and any other floating materials piled up on the upstream side of obstructions in the stream, on the streambank, in overhanging branches, and/or in the floodplain indicate high stream flows. Unless downstream of a stormdrain, non-perennial streams usually exhibit fewer or no drift lines within their channels. This is a secondary hydrologic indicator of perenniality.

   Strong - Large drift lines are prevalent along the upstream side of obstructions within the channel and the floodplain.
   Moderate - Large drift lines are dispersed mostly within the stream channel.
   Weak - Small drift lines are present within the stream channel.
   Absent - No drift lines are present.

5. **Sediment on debris or plants:** Are plants in the stream, on the streambank, or in the floodplain stained white, gray, red, or brown, with sediment? Look for silt/sand accumulating in thin layers on debris or rooted aquatic vegetation in the runs and pools. Be aware of upstream land-disturbing construction activities, which may contribute greater amounts of sediments to the stream channel, and can confound this indicator. Note these activities on the data sheet. This is a secondary hydrologic indicator.

   Strong - Sediment found readily on plants and debris within the stream channel, on the streambank, and within the floodplain throughout the length of the stream.
   Moderate - Sediment found on plants or debris within the stream channel although not prevalent along the stream. Mostly accumulating in pools.
   Weak - Sediment is isolated in small amounts along the stream.
   Absent - No sediment is present on plants or debris.

Geomorphology

1. **Riffle-Pool sequence**: A repeating sequence of riffle/pool (or riffle/run in lower-gradient streams) can be observed readily in perennial streams. This morphological feature is always present to some degree in higher gradient streams such as the piedmont streams that predominate much of Fairfax County. This is a result of sediment transport and the work of channel-shaping hydrologic forces. Riffle-Shallow, turbulent areas along narrower portions of a stream where the water has a tendency to churn and flow rapidly. In smaller streams, riffles are defined as areas of a distinct change in gradient where flowing water can be observed. Pool-Areas of slow moving water, where the stream widens and deepens. Along the stream reach, take notice of the frequency between the riffles and pools. Keep in mind that because of higher gradients, riffles are more frequent in the Piedmont physiographic province than in the Coastal Plains and many parts of the Triassic Basin.

   Strong - Demonstrated by an even and frequent number of riffles followed by pools along the entire reach. There is an obvious transition between riffles and pools.
   Moderate - Represented by a less frequent number of riffles and pools. Distinguishing the transition between riffles and pools is difficult.
   Weak - Streams show some flow but mostly have areas of pools or mostly areas of riffles.
   Absent - There is no sequence exhibited, or there is no flow in the channel.

2. **USDA Texture in stream bed/Substrate Sorting:** Observe the substrate comprising the bottom of the streambed. In pristine stream environments with a normal flow regime, substrate movement is highly dependent upon particle size; heavier substrate material (sands, gravel and cobbles) tends to remain in place while the finer silts and clays are transported quickly downstream. In urban and suburban areas, however, storm outfalls often drain runoff directly to the channel, and the highly erosive flash flows associated with heavy storm events remove all sized particles, and the channel quickly becomes incised. Although the distinction between the two situations should be kept in mind, the manner in which the remaining particles settle out will be consistent, and the question becomes, "is there an even distribution of various sized substrates throughout the reach or does partitioning occur (See Appendix C)?" The occurrence of depositional features will be infrequent in intermittent streams. Perennial streams, on the other hand, tend to exhibit correspondingly larger depositional features, with cobble/gravel/boulders being localized in riffles and runs, and with accumulations of fine sediments settling out in pools.

   Strong - There is a clear distribution of various sized substrates. Depositional features are present, finer particles are absent or accumulate in pools, and larger particles are located in the riffles/runs.
   Moderate - Various sized substrates are present but represented by a higher ratio of larger particles (cobble/gravel/rock). Small depositional features are present; small pools are accumulating some sediment.
   Weak - Substrate sorting is not readily observed. There may be some small depositional features present on the downstream side of obstructions (large rocks, etc…).
   Absent – Substrate sorting is absent. There are few depositional features.

3. **Natural levees**: Levees develop when sand or silt is deposited relatively parallel to the top of the bank. These aid in the concentration of water to the channel during periods of high flow. They are represented as large "mounds", "hills", or broad low "ridges" that may be covered by vegetation or remain as bare areas. Scoring is based on the presence and length of the levee through the stream reach.

4. **Sinuosity**: How much does the stream bend and curve? Is the channel meandering? Has the stream been straightened by human influence (i.e. piping, ditching, stormdrains, farming, roads, etc…). If so, is the stream beginning to meander around deposited sediments *within* its channelized banks? Sinuosity is the ratio of the stream channel length (SL) to the down-valley length (VL). The higher the ratio (SL/VL), the more sinuous the stream. Sinuosity is the result of the stream naturally dissipating its flow forces. Intermittent streams don't have a constant flow regime, and as a result exhibit a significantly less sinuous channel morphology. While ranking, take into consideration the size of the stream, which may also influence the stream wavelength. Sinuosity may be visually estimated, or approximated using a map and a map-wheel.

   Strong - Ratio > 1.4. Stream has numerous, closely-spaced bends, very few straight sections.
   Moderate - Ratio ≤ 1.4. Stream has good sinuosity with some straight sections.
   Weak - Ratio ≤ 1.2. Stream has very few bends and mostly straight sections.
   Absent - Ratio = 1.0. Stream is completely straight with no bends.

5. **Active (or Relic) Floodplain**: Floodplains are relatively flat areas usually located outside of or adjacent to the stream bank that accumulate organic matter and alluvium deposited during flooding. An active floodplain shows characteristics such as drift lines, sediment deposited on the banks or surrounding plants, which may also be flattened by flowing water. In cases of severe channel incision (down-cutting) the stream's new floodplain may be restricted to within the channel itself, and its disconnected (relic) floodplain will be harder to see (outside of channel). In these instances, look for

indicators along the sides and within the incised channel. In either case, there should be evidence of a floodplain if the stream has perennial flow.

Strong - The area displays all of the aforementioned characteristics.
Moderate - Most of the characteristics are apparent.
Weak - The floodplain is not obvious, however some of the indicators are present.
Absent - The characteristics are not present.

6. **Braided Channel**: Occurs in shallow, low gradient areas where abundant sediment has a tendency to build up, crosscutting the stream creating a braided pattern.

   Strong - The stream displays a braided appearance with many crossings creating many "islands".
   Moderate - The stream displays a braided pattern however, it does not cross many times and only has a few "islands".
   Weak - The braided pattern is present but the stream only crosses one or two times creating only one or two "islands".
   Absent - The gradient is too high such that the water is flowing too quickly in order to create a braided channel.

7. **Recent Alluvial Deposits:** Alluvium may be deposited as sand, silt, various sized cobble, and gravel. Observe whether or not there is any recent deposition or accumulation of these substrates within the stream channel (sand and point bars) or floodplain. The amount of alluvium deposited will indicate whether water is constantly pushing substrate downstream and will also determine ranking. Keep in mind that eroding stream channels influenced by stormwater drains/outfalls will likely score higher than natural channels for this indicator.

   Strong - Large amounts of sand, silt, cobble, and/or gravel alluvium present in the channel and in the floodplain.
   Moderate - Large to moderate amount of sand, silt, cobble, and/or gravel mostly present in the stream channel.
   Weak - Small amounts of sand, silt, and/or small cobble present within the channel.
   Absent - There is no sand or point bars present within the stream channel and no indication of overbank deposition within the floodplain.

8. **Bank-full Bench present:** When a stream channel conveys perennial flow, the forces of channel scouring and deposition create certain distinct physical features, which can be readily observed. One of these features includes scoured areas along the bank above which the stream banks are much less eroded. Another feature is accumulations sand or silt creating a bar or "bench" which may or may not be covered with vegetation. The former should be fairly continuous along the length of the stream's banks and should be seen at roughly the same elevation as the top of any sediment bars (where the stream bank slope begins to increase dramatically). Please see Figure 2 below.

***Figure 2**: Examples of bank-full elevation (bench) in a second order, perennial stream.*

Bank-full indicators imply that the channel experiences a relatively continuous hydrologic regime and is in dynamic equilibrium with the shaping forces of its water/sediment load. The flow regime, soils and grade determine the bank-full width and morphology of the conveyance channel. The more obvious and continuous the bank-full features are throughout the reach, the higher the score should be.

Strong - Bank-full indicators are obvious throughout the sample reach.
Moderate - Indicators are present throughout most of the reach.
Weak - Indicators are infrequent along sampling reach.
Absent - Indications of a bank-full bench are completely lacking.

9. **Continuous bed and bank:** Throughout the length of the stream, is the channel well defined by having a clearly discernable bank and streambed? The clarity of this indicator lessens upstream as the stream becomes ephemeral.
   Strong - There is a continuous bed and bank throughout the length of the stream channel.
   Moderate - The majority of the stream has a continuous bed and bank. However, there are obvious interruptions.
   Weak - The majority of the stream has obvious interruptions in the continuity of bed and bank. However, there is still some representation of the bed and bank sequence.
   Absent - There is little or no ability to distinguish between the bed and bank.

10. **Second order or greater *channel*:** The higher the channel order the more likely the stream is to be perennial. Stream order should be based on available information and evaluated in the field. The primary map sources to be use include the Fairfax County Soil Survey and the most recent Fairfax County GIS hydrography data layer. Second order flowing streams are almost always perennial, while second order channels are usually in the intermittent/perennial zone. It is often difficult to evaluate stream order on channels starting at a stormwater outfall. Based on field observations, these channels are considered 1st order. However, a review of historic data such as the County Soil Survey may indicate that the order is greater.
    YES - One or more first order channels are draining into the stream above sampling reach.
    NO – There are no first order inputs above sampling reach.

Streambed Soils

The soils indicators described here were taken from the wetland delineation procedures set forth in the 1987 US Army COE Manual:

Environmental Laboratory. (1987). "Corps of Engineers Wetlands Delineation Manual," Technical Report Y-87-1, U.S. Army Engineer Waterways Experimentation Station, Vicksburg, Miss.

1. **Redox-morphic features:** Iron found in the matrix of soil continuously inundated with water cannot come in contact with the oxygen in the air and thus stays in the reduced ferrous (Fe^{2+}) valence state. This is seen as a grayish soil matrix. If the soil goes through a wetting/drying phase (as with intermittent or ephemeral streambeds), the iron will oxidize once in contact with atmospheric O_2 to form the ferric (Fe^{3+}) valence state. This is seen as the classic iron oxide or "rust" red color mottling within the matrix (see Figure 3). This is a redox-morphic feature. Use a Dutch

Figure 3: *Iron oxidized mottling of a gleyed soil matrix.*

auger or Oakfield probe to obtain a 12 to 14-inch deep core of the streambed soil. This may be impossible in some very rocky bottom streams. In this case try to bore in at an angle where the stream bank meets the substrate. If this fails, the soils indicators are not applicable (N/A) and should not be scored. Be sure to split the soil pedon apart in many places to look for these small pockets of oxidized soil iron. Sometimes "oxidized rhizospheres" or higher colored mottles surrounding root cavities in the soil will be easily observed. Tiny (<2 mm), hard manganese or iron concretions in the matrix are also redox-morphic features. In inundated soils and wetlands, redox-morphic features are absent. Redox-morphic features are usually absent, or very difficult to observe in high chroma soils. However, the absence of redox features in these soils is not an indicator of inundation. Caution must be used when scoring this indicator in non-gleyed soils. In sandy soils, redox-morphic features are uncommon or very difficult to identify. In these instances look for organic matter distributed evenly throughout the matrix. Organic matter is moved downward through sandy soils as the water table fluctuates. As a result, dark organic streaks can be seen in most ephemeral and intermittent stream soils, which contain substantial amounts of organic materials. When soil from a darker area is rubbed between the fingers, the organic matter will leave a stain.

Scoring is ranked purely on the presence or absence of these features.

2. **Chroma:** Mineral soils which are exposed to atmospheric oxygen in the soil profile will have some degree of oxidation occurring and as a result will have bright red, orange, or yellow matrix colors (See Figure 4). Saturated soils, such as those found in the streambeds of perennial streams, have limited or no contact with O_2, will remain reduced and subsequently have a very dull color chroma or may be gleyed completely (dull gray hues or chroma throughout soil ped). See Figure 5. The soil sample should be representative of the major stream bed/bank soil type observed throughout the sample reach. Use the Munsell Color Charts book to determine the chroma of the soil matrix. The soil matrix is defined as the dominant soil constituent (>50%). Low chroma values (<2) or gleyed soils indicate continual saturation, while brightly colored soils or mottles (>2) indicate only short periods of wetting, typical of intermittent or ephemeral streambed soils or upland soils.

Figure 4: *A high chroma soil matrix*

Figure 5: *Completely gleyed, low-chroma soil matrix.*

Strong - Gleyed soils
Moderate - Matrix chroma of 1.
Weak - Matrix chroma of 2.
Absent - Matrix chroma of 2 or greater.

Vegetation

When ranking the presence of rooted aquatic plants in channel, periphyton/green algae and iron oxidizing bacteria/fungus use the following:

Strong - Found easily and consistently throughout the reach.
Moderate - Found with little difficulty but not consistently throughout the reach.
Weak - Takes 10 or more minutes of extensive searching to find.
Absent - Indicator is not present.

1. **Rooted AQUATIC plants in channel:** Aquatic plants rooted in the substrate can be described as SAV and floating leaved plants. Some of the most common found are Water Lilies (*Nymphaeaceae*). Use wetland plant/aquatic plants field identification guides for appropriate designations.

2. **Presence of Periphyton/Green Algae:** These forms of algae and aquatic mosses are attached to the substrate, and are visible as a pigmented mass or film, or sometimes hairlike growths on submerged surfaces of rocks, logs, plants and any other structure within the stream channel. These life forms require an aquatic environment to persist. Periphyton growth is influenced by chemical disturbances such as increased nutrient (N and P) inputs and physical disturbances such as increased sunlight to the stream from riparian zone disturbances.

3. **Iron Oxidizing Bacteria/Fungus:** Iron oxidizing bacteria/fungus in streams derives energy by oxidizing iron, originating from groundwater, in the ferrous form (Fe^{2+}) to the ferric form (Fe^{3+}). In large amounts, iron-oxidizing bacteria/fungus discolors the stream substrate giving it a red appearance. In small amounts, it can be observed as an oily sheen on the water's surface. This indicates that the stream is being recharged from a groundwater source, and these features are most commonly seen at seeps or springs.

4. **Wetland plants in streambed:**
   The U.S. Army Corp of Engineers wetland delineation procedure utilizes a plant species classification system upon which soil moisture regimes can be inferred. This same system can be used to determine the duration of soil saturation in streams. All wetland designations are defined by *1988 National List of Vascular Plant Species That Occur in Wetlands*, U.S. Fish and Wildlife Service.** Perennial indicator scores (0 through 3) corresponding to each class of vegetation are listed on field data sheet

   SAV - (Submerged Aquatic Vegetation) grows completely underwater.
   Example: Coontail (*Ceratophyllum demersum*)
   Mostly OBL - Obligate wetland plants are almost always found in a wetland (estimated probability is greater than 99 percent) and any EAV (Emergent Aquatic Vegetation)
   Examples: Skunk Cabbage (*Symplocarpus foetidus*), Cattail (*Typha spp.*)
   Mostly FACW - Facultative wetland plants are mostly found in wetlands (estimated probability is 67 to 99 percent).
   Example: Cardinal flower (*Lobelia cardinalis*)
   Mostly FAC - Facultative plants are equally likely to occur in wetlands or non-wetlands (estimated probability is 34 to 66 percent).
   Example: Southern Lady Fern (*Athryium felix-femina*)
   Mostly FACU (1 to 33% probability), UPL (0 – 1% probability), or no plants in streambed.

**Reed, Jr., Porter B. 1988. National List of Plant Species That Occur in Wetlands: National Summary. U.S. Fish & Wildlife Service. Biol. Rep. 88 (24). 244 pp.

Has been updated to 1996 National Listing (1998 revision still pending approval). Available at http://www.nwi.fws.gov/bha

USDA/NRCS 1994 synonymized checklist - PLANTS database:
Available at http://plants.usda.gov/index.html

Benthic Macroinvertebrates

When checking for the presence or absence of Benthic Macroinvertebrates, clams and crayfish, follow these procedures based on physiographic province.

Turn over the rocks and other large substrate found in areas of visible flowing water, (i.e. riffles) and scan the undersides for benthic macroinvertebrates. Also observe the newly disturbed area where the rock once was for signs of movement. This method may be more suitable for the Piedmont and Triassic Basin provinces where riffles predominate. For the lower gradient Coastal Plain and other areas of slow moving water, benthic macroinvertebrates may be located in a variety of habitats including root wads, undercut banks, pools, leaf-packs, and submerged aquatic vegetation (SAV). Note that some benthic macroinvertebrates will make small debris/sand cases, which can be covered with periphyton and easily confused for excess debris picked up from the substrate.

All macroinvertebrates should be identified to order, using the Virginia Isaac Walton League Save Our Streams Bug ID Charts, available at http://www.sosva.com/download_the_field_sheets_for_th.htm. For Ephemeroptera, Plecoptera, and Trichoptera (EPT), samples should be identified to the lowest taxonomic level possible and noted on the back of the field data sheet. Samples can be retained for further analysis in the laboratory. If clams, crayfish or amphibians are found in the sample then also fill out the respective lines on the datasheet. Several samples should be taken to accurately assess the reach's benthic community.

When ranking the presence of benthic macroinvertebrates and bivalves, use the following:

Strong - Indicator is easily found in all samples.
Moderate - Only takes a few samples to locate indicator.
Weak - Sampling takes 10 minutes or more to locate indicator.
Absent - Indicator is not present.

1. **Benthic Macroinvertebrates:** The larval stages of most aquatic insects are good indicators that the stream is perennial because they require a continuous aquatic habitat until maturity. Crayfish and other crustaceans, as well as aquatic worms and snails are also included under this indicator. The existence of crayfish can also be detected by the presence of "crayfish chimneys" (an extruded tunnel of clay) seen on the stream banks. Follow the sampling/identification procedures detailed above. When scoring, take note of the quantity as well as the diversity of your macroinvertebrate sample. Because some of the species observed are not strict indicators of a constant aquatic regime, this is a secondary indicator of perenniality.

2. **Bivalves:** Clams require a constant aquatic environment in order to survive. Incorporate the search for bivalves while looking for other benthic macroinvertebrates. This indicator also includes any empty shells found on stream banks and within the channel.

3. **Ephemeroptera, Plecoptera, and Tricoptera (EPT) taxa:** The larval stages of many species of these three orders require a period of at least a year, submerged in a constantly flowing aquatic environment before reaching maturity and therefore are commonly associated with perennial streams. Studies conducted by North Carolina State University have found that benthic samples collected in intermittent streams frequently display crustaceans (crayfish, isopods, and amphipods) as the dominant order. Downstream, where the stream has perennial characteristics, EPT taxa were collected. In highly urbanized areas, these indicators may be absent due to the degraded nature of the stream and, therefore, cannot be used to evaluate perennial or intermittent flow conditions. North Carolina State University is continuing to work on a list of specific genus that exhibit aquatic larval stages requiring a year before maturity. West Virginia's Department of Environmental Protection also maintains a list of macroinvertebrate species that have an extended aquatic life stage. These lists

should be consulted (family or genus level ID) before applying points to the reach score, because some genus, such as the baetis mayflies for example, are very ephemeral in their aquatic life stages.

Presence/Absence

Vertebrates

When ranking the presence of all vertebrates, use the following:

Strong - Indicator is readily visible in all prime habitats.
Moderate - Indicator is evident in smaller numbers. Some prime habitat is not occupied.
Weak - Indicator is not readily visible, requires 10 or more minutes to locate. Very sparse.
Absent - Indicator is not found.

1. **Fish:** The drastically fluctuating water levels of intermittent streams provide unstable and stressful habitat conditions for fish communities. Only a small number of species will opportunistically inhabit available areas within intermittent streams. Therefore, the presence of fish is used as a secondary indicator of perenniality. When looking for fish, all available habitats should be observed, including pools, riffles, root clumps, and other obstructions (to greatly reduce surface glare, the use of polarized sunglasses is recommended). In small streams, the majority of species usually inhabit pools and runs. Fish should be easily observed within a minute or two. Also, fish will seek cover once alerted to your presence, so be sure to look for them slightly ahead of where you are walking along the stream. Again, check several areas along stream sampling reach.

2. **Amphibians:** Newts, frogs, salamanders and tadpoles can be found under rocks, on streambanks and on the bottom of the stream channel. They may also appear in the benthic sample. Frogs will alert you of their presence by jumping into the water for cover, usually following an audible "squeak". Frogs and tadpoles typically inhabit the shallow, slower moving waters of the pools and near the sides of the bank. Amphibian eggs, also included as a minor indicator, can be located on the bottom of rocks and in or on other submerged debris. They are usually observed in gelatinous clumps or strings of eggs. Frog eggs will be much more prevalent in the springtime. Identify the species of amphibian or describe in detail the characteristics observed. A persistent water regime is not an exclusive requirement for all amphibious species, therefore this is a secondary indicator of perenniality.

Overall Score Interpretation

The final determination of whether a stream reach is perennial is based on a preponderance of information including the total score, supporting information and professional judgment. Based on the results of the pilot survey conducted in the Fall of 2001 and Spring 2002, a minimum total score of 25 was set as a guideline for classifying a stream as perennial. Higher scores indicate that a channel has more perennial characteristics. Streams with lower scores can be classified as perennial; however, other supporting information such as biological indicators should be used in making the final determination.

The total score can be affected by seasonal or hydrologic conditions as well as man-made impacts associated with activities in the watershed. For example, a reach may score less in drought conditions due to the lack of biological and/or certain hydrologic indicators. However, a reach may score higher on certain indicators, such as drift lines and alluvial deposits, if directly below a stormwater outfall. The final determination of perenniality must take these factors into account. If a stream is recognized as borderline, reaches upstream and downstream should be assessed to better evaluate the changes in stream classifications along a channel. Additional supporting information can be used with the total score to make the final determination. This supporting information includes:

Observation of flow: Observation of flow under certain seasonal or hydrologic conditions can directly support classifying a stream reach as intermittent or perennial.

Conditions supporting a perennial stream classification include:

- Stream reaches with flow during the dry season (July through September) or periods of drought are likely perennial. The longer the period from the last rainfall the stronger the presence of flow supports the perennial stream determination. Although the presence of flow during a drought indicates perennial conditions, care must be taken in evaluating the upper limits of perenniality because some perennial streams may only contain isolated pools of water or be dry during periods of drought.

Key biological indicators: As discussed under the biological criteria, the presence of aquatic organisms whose life cycle requires residency in flowing water for extended periods (especially those one year or greater) is a strong indication that a stream reach is perennial. A qualified aquatic biologist/environmental scientist should evaluate the presence and abundance of such macroinvertebrates and vertebrates species before determining the final stream classification.

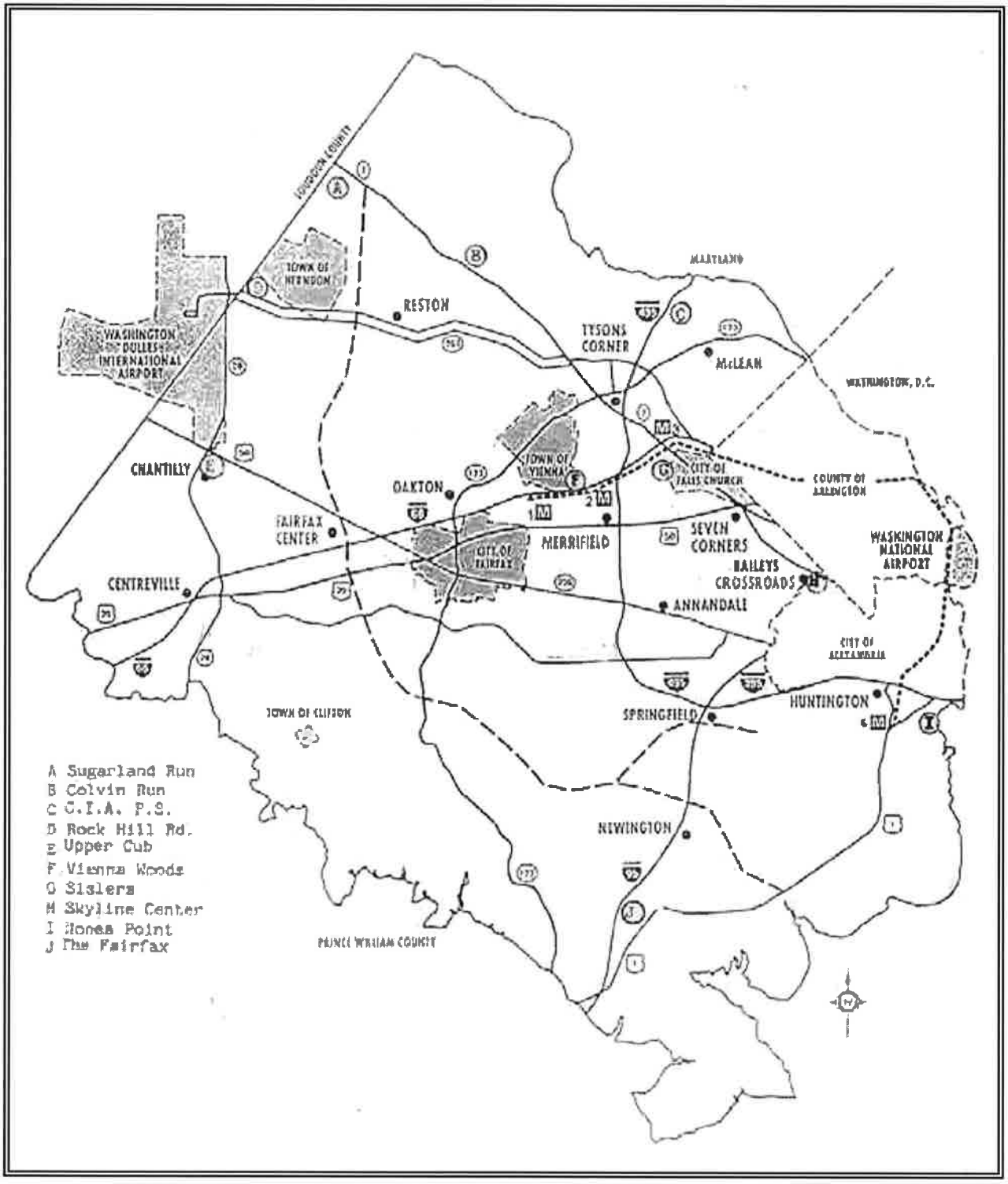
Other supporting information: Other data to be considered in determining the final stream classification includes:

- Information provided by a long-term resident and/or local professional who has observed the stream during the various seasons and hydrologic conditions.
- Review of historic information such as aerial photography or the Fairfax County Soil Survey. Based on the pilot field surveys and initial countywide surveys, many of the streams shown as perennial (solid lines) on the County Soil Survey have been determined to be perennial using the field protocol.

Professional judgment should be used in conjunctions with the total score and supporting information in making the final determination.

APPENDIX A.

FAIRFAX COUNTY-DEPARTMENT OF PUBLIC WORKS AND ENVIRONMENTAL SERVICES, WASTEWATER MANAGEMENT DIVISION'S RAIN GAUGE STATION LOCATIONS



APPENDIX B.

FEATURE/REACH CODES

FEATURES WITHIN REACH

TYPE	*CODE*
Beaver Dam	BDM
Concrete Ditch (trickle ditch)	CCD
Construction Activity	CON
Damaged Structure or Utility	DAM
Does Not Exist	DNE
Dry Pond Here	DPD
Dry Pond Intake	DPI
Dry Pond Outfall	DPO
Fish Present	FSH
Flow stops (point of drying)	POD
Grade Control (natural or artificial)	GRC
Grassy Drainage Swale	GSW
Groundwater Seep or Spring	GSP
Headcut	HCT
Non-Perennial Channel (Eph/Int) + date	NPC
Other (make comments)	OTH
Picture taken here + date	PIC
Point of Flow	POF
Rip-Rap Channel	RRC
Road Culvert	RCU
Roadside Ditch	RSD
Standing Pools Only (no connecting flow)	POL
Stormwater Drain (Inlet)	SDI
Stormwater Drain (Outfall)	SDO
Stream No longer Exists (gone or piped)	NLE
Unsurveyed Area	UNS
Utility Easement (state type if necessary)	ESM
Utility or Path Crossing	XNG
Wetland or Marshy Area	WTL
Wet Pond Here	WPD
Wet Pond Intake	WPI
Wet Pond Outfall	WPO

REACH END POINTS

TYPE	*CODE*
Arbitrary Point Chosen	ARB
Beaver Dam	BDM
Channel Changes	CCH
Dry Pond Intake	DPI
Dry Pond Outfall	DPO
Grade Control (natural or artificial)	GRC
Groundwater, Spring or Seep	GSP
Headcut	HCT
Other (make comments)	OTH
Point of Flow	POF
Property Boundary (public or private)	PBY
Resource Protection Area	RPA
Road Culvert	RCU
Stormwater Drain (Inlet)	SDI
Stormwater Drain (Outfall)	SDO
Tributary (or Confluence)	TRB
Utility Easement (state type if necessary)	ESM
Utility or Path Crossing	XNG
Wetland or Marshy Area	WTL
Wet Pond Intake	WPI
Wet Pond Outfall	WPO

APPENDIX C.

PARTICLE SIZE CLASSIFICATION AND DESCRIPTION

Adapted from *Stream Hydrology-An Introduction for Ecologists*
Nancy D. Gordon, Thomas A. McMahon, Brian L. Finlayson

Classification	Description
Silt/Clay	Size range is less than 0.06 mm
Sand	Size range is 0.06 - 2 mm
Gravel	Size range is 2-4 mm
Pebble	Size range is 4-64 mm
Cobble	Size range is 64-256 mm
Boulder	Size range is greater than 256 mm
Bedrock	

Date:_____ Recorder:_____

Time:_____ Evaluators:_____

Field Indicators:

I.) Streamflow and Hydrology	Absent	Weak	Moderate	Strong
1.) Presence or absence of flowing water and > 48 hrs since last rainfall	0	1	2	3
2.) Presence of high groundwater table or seeps and springs	0	1	2	3
3.) Leaflitter in streambed	1.5	1	0.5	0
4.) Drift lines	0	0.5	1	1.5
5.) Sediment on debris or plants	0	0.5	1	1.5

Total Streamflow and Hydrology Points: _____

II.) Geomorphology	Absent	Weak	Moderate	Strong
1.) Riffle-pool sequence	0	1	2	3
2.) Substrate Sorting (USDA texture in streambed)	0	1	2	3
3.) Natural Levees	0	1	2	3
4.) Sinuosity	0	1	2	3
5.) Active or Relic Floodplain	0	1	2	3
6.) Braided Channel	0	1	2	3
7.) Recent Alluvial Deposits	0	1	2	3
8.) Bankfull Bench present	0	1	2	3
9.) Continuous Bed and Bank	0	1	2	3
10.) 2nd order or greater **channel** present	***Yes*** = 3		***No*** = 0	

Total Geomorphology Points: _____

III.) Streambed Soils				
1.) Redoximorphic features present in sides of channel or head cut.	***Present*** = 0		***Absent*** = 1.5	
2.) Chroma	gleyed = 3	1 = 2	2 = 1	> 2 = 0

Total Streambed Soils Points: _____

IV.) Vegetation	Absent	Weak	Moderate	Strong
1.) Rooted AQUATIC Plants in Streambed	0	1	2	3
2.) Presence of Periphyton/green algae	0	1	2	3
3.) Iron Oxidizing Bacteria/Fungus	0	0.5	1	1.5

4.) Wetland Plants in Streambed (Skip if no plants present in streambed)

SAV = 3 Mostly OBL = 1.5 Mostly FACW = 1 Mostly FAC = 0.5 Mostly FACU, UPL, or None = 0

Total Vegetation Points: _____

Comments:

Front Page Total _____ points

V.) Benthic Macroinvertebrates	Absent	Weak	Moderate	Strong
1.) Benthic Macroinvertebrates	0	0.5	1	1.5
2.) Bivalves	0	1	2	3
3.) EPT taxa	***Present*** = 3			***Absent*** = 0

Total Benthic Macroinvertebrates Points: _____

VI.) Vertebrates	Absent	Weak	Moderate	Strong
1.) Fish	0	0.5	1	1.5
2.) Amphibians	0	0.5	1	1.5

Total Vertebrates Points: _____

Total Score:

Benthics/Amphibians Found:

Weather

Rain Gauge_____ Date of Last Rainfall_____ Rainfall Amount_____

Reach Description

Upstream: TRE HCT GRC RCL POF SDC ARE RPA Other: _____

Downstream: TRE HCT GRC RCL POF SDC ARE RPA Other: _____

Comments:

Storm Network Connections and Watershed Observations

Riparian Buffers Width

LB: Distance >25 feet 26-50 51-75 76-100 100+
Cover type: Tree Shrub Herbaceous Lawn Other:
Dominant Species:

RB: Distance >25 feet 26-50 51-75 76-100 100+
Cover type: Tree Shrub Herbaceous Lawn Other:
Dominant Species:

Riparian Buffer Comments

Other Observations and Comments:

Is the reach perennial? ☐ **YES** ☐ **NO**

Photo #	Direction (US, DS, LB, RB)	Notes

North Carolina
Division of Water Quality

Identification Methods for the Origins of Intermittent and Perennial streams

Version 3.1

Effective Date: February 28, 2005

This document should be cited as:

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Further Information can be obtained from:

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Copies of this document are available through the internet:

http://h2o.enr.state.nc.us/ncwetlands/regcert.html

Michael F. Easley, Governor

William G. Ross Jr., Secretary
North Carolina Department of Environment and Natural Resources

Alan W. Klimek, P.E. Director
Division of Water Quality

February 28, 2005

TO: All Interested Parties

FROM: Coleen Sullins, Deputy Director, NC Division of Water Quality

RE: Identification Methods for the Origins of Intermittent and Perennial Streams

The North Carolina Division of Water Quality (DWQ) has reviewed and made changes to the field methodologies used to identify the origins of intermittent and perennial streams. These changes are effective immediately and include:

1) Improvements to the field manual and rating form used to identify stream origins.

2) The addition of specific macroinvertebrate taxa that may be used to identify perennial streams.

Previously, the DWQ had used the "INTERNAL GUIDANCE MANUAL -- N.C. DIVISION OF WATER QUALITY STREAM CLASSIFICATION METHOD January 19, 1999, Version 2.0" for identifying intermittent streams, and a separate policy "Guidance for the Determination of the Origin of Perennial Streams, Version 2.3) for identifying perennial streams." During 2004, staff from the DWQ reviewed and improved both methods and solicited comments from the public. As a result both methods were combined into one document: Identification Methods for the Origins of Intermittent and Perennial Streams Version 3.1. This version was field tested during a Surface Water Identification Training and Certification (SWITC) Class during November and December 2004.

Effective immediately the methods discussed in Identification Methods for the Origins of Intermittent and Perennial Streams Version 3.1 should be used for intermittent and perennial stream origins. This document is available through the DWQ's website at: http://h2o.enr.state.nc.us/ncwetlands/regcert.html.

cc: DWQ Regional Wetland Contact
Steve Kroeger

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"Streams are gutters down which flow the ruins of continents."
Luna Leopold

PURPOSE

The purpose of this manual and accompanying field form is to identify and score geomorphic, hydrological and biological stream features that distinguish between ephemeral, intermittent and perennial streams. Section 1 pertains details on the field method and rating form that can be used to identify intermittent or perennial streams. Version 3.1 of the manual replaces Version 2.0 (January 19, 1999) and reflects five years of additional regulatory and academic experience. Changes are limited to organization and clarification and do not result in any changes in interpretation of scores. Section 2 provides details on the procedure and information needed to determine if a stream is perennial.

SECTION 1 – Stream Identification Method and Rating Form

Introduction

A stream can be described as flowing surface water in a channel resulting from:

- *Stormflow* – increased streamflow resulting from the relatively rapid runoff of precipitation from the land as interflow (rapid, unsaturated, subsurface flow), overland flow, or saturated flow from raised near surface water tables close to the stream, or
- *Baseflow* – low flow resulting from delayed discharge of ground water into the stream between rainfall events, or
- A combination of both stormflow and baseflow, and
- Contributions of discharge from upstream tributaries as stormflow or baseflow, if present.

Streams may exhibit both stormflow and baseflow characteristics as they flow from their origins to their destinations. This manual and accompanying field form can be used to identify points on the landscape that represent stream origins as well as stream, channel and flow characteristics resulting from these varying sources of water.

Streams are drainage features that often change from ephemeral to intermittent and intermittent to perennial along a gradient or continuum—sometimes with no single distinct point demarcating these transitions. In order to distinguish ephemeral streams from intermittent ones or intermittent streams from perennial ones using the information presented in this guide, the field evaluator should have experience making geomorphic, hydrological and biological observations in headwater streams. Determinations must not be made at one point without first walking up and down the channel. This initial examination allows the evaluator to examine and study the nature of the channel, observe characteristics of the watershed, and observe characteristics that indicate what source of water (stormflow, or baseflow plus tributary discharge, if present) may predominately or solely contribute to flow. Once these observations are made, the investigator can determine the areas along the stream channel where these various

sources of water (stormflow or groundwater) predominate flow and the constancy of flow (i.e. ephemeral, intermittent and perennial). As a general rule of thumb, several hundred feet (sometimes more) of channel should be walked to make these determinations. These initial observations aid in determining the magnitude (absent, weak, moderate or strong) of specific parameters.

All stream systems are characterized by interactions among hydrologic, geomorphic (physical) and biological processes. Variations in these characteristics along the length of a stream can help distinguish what source of water predominately contributes to flow. Thus, attributes of these three processes (geomorphic, hydrologic and biologic) are used in this stream identification methodology to produce a numeric score. The score is then used to assign a stream type such as "ephemeral" "intermittent" or "perennial" to the stream reach being evaluated.

Initially, the earliest versions of this manual and form were used to distinguish ephemeral, intermittent and perennial features of streams no matter where in the landscape the stream segment under consideration was located. Accordingly, the form and manual could conceivably be used on high order (e.g. 3rd, 4th, or higher) streams. However, these higher order streams are always perennial. Therefore, the persistence of water and flow has never been debated in these high order streams. Attributes of stream channels in headwaters or low order (1st, 2nd) streams can be subject to debate. Thus, this form and manual are best applied to these smaller streams. Beginning users of this manual and form should visit a variety of headwater streams, look for the geomorphic, hydrologic and biologic features discussed here, and gain experience observing the magnitude and variability of these features.

Background

The main purpose of the first version of the stream identification manual and scoring form was to derive a relationship between a score and the persistence of water or the size of a stream or river. The method has been used to distinguish ephemeral, intermittent, or perennial streams in low order (1st or 2nd) streams. However, characteristics found more commonly (but not exclusively) in higher order streams such as braided channels and stream levees remain in the manual.

This stream evaluation method is intended to distinguish (identify) ephemeral streams from intermittent streams and intermittent streams from perennial streams. The numerical rating system format was developed based on requests from the regulated community in North Carolina for an objective method of stream identification. In addition, this method has served as the basis of similar endeavors elsewhere e.g. Fairfax County, Virginia: (http://www.co.fairfax.va.us/dpwes/watersheds/perennial.htm) Results from over 300 individual field trials conducted in the Piedmont and Coastal Plain portions of the Neuse River Basin, North Carolina during May, June, July and August of 1998, as well as field testing conducted during December 1998 and January 1999 have supported a minimum score of 19.0 to distinguish ephemeral channels from intermittent streams. Scores less than 19.0 indicate ephemeral channels, whereas scores 19.0 or greater indicate that at least an intermittent channel is present. A score of 30 or more points is one factor that may be used to determine the presence of a perennial stream (see Section 2 – Guidance for the Determination of the Origin of Perennial Streams, page 29).

Definitions

The definitions of ephemeral, intermittent and perennial streams are found in North Carolina's administrative code and are also provided below. Complete language for the rules can be found at: (http://ncrules.state.nc.us/ncadministrativ /title15aenviron /default.htm) The definition of an intermittent stream refers to a stream channel only containing water for part of the year (typically winter and spring). Therefore the term "water table" that was used in the intermittent stream definition refers to the seasonal high water table in the riparian zone soil adjacent to the stream.

Ditch – 'Ditch or canal' means a man-made channel other than a modified natural stream constructed for drainage purposes that is typically dug through inter-stream divide areas. A ditch or canal may have flows that are perennial, intermittent, or ephemeral and may exhibit hydrological and biological characteristics similar to perennial or intermittent streams. 15A NCAC 02B .0233(2)(c)

Ephemeral Stream – Ephemeral (stormwater) stream means a feature that carries only stormwater in direct response to precipitation with water flowing only during and shortly after large precipitation events. An ephemeral stream may or may not have a well-defined channel, the aquatic bed is always above the water table, and stormwater runoff is the primary source of water. An ephemeral stream typically lacks the biological, hydrological, and physical characteristics commonly associated with the continuous or intermittent conveyance of water. 15A NCAC 02B .0233(2)(d)

Intermittent Stream – Intermittent stream means a well-defined channel that contains water for only part of the year, typically during winter and spring when the aquatic bed is below the water table. The flow may be heavily supplemented by stormwater runoff. An intermittent stream often lacks the biological and hydrological characteristics commonly associated with the conveyance of water. 15A NCAC 02B .0233(2)(g)

Modified Natural Stream – 'Modified natural stream' means an on-site channelization or relocation of a stream channel and subsequent relocation of the intermittent or perennial flow as evidenced by topographic alterations in the immediate watershed. A modified natural stream must have the typical biological, hydrological, and physical characteristics commonly associated with the continuous conveyance of water. 15A NCAC 02B .0233(2)(h)

Perennial Stream – Perennial stream means a well-defined channel that contains water year round during a year of normal rainfall with the aquatic bed located below the water table for most of the year. Groundwater is the primary source of water for a perennial stream, but it also carries stormwater runoff. A perennial stream exhibits the typical biological, hydrological, and physical characteristics commonly associated with the continuous conveyance of water. 15A NCAC 02B .0233(2)(i)

Groundwaters – "Groundwaters" means those waters occurring in the subsurface under saturated conditions. 15A NCAC 02L .0102 (11)

Water Table – "Water table" means the surface of the saturated zone below which all interconnected voids are filled with water and at which the pressure is atmospheric. 15A NCAC 02L .0102 (27)

Perched Water Table – "Perched water table" means a saturated soil horizon or horizon subdivision, with a free water surface periodically observed in a bore hole or shallow monitoring well, but generally above the normal water table, or may be as identified by drainage mottles or redoximorphic features, and caused by a less permeable lower horizon. 15A NCAC 18A .1935 (29)

Seasonal High Water Table – "Seasonal High Water Table" means the highest level that groundwater, at atmospheric pressure, reaches in the soil in most years. The seasonal high water table is usually detected by the mottling of the soil that results from mineral leaching. 15A NCAC 02H .1002 (15)

Sources of Variability

Spatial and temporal variations in stream attributes occur within and among stream systems. Perhaps the most predominate sources of variation within a stream system are the downstream changes in stream attributes related to increasing persistence and volume of flow and the temporal variation of flow related to precipitation variability and seasonal changes in evapotranspiration. The rate and duration of flow in stream channels is influenced by climate and by recent weather. Recent (within 48 hours) rainfall can influence scoring; therefore it is *strongly* recommended that field evaluations be conducted at least 48 hours after the last known rainfall. However, please note that the identification method has been designed with redundancy to allow for reasonably accurate ratings even after a recent rainfall.

Sources of variation among stream systems are due primarily to geology or soils (physiographic province) with interactions due to precipitation and climate. For example, riffles and pools result from in-channel structures and these structures can vary between rocks and boulders in the mountains and roots and wood debris in the coastal plain. Other examples of variability include the magnitude (height) of head cuts, which are greater in watersheds with greater relief.

Ditches and Modified Natural Streams

In North Carolina it may be difficult to differentiate between a man-made ditch and a natural stream that has been modified (e.g. straightened or relocated). There are a variety of techniques that can be employed to help with this distinction. The topographic lines depicted on a USGS topographic map may indicate a natural valley in which a natural stream could be present. Generally topographic crenulations (the 'folding' of contour lines) with angles 90^{o} or less can be indicative of the presence of streams. In addition an NRCS county soil survey may show the presence of linear (i.e. parallel to a stream channel) soil series, which are indicative of alluvial deposits.

Suggested Field Equipment

Soil auger – used to determine if hydric soils are present.
Small net – used to catch aquatic insects.
Global Positioning System (GPS) – used to determine latitude and longitude.
Camera – used to photograph and document site features.

Scoring

When the evaluator and landowner agree that the feature under investigation is a man-made ditch, then scoring is not necessary. In addition, the evaluator may determine scoring is not necessary when best professional judgment leads the evaluator to conclude that the feature is a man-made ditch and not a modified natural stream.

Identification of stream type is accomplished by evaluating 29 different attributes of the stream and assigning a numeric score to each attribute. A scoring sheet (last page of this manual) is used to record the score for each attribute and determine the total numeric score for the stream under investigation. The sheet specifically requests information for Date, Project, Evaluator, Site, County, Other (Quad Name), and Latitude and Longitude. However any other pertinent observations should also be recorded on this sheet. These may include the amount and date of the last recent rain, hydrologic unit codes, or evidence of stream modifications. The scoring sheet is an official record, so all pertinent observations should be recorded on it.

Scores should reflect the persistence of water with higher scores indicating intermittent and perennial streams. A four–tiered, weighted scale used for evaluating and scoring each attribute addresses the variability of stream channels. The scores, "Absent", "Weak", "Moderate", and "Strong" are applied to sets of geomorphic, hydrologic and biological attributes. The score given to an attribute reflects the evaluator's judgment of the average degree of development of the attribute along a reach of the stream at least 100 ft long. These categories are intended to allow the evaluator flexibility in assessing variable features or attributes. In addition, the small increments in scoring between gradations will help reduce the range in scores between different evaluators. The score ranges were developed in order to better assess the often gradual and variable transitions of streams from ephemeral to intermittent.

Previous versions of this form used a "yes" / "no" format and was found by NC Division of Water Quality staff and by the regulated community to be inadequate to properly encompass and assess the natural variability encountered when making stream identifications in the field. "Moderate" scores are intended as an approximate qualitative midpoint between the two extremes of "Absent" and "Strong." The remaining qualitative description of" Weak" represents gradations that will often be observed in the field.

Definitions of Absent, Weak, Moderate and Strong are provided in Table 1. These definitions are intended as guidelines and the evaluator must select the most appropriate category based upon experience and observations of the stream under review, its watershed, and physiographic region.

Table 1. Guide to scoring categories

Category	Description
Absent	The character is not observed
Weak	The character is present but you have to search intensely (i.e., ten or more minutes) to find it
Moderate	The character is present and observable with mild (i.e., one or two minutes) searching
Strong	The character is easily observable

A. Geomorphic Indicators

1. Continuous Bed and Bank

Throughout the length of the stream, is the channel clearly defined by having a discernable bank and streambed?

The bed of a stream or river or creek is the physical confine of the normal water flow. The lateral constraints (channel margins) during all but flood stage are known as the stream banks. In fact, a flood occurs when a stream overflows its banks and partly or completely fills its flood plain. As a general rule, the bed is that part of the channel below the "normal" water line, and the banks are that part above the water line; however, because water flow varies, this differentiation is subject to local interpretation. Usually the bed is kept clear of terrestrial vegetation, whereas the banks are subjected to water flow only during unusual or infrequent high water stages, and therefore can support vegetation much of the time. This indicator will lessen and may diminish or become fragmented upstream as the stream becomes ephemeral.

Strong – There is a continuous bed and bank present throughout the length of the stream channel.

Moderate – The majority of the stream has a continuous bed and bank. However, there are obvious interruptions.

Weak – The majority of the stream has obvious interruptions in the continuity of bed and bank. However, there is still some representation of the bed and bank sequence.

Absent – There is little or no ability to distinguish between the bed and bank.

2. *Sinuosity*

Is the stream channel sinuous throughout the reach being evaluated?

Sinuosity is a measure of a stream's "crookedness." Specifically, it is the total stream length measured along the stream thalweg (deepest part of the channel) divided by the valley length (Figure 1). The greater the number, the higher the sinuosity. Sinuosity is related to slope gradient along the channel. Natural undisturbed streams with steep channel slope gradients have low sinuosities, and streams with low channel slope gradients typically have high sinuosities.

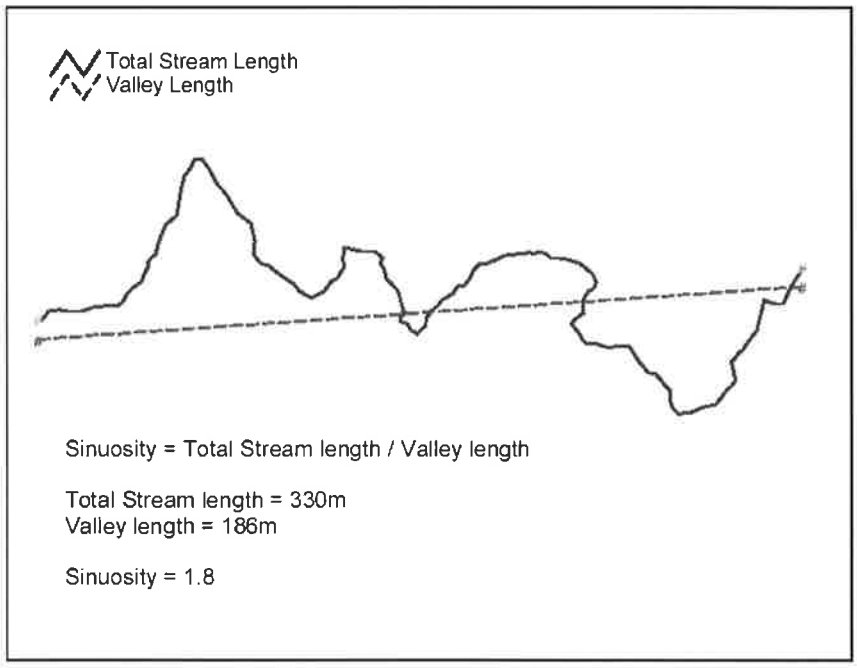


Figure 1. Stream sinuosity

Sinuosity is the result of the stream naturally dissipating its flow forces. Intermittent streams don't have a constant flow regime, and as a result generally exhibit a significantly less sinuous channel than farther downstream in the perennial stream. While ranking, take into consideration the size of the stream and its watershed, which may also influence the stream wavelength. Sinuosity should be visually estimated or measured in the field. Sinuosities of small headwater streams approximated from maps or aerial photos are usually not of sufficient accuracy. Examples are provided in Figure 2.

Strong – Ratio > 1.4. Stream has numerous, closely-spaced bends, very few straight sections.

Moderate – 1.2 < Ratio < 1.4. Stream has good sinuosity with some straight sections.

Weak – 1.0 < Ratio < 1.2. Stream has very few bends and mostly straight sections.

Absent – Ratio = 1.0. Stream is completely straight with no bends.

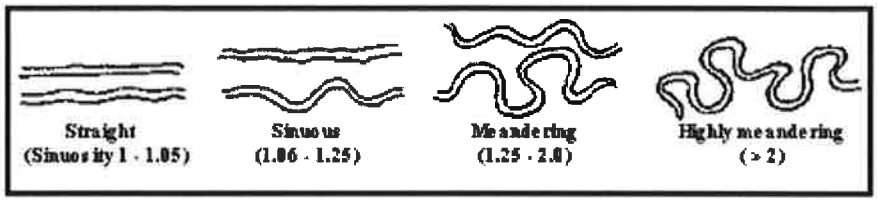


Figure 2. Examples of stream sinuosity

3. *In-channel Structure -- Riffle-Pool Sequences*

Is there a regular sequence of riffles and pools or other erosion/deposition structural features in the channel indicative of frequent high flows?

A repeating sequence of riffle/pool (riffle/run in lower-gradient streams, ripple/pool in sand bed streams, or step/pool in higher gradient streams) can be observed readily in perennial streams. This morphological feature is almost always present to some degree in higher gradient streams such as piedmont and mountain streams. Riffle-run (or ripple-run) sequences in low gradient streams, such as those in the coastal plain are often created by in-channel woody structure such as roots and woody debris. When present, these characteristics can be observed even in a dry stream bed by closely examining the local profile of the channel.

A riffle is a zone with relatively high channel slope gradient, shallow water, and high flow velocity and turbulence. In smaller streams, riffles are defined as areas of a distinct change in gradient where flowing water can be observed. The bottom substrate material in riffles contains the largest sedimentary particles that are moved by bankfull flow (bedload). A pool is a zone with relatively low channel slope gradient, deep water, and low velocity and turbulence. Fine textured sediments generally dominate the bottom substrate material in pools. Along the stream reach, take notice of the spacing and frequency of the riffles and pools or other types of instream structures. Riffles are more frequent in the mountain and piedmont physiographic provinces than in the coastal plain and many parts of the Triassic Basin.

Strong – Demonstrated by an even and frequent number of riffles followed by pools along the entire reach. There is an obvious transition between riffles and pools.

Moderate – Represented by a less frequent number of riffles and pools. Distinguishing the transition between riffles and pools is difficult.

Weak – Streams show some flow but mostly have areas of pools or mostly areas of riffles.

Absent – There is no sequence exhibited.

4. Soil Texture or Stream Substrate Sorting

Has channel erosional downcutting penetrated through the soil profile? Is the texture of the bottom substrate different (i.e. much coarser) than that of the soil in the adjacent floodplain? Is there evidence of sorting of the bottom substrate materials, indicative of frequent high flows?

This feature can be examined in two ways. The first is to determine if the soil texture in the bottom of the stream channel is similar to the soil texture outside the channel. If this is the case, then there is evidence that erosive forces have not been active enough to down cut the channel and support an intermittent or perennial stream. Soils in the bed of ephemeral channels typically have the same or comparable soil texture as areas close to but not in the channel. Accelerated stormflow resulting from development may produce deep, well-developed ephemeral or intermittent channels but which have little or no coarse bottom materials indicative of upstream erosion and downstream transport. The bottom substrate of intermittent or perennial streams often have accumulations of coarse sand and larger particles.

The second way this feature can be examined is to look at the distribution of the soil particles in the substrate in the stream channel. Is there an even distribution of various sized substrates throughout the reach or does partitioning or sorting occur? In the coastal plain one may need to look for size variations among sand grains – for instance, coarse versus fine sand. The occurrence of depositional features will be infrequent in intermittent streams. Perennial streams, on the other hand, tend to exhibit correspondingly larger depositional features, with cobble/gravel/boulders being localized in riffles and runs, and with accumulations of fine sediments settling out in pools.

Note, however, the usefulness of this attribute may vary among physiographic provinces. For instance, in the coastal plain or sandhills, the variability in the size of soil particles is less than in the piedmont and mountains.

Table 2. Standard USDA particle sizes

	Diameter	
Description	millimeters (mm)	inches (in.)
fine sand	0.1-0.25	.004-.01
medium sand	0.25-0.5	.01-.02
coarse/very coarse sand	0.5-2.0	.02-.08
pebbles (gravel)	2-75	.08-3.0
cobbles	75-250	3.0-9.8
stones	250-600	9.8-23.6
boulders	> 600	> 23.6

Strong – There is a well-incised channel through the soil profile with relatively coarse-textured bottom sediments compared to riparian zone soils: coarse sand, gravel, or cobbles in the piedmont; gravel, cobbles, stones, or boulders in the mountain regions, and medium or coarse sand in the coastal plain. There is a clear distribution of various sized substrates. Depositional features are present, finer particles are absent or accumulate in pools, and larger particles are located in the riffles/runs.

Moderate – There is a well-developed channel but it is not deeply incised through the soil profile. Some coarse-textured bottom sediments are present that indicates downstream transport. Relatively little sorting of fine material from coarser materials. Small depositional features are present; small pools are accumulating some sediment.

Weak – The channel is poorly developed, and incised only part way through the soil profile. Some coarse textured bottom sediments are present, but substrate sorting is not readily observed. There may be some small depositional features present on the downstream side of obstructions (large rocks, etc.).

Absent – The channel is poorly developed, very little to no coarse textured bottom sediments are present, and substrate sorting is absent. There are few to no depositional features.

5. *Active/Relic Floodplain*

Is there an active floodplain at the bankfull elevation or is there evidence of recent channel incision with a relic floodplain above the current bankfull elevation?

Floodplains are relatively flat areas usually located outside of or adjacent to the stream bank that accumulate organic matter and inorganic alluvium deposited during flooding. An active floodplain (at current bankfull elevation) shows characteristics such as drift lines, sediment deposited on the banks or surrounding plants, which may also be flattened by flowing water. In cases of severe channel incision (down-cutting) the stream's new floodplain may be restricted to within the channel itself and the previous but now disconnected (relic) floodplain will be harder to see (outside of the channel). In these instances, look for indicators along the sides and within the incised channel. Floodplains on smaller order, incised streams may not be continuous but rather may be present in some locations and absent in others. In many cases there should be evidence of a floodplain if the stream has perennial flow.

Strong – The area displays all of the aforementioned characteristics.

Moderate – Most of the characteristics are apparent.

Weak – The floodplain is not obvious, however some of the indicators are present.

Absent – The characteristics are not present.

6. *Depositional Bars or Benches*

Are there well-developed depositional benches or bars, the top of which at the transition to the bank is approximately at bankfull elevation?

When a stream channel conveys perennial flow, the forces of channel scouring and deposition create certain distinct physical erosional and depositional features, which can be readily observed. One of these features includes scoured areas along the bank above which the stream banks are much less eroded and below which little or no vegetation is present. Another feature is accumulations of sand or silt creating a bar or "bench" which may or may not be covered with vegetation. The former should be fairly continuous along the length of the stream's banks and should be seen at roughly the same elevation as the top of any sediment bars (where the stream bank slope begins to increase dramatically).

The presence of deposition bars or benches imply that the channel experiences a relatively continuous hydrologic regime and is in dynamic equilibrium with the shaping forces of its water/sediment load. The flow regime, soils and grade determine the bankfull width and morphology of the conveyance channel. The more obvious and continuous these deposition features are throughout the reach, the higher the score should be. Depositional features are often absent on very small channels. Sometimes there may be depositional features along the side of the channel, the tops of which are significantly below bankfull elevation. These features should not receive as many points as well-developed bankfull benches, but should receive some points.

> *Bankfull benches: Experience has shown that this attribute may cause confusion among persons making stream geomorphology observations, thus this attribute was renamed to "Depositional bars or benches." Bankfull flow is the stormflow volume that forms the channel and transports the greatest quantity of sediment. The bankfull (sometimes spelled as "bankful") stage can be defined as the point at which the flow just begins to enter the active floodplain. Thus there are a variety of indicators that can be used to identify this point.*

Strong – Depositional bars or benches are obvious throughout the sample reach.

Moderate – Indicators are present throughout most of the reach.

Weak – Indicators are infrequent along sampling reach.

Absent – Indications of depositional bars or benches are completely lacking.

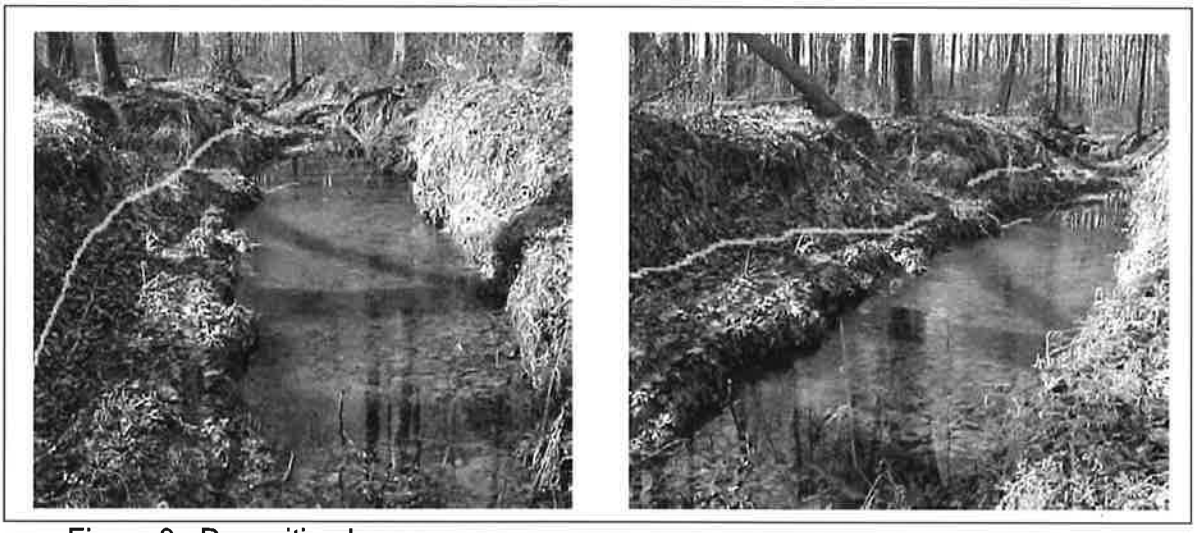


Figure 3. Deposition bars (source: http://www.co.fairfax.va.us/dpwes/watersheds/ps_protocols.pdf)

7. *Braided Channel*

Is there a reach with multiple channels present in a low gradient area of sedimentation?

Braided channels occur in shallow, low gradient areas where abundant sediment has a tendency to build up across the stream creating a braided pattern of channels and an extensive floodplain. Are there two or more small stream channels that cross or "braid" over one another? This usually occurs in areas where the land flattens significantly and where there is abundant sediment supply in a wide streambed with shallow water flow.

Strong – The stream displays a braided appearance with many crossings creating many "islands".

Moderate – The stream displays a braided pattern; however, it does not cross many times and only has a few "islands".

Weak – The braided pattern is present but the stream only crosses one or two times creating only one or two "islands".

Absent – The gradient is too high such that the water is flowing too quickly in order to create a braided channel.

8. *Recent Alluvial Deposits*

Are there fresh deposits of alluvial materials that have been transported and deposited on surfaces in the stream channel or on the floodplain by recent high flows?

Alluvium may be deposited as sand, silt, various sized cobble, and gravel. Observe whether or not there is any recent deposition or accumulation of these substrates within the stream channel (sand and point bars) or floodplain. The amount of alluvium deposited will indicate whether water is constantly pushing substrate downstream. Keep in mind that eroding stream channels influenced by stormwater drains/outfalls may score higher than undisturbed channels for this indicator.

Strong – Large amounts of sand, silt, cobble, and/or gravel alluvium present in the channel and in the floodplain.

Moderate – Large to moderate amount of sand, silt, cobble, and/or gravel mostly present in the stream channel.

Weak – Small amounts of sand, silt, and/or small cobble present within the channel.

Absent – There are no sand or point bars present within the stream channel and no indication of overbank deposition within the floodplain.

Figure 4. Recent alluvial deposits.

Striped stick is 1.0 m long, painted in decimeters and lying on the streambed
Note: rooted herbaceous plants in streambed

9. Natural Levees

Are well developed natural levees present on the active or relic floodplain?

Levees develop on the bank top adjacent to the stream when sand is deposited relatively parallel to the top of the bank from flood flows. These result from the deposition of heavier particles immediately adjacent to the channel as flood waters leave the channel. Natural levees are broad low ridges that may be covered by vegetation or remain as bare areas. Scoring is based on the presence and length of the levee through the stream reach.

It may be necessary to distinguish between natural levees and spoil piles. Spoil piles are created when a stream is ditched, when a ditch is created, or when sediment is removed from a stream. When natural levees are present, they will occur along both stream banks in generally equal heights. However spoil piles most often occur along only one stream bank. There may be times when it is difficult to distinguish between natural levees and spoil piles, and in these cases this must be noted on the field scoring sheet.

10. Head Cut

Is there a head cut at the upstream end of the reach being evaluated? Are there one or more head cuts within the reach being evaluated?

A head cut is an abrupt vertical drop in the bed of a stream channel that is an active erosion feature. It often resembles a small intermittent waterfall (or a miniature cliff) and will have a deep pool at the base resulting from the high energy, turbulent waterfall produced during high flows. Intermittent or perennial streams sometimes begin at a head cut in the piedmont and mountains. Head cuts are transient structures of the stream and often exhibit relatively rapid upstream movement during periods of high erosion rates. Groundwater seepage may also be present from the face or base of a head cut.

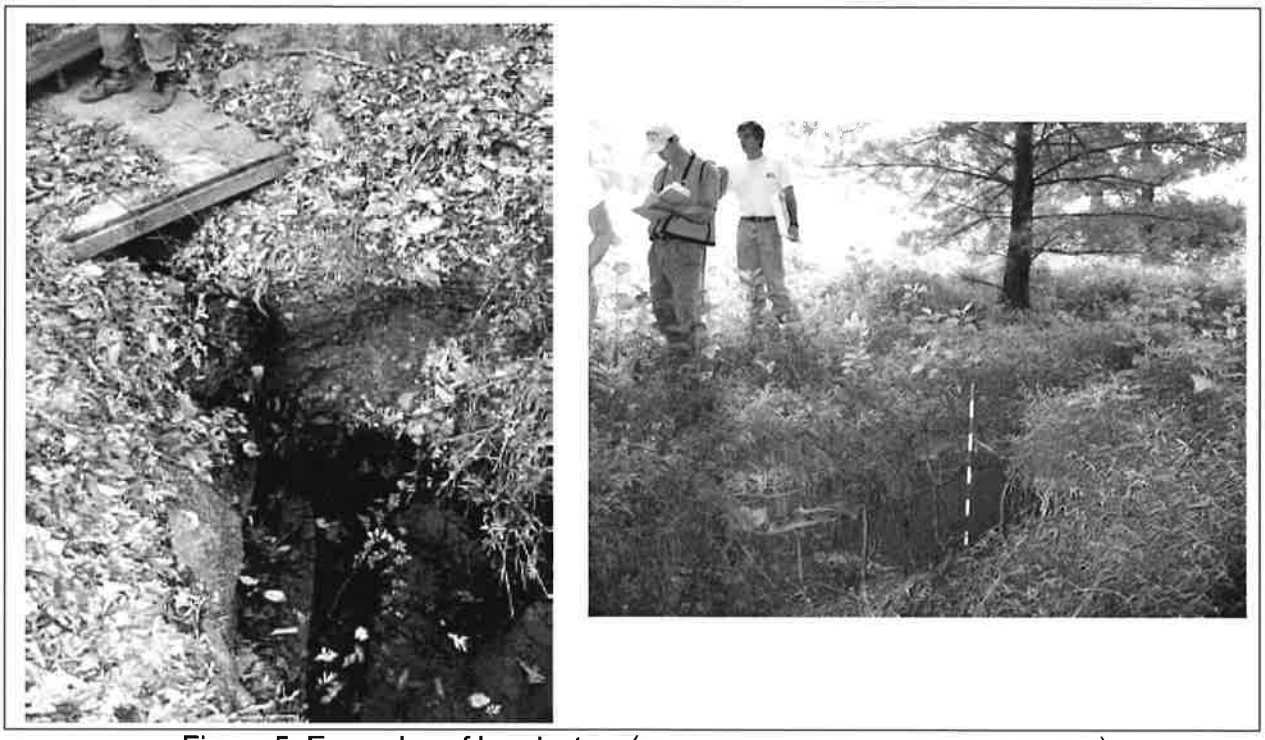


Figure 5. Examples of headcuts (Striped stick is 1.0 m long, painted in decimeters)

11. Grade Control Point

Are there grade control points within the reach being evaluated?

A grade control point is a structural feature in the channel that separates an abrupt change in grade of the stream bed or a point where erosional downcutting has been stopped by an obstruction. Grade controls may be caused by bedrock outcrops (nick points), large stones or large roots which extend across the channel, or accumulations of large woody debris. Stormwater or other discharges through pipes also serve as grade control points. These structures separate an abrupt change in grade of the stream bed.

12. Natural Valley or Drainageway

Is there a well-developed stream valley at the location of the reach being evaluated compared to the degree of valley development in the ephemeral reach of the stream?

When looking at the local topography in the field (or on a U.S. Geological Survey map), does the land slope towards the channel or are the contour lines fairly close together and v-shaped or u-shaped, thereby indicating a "draw" or valley? In other words, does the land have slopes that seem to drain to or indicate a natural valley or drainage way?

13. Second (or greater) Order Channel

Is the channel reach being evaluated second or greater in order, considering all channels, including ephemeral ones, that discharge to it?

The higher the channel order, the more likely the stream is to be perennial. Stream order is best evaluated in the field, since headwater streams are poorly depicted on maps. However for the purposes of this manual, a stream channel must be approximately shown on either the most recent version of the 1:24,000 USGS topographic map or Natural Resource Conservation Service (NRCS) county soil survey. In those unusual instances where a clearly defined intermittent or perennial stream channel is not shown on either map, the field evaluator may decide that the channel is second order or greater and provide clear documented evidence.

It is often difficult to evaluate stream order on channels starting at a stormwater outfall. Based on field observations, these channels are considered 1st order. However, a review of historic data such as the County Soil Survey may indicate that the order is greater.

YES – One or more first order channels are draining into the stream above sampling reach.

NO – There are only first order channels above sampling reach.

B. Hydrologic Indicators

14. Groundwater Flow/Discharge

Does the presence of baseflow, and indicators of groundwater presence and groundwater discharge indicate a significant period of groundwater discharge to the stream ?

Baseflow Presence: Water flowing in the channel more than 48 hours after significant rainfall is clear evidence of groundwater discharge from saturated soils below the water table adjacent to the stream. Even when there is no visible flow above the channel bottom, there may likely be slow groundwater discharge into and downstream flow in the ***hyporheic zone***. *The hyporheic zone is the accumulation of coarse textured sediments in the bottom of the channel that may be up to 2-3 ft deep in small streams. A functioning part of the stream, the hyporheic zone is the site of much groundwater discharge to the stream, downstream flow, and biological and chemical activity associated with aquatic functions of the stream.*

Groundwater Table: The presence of a seasonal high water table or groundwater discharge (i.e. seeps or springs) from the bank, both above the elevation of the channel bottom indicates a relatively reliable source of baseflow to a stream. Indicators of a current water table can be observed by digging a bore hole in the adjacent floodplain approximately two feet away from the streambed. The presence of water standing in the hole above the elevation of the channel bottom after waiting

for at least 30 minutes (longer for clayey soils) indicates the presence of a water table. The presence of hydric soil indicators above the elevation of the channel bottom in floodplain soils adjacent to the channel indicates the presence of a seasonal high water table that can provide a significant period of base flow. The presence of hydric soils should be determined in accordance with methods in the "*Corps of Engineers Wetlands Delineation Manual*" (1987 online ed., http://www.wes.army.mil/el/wetlands/pdfs/wlman87.pdf) or "*Field Indicators of Hydric Soils in the United States* (http://soils.usda.gov/use/hydric/).

Note that hydric soil indicators may be poorly developed at the seasonal high water table elevation in young, coarse textured, alluvial soil materials with low concentrations of clay, iron and manganese, or floodplain soils where moving water fails to become reduced.

Seasonal high water tables are commonly found in the Coastal Plain within areas with low relief. Seeps: Seeps have water dripping or slowly flowing out from the ground or from the side of a hill or incised stream bank. Springs: Look for "mushy" or very wet, and black decomposing leaf litter nearby in small depressions or natural drainage ways. Springs and seeps often are present at grade controls and headcuts. The presence of this indicator suggests that the stream is being recharged by a groundwater source except during a period of drought. Score this category based on the abundance of these features observed within the reach.

Strong – Significant base flow is present. Spring, seep or groundwater table is readily observable throughout reach.

Moderate – Some base flow is present. Springs, seeps or groundwater table are present, but not abundant throughout reach.

Weak – Water is standing in pools and the hyporheic zone is saturated, but there is not visible flow above the channel bottom. Indicators of groundwater discharge are present, but require considerable time to locate.

Absent – Little to no water in the channel. No springs or seeps present and no indication of a high groundwater table.

15. Water in Channel and > 48 Hours Since Last Rainfall, or Water in Channel During Dry Conditions or in Growing Season[1]

It is necessary to discern stormwater inflow (resulting from precipitation within the past 48 hours) and groundwater inputs. Flow observations preferably should be taken at least 48 hours after the last rainfall. Local weather data and drought information should be reviewed before evaluating flow conditions. Perennial streams will have water in their channels year-round in the absence of drought conditions. If a stream exhibits flowing water in the height of the dry season (mid-summer through

[1] The growing season varies geographically. Growing season dates are found in county soil surveys produced by the National Resources Conservation Service or may be found at the web page of the NRCS Water and Climate Center (http://www.wcc.nrcs.usda.gov/climate/wetlands.html).

early fall in a normal year), then it probably conveys water perennially. On the other hand, a stream that does not exhibit flow during periods of increased rainfall would indicate an intermittent or ephemeral flow. Flow is more readily observed in the riffles and very shallow, higher-velocity areas of the stream. Dropping a floating object on the water surface will aid in determining if flow is present. Flow is often very hard to discern in small, shallow, very low gradient coastal plain streams.

Intermittent streams do not always have water in them. Look for water in pool areas or in holes in the streambed. Another good rule of thumb for differentiating ephemeral streams from intermittent ones is if they have water in them during dry (drought) conditions or during the growing season. The presence or type of plants and fauna as well as the dampness of the soil in the channel (look under rocks) are also good indications of the presence of water during the growing season.

Strong – Flow is highly evident throughout the reach. Moving water is easily seen in riffles and runs.

Moderate – Moving water is easily seen in riffle areas but not as evident throughout the runs.

Weak – Flow is barely discernable in areas of greatest gradient change (i.e. riffles) or floating object is necessary to observe flow.

Absent – Water present but there is no flow; dry channel with or without standing pools.

16. Leaflitter

Are leaves (freshly fallen or older leaves that may be "blackish" in color and/or partially decomposed) accumulating in the streambed?

Perennial streams (with deciduous riparian vegetation) should continuously transport plant material through the channel. Leaves and lighter debris will predominate throughout the length of non-perennial stream channels, whereas there will be little to no leaves present in the stronger flowing areas (riffles) with small accumulations on the upstream side of obstructions. This indicator may be hindered during autumn sampling between rain events. This is a secondary hydrologic indicator in which strong evidence receives fewer points than absent.

Strong – Abundant amount of leaf litter is present throughout the length of the stream.

Moderate – Leaf litter is present throughout most of the stream's reach with some accumulation beginning on the upstream side of obstructions and in pools.

Weak – Leaf litter is present and is mostly located in small packs along the upstream side of obstructions and accumulated in pools.

Absent – Leaf litter is not present in the fast moving areas of the reach but there may be some present in the pools.

17. Sediment on Plants or Debris

Is fine sediment deposited on plants or debris in the channel or on the active floodplain, indicative of recent high flows?

The transportation and processing of sediment is a main function of streams. Therefore, evidence of sediment on plants or other debris in the stream channel may be an important indicator of the persistence of flow. Note that sediment production in stable, vegetated watersheds is considerably less than in disturbed watersheds. Are plants in the stream, on the streambank, or in the floodplain covered with sediment? Look for silt/sand accumulating in thin layers on debris or rooted aquatic vegetation in the runs and pools. Be aware of upstream land-disturbing construction activities, which may contribute greater amounts of sediments to the stream channel, and can confound this indicator. Note these activities on the data sheet if these confounding factors are present.

Strong – Sediment found readily on plants and debris within the stream channel, on the streambank, and within the floodplain throughout the length of the stream.

Moderate – Sediment found on plants or debris within the stream channel although not prevalent along the stream. Mostly accumulating in pools.

Weak – Sediment is isolated in small amounts along the stream.

Absent – No sediment is present on plants or debris.

18. Organic Drift Lines (Wrack lines)

Are there accumulations of organic debris in piles or lines in the channel or on the active floodplain indicative of recent high flows?

Organic drift lines are defined as twigs, sticks, logs, leaves, trash, plastics, and any other floating materials piled up on the upstream side of obstructions in the stream, on the streambank, in overhanging branches, and/or in the floodplain that indicate high stream flows. (These lines of debris are also commonly referred to as "wrack lines.") Ephemeral streams usually exhibit fewer or no drift lines within their channels unless downstream of a stormdrain or extensive urban runoff. The magnitude of the accumulation of drift may be influenced by watershed characteristics and sources of debris. For example, streams in watersheds dominated by herbaceous vegetation may not exhibit drift lines.

Strong – Large drift lines are prevalent along the upstream side of obstructions within the channel and the floodplain.

Moderate – Large drift lines are dispersed mostly within the stream channel.

Weak – Small drift lines are present within the stream channel.

Absent – No drift lines are present.

19. Hydric Soils

Are there hydric soils present at the toe of the bank or base of head cuts above the stream bottom or well developed hydric indicators in the hyporheic zone?

Hydric soils are defined as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part of the soil (Federal Register, July 13, 1994). Nearly all hydric soils exhibit characteristic morphologies that result from repeated periods of saturation or inundation, or both, for more than a few days during the growing season that results in extended periods of soil reduction. Thus the presence of well-developed hydric soil indicators in soils at the base of the bank or strongly reduced hyporheic zone materials provides strong evidence of extended annual periods of base flow.

Soils with sufficient periods of inundation or saturation and that contain significant amounts of clay or silt and significant amounts of iron and manganese will develop color features indicative of extended saturation and reduction. These features are commonly referred to as redoximorphic features and include mottling and gleying (low chroma). Soils immediately adjacent to the stream bed along the stream bank may have redoximorphic features if persistent groundwater discharge is present. Use a Dutch auger or Oakfield probe to obtain a 12 to 14-inch deep core and examine the soil pedon for mottles and low chroma. These features indicate that a seasonal water table is commonly present and that the channel is at least intermittent. Look for redoximorphic features several inches below the surface. Note that non-soil (i.e. relatively young) alluvial accumulations of coarse sand, gravel, and cobble in the stream bank or hyporheic zone, will not develop hydric soil indicators.

Mineral soils which are exposed to atmospheric oxygen in the soil profile will have some degree of oxidation occurring and as a result will have bright red, orange, or yellow matrix colors (Figure 6). Saturated soils, such as those found in the streambeds of perennial streams, have limited or no contact with oxygen, will remain reduced and subsequently have a very dull color chroma or may be gleyed completely (dull gray hues or chroma throughout the soil ped (Figure 6). The soil sample should be representative of the major stream bed/bank soil type observed throughout the sample reach. If necessary, use the Munsell Color Charts book to determine the chroma of the soil matrix. The soil matrix is defined as the dominant soil constituent (>50%). Low chroma values (< 2) or gleyed soils indicate continual saturation, while brightly colored soils or mottles (> 2) indicate only short periods of wetting, typical of intermittent or ephemeral streambed soils or upland soils. Table 2 provides a key for scoring.

Table 3. Scoring redoximorphic features

Redoximorphic feature	**Score (see form)**
Strong - Gleyed soils	1.5
Moderate - Matrix chroma of 1	1.5
Weak - Matrix chroma of 2	1.5
Absent - Matrix chroma of 2.5 or greater.	0

Upland Soil

Hydric soil depicting gleying

Hydric soil depicting mottling

Figure 6. Photographs of hydric and nonhydric soils.

C. Biological Indicators

20. Fibrous Roots

Are fibrous roots present near the surface of the hyporheic zone in the thalweg of the stream?

Fibrous roots are non-woody, small diameter (< 0.25 in), shallow wide spreading roots that often form dense masses in the top few inches of the soil. Roots in the root mass consist of many roots with generally equal diameters. Fibrous roots of woody plants are those which function in water and nutrient uptake. Since oxygen is needed for respiration, fibrous roots are intolerant of water, unless they are roots of water tolerant plants. Thus, in areas of stream bottom substrates where water is persistent or frequent high energy flows disturb the bottom substrate, fibrous roots may be infrequent or even absent. A higher score is given for the absence of fibrous roots. Observe the bottom (or edge) of the stream and determine if very small (fibrous) roots are present. Note that during extended growing season, or dry periods, fast growing fibrous roots may grow across the bottom of a stream that would not be present during normal flow conditions. Note that this indicator refers to fibrous roots of upland plants rather than aquatic plants that may be growing in the channel.

21. Rooted Plants in Streambed

Are rooted plants growing in the hyporheic zone in the thalweg area of the stream?

This attribute relates flow to the absence of rooted plants, since flow will often act as a deterrent to plant establishment by removing seeds or preventing aeration to roots (see No. 20 Fibrous Roots above). A higher score is given for the absence of rooted plants. Focus should be on the presence of plants in the bed or thalweg of the stream and plants growing on any part of the bank of the stream should not be considered. Note, however, there will be exemptions to this attribute. For example, rooted plants can be found in shaded perennial streams with moderate flow but in all cases these plants will be water tolerant (OBL, FACW; see No. 29 – Wetland Plants in Streambed, page 27). Cases where rooted upland plants are present in the streambed may indicate ephemeral or intermittent flow.

Figure 7. Rooted plants in streambed

22. Crayfish

Most species of crayfish are associated with aquatic or wet environments such as streams and wetlands. A small net can be used to examine small pools, under rocks, under logs, sticks or within leaf packs in the stream for crayfish. Crayfish associated with small holes in the muddy streambank or "chimneys" (roughly cylindrical chimneys) on the muddy bank or floodplain may be indicators of wet soils (wetlands) rather than streams.

23. Bivalves

Clams cannot survive outside of water, thus one should examine the streambed or look for them where plants are growing in the streambed. Also, look for empty shells washed up on the bank. Some bivalves (e.g., Fingernail clams; Figure 8) can be pea-sized or smaller. Since clams require a fairly constant aquatic environment in order to survive, the search for bivalves can be conducted while looking for other benthic macroinvertebrates. A small net may be useful.

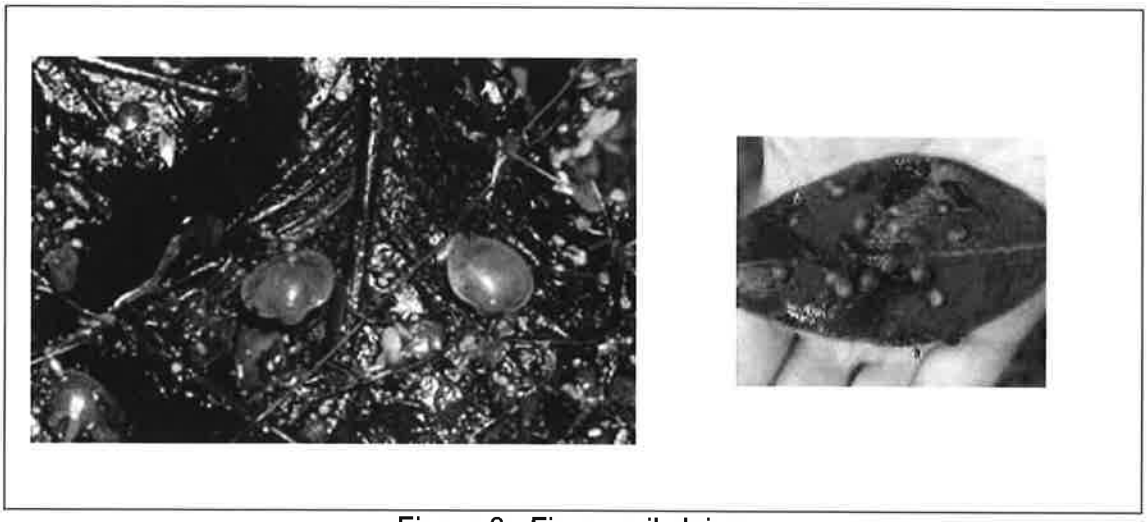


Figure 8. Fingernail claims

24. Fish

Fluctuating water levels of intermittent streams provide unstable and stressful habitat conditions for fish communities. When looking for fish, all available habitats should be observed, including pools, riffles, root clumps, and other obstructions (to greatly reduce surface glare, the use of polarized sunglasses is recommended). In small streams, the majority of species usually inhabit pools and runs. Fish should be easily observed within a minute or two. Also, fish will seek cover once alerted to your presence, so be sure to look for them slightly ahead of where you are walking along the stream. Check several areas along the stream sampling reach, especially underneath undercut banks. In most cases, fish are indicators of perennial streams, since fish will rarely inhabit an intermittent stream.

25. Amphibians

Salamanders and tadpoles can be found under rocks, on streambanks and on the bottom of the stream channel. They may also appear in the benthic sample. Frogs will alert you of their presence by jumping into the water for cover, usually following an audible "squeak". Frogs and tadpoles typically inhabit the shallow, slower moving waters of the pools and near the sides of the bank. Amphibian eggs, also included as an indicator, can be located on the bottom of rocks and in or on other submerged debris. They are usually observed in gelatinous clumps or strings of eggs.

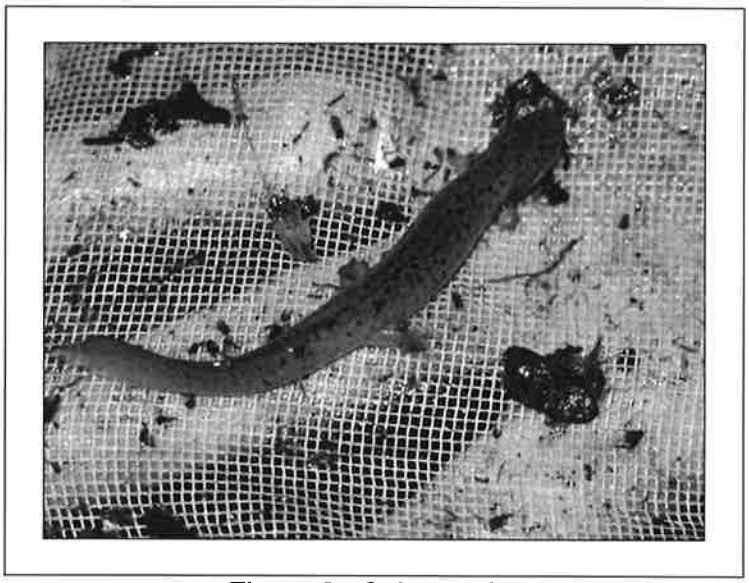
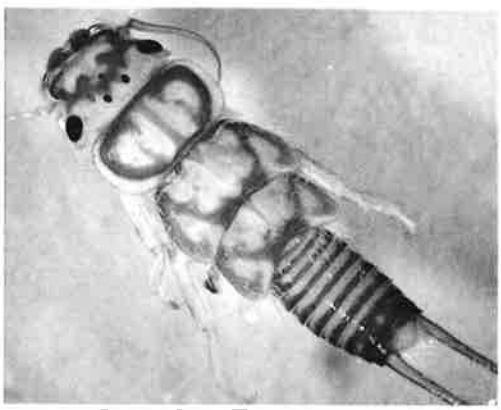


Figure 9. Salamander

26. Benthic Macroinvertebrates

The larval stages of many aquatic insects are good indicators that a stream is perennial because a continuous aquatic habitat is required for these species to mature. Use a small net and sample a variety of habitats including water under overhanging banks or roots, accumulations of organic debris (e.g. leaves) and the substrate. Note both the quantity as well as the diversity of your macroinvertebrate sample on the field form when scoring. Details on specific macroinvertebrate taxa that indicate perennial flow can be found in Section 2 – Guidance for the Determination of the Origin of Perennial Streams" (page 29).

Caddisfly: *Diplectrona sp*



Stonefly: *Eccoptera sp.*

Figure 10. Benthic macroinvertebrates

27. Presence of Filamentous Algae and Periphyton

These forms of algae are attached to the substrate. They are visible as a pigmented mass or film, or sometimes hairlike growths on submerged surfaces of rocks, logs, plants and any other structure within the stream channel. These life forms require an aquatic environment to persist. Periphyton growth is influenced by chemical disturbances such as increased nutrient (nitrogen or phosphorus) inputs and physical disturbances such as increased sunlight to the stream from riparian zone disturbances.

28. Iron Oxidizing Bacteria/Fungus

In slow moving (or stagnant) areas of the stream, are there clumps of "fluffy" rust-red material in the water? Additionally, on the sides of the bank (or in the streambed) are there red or rust colored stains (usually an "oily sheen" or "oily scum" will accompany these areas) on the soil surface? These features are often (although not exclusively) associated with groundwater. Iron oxidizing bacteria/fungus in streams derives energy by oxidizing iron, originating from groundwater, in the ferrous form (Fe2+) to the ferric form (Fe3+). In large amounts, iron-oxidizing bacteria/fungus discolors the stream substrate giving it a red appearance. In small amounts, it can be observed as an oily sheen on the water's surface. This indicates that the stream is being recharged from a groundwater source, and these features are most commonly seen at seeps or springs.

Filmy deposits on the surface or banks of a stream are often associated with the greasy "rainbow" appearance of iron oxidizing bacteria. This is a naturally occurring phenomenon where there is iron in the groundwater. However, a sudden or unusual occurrence may indicate a petroleum product release from an underground fuel storage tank. One way to differentiate iron-oxidizing bacteria from oil releases is to trail a small stick or leaf through the film. If the film breaks up into small islands or clusters, it is most likely bacterial in origin. However, if the film swirls together, it is most likely a petroleum discharge.

Figure 11. Iron oxidizing bacteria. Figure on right depicts iron bacteria on a twig.

29. Wetland Plants in Streambed

The U.S. Army Corp of Engineers wetland delineation procedure utilizes a plant species classification system upon which soil moisture regimes can be inferred (Table 4). This same system can be used to infer the duration of soil saturation in stream channels. Small, low gradient, low velocity intermittent and perennial streams with adequate sunlight will often have OBL and FACW wetland plants or submerged aquatic vegetation growing in the stream bed. All wetland designations are defined by *National List of Plant Species That Occur in Wetlands: Southeast Region 2*. 1988. U.S. Fish and Wildlife Service. (http://wetlands.fws.gov/plants.htm) Submerged Aquatic Vegetation (SAV) grows completely underwater (for instance Coontail -- *Ceratophyllum demersum*)

Table 4. Indicator categories of wetland plants.

Code	Wetland Type	Comment
OBL	Obligate Wetland	Occurs almost always (estimated probability 99%) under natural conditions in wetlands.
FACW	Facultative Wetland	Usually occurs in wetlands (estimated probability 67%-99%), but occasionally found in non-wetlands.
FAC	Facultative	Equally likely to occur in wetlands or non-wetlands (estimated probability 34%-66%).
FACU	Facultative Upland	Usually occurs in non-wetlands (estimated probability 67%-99%), but occasionally found on wetlands (estimated probability 1%-33%).
UPL	Obligate Upland	Occurs in wetlands in another region, but occurs almost always (estimated probability 99%) under natural conditions in non-wetlands in the regions specified. If a species does not occur in wetlands in any region, it is not on the National List.

History of the Stream Identification Manual and Forms.

Version 1.0 – Method was originally derived to correlate scores with the persistence of water. Low scores would indicate stream channels in the upper portions of watersheds (low order streams), and the highest scores would indicate major rivers (high order streams).

Version 2.0 – Effective January 19, 1999. The method was termed the NC Stream Classification Method and was adapted as a result of HB 1257 (Stream Identification for Buffer Rules); 2000-2001 Session of the NC General Assembly. The Stream Technical Advisory group evaluated Version 1.0 of the form and recommended the use of the modified form for use by the DWQ.

Version 3.0 – Added considerable amount of explanatory material and restructured the rating form. Issued for public comment: September 21, 2004. Version 3.0 was developed during the summer and fall of 2004. Version 3.0 was used in the development of Version 3.1.

Version 3.1 – Effective February 28, 2005. Minor editions and corrections resulting from a test of the Version 3.0 material during the Surface Water Identification Training and Certification (SWITC) Class; November 15-17, 2004 and December 8-9, 2004. Version 3.1 incorporated the "Guidance for the Determination of the Origin of Perennial Streams."

SECTION 2 – Guidance for the Determination of the Origin of Perennial Streams

Background

A Stream Technical Advisory Committee (TAC) was established by the DWQ in December 1998 to provide technical, scientific input related to the definitions of streams and waterbodies in the Neuse River basin. The TAC approved a stream classification methodology that evaluates the geomorphology, hydrology and biology of stream features to determine the origin of intermittent streams as well as narrative definitions for these stream types (NCDWQ 1999).

The DWQ utilizes a numerical cutoff of 19 points with this evaluation form as an appropriate value to classify a stream as at least "intermittent". However, DWQ has not previously utilized a numerical cutoff for the perennial threshold. Currently, the DWQ relies on a policy to describe the thresholds between an intermittent and a perennial channel which suggests that investigators use the presence of biological indicators such as fish, crayfish (in channel), amphibians, mussels (clams) or large (multi-year) tadpoles as perennial stream indicators. This internal policy has proven to be effective in many instances such as intermittent/perennial determinations during unusual flow periods (such as extreme drought) and in some ecoregions of North Carolina (Triassic Basin and coastal plain streams). In addition, DWQ's water supply watershed protection rules, which are implemented by local governments, and compensatory stream mitigation requirements are affected by whether a stream is perennial or intermittent. This provides another reason for DWQ to develop and utilize a more scientifically valid definition for perennial streams.

Recent and on-going Investigations

As part of a recent investigation for the City of Greensboro, personnel with Law Engineering and Environmental Services (now MacTec Environmental Services), with the support of DWQ personnel, used a modification of the DWQ stream classification method and recommend a numerical cutoff for a perennial stream origin in the piedmont of 30 points (Lawson, et al. 2002). In addition, DWQ biologists have been looking for the presence of long-lived aquatic species as reliable determinants for perennial channels. These investigations suggest that the presence of a select group of benthic macroinvertebrates that require water for their entire life cycles (rheophilic taxa) is a reliable method to determine the origins of perennial channels. A proposed list of these organisms is included with this policy revision (Tables 5 and 6). The DWQ is currently conducting an investigation of the ecological functions of intermittent stream channels. Results from this federally funded investigation also have corroborated the technique of using a suite of rheophilic aquatic insect taxa to determine perennial stream origins.

Revised DWQ Policy for the Definition of Perennial Stream Origins

A perennial stream is defined as a well-defined channel that contains water year round during a year of normal rainfall[2] with the aquatic bed located below the water table for most of the year (15A NCAC 2B.0100). This definition also notes that perennial streams exhibit the typical biological, hydrological, and physical characteristics commonly associated with the continuous conveyance of water.

A stream channel is perennial when any of the following criteria are met:

1. Biological indicators such as fish, crayfish (in channel), amphibians (larval salamanders and large, multi-year tadpoles), or clams are present. If only crayfish or fingernail clams are present, a numerical value of at least 18 on the geomorphology section of the most current version of the DWQ stream classification form is required.

OR

2. A numerical value of at least 30 points is determined from the most recent version of the DWQ stream identification form[3].

OR

3. More than one benthic macroinvertebrate that requires water for entire life cycles are present as later instar larvae[4]. A list of the benthic organisms commonly collected by DWQ biologists during perennial stream determinations are shown in Tables 5 and 6.

DWQ staff suggest that a stream be examined using these three criteria in the sequence above – namely, a field examination should first look for criterion 1 and then criterion 2. If the channel does not meet either of these two criteria and the field biologist believes the channel to be perennial, then the third criterion should be utilized – however identification by a well-trained aquatic entomologist is required for the proper use of this criterion. In most instances, the use of either of the first two criteria should be sufficient to make a stream determination.

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[2] Normal Rainfall is defined as the 30 year average, provided by NOAA National Climatic Data Center, computed at the end of each decade. These data are available as annual and monthly means.

[3] Use of this form requires Division-based or approved training (or appropriate certification in accordance with GS 143-214.25

[4] Recognition and/or identification of these organisms will require Division-based or approved training.

Table 5. Ephemeroptera, Plecoptera and Trichoptera (EPT) perennial stream indicator taxa

	Ephemeroptera (Mayflies)	Plecoptera (Stoneflies)	Trichoptera (Caddisflies)
Family:	Baetidae	Peltoperlidae	Hydropsychidae
	Caenidae	Perlidae	Lepidostomatidae
	Ephemerellidae	Perlodidae	Limnephilidae
	Ephemeridae		Molannidae
	Heptageniidae		Odontoceridae
	Leptophlebiidae		Philopotamidae
	Siphlonuridae		Polycentropidae
			Psychomyiidae
			Rhyacophilidae

Table 6. Additional indicators of perennial stream features.

	Megaloptera	Odonata	Diptera	Coloptera	Mollusca
Family:	Corydalidae	Aeshnidae	Ptychopteridae	Elmidae	Unionidae
	Sialidae	Calopterygidae		Psephenidae	Ancylidae
		Cordulegastridae			Planorbidae
		Gomphidae			Pleuroceridae
		Libellulidae			
Family & *Genus:*			Tipulidae *Tipula* sp.	Dryopidae *Helichus* (adult)	

Special Provision for Coastal Plain Streams

Reduced topography, which causes fewer channel forming features, can make the geomorphology section of the stream form problematic in the Middle Atlantic Coastal Plain and Southeastern Plains (Griffith et. al. 2002) – approximately east of I-95. In this area, biology should take precedence over geomorphology for determining a stream. Therefore the criteria should be utilized in the following sequence: 1, 3, and then 2.

History of the *Guidance for the Determination of the Origin of Perennial Streams*

Version 1.0 – Developed in 1997/1998. Fish, salamanders, turtles, crayfish and multiyear (large) tadpoles were used as indicators.

Version 2.1 – Added Stoneflies, Mayflies and Caddisflies

Version 2.2 – Added section about the coastal plain

Version 2.3 – Added taxa lists (Tables 5 and 6)

Version 2.4 – Effective February 28, 2005. Added tables of macroinvertebrate taxa found in perennial streams. Issued for public comment October 13, 2004.

List of References

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APPENDIX – Comparison Between Version 2.0 and 3.1 Scoring Forms.

VERSION 2.0 FORM	Versions 3.x Forms
Primary Field Indicators	
I. Geomorphology	
1) Is there a riffle-pool sequence?	3. In-channel structure: riffle-pool sequence
2) Is the USDA texture in streambed different from surrounding terrain?	4. Soil texture – Substrate sorting (Renamed attribute)
3) Are natural levees present?	9. Natural Levees
4) Is the channel sinuous?	2. Sinuosity
5) Is there an active (or relic) floodplain present?	5. Active/relic floodplain
6) Is the channel braided?	7. Braided channel
7) Are recent alluvial deposits present?	8. Recent alluvial deposits
8) Is there a bankfull bench present?	6. Depositional bars or benches
9) Is a continuous bed & bank present?	1. Continuous bed and bank
10) Is a 2nd order or greater channel (as indicated on topo map and/or in field) present?	13. Second or greater order channel on existing USGS or NRCS map
II. Hydrology	
1) Is there a groundwater flow/discharge present?	14. Groundwater flow/discharge
III. Biology	
1) Are fibrous roots present in streambed?	20. Fibrous roots in channel
2) Are rooted plants present in streambed?	21. Rooted plants in channel
3) Is periphyton present?	*27. Filamentous algae; periphyton (Version 2.0 items combined)
4) Are bivalves present?	23. Bivalves
Secondary Field Indicators	
I. Geomorphology	
1) Is there a head cut present in channel	10. Headcuts
2) Is there a grade control point in channel	11. Grade Control
3) Does topography indicate a natural drainage way?	12. Natural Valley and drainageway
II. Hydrology	
1) Is this year's (or last's) leaf litter present in streambed?	16. Leaflitter
2) Is sediment on plants (or debris) present	17. Sediment on plants
3) Are wrack lines present?	18. Organic debris lines or piles (Wrack lines)
4) Is water in channel and >48 hrs. since last known rain?	15. Water in channel and > 48 hrs since rain. or Water in channel – dry or growing season (Version 2.0 items combined)
5) Is there water in channel during dry conditions or in growing season?	
6) Are hydric soils present in sides of channel (or in headcut)	19. Hydric soils (redoximorphic features) present?
III. Biology	
1) Are fish present?	24. Fish
2) Are amphibians present?	25. Amphibians
3) Are aquatic turtles present?	DELETED (No aquatic turtles ever scored)
4) Are crayfish present?	22. Crayfish
5) Are macrobenthos present?	26. Macrobenthos
6) Are iron oxidizing bacteria/fungus present?	28. Iron oxidizing bacteria/fungus
7) Is filamentous algae present?	*27. Filamentous algae; periphyton
8) Are Wetland Plants in Streambed?	29. Wetland plants in streambed

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date:	Project:	Latitude:
Evaluator:	Site:	Longitude:
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30*	County:	Other *e.g. Quad Name*:

A. Geomorphology (Subtotal = _____)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	3
2. Sinuosity	0	1	2	3
3. In-channel structure: riffle-pool sequence	0	1	2	3
4. Soil texture or stream substrate sorting	0	1	2	3
5. Active/relic floodplain	0	1	2	3
6. Depositional bars or benches	0	1	2	3
7. Braided channel	0	1	2	3
8. Recent alluvial deposits	0	1	2	3
9[a] Natural levees	0	1	2	3
10. Headcuts	0	1	2	3
11. Grade controls	0	0.5	1	1.5
12. Natural valley or drainageway	0	0.5	1	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0		Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = _____)				
14. Groundwater flow/discharge	0	1	2	3
15. Water in channel and > 48 hrs since rain, **or** Water in channel -- dry or growing season	0	1	2	3
16. Leaflitter	1.5	1	0.5	0
17. Sediment on plants or debris	0	0.5	1	1.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	1	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5	

C. Biology (Subtotal = _____)				
20[b]. Fibrous roots in channel	3	2	1	0
21[b]. Rooted plants in channel	3	2	1	0
22. Crayfish	0	0.5	1	1.5
23. Bivalves	0	1	2	3
24. Fish	0	0.5	1	1.5
25. Amphibians	0	0.5	1	1.5
26. Macrobenthos (note diversity and abundance)	0	0.5	1	1.5
27. Filamentous algae; periphyton	0	1	2	3
28. Iron oxidizing bacteria/fungus.	0	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Sketch:

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