



ANNE ARUNDEL COUNTY

M A R Y L A N D

STORMWATER MANAGEMENT PRACTICES AND PROCEDURES MANUAL

**Revised 11-22-10
Updated 02-01-12**

Anne Arundel County Stormwater Management Practices and Procedures Manual

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Chapter 1 Introduction to the Anne Arundel County Stormwater Management Practices and Procedures Manual

1.1. Acknowledgements

We would like to acknowledge the members of the Stormwater Management Planning Committee who met regularly during the course of over a year to provide invaluable technical and policy feedback in order to facilitate the development of this Manual.

1.2. Background

The Environment Article, Title 4, Subtitle 2 requires the Maryland Department of the Environment (MDE) to implement a statewide stormwater management program to control new development runoff. MDE is obligated to perform many duties to meet this mandate. The most significant of these is adopting regulations that establish criteria and procedures for stormwater management throughout Maryland.

The Stormwater Management Act of 2007 (Act) further requires that the Code of Maryland Regulations (COMAR) be modified and a model document developed for the purpose of implementing environmental site design (ESD) to the maximum extent practicable (MEP). Significant changes to COMAR and the 2000 Maryland Stormwater Design Manual, Volumes I & II (Design Manual) were adopted in May 2009. These changes specify how ESD is to be implemented, the MEP standard is to be met, and the review of erosion and sediment control and stormwater management plans is to be integrated. This document represents the next step toward meeting MDE's obligations under current law and serves as the model for developing, reviewing, and approving county and municipal stormwater management documents.

The Act defines ESD as "...using small-scale stormwater management practices, nonstructural techniques, and better site planning to mimic natural hydrologic runoff characteristics and minimize the impact of land development on water resources." ESD also includes conserving natural features, drainage patterns, and vegetation; minimizing impervious surfaces; slowing down runoff; and increasing infiltration. This definition, along with COMAR modifications will require major changes to the way runoff is managed in the State. Also, stormwater management for new development and redevelopment will be conceived, designed, reviewed, and built differently from procedures used prior to passage of the Act.

The changes required to implement the Act are significant and will require developers, designers, and plans review agencies to consider runoff control from the start of the land development process. It is understood that transitioning to new methods may take some period of time and will encounter obstacles.

The bulk of the guidance regarding stormwater management is addressed within the **Maryland Stormwater Design Manual**. There are a few areas however, that require additional guidance to be provided by local jurisdictions.

Under the guidance provided by the Anne Arundel County annotated code, the Anne Arundel County Stormwater Management Practices and Procedures Manual is required to be updated on a regular basis.

These changes will serve as a revision to the current Anne Arundel County Stormwater Management Practices and Procedures Manual July 2001 revised July 2006.

1.3. Purpose of the Stormwater Management Practices and Procedures Manual

The purpose of this manual is to provide developers, consultants and County staff with guidance regarding the procedures, processes, policies, and regulations that apply to stormwater management for proposed developments within Anne Arundel County.

The manual addresses criteria specific to Anne Arundel County that are not addressed within the Maryland Stormwater Design Manual

1.4. Authority

- Environment Article, Title 4, Subtitle 2, Annotated Code of Maryland
- 2000 Maryland Stormwater Design Manual, Volumes I & II (Maryland Department of the Environment, April 2000), and all subsequent revisions.
- Anne Arundel County Code Articles 16 and 17

1.5. Incorporated by Reference

- Comprehensive Watershed Studies. Of the twelve watersheds within Anne Arundel County, Comprehensive Watershed Studies have been completed for:
 - The Severn River Watershed
 - The South River Watershed
 - The Upper Patuxent Watershed
 - Magothy
 - Below is the schedule for proposed completion of the remaining watersheds.

Watershed	Timeline for Targeted Bioassessment Completion (Calendar Year)	Timeline for Physical Habitat Assessment Completion (Calendar Year)	Timeline for Comprehensive Study Completion (Calendar Year)
Severn	Complete	Complete	Complete
South	Complete	Complete	Complete
Upper Patuxent	Complete	Complete	Complete
Magothy	Complete	Complete	2009
Patapsco Non-Tidal	Complete	2009	2010
Patapsco Tidal	2010	2010	2011
Bodkin	2010	2010	2011
Little Patuxent	2011	2012	2012
Rhode	2012	2013	2013
West	2013	2014	2014
Herring Bay	2014	2015	2015
Middle Patuxent	2015	2016	2016

- Baltimore Washington International Airport Criteria – Subject to Maryland Aviation Administration requirements.

1.6. Effective date of revised document

1.6.1. The effective date of this revised document is November 22, 2010

1.6.2. Applies to all projects that have not received Final Project Approval by May 4, 2010

1.7. Grandfathering of projects already in the review process

Projects that are currently in the review process and have been granted Preliminary plan approval by May 4, 2010 may be eligible for an administrative waiver which allows the development plans to be reviewed under the stormwater management regulations that were in effect prior to May 4, 2009.

Details are found in the Appendix 11.1 of this document.

1.8. How to use the Manual

The Anne Arundel County Stormwater Management Practices and Procedures Manual is provided in a single volume and is to be used in conjunction with the 2000 Maryland Stormwater Design Manual, Volumes I & II (Maryland Department of the Environment, April 2000), and all subsequent revisions. This document will be referred to as the **State Manual**.

1.9. What is new?

- Q_{p10} and Q_{f100} on site tied to the results of the downstream analysis.
- Revised definition for the Point of Investigation
- Updated guidelines for 100 year non tidal flood plain analysis and delineation.
- Review of SWM for modifications, variances and or special exceptions that impact environmentally sensitive areas
- Design criteria based on State Manual
 - All stormwater management will be based on the design criteria as outlined in the State Manual
- Modified designation of public vs. private facilities
- New format for Stormwater Management Practices and Procedures Manual
 - For any proposed development, the owner/developer shall submit phased stormwater management plans for review and approval. At a minimum, plans shall be submitted for the **Concept, Site Development, and Final** stormwater management construction phases of project design.
 - The revised design manual will address processes and procedures related to submittal of documents for each phase followed by specific design guidelines that pertain to Anne Arundel County and are not covered in the State Manual

1.10. What is covered in the Stormwater Management Practices and Procedures Manual?

The Anne Arundel County Stormwater Management Practices and Procedures Manual will address only the items that are pertinent to Anne Arundel County and have not been fully addressed in the State Manual. These items include but are not limited to:

- Design guidelines for addressing Q_{p10} . (Overbank flood protection volume)
- Design guidelines for addressing Q_{f100} (Extreme Flood Volume)
- Redevelopment (additional criteria not addressed in the State Manual)
- Development within the critical area
- New Development of single lots within infill areas.
- Applications for Modifications, Special Exceptions and Variances that impact sensitive areas

Anne Arundel County Stormwater Management Practices and Procedures Manual

- Drawings, documents and reports
- Security, Fees and agreements
- Construction Inspection

Chapter 2 General Review Process

The Stormwater Management Act of 2007 requires that “a comprehensive process for approving grading and sediment control plans and stormwater management plans” be established that takes into account the cumulative impacts of both.

The current goal is to use ESD to the MEP from project conception through final approval using processes and planning techniques that protect natural areas, minimize imperviousness, integrate available landscaping and combine stormwater and erosion and sediment control strategies.

2.1. Process for SWM plan approval

2.1.1. Three phased review for SWM Plan Approval

For any proposed development, the owner/developer shall submit phased stormwater management plans for review and approval. At a minimum, plans shall be submitted for the following phases:

- A.** Stormwater Management Concept plan
- B.** Stormwater Management Site Development plan
- C.** Stormwater Management Final plan

2.1.2. Contents of Submittal Package

Each plan submittal shall include the minimum content specified by this document.

2.2. When must the Stormwater Management Concept Plan be submitted?

Unless exempted from the requirement, the Stormwater Management Concept Plan must be included with the first submittal of a project under any of the processes listed below. (Articles 16, 17 and 18)

- A.** Special Exception
- B.** Variance
- C.** Modifications (Except modifications to skip steps in the development process)
- D.** Standard Grading Plan
- E.** Amended Plats
- F.** Sketch Plan (Major Subdivision Process)
- G.** Preliminary Plan (Minor Subdivision Process)
- H.** Preliminary Plan (Site Development Process)
- I.** Grading Permit Application (submitted independently of any processes listed above).

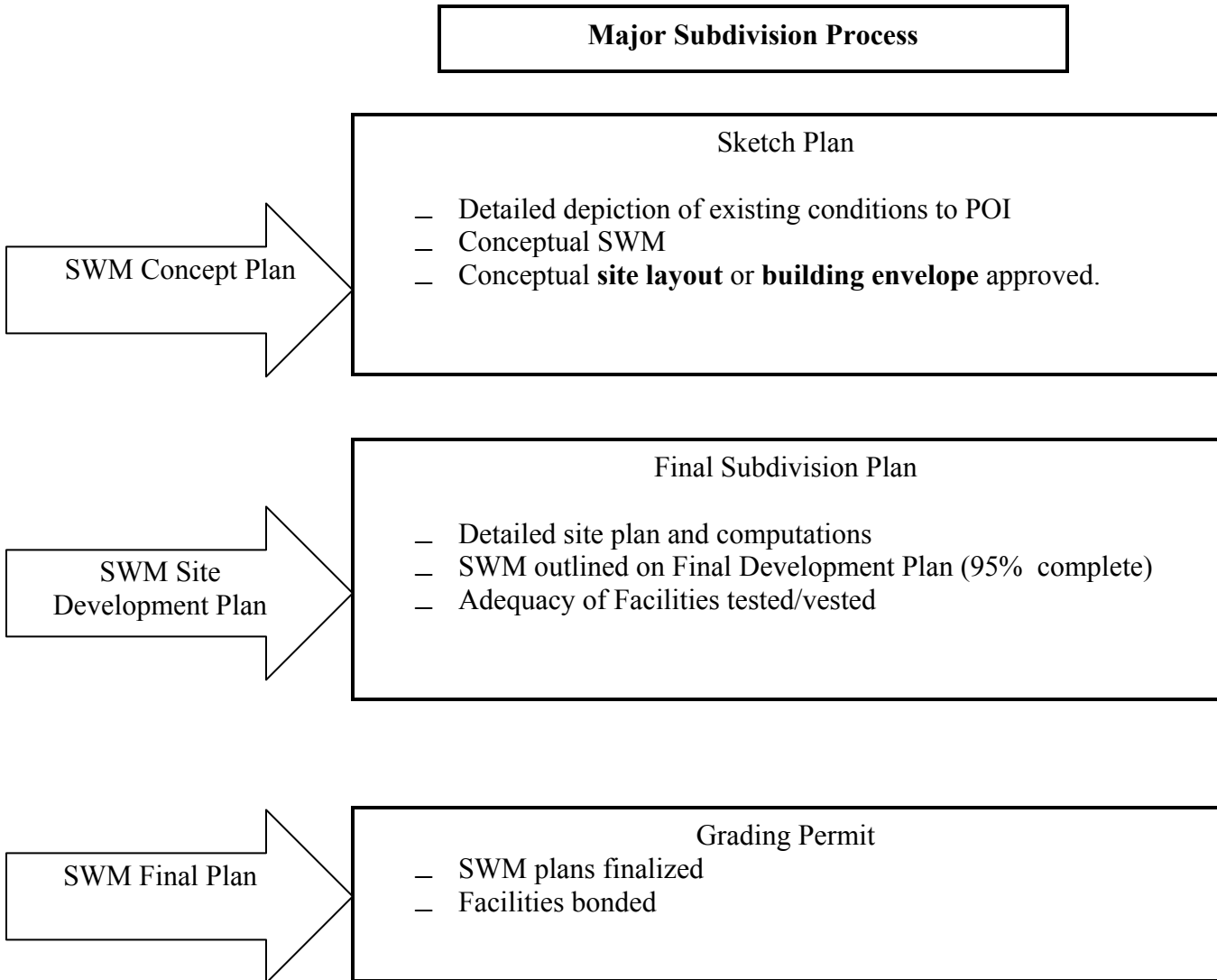
2.3. When must the Stormwater Management Site Development Plan be submitted?

- A.** With the Final Plan for the Major and Minor Subdivision Processes
- B.** With Site Development Plan for the Site Development Plan Process
- C.** With the second submittal of a grading permit application submitted under I. above.

2.4. When must the Stormwater Management Final Plan be submitted?

With the Grading Permit Application for all projects listed in 2.2. A-H

2.5. Schematic of processes



Minor Subdivision Process

The required three steps will be processed as part of a single application. The first submittal should address only the SWM concept and must be submitted using the guidelines outlined in the Preliminary Plan Checklist.

SWM Concept Plan

Minor Subdivision first submittal

- Detailed depiction of existing conditions to POI
- Conceptual SWM
- Conceptual **site layout** or **building envelope** approved.

SWM Site
Development Plan

Minor Subdivision

Subsequent submittals **after** the Concept Plan is approved

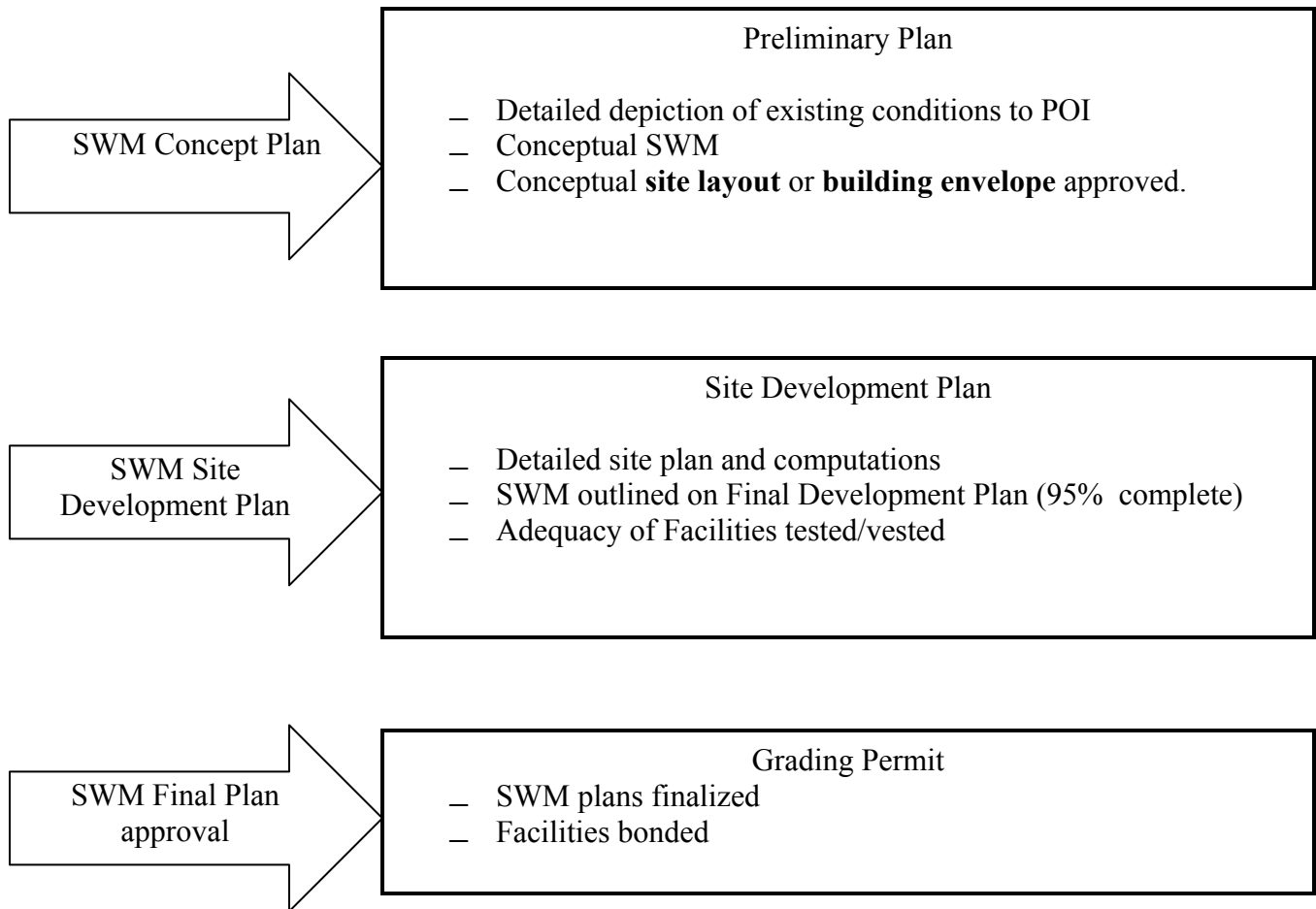
- Detailed site plan and computations
- SWM outlined on Final Development Plan (95% complete)
- Adequacy of Facilities tested/vested

SWM Final Plan
approval

Grading Permit

- SWM plans finalized
- Facilities bonded

Commercial (Site Development Plan) Process
Redevelopment projects *where existing impervious coverage does not meet or exceed the maximum allowed by zoning designation of the underlying parcel*

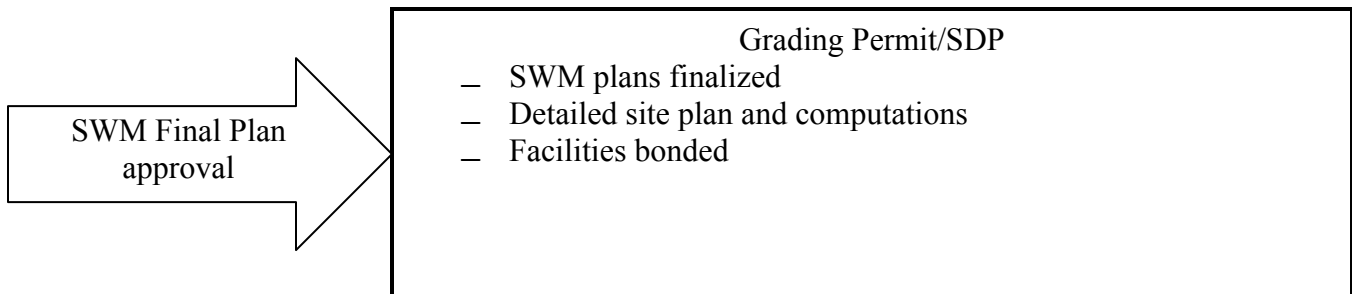
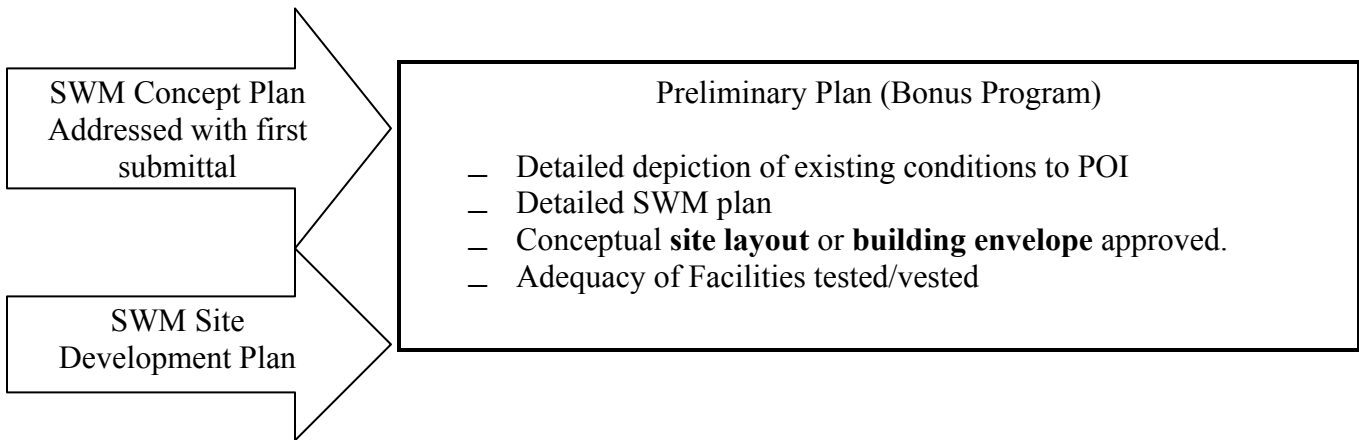


Development in Areas with Special Designations
Town Centers

- Odenton
- Parole
- Glen Burnie

AND

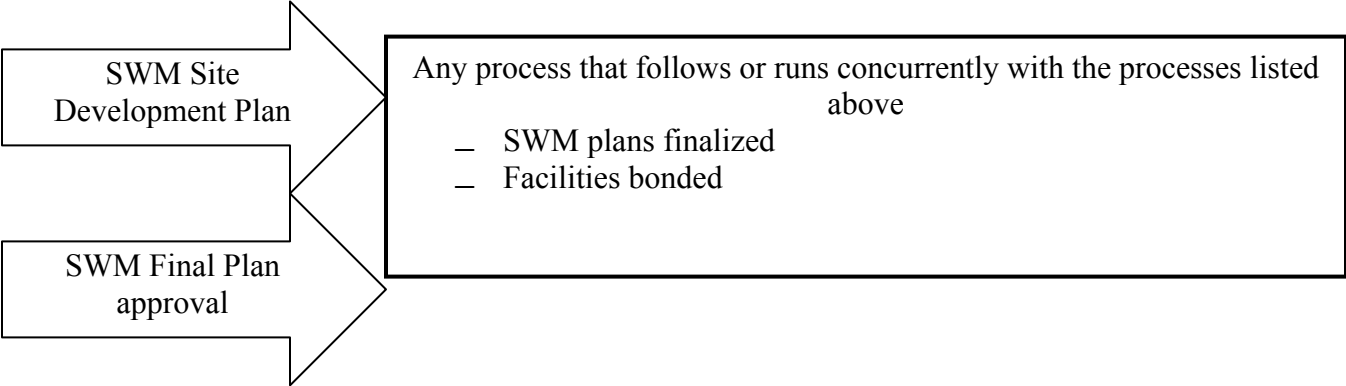
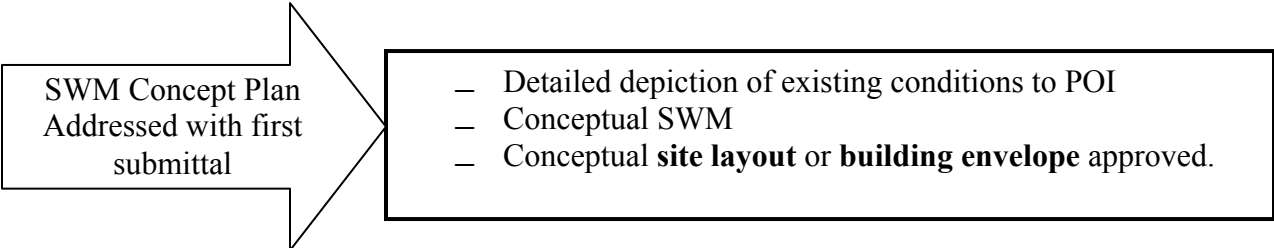
Redevelopment projects
Where existing impervious coverage meets or exceeds the maximum allowed by zoning designation of the underlying parcel



- Other Processes**
- Amended Plat
 - Special Exceptions
 - Variances
 - Modifications
 - Standard Grading Plan
 - Building Permit

Required only if there is a proposed disturbance to environmentally sensitive areas **and** the proposed development is **not exempt** from addressing SWM requirements.

The first submittal should address only the SWM concept and must be submitted using the guidelines outlined in the Preliminary Plan Checklist.



Grading Permit

Not associated with Subdivision or Site Development Plan Process
The required three steps will be processed as part of a single application. The first submittal should address only the SWM concept and must be submitted using the guidelines outlined in the Preliminary Plan Checklist.

SWM Concept Plan
Addressed with first
submittal

First submittal of Grading Permit Plan

- Detailed depiction of existing conditions to POI
- Conceptual SWM
- Conceptual **site layout** or **building envelope** approved.

SWM Site
Development Plan

SWM Final Plan
approval

**Subsequent submittals of the permit plans
after the conceptual site layout is approved**

- SWM plans finalized
- Facilities bonded

Chapter 3 Review and Approval process for SWM Concept Plan

The concept plan phase of project review and approval requires site mapping to ensure that significant natural resources are protected and preserved to the maximum extent practicable.. Site fingerprinting, downstream investigation, development layout, protection and conservation strategies, preliminary ESD stormwater management locations, and calculations must be submitted.

Impervious cover should be minimized, nonstructural practices should be used to disconnect impervious surfaces where possible, and the use of alternative surfaces explored.

Micro-scale practices should be used to capture and treat runoff and **structural practices may be used only when all reasonable options for the use of ESD have been exhausted.**

In order to address these requirements, the owner/developer shall submit a concept plan that provides sufficient information for an initial assessment of the proposed project and demonstrates whether stormwater management can be provided according to Article 16 Title 4 of the Anne Arundel County Code, and the Anne Arundel County Stormwater Management Practices and Procedures Manual.

3.1. Documents required for SWM Concept Plan approval

3.1.1. Reports

Reports must be presented in a bound booklet containing the following information:

- A.** Narrative, that supports the concept design and describes how ESD will be implemented to the MEP
- B.** Preliminary estimates of stormwater management requirements, including estimates of P_e and ESD_v
- C.** Computations to support the selection of the Point of Investigation (POI)
- D.** Runoff computations for all drainage areas to the site
- E.** Flood plain estimation computations
- F.** Sketch/Preliminary plan checklist

3.1.2. Review Plans

Concept review plans must clearly show and/or delineate the following:

- A.** Site location
- B.** Composite tax map and tabulated information regarding acreage and tax account numbers for all parcels included as part of the development plan
- C.** Existing natural features
- D.** Sensitive resources
 - i.** Steep slopes
 - ii.** Wetlands
 - iii.** 100 year flood plain
 - iv.** Bog drainage/impact areas
 - v.** Erodeable soils
- E.** Critical area designations
- F.** Topography and natural drainage patterns
- G.** Delineation of off site drainage areas to site
- H.** Delineation of drainage area to the POI

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- I.** Delineation of on site drainage areas if multiple areas exist
- J.** Delineation of Soils; Name, Symbol and Hydrologic Soil Group (HSG)
- K.** Existing roads
- L.** Proposed impervious areas (e.g., buildings, roads, parking)
- M.** Existing utilities
- N.** Buildable envelope showing areas to be protected (Significant natural features highlighted)
- O.** Preliminary site layouts
- P.** Selection and location of ESD practices to be used

3.1.3. Stormwater Management Concept Plan submittal requirements

Minimum submittal requirements for the stormwater management concept plan are included in the checklist for the sketch/preliminary plan submittal.

Chapter 4 Review and Approval Process for SWM Site Development Plan

The SWM Site Development Plan shall include detailed designs for stormwater management and erosion and sediment control. Information on the footprint of the proposed project and the relationship between proposed impervious surfaces and the existing natural conditions identified during the concept plan design phase must be demonstrated. To ensure that all options for implementing ESD have been exhausted, detailed designs, computations, and grading plans must be submitted for comprehensive review and approval. Any applicable comments received during the concept plan review process must be incorporated into the site development plans.

The SWM Site Development plan is to be submitted as part of the submittal package for Final Subdivision in the Major or Minor Subdivision process or with the Site Development Plan in the Site Development Plan Process.

4.1. Documents to be provided for SWM Site Development Plan approval

4.1.1. Reports

Reports must be presented in a bound booklet containing the following information

- A.** All information previously provided during the Concept Plan review and approval stage.
- B.** Any applicable Stormwater Management Plan checklists
- C.** Final Storm Drainage plan checklist
- D.** Final Flood plain checklist
- E.** Geotechnical investigations including:
 - i.** Soil maps
 - ii.** Borings
 - iii.** Site specific recommendations, and
 - iv.** Any additional information necessary for the final stormwater management design
- F.** Drainage area maps depicting:
 - i.** Predevelopment and post development runoff
 - ii.** Flow path segmentation and
 - iii.** Land use
- G.** Hydrologic computations of the applicable ESD and unified sizing criteria according to the State Manual for all points of discharge from the site
- H.** Hydraulic and structural computations for all ESD practices and structural stormwater management measures to be used
- I.** A narrative that supports the Stormwater Management Design
- J.** Final Water and Sewer Checklist

4.1.2. Review Plans

Stormwater Management Site Development review plans must clearly show and delineate the following:

- A.** Site location
- B.** A vicinity map
- C.** Existing and proposed topography and proposed drainage areas, including areas necessary to determine downstream analysis for proposed stormwater management facilities
- D.** Any proposed improvements including location of buildings or other structures, impervious surfaces, storm drainage facilities, and all grading
- E.** The location of existing and proposed structures and utilities

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- F.** Existing natural features
- G.** Sensitive resources
 - i.** Steep slopes
 - ii.** Wetlands
- H.** 100 year flood plain
- I.** The delineation of the following shall be shown using coordinates that depict the point of beginning, and bearing and distances for each line that demarcates the limits:
 - i.** Easements and rights-of-way to be deeded for public use
 - ii.** 100 year flood plain
 - iii.** On-site wetlands
- J.** Bog drainage area
- K.** Critical area designations
- L.** Topography and natural drainage patterns
- M.** Delineation of off site drainage areas to site
- N.** Delineation of drainage area to the POI
- O.** Delineation of drainage areas to all points of discharge from the site for existing and proposed conditions
- P.** Existing roads
- Q.** Proposed roads
- R.** Existing utilities
- S.** Final site layouts showing exact location of impervious surfaces
- T.** Preliminary erosion and sediment control plans that contain:
 - i.** The construction sequence
 - ii.** Any phasing necessary to limit earth disturbances and impacts to natural resources
 - iii.** An overlay plan showing the types and locations of SWM structures and any erosion and sediment control practices to be used
- U.** Structural and construction details including representative cross sections for all components of the proposed drainage system or systems, and stormwater management facilities
- V.** All necessary construction specifications
- W.** Tabulation of the following:
 - i.** Total site area
 - ii.** Disturbed area
 - iii.** New impervious area
 - iv.** Total impervious area
- X.** A table showing the ESD and unified sizing criteria volumes required.
- Y.** A table of materials to be used for stormwater management facility planting
- Z.** All soil boring logs and locations

Chapter 5 Review and Approval Process for SWM Final Plan

A SWM final plan is the last phase and is submitted for review to both stormwater and erosion and sediment control approval agencies.

The final design shall demonstrate that where structural practices are used, all reasonable ESD options were first exhausted. Final plans shall be required for issuing local grading and building permits.

Final stormwater management plans shall be submitted for approval in the form of construction drawings and are to be accompanied by a report that includes sufficient information to evaluate the effectiveness of the proposed runoff control design. Any applicable comments received during the SWM site development phase must be addressed and incorporated into the final design.

If a stormwater management plan involves direction of some or all runoff off of the site, it is the responsibility of the developer to obtain from adjacent property owners any easements or other necessary property interests concerning flowage of water. **Approval of a stormwater management plan does not create or affect any right to direct runoff onto adjacent property without that property owner's permission.**

The SWM final plan is to be submitted with the first submittal of a Grading permit.

5.1. Documents to be provided for SWM Final Plan Approval

Documents required for SWM final plan approval include the Stormwater Management Report, Geotechnical report, Construction drawings, and any necessary plats required. The report and final plan shall contain sufficient engineering design information, and all supporting documentation and computations required to describe the type and location of all stormwater management practices proposed for the development.

5.1.1. Stormwater Management Reports

Reports for final stormwater management plan approval must be presented in bound booklets and shall include, but not limited to:

A. Stormwater Management Report

- i.** Information presented at the previous stages of stormwater management design
- ii.** Narrative, which supports the final design and describes how ESD will be implemented to the MEP
- iii.** Computations to support the selection of the Point of Investigation (POI)
- iv.** Final computations for stormwater management requirements (See chapter 7 of this manual)
- v.** Hydrologic computations of the applicable ESD and unified sizing criteria according to the Design Manual for all points of discharge from the site
- vi.** Hydraulic and structural computations for all ESD practices and structural stormwater management measures to be used
- vii.** Drainage Area maps
 - a.** Provide copies of all drainage area maps shown on the final development and or stormwater management plans
 - b.** Maps should be folded and placed in a pocket at the rear of the report

- c. Maps that are presented on more than one sheet must be cut and pasted to represent one composite map
- VIII. Flood plain computations

5.1.2. Geotechnical report

- A. The geotechnical report documents geotechnical investigations, including soil maps, borings, site specific recommendations, and any additional information necessary for the final stormwater management design.
- B. Preparer's Credentials
Testing shall be conducted and report prepared by a qualified professional. This professional shall either be a registered professional engineer, soils scientist or geologist and must be licensed in the State of Maryland.
- C. Subsurface Exploration
 - i. The exploration will follow the procedures as outlined in the State Manual and this manual, whichever is more restrictive.
 - ii. Borings and/or test pits
 - a. Borings and/or test pits must be performed at all proposed stormwater management locations. Borings for all proposed stormwater management practices shall be in accordance with USDA-Natural Resource Conservation Service Maryland Conservation Practice Standard for Ponds (MD-378).
 - b. A standard percolation test is acceptable for establishing the feasibility of infiltration for stormwater management, on single lot residential development. The location of the percolation test cannot be greater than 50-feet from the proposed location of the SWM device. ***Infiltration testing will occur at an elevation consistent with the bottom of the design trench.
 - c. When groundwater is not encountered, a maximum permeability rate of 1×10^{-6} centimeters per second must be established by the placement of material or confirmation that soils exist in-situ that meets or exceeds the requirements set forth in USDA-Natural Resource Conservation Service Standard for Ponds (MD-378) or impervious core material at the bottom of all wet ponds and wetland complexes.
 - d. Standard penetration testing consisting of split spoon, bulk sampling or Dynamic Core Penetrometer shall be conducted for the entire depth of the boring/test pit (at close intervals).
 - e. The minimum boring depth shall be five feet below the lowest point of excavation for the proposed device. If groundwater is encountered, the elevation of the groundwater shall be shown in the geotechnical report and with the boring data, typically shown on the plans.
 - f. All samples must be visually identified using the USDA-Natural Resource Conservation Service Unified Soil Classification System.
 - g. All other borings and test pits must be located as required as per the respective section of the state design manual or as deemed necessary by the Department and shall be clearly labeled and left in the field for inspection purposes.
- D. Required Data and Laboratory Testing
 - i. Soil Series and Classification
The soil series, as mapped in the Soil Survey of Anne Arundel County USDA-Natural Resource Conservation Service and geologic formation as mapped by the Maryland Geologic Services, must be noted. The soil classification (Unified Soil Classification

System and USDA Textural Classification System) for all samples as supported by appropriate laboratory testing must be noted.

- ii. The in-situ moisture content must be determined for all samples.
- iii. Munsell color chart identification must be included for all samples.
- iv. All soil samples identified as potentially acidic must be tested for acidity. Acceptable methodologies for testing the soils have been established by the Anne Arundel Soil Conservation District and are found in Appendix I. Other testing methods must be approved by the Department and the Anne Arundel Soil Conservation District.
- v. Textural, chemical, pH and organic analysis (see Appendix B.3.B. of the State Manual) must be performed for planting and topsoil mediums used in bioretention systems.
- vi. Potentially cationic or fat plastic clays, weak or frost-heave susceptible soils or clays, highly erodible silty/sandy soils and hydric soils must be identified. At the discretion of the Office of Planning and Zoning, or Anne Arundel County Soil Conservation District, additional laboratory or field testing of these soils may be required.

E. Conclusion

The conclusion must include the following:

- i. Stormwater Management Practice Feasibility
Explain subsurface exploration methods, provide location map for testing, summarize findings, summarize field and laboratory testing results and provide recommendation regarding physical feasibility of use of the various BMPs (*See the State Manual*).
- ii. Earth moving
Recommendations for earth moving, storage, methods of compaction and stabilization, and suitability of on-site or borrow soils for use in construction of various stormwater practices must be provided.
- iii. Inadequate and Acid/Sulfate Soils
Provide recommendations for movement, storage compaction, stabilization and/or disposal of identified inadequate or acid/sulfate soils.
- iv. Describe the site's general groundwater characteristics and provide: recommendations on feasibility of various BMPs; for management of groundwater during and/or need for management after construction of recommended BMPs

5.1.3. Construction drawings

Construction drawings must be submitted to support the Final Stormwater Management design and shall include, but are not limited to:

A. A vicinity map

B. Drainage Area Maps

- i. Must be provided to depict the following:
 - a. Areas used to compute the point of investigation (POI)
 - b. Existing and proposed conditions on site
 - c. The map scale shall selected based on the ability to depict information clearly. However the following minimums apply:
 - i) 1" = 100' for drainage areas of 25 acres or less
 - ii) 1" = 200' for drainage areas
 - d. Minimum information presented on each map must include but is not limited to:
 - i) Actual drainage area under consideration represented by a measureable clearly delineated area

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- a) Sub-areas must be shown with different shading or coloring that represents areas of zoning and hydraulic soil group (HSG).
 - b) Each sub area must be labeled with a specific letter (e.g. A, B, etc.)
 - ii) Contour lines
 - a) Clearly labeled
 - b) Contour lines must extend a minimum of 200 feet beyond the delineated area
 - iii) Travel path for time of concentration must be clearly shown with each segment labeled with:
 - a) Distance
 - b) Slope
- C. Table of drainage area information
 - i. Provide a table for each drainage area that shows:
 - a. Each sub area identified in 5.1.3.B.I.d.i)b)
 - b. Acreage of each area
 - c. Computed curve number of "C" factor
 - d. Summation of all area
 - i) Summation must be equal to the total area for the drainage area under consideration.
- D. On site drainage area maps must show:
 - i. Existing and proposed topography
 - ii. Any proposed improvements including location of buildings or other structures, impervious surfaces, and storm drainage facilities
- E. The location of existing and proposed structures and utilities
- F. The delineation of the following shall be shown using coordinates that depict the point of beginning, and bearing and distances for each line that demarcates the limits:
 - i. All existing and proposed easements, rights-of-way, and proposed fee simple areas to be deeded for public use.
 - a. All should be labeled to indicate whether they are public or private.
 - ii. 100-year floodplain
 - a. Cross sections utilized in flood plain studies must be clearly shown on the final development and/or grading plan labeled with the computed water surface elevation
 - iii. On-site wetlands
- G. Structural and construction details including representative cross sections for all components of the proposed drainage system or systems, and stormwater management facilities
- H. All necessary construction specifications
- I. A sequence of construction
- J. Tabulation of the following:
 - i. Total site area
 - ii. Disturbed area
 - iii. New impervious area
 - iv. Total impervious area
- K. A table showing the ESD and unified sizing criteria volumes required
- L. A table of materials to be used for stormwater management facility planting
- M. All soil boring logs and locations
- N. An inspection and maintenance schedule
- O. Certification by the owner/developer that all stormwater management construction will be done according to this plan
- P. An as-built certification signature block to be executed after project completion

Chapter 6 General SWM Design Guidance

6.1. General Requirements

6.1.1. Stormwater management plan required

- A.** A developer may not undertake any development or land disturbance that is subject to the provisions of Anne Arundel County Code without an approved stormwater management plan.
- B.** The ESD planning techniques and practices and structural stormwater management measures established in the State Design Manual and this manual shall be used, either alone or in combination in a stormwater management plan.

6.1.2. Exemptions

The following developments are exempt from meeting the requirements of this document.
Please see 7.10 of this manual for critical area requirements.

- A.** Agricultural land management practices
- B.** Sites, other than a new single family detached dwelling, that do not disturb over 5,000 square feet of land area and commercial, industrial and institutional land uses that have not previously been exempted under this criteria.
- C.** Additions or modifications that are not classified as substantial improvements to existing single family detached dwellings if land disturbance is less than 5,000 square feet
- D.** Development regulated under State law that provides for managing stormwater runoff.

6.1.3. Environmental Site Design (ESD) utilized to the Maximum Extent Practicable (MEP)

- A.** All Stormwater Management Plans shall demonstrate that environmental site design (ESD) has been implemented to the maximum extent practicable (MEP)
- B.** The use of ESD planning techniques and treatment practices shall be exhausted before any structural best management practice (BMP) is implemented.
- C.** Structural management practices may be used only if determined to be absolutely necessary.

6.1.4. ESD Planning Techniques and Practices

- A.** The following planning techniques shall be applied, according to the State Design Manual, in order to satisfy the applicable minimum control requirements:
 - I.** Preserving and protecting natural resources
 - II.** Conserving natural drainage patterns
 - III.** Minimizing impervious area
 - IV.** Reducing runoff volume
 - V.** Using ESD practices to maintain 100 percent of the annual predevelopment groundwater recharge volume
 - VI.** Using green roofs, permeable pavement, reinforced turf, and other alternative surfaces
 - VII.** Limiting soil disturbance, mass grading, and compaction
 - VIII.** Clustering development and
 - IX.** Any practices approved by the Administration

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B. The following ESD treatment practices shall be designed according to the State Design Manual to satisfy the applicable minimum control requirements:

- I. Disconnection of rooftop runoff
- II. Disconnection of non-rooftop runoff
- III. Sheet flow to conservation areas
- IV. Rainwater harvesting
- V. Submerged gravel wetlands
- VI. Landscape infiltration
- VII. Infiltration berms
- VIII. Dry wells
- IX. Micro-bioretenement
- X. Rain gardens
- XI. Swales
- XII. Enhanced filters, and
- XIII. Any practices approved by the Administration

C. Structural Stormwater Management Measures

The following structural stormwater management practices shall be designed according to the Design Manual to satisfy the applicable minimum control requirements:

- I. Stormwater management ponds
- II. Stormwater management wetlands
- III. Stormwater management infiltration
- IV. Stormwater management filtering systems
- V. Stormwater management open channel systems
- VI. Step Pool Storm Conveyance System (SPSC)

D. The performance criteria specified in the Design Manual with regard to general feasibility, conveyance, pretreatment, treatment and geometry and landscaping, and maintenance shall be considered when selecting structural stormwater management practices

E. Structural stormwater management practices shall be selected to accommodate the unique hydrologic or geologic region of the site.

6.1.5. Meeting the MEP standard

A. The MEP standard is met when:

- I. Channel stability is maintained;
- II. Predevelopment groundwater recharge is replicated;
- III. Nonpoint source pollution is minimized;
- IV. Structural SWM practices are used only if determined to be absolutely necessary; and
- V. Step Pool Storm Conveyance Systems are employed wherever practicable on all public storm drainage systems.

6.1.6. Preparer's Credentials

A. The design of stormwater management plans shall be prepared by either a Professional

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Engineer, Professional Land Surveyor, or Landscape Architect licensed in the State of Maryland.

- B.** If a stormwater BMP requires either a dam safety permit from MDE or small pond approval from the Anne Arundel Soil Conservation District, the design shall be prepared by a Professional Engineer licensed to practice in the State of Maryland.

6.1.7. Minimum Stormwater Management Requirements – New Projects

A. Minimum Requirements for all New Development Projects

- I.** All stormwater management measures shall be designed in accordance with this manual to provide for:
 - a.** Recharge volume (Rev) (See State Manual)
 - b.** Water quality volume (WQv) (See State Manual)
 - c.** Channel protection storage volume (Cpv) (See State Manual)

6.1.8. Minimum Stormwater Management Requirements – Redevelopment projects

A. Minimum Requirements for Redevelopment Projects

- I.** See State Manual Section 5.5.
- II.** For additional requirements see 7.11 of this document

6.2. Critical Area Guidelines

Developments within critical areas shall address all stormwater management requirements in accordance with this manual.

Chapter 7 Detailed Design Criteria

7.1. All projects

7.1.1. Environmental Site Design Volume (ESDv)

- A.** Recharge volume (Rev) (See State Manual)
- B.** Water quality volume (WQv) (See State Manual)
- C.** Channel protection storage volume (Cpv) (See State Manual)

7.1.2. Overbank protection storage volume (Qp) – Details in this manual

7.1.3. Extreme flood control (Q_f) Details in this Manual

7.1.4. Additional requirements for individual practices

A. Submerged Gravel Wetlands

If the Submerged Gravel Wetlands (M-2), as outlined in the State Manual, is proposed as a micro practice, then the maximum drainage area must be 40,000 square feet or less.

7.1.5. Use of the Step Pool Stormwater Conveyance System as a structural device

- A.** The Regenerative Step Pool Conveyance System means the same as Step Pool Storm Conveyance (SPSC)
- B.** The SPSC, or portions of it, may be designed and utilized as a structural device to meet water quality, recharge and channel protection volume requirements if it is demonstrated that it mimics a structural device located in Chapter Three of the State Manual.
- C.** ESD to the MEP must be adequately addressed, prior to the use of SPSC as part of the stormwater management design for the development
- D.** The plans and computations must clearly delineate the portion of the SPSC to be considered and design limitations/criteria must meet the criteria that the SPSC mimics.
- E.** The post development discharge rate utilized when addressing channel protection volume should be based on the reduced curve number (CN*) computed for the drainage area.

7.1.6. Computations

- A.** Computations must be presented in a bound booklet and shall include the following information:
 - a.** Introduction, which includes:
 - i)** The general description of the project and computational methodology
 - ii)** Explanation of all assumptions made.
 - iii)** Any other pertinent information that will aid in the review process
 - b.** The models TR-55 or TR-20 will be used to determine peak discharge rates.
 - i)** A schematic for the TR-20 process must be included in the computations
 - ii)** For SWM pond designs where the riser structure discharges to a closed storm drainage system, the stage discharge calculations must take into account the fact that the discharge may be controlled by the flow already passing through the system. The tail water elevation to be used is the elevation of the hydraulic grade line within the system.
- B.** Tabulate results on Final Development Plan/Grading permit
 - a.** Provide a table that lists the following on the cover sheet of the Final Development and Grading permit plan

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- b. Use the format of the Stormwater Management Structure Summary sheet located in appendix 11.7

C. Input Parameters

- i. Soils**
 - a. The current version of the Soil Survey of Anne Arundel County from the USDA-NRCS shall be used to classify the soils into hydrologic soil groups. Copies of the most current version of the Soil Survey may be obtained from the Anne Arundel Soil Conservation District Office upon request.
- ii. Time of Concentration (Tc)**
 - a. The methods described in the latest version of TR-55 shall be used to compute time of concentration in each sub-area. The maximum length of overland flow shall be;
 - i) No more than 150 feet for the pre-developed condition, and
 - ii) No more than 100 feet for the post-developed condition, based on proposed land use conditions.
- iii. Rainfall Depth (P)**

The rainfall depths to be used in hydrologic computations are listed below:			
Storm event (year)	1	10	100
Rainfall depth (inches)	2.7	5.2	7.4

7.2. Overbank Flood Protection - (Q_p)

The primary purpose of the overbank flood protection is to prevent an increase in the frequency and magnitude of out-of-bank flooding generated by development and to maintain lateral and vertical stability within receiving stream channels. In order to determine if overbank protection will be required, an analysis of the channel conditions downstream of the development must be completed. The limits of the assessment will begin at the outfall(s) from the site and progress downstream to the Point(s) of Investigation (POI).

7.2.1. Establish the Point of investigation (POI)

- A.** The point of investigation is the point located downstream of the site, where the maximum post development runoff (based on current zoning) from the site is less than or equal to 10 percent of the total runoff to that point.
 - i.** Runoff computations will be based on the 10 year 24 hour design storm.
 - ii.** Runoff Curve Numbers and times of concentration must be based on ultimate development conditions assuming no storage within existing BMPs located within the drainage area.

7.2.2. Determine if Overbank Flood Protection (qp) is required

Overbank Flood Protection is required if the development does not have direct discharge to tidal water, and one or more of the following conditions exists between the site outfall and the POI:

- A.** The site discharges to an area where it is determined that historical flooding problems exist downstream of the discharge point.
 - i.** The following information addresses methods to be used to establish whether flooding problems exist.
 - a.** Evaluate runoff impacts to downstream properties based on maps and runoff computations.
 - b.** Flooding must be based on runoff from the 10 year 24 hour design storm.

- c. The applicant is encouraged to contact the Infrastructure Management Division of the Department of Public Works to obtain any information regarding flooding concerns within the study area.
 - B. The site discharges to flood plain areas, downstream of the site, that are not contained within easements that preclude development, or are not dedicated to Anne Arundel County Government or other public entity that has the ability to control development within the flood plain.
 - i. The following information addresses methods to be used to establish that flood plain areas are contained within easements or dedicated to a public entity.
 - a. Provide a plan that shows the properties that would be affected by the flood plain.
 - b. The plan should include all properties from the outfall(s) from site to the point(s) of investigation
 - c. Each property must be clearly delineated and cross referenced to the supporting documentation provided.
 - d. Provide copies of any plats, deeds, easement documents and any other supporting documentation or information required in order to establish the existence of easements and or flood plain dedications within or directly adjacent to the parcels established under item **7.2.2.B.I.a** above.
 - C. The site discharges to a location that is deemed to have an inadequate outfall.
 - i. The following information addresses methods to be used to establish whether or not the site has an adequate outfall:
 - a. Locate the outfall(s) for the site.
 - b. Each outfall from the site must be assessed separately.
 - c. Provide runoff computations for post development conditions to each site outfall.
 - d. Post development runoff curve numbers are to be based on ultimate development of the site, based on zoning.
 - e. Pre development runoff curve numbers are to be based on existing conditions on site.
 - f. If there is an increase in the computed pre and post development (based on ultimate development attributed to zoning) discharge, from a site or the flow characteristics change from sheet flow to concentrated flow, at any outfall from the site then an analysis of the downstream conveyance system (downstream analysis) is required for the outfall.
 - g. If the site outfall discharges via sheet flow conditions, and the characteristics of sheet flow, after development, mimics existing conditions when flow rate and sheet flow characteristics are considered, then the outfall is deemed to be adequate.
 - h. Unless superseded by critical area legislation, if the outfall discharges directly to a closed storm drain system or an open channel, or sheet flows to a property which is publicly owned and maintained, and the difference between the pre and post development discharge, is 10 % or less, then an analysis of the downstream conveyance system (downstream analysis) is not required and that outfall is deemed to be adequate.
 - i. If the outfall discharges directly to a closed storm drain system or an open channel, or sheet flows to a property which is privately owned and maintained, and there is an increase in the post development discharge then the site does not have an adequate outfall and an analysis of the downstream conveyance is required.
 - j. For Single lot single family development plan submitted only under the grading or building permit process, the following applies:

- i) If the site outfall discharges directly to a publicly maintained closed storm drain system or a publicly maintained open channel, that is located within a publicly maintained easement or right of way, then an analysis of the downstream conveyance system (downstream analysis) is not required and that outfall is deemed to be adequate.
- ii) If the outfall discharges directly to a closed storm drain system or an open channel, or sheet flows to a property which is privately owned and maintained, and there is an increase in the post development discharge then the site does not have an adequate outfall and an analysis of the downstream conveyance is required.

D. Downstream analysis and determination of adequate outfall

- i. If the site discharges directly to an existing closed storm drain system, the following information is required:
 - a. Provide copies of as built maps of the system. If as-built maps are unavailable, then an as-built survey must be completed by the design consultant.
 - b. Determine, from the as-built information, the location of the most restricted segment of the system, e.g. the run of pipe with the lowest capacity or structure with the greatest hydraulic gradient.
 - c. Determine the runoff rate (cfs) that would make the system adequate (q adequate)
 - d. Compute the total runoff rate to that point, based on the total drainage area (q ultimate).
 - e. Adequacy of the system is established if q ultimate is less than or equal to q adequate.
- ii. If the site discharges to a clearly defined open channel, the following is required:
 - a. An assessment of the channel using the Rapid Stream Assessment methodology as outlined in the Stream Assessment Protocol for Anne Arundel County.
<http://www.aacounty.org/DPW/Watershed/DownstreamAdequacyProtocols.cfm>
 - b. If there is an instability issue, provide a narrative description of the potential cause of instability.
 - i) Use the data from both the stream characterization and stability assessment forms when recording the description.
 - ii) The narrative should identify the potential cause of instability and clearly explain, based on fluvial geomorphic processes, how the cause has resulted in the instability of the stream.
 - c. Provide a recommendation for addressing the inadequate conditions.
 - i) If the recommendation entails regulation of flows to the channel, the appropriate runoff rate that is required to address the issue must be determined and stated.
 - a) This runoff rate is to be used in the determination of Overbank Flood Protection management to be addressed by the development.
 - ii) If the recommendation entails rehabilitation of the channel, then:
 - a) A plan and cost estimate must be developed.
 - b) Any associated easements that are required must be obtained prior to final approval of the project.
 - d. If there is no instability concern, based on existing conditions, then documentation must be provided to indicate how adequacy of the system, based on assessment of lateral and vertical stability of the channel, will be maintained after development of the site.

7.2.3. Providing Overbank Flood Protection (Peak Management)

- A.** If there is an inadequate condition, downstream of the development, within the limits of the site outfall and the POI and the inadequacy is linked to runoff rates, then peak management of the 10 year 24 hour design storm is required.
- B.** Peak management will be applied by controlling discharge rates from the development site, by storing the runoff depth that may be required based on the review of the outfall conditions downstream of each discharge point from the site.
- C.** Peak management must be addressed utilizing ESD to the MEP.
- D.** The following are the computational steps to be followed to address Peak Management;
 - i.** Determine the allowable discharge from the site at each outfall. (q allowable)
 - a.** If the site discharges to a publicly owned and maintained storm drain system then the allowable discharge is the site's proportionate share of the adequate discharge rate as computed in 7.2.2.D.I.c
 - b.** If the site discharges to property that is privately owned and maintained, then the allowable discharge is the lesser of the following:
 - ii.** The site's proportionate share of the adequate discharge rate as computed in 7.2.2.D.I.c or the runoff rate based on pre development conditions on site
 - iii.** If the site has employed ESD to the MEP then the curve number, used to calculate post development discharge from the site, may be reduced to account for the storage in the micropractices.
 - iv.** The following are computational steps to be followed to determine the reduced curve number (CN^*)
 - a.** Compute the total volume of storage provided within the ESD practices designed to address water quality, recharge volume and channel protection volume, located within the drainage area of the outfall (V_{stored}).
 - b.** Compute the runoff depth stored in the devices
$$Q_{\text{stored}} \text{ (inches)} = [V_{\text{stored}} \text{ (cf)} \times 12 \text{ (inch/foot)}] / \text{DA}(\text{Ac}) \times 43560 \text{ (ft}^2\text{)}$$
 - c.** Compute the post development runoff depth for the 10 year 24 hour design storm (Q_{dev}). The actual site data should be utilized
 - d.** Calculate CN^* (Change in curve number based on storage)
$$CN^* = 200 / [(P+2Q+2) - \sqrt{(5PQ+4Q^2)}]$$
$$Q = Q_{\text{dev}} - Q_{\text{stored}} \text{ (inches)}$$
$$P = 10 \text{ year rainfall depth (5.2 inches)}$$
 - v.** Use either TR-55 or TR-20 to compute runoff rate at the outfall and compare with q allowable computed in 7.2.3.D.I above
 - vi.** Peak management has been adequately addressed for the outfall if it is demonstrated that the post development discharge is less than or equal to the allowable discharge rate at the outfall.

7.3. Outfall design standards

7.3.1. Discharge leaves site via open channel

- A.** Allowable discharge after development (q_a) is based on the following:
 - i.** Channel is within public easement or dedicated flood plain, q_a is based on capacity of the receiving channel.
 - a.** Allowable discharge from site is based on the ratio of the site's contribution of flow to the channel when compared to flow from the total drainage area to the channel at the POI.

- B.** All new stormwater outfalls that discharge to open channels shall be constructed as Step Pool Storm Conveyance Systems (SPSCS) whenever it is feasible.
- C.** If a SPSCS is not being proposed, then documentation must be provided by the developer that adequately demonstrates why the SPSCS can not be constructed.

7.3.2. Discharge leaves site via closed storm drain system or culvert.

- A.** Design must conform to the design of storm drain systems as outlined in the Anne Arundel County Department of Public Works Design Manual.

7.3.3. Discharge leaves site in sheet flow condition.

- A.** Sheet flow condition must be maintained after development.
- B.** The applicant is required to ensure that the post development runoff mimics the pre development linear discharge rate.

7.4. Mitigation for inadequate downstream conveyance system

- i.** If on site peak management or extreme flood control is required and it has been demonstrated that on site management is infeasible, then a mitigation plan is required.
- ii.** The following steps are to be utilized for closed (piped) or open channel systems, when developing the mitigation plan:
 - a.** For peak management, computations will be based on runoff from the 10 year twenty four hour design storm. For extreme flood control, the 100 year twenty four hour design storm should be applied.
 - b.** Determine the location and cause of the downstream inadequacy (design point)
 - c.** Compute the total flow rate, based on the entire drainage area, to the design point. Flow rate will be modeled using runoff curve numbers and times of concentration based on present zoning for the properties draining to the design point.
 - d.** Based on the computed runoff rate from the development, calculate the percentage of flow from the proposed development when compared with the total runoff rate to the design point.
 - e.** Develop a plan to correct the inadequacy and prepare a cost estimate for completion of the work.
 - f.** Corrective measures proposed must be commensurate with your site's percentage contribution of runoff to the design point.
 - g.** Submit a mitigation proposal for review.
 - i)** The proposal should include the following information:
 - a)** Narrative that explains why the required management can not be totally or partially accomplished on site.
 - b)** Statement that explains the actual mitigation proposed.
 - c)** The percentage of the site runoff rate when compared to the total runoff rate to the design point
 - d)** Cost of the proposed work.
 - e)** If the development is expected to partially complete the necessary work, then a computation should be provided that demonstrates that the partial work completed is commensurate with the percentage of the runoff rate from the site to the design point.
 - h.** Once the mitigation has been approved, plans must be prepared and included in the storm drainage or stormwater management package.

- i. The outfall statement must be modified to indicate the approval date of the mitigation plan.
- j. Any offsite easements required for the mitigation must be procured prior to approval of the Final plan or Site Development plan.

7.5. Rights-to-Discharge

7.5.1. When is a Right-to-Discharge required?

If a development plan involves the direction of some or all of the stormwater runoff from the site in a manner that alters the flow characteristics of depth, velocity, width, or rate from that which exists in the pre-developed condition, the developer shall obtain from abutting property owners any necessary easement, right-to-discharge, or other property concerning flow of water. Rights to discharge are required if:

- A. The post development discharge rate is increased when compared to the pre development discharge rate of flow leaving the site.
- B. Flow characteristics (e.g. sheet flow changes to concentrated, etc) have been altered.

7.5.2. Basis for determination of rights-to-discharge

- A. The requirement for rights-to-discharge must be evaluated for every point where discharge is expected to leave the site based on post development conditions.
- B. Rights-to-discharge are not required if flow is directed to a publicly maintained storm drainage system.
- C. Rights-to-discharge are required at points where flows from publicly maintained facilities are directed to privately maintained systems.
- D. Runoff is based on the 10 year 24 hour design storm.

7.5.3. Documentation

The right to discharge symbol must be placed on the final development plan and any necessary plats required as part of the development plan approval process.

7.6. Downstream easement for dam breach area

7.6.1. Breach area delineated.

If a dam is constructed as part of the development, then the breach area must be clearly delineated for onsite and offsite parcels.

7.6.2. Easements platted.

- A. Dam breach easements must be platted for all affected areas within the development parcel.
- B. Easements must be acquired and platted for all offsite properties located within the breach area.
- C. These easements will preclude construction of habitable structures within the limits of the easement area.

7.7. Extreme flood control (Q_f)

7.7.1. When is Extreme Flood control (Q_f) required?

- A. Extreme flood control is required if one or more of the following conditions exists prior to development of the site.

- I. Flood plain areas downstream of the site are not contained within easements that preclude development or are dedicated to Anne Arundel County Government or other public entity that has the ability to control development within the flood plain.
- II. It is determined that historical flooding problems exist downstream of the development

7.7.2. Point of investigation for extreme flood determination

The point of investigation for the 100 year storm is to be determined for overbank flood protection.

7.7.3. Providing Extreme Flood control Q_f

- A. Extreme flood control will be addressed by controlling the increase in discharge rates, caused by development, by storing the increased runoff depth attributed to the change in land use.
- B. Q_f must be addressed utilizing ESD to the MEP.
- C. The following are the computational steps to be followed to address Extreme Flood Management:
 - I. Determine the allowable discharge from the site at each outfall. (q allowable)
 - a. The allowable discharge is the site's proportionate share of the adequate discharge rate, based on the 100 year design storm, as computed in 7.2.2.D.I.c
 - b. If the site discharges to property that is privately owned and maintained, then the allowable discharge is the lesser of the following:
 - i) The site's proportionate share of the adequate discharge rate as computed in 7.2.2.D.I.c or
 - ii) The runoff rate based on pre development conditions on site
 - II. If the site has employed ESD to the MEP, then the curve number, used to calculate post development discharge from the site, may be reduced to account for the storage in the micropractices.
 - III. The following are computational steps to be followed to determine the reduced curve number (CN^*)
 - a. Compute the total volume of storage provided within the ESD practices designed to address water quality, recharge volume, channel protection volume, and Q_p , located within the drainage area of the outfall (V_{stored}).
 - b. Compute the runoff depth stored in the devices
$$Q_{\text{stored}} \text{ (inches)} = [V_{\text{stored}} \text{ (cf)} \times 12 \text{ (inch/foot)}] / DA(Ac) \times 43560 \text{ (ft}^2\text{)}$$
 - c. Compute the post development runoff depth for the 100 year 24 hour design storm (Q_{dev}). The actual site data should be utilized
 - d. Calculate CN^* (Change in curve number based on storage)
$$CN^* = 200 / [(P+2Q+2) - \sqrt{(5PQ+4Q^2)}]$$
$$Q = Q_{\text{dev}} - Q_{\text{stored}} \text{ (inches)}$$
$$P = 100 \text{ year rainfall depth (7.4 inches)}$$
 - IV. Use either TR-55 or TR-20 to compute runoff rate at the outfall and compare with q allowable computed in 7.2.3.D.I above
 - V. Peak management has been adequately addressed for the outfall if it is demonstrated that the post development discharge is less than or equal to the allowable discharge rate at the outfall.
 - VI. If the post development discharge is less than or equal to the allowable discharge rate at the outfall then management for extreme flood control has been adequately addressed for the outfall.

7.8. 100 Year Flood Plain Delineation

7.8.1. Determination of 100 year flood plain

- A.** If the total runoff, from the 10 year 24 hour storm, to any discharge point from a site is equal to or exceeds 100 cfs, then a flood plain exists on the site.
- B.** If a platted 100 year flood plain is located adjacent to or upstream of the site, then a flood plain exists on the site.

7.8.2. Delineation of the flood plain

- A.** 100 year flood plains may be delineated by any of the following methods:
 - i.** FEMA flood elevation limits
 - ii.** Previously platted
 - a.** Plat must indicate “100 year flood plain”
 - b.** Provide verification that the flood plain was established by utilizing our current criteria. (Approved flood plain study) The consultant may need to contact the engineering firm that completed the original study.
 - c.** Flood plain on adjacent site must traverse the entire length of the site currently being reviewed.
 - d.** Provide a final development plan of the adjacent site, that shows the computed water surface elevation.
 - iii.** Flood plain studies
 - a.** Flood plain studies are comprised of plans and computation booklet.
 - b.** Studies must be completed by a Design Professional, registered in the State of Maryland.
 - c.** Runoff computations must be based on the 100 year storm.
 - d.** Runoff curve numbers and time of concentration calculations must reflect ultimate development based on zoning for all parcels within the drainage areas.
 - e.** No allowance should be made for storage within ponds or other detention structures or behind undersized culverts.
 - iv.** Simplified Flood plain study
 - a.** May be utilized for single family lot permits, and minor subdivisions consisting of five lots or less only
 - b.** Hydrology may be developed utilizing TR-55, TR-20 or Rational methods.
 - c.** Drainage area maps must be developed using standard methods as outlined in the storm drain checklist, which may be found in the appendix of this manual
 - d.** Site must not be located directly upstream of any constriction or structures such as culverts which would create backwater effects within the site area.
 - e.** Water surface elevation may be calculated using Manning's equation for cross sections located at:
 - i)** Upstream property line
 - ii)** Downstream property line
 - iii)** Areas of significant topographical changes between the upstream and downstream property lines
 - v.** Detailed Flood plain study
 - a.** Must be utilized for all project types not listed in 7.8.2.A.IV.a
 - b.** Plans
 - i)** Plans must be at a scale that allows for legible depiction of the required information.

- ii) Cross sections must be based on field run topography and must be shown on the plan view.
 - iii) If the flood plain study is being prepared as part of a subdivision or site development plan, the location of the cross sections must be plotted on the final development or site plan. The cross sections must be labeled with the applicable number utilized in the computations along with the final computed water surface elevation.
- c. Computations
- i) Computations must be presented in a bound booklet and shall include the following information:
 - a) Introduction, which includes:
 - 1) The general description of the project and computational methodology
 - 2) Explanation of all assumptions made.
 - 3) Explanation of how the starting water surface elevation was determined.
 - 4) Any other pertinent information that will aid in the review process
 - b) The hydrology will be determined for ultimate development based on zoning, within the watershed.
 - c) The models TR-55 or TR-20 will be used to determine peak discharge rates.
 - d) Water Surface Elevations (WSEL) shall be computed utilizing HEC-2 or, HEC RAS
 - e) Cross sections shall be taken at each constriction, structural crossing and at each significant change in slope or stream direction.
 - f) Error messages must be evaluated to determine whether or not additional cross sections are warranted.

7.9. Stream Buffers

7.9.1. Buffers required

- A.** Stream buffers must be placed on both sides of all intermittent and perennial streams that are located within the site. If the stream is adjacent to the site then the buffer is placed on the side adjacent to the site.
- i.** **Intermittent Stream-** means a stream, or reach of a stream, that is below the local water table for at least some part of the year, and obtains its flow from both surface runoff and ground water discharge, or those areas that are surface waters, contained within a defined channel or bed, that flow at least once per year (*a defined channel or bed is indicated by hydraulically sorted sediment, or the removal of vegetative litter or loosely rooted vegetation by the action of moving water*).
 - ii.** **Perennial Stream-** means a stream, or part of a stream, containing surface water throughout an average rainfall year, or that flows continuously during all of the calendar year, as a result of ground water discharge or surface runoff, as confirmed by field verification.
- B.** Once determined, the buffers must be clearly delineated on all SWM plans.

7.9.2. Minimum buffer width

The minimum buffer width is 100 feet

7.9.3. Measuring the buffer width

- A.** Determine the stream order
 - i.** See Appendix 11.11
 - ii.** For 1st and 2nd order headwater streams, measure the buffer width from the centerline of the stream.
 - iii.** For stream orders greater than 2, measure the buffer width from the stream bank of the active channel (bank-full flow)
- B.** Stream buffer widths may be greater if floodplains, wetlands, or steep slopes extend beyond the buffer line.

7.10. Projects located within the Critical Area

7.10.1. Intensely Developed Areas (IDA)

- A.** Pollutant reduction requirements
 - i.** For new development and redevelopment sites, pollutant loadings from impervious surfaces shall be reduced by at least 10% below the level of pollution from the site prior to development.
 - ii.** This requirement will be met by implementing ESD to the MEP.
 - iii.** Offsets permitted by the design standards and the technical report may be used either onsite or offsite in the same critical area watershed to reach the 10% pollutant reduction requirement of this section after implementing ESD to the MEP.
- B.** Disturbance of less than 5,000 square feet in the buffer and expanded buffer
 - i.** For development sites, located within the buffer and expanded buffer, where disturbance is less than 5,000 square feet, pollutant loadings from new impervious surface shall be reduced as follows and in the following order of priority:
 - a.** For disturbance of less than 1,000 square feet:
 - i)** Planting onsite, in the buffer and expanded buffer at a ratio of two times the area of new impervious surface
 - ii)** Planting onsite in the critical area outside the buffer and expanded buffer at a ratio of two times the area of new impervious surface
 - iii)** Planting at an offsite location in the critical area at a ratio of two times the area of new impervious surface
 - iv)** Payment of a fee-in-lieu in the amount of \$1.20 per square foot of new impervious surface
 - b.** For disturbance greater than 1,000 and less than 5,000 square feet:
 - i)** Planting onsite in the buffer and expanded buffer at a ratio of two times the area of new impervious surface
 - ii)** Planting onsite in the critical area outside the buffer and expanded buffer at a ratio of two times the area of new impervious surface
 - iii)** Planting at an offsite location in the critical area at a ratio of two times the area of new impervious surface
 - iv)** Payment of a fee-in-lieu of \$1.20 per square foot of new impervious surface
 - ii.** For development sites in the IDA on which disturbance is less than 5,000 square feet outside the buffer and expanded buffer, pollutant loadings from new impervious surface shall be reduced as follows and in the following order of priority:
 - a.** For disturbance of less than 1,000 square feet
 - i)** Planting onsite in the critical area at a ratio equal to the area of new impervious surface or

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- ii)** Payment of a fee-in-lieu in the amount of \$0.60 per square foot of new impervious surface or
- b.** For disturbance greater than 1,000 and less than 5,000 square feet:
 - i)** Planting onsite in the critical area at a ratio equal to the area of new impervious surface;
 - ii)** Planting offsite in the critical area at a ratio equal to the area of new impervious surface; or
 - iii)** Payment of a fee-in-lieu of \$0.60 per square foot of new impervious surface.

7.10.2. Limited Development Areas (LDA)

No additional requirements.

7.10.3. Resource Conservation Area (RCA)

No additional requirements.

7.11. Redevelopment Criteria

The goal of the current redevelopment regulations is to gain water quality treatment on existing developed lands while supporting local initiatives to improve urban communities.

7.11.1. Minimum control requirements

For minimum requirements see 5.5.2 of the State Manual

7.11.2. Alternative stormwater management measures,

Alternative stormwater management measures may be used to meet the minimum requirements for redevelopment projects if it can be satisfactorily demonstrated to the Office of Planning and Zoning that impervious area reduction has been maximized and ESD has been implemented to the MEP. Alternative stormwater management measures include but are not limited to:

- A.** Use of an on-site structural BMP
- B.** Use of an off-site structural BMP to provide water quality for an area equal to or greater than 50% of the existing impervious area
- C.** Use of a combination of impervious area reduction, ESD implementation, and on-site or off-site structural BMP for an area equal to or greater than 50% of the existing site impervious area within the limits of disturbance.

7.11.3. Additional Alternatives

If it can be demonstrated to the Office of Planning and Zoning that all attempts to reduce impervious area, and implement ESD to the MEP, and use alternative measures described in 7.11.2 above have been exhausted, then the following alternatives may be considered:

- A.** Watershed or stream restoration
- B.** Retrofitting an existing stormwater management facility, including existing BMP upgrades, filtering practices, and off-site ESD implementation
- C.** A combination of ESD and an on-site or off-site structural BMP
- D.** Payment of a fee-in-lieu
- E.** A partial modification of the treatment requirements if ESD is not practicable
- F.** Using design criteria based on watershed studies conducted by the County or
- G.** Implementing stormwater management practices to provide water quality control for 50% of the existing impervious area

7.11.4. SWM for net increase in impervious area

Stormwater management shall be addressed according to the new development requirements in the Design Manual for any net increase in impervious area .

7.11.5. SWM for existing impervious areas that drain to an existing BMP

When existing impervious areas drain to a BMP meeting current standards, these areas are considered treated. Therefore, redevelopment requirements will apply to the remaining unmanaged existing impervious areas.

7.12. Additional details for construction and layout of Stormwater Management Facilities

7.12.1. Side Slopes

The side slopes shall not exceed 3:1 for all interior or exterior slopes

7.12.2. Fencing

- A.** Dry facilities are not required to be fenced.
- B.** Retention and detention devices located within 500 feet of a residential area, or in the proximity of an elementary school playground or other areas where small children may congregate without adult supervision and that meet any one of the following criteria shall be fenced:
 - i.** Retention devices with designed wet storage depth greater than twenty-four inches
 - ii.** Retention and detention devices designed to retain the 10-year storm for more than 24 hours at depth greater than twenty-four inches
- C.** The need for fencing must be minimized by utilizing designs that incorporate grading which eliminates steep drop-offs, provides an 8 foot safety bench above the permanent pool elevation if slopes are between 3:1 and 4:1
- D.** If fencing is required materials must meet the following criteria
 - i.** Fence height shall be a minimum of 42 inches
 - ii.** Gates shall have minimum width of 12 feet and be equipped with the county standard stormwater pond lock
 - iii.** Fences shall be constructed so as not to impede flow through the supplemental spillway
 - iv.** Material shall be black vinyl coated chain link.
 - v.** Fences and gates will be constructed in accordance with the standard details
 - vi.** Installation of permanent wood fencing in lieu of temporary sediment control fence is not allowed
 - vii.** Fencing around public facilities will not be painted
 - viii.** Variations to the standard fencing details will be considered for privately maintained fences
 - ix.** Gate locations
 - a.** The primary access gate should be set back from the road to provide ample off road parking.
 - b.** A secondary 6' wide gate shall be installed to allow access to the downstream side of the dam from within the stormwater management practice.
 - c.** Gate placement
 - i)** If fences are constructed across the dam then the gate must be placed at the best location on the dam for mower access/use, such that equipment will not hang up when crossing the dam crest
 - ii)** If fences are located along the toe of slope, the secondary gate shall be placed in close proximity to the principal spillway barrel.

7.12.3. Access to Riser Structures

Riser structures must be designed to prohibit unauthorized access.

7.12.4. Warning signs

Warning signs prohibiting swimming and skating must be posted for facilities that are designed to maintain a permanent pool.

7.12.5. Setbacks and Buffers

- A.** Setbacks and buffers must adhere to the guidelines stipulated in the County Landscape Manual
- B.** Residential Setbacks/Buffers
 - i.** The buffer width from the toe of embankment slope, top of cut slope, or freeboard

elevation for large cut slopes, from the stormwater management practice to structures, property lines, lot lines, and rights-of-way shall be a minimum of 25 feet (except around the riser structure which shall be 60 feet, of which 50 feet is clear space).

- ii. The first 15 feet of the buffer, within the embankment, will be clear space
 - iii. The remaining 10 feet shall be landscaped in accordance with the County Landscape Manual. This pertains only to the embankment area.
- C. Commercial & Industrial Setbacks and Buffers**
- i. The buffer width from the toe of embankment slope, top of cut slope, or freeboard elevation for large cut slopes from the stormwater management practice to structures, property lines, lot lines, and rights-of-way shall be a minimum of 25 feet (except around the riser structure which shall be 60 feet, of which 50 feet is clear space).
 - ii. The first 15 feet of the buffer, within the embankment, will be the clear space
 - iii. The remaining 10 feet shall be landscaped.
- D. Easements and Setbacks to Underground Devices**
- i. Easement widths for all storm drain pipes and underground stormwater management practices must be large enough to allow maintenance (removal and replacement, if necessary) after construction, without causing damage to any structures nearby
 - ii. The setbacks to all underground devices shall be established in accordance with the underground facility and storm drain pipe easement sizing criteria in appendix 11.2 of this manual.

7.12.6. Landscaping

- A.** All landscaping shall be designed in accordance with the Anne Arundel County Landscape Manual and the Maryland Aviation Administration requirements (where applicable).
- B.** Restrictions for tree & shrub plantings
- i. Trees and shrubs are not allowed on pond or basin side slopes and/or within 5 feet of the outer periphery of the fence
 - ii. No woody plants shall be planted on the dam embankment or within the basin.
 - iii. Only herbaceous plants such as low maintenance ground covers and required stabilization grasses are permitted on the dam.
 - iv. Areas around pipes and structures must be kept clear of plantings

7.12.7. Plunge Pool

- A.** Channel lock, rip-rap, concrete, a-jacks, etc. may be used for the bottom treatment of any plunge pools.
- B.** A vertical staff gauge shall be placed in the plunge pool to establish the clean out elevation.

7.12.8. Animal Protection

- A.** Muskrat barriers will be installed as required for facilities that require an embankment.
- B.** Galvanized or vinyl clad, one inch wire mesh will be installed along the periphery of the designed pool depth.
- C.** The wire will be toed 6" into the basin floor and pinned to lie flat on the embankment.
- D.** The mesh will extend a minimum of 3' in both directions from the designed pool elevation.
- E.** All mesh will be covered with 4" of topsoil and seeded and fertilized as per the County Standard Specifications for Construction.
- F.** If the facility is utilized as a sediment control device, then installation will occur at the time of conversion of the facility from sediment control device to stormwater management.

7.12.9. Access to Stormwater management facilities

- A.** Access must be provided to allow for maintenance of all stormwater management facilities.
- B.** The stormwater management plans must clearly show the access path to each facility
- C.** If access must traverse private property, then an access easement must be procured and clearly delineated on the plans and any necessary plats.
- D.** The minimum width of the access must be 12 feet.

7.12.10. Access Ramps

- A.** Access ramps must be provided to allow vehicular access to the riser structure and side slopes of the facilities
- B.** They shall be located so that maintenance may be easily performed on the riser, inflow pipes, and the embankment.
- C.** They must extend down to the forebay, safety bench, riser, and outlet and must be designed to allow vehicles to turn around.
- D.** The design and location of the ramps must assume that the basin contains standing water.
- E.** Construction and maintenance for access ramps shall meet the following minimum requirements:
 - I.** All access ramps that serve publicly maintained facilities must connect to publicly maintained roads with curb ramps.
 - II.** Width shall be at least 12 feet.
 - III.** Slope: The maximum acceptable slope is 15 percent.
 - IV.** Slopes between 8 percent and 15 percent grade shall be stabilized with a 6-inch minimum layer of CR-6 underlain with filter cloth.
 - v.** Slopes flatter than 8 percent may be stabilized with approved grasses

7.13. Development within the Airport Zone

- A.** Maryland Aviation Administration (MAA) requirements

In order to reduce the danger from the nesting of flocking birds near the airport, the Maryland Aviation Administration (MAA) has prepared criteria that must be addressed by any development within the airport zone. Refer to the Maryland Aviation Administration for exhibits and detailed information

7.14. Special Watersheds

7.14.1. Jabez Branch

- A.** Use III stream
- B.** It is the only native brook trout stream in Anne Arundel County and it is highly susceptible to thermal impacts and excess sediments.

7.14.2. Severn Run

- A.** Use IV stream
- B.** It is highly susceptible to thermal impacts and excess sediments.

7.14.3. Arden Bog

- A.** This is a very rare wetland habitat that contains State and federally listed rare and threatened plant species and is characterized by acidic, nutrient poor conditions and is almost exclusively fed wetland systems.

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- I. The site designer must consult with the Office of Planning and Zoning for additional requirements.
- II. The applicant may be required to solicit input from the Maryland Department of Natural Resources if there are any specific legal requirements

7.14.4. Mountain Road Peninsula Bog Complex

- A. This complex is listed, by the State, as wetlands of Special State Concern and is a very rare wetland habitat that contains State and federally listed rare and threatened plant species.
- B. The Maryland Department of the Environment (MDE) regulates all activities within the 100-foot buffer to these wetlands of Special State Concern.
- C. The site designer must consult with the County for additional requirements
- D. The County bog regulations are published in Article 17 title 9. Copies of the mappings are available from Mappings and Publications

7.15. Additional BMP Design and Construction Specifications

The following information is to be used in conjunction with the design guidance outlined in the State Manual and the county Landscape Manual. If there are any conflicts, then the more restrictive guidance will apply.

7.15.1. Stormwater Management Ponds

- A. All ponds shall be designed with gravity outlet structures.
- B. Outflow Piping and Seepage Control
 - I. Outflow pipes shall be round reinforced concrete pipe with rubber gasket joints as specified in the current MD 378. Outflow pipes require a low concrete cradle within the embankment area (see Standard Detail CC-1).
 - II. Seepage along outflow piping extending through the embankment shall be controlled by use of filter and drainage diaphragms. Seepage control will not be required on pipes 6-inches and less in diameter.
- C. Proposed utilities
 - I. Proposed utilities are to be located away from the embankment.
 - II. Existing utilities shall be relocated around the stormwater management facility embankment.
 - III. Minimum clearance for utilities from the toe of the embankment shall be 20 feet.
- D. Riser
 - I. The riser shall be a reinforced concrete structure (see Standard Detail D/88).
 - II. See Standard Detail D/1 for the required size of access opening
 - III. The riser/barrel connection shall be watertight and sealed by grout or rubber gasket.
 - IV. Risers must have a lockable manhole covers
 - V. Riser details must include railing details per the County standard detail
 - VI. Riser structure openings shall be protected from clogging by trash racks which meet the following requirements:
 - a. The dimensions of the trash rack openings shall be no larger than three-quarters the dimension of the opening to be protected
 - b. The trash rack on the primary outflow shall have 3 times the cross-sectional area of the protected outflow opening. Computations must indicate that the criteria is met
 - c. Vertical bars shall be located outside of horizontal bars and spaced 9-inches maximum on center
 - d. The trash rack shall project out a minimum of 8-inches from the riser wall

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- e. The reinforcing bars used in the fabrication of a trash rack shall be sized according to the design. However, in no case shall bars less than 1/2" in diameter (#4) be utilized.
- f. All trash racks shall be hot dipped galvanized to prevent corrosion.
- VII. A stormwater management pond buffer shall be created encompassing the land area surrounding the outside toe of slope for the pond.
 - a. The buffer is to be at least 25 feet in width and shall not contain any stormwater management devices with the exception of outfall structures and access drives for maintenance.
- VIII. Pond Drain
 - a. If the design includes a permanent pool, a pond drain capable of draining the pond within a 24-hour time period shall be provided.
 - b. A gate valve must be provided as part of the pond drain.
 - i) All gate valves will be chained and locked with the standard County stormwater lock
 - ii) Where PVC pipe is used for pond or draw down drain, schedule 40 is required.
- IX. Restrictions for tree & shrub planting are as follows.
 - a. Trees and shrubs are not allowed on pond side slopes, or within 5 feet of the outer periphery of the fence line.
- X. Minimum stabilization requirements
 - a. Seeding shall be accomplished as detailed within the County Standards for Construction, Section 02813 & 02820 except that soil preparation will include 3:1 slopes.
 - b. Seed mix will be Anne Arundel seed mix #1 or approved substitute. (Seeding done outside of the prescribed planting season shall be considered as temporary.)
 - c. Mulch shall be installed to protect and promote grass establishment.
 - d. Mulch material shall be either straw with tack or erosion control blankets.
 - i) Erosion control blankets must be installed as per the manufacturers directions and consist of a low profile not to exceed 2 inch in lift.
 - ii) Sodding shall be accomplished as detailed within the County Standards for Construction, Section 2830 & 2840
- XI. Maintenance of vegetation
 - a. It is the intent of the County to accept only those stormwater management facilities that are densely (no weak, sparsely vegetated or bare spots) and contiguously vegetated with the desired grasses of the approved seed mix. Weeds, woody (including cut stumps) vegetation and otherwise rank vegetation will not be allowed.
 - i) Turf Maintenance
 - a) Sediment control/stormwater ponds will be mowed a minimum of three times annually by the permittee: May, July, and once between September 1st and October 15th.
 - b) Over-seeding of sparsely vegetated areas and fertilization of the pond easements will be done in the fall, prior to October 15th of each year
- E. Pond Conversion
 - I. The conversion and completion of a stormwater management pond, being used as a sediment control feature, must begin within 30 days of completion of stabilization of the last residence or commercial building constructed under the permit.
 - II. Work must continue in a workmanlike manner until completed.
- F. Stormwater Wetlands
 - Pond drains as per 7.15.1 must be included in the design.

7.16. Infiltration Practices

The following information is to be used in conjunction with the design guidance outlined in the State Manual. If there are any conflicts, then the more restrictive guidance will apply.

7.16.1. Not used as Sediment Control

The infiltration facility will not be used as a sediment control feature at any time during construction.

7.16.2. Not Traversed by Construction Equipment

The infiltration facility will not be traversed by construction vehicles at any time during the excavation of the 2 feet immediately above the facility invert.

7.16.3. Location of Infiltration Devices

- A.** Devices located uphill of any existing house or structure shall be evaluated for possible adverse effects to the existing house or structure.
- B.** A minimum distance of four feet shall be maintained between the bottom of any infiltration device and the seasonal high water table, as measured in the test boring hole a minimum of 24 hours after drilling, bedrock or impermeable soil layer.
- C.** Infiltration trenches shall be located a minimum of 12-inches below finished grade.

7.16.4. Vegetative Buffers

- A.** Vegetative buffers or other approved runoff filtering or sediment trapping devices should be provided for infiltration practices.
- B.** The filtering strip should be a minimum of 20 feet wide around the infiltration system with sheet flow only over the strip

7.16.5. Observation Wells

- A.** An observation well shall be installed in every infiltration trench and drywell.
 - i.** The observation well shall consist of a perforated schedule 40 PVC, SDR-35 PVC or other pipe with a minimum of 3,000 pounds crush strength, 6-inches in diameter.
 - ii.** It shall be located in the center of the structure.
 - iii.** A foot plate shall be provided under the observation well (pipe) to keep it from settling into the earth.
 - iv.** Observation wells constructed in residential lots shall project 4- to 6-inches above grade and be constructed in such a way that they will not be damaged by lawn mowing.
 - v.** The top of the observation well shall be capped with threaded PVC cap.
 - vi.** When observation wells are constructed in driveways, parking lots, etc., Anne Arundel County Standard Detail S-10 must be used.

7.16.6. Geogrid and Filter Cloth Placement

- A.** Geogrid shall be included in the bottom of trenches located within paved areas.
- B.** Permeable filter cloth shall be placed on the sides and on top of the trench.

7.16.7. Setbacks and clearances for infiltration devices

- A.** The set back from structures on slabs is 10 feet.
- B.** Infiltration devices uphill from buildings and structures with basements shall be located a minimum of 20 feet from the structure, or the intersection of the structure foundation footing with the phreatic line from the overflow depth of the device, whichever is greater.

Anne Arundel County Stormwater Management Practices and Procedures Manual

- C.** When placed downhill from buildings and structures with basements provide a clearance of 10 feet from the structure foundation or the intersection of the foundation footing with the phreatic line from the overflow depth of the device whichever is greater.
- D.** No infiltration device shall be located within 100 feet of any water supply well for commercial and industrial development.
- E.** No infiltration device shall be located within 50 feet of any water supply well for residential development.
- F.** All infiltration devices shall be located a minimum of 20 feet horizontally from the 100-year floodplain.
- G.** Infiltration systems shall be located a minimum of 25 feet or in accordance with the latest Health Department criteria, whichever is greater, from a septic system and alternate septic systems.
 - i.** The set back shall be maintained at the perimeter of the 10,000 square feet septic system area.
 - ii.** All infiltration devices shall be located a minimum of 25 feet from the top of slopes 25% or greater and retaining walls.
 - a.** In no case shall the phreatic line from the overflow depth of the device intersect existing and/or final ground line of the slope or the retaining wall.
 - b.** Infiltration devices, including individual lot devices, shall be located a minimum of 10 feet horizontally from any public sanitary sewer or house connection.
 - c.** Where "O" ring or glue weld schedule 40 connections are not used for sanitary sewer or house connections, infiltration devices shall be located a minimum of 50 feet horizontally from any public sanitary sewer or house connection.

7.16.8. Filtering practices

- A.** Shall not:
 - i.** Be used as a sediment control feature at any time during construction
 - ii.** Receive any runoff until the entire contributory drainage area to the device has received final stabilization and has passed inspection by I&P
- B.** A gravity outfall pipe shall be located within the trench and placed with a minimum of 2 feet separation from the distribution pipe and 6-inches above the bottom of the trench.
- C.** Piping located within the trench shall be perforated.
- D.** An observation well shall be installed in every filter device.
 - i.** Design and construction of the observation well shall be as described previously for infiltration devices.
- E.** Permeable filter cloth shall be placed on the sides and on top of the device.
- F.** Location and setbacks of filtering devices shall be the same as for infiltration trenches.

Chapter 8 Ownership of Facilities

8.1. Public vs. Private Designation for Facilities

Stormwater management facilities that provide SWM solely for public facilities such as roads etc. and are owned and/or maintained by the County, may be designated as public. All other facilities are considered private.

8.2. Public Stormwater Management Practices

8.2.1. Criteria for Public Practices

The following criteria shall apply:

A. Location

- i.** All public facilities must be located in expanded public rights-of-way, in a community area or open space
- ii.** Public facilities that are not located in public rights-of-way shall be contained within public easements, deeded to Anne Arundel County.
- iii.** May not be located on individual residential lots

8.2.2. Approval and Construction of Public Practices

A. Submitted on Public Plan Sheets

The public practice must be submitted on public plan sheets; and once approved, must be filed at the Department of Public Works

B. Secured under Grading Permit

The public practice(s) constructed by a developer must be secured under a grading permit.

8.3. Private Stormwater Management Practices

8.3.1. Criteria for Private Practices

A. Private Practices that manage a single lot

- i.** Must be located within the boundaries of the lot
- ii.** The private practice shall manage onsite contributing runoff.
- iii.** Where practical, offsite stormwater runoff may be redirected around the private stormwater management practice.
- iv.** If it is infeasible to redirect offsite runoff, the offsite runoff must be routed (no management provided) through the facility.
- v.** Individual practices placed on individual lots during the subdivision process must be:
 - a.** Noted on the plat and
 - b.** Recorded in, either, a deed of easement or a private stormwater management inspection and maintenance agreement established to be binding with the property;

B. Private practices that manage multiple lots within single family dwelling subdivisions

- i.** Private practices that manage multiple lots within single family subdivisions are only allowed within subdivisions that are required to establish and maintain a Home Owners' Association.
- ii.** All private practices that manage multiple lots must be:
 - a.** Located in common area of the subdivision
 - b.** Noted on the plat

- c. Contained within an easement
- d. Recorded in either a deed of easement or a private stormwater management inspection and maintenance agreement
- e. Owned and maintained by the Home Owners' Association.
- f. The responsibility for maintenance of the facility shall be clearly identified in the standard Home Owners Association documents, for residential subdivisions, and noted on the subdivision plat.

8.3.2. Maintenance Agreement

A private stormwater management maintenance and inspection agreement is required for all private practices

8.4. Use of Existing Off Site Stormwater Management Facilities

Every effort should be made to manage increases in runoff generated by the development within the confines of the proposed development site. If the development proposes to utilize stormwater management practices that are located off site then:

- A. The use of offsite facility must be approved as part of the SWM concept.
- B. If the facility is privately owned, then the proposed utilization of the facility must be permitted by the current owner of the private stormwater management practice.
 - I. Documentation must be provided that clearly indicates the facilities owner's agreement to allow the additional flow into the facility.
- C. The applicant must obtain an inspection report that determines the condition of the facility and lists any remedial action that is necessary in order to ensure that the facility will be able to adequately address the needs of the total area that it serves.
 - I. Private facilities will be inspected by the Department of Inspection and Permits
 - II. Public facilities will be inspected by the Department of Public Works
- D. If, based on the inspection report, there are deficiencies, violation or maintenance needs then the resolution of these deficiencies:
 - I. Must be addressed in the stormwater management report for the project
 - II. Any design modifications must be approved as part of the final approval process for the project.
 - III. The cost of resolving the deficiencies must be included in the cost estimate for bonding purposes.
 - IV. The construction of the modifications and or correction of deficiencies must be completed prior to allowing discharge into the existing facility.

Chapter 9 Security, Fees and Maintenance Agreements

9.1. Security

9.1.1. Public and Private Stormwater Management Facilities

A. Requirement to provide security

- I.** The construction of public or private stormwater management devices must be secured under grading permit.
- II.** The security shall be in an amount of \$200 plus \$0.10 for each square foot of total site disturbance plus the estimated cost of the stormwater management devices.
- III.** This security may be:
 - a.** Performance bond executed by the owner and a corporate surety authorized to do business in the State as a security,
 - b.** Cash deposit, certified check or cashier's check from a local bank or other local accredited institution, or
 - c.** Irrevocable letter of credit approved by the Controller and acceptable to the County Attorney

9.1.2. Security Release

A. The grading permit security may not be returned until:

- I.** As-built plans have been submitted and approved,
- II.** Certification has been submitted by the Developer and a registered professional that the construction and required testing for the stormwater management facilities have been:
 - a.** Completed and
 - b.** Comply with the approved plans and Article 16 of the County Code, and
 - c.** The site has passed a final inspection by the Department of Inspection and Permits.

9.1.3. Forfeited Grading Permit Security

A. The County shall apply the proceeds of a forfeited grading permit security to completion of the construction of the required device and placing the site in an environmentally secure condition.

- I.** In the event that the proceeds exceed the costs of completion, including engineering, inspection, overhead, and other administrative costs, including attorneys' fees, the excess funds shall be returned.

9.2. Inspection Fees

9.2.1. Computing

- A.** Inspection fees are to be computed from the Grading and Sediment Control Computation Sheet.
- B.** The fee is computed by either listing each of the systems' components with a unit price or by listing the cost as a lump sum item.

9.2.2. Payment method

- A.** This fee is to be paid with cash, check or money order.

9.3. Inspection and Maintenance of Private SWM Facilities

A. Inspection and Maintenance Agreement.

Prior to the issuance of a grading permit for property that will have private stormwater management, the owner of the property shall execute an inspection and maintenance agreement with the County.

- i.** Scope of the agreement.
 - a.** The inspection and maintenance agreement shall:
 - i)** Provide that the owner is responsible for installation of the private stormwater management;
 - ii)** Adopt by reference and incorporate the final stormwater management plan and the maintenance schedule required by § 16-4-201(c);
 - iii)** Require the owner to maintain inspection records for the stormwater management system and to supply them to the Department every three years or upon request;
 - iv)** Prohibit the owner from altering the private stormwater management without prior approval from the Department;
 - v)** Allow the County or its agents to access the private stormwater management system to ensure that the system is properly still in place and maintained and functioning as intended;
 - vi)** Allow the Department to perform any necessary work to correct a violation and return the stormwater management practice to proper working condition if the property owner, after reasonable notice from the Department, fails to correct a violation;
 - vii)** Provide that the cost of work performed by the Department be levied and collected from the owner of the property.
 - viii)** Bind subsequent owners of the property to the agreement; and
 - ix)** Be recorded among the land records of the County.

B. Liability for the cost of work performed by the Department.

The cost of work performed by the Department under the provisions of this section shall be levied and collected as provided in § 1-9-101 of the Anne Arundel County Code.

C. Repairs, Restoration, and Maintenance by Owner

- i.** The owner of property with a private stormwater management practice, and any other person or agent in control of the property, shall:
 - a.** Perform preventive maintenance to ensure that the stormwater management system is functioning properly
 - b.** Maintain the private stormwater management facilities and
 - c.** Promptly repair and restore it so that it remains at all times in a condition that is in accordance with the final stormwater management plan.

Chapter 10 Construction Inspection

10.1. Inspection Schedule and Reports

The permittee shall notify the Department at least 48 hours before commencing any work in conjunction with site development, the stormwater management plan, and upon completion of the project.

10.2. Inspections by the County

- A.** Regular inspections shall be made and documented for each ESD planning technique and practice at the stages of construction specified in the Design Manual by the Department or certified by a professional engineer licensed in the State of Maryland. At a minimum, all ESD and other nonstructural practices shall be inspected upon completion of final grading, the establishment of permanent stabilization, and before issuance of use and occupancy approval.
- i.** Written inspection reports shall include:
 - a.** The date and location of the inspection
 - b.** Whether construction was in compliance with the approved stormwater management plan
 - c.** Any variations from the approved construction specifications and
 - d.** Any violations that exist
 - ii.** At a minimum, regular inspections shall be made and documented at the following specified stages of construction:
 - a.** All Ponds:
 - i)** Upon completion of excavation to sub-foundation and when required, installation of structural supports or reinforcement for structures, including but not limited to:
 - a)** Core trenches for structural embankments
 - b)** Inlet and outlet structures, anti-seep collars or diaphragms, and watertight connectors on pipes
 - c)** Trenches for enclosed storm drainage facilities
 - ii)** During placement of structural fill, concrete, and installation of piping and catch basins
 - iii)** During backfill of foundations and trenches
 - iv)** During embankment construction
 - v)** Upon completion of final grading and establishment of permanent stabilization
 - b.** Wetlands
 - i)** At the stages specified for pond construction
 - ii)** During and after wetland reservoir area planting
 - iii)** During the second growing season to verify a vegetation survival rate of at least 50 percent
 - c.** For infiltration basins
 - i)** At the stages specified for pond construction
 - ii)** During placement and backfill
 - iii)** During the placement of under drain systems
 - d.** Infiltration trenches:
 - i)** During excavation to sub-grade

- ii) During placement and backfill of under drain systems and observation wells
- iii) During placement of geotextiles and all filter media
- iv) During construction of appurtenant conveyance systems such as diversion structures, pre-filters and filters, inlets, outlets, and flow distribution structures
- v) Upon completion of final grading and establishment of permanent stabilization
- e. For filtering systems:
 - i) During excavation to subgrade
 - ii) During placement and backfill of under drain systems
 - iii) During placement of geotextiles and all filter media
 - iv) During construction of appurtenant conveyance systems such as:
 - a) Flow diversion structures
 - b) Pre-filters and filters
 - c) Inlets, outlets, orifices, and flow distribution structures
 - v) Upon completion of final grading and establishment of permanent stabilization
- f. For open channel systems:
 - i) During excavation to subgrade
 - ii) During placement and backfill of under drain systems for dry swales
 - iii) During installation of diaphragms, check dams, or weirs
- g. Upon completion of final grading and establishment of permanent stabilization

10.2.2. Violations

When any violation is observed, the Department of Inspections and Permits shall provide to the developer, and to any onsite personnel, written notice describing the nature of the violation and the required corrective action. The developer may not proceed with work until the Department inspects and approves the work previously completed.

10.2.3. Maintenance Inspection

The Department shall ensure that preventative maintenance is performed by inspecting all ESD treatment systems and structural stormwater management measures.

- A.** Inspection shall occur during the first year of operation and at least once every 3 years thereafter.
- B.** Inspection reports for ESD treatment practices and structural stormwater management measures shall include the following:
 - i.** The date of inspection
 - ii.** Name of inspector
 - iii.** An assessment of the quality of the stormwater management system related to ESD treatment practice efficiency and the control of runoff to the MEP
 - iv.** An assessment of the condition of:
 - a.** Vegetation or filter media
 - b.** Fences or other safety devices
 - c.** Spillways, valves, or other control structures
 - d.** Embankments, slopes, and safety benches
 - e.** Reservoir or treatment areas
 - f.** Inlet and outlet channels or structures
 - g.** Underground drainage
 - h.** Sediment and debris accumulation in storage and forebay areas
 - i.** Any nonstructural practices to the extent practicable

- j. Any other item that could affect the proper function of the stormwater management system
- k. Description of needed maintenance

10.3. Completion.

10.3.1. As-Built Plans and Certification.

- A. When construction is complete, the applicant shall submit to the Department as-built plans and an as-built certification prepared by a design professional.
- B. At a minimum, the as-built certification shall include a set of drawings comparing what was constructed to the approved stormwater management plan.
- C. The Department may require any additional information that is necessary to determine that the work complies with the approved stormwater management plan.

10.3.2. Certificate of Occupancy.

A certificate of occupancy may not be issued until the required stormwater management system is completed to the satisfaction of the Department.

Chapter 11 Appendix

11.1. Grandfathering

11.1.1. Definitions

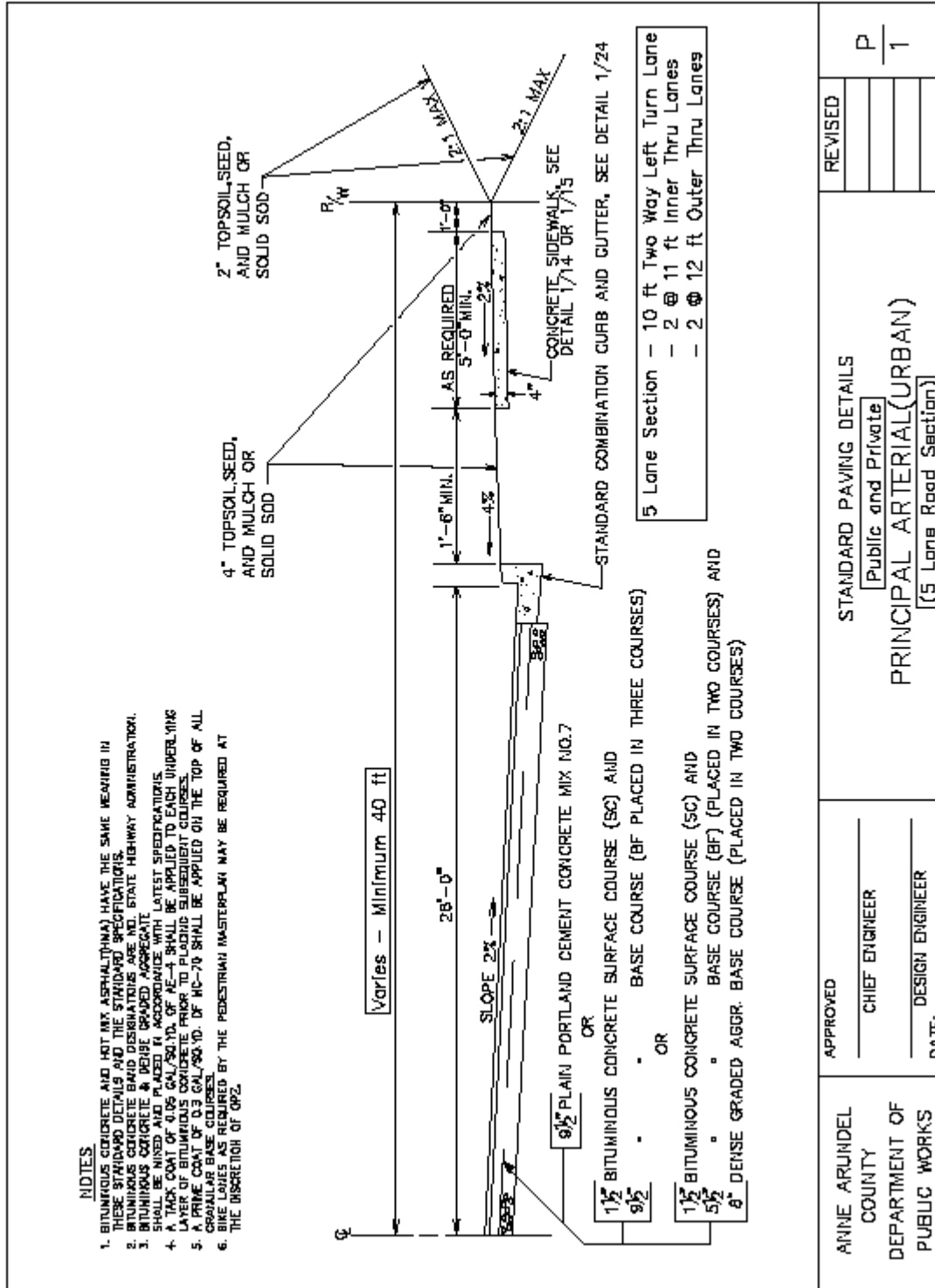
A. The following terms have the meanings indicated:

- I. Administrative waiver.
 - a. **Administrative waiver** means a decision by the Anne Arundel County Office of Planning and Zoning to allow the construction of a development to be governed by the stormwater management document in effect as of May 4, 2009
 - b. **Administrative waiver** is distinct from a modification granted pursuant to Article 16 or Article 17 of the Anne Arundel County code.
- II. Approval
 - a. **Approval** means a documented action by the Office of Planning and Zoning, following a review to determine and acknowledge the sufficiency of submitted material, to meet the requirements of a specified stage in a local development review process.
 - b. **Approval** does not mean an acknowledgement by the Office of Planning and Zoning that submitted material has been received for review.
- III. Final Project Approval
 - a. **Final project approval** means approval of the final stormwater management plan and erosion and sediment control plan required to construct a project's stormwater management facilities.
 - b. Final project approval also includes securing bonding or financing for final development plans if either is required as a prerequisite for approval.
 - c. The following projects are deemed to have Final project approval if an approval letter dated on or prior to May 4, 2010 has been received by the applicant from the Office of Planning and Zoning.
 - i) Major Subdivision Process Final Plan
 - ii) Minor Subdivision Process Final Plan
 - iii) Site Development Plan Process Site Development Plan Approval
 - iv) Grading Permit Process- Development plans submitted under the grading permit process only, are considered to have obtained final project approval if the grading permit has been issued.
- IV. Preliminary project approval
 - a. **Preliminary project approval** means an approval as part of a local preliminary development or planning review process that includes, at a minimum:
 - i) The number of planned dwelling units or lots;
 - ii) The proposed project density;
 - iii) The proposed size and location of all land uses for the project;
 - iv) A plan that identifies:
 - a) The proposed drainage patterns;
 - b) The location of all points of discharge from the site; and
 - c) The type, location, and size of all stormwater management measures based on site-specific stormwater management requirement computations;

- d) *Any other information required by the Office of Planning and Zoning including, but not limited to:*
 - 1) *The proposed alignment, location, and construction type and standard for all roads, access ways, and areas of vehicular traffic;*
 - 2) *A demonstration that the methods by which the development will be supplied with water and wastewater service are adequate; and*
 - 3) *The size, type, and general location of all proposed wastewater and water system infrastructure*
- b. *A project is considered to have received Preliminary Project Approval if an approval letter dated on or prior to May 4, 2010 has been received by the applicant from the Office of Planning and Zoning for the submitted Sketch plan and stormwater and management comments were not deferred to final submittal stage of the process.*
- B. *The Office of Planning and Zoning may grant an administrative waiver to a development that received a [preliminary project approval](#) prior to May 4, 2010.*
 - a. *[Administrative waivers](#) expire according to 11.1.1.C. of this document and may be extended according to 11.1.1.D of this document.*
- C. *Expiration of Administrative Waivers.*
 - i. *Except as provided for in 11.1.1.D of this Document, an administrative waiver shall expire on:*
 - a. *May 4, 2013, if the development does not receive final project approval prior to that date; or*
 - b. *May 4, 2017, if the development receives final project approval prior to that date;*
 - c. *All construction authorized pursuant to an administrative waiver must be completed by May 4, 2017 or, if the waiver is extended as provided in 11.1.1.D. of this Document, by the expiration date of the waiver extension.*
- D. *Extension of Administrative Waivers.*
 - i. *Except as provided in 11.1.1.D.II of this Document, an administrative waiver shall not be extended.*
 - ii. *An administrative waiver may only be extended if, by May 4, 2010 the development:*
 - a. *Has received a preliminary project approval; and*
 - b. *Was subject to a Development Rights and Responsibilities Agreement, a Tax Increment Financing approval, or an Annexation Agreement.*
 - iii. *Administrative waivers extended according to 11.1.1.D.II of this document shall expire when the Development Rights and Responsibilities Agreement, the Tax Increment Financing approval, or the Annexation Agreement expires*

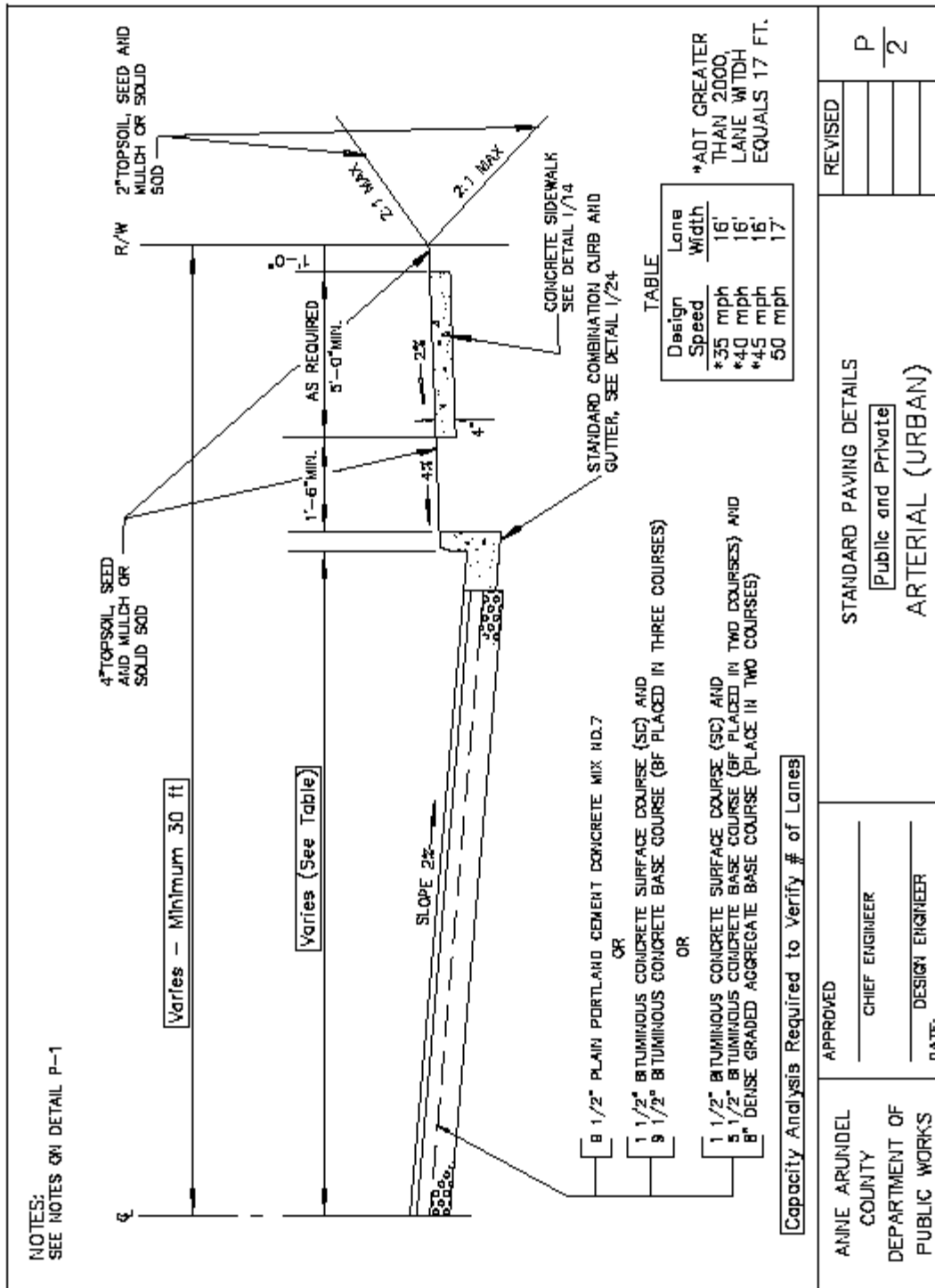
11.2. Modified Road Standards to support ESD

11.2.1. P-1 Principal Arterial Urban



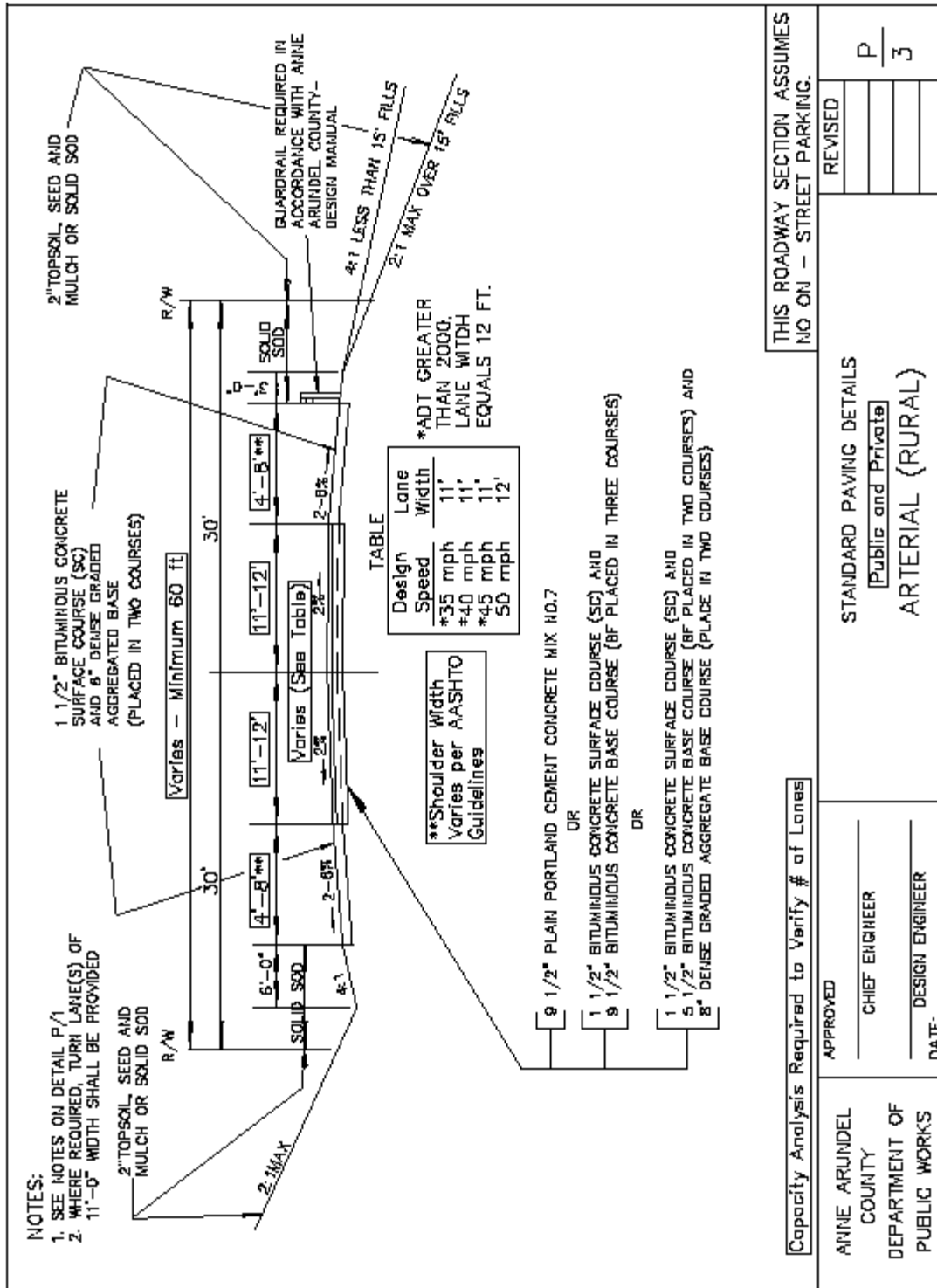
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11.2.2. P-2 Minor Arterial Urban



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11.2.3. P-3 Minor Arterial Rural



THIS ROADWAY SECTION ASSUMES NO ON - STREET PARKING.

STANDARD PAVING DETAILS
 [Public and Private]
 ARTERIAL (RURAL)

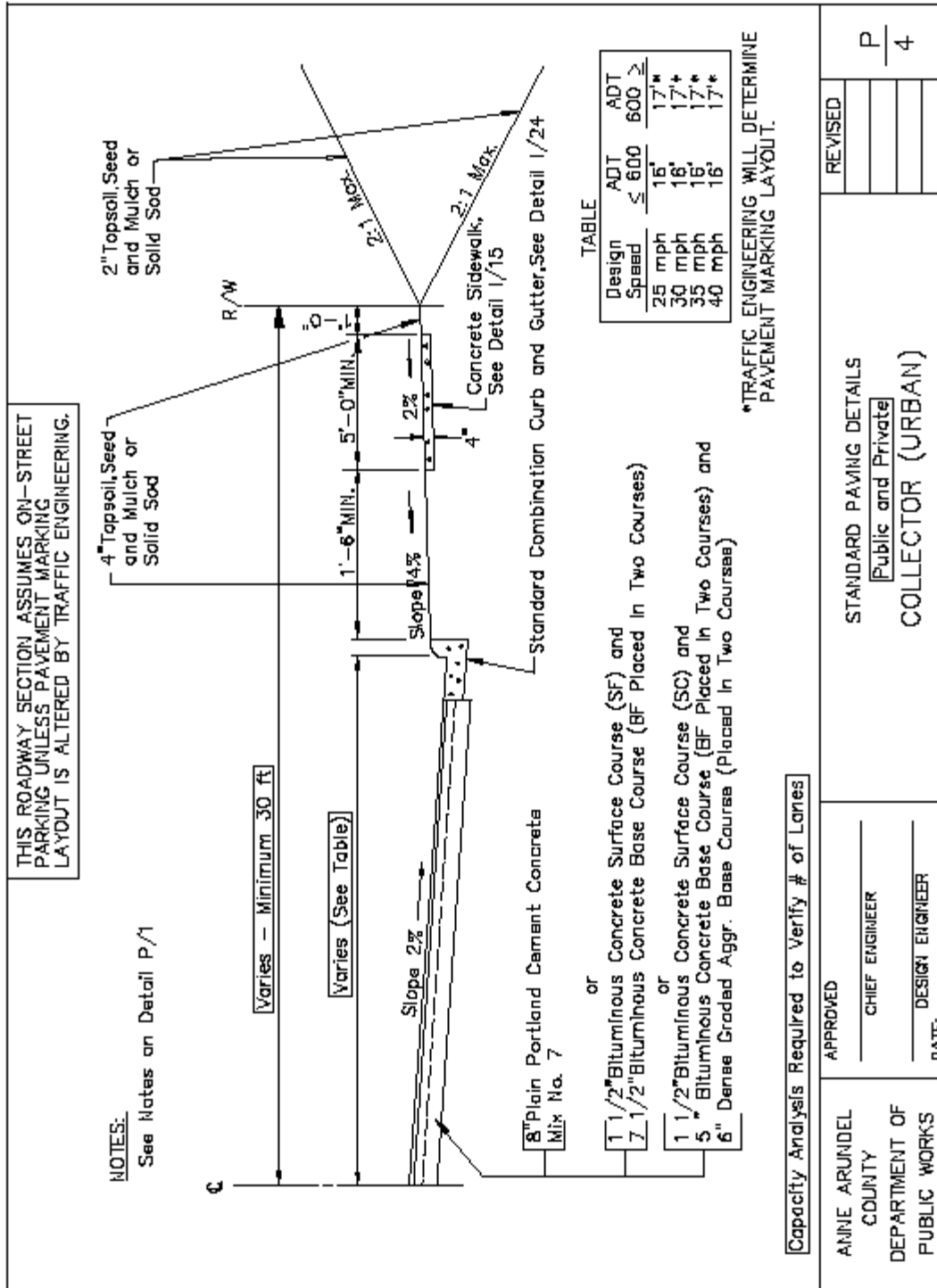
APPROVED
 CHIEF ENGINEER
 DESIGN ENGINEER
 DATE:

Capacity Analysis Required to Verify # of Lanes
 ANNE ARUNDEL COUNTY
 DEPARTMENT OF PUBLIC WORKS

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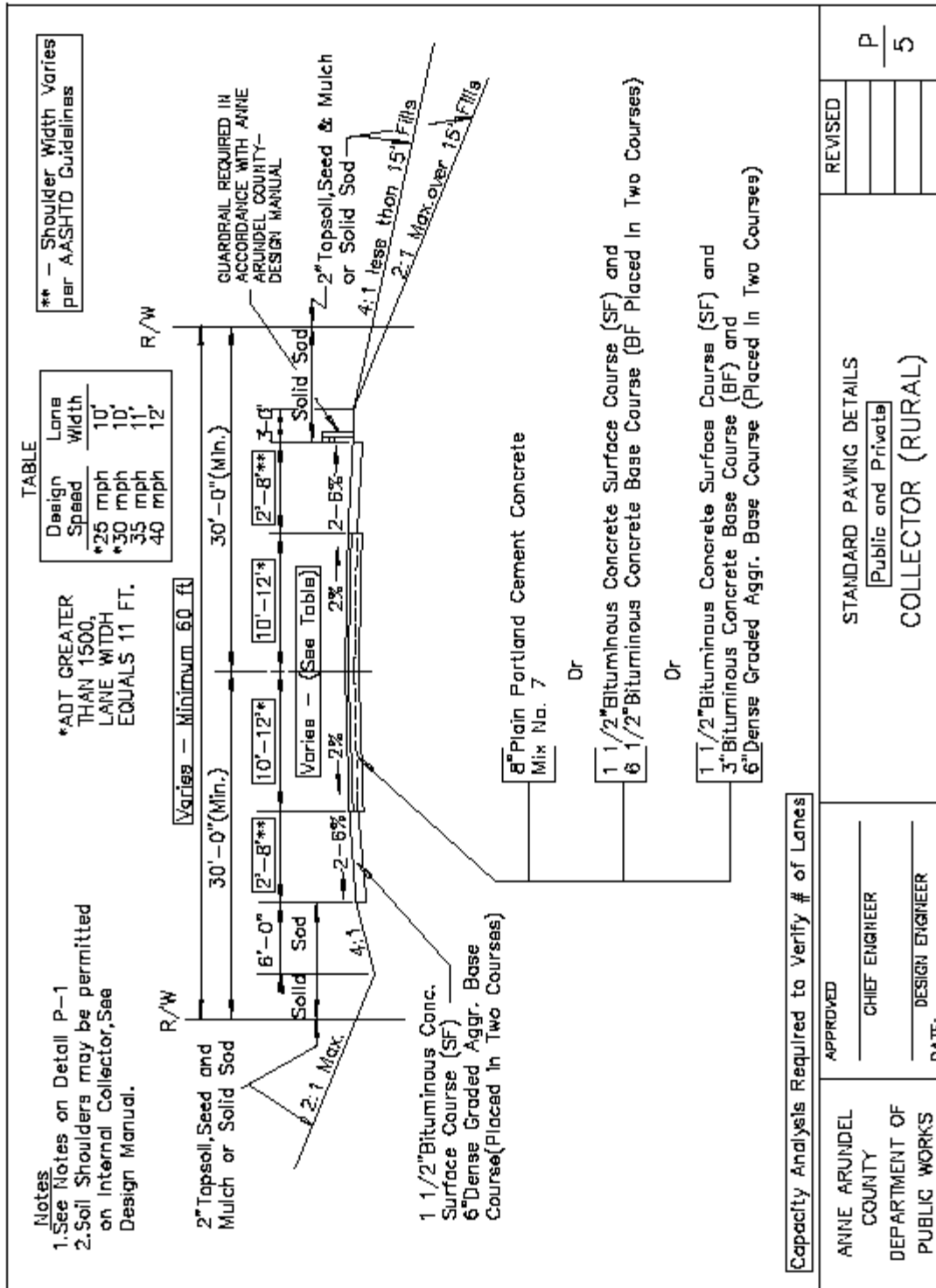
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11.2.4. P-4 Collector Urban



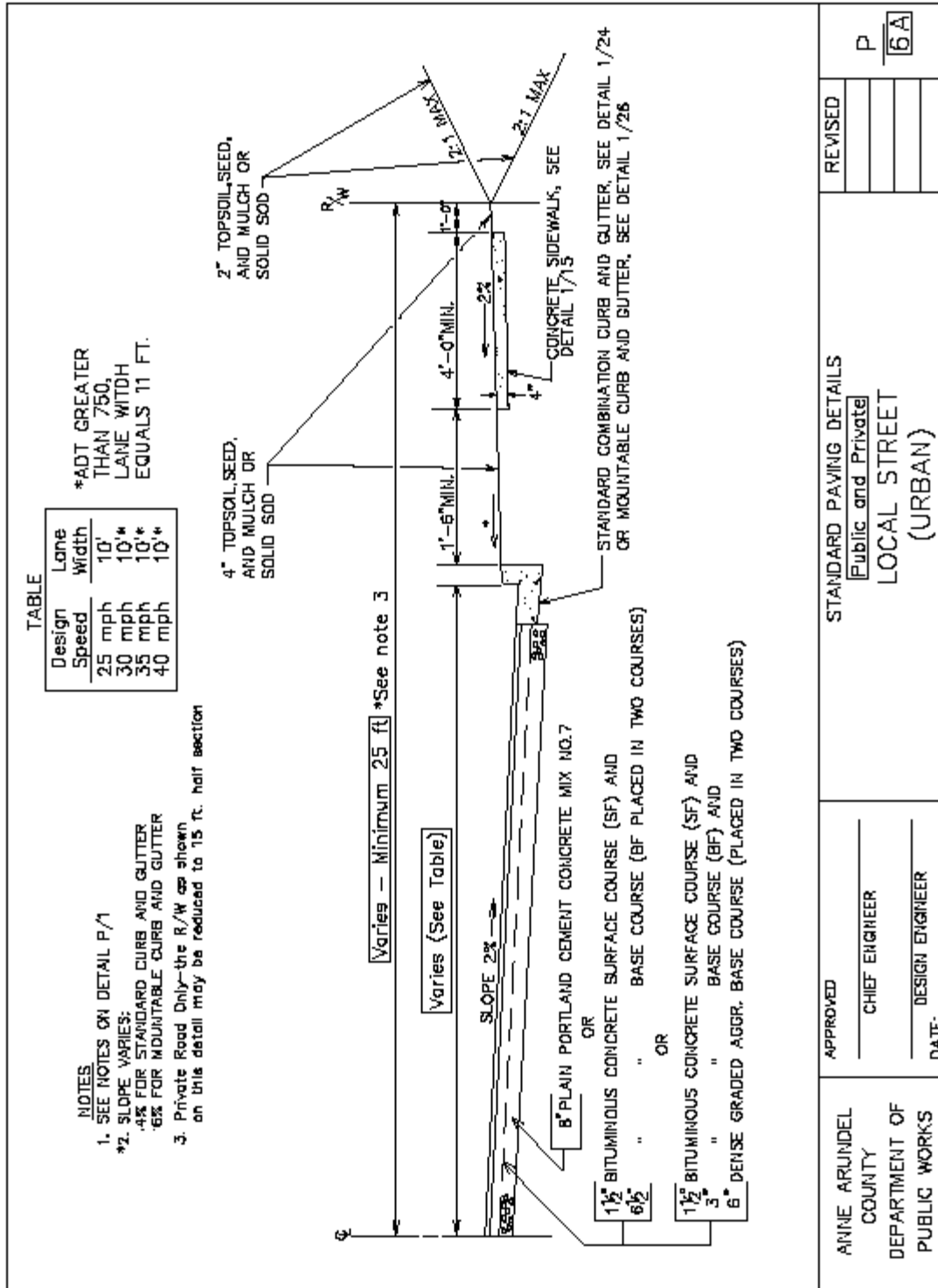
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11.2.5. P-5 Collector Rural



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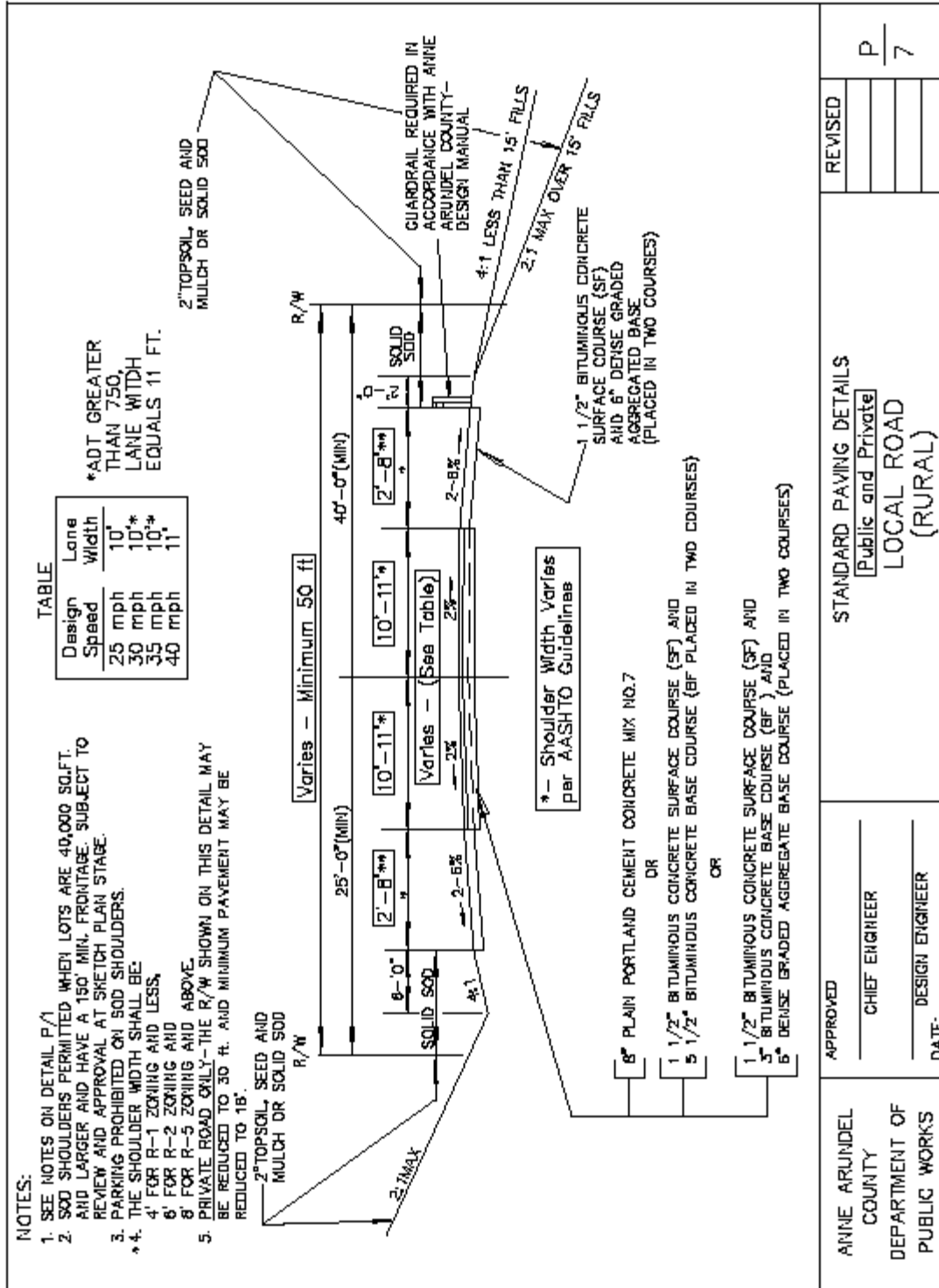
11.2.6. P-6 Local Street Urban



ANNE ARUNDEL COUNTY DEPARTMENT OF PUBLIC WORKS	APPROVED	STANDARD PAVING DETAILS Public and Private LOCAL STREET (URBAN)	REVISED
	CHIEF ENGINEER		P 6A
	DATE:		

5/06

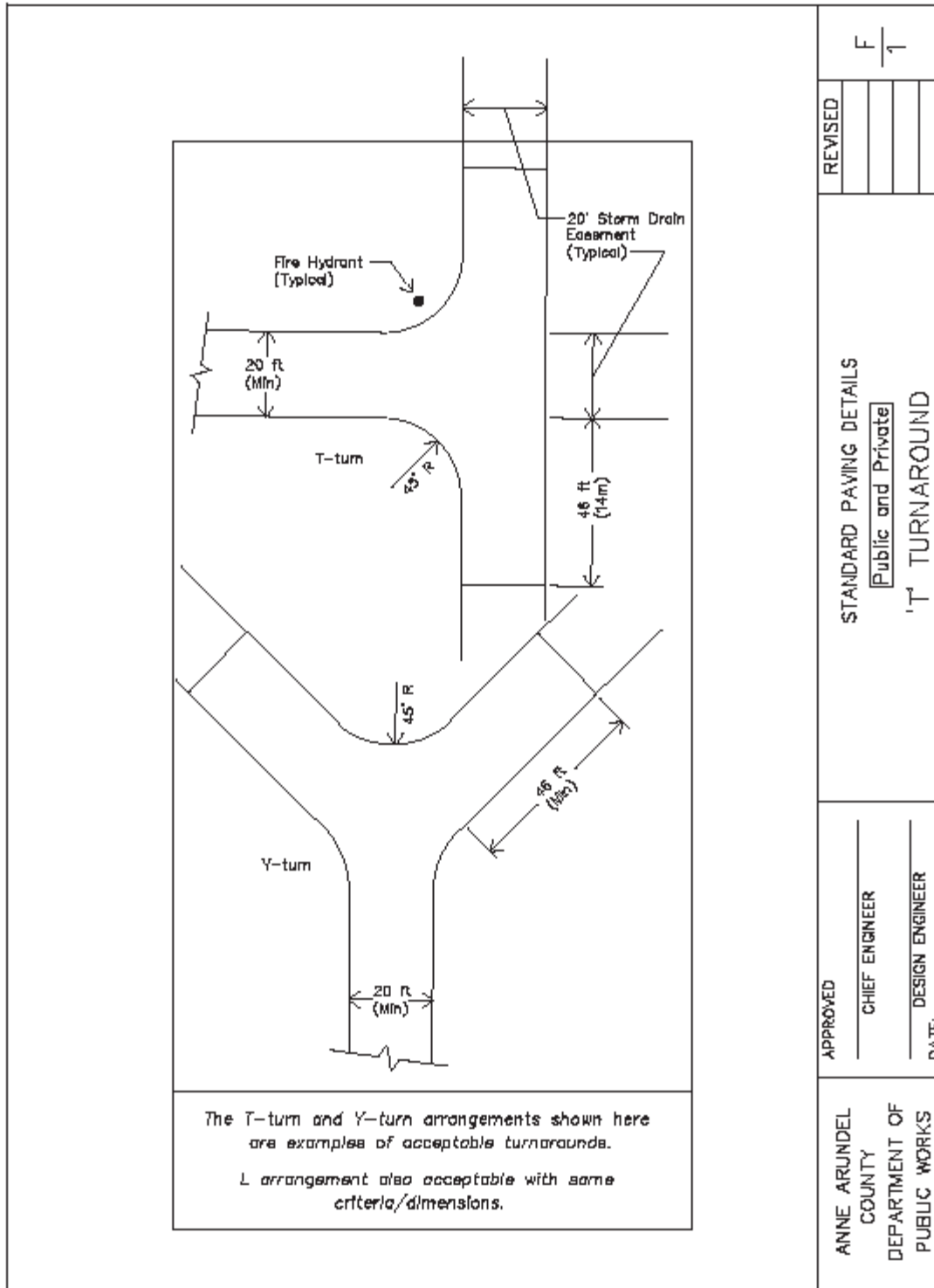
11.2.7. P-7 Local Street Rural



ANNE ARUNDEL COUNTY DEPARTMENT OF PUBLIC WORKS	APPROVED	STANDARD PAVING DETAILS [Public and Private] LOCAL ROAD (RURAL)	REVISED
	CHIEF ENGINEER		
	DESIGN ENGINEER		
	DATE:		

6/06

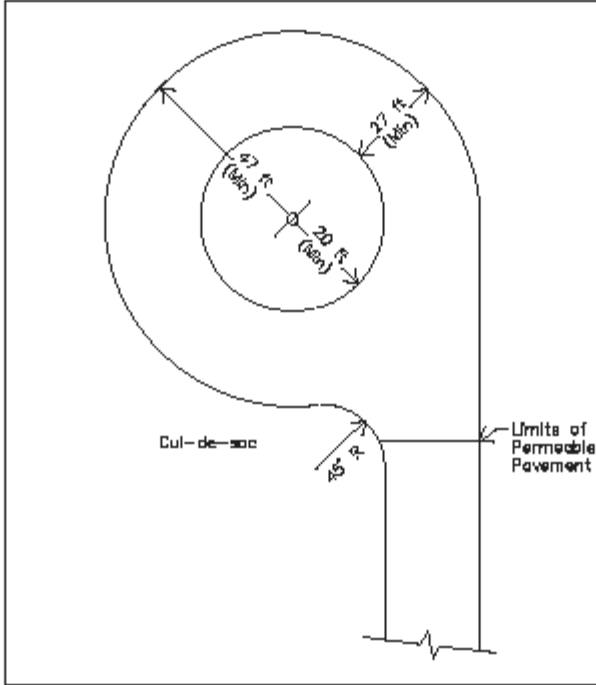
11.2.8. F-1 "T" and "Y" Turnaround



REVISIONS	F
	1
STANDARD PAVING DETAILS	
Public and Private	
'T' TURNAROUND	
APPROVED	DATE:
CHIEF ENGINEER	DESIGN ENGINEER
ANNE ARUNDEL COUNTY DEPARTMENT OF PUBLIC WORKS	

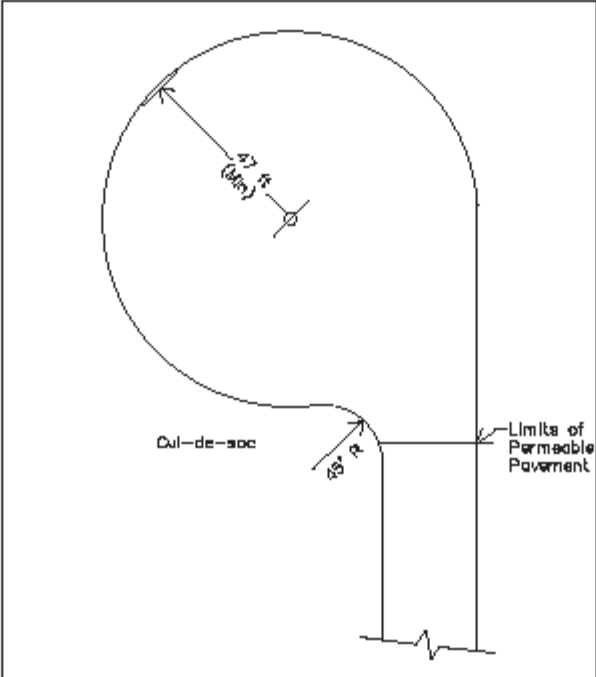
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11.2.9. F-2 Hollow Core Cul-de-Sac

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F — 2						
REVISED						
STANDARD PAVING DETAILS						
Public and Private						
HOLLOW CORE CUL DE SAC						
<p>Example of Hollow Core cul-de-sac</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">APPROVED</td> <td style="width: 50%;">DATE:</td> </tr> <tr> <td style="text-align: center;">_____ CHIEF ENGINEER</td> <td style="text-align: center;">_____ DESIGN ENGINEER</td> </tr> </table>	APPROVED	DATE:	_____ CHIEF ENGINEER	_____ DESIGN ENGINEER	
APPROVED	DATE:					
_____ CHIEF ENGINEER	_____ DESIGN ENGINEER					
<ul style="list-style-type: none"> - For use generally in RA, RLD and R1 zones or non clustered lots - Minimum length of apparatus is 46 feet - Minimum inside turning radius is 20 feet for hollow core - Minimum outside turning radius is 47 feet - Minimum roadway width is 27 feet - Other requirements for materials, markings, signage, etc. apply 	<p>ANNE ARUNDEL COUNTY DEPARTMENT OF PUBLIC WORKS</p>					

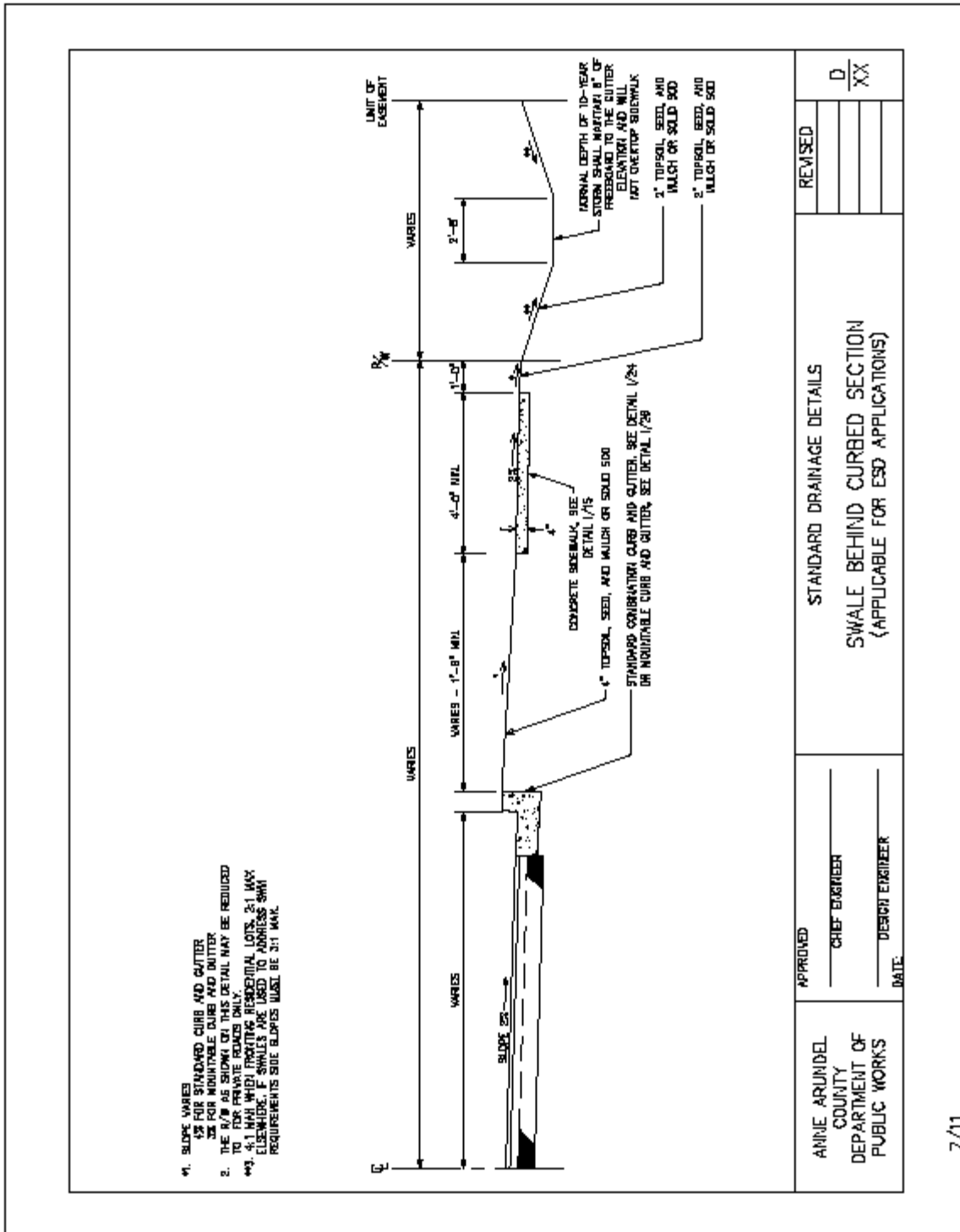
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11.2.10. F-3 Solid Core Cul-de-Sac

 <p style="text-align: center;">Example of Solid Core cul-de-sac</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <ul style="list-style-type: none"> - Minimum outside turning radius is 47 feet - Other requirements for materials, markings, signage, etc. apply </div>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">REVISIONS</td> <td style="text-align: center;">F 3</td> </tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> </table> <p style="text-align: center; font-weight: bold;">STANDARD PAVING DETAILS Public and Private</p> <p style="text-align: center; font-weight: bold;">SOLID CORE CUL DE SAC</p>	REVISIONS	F 3								
REVISIONS	F 3										
<p>APPROVED</p> <p style="text-align: center;">_____ CHIEF ENGINEER</p> <p style="text-align: center;">_____ DESIGN ENGINEER</p> <p>DATE: _____</p>	<p>ANNE ARUNDEL COUNTY DEPARTMENT OF PUBLIC WORKS</p>										

1/99

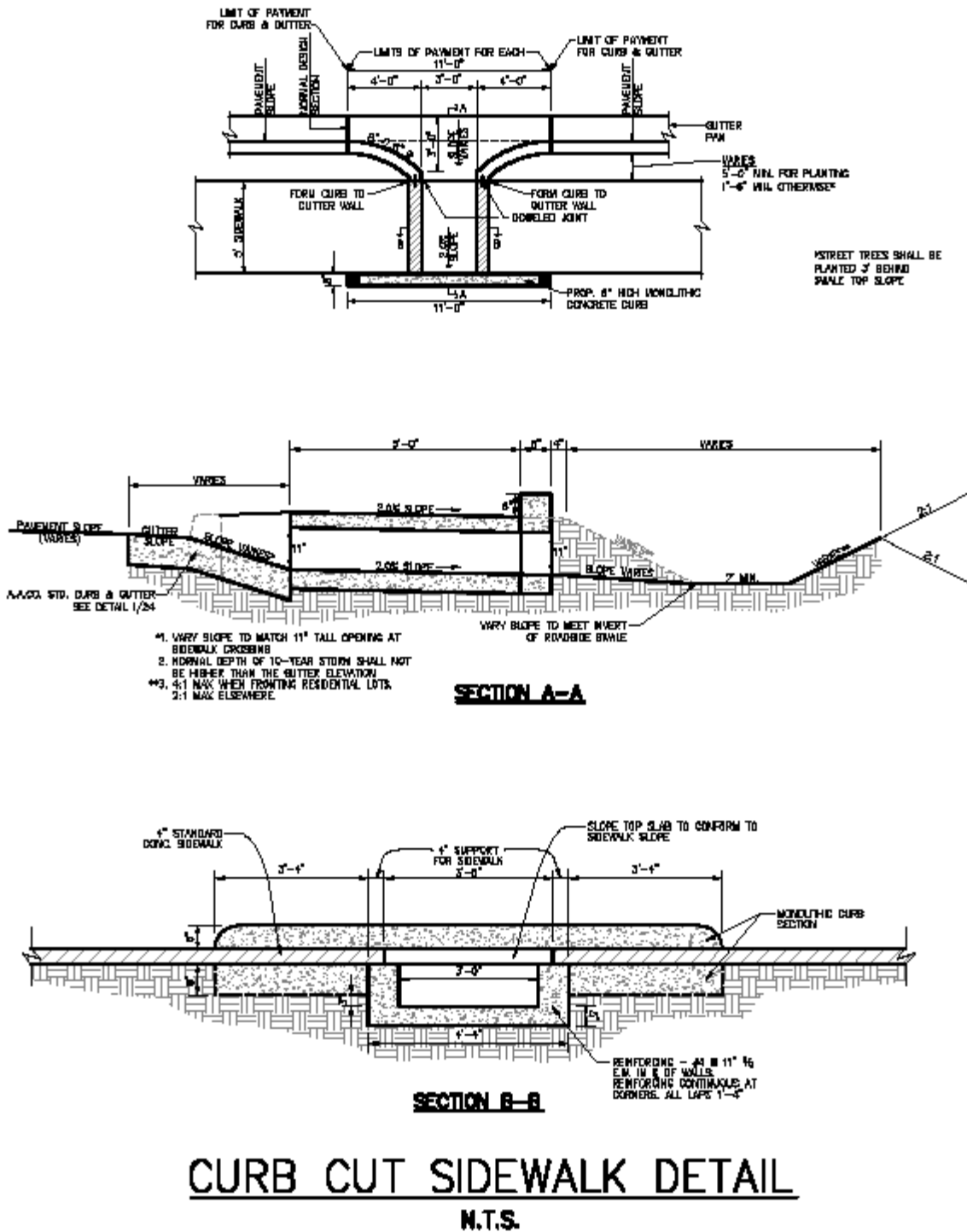
11.2.11.Detail Swale behind Curb

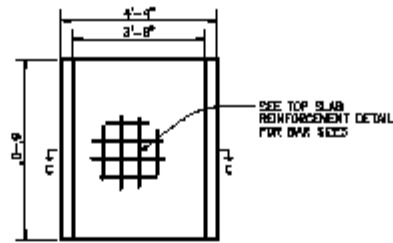


ANNE ARUNDEL COUNTY DEPARTMENT OF PUBLIC WORKS	APPROVED	STANDARD DRAINAGE DETAILS	REVISED
	CHIEF ENGINEER	SWALE BEHIND CURBED SECTION (APPLICABLE FOR ESD APPLICATIONS)	D/XX
	DESIGN ENGINEER		
	DATE		

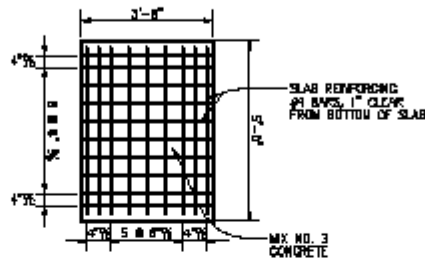
7/11

11.2.12.Curb Cut Sidewalk Detail

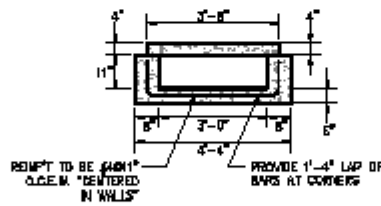




PLAN



TOP SLAB REINFORCEMENT DETAIL



SECTION C-C

NOTES

- 1) STRUCTURE TO BE CONSTRUCTED IN ACCORDANCE WITH ASTM C-913.
- 2) CONCRETE MIX DESIGN PER MD BTL MIX B. (STRONGER PRECAST ALTERNATE IN LIEU OF MIX #6) CONCRETE TO BE 4,500 PSI AT 28 DAYS MIN. TYPE I PORTLAND CEMENT.
- 3) REINFORCING DEFORMED BARS SHALL BE ASTM A-615, GR. 60, AND WELDED WIRE FABRIC REINFORCING IN ACCORDANCE WITH ASTM A185 & A82 GRADE 65.
- 4) REINFORCING STEEL SHALL HAVE MINIMUM 2" COVER UNLESS NOTED.
- 5) LIFT HOLES OR LIFT EYES PROVIDED IN EACH SECTION FOR HANDLING, AND THEY ARE TO BE FILLED WITH AN APPROVED NON-SHRINK GROUT OR CONCRETE BY CONTRACTOR AS SPECIFIED (IF APPLICABLE).
- 6) CONTRACTOR TO FORM INSIDE BASE OF STRUCTURE WITH BRICK, MORTAR, GROUT, AND OR CONCRETE AS REQUIRED BY CONTRACT.
- 7) PROVIDE BENT CONTINUOUS WRF OR BAR AT WALL CORNERS TO PROVIDE CONTINUOUS HORIZONTAL REINFORCING. BAR LAPS 18 INCHES MINIMUM.

CURB CUT SIDEWALK DETAIL (cont.)

N.T.S.

11.3. Easement Sizing Criteria

11.3.1. Permanent and Temporary Easement

Table 1 shall be used to establish the size of permanent and temporary easements on the basis of pipe size and the pipe depth needed to install and maintain utilities (water, sewer and storm drainage)

11.3.2. Underground Devices

Table 2 shall be used for installation of underground devices

PERMANENT EASEMENT WIDTH FOR UTILITY PIPE INSTALLATION																
Pipe Diameter inches	Table 1															
	Depth of Excavation (feet)															
	4	5	6	7	8	10	12	14	16	18	20	22	24	26	28	30
REQUIRED EASEMENT WIDTH IN FEET																
12	15	15	15	20	20	20	25	25	25	25	25	30	30	35	40	40
24	15	15	20	20	20	25	25	25	25	25	30	30	35	35	40	45
36	15	20	20	20	25	25	25	25	25	30	30	35	35	40	40	45
48		20	20	20	25	25	25	25	30	30	35	35	35	40	45	45
60			20	25	25	25	25	30	30	30	35	35	40	40	45	50
72				25	25	25	25	30	30	35	35	35	40	45	45	50
84					25	30	30	30	30	35	35	35	40	45	50	50

Note:

- A.** Pipes shall be placed along centerline of the easement.
- B.** Any pipes not placed along centerline of easement shall have, at least, half of the width noted in above table on either side of the pipe.
- C.** If more than one pipe (at different depths or different pipe sizes, etc.) is within the easement, then half of the width noted in the above table for that pipe, at that depth, shall be placed on the outside edge of that pipe. The same procedure should be done for the other pipe. The total width of the easement, as determined above, shall not be less than the largest easement required for any of the pipes within the easement.

PERMANENT EASEMENT WIDTH FOR UNDERGROUND SWM FACILITY INSTALLATION						
(Table 2)						
Depth to Bottom of Facility (feet)	0-6	6-12	12-22	22-24	24-28	28-30
Easement Width from Edge of Device (feet)	7.5	10	12.5	15	17.5	20

Note:

- A.** The easement width specified above shall extend from the edge of the facility to the outside

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edge of the easement (on all sides of the device).

- B.** If one side of the facility is deeper than another then the easement width will be correspondingly larger.

<i>TEMPORARY CONSTRUCTION EASEMENT</i>		
<i>Permanent Easement Size</i>		<i>Temporary Construction Easement Width (feet)</i>
<i>(from Table 1)</i>	<i>(from Table 2)</i>	
<i>15</i>	<i>7.5</i>	<i>10</i>
<i>20</i>	<i>10</i>	<i>10</i>
<i>25</i>	<i>12.5</i>	<i>15</i>
<i>30</i>	<i>15</i>	<i>15</i>
<i>35</i>	<i>17.5</i>	<i>15</i>
<i>40</i>	<i>20</i>	<i>20</i>
<i>45</i>	<i>n/a</i>	<i>20</i>
<i>50</i>	<i>n/a</i>	<i>20</i>

Note:

- A.** A temporary easement will, in all probability, be cleared in its entirety. Any reforestation requirements must be clearly spelled out on the plat and plans.
- B.** Any requirements for the temporary easement must be noted on the plat and plans.

11.4. Links to required resources/information

11.4.1. [All checklists](#)

<http://www.aacounty.org/IP/Forms.cfm>

11.4.2. [ESD Process & Computations July 2010 \(State Guidance document for new development\)](#)

<http://www.mde.state.md.us/programs/Water/StormwaterManagementProgram/Pages/Programs/WaterPrograms/SedimentandStormwater/swm2007.aspx>

11.4.3. [ESD Process & Computations November 2010 \(State design guidance document for redevelopment projects\)](#)

<http://www.mde.state.md.us/programs/Water/StormwaterManagementProgram/Pages/Programs/WaterPrograms/SedimentandStormwater/swm2007.aspx>

11.4.4. [Stream Assessment Protocol](#)

<http://www.aacounty.org/DPW/Watershed/DownstreamAdequacyProtocols.cfm>

11.4.5. [Step Pool Storm Conveyance design guidelines](#)

<http://www.aacounty.org/DPW/Watershed/StepPoolStormConveyance.cfm>

11.4.6. [Step Pool Storm Conveyance design tool](#)

<http://www.aacounty.org/DPW/Watershed/StepPoolStormConveyance.cfm>

11.4.7. [Department of Public Works design manual](#)

Please note Chapter VI (SWM) is no longer valid.

<http://www.aacounty.org/DPW/Engineering/DesignManual.cfm>

11.4.8. [Department of Public Works watershed management tool](#)

<http://gis-world.aacounty.org/wers/>

11.4.9. [USDA Soil Data Mart SCD soil mapping information](#)

<http://soildatamart.nrcs.usda.gov/Report.aspx?Survey=MD003&UseState=MD>

11.5. Step Pool Storm Conveyance

Detailed information is available on the Department of Public Works web page
<http://www.aacounty.org/DPW/Watershed/StepPoolStormConveyance.cfm>

May 2009

Step Pool Storm Conveyance (SPSC) – aka Regenerative Storm Conveyance/Coastal Plain Outfalls (RSC/CPO)



Ron Bowen, P.E.

By:

Hala Flores, P.E.

Janis Markusic

Dennis McMonigle

Keith Underwood

11.6. Sample Standard Notes and Tables

11.6.1. Outfall Statement

The outfall statement is placed on the plans to establish, *clearly*, the condition, quality and description of the outfall and the ground downstream of the outfall (*keep in mind the definition of Outfall is where the proposed conveyance system meets the existing conveyance system*). The outfall statement will also certify that a field investigation was performed on a certain date by certain company, what the types of predominant vegetative cover and the channel configuration are, and that adverse impacts (see definition of adverse impacts) such as erosion, sedimentation, or flooding, are or are not occurring, and will not occur, as a result of the proposed development. Examples of this statement are as follows (*although the following examples are fictitious, they represent the level of detail and information necessary for approval of the SWM plans*):

A. Sample Outfall Statement # 1

A field investigation of outfall #3 and the ground downstream of outfall #3 was performed on April 13, 2002 by the ABC Engineering Company. Outfall #3 is located where the 24 inch concrete pipe carrying the discharge from Wet Extended Detention Pond #1 enters an existing grassed swale south of lot #117 in Open Space D. The roughly trapezoidal grassed swale is currently stable and conveys the runoff in a southeasterly direction toward the eastern property line. There is no evidence of flooding, or sedimentation. However, there are indications of erosion and the computations confirm erosive velocities exceeding 6 feet per second. Therefore, Wet Extended Detention Pond #1 was designed to reduce these velocities below 6.0 feet per second (actually they are projected to be 5.3 fps in the ten year storm event) and the plans show the developer seeding portions of the downstream swale where the erosion is worst. The grassed swale ultimately discharges into a dedicated 100 year floodplain prior to leaving the site at the eastern property line.

B. Sample Outfall Statement # 2

A field investigation of outfall #2 and the conveyance system downstream of outfall #2 was performed on March 15, 2002 by the ABC Engineering Company. Outfall #2 is located where the 15 inch concrete discharge pipe enters County Manhole #32186. The downstream storm drain system cannot adequately convey the ten year storm runoff to the point where the system discharges into the Severn Run tributary west of the parking lot adjacent to the Van Bokkelen Elementary School along Reece Road. The computations showed the hydraulic grade line surcharging at existing inlet #8. Therefore, the pipe just downstream of existing inlet #8 will be replaced with a 24 inch concrete pipe. This will allow the storm drain system to not experience any surcharging due to the increased flows, nor will the hydraulic grade line exceed the limitations set by the County Design Manual. The outfall into the Severn Run is stable and will remain stable in the post developed conditions (velocities are designed not to exceed 3 feet per second).

11.6.2. General Stormwater Management Notes

These are notes that generally, will be placed on all stormwater management plans. **If a particular note is not appropriate, then it should not be added to the plans.**

- A.** Coordinates are based on the Maryland State Coordinate System NAD 83 DATUM projected by the Department of Public Works of Anne Arundel County, Maryland.
- B.** Elevations are based on the U.S.C. and G.S. 1929 DATUM projected by the Anne Arundel County Office of Planning and Zoning.
- C.** All construction shall be in accordance with the most current version of the Anne Arundel County Department of Public Works standard details for construction of storm drains, roads and stormwater management.
- D.** Necessary precautions shall be taken by the Contractor to protect existing services and mains. Any damage to existing services and mains due to their negligence shall be repaired immediately at the contractor's expense.
- E.** The existing utilities and obstructions shown are from the best available records and shall be verified by the contractor to his own satisfaction before starting construction. Neither the owner nor Anne Arundel County Department of Public Works warrant or guarantee the completeness or the correctness of the information given.
- F.** It shall be distinctly understood that failure to specifically mention any work which would normally be required to complete the project shall not relieve the contractor of his responsibility to perform such work.
- G.** The contractor shall notify all utility companies at least 5 days prior to starting construction of this project.
- H.** The contractor shall notify the Anne Arundel County Office of Planning and Zoning, Inspection and Permits Department, five (5) working days before starting work shown on the drawings.
- I.** The contractor shall notify Miss Utility@ 1-800-257-7777 five (5) working days before starting work shown on these drawings.
- J.** All utility poles shall be braced as necessary at contractor ' s expense. Utility poles shall be relocated at the owner's expense in cases where they will interfere with construction.
- K.** Pipe elevations refer to inverts unless otherwise noted.
- L.** All storm drain pipes are reinforced concrete pipe (RCP) unless otherwise noted.

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11.6.3. Stormwater Management Summary

An explanation of all stormwater management solutions for all minimum sizing criteria requirements must be provided for each along with a summary table as shown below:

A. Sample Stormwater Management Note

Notes should be provided for each the drainage area to each study point where stormwater runoff is discharged from the site.

- I. The Environmental Site Design Volume is addressed, including:
 - a. The Recharge Volume (Re_v)
 - b. The Water Quality Volume (WQ_v) for the entire building rooftop and approximately 2.7 acres of parking lot is treated by providing an on-site private shallow wetland with a forebay.
 - c. The Channel Protection Volume (Cp_v)
- II. Overbank Flood Protection Volume (Q_{p10}) is treated by providing sufficient storage above the shallow wetland Water Quality Volume storage in the an on-site private shallow wetland with a forebay.
- III. Flood Protection Volume Q_f is not required as the downstream analysis indicated that there would be no flooding downstream of the project, and the project is not located in a floodplain.....

<i>STORMWATER MANAGEMENT SUMMARY TABLE..... DA __XX__</i>				
<i>Minimum Sizing Criteria</i>	<i>Symbol</i>	<i>Volume Required (acre-feet)</i>	<i>SWM Practice</i>	<i>Notes</i>
Water Quality Volume	(WQ_v)	0.167	SWM Practice #3	
Recharge Volume	(Re_v)	0.046	SWM Practice #1, SWM Practice #2	
Channel Protection Storage Volume	(Cp_v)	0.204	SWM Practice #3	
Overbank Flood Protection	(Q_{p10})	0.360	SWM Practice #3	
Extreme Flood	(Q_f)	N/A	N/A	

11.7. Stormwater Management Structure and Stream Restoration Summary Sheet

A. The structure data sheet must be completed to include each drainage area on the site.

Example

Stormwater Management Structure and Stream Restoration Summary Sheet									
Project Name and number									
Design Professional									
Date									
Overall Drainage Area	Practice	Structure #	Type	Location (NAD Grid Coordinates)	Drainage Area treated (Ac)	Runoff from 1 year 24 hour storm	Water Quality Volume	Actual device volume	
ESD Practices									
DA-1	Permeable Pavement		A-2		0.42				
	Bio-Swale	M8-1	M-8	Nxxx Exxxx	0.72				
	Non-Rooftop Disconnect		N-2		0.10				
	Submerged Gravel Wetland	M2-1	M-2	Nxxx Exxxx	0.80				
	Bio-Swale	M8-2	M-8	Nxxx Exxxx	0.20				
	Total Drainage Area treated					2.24			
	Structural Practices								
	Infiltration Trench	I1-1	I-1	Nxxx Exxxx	1.5				
2.24 Acres	SPSC	SPSC-1		Nxxx Exxxx	0.74				
Totals					2.24				
DA - 2									
	Structural Practices								
0.9 Acres									
Stream Restoration and or Outfall Stabilizations Associated with this Project									
No.	Practice			Location		Length			
1	SPSC			Nxxx Exxxx	Nxxx Exxxx				

11.8. Maintenance and Inspection Notes for Private SWM Practices

The following notes are required when the particular type of stormwater management practice is used. In other words, whenever a Group 1 Stormwater Management Pond is used then the following appropriate notes listed under the heading of *Group 1 Stormwater Management Ponds* must be included on the stormwater management plans.

A. Stormwater Management Ponds:

- I. Wet weather inspections must be conducted after major storms during the first year after construction then annually thereafter to ensure that the pond is operating as designed and intended. Inspections shall examine for evidence of clogging, excessive flow rate, erosion, condition of embankment, cracking, leakage or tree growth on embankment, sedimentation, adequacy of inflows and outflows, etc. Inspections should be performed with As-Built plans in hand.
- II. The upper stages, buffer, side slopes, embankment, emergency spillway of a pond must be mowed at least twice a year to prevent woody growth and control weeds.
- III. More frequent mowing may be required in residential areas as needed.
- IV. Debris and litter removal shall be ensured during regular mowing operations.
- V. Any slumping or erosion of pond side slopes, emergency spillway and embankment will require immediate repair. Additional regrading, revegetation and repair or replacement of rip rap aprons may be required as necessary to address the erosion problem.
- VI. Sediment removal must be performed when the total forebay capacity has been diminished by 50%. Sediment removal from ponds not managing runoff from designated hotspots can be safely disposed as land application or land filling. Sediment removal from ponds managing runoff from designated hotspots may be considered toxic or hazardous material and will require sediment testing prior to sediment disposal.
- VII. Any cracking or leakage at outflow pipes will require immediate replacement.
- VIII. Clear vehicular access must be maintained to control structures for regular maintenance responsibilities and operations.

B. Stormwater Management Wetlands:

- I. Wet weather inspections must be conducted after major storms during the first year after construction then annually thereafter to ensure that the wetland is operating as designed and intended. Inspections shall examine for evidence of clogging, excessive flow rate, erosion, condition of embankment, cracking, leakage or tree growth on embankment, sedimentation, adequacy of inflows and outflows, etc. Inspections should be performed with As-Built plans in hand.
- II. The upper stages, buffer, side slopes, embankment, emergency spillway of a wetland must be mowed at least twice a year to prevent woody growth and control weeds. More frequent mowing may be required in residential areas as needed. Extreme caution shall be provided to ensure that the plated wetland areas are not mowed, damaged or disturbed.
- III. Debris and litter removal shall be ensured during regular mowing operations.

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- IV. Any slumping or erosion of pond side slopes, emergency spillway and embankment will require immediate repair. Additional regrading, revegetation and repair or replacement of rip rap aprons may be required as necessary to address the erosion problem.
- V. Sediment removal must be considered as a regular maintenance operation and should be properly disposed.
- VI. Any cracking or leakage at outflow pipes will require immediate replacement of the pipes.
- VII. A five year inspection, maintenance and replacement period is required after each wetland planting has been installed and an acceptance certification by a qualified environmental consultant (selected by the applicant and acceptable to the County) has been provided to the County. (This exceeds the State=s requirement of a reinforcement planting plan if a minimum 50% coverage is not achieved in the planted wetland zones after the second growing season).
- VIII. Clear vehicular access must be maintained to control structures for regular maintenance responsibilities and operations.
- IX. A schedule for the proposed wetland planting installation shall be provided on plans.
- X. Inspection of the wetland plantings must be by a qualified environmental consultant selected by the applicant and acceptable to the County.

C. Stormwater Management Infiltration:

I. Infiltration Basins:

- a. Wet weather inspections must be conducted after major storms during the first year after construction then annually thereafter to ensure that the pond is operating as designed and intended. Inspections shall examine for evidence of clogging, excessive flow rate, erosion, condition of embankment, cracking, leakage or tree growth on embankment, sedimentation, adequacy of inflows and outflows, etc. Inspections should be performed with As-Built plans in hand.
- b. The upper stages, buffer, side slopes, embankment, emergency spillway of a basin must be mowed at least twice a year to prevent woody growth and control weeds. More frequent mowing may be required in residential areas as needed.
- c. Debris and litter removal shall be ensured during regular mowing operations.
- d. Any slumping or erosion of pond side slopes, emergency spillway and embankment will require immediate repair. Additional regrading, revegetation and repair or replacement of rip rap aprons may be required as necessary to address the erosion problem.
- e. Sediment removal must be considered as a regular maintenance operation and should be properly disposed. Sediment removal should occur when bottom of basin is thoroughly dry. The top layer should be removed with light equipment without compacting the basin floor then till with a rotary tiller to restore. Any disturbed areas should be stabilized immediately.
- f. Any cracking or leakage at outflow pipes will require immediate replacement
- g. Clear vehicular access must be maintained to control structures for regular maintenance responsibilities and operations.

II. B. Infiltration Trenches:

- a. The infiltration trench must be inspected several times during the first few months of operations after major storms, then annually thereafter. Inspections shall examine

evidence of surface ponding, clogging, etc. Water levels in observation wells should be recorded over a several day period to check trench drainage.

- b.** Buffer strips must be inspected annually. Growth should be vigorous and dense. Any bare spots, burned out areas, or eroded areas must be re-seeded or re-sodded immediately. Watering and/or fertilization should be provided during the first few months after strip is established and may periodically be needed during periods of drought.
- c.** Buffer strips must be mowed at least twice a year to prevent woody growth and for proper maintenance. More frequent mowing may be required in residential areas. Extreme care should be taken to ensure that buffer strip is not mowed too short and that baggers be used to prevent clippings from clogging the trench.
- d.** The pre-treatment inlets of underground trenches should be checked periodically and cleaned out when sediment depletes more than 10% of the available capacity. Sediment removal can be performed manually or by use of a vacuum pump. Inlet and outlet pipes must be checked for clogging and vandalism.
- e.** Any adjacent trees may require trimming to ensure that the drip-line does not extend over a trench surface so that tree leaves do not clog the trench. Any seedling growth that develops in vicinity of a trench should be removed to prevent root puncture which may cause sediment to enter trench.
- f.** Clogging of surface trenches can be addressed by carefully removing the top layer of stone, removing clogged filter fabric, installing new filter fabric and cleaning or replacing the top stone layer.
- g.** Rehabilitation of a clogged underground trench requires the removal of the topsoil, vegetation or structural (paved, concrete, etc) layer, removal of the protective plastic layer, removal of the entire stone aggregate layer, removal of the bottom filter fabric, tilling of the subsoil layer to promote better infiltration and then replacement of each layer.

D. Stormwater Management Filtering Systems:

i. Underground Filter Systems:

- a.** The sediment chamber outlet devices must be cleaned or repaired when the drawdown times within the chamber exceeds 36 hours.
- b.** Trash and debris shall be removed as necessary.
- c.** Sediment removal from the sedimentation chamber shall be performed when the accumulation exceeds six inches.
- d.** Vegetation within the sedimentation chamber shall not exceed a height of 18 inches.
- e.** Filter bed replacement may be required when the filtering capacity is significantly diminished.

ii. Surface Filtering Systems:

- a.** Filtering systems must be inspected regularly. When ponding is evident on the surface of the filter bed for more than 72 hours, the top few inches of discolored material shall be removed and replaced with fresh material and disposed of properly.
- b.** Silt/sediment removal shall be performed when sediment accumulates a depth that exceeds one inch.
- c.** Filters with a grass cover shall be mowed a minimum of three times per growing season to maintain grass heights that do not exceed 12 inches.

- d.** Dead or diseased plant material shall be replaced. Areas devoid of mulch should be re-mulched on an annual basis.
- e.** Direct maintenance access to the pre-treatment area and filter bed shall be maintained.
- f.** Vigorous and dense growth should be maintained. Any bare spots, burned out areas, or eroded areas must be re-seeded or re-sodded immediately. Watering and/or fertilization should be provided during the first few months after strip is established and may periodically be needed during periods of drought.

E. Stormwater Management Open Channel Systems:

- a.** All open channel systems and filter strips shall be inspected periodically during the first few months or years until adequately established then annually thereafter. Inspections should examine for evidence of damage by vehicular or foot traffic, encroachment, erosion, density of vegetation, concentrated flows
- b.** Vigorous and dense growth should be maintained. Any bare spots, burned out areas, or eroded areas must be re-seeded or re-sodded immediately. Watering and/or fertilization should be provided during the first few months after strip is established and may periodically be needed during periods of drought.
- c.** Mowing of open channel systems and grass filter strips must be performed as required during the growing season to maintain grass heights at 4-6 inches.
- d.** Wet swales with wetland vegetation or other low maintenance ground cover may not require frequent mowing.
- e.** Sediment build-up within the bottom of the channel or filter strip must be removed when 25% of the original water quality volume has been exceeded.

11.9. Runoff Curve Numbers (RCN) by Zoning Land Use

<i>Runoff Curve Numbers (RCN) by Zoning</i>						
<i>Zoning Types</i>	<i>Zoning</i>	<i>% Impervious by Zoning</i>	<i>Soil Type A</i>	<i>Soil Type B</i>	<i>Soil Type C</i>	<i>Soil Type D</i>
<i>Residential</i>	<i>RA</i>	<i>5%</i>	<i>44</i>	<i>64</i>	<i>76</i>	<i>81</i>
	<i>RLD</i>	<i>10%</i>	<i>47</i>	<i>66</i>	<i>77</i>	<i>82</i>
	<i>R-1</i>	<i>20%</i>	<i>51</i>	<i>68</i>	<i>79</i>	<i>84</i>
	<i>R-2</i>	<i>25%</i>	<i>54</i>	<i>70</i>	<i>80</i>	<i>85</i>
	<i>R-5</i>	<i>35%</i>	<i>70</i>	<i>81</i>	<i>87</i>	<i>90</i>
	<i>R-10</i>	<i>65%</i>	<i>75</i>	<i>83</i>	<i>88</i>	<i>91</i>
	<i>R-15 & above</i>	<i>75%</i>	<i>80</i>	<i>85</i>	<i>90</i>	<i>93</i>
<i>Commercial</i>	<i>C</i>	<i>85%</i>	<i>89</i>	<i>92</i>	<i>94</i>	<i>95</i>
<i>Industrial</i>	<i>W1</i>	<i>72%</i>	<i>80</i>	<i>85</i>	<i>90</i>	<i>93</i>
	<i>W2 & W3</i>	<i>72%</i>	<i>81</i>	<i>88</i>	<i>91</i>	<i>94</i>
<i>Individual Land Use RCN Values</i>	<i>Impervious</i>	<i>-</i>	<i>98</i>	<i>98</i>	<i>98</i>	<i>98</i>
	<i>Lawn</i>	<i>-</i>	<i>39</i>	<i>61</i>	<i>74</i>	<i>80</i>
	<i>Meadow</i>	<i>-</i>	<i>30</i>	<i>58</i>	<i>71</i>	<i>78</i>
	<i>Woods</i>	<i>-</i>	<i>30</i>	<i>55</i>	<i>70</i>	<i>77</i>
	<i>Fill in ROW</i>	<i>-</i>	<i>88</i>	<i>88</i>	<i>88</i>	<i>88</i>

11.10. Residential single lot development

11.10.1. Single lots submitted only under the grading permit process

- A.** Single lots, submitted under the grading permit process only, must submit a stormwater management concept plan.
- B.** The checklist for sketch plan must be utilized in preparation of the concept plan and must be included with the first submittal of the permit application package
- C.** The concept plan must be the first plan submitted with the application
- D.** Once the concept plan has been approved, any subsequent submittals will follow the standard grading permit process and will continue in the process until the permit is approved and issued.

11.10.2. Standard stormwater management plan

- A.** Single residential lots that meet the criteria listed on the standard stormwater management plan may submit the standard stormwater management plan along with the standard grading permit application.

11.10.3. Establishing the limit of disturbance for single lot development

- A.** The limit of disturbance includes a minimum of 10 feet outside of the placement of any structures.
- B.** It must include the construction of any utility extensions and or house connections. The limit of disturbance will be 10 feet on both sides of the extension/house connection.

11.11. Stream order determination

Stream order is a classification system based on stream hierarchy; the smaller the stream the lower its numerical classification. Stream order is determined by starting in the headwaters of a watershed and continuing until the stream reaches the ocean or the Chesapeake Bay.

Headwater streams are classified as first order streams. There are no tributaries to first order streams and they often originate from springs and/or seeps.

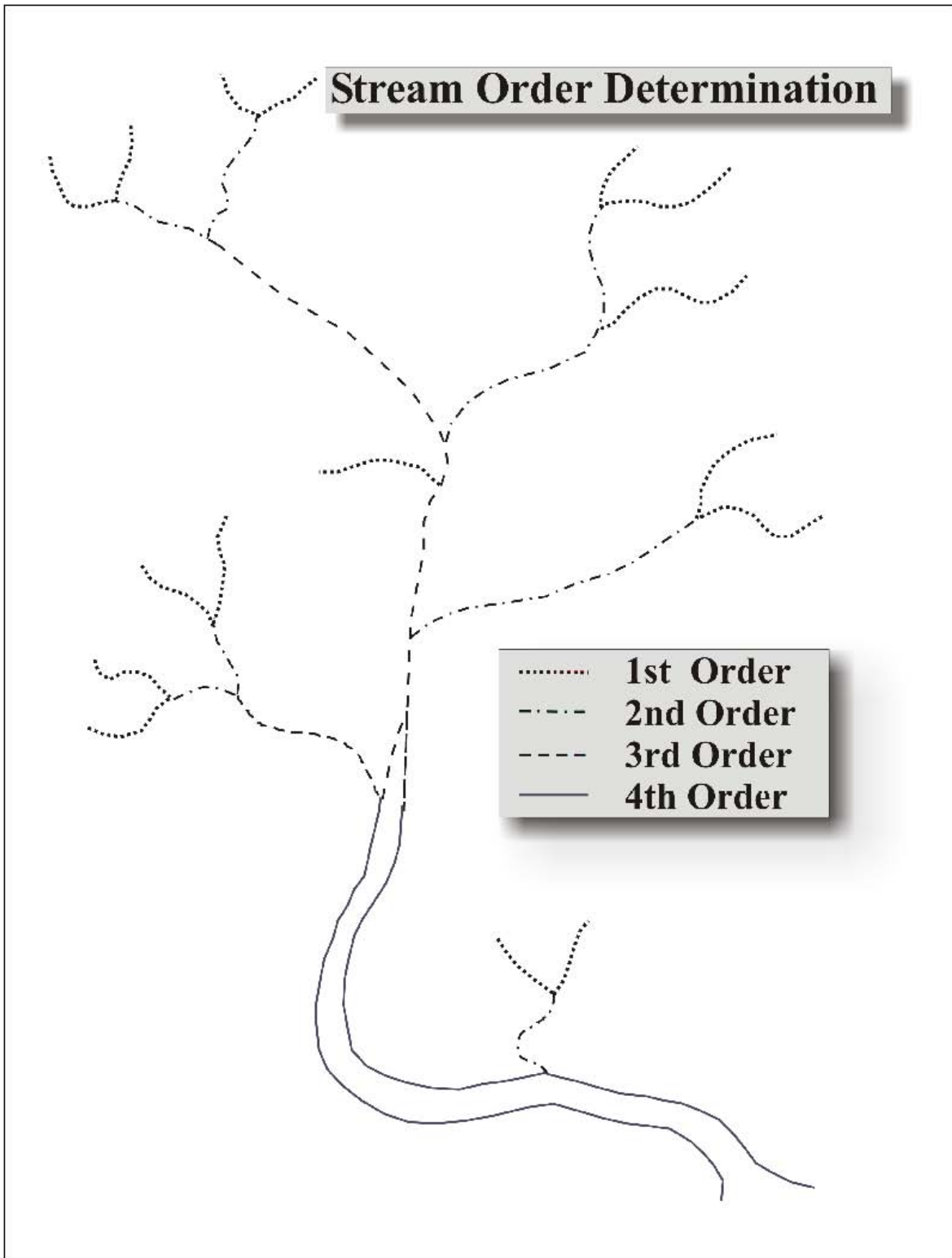
When two first order streams join to form a larger stream, that reach of stream is labeled a second order stream.

Third order streams originate at the confluence point of two second order streams. Please note that when a first order and a second order stream join, the resulting stream remains a second order stream.

In determining stream order, the consulting professional should refer to the most recent County data (e.g., photogrammetric maps, GIS data) as the initial guide for preliminary establishment of stream location. When necessary, this data should be supplemented with field survey data of the proposed site.

The width of the stream buffer is measured either from the top of bank or from the centerline of the stream, as determined by stream order.

For an illustration, please refer to the example on the following page.



11.12. Stream Assessment Protocol

The complete document may be downloaded from the following location
<http://www.aacounty.org/DPW/Watershed/DownstreamAdequacyProtocols>.

U.S. Fish & Wildlife Service

Stream Assessment Protocol

Anne Arundel County
Maryland

CBFO-S09-01
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