RICHLAND COUNTY GOVERNMENT

COMMUNITY PLANNING & DEVELOPMENT DEPARTMENT
DIVISION OF PUBLIC WORKS

RICHLAND COUNTY SOUTH CAROLINA 1799

DHEC PROMOTE PROTECT PROSPER

FEMA

US Army Corps of Engineers.

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Chapter 1: General

Purpose

The purpose of the Land Development Manual is to establish minimum standards for design and construction of site grading and land development and re-development projects within the unincorporated areas of Richland County and other municipalities as approved by the Richland County Council. This document contains the policies and procedures used by the Richland County Public Works Department and the Community Planning & Development Department. The manual provides parameters and criteria for addressing some of the specific issues which must be resolved during the planning, designing, and construction phases of land development. The minimum standards for site and land development are intended to protect and promote the general welfare of all citizens. The purpose of this Land Development Manual is to provide engineers, developers, plan reviewers, inspectors, contractors, property owners, and interested citizens involved in land development within the unincorporated, non-SCDOT regulated areas of Richland County and within any municipality that chooses to participate as a co-permittee with Richland County in its National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit, with the following information:

- Summarization of the plan submission process;
- Submittal requirements and the plan review process;
- Guidelines for designing and constructing roads in accordance with SCDOT standards;
- Roadway testing requirements;
- Guidelines for designing, implementing, and maintaining Stormwater best management practices (BMPs) to be used in Richland County to improve water quality, and minimize Stormwater runoff impacts due to increased flow volumes and peak discharge rates from developed areas.
- Stormwater management requirements;

The use of the Land Development Manual is designed to accomplish the following objectives:

- Reduce Stormwater impacts on water quality;
- Reduce Stormwater impacts on water quantity;
- Protect downstream areas from adverse Stormwater impacts resulting from development;
- Ensure that roads taken into the County inventory are designed and constructed to last for 25 years;
- Explain all internal procedures associated with development, to include conveying property to the County.

In the sections below, the minimum standards and other submittal information required to obtain a land disturbance permit is provided. In developments where they are fully complied with (that is, no deviations are required), the review process can be completed in a relatively straightforward manner, often with no questions asked nor any additional information requested; in developments where

deviations/exceptions are required, the submitting developer/engineer should include rationale/justification to support the desired changes. Proposed deviations from the standards will be considered on a case by case basis.

It must be recognized that some tracts of land are simply not economically feasible for certain types of development. In other cases, certain types of development may be economically feasible, but prohibited by ordinance measures, such as road classification, or the 100-year floodway designations. Therefore, coordination with County staff is encouraged during the initial concept and planning stages of a development, before significant resources are committed privately. It is Richland County's desire to provide safe, adequate, maintainable, and attractive infrastructure essential for the planned development within our borders.

Every effort has been made to cover the common conditions and information needed by those involved in land development activities, however, the requirements in this Manual and the County Ordinances should be reviewed carefully to ensure that all requirements are being met. If the Land Development Manual fails to resolve any interpretation conflicts, the Public Works Department and Community Planning & Development Department has the authority to settle any such issues related to land development.

Scope

The scope of the Land Development Manual is limited to the requirements for submitting site plans and related projects to the Community Planning & Development Department (CP&D). The CP&D is only one part of the Richland County review process, as is explained further. State and federal agencies may have additional requirements other than those listed. The Land Development Manual is not intended as a textbook or a comprehensive engineering design reference.

Site plans, details, calculations, construction specifications, and other technical documents must be designed and sealed by a professional engineer or Tier B Land Surveyor registered in the state of South Carolina.

Most types of engineering calculations are not explained or defined within the Land Development Manual, either due to the very complex nature of the subject matter or the fact that the design equations and methods are well-known.

The Manual contains several references to some of the most common technical design manuals, such as the Natural Resources Conservation Service's (NRCS) TR-55 and South Carolina Department of Health and Environmental Control's (SCDHEC) BMP Manual, and where such information can be found.

In addition to technical design, submitted projects must also meet federal and state standards for health and safety. For instance, trenching and excavations must satisfy OSHA standards in 29 CFR 1926 Subpart P - Excavations. Scaffolding and temporary work platforms must also meet OSHA standards. Traffic signs must be designed to meet FHWA and AASHTO requirements unless otherwise specified in

this manual. Consideration for public safety must be emphasized throughout the design process.

Manual Organization

The Manual contains eleven chapters, organized to present recommended technical and engineering procedures along with the criteria needed to comply with the State of South Carolina's Stormwater Management and Sediment Reduction Act (SC Code Ann. §§ 48-14-10 et seq R.72- 300), the Construction General Permit (SCR10000) the Medium Municipal Separate Stormwater System permit (SCS030000), and Richland County's Stormwater Management and Flood Damage Prevention Ordinances. This chapter provides information on Richland County's authority to develop and enforce design requirements along with several legal matters, and some background information on Stormwater management and its importance.

Authorization

The Manual has been prepared under the direction of the Public Works/Stormwater Division (PW/SWD), which has been granted the authority to develop engineering design standards and enact programs and policies to ensure compliance with State and Federal laws for the purposes described above. A detailed description of the law, regulations, and assigned authorizations to Richland County is provided below.

Clean Water Act

Federal Water Pollution Act, as amended by the Clean Water Act (CWA) requires the reduction of water pollution and gave EPA the congressional authority to develop programs to improve the health of navigable waters. EPA in response developed regulations that created a program of discharge permits as part of the National Pollutant Discharge Elimination System (NPDES) to regulate point source from a variety of discharges. The 1987 amendments to the CWA extended NPDES permits to industrial discharges, including Stormwater runoff associated with land disturbing activity. The 1987 CWA Amendments also require NPDES permitting for Stormwater runoff from urbanized areas. A municipal separate storm sewer system (MS4) NPDES permit is required based on population. Authority to administer the NPDES permit program was delegated to state agencies, such as SCDHEC and the EPA.

South Carolina Pollution Control Act

South Carolina Pollution Control Act (PCA) S.C. was originally enacted in 1950 and was last amended in 1970 during the initial stages of the environmental movement. It was written very broadly and is applicable to essentially any activity that could negatively impact the environment by requiring attainment of a permit and implementation of measures to mitigate potential impacts.

South Carolina Stormwater Management and Sediment Reduction Act

The South Carolina Stormwater Management and Sediment Reduction Act of 1991 (SMSRA) S.C. Code Ann. §§ 48-14-10 et seq. was enacted to address the increase in Stormwater runoff rate and quantity, the decrease of rainwater infiltration, and the increase in erosion associated with the extensive urban development that has been occurring throughout the state. Lexington County was authorized to implement the requirements of this Act and its associated regulations through delegated review development and implementation of a Stormwater Management Program (SWMP), and other measures deemed necessary. The Act gave legislative authority to SCHEC to enact programs to meets its purpose. This authority has also been given the local governments to administer the necessary steps to address Stormwater impacts on waters of the State.

Description and Use of the Manual

The Manual is developed under the assumption that the user possesses a basic understanding of Stormwater control design, construction, or land development depending on the user's particular area of expertise. The Manual provides those groups and others with required information for proper formatting of application packages on proposed land disturbance activities in Richland County. Users of this Manual who are not justly qualified by education or experience in the fields of Stormwater control design, construction, or land development should consult with a qualified professional in one or more of these areas prior to planning for land disturbance activities.

This Manual is not intended to be a systematic design methodology that addresses every land development situation that may occur in Richland County nor is it a detailed reference for the various methods and procedures used in the design process. The application of engineering principles and judgment combined with the information contained within this and other referenced material are necessary to successfully complete the planning, design, and preparation of documents for acquiring a land disturbance permit. References to guidance documents from federal, state, and local agencies are given throughout the Manual to provide additional information to users.

This Manual is not intended to restrain or inhibit engineering creativity, freedom of design, or the need for engineering judgment. When shown to be applicable, it is encouraged that new procedures, techniques, and innovative Stormwater BMPs be submitted. The use of such approaches should be substantiated with submitted documentation by design professionals showing that the proposed design is equal to, or exceeds the traditional procedures in terms of performance and economic feasibility.

Updates to the Manual

This Manual is intended to be a working document. As design technology and criteria evolve or change or it becomes evident that additional measures are needed to ensure the public general welfare, the Manual will be updated. Updates will always include oversight by a process that involves a stakeholders group.

Chapter 2: Project Classifications

Project Types

Commercial Development (Major)

Commercial projects that meet or exceed the threshold of 100,000 square feet of non- residential floor space or involves the development of one hundred and fifty (150) or more multi-family residential dwelling units, lots or manufactured home spaces in a manufactured home district are considered Major.

Due to the size of these projects, a more formal review process is required. This review process is established to ensure the safety of the public and to assure that adequate services and facilities can be provided for these developments and to assure that they do not negatively impact the area in which they are proposed to be located or the county as a whole.

Commercial Development (Minor)

A project is defined as Minor if, projects are less than the threshold of 100,000 square feet of non-residential floor space or has less than one hundred and fifty (150) or more multi-family residential dwelling units, lots or manufactured home spaces in a manufactured home district. However, if a phased project would reach the thresholds for a major land development within a five (5) year period, then the project shall be treated as a major land development, regardless of the size of the individual phases. To be considered a minor land development, the subdividing of property or the dedication of land to the county for open space or other public purposes shall not be part of the development.

Residential Development (Major)

A Residential Development is considered Major when it involves fifty (50) or more single-family residential dwelling units or lots or when land for open space or other public purpose is to be dedicated to the County.

Due to the size of these projects, a more formal review process is required. This review process is established to ensure the safety of the public and to assure that adequate services and facilities can be provided for these developments and to assure that they do not negatively impact the area in which they are proposed to be located or the county as a whole.

Residential Development (Minor)

A project is defined as Minor if; projects are less than the maximum threshold of fifty (50) single-family residential dwelling units. However, if a phased project would reach the thresholds for a major land development within a five (5) year period, then the project shall be treated as a major land development,

regardless of the size of the individual phases. To be considered a minor land development, the subdividing of property or the dedication of land to the county for open space or other public purposes shall not be part of the development.

Linear Utility

Linear Utility projects occur in County-owned right-of-way, as well as private roads. Land disturbing activities in the right-of-way include, but are not limited to: installation of utilities, driveway connections involving a curb cut or pipe installation, curb cuts, utility taps, utility crossings and storm drainage installation.

A Linear Utility Permit is required for all linear construction greater than 50 linear feet within or affecting the right-of-way of any County maintained road.

Encroachment Permit

An encroachment permit is required for any work proposed in the County Roadway, to include utilities, driveway installation and/or modification, storm drainage installation and/or modification, open cuts, pavement structure repairs, etc. The encroachment permit is reviewed and issued by the Community Planning & Development Department and will include coordination with the Department of Public Works.

Encroachment Permits must include an anticipated date of completion. If the work is minor in scope, the review may be conducted by the Department of Public Works exclusively.

Application Process

The first step is to log in to Trakit and apply for a “Project”.

Note: For Encroachment Permits and IL-NOIs, these will be applied for as a “Permit” (see Flow Chart 2 below), instead of selecting Land Disturbance Permit in the drop-down menu, select the Appropriate Permit.

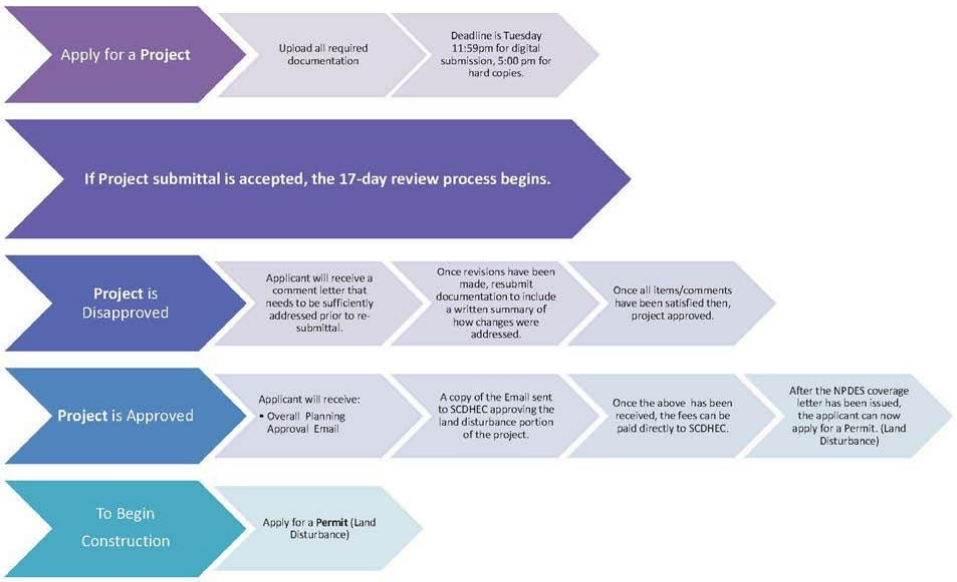

Figure 1: Submittal Process Flow Chart

Submittal Process

All documentation that is required to meet the minimum DHEC standard for issuance of a NPDES permit needs to be uploaded with the project.
At a minimum;

1. Notice of Intent (NOI)
2. C-SWPMP (Include all calculations)
3. Construction Plans
4. Any encroachment permit applications sent to outside Agencies. (Include all Exhibits) Once the Project has been approved, log in to Trakit and apply for a "Permit"

Permitting Procedures

Land Disturbance Permit

A land disturbance permit (LDP) is required for any land-disturbing activity, to include all improvements to land as defined in the Richland County Land Development Ordinance. The LDP is issued by the Community Planning & Development Department after the project is approved by all required divisions and outside agencies (if applicable). The land disturbance permit has an expiration of two (2) years. If no land disturbance occurs within two (2) years of issuance, the permit shall expire and be deemed invalid.

If no land disturbance occurs within two (2) years of issuance, the developer can renew the permit with a written request to the Community Planning & Development Department (c/o Engineering

Services) and attend a new mandatory pre-construction meeting; an updated permit will be issued.

The Land Disturbance Permit is issued at the required pre-construction meeting. Upon approval of the project, the developer and engineer-of-record will receive an email stating that the project is approved and a pre-construction meeting can be requested. The developer or Engineer-of-Record can login into the Permitting Software system and "Apply" for the Land Disturbance Permit and indicate a preferred date and time to meet. The request will be acknowledged within 24 hours and a representative will call to complete the scheduling of the pre-construction meeting.

Pre-construction meetings are held in the office and for projects that are disturbing 10 acres or more, the required on-site meeting must still occur. In some cases, the Department can coordinate with the contractor to satisfy all meeting requirements. The following representatives are required at the pre-construction meeting:

- Grading Contractor
- Engineer-of-Record
- Third-party SWPMP Inspector

The following Items are discussed at the pre-construction meeting:

- Project Construction
- Stormwater Pollution Management Plan (SWPMP)
- County Expectations
- Enforcement
- Communication
- Permitting Software System

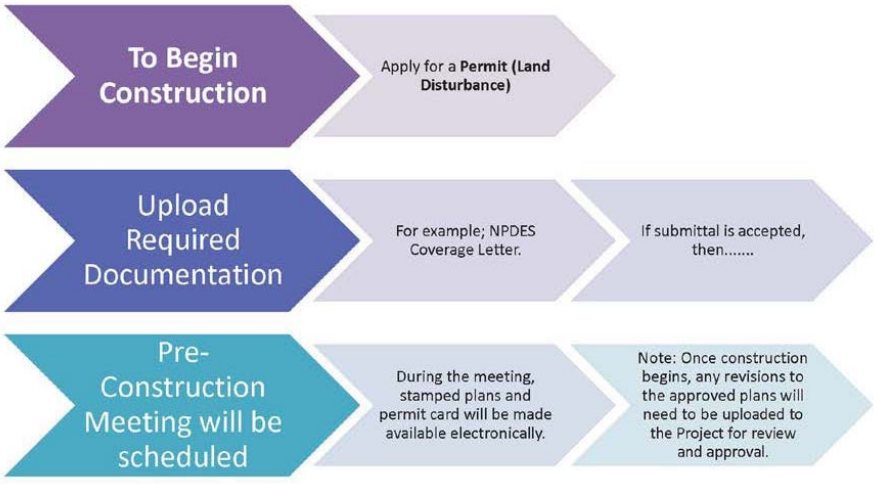

Figure 2: Land Disturbance Permit Process

Note: This is an administrative function only. Once it is confirmed that the DHEC NPDES coverage letter

has been attached to the Permit, a Pre-Construction Meeting can be scheduled. If the Project is less than an acre and not part of a Larger Common Plan, there will not be any DHEC coverage letter required.

Permitting Software Guidelines

All submittals are to be made using the Trakit electronic system. See Guidelines for submission in the Appendix, Trakit User Guide.

Fees

Engineering Inspection:

- $368.59 flat fee added to all Projects

Commercial Development (Major/Minor):

- For the first 15,000 sq. ft.: $210.00 plus 0.20/ square foot
- For 15,001 to 60,000 sq. ft.: Add 0.15/ square foot
- For 60,001 and up: Add 0.10/ square foot

If Commercial Project is Multi-family:

- $526.55 plus $10.53/Unit

If Commercial Project is a Communication Tower:

- $210.62 plus 1% of the construction cost

Residential Development (Major):

- For Lots 1-80: $421.25 plus $16.86/Lot
- For Lots 81 or more: Add $8.42/Lot

Chapter 3: Stormwater Management General Design Requirements

Special Protected Areas

When designing for maximum water quantity, erosion prevention, sediment control, and water quality benefits, the design professional should take the following considerations in mind:

- Stormwater quantity and quality are best controlled at the source of the problem by reducing the potential maximum amount of runoff and pollutants; and
- Best site design techniques implement Stormwater management by using simple, nonstructural methods along with or in place of traditional Stormwater management structures when applicable.
- Conservation of site resources and natural undisturbed areas helps to reduce the post development runoff volume and provide areas for natural Stormwater management. Some natural site resources that should be maintained include, but are not limited to:

    - Natural drainage ways,
    - Vegetated buffer areas along natural waterways,
    - Floodplains,
    - Areas of undisturbed vegetation,
    - Low areas within the site terrain,
    - Natural forested infiltration areas and wetlands.

Low Impact Site Layout Techniques

Lower impact site layout techniques involve identifying and analyzing the location and configuration of structures on the site to be developed. Where applicable, the following options that create lower impacts layouts should be used:

- Fit the design layout to follow the natural contours of the site to minimize clearing and grading and preserve natural drainage ways.
- Limit the amount of clearing and grading by identifying the smallest possible area on the site that would require land disturbance.
- Place development areas on the least sensitive areas of the site.
- Utilize nontraditional lot designs for residential areas to reduce the overall imperviousness of the site by providing more undisturbed open space by minimizing clear-cutting.
- Utilize vegetated buffers and undisturbed areas on the site to control sheet flow (not concentrated flows) by providing infiltration, runoff velocity reduction, and pollutant removal.
- Where ditched roadways are not practicable, curb and gutter systems may be combined with vegetated swales at outfalls to provide added water quality benefits versus the traditional piped outfall designs.
- When applicable, direct rooftop runoff to pervious natural areas for water quality treatment

and infiltration instead of connecting rooftop drains to roadways and other structural Stormwater conveyance systems.

Hydrology and Hydraulics

The design of properly sized storm drainage facilities requires knowledge of the hydrologic behavior of the watershed(s) in question. For small watersheds areas, it is adequate to estimate the peak discharge of the drainage area for the required design frequency using the rational method. Larger, more complicated watersheds require the use of models in order to estimate the discharge hydrograph.

Every model has certain limitations that will affect its behavior for different size drainage areas. The designer should be familiar with the limitations of the method used. In general, street drainage and small drainage areas (less than 2 acres) can be modeled using the rational equation. Larger areas can be modeled using methods developed by the Natural Resources Conservation Service. Many hydrologic methods and models are available determining peak runoff rate and runoff volumes. Richland County will accept commonly used hydrologic and hydraulic computers models.
If other methods are used, they should first be calibrated to local conditions and tested for accuracy and reliability. Any assumptions used in the computations shall be clearly identified. The computation results shall be presented in a format that will provide confirmation of the results.

Rainfall Frequency

The rainfall frequency, or return period, is the average time interval between equal magnitude storms. The rainfall frequency to be used in storm drainage design in Richland County varies with the watershed size for the drainage structure under consideration, as presented in Table 1.

Table 1: Design Storm Recurrence Interval

Size-Acres (rounded to the nearest acre)	Design Storm Recurrence Interval (years)
0 < 40	10-year; 25-year for ditches and channels
41 < 100	25-year
101 < 300	50-year
300 and larger	100-year

In addition, the 100-year rainfall is required for determination of minimum building elevations, floodplain boundaries, etc.

Rainfall

The storm duration for computational purposes shall be the 24-hour rainfall event; SCS Type II distribution with a 0.1 hour burst duration time increment. Table 2 contains the 24-hour rainfall depths for the 2-, 10-, 25-, 50-, and 100-year rainfalls for Richland County.

Table 2: Richland County 24-Hour Rainfall Depths for Type II Storm Events (Inches)

2-yr	10-yr	25-yr	50-yr	100-yr
3.6	5.3	6.4	7.3	8.3

Rational Method

The design discharge rate for a single pipe or culvert that is not part of a pipe network or system draining a watershed of 2 acres or less may be calculated using the Rational Formula. In general, for larger areas the rational method will yield over-simplified results.

When using the rational method some precautions should be considered:

- In determining the C value (land use) for the drainage area, hydrologic analysis should take into account any changes in land use.
- The rational method uses a composite C value for the entire drainage area. If the distribution of land uses within the drainage basin will affect the results of hydrologic analysis, then the basin should be divided into two or more sub-drainage basins for analysis.

The charts, graphs, and tables included in this section are given to assist the designer in applying the rational method. The designer should use good engineering judgment in applying these design aids and should make appropriate adjustments when specific site characteristics dictate that these adjustments are appropriate.

The rational equation is based on the assumption that rainfall is uniformly distributed over the entire drainage area and at a steady rate, causing flow to reach a maximum at the outlet to the watershed at the time to peak (Tp). The rational method also assumes that all land uses within a drainage area are uniformly distributed throughout the area. If it is important to locate a specific land use within the drainage area, then another hydrologic method should be used where hydrographs can be generated and routed through the drainage system.

The rational formula estimates the peak rate of runoff at any location in a watershed as a function of the drainage area, runoff coefficient, and mean rainfall intensity for a duration equal to the time of concentration (the time required for water to flow from the most remote point of the basin to the location being analyzed). The rational formula is expressed as follows:

Q=CIA, where:
Q = discharge rates in cubic feet per second (cfs),
C = runoff coefficient for the watershed,
I = rainfall intensity (for duration equal to time of con.) (in inches per hour),
A = area of watersheds contributing to the design location (in acres)

Rainfall Intensity (I)

Rainfall intensity (I) is the average rainfall rate, in inches per hour, for duration equal to the time of concentration for a selected rainfall frequency. Rainfall intensities may be computed using the following formula[1]:

$$i = \frac{a}{(b + t_c)^c}$$

Where: i = *rainfall intensity in inches per hour (Table 4),*
t_c = *time of concentration in minutes,*
And a, b, and c are coefficients as included in the following table:

[1] Rainfall Intensity Values Used by the South Carolina Department of Transportation (undated)

Table 3: Rainfall Intensity Coefficients (a, b, c)

Recurrence Interval (years)	a	b	c
2	244.34492	34.95806	1.03155
5	258.50572	32.75684	1.01773
10	267.54247	31.39986	1.00904
25	279.77346	29.59043	0.99735
50	288.71309	28.26125	0.98879
100	296.66217	27.04859	0.98111

Rainfall intensities may be selected using the following table:

Table 4: Richland County Rainfall Intensities (Inches per Hour)

	Recurrence Intervals (years)				
Time of concentration (minutes)	**2**	**10**	**25**	**50**	**100**
5	6.36	8.14	9.13	9.92	10.70
10	5.08	6.51	7.27	7.91	8.5
15	4.26	5.49	6.15	6.67	7.16
30	2.94	3.98	4.55	5.03	5.48
60	1.85	2.59	3.03	3.40	3.78

Source: NOAA Atlas 14 Point Precipitation Frequency Estimates for SC: Columbia Airport: http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=sc

Time of Concentration

The time of concentration (Tc) shall be determined by calculating the time for a particle of water to travel from the hydraulically most remote point of the project area to the point of interest. Richland County will accept commonly used time of concentration calculations and methodologies.

The storm duration shall be equal to the time of concentration (Tc) of the contributing drainage area, with a minimum time of concentration equal to 5 minutes.

The maximum allowable overland (sheetflow) flow paths are 100 feet in urban areas and 300 feet in rural areas.

NRCS (SCS) Unit Hydrograph

Runoff calculations involving any watershed of over 2 acres, multiple sub-watersheds or multiple drainage inlets and pipes must be analyzed using computer or numerical models that model complex hydrologic and hydraulic watershed responses. Models that incorporate the NRCS / SCS unit hydrograph methodology are acceptable.

The County reserves the right to require verification of hydrologic computations by use of a second computational method at its discretion. The County may require drainage systems to be designed assuming future conditions or build-out of the contributing watershed.

Pond routing is required for computing flow rates through detention ponds. Multiple methods, including the NRCS routing methods are accepted. The quantity of runoff in the NRCS method can be attributed to several factors. Watershed slope, soil type, ground cover, and antecedent moisture content all affect the quantity of runoff.

Change in Storage Equation

Hydrologic routing is used to model the change in storage in a detention facility by comparing inflow and outflow at small increments in time.

Inflow Hydrograph Formulation

The nature of impoundment basin routing is such that the inflow to the basin must be described in small time increments. In order to accomplish this, an inflow hydrograph must be formulated for each of the design storm events. If one of the more complex hydrologic methods is used to determine discharge from the drainage area, the inflow hydrograph is already available and can be used for the routing. If only the peak discharge has been determined; a hydrograph must be formulated based on that peak.

It is widely accepted that storms in Richland County can generally be described by the SCS Type II storm distribution.

Soil types are divided into four major hydrologic soil groups (HSG) denoted by the letters A through D. HSG A soils are those which have high infiltration capacity and subsequently low runoff rates. HSG D soils are those with very low infiltration capacity and very high runoff rates. Soil data for soils common in South Carolina and Richland County can be found at USDA Natural Resources Conservation Service (NRCS) Web Soil Survey (WSS). (https://websoilsurvey.nrcs.usda.gov/app/HomePage.htm)

For the purposes of the NRCS method, antecedent moisture content (AMC) is divided into dry, normal, and wet conditions based on the rainfall in the prior five days. If the 5-day antecedent rainfall is greater than 2.1 inches in the growing season or 1.1 inches in the dormant season the moisture content is presumed wet (AMC III). If the 5-day antecedent rainfall is less than 1.4 inches or 0.5 inches respectively, it is presumed dry (AMC I). Typical posted runoff curve numbers are based on normal conditions (AMC II). For design of proposed facilities, normal conditions are generally used.

Watershed Areas

On-site watershed areas (drainage area maps) shall be determined from the topographic maps of the proposed development. This topographic map, with the watershed area delineated for each drainage structure, is to be submitted to the County Engineer's office together with the drainage plans and calculations for any project requiring the review and approval of that office.

In all cases, drainage systems shall be designed to accommodate the runoff from those portions of the natural watershed located off-site as well as on-site areas. For developments with multiple phases and/or anticipated future development, (commercial or residential), the future use of any undeveloped land located in off-site watershed areas shall be evaluated by considering such factors as zoning, location relative to transportation facilities and nearby development trends. Runoff coefficients and curve numbers appropriate to the expected future land use of off-site watershed areas are to be used in all drainage calculations and design.

Water Supply Watershed Protection (Pending)

Downstream Analysis

Downstream analysis shall be required for all new development and re-development sites unless the County Engineer or designee determines it is not required. In some cases, the design professional may verify that Stormwater quantity controls may adversely impact downstream conditions. Therefore, downstream analysis shall be performed prior to sizing Stormwater quantity control structures to determine the extent of the controls to be implemented. Downstream analysis may show that more stringent controls need to be implemented to effectively prevent any adverse downstream impacts.

The downstream peak flow analysis shall include the assumptions, results and supporting calculations to show safe passage of post-development design flows downstream. The analysis of downstream conditions in the report shall address each discharge point along the project site's boundaries at which runoff exits the property. The analysis shall focus on the portion of the drainage channel or watercourse immediately downstream from the project. This area shall extend downstream from the project to a selected point of concern. In calculating runoff volumes and discharge rates, consideration may need to be given to any planned or known future upstream land use changes.

Downstream Analysis Limits

Hydrologic and hydraulic engineering analysis shall be implemented to determine the downstream effects from any development activity. This analysis shall extend downstream to a specific point of concern. The point of concern may be identified by the County Engineer. The following are typical points of concern:

A. The point downstream where the development represents less than ten (10) percent of the total drainage of the watershed
B. The first downstream road crossing
C. Downstream development
D. Downstream receiving waterbody
E. Location of known existing flooding, drainage, or erosion problems
F. Any point as directed by the County at pre-application meeting

The primary areas of analysis shall be done for the following:

- The development area;
- All drainage exits points from the property;
- The receiving channel or storm drainage system at the exit points; and
- Each component of the downstream system including:
    - Channels
    - Pipes
    - Culverts
    - Bridges
    - Overbank areas
    - Overbank structures

If there is any discrepancy or question about points of concern, please contact the County for a pre-application meeting. The County reserves the right to request a pre-application meeting at its discretion.

Downstream Analysis Design Storm Events

The downstream analysis shall determine whether the design storm events of interest (2 year, 10 year and 25 year) cause or increase flooding, drainage, or erosion impacts to downstream properties

or road crossings. The analysis criteria shall include but is not limited to:

- Existing land use curve numbers shall be used for undeveloped and developed areas upstream.
- Where future development areas are known upstream, the County Engineer may require these areas to be considered developed in the future land use condition;
- Existing land use for downstream areas of interest may be used, but future land use, when applicable, is recommended for conservative results;
- Routing of flows using accepted hydrologic and hydraulic methods;
- Hydraulic step-backwater calculations (Corps of Engineer's HEC-2 or HEC-RAS models or equivalent) shall be performed to determine flood elevations of any downstream impacted areas; and
- The effects of any upstream and proposed stormwater quantity or quality structures.

Improvement Options

If the downstream analysis determines that the development of a particular site does contribute to flooding, drainage, or erosion problems, then at least one the following improvements shall be implemented:

- On-site water quantity control
- Off-site water quantity control
- Improvements to the downstream stormwater conveyance system

Post-Construction Water Quality Design Standards

Best Management Practices (BMPs) are required to control and minimize water quality degradation resulting from post-construction land uses. These BMPs shall be designed according to one of the two Richland County Water Quality (WQ) Design Standards, which are:

Table 5: Richland County Water Quality Design Standards

Water Quality Design Standard	Non-sensitive Watersheds	Sensitive Watersheds[1]
WQ Design Standards #1: Water Quality Storm Event Design Standard	Manage the runoff from the Water Quality Storm Event	
WQ Design Standard #2: TSS Removal Design Standard[2]	Obtain 85% removal efficiency of the annual TSS loading	Demonstrate that the annual post-development pollutant loading does not exceed the annual pre-development pollutant loading for the pollutant(s) of concern.

1. Sensitive watersheds include TMDL, 303(d), or other sensitive watersheds as determined by the County.

2. A Hardship Exemption may be approved in exceptional circumstances such that the TSS Removal Design Standard results in unnecessary hardship and does not fulfill the intent of the requirement. See Hardship Exemption Criteria section below.

Site-specific factors (location within the County, soil type, groundwater table depth, available space, and other constraints) will dictate the feasibility of meeting each specific Design Standard. It is the responsibility of the designer to select and demonstrate compliance with Richland County Design Standard requirements, as laid out in this section. For further guidance refer to the *Richland County Design Standards Guidance Document*.

IDEAL Model - In an effort to aid the design community as well as assist the County in meeting MS4 permit goals, the County has developed and made available the IDEAL Model (software application). Selection of a particular BMP to achieve the required pollutant removal efficiency shall be determined through the use of the IDEAL model, or through review of monitoring studies of similar BMPs, applicable computation methods and other methodologies as deemed acceptable by the County Engineer. For further guidance on the IDEAL model refer to the *Richland County Design Standards Guidance Document*.

WQ Design Standard #1: Manage the Water Quality Storm Event Design Standard

This Richland County performance standard defines BMP effectiveness in terms of managing (infiltrating) the runoff from the majority of storm events, characterized by the Water Quality (WQ) Storm Event.

The WQ Storm Event is defined as:

A. The 90th percentile storm, or the storm with a 24-hour rainfall amount that is greater than or equal to 90% of storms based on historical data
B. The 1.4-inch, 24-hour duration, NRCS Type II storm event

BMPs shall be designed (using the IDEAL model) and constructed to manage (infiltrate) the runoff generated by the WQ Storm Event from the developed or redeveloped portion of the site. This infiltration shall occur within 72 hours of the end of the storm event.

This is typically the most feasible Design Standard in areas with sandy soils with high infiltration rates and should be the primary methodology utilized by sites in those areas.

For site constraints, soil conditions, or groundwater table conditions which do not permit the infiltration of the WQ Storm Event within a 72-hour period after the storm event, the County will approve BMPs meeting the TSS Removal Standard, described in the following section.

WQ Design Standard #2: TSS Removal Design Standard

This Richland County performance standard defines BMP effectiveness in terms of removal of total suspended solids (TSS) from polluted stormwater. Water quality impairment results, in part, because a number of pollutants are preferentially adsorbed onto mineral or organic particles found in fine

sediment. The interconnected process of erosion (detachment of the soil particles), sediment transport, and delivery is therefore an important conduit for introducing other key pollutants, such as nutrients (particularly phosphorus), metals, and organic compounds into surface waters. Pollutants also exist in particulate forms which may be transported through the same processes as sediment and trapped along with sediment. Thus, TSS is a good indicator for many stormwater pollutants in evaluating a BMP's effectiveness in pollutant removal.

Richland County has adopted a BMP performance standard that requires all permanent BMPs be designed (using the IDEAL model) and constructed to accommodate the expected sediment loading from post-construction land use with a removal efficiency of 85% of total suspended solids (TSS) based on an annual removal basis.

> **Sensitive Watersheds -** For sites utilizing the TSS Removal Design Standard which are in TMDL, 303(d), or other sensitive watersheds, designers must also show that the annual post-development pollutant loading does not exceed the annual pre-development pollutant loading for the pollutant(s) of concern.

This Design Standard is typically the most feasible Design Standard in areas with silt/clay soils where infiltration is infeasible or problematic and should be the primary methodology utilized by sites in those areas.

Sites that cannot achieve 85% removal efficiency of annual TSS loadings due to very low initial TSS loads or other site constraints may be applicable to meet the Hardship Exemption Criteria.

Hardship Exemption Criteria

The New Development Division may approve a Hardship Exemption if there are exceptional circumstances applicable to the site such that strict adherence to the provisions of the TSS Removal Design Standard requirement results in unnecessary hardship and does not fulfill the intent of the requirement. A written request should be provided to the New Development Division that states the reason with supporting data. The New Development Division may not grant an approval unless and until sufficient specific reasoning to justify the exception is provided by the applicant. The New Development Division typically conducts its review of the request for exemption approval within 17 working days.

The required Hardship Exemption criteria are:

- The designer demonstrates that by the nature of the development, it is impractical to reduce the size of the facility and parking area;
- The designer shows that there is no space for additional stormwater treatment practices other than proprietary devices;
- All pervious areas are designed to produce the least amount of runoff practicable;
- Sensitive watershed requirements, if applicable, are met;

- The designer utilizes the IDEAL model to demonstrate that the annual post-development TSS loading leaving the site is no more than 600 pounds/acre/year.

Sensitive watershed requirements for sites receiving a Hardship Exemption are the same as when utilizing the TSS Removal Design Standard. The designer should show that the annual post-development pollutant loading does not exceed the annual pre-development pollutant loading for the pollutant(s) of concern.

Pre-Treatment Practices

Pre-treatment practices for post-construction BMPs improve BMP function and reduce the overall maintenance requirement. Typical pre-treatment methods are forebays and manufactured treatment devices. Pre-treatment is recommended for all post-construction BMPs. Pre-treatment is strongly recommended for industrial and commercial projects due to the tendency for pollutants from these sites to hinder the function of post-construction BMPs (e.g. clogging due to trash, surface sealing due to oil and grease that hinders infiltration, etc.).

Impoundment (Basin) Design Requirements

These Storm Drainage Design Standards may require that some form of impoundment, either detention or retention, be used for development and redevelopment projects. The type and size of the facility required will usually depend on the size of the proposed development, its impact on the downstream watercourse and the impact on water quality. If areas immediately downstream of the proposed development are not sensitive to increases in runoff but areas further downstream are sensitive, a regional impoundment facility may be an option. If areas immediately downstream of the proposed development are sensitive to any increases in runoff, an on-site impoundment may be the better option. It is the intention of the County to control Stormwater problems resulting from development and lessen some existing flooding problems through the placement of impoundments as close to the problem area as possible. Therefore, impoundments may not apply to every new development but will be a combination of large and small facilities.

County standards may require that some form of impoundment, either detention or retention, be used for new developments. The type and size of facility required will usually depend on the size of the proposed development, its impact on the downstream watercourse and whether or not downstream water quality is of primary concern. If areas immediately downstream of the proposed development are not sensitive to increases in runoff but areas further downstream are sensitive, the County will prefer a regional impoundment facility. If areas immediately downstream of the proposed development are sensitive to any increases in runoff, an on-site impoundment will be required. It is the intention of the County to control Stormwater problems resulting from urbanization and lessen some existing flooding problems through the placement of impoundments as close to the problem area as possible. Therefore, the County's impoundment requirement will not apply to every new development but will be a combination of large and small facilities. If on-site facilities are not required, a fee determined by the Inspections Department may be required in lieu of any

impoundment facility.

The design of impoundment facilities may be quite simple, as is the case with some small on-site facilities. Larger facilities, however, can be quite complex. This manual is intended to serve as a reference to the designer by providing general guidelines and techniques for analysis. Complex designs should only be undertaken by professionals with a thorough knowledge of impoundments. All impoundment designs and their associated calculations should be sealed by a Professional Engineer registered in South Carolina.

Water Quantity Design Requirements

Water quantity control is an integral component of overall stormwater management. The following design criteria for flow control are established for water quantity control purposes:

- Post-development peak discharge rates shall not exceed pre-development discharge rates for the 2, 10 and 25-year frequency 24-hour duration storm event. The County may require a less frequent storm event (e.g. 50 or 100-year, 24- hour) to address existing or future stormwater quantity or quality problems.
- The appropriateness of stormwater storage facilities for mitigating peak flow increases should be determined in consultation with the County Engineer. At the request of the County, a comprehensive hydrology study of a receiving drainage system, stream or identified watershed under pre-development and post-development conditions may be required to assess potential impacts. Based on the finding of such studies, the design criteria for stormwater quantity management may be revised.

BMP Pollutant Removal

BMPs can be used independently as the “only” management practice employed for a specific area or combined as components in an overall BMP plan, frequently called a stormwater "treatment train." Estimation of BMP efficiency, i.e. the pollutant removal rate, for a single BMP measure is simple and straightforward.

For two or more BMPs used in series (Figure 1), the pollutant removal rates are not additive. For example, for two BMPs in series, the second BMP will function very differently than if it was the only BMP used to treat the polluted stormwater. The first BMP will capture the more easily removed larger sediment sizes, passing on an outflow with a lower concentration, but with a considerably higher proportion of finer particle sizes.

Upstream BMPs in a treatment train thus reduce downstream structural control average pollutant removal percentages. When calculating removal of pollutants to achieve a target, the removal efficiency of a downstream control must be reduced to account for the pollutant removal achieved by an upstream control(s).

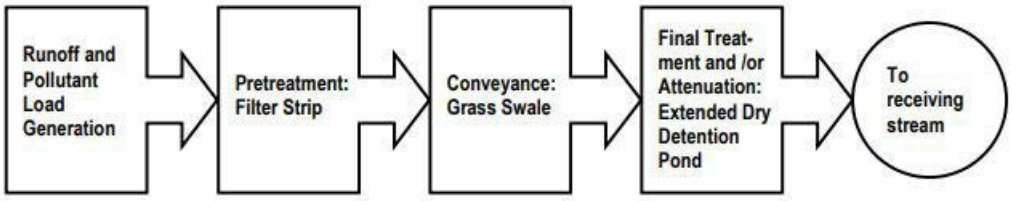

Figure 3: Example of a Stormwater Treatment Train

To estimate the pollutant removal rate of structural controls in series, a method is used in which the removal efficiency of a downstream structural control is reduced to account for the pollutant removal of the upstream control(s). The following steps are used to determine the pollutant removal:

1. For each drainage area list the structural controls in order, upstream to downstream, along with their expected average pollutant removal rates for the pollutants of concern.

2. Apply the following equation for calculation of approximate total accumulated pollution removal for Controls in series:

> ***Final Pollutant Removal*** *= (Total load × Control$_1$ removal rate) + (Remaining load × Control$_2$ removal rate) + … for other Controls in series*

Table below demonstrates these calculations for the example Stormwater treatment train presented above

Table 6: Stormwater Treatment Train Calculations

State in Stormwater Treatment Train	Inflow Pollutant Load	X	Pollutant Removal Efficiency	=	Remaining Pollutant Load (%TSS)
Runoff and Pollutant Load Generation	=		=		100%
Pretreatment: Filter Strip	100%	X	50%	=	50%
Conveyance: Grass Swale	50%	X	30%	=	15%
Final Treatment and/or Attenuation: Extended Dry Detention Pond	15%	X	45%	=	7%
		Initial TSS Load			100%
		Final TSS Load		-	77%
		TSS Removal Efficiency			93%

Types of Storage

In general, the type of storage device selected depends on the quantity of water to be stored and the associated cost of storage. Guidelines for each are included herein. The selection of the type of

storage used is up the individual owner or engineer. Although all of the following types of facilities will work, some will present more of a maintenance problem.

Dry Basins

Detention basins should be designed such that the primary outlet devices restrict the flow and allow water to pond in a safe contained fashion. A properly designed emergency spillway should be provided capable of passing the 100-year storm. Side slopes should be no steeper than 3:1 with vegetative groundcover. If site constraints are such that the slopes warrant anything steeper than 3:1, then slopes that are designed at 2:1 will require matting, ECBs or TRMs. The basin should be constructed to insure positive drainage. This will reduce the risk of mosquito problems and reduce maintenance costs. In larger basins, a concrete low flow swale is recommended since vegetation may be difficult to maintain with frequent flow through the basin.

Note: Multiple configurations may need to be considered to insure no system "short-circuits".

Wet Basins

The same basic standards apply to wet basins as to dry impoundment facilities. Outlet devices should be appropriately sized and an emergency spillway provided. Because of their added benefit to water quality, wet basins are highly encouraged by the County staff. Although they may be impractical for smaller areas, their use in larger drainage areas can provide improved water quality and an attractive, aesthetic component to the development. Hydrologic modeling of the wet basin is similar to that of other basins with only some minor changes to the stage-storage curve. Careful consideration should be given to the frequency of inflow and nutrient levels in the influent when deciding whether or not to use a wet impoundment basin. Low flows and high nutrient levels may result in the eutrophication of the pond and subsequently high maintenance costs.

Parking Lot Storage

For on-site detention where topography or space is a problem, parking lot storage may be an option. Naturally, not much water can be stored in a parking lot. Therefore, it should be considered for only small sites with little or no off site drainage entering the parking lot. The depth of storage should be limited to 8 inches and if possible should be restricted to a remote portion of the parking lot. Storage may not inundate handicap spaces or the primary access to the site. Some form of emergency overflow should be provided to pass the 100-year storm for drainage areas over 25 acres, usually by overtopping the curb. Since small outlet devices are required for parking lot storage, weirs are preferred to orifices. In general, parking lot storage creates more of a maintenance problem than any other type of on-site storage and should be used only when other facilities are impractical.

Pipe Storage

When space is severely limited on the site pipe storage may be an option. Oversized pipes with a restricted outlet can provide storage but usually only at a very high cost. Access to the pipe and outlet device must be provided for adequate maintenance. Debris control should be a prime consideration in designing pipe storage since the restricting outlet device is generally much smaller than the storage or inflow pipes.

Underground Storage

When space is severely limited on the site underground storage may be an option. Underground pipes, chambers or facilities with a restricted outlet can provide storage but usually at a high cost. Access to the underground storage area and outlet device must be provided for adequate maintenance. Trash and debris control is a prime consideration in designing underground storage.

Underground storage design includes:

- Materials: Corrugated metal structures are prohibited for underground storage.
- Emergency Spillways: Overflow must discharge to a stable outlet.
- Pretreatment: All underground storage systems must include pretreatment for the removal of sediments and debris prior to entering the main detention structure.
- Water Quality Design: Undergrounds storage alone is not applicable for water quality treatment during construction. Additional water quality treatment measures such as MTDs may be required to meet water quality standards.
- Observation Ports: Underground storage systems must have multiple observation ports for monitoring sediment and debris levels and determining when maintenance is required.
- Access Port: Access to the underground storage system must be provided to allow for the removal of accumulated sediment and debris.
- Design to support a minimum of an AASHTO HL-93 live load together with the appropriate dead load. Heavier live loads may be required if conditions dictate.
- Minimum life expectancy is 75 years.

Detention | Retention Design Parameters

The construction of detention structures usually requires excavation or the placement of earthen embankments to obtain a required storage volume. This section discusses the design criteria of detention structures to ensure the long term function of the structure while minimizing the maintenance responsibilities.

Outlet structures shall be designed in accordance with accepted engineering principles, with particular attention to appropriate hydraulics including orifice, weir, and culvert hydraulics. Outlet structures shall be designed to discharge equal to or less than the pre-development runoff peak flow rates for the 2- year, 10-year, and 25-year frequency 24-hour duration Type II storm event.

If downstream drainage facilities are inadequate to convey the peak discharge for the design storm events for the development of a particular site, please refer to the section "Improvement Options" on page 24 when the downstream actual carrying capacity and the outlet structure shall be sized to restrict the peak discharge rates to accommodate downstream conditions.

Where a basin discharges into a stream, ditch, swale or water body, appropriate velocity dissipation devices and/or erosion prevention BMPs are required to minimize soil erosion and sediment transport. An emergency spillway shall be required for detention and retention basins to discharge flows for the 100-year, 24-hour storm event with 1.0-foot of freeboard. The spillway shall be located so the discharge does not erode the basin or receiving channel. If the 100-year storm can be retained completely on site, an emergency spillway is not required.

Detention Structure Design Criteria

Shape

Place inlets and outlet as far apart as feasible. Provide a long and narrow basin shape, with a minimum flow length to flow width ratio of 2L: 1W and an optimum flow length to flow width ratio of 3L: 1W. Design runoff to travel the longest distance possible thorough the basin before being discharged. The flow length to flow width ratio can be increased by:

- Designing irregularly shaped basins such as a kidney bean shape,
- Using baffles to create a longer path of flow,
- Utilizing double chamber ponds, or
- A combination of these techniques.

The shallow and narrow end of the basin should be located near the inlet and the deeper and wider end near the outlet. The allowable dead storage space of a basin is limited to a maximum of 20%.

Side Slopes

Vegetated embankments shall be less than 15-feet in height and shall have side slopes no steeper than 3H:1V. Vegetated embankments shall be protected with Erosion Control Blankets or Turf Reinforcement Matting. Geotechnical slope stability analysis is required for slopes greater than 10-feet in height and embankments that have steeper slopes than those indicated above.

Inlet

The inlet must be designed with riprap or other energy dissipater, such as a baffle below the inflow structure to reduce erosive forces and pretreatment to remove sediment. Sediment forebays will be required on all ponds for post-construction water quality and shall be designed with a minimum length to width ratio of 2:1. Prevention of scour at the inlet is necessary to reduce maintenance problems and

prevent damage to basin floor vegetation. The velocities of flow through the inlet sediment control structure and basin should not exceed 2.5 feet per second. Energy dissipation should be provided at the inlet and outlet to prevent scour and reduce the velocity of storm water.

Dry Detention Bottom Slopes

The bottom of detention structures shall be graded towards the outlet structure to prevent standing water conditions and be stabilized to prevent scour. A minimum 2 percent bottom slope is recommended for both cross slope and a minimum 0.5 percent bottom slope is recommended longitudinal slope.

Under Drains

If the 2 percent grade cannot be obtained an acceptable alternative is to install an under drain. The under drain shall be constructed in the following manner:

- The under drain shall be one of the last items to be installed to eliminate any sediment build-up that would cause the under drain to not function properly.
- A non-woven geotextile fabric shall be laid in the excavated trench first. The perforated drainpipe shall be covered with washed stone.
- Both stone and drain shall then be wrapped with the non-woven geotextile and backfilled with sandy porous material.

Permanent Pool Detention

The maximum depth of permanent storage facilitates shall be determined by site conditions, design constraints, and environmental needs. The facility should provide a permanent pool of water with a depth sufficient to discourage weed growth without creating undue potential for anaerobic bottom conditions. The minimum allowable permanent pool depth is 4 feet and a maximum allowable depth is 12 feet. A depth of 6 to 8 feet is reasonable unless fishery requirements dictate otherwise. Aerating may be required for permanent pools to prevent anaerobic conditions. Wildlife experts shall be contacted where aquatic habitat is required.

Principal Spillways

All principal spillways shall be made of reinforced concrete structures. Corrugated metal principal spillways are not accepted.

Trash Racks

All basin outlets must have a trash rack to control clogging by debris and to provide safety to the public. The surface area of each rack must be at least four times the outlet opening it is protecting. The spaces

between rack bars must be no more than six inches or one-half the dimension of the smallest outlet opening behind it, whichever is less. Trash racks should be inclined to be self-cleaning.

Pipe Barrel Materials

All pipe barrel material shall be concrete pipe. Corrugated Metal Pipe is not accepted. All pipe barrel pipe joints shall be water tight using AASHTO M-315 (13PSI) pipe joint, O-ring gaskets (ASTM C361), or a coupling band.

Seepage Control

Use a water tight pipe outlet barrel to riser connection. All pipes that extend though an embankment shall have anti-seep collars or filter diaphragms to control the migration of soil materials and, so prevent potential embankment failure from "piping" within the backfill soil along the conduit. All constructed dams or embankments shall have a clay core with an excavated cutoff trench.

Anti-floatation

All outlets employing a riser structure must be designed to prevent the riser from floating.

Emergency Spillways

Emergency spillways shall be designed to covey the routed runoff of the 100- year 24-hour design storm event while maintaining at least 1.0-foot of freeboard between the high water elevation and the top of the embankment crest. Overflow must discharge to a stable channel or stable area.

Location of Spillways

Emergency spillways must be located on undisturbed, non-fill soil wherever possible. If the spillway must be located on fill soils, then it must be horizontally offset at least 20 feet from the principal outlet. Discharge from the emergency spillway should not impinge upon the toe of the dam or the embankment.

Protection

Emergency spillways must be designed with a permanent erosion prevention lining (i.e.: riprap, permanent turf reinforcement matting, nonflexible lining, etc.). Grass only emergency spillways are acceptable, if it is in the cut section. The top elevation of the spillway shall be the actual top of the permanent erosion prevention lining.

Exit Channel

All exit channels must be designed with a permanent erosion prevention lining (i.e.: riprap, permanent turf reinforcement matting, articulated blocks, concrete, nonflexible lining, etc.). Grass only exit channels are not acceptable. All linings must be evaluated for stability at the channel grade chosen.

Outlet

Each basin outlet shall be designed to prevent scour and to reduce velocities during peak flow conditions. Each outlet should be directed towards pre-existing point source discharges or be equipped with a mechanism to release the discharge as close to sheet flow as possible to prevent the creation of new point source discharges.

Restrict the basin outlet from being placed within 20 linear feet of adjacent properties lines. Outlet

Devices

The following sections are a general description of some common outlet devices used in impoundment facilities. Other devices are available. Because controlling multiple design storms may be required, some rather imaginative outlet devices may result. To the extent possible, outlet devices should be kept simple. This may require and optimal design for one storm frequency and an over design for the other storm event.

Orifices

The discharge through an orifice can be described by an energy balance analysis. Assuming the upstream velocity is negligible (i.e. a reservoir) and the water surfaces both upstream and downstream are free surfaces, the energy balance can be simplified to what is referred to as the orifice equation.

- *Orifice Equation*
- *Weir Equation*

Riser Barrel Outlets

Riser-barrel outlets act as a combination of several types of outlet devices. At different stages the outlet may behave differently. At shallow depths the riser may act as a weir. As the depth increases the riser may begin to act as an orifice or the barrel may begin to control. The controlling factor will be that with the smallest discharge at a given depth.

- *Sharp Crested Weir Equation*
- *Orifice Equation*
- *Barrel as Orifice Equation*

Earthen Dam Embankment

Earthen dam embankments shall be no steeper than 3H:1V with vegetative groundcover. If site constraints are such that the slopes warrant anything steeper than 3H:1V, then slopes that are designed at 2H:1V will require matting, ECBs or TRMs. Earthen dam embankment shall not be planted with shrubs, trees or woody vegetation.

The minimum earthen dam top width shall be 10-feet for embankments to provide adequate maintenance access.

Engineer Certification

All constructed dams or the engineer or geotechnical engineer ensuring proper compaction, clay core installation, and seepage control measure installations must certify embankments.

Maintenance Access

Maintenance access at least 10 feet wide with a maximum slope of 15% and a maximum cross slope of 3% shall be provided and shall be stabilized. Sufficient areas for equipment access for basin maintenance shall be provided. This access shall extend to the forebay, micropool and outlet structure. It should never cross the emergency spillway, unless the spillway has been designed for that purpose and to the extent feasible, be designed to allow for vehicle turnaround. An easement may be required.

Provide a flat maintenance shelf/berm with a minimum width of 10-foot around the perimeter of the basin, nothing shall encroach within the property boundary line. The basin berm must provide load bearing capability for industrial maintenance mowers.

Reduced maintenance access may be allowable on a limited case by case basis depending on site constraints and the design of the pond as determined during formal review submittal.

Safety Fence

A safety fence or vegetative barrier is required where a detention structures interior side slopes are steeper than 3H: 1V or when the impoundment is a wall greater than 24 inches in height. If the wall is adjacent to a walkway or street a railing may be required instead of a fence.

Basins on Slopes

When basins are created by cutting and filling a slope, care should be taken that the seasonal groundwater table on the slope above the basin is not exposed, thus creating a seasonal spring.

Controlling the groundwater flow or spring flow into a basin may be accomplished by the proper installation of a subsurface interceptor drainage system. To prevent destabilization from groundwater seepage, riprap may be needed.

Relationship to Groundwater

The basin bottom should be located 2 feet above the seasonal high groundwater table to avoid standing water in dry basins or ground water intrusion in wet basins.

Safe Dams Act

A dam is defined as being an artificial barrier that impounds water to a depth of 15- feet or greater and has a maximum storage volume of 10-acre-feet or greater; therefore, impoundment depths greater than 15-feet are subject to the requirements of the Safe Dams Act unless the facility is excavated. Several exemptions are allowed from the Safe Dams Act and any questions concerning specific design application should be addressed by SCDHEC.

During Construction Basic Design Procedures

Control of sedimentation from construction sites may be accomplished through the utilization of a variety of erosion and sediment control BMPs. The complexity of the erosion and sediment control plan will vary depending on the individual site conditions. The goal of implementing the erosion control plan is to limit the quantity of sediment being eroded from, and leaving a construction site. This may be partially accomplished through the implementation of sediment control BMPs. However, these sediment trapping controls typically only remove a small portion of the clay particles eroded from the site. The best protection is provided by a combination of practices including temporary and permanent stabilization, flow diversions, and streambank protection, all which minimize the amount of soil that is eroded from the site.

All land development shall be planned in such a way to control and limit erosion and sediment discharge from construction sites. The goal of these erosion and sediment control BMPs shall be to:
Minimize the extent and duration of disturbed soil exposure.
Protect off-site and downstream locations, drainage systems and natural waterways from the impacts of erosion and sedimentation.

Limit the exit velocities of the flow leaving the site to non-erosive or pre-development conditions.
Design and implement an ongoing inspection and maintenance plan.
Removal of all temporary BMPs prior to final project closeout.

During Construction Water Quality Design Requirements

Best Management Practices (BMPs) are required to control and minimize water quality degradation

resulting from construction activities. Richland County has implemented a during construction performance standard that defines BMP effectiveness in terms of removal of total suspended solids (TSS) from stormwater runoff.

Richland County has adopted a BMP performance standard that requires all temporary during construction BMPs shall be designed and constructed to accommodate the expected sediment loading from construction activities with a removal efficiency of 80% of total suspended solids (TSS). The efficiency shall be calculated for disturbed conditions for the 10-year 24-hour design event.

The removal efficiency may be calculated using South Carolina Design Aids, SEDIMOT, SEDCAD4, Pond Pack, SEDPRO and other computer models that utilize eroded particle size distributions and calculates a corresponding 80% trapping efficiency for TSS.

Stormwater runoff that drains to a single outlet from land disturbing activities which disturb five (5) acres or more shall be controlled during the land disturbing activity by a sediment basin where sufficient space and other factors allow these controls to be used. The outfall device or system design shall take into account the total drainage area flowing through the disturbed area to be served by the basin. When discharging storm water runoff from sediment basins, utilize outlet structures that only withdraw water from near the surface of the basin or impoundment, unless infeasible. The use of perforated riser structures during construction are not allowed. This outlet structure should be capable of conveying the flow for the 10-year, 24-hour storm event.

Temporary sediment basins shall be designed to completely dewater in a minimum of 2 days with a maximum of 5 days.

Unless infeasible, properly design, install and maintain porous baffles, or similar control measures capable of enhancing settling capabilities and restricting the accumulation of sediment around the outlet structure, in all sediment basins to reduce velocity, turbulence, and improve sediment trapping efficiency. Each sediment basin must be equipped with a cleanout stake indicating when the basin is to be cleaned.

Perform temporary stabilization by seeding and install temporary erosion control blankets on exposed basin side slopes.
Sediment basins may be converted to permanent use for detention or water quality after construction is completed provided all accumulated silt is removed from the basin and disposed of after all disturbed areas have been stabilized.

Stormwater runoff that drains to a single outlet from land disturbing activities which disturb less than five (5) acres shall be controlled during the land disturbing activity by sediment control BMPs. The maximum allowable drainage area for a single sediment trap is five (5) acres.

Unless infeasible, properly design, install and maintain porous baffles, or similar control measures capable of enhancing settling capabilities and restricting the accumulation of sediment around the outlet structure in all temporary sediment traps to reduce velocity, turbulence, and improve sediment

trapping efficiency.

SWPMP Development Standards

SWPMPs shall be developed to achieve an 80 percent design removal efficiency of total suspended solids (TSS) goal. The design storm event associated with this level of control is the 10-year 24-hour SCS Type II storm event. SCS procedures should be used to determine runoff amounts. It is important to note that when a BMP is designed for the 10-year 24-hour storm event, the BMP will have a greater trapping efficiency for more frequent events such as the 2-year 24-hour storm event.

Each SWPMP must delineate the following elements:

- All Sensitive Features (including steep slopes 30%)
- Sources of sediment that may potentially leave the site
- The location and depth of all structural and nonstructural BMPs necessary to achieve the 80 percent design removal efficiency goal to protect receiving water bodies, off-site areas and all Sensitive Features
- Installation and maintenance of required BMPs
- The sequencing of construction activities to be utilized on the project

The following nonstructural site management practices shall be utilized on the plans where applicable:

- Minimize site disturbance to preserve and maintain existing vegetative cover.
- Limit the number of temporary access points to the site for land disturbing activities.
- Phase and sequence construction activities to minimize the extent and duration of disturbed soil exposure.
- Locate temporary and permanent soil disposal areas, haul roads and construction staging areas to minimize erosion, sediment transport and disturbance to existing vegetation.

SWPMPs shall comply with the following specific standards and review criteria:

- Sediment Tracking Control. Stabilized construction entrances shall be located and utilized at all points of ingress/egress on a construction site. The transfer of soil, mud and dust onto public rights of ways shall be prevented.
- Crossings of waterways during construction should be minimized and must be approved by the County Engineer. Encroachment into stream buffers, riparian areas and wetlands should be avoided when possible.
- Topsoil shall be stockpiled and preserved from erosion or dispersal both during and after site grading operations when applicable.
- Temporary Stabilization Measures. Where construction or land disturbance activity will or has temporarily ceased on any portion of a site, temporary site stabilization measures shall be required as soon as practicable, but no later than 14 calendar days after the activity has ceased.
- Final Stabilization. Final Stabilization of the site shall be required within 14 calendar days of construction completion.

- Temporary Structural Controls installed during construction shall be designed to accomplish maximum stabilization and control of erosion and sedimentation, and shall be installed, maintained, and removed at the end of the project.

SWPMPs shall include requirements for the design, installation and maintenance of effective pollution prevention measures for construction site operators to:

- Minimize the discharge of pollutants from equipment and vehicle washing, wheel wash water and other wash waters. Wash waters must be treated in a sediment basin or alternative control that provides equivalent or better treatment prior to discharge,
- Minimize the exposure of building materials, building products, construction wastes, trash, landscape materials, fertilizers, pesticides, herbicides, detergents, sanitary waste and other materials present on site to precipitation and to stormwater runoff that may cause adverse impacts to water quality, and,
- Minimize the discharge of pollutants from spills and leaks and implement chemical spill and leak prevention and response procedures.

SWPMPs shall ensure the following discharges from construction sites are prohibited:

- Wastewater from washout of concrete, unless managed by an appropriate control;
- Wastewater from washout and cleanout of stucco, paint, from release oils, curing compounds and other construction materials;
- Fuels, oils, or other pollutants used in vehicle and equipment operation and maintenance; and,
- Soaps or solvents used in vehicle and equipment washing.

Phased Sediment and Erosion Control Plans

Phased Sediment and Erosion Control Plans are not required when the total land-disturbance is 1 to 2 acres or less.

For land-disturbance between 2 and 5 acres, a minimum of two-phased stormwater management and sediment and erosion control plan is required for all non-linear projects. Each phase must be shown on a separate plan sheet. Plans should address the transition between phases.

Phase 1 – Initial Land Disturbance – Must include perimeter sediment and erosion control BMPs required prior to initial/ mass clearing and other appropriate BMPs needed to maintain compliance with the permit. On some sites, this may include appropriate BMPs for demolition of existing structures.

Phase 2 – Stabilization – Includes sediment and erosion control BMPs required during the remainder of grading and construction. Must also include appropriate BMPs for stabilization, grassing, inlet protection, etc.

For land-disturbance greater than 5 acres, a minimum of three-phased stormwater management and sediment and erosion control plan is required for all non-linear projects. Each phase must be shown on a separate plan sheet. Plans should address the transition between phases.

Phase 1 – Initial Land Disturbance – Must include perimeter sediment and erosion control BMPs required prior to initial/ mass clearing and other appropriate BMPs needed to maintain compliance with the permit. On some sites, this may include appropriate BMPs for demolition of existing structures.

Phase 2 – Construction – Includes sediment and erosion control BMPs required during the majority of grading and construction activities.

Phase 3 – Stabilization – Includes sediment and erosion control BMPs required near the completion of the construction project. Must also include appropriate BMPs for stabilization, grassing, inlet protection, etc.

Alternative Erosion Prevention and Sediment BMPs

To encourage the development and testing of innovative alternative EPSC BMPs, alternative management practices may be allowed upon review and approval. To use an alternative BMP, the design professional shall submit substantial evidence that the proposed measure will perform at least equivalent to currently approved methods.

Evidence may include, but is not limited to:

- Supporting hydraulic and trapping efficiency calculations.
- Research results as reported in professional journals.
- Manufacturer literature.

To justify the efficiency of innovated EPSC BMPs, the owner may be required to monitor the trapping efficiency of the structure. If satisfactory results showing that trapping efficiencies of greater than 80 percent are obtained, the innovative BMP may be used and no other monitoring studies shall be required. If monitoring shows that a certain BMP is not sufficient or if Richland County finds that a BMP fails or is inadequate to contain sediment, other upstream and downstream BMPs shall be implemented to reach the required efficiency.

Multipurpose Basin Design

Permanent Multipurpose Basin storage volumes, dimensions, and riser configurations are designed to meet the permanent post-construction requirements for the specific basin.

Two spillway configurations are required for Permanent Multipurpose Basins that are used for both during construction sediment control and post-construction water quantity or water quality control. The first configuration is the temporary Sediment Basin Primary Riser Spillway consisting of a solid

concrete riser with no staged discharges. Runoff only enters the Primary Riser structure by overtopping and through the Floating Skimmer.

The second configuration is the Permanent Basin Riser spillway designed to reduce post-development peak flow rates to pre-development peak flow rates and designed for post-construction water quality control.

Post-construction staged orifices, low flow orifices, or staged weirs are securely covered or sealed during the construction phase. Uncover post-construction staged orifices, low flow orifices, or staged weirs
after the construction phase is complete.

Floating Skimmers and Baffles may be removed when the construction phase ends.
Clean the temporary Sediment Basin of deposited sediment and re-grade the Basin to meet the Permanent Basin contours if necessary when the construction phase ends.

Receiving Waters with TMDLs or Impairments

If an Impaired or TMDL Water with a pollutant of concern applicable to stormwater discharges from the proposed land development has been established and is in effect, then the SWPMP should address the following, depending on the total disturbed area.

Disturbed area less than 25 acres:

For construction projects that disturb *less than 25 acres*, carefully evaluate all selected BMPs and their ability to control the pollutant(s) of concern.

Disturbed area greater than or equal to 25 acres:

Construction projects that disturb *25 acres or more* require a **written quantitative and qualitative assessment** showing that the selected BMP controls the discharge of the pollutant, or pollutants, of concern from construction and post construction within a TMDL watershed, or to a water on the 303(d) List of Impaired Waters.

Design professionals should determine whether runoff from the proposed land development contains pollutants that are already causing impairment of the adjacent waterbody. These pollutant discharges vary from site to site.

If stormwater runoff from the proposed land development contributes pollutants that already cause water quality impairment, the design professional should demonstrate to the extent practicable that the measures and controls to be implemented prevent further problems to the impairment.

The IDEAL model should be used by designers to calculate the annual loading for the pollutant(s) of concern for the pre-developed condition as a baseline and compare the baseline to the developed annual loading condition. No increase in annual loading of the pollutant(s) of concern provides a quantitative assessment showing that the selected BMP(s) control the discharge of the pollutant(s) of concern.

Alternative approaches, methodologies and solutions may be allowed; however, it is incumbent on the designer proposing an alternative to adequately demonstrate both the effectiveness and equivalency of that alternative.

For pollutants causing impairment for which a numeric water quality standard has been adopted (fecal coliform, pH, metals), calculations should be performed and submitted showing that the pollutants in the runoff from the development site should not exceed the applicable in-stream water quality standards. The runoff discharged through the last water quality BMP should have a water quality level equal to or better than the in-stream standard.

The design professional should demonstrate to the extent practicable in a different manner when the water quality impairment is not a pollutant itself, but is affected by a pollutant that can be regulated such as dissolved oxygen levels are affected by biochemical demand. In these situations, a reasonable approach to show that runoff should not further degrade the adjacent impaired waterbody is to show that the post-development loading of a particular pollutant is less than or equal to pre-development loading.

This demonstrates to the extent practicable that there should be no net increase of loading of that particular pollutant and no further lowering of the water quality standard. In most cases, the effectiveness of the designed water quality BMPs should not require water quality sampling. However, for certain situations, it may be required for the applicant or landowner to collect monitoring data to confirm the effectiveness of the BMPs.

Assessing Sediment and Erosion Control Measures

Sediment Storage Volumes and Maintenance Schedules

Calculating the appropriate sediment storage volume is very important in sediment basin and sediment trap design. This volume is the storage occupied by the sediment deposited over the given design period. Design periods may be the life of the basin, or the time between scheduled clean outs.

Sediment storage volumes may be predicted by the Modified and the Revised Universal Soil Loss Equations or methods acceptable to the County Engineer or designee.

Using the computed sediment yields, Y_D, from the Modified and Revised Universal Soil Loss Equations (MUSLE and RUSLE), along with the sediment bulk (or weight) density, the sediment storage volume can be calculated by:

$$V_{SS} = \frac{YD}{W * 27}$$

Where:
V_{SS} is the sediment storage volume (cubic yards),
Y_D is the sediment deposited over the design period (pounds), and
W is the weight density (bulk density) of the deposited sediment (lbs./ft^3).
W can be determined from soil survey data (usually given in grams/cm^3) or from the following default table (lbs./ft^3) for Richland County:

Table 7: Default Weight Density Values for Sediment Storage

Type of Basin Operation	W (lbs./ft^3)
Sediment always submerged (Wet Pond)	96
Basin normally empty (Dry Pond)	97

R Factors and EI Values

When designing for sediment storage volume, the sediment deposited over the design period Y_D, must be calculated. This value can be obtained by converting the sediment yield calculated by both the Modified and Revised Universal Soil Loss Equation (MUSLE and RUSLE) into pounds of sediment.

By using the MUSLE equation, sediment yield from a watershed can be calculated for the smaller storm events.

Equation 1-1 MUSLE Equation:

$$\mathbf{T = \Psi \times (V \times Q_p)^{0.56} \times (K \times LS \times C \times P)}$$

Where:
T = Sediment yield per storm event (tons)
Ψ = 95.0 for Imperial units

V = Volume of runoff (acre-feet) Q_p = Peak flow (ft^3/sec)
K, LS, C and P are MUSLE and RUSLE Parameters

One of the variables used in the RUSLE is the R factor. R is the factor in the RUSLE that accounts for the damaging effects of rainfall. The R factor indicates the erositivity of the rainfall, not the average annual precipitation in a locality. The R factor is defined as the number of erosion index (EI) values in a normal year's rain. The EI index value of a given storm is equal to the kinetic energy of the storm (hundreds of foot-tons per acre) multiplied by its maximum 30-minute intensity (inches/hour). The EI values of individual storms may be summed to get an EI value for a month, six months, or for any period of time. When EI values are summed and averaged over a period of years, they become R factors.

The distribution of EI values become important when soil losses need to be calculated for a period of time less than one year, such as a construction season. The distribution of the EI values over a known period of time is used to calculate an R factor for that time period. Table 10 of this chapter shows the distribution of EI values for Richland County as a percentage of the R factor for Richland County. This design procedure shall require a minimum EI value of 50 for any construction period.

Table 8: Average Example Distribution of Rainfall Erosion Index (EI Curves) for Richland County

Date	Percent of EI Value		Date	Percent of EI Value
1-Jan	0.0		15-Jul	46.0
15-Jan	1.0		1-Aug	58.0
1-Feb	2.0		15-Aug	69.0
15-Feb	3.0		1-Sep	80.0
1-Mar	5.0		15-Sep	89.0
15-Mar	7.0		1-Oct	93.0
1-Apr	10.0		15-Oct	94.0
15-Apr	14.0		1-Nov	95.0
1-May	18.0		15-Nov	96.0
15-May	22.0		1-Dec	97.0
1-Jun	27.0		15-Dec	97.0
15-Jun	32.0		1-Jan	100.0
1-Jul	37.0			

*The minimum EI value for any construction period shall be 50. The annual R factor value for Richland County is 350.

Factors and EI Value Example Problem:

- The annual R factor value for Richland County is 350.

- If construction of a particular site is scheduled to take place for 5 months from January 1 to June 1, the EI Curve value would be 27.0 – 0.0 = **27.0**
- The corresponding R factor for this time period is calculated to be 0.27 * 350 = **94.5.**
- If construction of a particular site is scheduled to take place for 5 months from March 1 to August 1, the EI Curve value would be 58.0 – 5.0 = **53.0**
- The corresponding R factor for this time period is calculated to be 0.53 * 350 = **185.5**

Calculating Sediment Storage Volumes

The following steps are used to determine the storage volume for a sediment trapping structure. All Modified and Revised Universal Soil Loss Equation input values are found in the Appendix of these Design Standards.

1. Determine the average soil loss per unit area from the site using the Revised Universal Soil Loss Equation:

E = R x K x LS x CP

Where:
E=Annual erosion rate in (dry weight) (tons/acre/year),

R=Rainfall erosive factor and is an erosion index for the 10-year, 24-hour individual storm (tons/acre)/yr (EI Value for given design period * average annual R Value)

K=Soil erodibility factor and is a numerical representation on the susceptibility of a soil to particle detachment and transport by rainfall and runoff.

LS= Topographic factor. A numerical representation as to how topographic length and slope steepness impact the rate of erosion. Length-slope steepness factor (length is the slope distance from the point of origin of overland flow to the point of concentrated flow or until deposition occurs (dimensionless),

C=Cover factor. A numerical representation on how erosion controls practices minimize soil loss when compared to bare soil conditions. The smaller the number the more effective.

P=Management practice factor. A numerical representation on how sediment control practices remove suspended particles from runoff waters. (dimensionless).

Equation 1-2 assumes the following about potential erosion rates on construction sites:

- R-Factors and K-Factors are site specific parameters that do not change.
- K-Factor accounts for seasonal changes, such as freezing and thawing, soil moisture and soil consolidation.

- LS-Factors can change by altering the distance runoff flows and varying slope steepness of the land.
- C-Factor values represent the "ineffectiveness" of a practice to minimize soil erosion when compared to bare ground conditions.
- P-Factor values represent the "ineffectiveness" of barrier or filter to remove sediment out of runoff waters.

2. Determine the weight density (**W**) of the specific soil. Use Richland County default table, results from site specific soil test, or the Richland County Soil Survey, which provides soil bulk density usually given in grams/cm^3.

   - Convert (grams/cm^3) to (lbs/ ft^3) by multiplying by 62.43
   - W= (bulk density in grams/cm^3) x (62.43) = lbs./ft^3

3. Calculate sediment yield ($\mathbf{Y_D}$) in pounds.

   - Determine the total disturbed area **DA** (acres).
   - Determine the sediment yield ($\mathbf{Y_D}$) in tons, calculated by multiplying **A** * **DA**

   (tons/acre) * (acres) = tons

   - Convert tons to pounds to calculate $\mathbf{Y_D}$:

   $\mathbf{Y_D}$ in pounds = (tons) * (2000 lbs./ ton)

4. Calculate the required sediment storage volume, **VSS**, in cubic yards:

$$\mathbf{VSS} = \frac{YD}{W*27} = \text{Cubic Yards}$$

5. The design professional can determine the elevation the required sediment storage corresponds with and require a clean out stake to be installed marking this elevation. The contractor shall be required to clean out the basin or trap when this level is reached. The designer shall state the clean out time interval on which the calculations were based, such as weeks, months or years.

Sediment Storage Volume Example

Given: A 10-acre construction site is to be cleared to a bare soil condition and developed. The contributing runoff slope length is 400 feet with a 2.5 percent slope. The primary soil is Lakeland Sand. A normally dry sediment basin is to be designed to be the primary sediment control structure on the site.

Calculate: Required sediment storage volume if construction takes place between March 1 and September 1.

1. Determine the average soil loss per unit area from the site using the Revised Universal Soil Loss Equation.

$$\mathbf{E = R \bullet K \bullet LS \bullet CP}$$

Where:
R = From Table 10, EI for September 1 = 80.0 and EI for March 1 = 5.0 (80.0-5.0) = 75% of 350 =**262.5**
K = **0.10** for Lakeland Sand soil
LS = **0.362** for 400ft slope length with 2.5%
CP = **1.0** for a bare soil condition

Then:

$$\mathbf{E = (262.5) \times (0.10) \times (0.365) \times (1.0) = 9.58 \text{ tons/acre}}$$

2. Determine the weight density (**W**) of the Lakeland Sand soil.

The default dry sediment basin weight density for Richland County is: **W = 97 lbs./ft^3**

3. Calculate sediment yield (**Y_D**) in pounds.

- Determine the total disturbed area **DA**: **10 acres**
- Determine the sediment yield (**Y_D**) in tons, calculated by multiplying **A** * B

9.58 (tons/acre) * 10 (acres) = **95.8 tons**

- Convert tons to pounds to calculate **Y_D**

Y_D = (95.8 tons) * (2000 lbs./ ton) = **191,600 pounds**

4. Calculate the required sediment storage volume, **VSS**, in cubic yards:

$$\mathbf{V_{SS}} = \frac{YD}{W*27} = \text{Cubic Yards}$$

V_{SS} = 191,600 pounds / (97 lbs./ft^3 * 27 cubic yards/ ft^3) = 73.2 Cubic Yards

Selection of During Construction BMPs

The following table lists the acceptable during construction BMPs:

Table 9: Acceptable During Construction BMPs

Erosion Prevention BMP's	Sediment Control BMP's	Runoff Conveyance BMP's
Surface Roughening	Sediment Basin	Pipe Slope Drains
Temporary Seeding/Stabilization Mulching	Floating Skimmer	Temporary Steam Crossing Diversion Measures
Erosion Control Blankets	Porous Baffle	Level spreader
Turf Reinforcement Matting	Sediment Trap	Subsurface Drains
Hydraulic Erosion Control Products (HECP's)	Silt Fence Rock	Construction Dewatering Concrete Washout
Permanent Seeding/Stabilization	Checks	
Sodding	Sediment Tubes	
Riprap	Construction Entrance	
Outlet Protection Dust Control Polyacrylamide (PAM) Slop Interruption Devices	Inlet Protection	
	Filter Fabric Inlet Protection	
	Sediment Tube Inlet Protection	
	Wire Mesh and Stone Inlet Protection	
	Block and Gravel Inlet Protection	
	Rigid Inlet Protection	
	Surface Course Curb Inlet Protection	
	Inlet Tubes Rock Sediment dikes	

Erosion Prevention BMPs

Use erosion prevention measures during and after construction site preparation in order to safely convey clean water to storm drains or adequate watercourses. One or more measures should be utilized as appropriate during the project's construction phase. Such measures may include but are not limited to: phasing and construction sequencing, surface roughening, temporary seeding, mulching, erosion control blankets, and reinforcement matting. Each of these measures is discussed in the Sections below. In addition to site-specific erosion control measures, the grading plan includes the following general measures as a minimum:

- Vegetated finished cut and fill slopes should not be steeper than 3H: 1V, unless an erosion control blanket or turf reinforcement mat is used.

- Do not place cuts or fills close to property, endangering adjoining property without adequately protecting such properties against erosion, sedimentation, slippage, settlement, subsidence, or other damages.
- Provide subsurface drainage in areas having a high water table to intercept seepage that affects slope stability, bearing strength, and undesirable wetness.
- Do not place fill material where it can slide or wash onto another property.
- Do not place fill adjacent to channel banks where it can create bank failure, reduce the capacity of the stream, or result in downstream sediment deposition.
- Include all borrow and disposal areas as part of the grading plan.
- Provide adequate channels and floodways to safely convey increased runoff from the developed area to an adequate outlet without causing significant channel degradation, or increased off-site flooding.
- Grade the site to direct flows to appropriate controls.

Table 10: Erosion Prevention BMPs

Erosion Prevention BMP's	Description
Surface Roughening	Surface roughening is the creation of horizontal grooves, depressions, or steps that run **parallel** to the contour of the land. Several methods can be used for surface roughening. The most commonly used method is tracking. Perform tracking as soon as possible after vegetation is removed and immediately after grading activities have ceased. Perform tracking by moving equipment up and down the slope. Avoid excessive compacting of the soil surface when tracking; **use few passes as possible with the machinery in order to minimize compaction.**
Temporary Seeding/Stabilization	Temporary stabilization measures shall be initiated as soon as practicable in portions of the site where construction activities have temporarily ceased, but in no case than 14 days after work has ceased, except as stated below. Where stabilization by the 14th day is precluded by snow cover or frozen ground conditions stabilization measures must be initiated as soon as practicable. Where construction activity on a portion of the Site is temporarily ceased, and earth-disturbing activities will be resumed within 14 days, temporary stabilization measures do not have to be initiated on the portion of the Site. Initiate temporary stabilization measures on any exposed steep slope (3H:1V or greater) where land-disturbing activities have temporarily ceased, and will not resume for a period of 7 calendar days.
Mulching	Mulching is a temporary soil stabilization erosion control method where materials such as hay, straw, wood chips, wood fibers, or

	hydraulic erosion control products (HECPs) are placed on the soil surface. In addition to stabilizing soils, mulching enhances the absorption of water by the soil, reduce evaporation losses, regulate soil temperatures, and reduce the speed of storm water runoff over an area.
Erosion Control Blankets (ECB)	Temporary erosion control blankets (ECBs) are products composed primarily of biologically, photo-chemically, or otherwise degradable constituents such as wheat straw, coconut fiber, or aged curled excelsior wood product with longevity of approximately 1- to 3-years. Applicable for slopes 2H:1V or flatter only. Slopes greater than 2H:1V require Turf Reinforcement Matting (TRM). The maximum allowable continuous slope length for ECB applications is 50 feet. Applicable for channels and concentrated flow areas with a maximum calculated shear stress less than 1.75 lb./ft^2. Channels and concentrated flow areas with design shear stresses greater than 1.75 lb./ft^2 require TRM. Consist of double netted matting, defined as matting with netting on both sides of the blanket. If necessary, slopes, which exceed 8 vertical feet, should be stabilized with erosion control blankets or turf reinforcement mats in addition to hydroseeding. See SCDOT Qualified Products List 55 for acceptable Temporary Erosion Control Blankets.
Turf Reinforcement Matting (TRM)	Turf Reinforcement Mats are products composed primarily of nondegradable products that enhance the ability of living plants to stabilize soils. They bind with roots to reinforce the soil matrix with longevity greater than 5-years. Use TRM Type 1 on slopes 2.0H: 1V or flatter or in channels where the calculated design shear stress is 4.0 lb./ft^2 or less. Use TRM Type 2 on slopes 1.5H: 1V or flatter or in channels where the calculated design shear stress is 8.0 lb./ft^2 or less. Use TRM Type 3 on slopes 1.0H: 1V or flatter or in channels where the calculated design shear stress is 12.0 lb./ft^2. If necessary, slopes which exceed 8 vertical feet should be stabilized with erosion control blankets or turf reinforcement mats in addition to hydroseeding. See SCDOT Qualified Products List (QPL) 56 for acceptable Turf Reinforcement Matting.
Hydraulic Erosion Control Products (HECP's)	Use HECPs as an allowable mulch for temporary cover by mulch, temporary cover by seeding or permanent cover by seeding applications.

	Do not use HECPs as a channel liner or for areas receiving concentrated flow. Apply HECP Type 1, 2, 3, and 4 at the appropriate rate on the appropriate maximum slope gradient. Type 1 Slope ≤ 4H:1V @ 2,000 lbs./acre Type 2 4:1 < Slope ≤ 3:1 @ 2,500 lbs./acre Type 3 3:1 < Slope ≤ 2:1 @ 3,000 lbs./acre Type 4 2:1 < Slope ≤ 1:1 @ 3,500 lbs./acre The maximum allowable continuous slope length for HECP application is 50 feet. Provide slope interruption devices for continuous slope length longer than 50 feet. See SCDOT Qualified Product List (QPL) 65 for acceptable HECPs.
Permanent Seeding/Stabilization	Permanent stabilization measures shall be initiated as soon as practicable in portions of the site where construction activities have ceased, but in no case more than 14 days after work has ceased, except as stated below. • Where stabilization by the 14th day is precluded by snow cover or frozen ground conditions stabilization measures must be initiated as soon as practicable. • Where construction activity on a portion of the Site is temporarily ceased, and earth-disturbing activities will be resumed within 14 days, • Initiate temporary stabilization measures on any exposed steep slope (3H: 1V or greater) where land-disturbing activities have temporarily ceased, and will not resume for a period of 7 calendar days.
Sodding	Sodding is transplanting vegetative sections of plant materials to promptly stabilize areas that are subject to erosion. Use commercial sod which is a cultured product utilizing specific grass species. Sodding is appropriate for any graded or cleared area that may erode, and where a permanent, long-lived plant cover is immediately needed. Examples of where sodding is used are yards, buffer zones, streambanks, dikes, swales, slopes, outlets, level spreaders, and filtered strips. In general, do not use sod on slopes greater than 2H: 1V or 3H: 1V if it is to be mowed. If sod is placed on steep slopes, lay it with staggered joints and/or staple the sod down.
Riprap	Riprap is a permanent, erosion-resistant channel lining aggregate consisting of large, loose, angular, stone with a filter fabric or granular underlining. The purpose pf riprap is to protect the soil from the erosive force of concentrated runoff and to slow runoff velocities while enhancing the potential for infiltration.

	The purpose of the filter fabric or granular underlining is to prevent undermining of the riprap layer by the migration of soil particles under seepage forces through the riprap.
Outlet Protection	Outlet protection dissipates the energy of concentrated storm water flows thereby reducing erosion or scouring at storm water outlets and paved channel sections. In addition, outlet protection lowers the potential for downstream erosion. This type of protection can be achieved through a variety of techniques, including permanent TRMs, riprap, concrete aprons, paved sections and other structural materials. The most typical application is a riprap for outlet protection. Outlet protection should be placed at the outlets for all pipes, channels, and other stormwater conveyance structures in order to reduce the potential for erosion. The design criteria, calculations, and procedures for sizing the riprap and determining the dimensions of riprap pads shall be provided.
Dust Control	Wind erosion occurs when the surface soil is loose and dry, vegetation is sparse or absent, the wind is sufficiently strong, and when construction traffic disturbs the soil. Wind erodes soils and transports the sediment off site in the form of fugitive dust, where it may be washed into receiving water bodies by the next rainfall event. Fugitive dust is a nuisance for neighbors. It settles on automobiles, structures and windows and finds its way into homes. It also makes breathing difficult for those with respiratory problems and becomes a safety problem when it blinds motorists, equipment operators, and laborers. When and where to use it utilize dust control methods whenever there are offsite impacts, especially during periods of drought. Implemented dust control until final stabilization is reached.
Polyacrylamide (PAM)	Apply PAM as a means of sediment and turbidity control in high sensitive areas or waterbeds. PAMs are used to treat construction stormwater runoff that contains high amounts of eroded fine silt, clay, or colloidal particles resulting in high turbidity in the runoff water. The most common flocculants used in stormwater treatment systems are anionic Polyacrylamide (PAM) typically available in four media types (dry, powder, liquid, emulsion, and solid). Conduct a site-specific assessment (soil and water testing) by a qualified manufacturer or qualified professional to select the specific PAM, application rate, application method(s), and maintenance procedure tailored to the site specific soil

	characteristics, topography, hydrology, and the type of sediment control structure utilized.
Slope Interruption Devices	Use slope interruption devices for erosion prevention or slopes greater than 50 feet in length for Hydraulic Erosion Control Products (HECP) and Temporary Erosion Control Blanket (ECB) slope applications. At the discretion of the engineer, use slope interruption devices on slope lengths less than 50 feet when slope erosion is expected or observed. For slope interruption devices for erosion prevention, use non-weighted inlet tubes composed of processed degradable natural material within synthetic or natural fiber tubular, flexible outer netting. Do not use straw bales, pine bales, leaf mulch, and or grass clippings for slope interruption devices. Ensure that the inner material is long term biodegradable and/or photodegradable. Use tube diameter ranging from 6 inches to 12 inches. See SCDOT Qualified Product List 58, Type F Non-Weighted Inlet Tubes for acceptable slope interruption devices.

Sediment Control BMPs

Standard application sediment control BMPs are recommended for use in a wide variety of application situations. These sediment control BMPs have demonstrated the ability to effectively treat during construction stormwater runoff for TSS removal. Design methodologies and computer models are available that can compute the efficiency of these BMPs.

Table 11: Sediment Control BMPs

Sediment Control BMP's	Description
Sediment Basin	Sediment Basins are used to collect and impound stormwater runoff from disturbed areas of *5 acres or more* to restrict sediments and other pollutants from being discharged off-site. Sediment basins work most effectively in conjunction with additional sediment and erosion control BMPs installed and maintained up gradient of the basins. Trapping efficiency calculations show that all sediment basins are capable of achieving a sediment trapping efficiency of at least 80% TSS for the 10-year, 24-hour storm event. Sediment basins provide storage for the 10-year, 24-hour storm event for disturbed conditions to obtain 80% TSS removal efficiency or 3,600 ft^3/acre draining to the basin.

	When discharging stormwater runoff from sediment basins, utilize outlet structures that only withdraw water from near the surface of the basin or impoundment, unless infeasible. The use of perforated riser structures during construction are not allowed. This outlet structure should be capable of conveying the flow for the 10-year, 24-hour storm event. Sediment basins are designed for the total area draining to them. Forebays accounting for 20% of the overall sediment storage volume must be installed, unless infeasible. A riprap berm, gabion, or an earthen berm with a rock filled outlet may be constructed across the bottom of the sediment basin to create a cell within the basin for use as the sediment forebay. The location and height of the berm should be designed to meet the appropriate sediment forebay volume and depth criteria. Alternatively, plunge pools or rock berms may be constructed around each inlet to create a combined volume behind the berms equal to the minimum sediment forebay volume recommendation. The depth of the forebay will be dependent upon the required volume. It is recommended to keep the depth between 2 and 4 feet. A fixed sediment forebay cleanout stake is recommended. This cleanout stake is beneficial since the forebay may become inundated with sediment faster than the rest of the basin. The recommended cleanout height for sediment forebays is ½ the height of the forebay berm. A clean-out stake marked at 50% of the designed sediment storage depth shall be provided in all sediment basins. Basin length to width ratio minimum of 2L: 1W. Bottom slope of 0.5% or steeper. Maximum embankment side slopes of 2H: 1V. The recommended slope is 3H: 1V to allow for ease of maintenance and stabilization of the banks. Promptly stabilize all areas disturbed by the construction of the embankment including embankment side slopes and access areas. All earthen basin side slope shall be protected with an erosion control blanket and appropriate seeding. Temporary or permanent stabilization measures should be conducted as necessary. Each outlet shall be designed to prevent scour and to reduce velocities during peak flow conditions. Each outlet should be directed towards pre-existing point source discharges or be equipped with a mechanism to release the discharge as close to sheet flow as possible to prevent the creation of new point source discharges. Restrict the outlet from being placed within 20 linear feet of adjacent properties lines.

Floating Skimmer	Sediment basins must dewater via an outlet structure that pulls water from the surface, unless infeasible. Options for this include skimmers and flashboard risers. Sediment basins shall be designed to fully dewater in a minimum of 2 days and a 5-day maximum. Provide drawdown calculations of the selected skimmer(s).
Porous Baffle	Porous baffles must be provided in all sediment basins and sediment traps, unless infeasible. A minimum of 3 porous baffle rows should be installed across the width of the entire sediment basin (including side slopes) where the basin length is greater than 50 feet. For basins with a length of 50 feet. or less, only 2 rows of porous baffles are necessary to be installed. The minimum spacing between baffle rows is 10 feet. The recommended height of each baffle is 3 feet. When possible, the height of each baffle should be equal to or above the 10-year, 24-hour storm design water surface elevation within the sediment basin. Porous baffles should be composed of coir-based materials or TRMs with a light penetration (open space0 between 10% and 35%. Do not use baffles made of straw materials. **Silt fence shall not be used as porous baffles.** Use steel posts with a minimum weight of 1.25 lb. per liner foot. Install steel posts at a maximum of 4-feet on center. A rope or wire can be used along the top of the baffle to prevent excessive sagging between the posts.
Sediment Trap	Sediment traps are used for drainage areas **less than 5 acres.** Do not place sediment traps in Waters of the State or USGS blue-line streams. Trapping efficiency calculations showing a sediment trapping efficiency of at least 80% for the 10-yar, 24-hour storm event. Sediment traps provide storage for the 10-year, 24-hour storm event for disturbed conditions or 1,800 ft^3/acre draining to the trap. The 10-year, 24-hour storm event for construction conditions cannot overtop the trap's spillway. Sediment traps are designed for total area draining to them. Rock outlet structure composed of 12-inch D50 riprap with 1-inch D50 washed stone on the upstream face. Place an underlying non-woven geotextile beneath the rock. Design internal side slopes to be 3:1 or flatter. Embankment Requirements: • Maximum dam height: 5-feet • Maximum stone height: 3.5 feet • Maximum rock bottom width: 3-feet

	• Maximum top flow length at top of riprap: 2-feet • Maximum rock embankment upstream and downstream side slopes: 2:1 Surface dewatering is not required for sediment traps. Install at least 2 rows of porous baffles in the sediment trap. There should be at least 10 feet between each baffle and between any baffle row and any of the sediment trap inlets or outlet. Install clean-out stake, marked at 50% of the designed sediment storage volume.
Silt Fence	Only use silt fence in areas with drainage areas of less than ¼ acre per 100 LF of fence and not use in areas with concentrated flows. The maximum allowable slope steepness perpendicular to the fence line is 2:1. See SCDOT Qualified Product (QPL) 34 for acceptable silt fence fabric. Install filter fabric from continuous rolls cut to the length of the barrier. 12 inches of fabric should be placed within an excavated trench and toed in when the trench is backfilled. Install filter fabric a minimum of 24 inches above the ground.
Rock Checks	A rock check dam is a small, temporary or permanent rock fill dam constructed across a drainage ditch, swale, or channel to lower the speed of concentrated flows. Design rock check dams to have an 80% design removal efficiency goal of the total suspended solids (TSS) in the inflow. Do not place check dams in Waters of the State or USGS blue-line streams (unless approved by Federal authorities). Install in steeply sloped swales, or in swales where adequate vegetation cannot be established. Use rock check dams in small open channels. Place a non-woven geotextile fabric over the soil surface where the rock ditch check is to be placed. Composed of 12-inch D50 riprap with 1-inch D50 washed stone on the upstream face. Shall not exceed a height of 2-feet at the center line of the channel. Ensure center of ditch check is lower than the edges. Have a minimum top flow length or 2-feet. Place riprap over channel banks to prevent runoff from cutting around the ditch check. Place riprap by hand or mechanical placement (no dumping of rock to form dam). Spacing varies with the bed slope of the ditch. Space rock checks such that the toe of the upstream check is at the same elevation as the top of the downstream check.

Sediment Tubes	Sediment tubes are elongated tubes of compacted geotextiles, curled excelsior wood, natural coconut fiber or hardwood mulch. Straw, pine needle, and lead mulch-filled sediment tubes are not permitted. Do not use straw, curled excelsior wood, or natural coconut rolled erosion control products (RECPs) rolled up to create a sediment tube. See SCDOT Qualified Product List (QPL) 57 for acceptable Sediment Tubes. Install sediment tubes along contours, in drainage conveyance swales, and around inlets to help reduce the effects of soil erosion by energy dissipation and retaining sediment. Sediment tubes, when used as checks within channels should range between 18-inches and 24-inches depending on the channel dimensions. Diameters outside this range may be allowed where necessary when approved. Install each sediment tube in a trench with a depth of 20% the tube diameter. Place sediment tubes up the side slopes of the channel a minimum of 1-foot above the design flow depth of the channel.
Construction Entrance	A stabilized construction entrance is a temporary stone-stabilized pad located at all points of vehicular ingress and egress on a construction site to reduce the amount of mud, dirt, and rocks transported onto public roads by motor vehicles equipment and runoff. Install a non-woven geotextile fabric on the underlying soil prior to placing stone. Install a culvert pipe underneath the entrance when needed to provide positive drainage. Consists of 2-inch to 3-inch D50 stone placed at a minimum depth of 6-inches.
Inlet Protection	Storm drain inlet protection is achieved by placing a temporary filtering device around any inlet to trap sediment. This mechanism prevents sediment from entering inlet structures. Additionally, it serves to prevent the silting-in of inlets, storm drainage systems, or receiving channels. There are six (6) types of inlet structure filters, including: • Type A- Low Flow • Type B- Medium Flow, Low Velocity • Type C- Medium Flow, Medium Velocity • Type D- High Flow, High Velocity • Type E- Surface Course Curb Inlet • Type F- Inlet Tubes • Type G- Suspended Internal Inlet Filters

	• See SCDOT Qualified Product List (QPL) 58 for acceptable Inlet Protection.
Type A – Filter Fabric Inlet Protection	Low Flow Inlet Filters include filter fabric inlet protection. Applicable for inlets with peak flow rates less than 1 cfs where the inlet drain area has grades less than 5% and the immediate drainage area (5-foot radius around the inlet) has grades less than 1%. Do not use Type A inlet filters for areas receiving concentrated flow.
Type A – Sediment Tube Inlet Protection	Low Flow Inlet Filters include 18-inch diameter sediment tubes. Applicable for inlets with peak flow rates less than 1 cfs where the inlet drain area has grades less than 5% and the immediate drainage area (5-foot radius around the inlet) has grades less than 1%. Do not use Type A inlet filters for areas receiving concentrated flow.
Type B – Wire Mesh and Stone Inlet Protection	Medium Flow, Low Velocity Inlet Filters include wire mesh and stone inlet protection. Applicable for inlets with peak flow rates less than 3 cfs where the inlet drain area has grades less than 5%. Flow velocities to the inlet may not exceed 3 feet per second. Applicable where an overflow capacity is not required to prevent excessive ponding around the structure.
Type C – Block and Gravel Inlet Protection	Medium Flow, Medium Velocity Inlet Filters include block and gravel inlet protection. Applicable for inlets with peak flow rates less than 3 cfs where the inlet drain area has grades less than 5%. Flow velocities to the inlet may not exceed 5 feet per second. Applicable where an overflow capacity is not required to prevent excessive ponding around the structure. Not applicable in areas exposed to traffic, such as median drains.
Type D – Rigid Inlet Protection	Rigid Inlet Filters include prefabricated inlet filters composed of a geotextile fabric connected to a rigid structure. Applicable for drainage areas up to 2 acres with peak flow rates greater than 3 cfs where the inlet drain area has grades greater than 5%. Flow velocities to the inlet may exceed 3 feet per second. These filters are used for median applications (Type D1) and for sump applications (Type D2). Applicable where an overflow capacity is required to prevent excessive ponding around the structure. Capable of protecting inlet structures not associated with curb inlets. The inlets may include, but are not limited to yard inlets, DI 24-inches, DI 24-inches by 36-inches and manholes.
Type E – Surface Course Curb Inlet Protection	Surface Course Curb Inlet Filters include prefabricated inlet filters composed of a synthetic material that has aggregate compartments

	for stone, sand, or other weighted mechanisms to hold the unit in place. Applicable for roadway catch basins after the road surface course is places.
Type F – Inlet Tubes	Inlet Tubes are classified in two categories: weighted and non-weighted. • Weighted inlet tubes are applicable for inlets with drainage areas less than 1 acre. Weighted inlet tubes are used for placement on gravel, concrete, asphalt or other hard surfaces around drainage inlets where stakes cannot be driven. Weighted inlet tubes are applicable where construction traffic may occur around the inlet. All weighted Type F Inlet Structure Filters are applicable as Type E Inlet Structure Filters. • Non-weighted inlet tubes are inlet tubes applicable for Catch Basins with drainage areas less than 1 acre where stakes or posts are driven to hold the tube in place. For non-weighted inlet tube applications, an inlet tube is placed on subgrade and is applicable until the road base course is placed. Both weighted and non-weighted inlet tubes are applicable as weep hole inlet filters, but non-weighted inlet tubes can only be used in situations where stakes are driven into the ground or subgrade to secure the tube.
Type G – Suspended Internal Inlet Filters	Install a Type G suspended inlet filter for inlets with drainage areas less than 1 acre and peak flow rates to the inlet less than 3 ft. 3/sec. Use Type G suspended inlet filters to protect inlet structures such as Catch Basin Type 9, yard inlets, Drop Inlet 24 inches by 24 inches, Drop Inlet 24 inches by 36 inches, and manholes. Use Type G internal inlet filters that are manufactured to fit the opening of the catch basin or drop inlet. Use Type G internal inlet filters during construction to prevent silt and sediment from entering drainage systems while allowing water to pass through freely.
Rock Sediment Dikes	Rock sediment dikes are semi-circular sediment control structures constructed across drainage ditches, swales, low areas or other areas that receive concentrated flow. A rock sediment dike consists of a half circular shaped rock embankment with a sump area constructed for sediment storage. Design rock sediment dikes to have an 80% design removal efficiency goal of the total suspended solids (TSS). Rock sediment dikes are most effective in areas where sediment control is needed with minimal disturbance. Use as a sediment control structures for the outfalls of diversion swales, diversion dikes, in low areas or other areas where concentrated sediment

	laden flow is expected. Use rock sediment dikes for drainage less than 2.0 acres. Do not place rock sediment dikes in Waters of the State (unless approved by SCDHEC, State or Federal authorities).

Runoff Conveyance BMPs

Standard application runoff conveyance BMPs are recommended for use in a wide variety of application situations. These structural controls have demonstrated the ability to effectively convey runoff or standing water during construction. Design methodologies are available to design these BMP types.

Table 12: Runoff Conveyance BMPs

Runoff Conveyance BMP's	Description
Pipe Slope Drains	Pipe slope drains reduce the risk of erosion by discharging concentrated runoff from the top to the bottom of slopes. Use pipe slope drains when it is necessary for water to flow down a slope without causing erosion, especially before a slope has been stabilized or before permanent drainage structures are installed. Install temporary pipe slope drains prior to construction of permanent drainage structures. Stabilize the inlets and outlets of pipe slope drains with flared end sections, Erosion Control Blankets (ECBs), Turf Reinforcement Mats (TRMs) or riprap. Fully compact the soil around the pipe entrance to prevent bypassing and undercutting of the structure. Stabilize the discharge end of the pipe and along the bottom of any swales that lead to sediment trapping structures. Typical pipe slope drains are made of non-perforated corrugated plastic pipe and are designed to pass the peak flow rates for the 10-year 24-hour storm event.
Temporary Steam Crossing	A temporary stream crossing is a bridge or culvert across a stream or watercourse for short-term use by construction vehicles and heavy equipment. A stream crossing provides a means for construction vehicles to cross streams or watercourses without moving sediment to streams, damaging the stream bed or channel, or causing flooding. Prior to constructing a temporary stream crossing, the owner/person financially responsible for the project must submit an Application for Permit to construct across or along a stream to South Carolina Department of Health and Environmental Control (SCDHEC). Temporary stream crossings require authorization. Refer to the US Army Corps of Engineers and SCDHEC nationwide 401 and 404 regulations for information on permitting requirements.

Diversion Measures	Diversion dikes and berms (ridges of compacted soil) and diversion swales (excavated depressions) are used to divert upslope runoff from crossing areas where there is a high risk of erosion. Use runoff conveyance structures as temporary clean water diversions, temporary sediment laden diversions, or permanent clean water diversions. Use runoff control measures as either temporary or permanent storm water control structures. Complete stabilization of stormwater conveyance channels within 7 days of channel construction. Examples of vegetative and non-vegetative stabilization techniques include channel liners, rolled erosion control products (e.g., erosion control blankets and turf reinforcement mats), riprap, geotextiles, or other armoring materials that are suitable for use in areas with concentrated or channelized flow. Application of mulch, hydromulch, tackier or similar erosion prevention practices that are erodible, conveyable, or that obstruct flow when used in areas with concentrated or channelized flow in stormwater conveyance channels is prohibited.
Level Spreader	A level spreader is a permanent outlet for dikes and diversions consisting of an excavated channel constructed at zero grade across a slope that converts concentrated runoff to sheet flow and releases it onto areas stabilized by existing vegetation. Sediment-laden waters should not be directed towards level spreaders.
Subsurface Drains	A subsurface drain is a perforated pipe or conduit placed beneath the surface of the ground at a designed depth and grade. Subsurface drains are used to do the following: • Draining areas by intercepting and conveying groundwater • Lower the water table • Drain or de-water storm water detention structures • Prevent sloping soils from becoming excessively wet and subject to slippage.
Construction Dewatering	Construction de-watering involves removing storm water or ground water from bore pits, trenches, and other excavations on a construction site. Typically, this removal of water involves the pumping of the water to an appropriate receiving area. Direct pumping to lakes, rivers, and streams is illegal and must be avoided. Size the pump utilized for de-watering purposes properly. Each pump has its own unique rating curve; therefore, it is not feasible to list them in this chapter. The pump rating curve is used to calculate pump design flows based on head loss through the pump system. Pump sediment-laden groundwater directly to: • A sediment control structure (sediment basin, sediment trap, manufactured de-watering device or bag) • An infiltration trench

	• A buffer strip or zone
Concrete Washout	Concrete washouts are designed to minimize or eliminate the discharge of concrete waste materials to storm drain systems or to waterbodies. Concrete waste management procedures and practices are implemented on construction projects where: • Concrete or mortar is used as a construction material or where concrete dust and debris result from demolition activities. • Slurries containing Portland cement concrete (PCC) or asphalt concrete (AC) are generated, such as from saw cutting, coring, grinding, grooving, and hydro-concrete demolition. • Concrete trucks and other concrete-coated equipment are washed on site. • When mortar-mixing stations exist. • Place a sign within 30 feet of each temporary concrete washout facility to inform concrete equipment operators to utilize the proper facilities. • Temporary concrete washout facilities are located a minimum of 50 feet from storm drain inlets, open drainage facilities, waterbodies, creek banks, or perimeter control unless determined infeasible by the Design Engineer. Each facility is located away from construction traffic or access areas to prevent disturbance or tracking. • Above Grade Temporary concrete washout facilities are constructed, with a minimum length of 10 feet and a minimum width of 10 feet, but with sufficient quantity and volume to contain all liquid and concrete waste generated by washout operations. The length and width of a facility may be increased, upon approval from the Design Engineer. Plastic lining material is a minimum of 10-millimeter polyethylene • sheeting and is free of holes, tears, or other defects that compromise the impermeability of the material. Portable delineators are applied only to a clean, dry surface. • Below Grade Temporary concrete washout facilities are constructed, with a recommended minimum length and minimum width of 10 feet. The quantity and volume is sufficient to contain all liquid and concrete waste generated by washout operations. The length and width of a facility may be increased, upon approval of the Design Engineer. Lath and flagging shall be commercial type. Plastic lining material is a minimum of 10-millimeter polyethylene sheeting and is free of holes, tears or other defects that compromise the impermeability of the material. The soil base is prepared free of rocks or other debris that may cause tears or holes in the plastic lining material.

	• Clean out all temporary concrete washout facilities when they are 50% full. • When temporary concrete washout facilities are no longer required for the work, the hardened concrete shall be removed and disposed of in conformance with the provisions in the Project Standard Specifications. Materials used to construct temporary concrete washout facilities shall be removed from the site of the work. Holes, depressions, or other ground disturbance caused by the removal of the temporary concrete washout facilities shall be backfilled and stabilized.

Maintenance of BMPs During Construction

Proper operation and maintenance of BMPs is critical to insure that the effectiveness and integrity of the BMPs as water quality control is maximized. This insurance is critical in a performance-based program of stormwater runoff controls. BMP maintenance is the responsibility of the facility owner.

All BMPs and other protective measures identified in the SWPMP shall be maintained in effective operating condition. If construction site inspections identify BMPs that are not operating effectively, maintenance shall be performed within seven (7) calendar days, before the next inspection, or as reasonably possible, and before the next storm event whenever practicable to maintain the continued effectiveness of the BMPs.

If periodic inspection or other information indicates that a BMP has been used inappropriately, or incorrectly, the Permittee shall address the necessary replacement or modification required to correct the BMP within a time frame of forty-eight (48) hours of identification. If existing BMPs need to be modified or if additional BMPs are necessary, implementation shall be completed before the next storm event whenever practicable. If implementation before the next storm event is impracticable, the situation shall be documented in the SWPMP and alternative BMPs shall be implemented as soon as reasonably possible.

Remove deposited sediment from sediment traps or sedimentation basins when the design capacity has been reduced by fifty (50) percent or the sediment has reached the clean out point on the cleanout stake (whichever occurs first).

Remove deposited sediment collected by sediment control measure (silt fence, check dams, sediment tubes, etc.) when the deposited sediment reaches one-third (1/3) the height of the above-ground portion of these BMPs, or

Selection of Permanent BMPs

BMP selection is a complex process. There are a number of competing factors that need to be

addressed when selecting the appropriate BMP or suite of BMPs. BMPs should be incorporated into a comprehensive stormwater management plan. Without proper BMP selection, design, construction, and maintenance, BMPs will not be effective in managing stormwater runoff. BMP selection can be tailored to address the various sources of runoff and pollutants produced from urbanized areas. Site suitability for selecting a particular BMP strategy is key to successful performance. Most BMPs have limitations for their applicability and therefore cannot be applied in all areas. A few considerations to incorporate into BMP selection are:

- drainage area land uses
- average rainfall frequency, duration and intensity
- runoff volumes and flow rates soil types
- site slopes geology/topography availability of land
- future development/land use in watershed depth to groundwater table
- availability of supplemental water to support
- vegetative BMPs susceptibility to freezing
- safety and community acceptance proper access for maintenance
- periodic and long-term maintenance and rehabilitation needs

Use the following criteria for selecting and locating BMPs.

In most cases, Permanent Wet/Dry Detention Ponds are the most common post-construction feature that is for both stormwater quantity and quality control. Other practices may be acceptable to the County, if they can be show equivalent or superior pollutant removal efficiency and provide adequate peak flow control. Use of other BMP practices shall be approved as determined during the formal review submittal.

Placement of stormwater BMPs within a designated 100-year floodplain as shown on FEMA's Flood Insurance Rate Map (FIRM), is strongly discouraged. In case of a large flood, floodwaters could cause significant damage to the BMP. No stormwater BMP will be allowed in the designated "floodway" without a Conditional Letter of Map Revision (CLOMR) obtained from FEMA certifying that the proposed BMP will not adversely affect flood elevations. Stormwater BMPs placed in the floodplain should be appropriately constructed to prevent damage from floodwaters.

Stream buffers protect the overall quality of the stream, by achieving pollutant removal as runoff flows through the buffer, by providing shade for the stream and habitat for wildlife. Placing stormwater BMPs in stream buffers is strongly discouraged; other alternative locations should be examined. Whenever there is a practical alternative, structural BMPs should not be placed in stream buffers. If encroachment into the stream buffer is needed, the amount of stream buffer area that is impacted should be minimized and the distance between the impact and the stream channel should be maximized. In addition, consideration should be given to the design of the BMP discharge to prevent erosion in the buffer zones and of stream banks. It is the intent to design stormwater management devices to remove pollutants before they have a chance to enter jurisdictional waters and wetlands. Stormwater BMPs should be constructed outside of perennial streams and natural wetland areas unless

no practical alternative exists. In addition, natural or existing lakes, ponds, and wetlands should not be considered for stormwater BMP retrofits until Federal and State Permits for such purpose have been obtained. The U.S. Army Corps of Engineers (USACE) requires that all impacts to jurisdictional waters and wetlands are reported. Depending on the impact, the USACE and other federal and state agencies may require the applicant to obtain permits, prepare environmental documents, mitigate for the impact, and adhere to other permit requirements. Stormwater BMPs designed to impound water may pose a potential hazard to downstream citizens and property. Because stormwater BMPs are mostly used in urbanized areas or rapidly growing areas, potential hazards related to water impoundments and dams are increased. Construction of a dam to create a stormwater impoundment (pond) shall be classified according to size and potential hazard to downstream areas and meet South Carolina dam safety regulations applicable for those size and hazard classifications. All permanent BMPs must have as-built certifications submitted to the appropriate Richland County department for recording. All permanent BMPs must be shown on an as-built plat, have appropriate access for maintenance, and must include the appropriate maintenance agreement.

Impervious Areas: Runoff shall be discharged from impervious surfaces through retention basins, detention basins, filtering BMPs, Manufactured Treatment Devices (MTDs) and/or subject to some type of BMP prior to discharge from the project site. BMP means a practice or combination of practices determined by the design professional to be the most effective means of preventing or reducing the amount of siltation and pollution discharged from the project site.

Stagnant Water Conditions: Dead end flow configurations, which create stagnant water conditions, shall not be allowed. All BMPs shall be designed, constructed, and maintained with consideration for the proper control of mosquitoes and other vectors.

Stormwater Management Structure Access and Maintenance: Areas to be utilized for the conveyance or storage of stormwater shall be legally reserved for that purpose by plat, easement or other means so that subsequent owners or others may not remove such areas from their intended use. Such areas shall be connected to a public road or other location from which operation and maintenance is legally available. Ease of maintenance shall be considered as a site design component. Access to the stormwater management structure shall be provided.

A clear statement of defined maintenance responsibility shall be established during the SWPMPP review and approval process. A Maintenance Agreement shall be signed for all permanent structural BMPs. Runoff: Runoff from higher adjacent or upstream lands shall be considered and provisions for conveyance of such runoff shall be included in drainage plans. As directed by the County Engineer, upstream analysis shall be conducted to demonstrate to the extent practicable the project has capacity to convey upstream runoff and does not cause adverse upstream impacts, such as flooding.

BMP Infiltration Requirements and Soil Testing

Infiltration is an effective practice of controlling post-construction stormwater runoff since it reduces

the volume of runoff that is discharged to receiving waters and the associated water quality and quantity impacts that runoff can cause. Infiltration is also an important mechanism for pollutant control. As runoff infiltrates into the ground, particulates and attached contaminants such as metals and nutrients are removed by filtration, and dissolved constituents can be removed by adsorption. Infiltration is not appropriate in all areas. Low soil infiltration rates, high or perched groundwater tables, or bedrock may limit the feasibility and/or the effectiveness of infiltration practices.

Design

Permanent infiltration practices, when used, shall be designed to accept, at a minimum, the first one (1) inch of runoff from all impervious areas.

The minimum allowable infiltration rates of all underlying soils shall be greater than 0.5 inches per hour. Infiltration BMPs shall be designed for the prevention of clogging by fine materials and for ease of cleaning with conventional vacuum cleaning equipment. This may include but not necessarily be limited to wrapping of the Infiltration BMP (perforated pipes/chambers/trenches) with an appropriate fabric and providing sufficient clean outs for the system.

Systems shall have an overflow to a positive drainage system with a control device, if necessary, between the subsurface system and the positive drainage system. The overflow pipe shall be sized for the allowable discharge.

Soil Testing – Infiltration Rates

Soil testing for infiltration rates shall be performed by a registered licensed geotechnical engineer for BMPs such as Infiltration Trenches, Bioretention, Dry Detention Ponds, and Wet Detention Ponds.
A minimum of 5 separate locations shall be tested for infiltration rates for each BMP. In general, these test shall be conducted in the four corners and the center of the BMP.

The initial test elevation locations shall be at the same contour elevation as the bottom/invert of the Infiltration BMP.

Each test shall be conducted to a depth 4 feet below the bottom/invert of the BMP.

Infiltration BMPs shall be designed and validated on the basis of actual test data. Tests shall be consistent as to soil conditions, proposed Infiltration BMP elevations, Infiltration BMP locations and water table depths with the proposed Infiltration BMP system.

The following tests are allowable to determine infiltration rate for soils (Other test methods must be approved by the County Engineer):

- Laboratory Permeameter Test for saturated hydraulic conductivity on undisturbed soil samples (ASTM D5084).

- Double Ring Infiltrometer Test to estimate the initial vertical unsaturated permeability data of the upper soil layer (ASTM D 3385).
- Constant Head Test in soils with permeability that allow keeping the test hole filled with water during the field test (AASHTO T 215).
- Falling Head Test in areas with excellent soil percolation where keeping the test hole filled with water is not feasible during the test.

Best Management Practices

There are two major categories of best management practices (BMPs), non-structural and structural. Non-structural BMPs are basically passive or programmatic BMPs. Non-structural BMPs include public education and outreach, used oil recycling, household hazardous waste turn-in, litter control programs, zoning and land use controls, chemical applicator certification and training, etc. Non-structural BMPs tend to be source control BMPs that reduce pollution in runoff by reducing the opportunity for the pollutants to be exposed to stormwater runoff.

Structural BMPs are physical structures that can be seen on the ground, including wet and dry ponds, Bioretention areas, grassed swales, filter strips, buffer strips, and manufactured BMPs, such as catch basin inserts. Some structural BMPs are passive and would be considered source controls while others would be considered end of pipe treatment.

Acceptable Post-Construction Water Quality BMPs

The following table lists the acceptable water quality BMPs:

Table 13: Acceptable Post-Construction Water Quality BMPs

Standard Application Structural BMPs	Limited Application BMPs	Minimal Application Controls
Wet Detention Ponds	Grass Swale	Infiltration Basin
Wet Modified Extended Detention Ponds	Enhanced Swale	Constructed Stormwater Wetlands
Dry Extended Detention Ponds	Porous Paver Systems Porous Asphalt or Concrete	
Infiltration Trenches and Dry Wells	MTD Type 3 (Media Filter Inserts)	
Bioretention		
Vegetated Filter Strip		
Manufactured Treatment Devices (MTDs) (MTD Type 1 and MTD Type 2)		

More information regarding the acceptable list of post-construction water quality BMPs can be found in Appendix A: Acceptable Post-Construction Water Quality BMP Selection Chart.

Standard Application Structural BMPs

Standard application structural BMPs are recommended for use in a wide variety of application situations. These structural controls have demonstrated the ability to effectively treat stormwater runoff for water quality for post-development stormwater runoff. Design methodologies and computer models are available that can compute the efficiency of these BMP types.

Table 14: Standard Application Structural BMPs

Standard Application Structural BMPs	Description
Wet Detention Ponds	Wet Detention Ponds are constructed stormwater basins that have a permanent pool of water. They are applicable to drainage areas over 25 acres. The water quality volume from stormwater runoff from each rain event is detained and treated in the pool and released at a designed rate to achieve water quality requirements. They are also applicable to achieve water quantity requirements.
Wet Modified Extended Detention Ponds	Wet Modified Extended Detention Ponds are constructed stormwater basins that have a permanent micropool of water. They are applicable to drainage areas between 10 and 25 acres. The water quality volume from stormwater runoff from each rain event is detained and treated in the pool and released at a designed rate to achieve water quality requirements. They are also applicable to achieve water quantity requirements.
Dry Extended Detention Ponds	Dry Extended Detention Ponds are constructed stormwater basins that ***do not*** have a permanent pool of water. They are restricted to sites with a maximum drainage area of 25 acres. The water quality volume from stormwater runoff from each rain event is temporarily detained and released at a designed rate to achieve water quality requirements. They are also applicable to achieve water quantity requirements.
Infiltration Trench	An infiltration trench is an excavated trench filled with stone aggregate used to capture and allow infiltration of water quality volume from stormwater runoff into the surrounding soils from the bottom and sides of the trench to achieve water quality requirements. Alone, they are typically not applicable to achieve water quantity requirements. They are applicable for drainage areas up to 2 acres.
Bioretention	Bioretention Areas are shallow stormwater basins or landscaped areas that utilize engineered soils and vegetation to capture and treat stormwater runoff to water quality requirements. Runoff may be returned to the conveyance system or partially exfiltration into the soil. Alone, they are not typically applicable to achieve water quantity requirements. They are applicable for drainage areas up to 2 acres.
Vegetated Filter Strips	Vegetated filter strips provide filtering of stormwater runoff as it flows across the vegetation and are capable of achieving water quality requirements for small drainage areas less than 1 acre.

Manufactured Treatment Devices (MTDs) Type 1 and Type 2	MTDs use the movement of stormwater runoff through a specially designed structure to achieve water quality requirements. MTDs are not designed, or are intended to store a water quality volume. MTD Pollutant removal efficiencies are variable and are highly dependent on storm size, influent pollutant concentrations, rainfall intensity, and other factors. There are three types of MTDs, MTD Type 1 – Separation, Hydrodynamic Devices, MTD Type 2 - Filtration Devices, and MTD Type 3 - Catch Basin Inserts (Filter Media Inlet Protection). MTD Type 1 and 2 are applicable for drainage areas up to 3 acres.

Limited Application Structural BMPs

Limited application structural controls are recommended only for limited use with special site or design conditions. Limited application structural controls may be used within a system of water quality controls. Limited application structural controls should be used only in situations where regular maintenance is practicable. Limited structural controls demonstrate the ability to effectively treat stormwater runoff for water quality.

Table 15: Limited Application Structural BMPs

Limited Application Structural BMPs	Description
Grassed Swale	Grassed swales provide filtering of storm water runoff as it flows across vegetation and may be capable of achieving water quality standards. By Grassed swales are best used as pretreatment measures or part of a treatment system approach. Grassed channels and swales must be a minimum of 100 feet long with minimum 0.5-foot high flow controls structures installed to provide effective treatment. The maximum drainage area to grassed swales is 5 acres.
Enhanced Swales	Enhanced Swales are vegetated open channels that are explicitly designed and constructed to capture and treat stormwater runoff within dry or wet cells formed by flow control structures to achieve water quality requirements.
Porous Paver Systems	Porous paver systems consist of open void paver units laid on gravel subgrade to promote storm water infiltration. Porous pavers provide water quality and quantity benefits, but has high maintenance requirements.

Porous Asphalt or Concrete	The use of porous pavement other than the modular block porous pavers provides limited water storage and infiltration of runoff from small, low-intensity storm events. Porous asphalt and concrete pavement surfaces are easily clogged by clays, silts, and oils resulting in a potentially high maintenance burden to maintain the effectiveness of this structural control. Seventy-five percent of all porous pavement systems surveyed in Maryland have partially or totally clogged within five years. Failure has been attributed to inadequate construction techniques, low permeable soils and/or restricting layers, heavy vehicular traffic, and resurfacing with nonporous pavement materials.
MTD Type 3 (Media Filter Inserts)	MTDs use the movement of stormwater runoff through a specially designed structure to achieve water quality requirements. MTDs are not designed, or are intended to store a water quality volume. MTD Pollutant removal efficiencies are variable and are highly dependent on storm size, influent pollutant concentrations, rainfall intensity, and other factors. MTD Type 3 is applicable for drainage areas up to 0.5 acres.

Minimal Application Controls

Minimal Application Controls are <u>not recommended</u> for use for use in Richland County to meet stormwater management objectives. Minimal application controls present difficulties in long term operation and maintenance.

Table 16: Minimal Application Controls

Minimal Controls	Rationale for Lack of Recommendation
Infiltration Basin	While in theory, infiltration basins provide excellent pollutant removal capabilities, the reality is that infiltration basins have historically experienced high rates of failure due to clogging associated with poor design, poor soil testing, poor soils, improper construction and lack of needed maintenance. Records show that 60% to 100% percent of basins studied could no longer exfiltrate runoff after five years. Major design refinement and site investigation will be required to achieve sufficient longevity. They also require an exceptionally high maintenance burden.

Constructed Stormwater Wetlands	Stormwater wetlands are capable of remove pollutants by acting like natural wetlands. To accomplish pollutant removal goals, remain safe, aesthetically pleasing, maintain adequate pool depths, and free of mosquitoes, they must be maintained properly. Constructed wetlands must have the proper underlying soils to maintain the proper water level to support the wetland environment while also receiving enough base flow or intermediate flow to inhibit the system from becoming stagnant. Without consistent maintenance, modifications, and up keep of the wetland vegetation, the effectiveness of the stormwater wetland rapidly decreases.

Using Other or New Structural Stormwater BMPs

Innovative technologies are allowed and encouraged providing there is sufficient documentation as to their effectiveness and reliability. Other structural stormwater BMPs not presented in this document are allowed, subject to pre-approval by the County Engineer. Justification for use of other stormwater controls must be based on independently derived information concerning performance, maintenance, and use requirements and limitations.

More specifically, new structural stormwater control designs will not be accepted for inclusion in until independent pollutant removal performance monitoring data determine that the practice can aid in meeting County water quality/quantity objectives, and that the stormwater control conforms with local and/or State criteria for treatment, maintenance, and environmental impact.

Required Specifications

Due to the variable nature and limited performance data available for most innovative technologies, it is highly recommended that the designer meet with County staff to discuss the proposal before developing detailed plans. All available data concerning system efficiencies and performance will be evaluated at that time.

If applicable, follow the manufacturer's specifications for installing proprietary systems.

A maintenance plan and schedule shall be submitted for approval. When maintenance guidelines are available from the manufacturer, they should be incorporated into the maintenance plan.

If the Innovative technology will ultimately be maintained by the County, easements will be required for access. Adequate grading and widths shall be provided to safely accommodate the County's operation and maintenance vehicles.

Chapter 4: Water Quality Buffer Requirements

It is the intent of the Public Works Department to establish minimal acceptable requirements for the design of buffers to protect the streams, wetlands and floodplains of the County of Richland; to protect the water quality of watercourses, reservoirs, lakes, and other significant water resources; to protect riparian and aquatic ecosystems; and to provide for the environmentally sound use of the county's land resources.

A water quality buffer is an area of original or re-established vegetation that borders streams, rivers, ponds, lakes, wetlands, and seeps. Buffers are most effective when storm water runoff is flowing into and through the buffer zone as shallow sheet flow, rather than concentrated flow such as channels, gullies, or wet weather conveyances. Therefore, it is critical that design of all development include management practices, to the maximum extent practical, that will result in storm water runoff flowing into the buffer zone as shallow sheet flow. Water quality buffers provide numerous environmental protection and resource management benefits including:

- Restoring and maintaining the chemical, physical and biological integrity of the water resources,
- Removing pollutants delivered in urban storm water,
- Reducing erosion and controlling sedimentation,
- Stabilizing stream banks,
- Providing infiltration of storm water runoff,
- Maintaining base flow of streams,
- Contributing the organic matter that is a source of food and energy for the aquatic ecosystem,
- Providing tree canopy to shade streams and promote desirable aquatic organisms,
- Providing riparian wildlife habitat, and
- Furnishing scenic value and recreational opportunity.

Exemptions

The water quality buffer requirements shall not apply to the following:

- Ephemeral streams, ditches, manmade ponds, and lakes, which are outside of natural hydrologic connectivity.
- Any existing structure or structure under construction located within the buffer area provided the land owner can document prior existence.
- The addition or expansion to an existing structure provided it does not result in an increase in the total impervious area within the buffer area.
- Activities associated with emergency operations, such as hazardous materials removal, flood or fire control, evacuations, and storm damage clean up.
- Single-family parcels of land, which exist as individual lots that are two (2) acres or less and are not part of a new subdivision development.

If any portion of a parcel proposed for development lies within an area designated on an officially adopted Conservation Easement as a proposed trail or greenway, the developer shall construct the designated improvements in accordance with county standards and dedicate such land to the county.

Stream Buffers

Stream buffers shall be considered a "no disturb zone" along jurisdictional lines. Vegetation cannot be disturbed, removed or replanted unless a buffer restoration plan has been approved by the Public Works Department. The following are requirements to expand the buffer widths depending on slopes, water pollution hazards, or other uses that may contribute to water quality degradation. The buffer width shall be calculated as follows:

- Along jurisdictional perennial streams identified by the USACE, not associated with a floodplain or wetlands, the buffer during construction shall be at least fifty (50) feet perpendicular from the jurisdictional line on each side of the waterway. Once the site is stabilized, the buffer may be reduced to an overall width of thirty (30) feet.
- In areas where a floodway profile has been computed along a perennial stream (AE Zones) as part of an approved flood study, the buffer area shall be equal to the width of the floodway, but never less than fifty (50) feet during construction. Once the site is stabilized, the buffer may be reduced to an overall width of thirty (30) feet.
- In areas where a floodway profile has not been computed along a perennial stream (A Zones) the developer shall perform a flood study, determine the floodway and follow the buffer requirements outlined above. As an alternative to preparing the flood study, the buffer limits shall extend to the delineated flood plain limits.
- Along jurisdictional intermittent streams identified by the USACE, the buffer shall be at least fifty (50) feet perpendicular from the jurisdictional line on each side of the waterway during construction. If these streams have associated floodway as described above, the same requirements would apply to have a total width of fifty (50) feet. Once the site is stabilized, the buffer may be reduced to an overall width of thirty (30) feet.
- For delineated wetland areas associated with perennial streams, the buffer shall be at least fifty (50) feet during construction. This buffer width is independent of any wetland offset requirements of the USACE.
- For delineated wetland areas associated with intermittent streams, the buffer shall be at least fifty (50) feet during construction. This buffer width is independent of any wetland offset requirements of the USACE.
- For wetland areas not associated with perennial, intermittent streams, or floodway, the buffer during construction shall be the extent of the wetland area plus an additional fifty (50) feet perpendicular beyond the wetland edge.

During Construction

A temporary undisturbed 50' Water Quality buffer must be provided. These temporary buffers cannot be averaged, except if one or more of the following conditions can be adequately substantiated;

a. Where a permanent water quality/quantity pond is proposed adjacent to a temporary buffer, cutting off sheet flow into the buffer, the buffer can be averaged to a minimum of 30'.
b. Considered on a case-by-case basis only, where there is a hardship to provide the 50' buffer due to site constraints. Isolated areas may be averaged to a minimum of 30', provided that the engineer demonstrates how the area affected by the reduced buffer is protected with additional BMPs.

Post Construction

Provide a permanent undisturbed 30' water quality buffer which may be reduced to a minimum of 25', provided that the buffer averaging is shown to meet the requirements.

The point at which a temporary 50' buffer can be reduced to a permanent 30' buffer can be identified as any of the following:

a. As provided specifically in the construction sequence, once upstream areas draining to the buffer have been stabilized. If the buffer is located within a residential lot, the home construction must be complete and the permanent signage installed.
b. Once the upstream areas draining to the buffer have been graded or reshaped, diverting 80% or more of the natural drainage away from the buffer.
c. Once the entire site is 80% stabilized.

Stream Buffer Management and Maintenance

The function of the stream buffer is to protect the physical and ecological integrity of the waterway, to reduce flooding potential, and to filter runoff from all development. The objective of a stream buffer is undisturbed native vegetation.

Management of the stream buffer includes specific limitations on alteration of the natural conditions. The following practices and activities are restricted within stream buffers, except with prior approval by the Public Works Department:

- Clearing or grubbing of existing vegetation,
- Clear cutting of vegetation,
- Soil disturbance by grading, stripping, or other practices,
- Filling or dumping,
- Use, storage, or application of pesticides, herbicides, and fertilizers,
- Conversion of vegetation from native to exotic species.

- Motor vehicles are not permitted in stream buffers unless during the installation of certain utilities permitted in the buffer zone.

The following structures, practices, and activities are permitted in the stream buffer, subject to prior approval of the Public Works Department, and when specific design or maintenance features are adhered to:

- Stream crossings and utilities:
- An applicant shall demonstrate that stream crossings are minimized;
- The right of way should be the minimum width needed to allow for maintenance access and installation;
- The angle of a crossing shall be as nearly perpendicular to the stream or buffer as practical in order to minimize clearing requirements; and
- The minimum number of crossings should be used within each development, and no more than one crossing is allowed for every one thousand (1,000) linear feet of buffer zone unless the applicant demonstrates to the Public Works Department the need for additional crossings. Where possible, the design of roadways and lots within a development should be aligned such that all streams are either to the rear or the side of individual lots, never along the front.

Transportation right-of-ways, pedestrian crossings, public access, boat ramps, docks, fishing platforms, unpaved paths (i.e. trails and greenways), and stream bank stabilization efforts.

Utilities are allowed; and shall be installed a minimum distance of twenty-five (25) feet measured perpendicular from the jurisdictional line within the buffer area.

In order to maintain the functional value of the stream buffer, indigenous vegetation may be removed as follows:

- Dead, diseased, or dying trees that are in danger of falling and causing damage to dwellings or other structures may be removed with approval from the Public Works Department;
- Debris in the buffer area that is caused by storm damage may be removed; and
- Invasive plant species may be removed if they are replaced by native species that are equally effective in retarding runoff, preventing erosion and filtering non-point source pollution from runoff. A buffer restoration plan for removal of invasive species must be approved by the Public Works Department.

Shoreline Buffers

Shoreline buffers shall be considered an area of managed vegetation adjacent to shorelines with hydrologic connectivity (stream leading into/out of the pond/lake or obvious spring input. The shoreline buffer width shall be fifty (50) feet perpendicular from the jurisdictional line. For ponds and lakes, the buffer shall be a minimum of fifty (50) feet from the jurisdictional line.

For Lake Murray, the buffer shall be measured from the 360' elevation or current jurisdictional line as determined by USACE.

Shoreline Buffer Management and Maintenance

The function of the shoreline buffer is to protect the physical and ecological integrity of the water body by providing a functional distance to reduce flooding potential; reduce erosion, sedimentation, and filter runoff between development and the water body.

Management of the shoreline buffer includes specific limitations on alteration of the natural conditions. The following structures, practices and activities are restricted in the shoreline buffer unless prior approval is granted by the Public Works Department:

- Septic systems;
- Permanent structures;
- Impervious cover, with the exception of paths;
- Soil disturbance by grading, stripping or other practice;
- Filling or dumping;
- Stormwater management facilities; and
- Use, application, or storage of pesticides or herbicides except for the spot spraying of noxious weeds or other nonnative species consistent with approved agency recommendations. (Richland County, South Carolina Forestry Commission, South Carolina Electric & Gas' Lake Management Department).

The following structures, practices, or activities are permitted in the shoreline buffer, subject to the prior approval of the Public Works Department:

- Biking or hiking paths;
- Recreational uses as approved by the Public Works Department; and
- Limited tree or underbrush clearing with approval from the Public Works Department.

Water Quality Buffer Width Adjustment Requirements

Adjustments to the buffer width shall be made for the following conditions:

- If streams are on a current 303d list or with an approved TMDL, the buffer area shall be increased to one hundred (100) feet.
- If water bodies are on DHEC'S Outstanding National Resource Waters (ONRW) list, the buffer area shall be increased to one hundred (100) feet.

- If there are fifteen percent (15%) to twenty-four percent (24%) slopes within the required buffer area, the buffer width must be adjusted to include an additional ten (10) feet.

- If there are twenty-five percent (25%) or greater slopes within the required buffer area width, the buffer width must be adjusted to include an additional twenty-five (25) feet.
- If the adjacent land use involves drain fields from on-site sewage disposal and treatment systems (i.e., septic systems), subsurface discharges from a wastewater treatment plant, or land application of bio-solids or animal waste, the buffer area width must be adjusted to include an additional twenty-five (25) feet.
- If the land use or activity involves the storage of hazardous substances or petroleum facilities, the buffer area width must be adjusted to include an additional fifty (50) feet.
- If the land use or activity involves raised septic systems or animal feedlot operations, the buffer area width must be adjusted to include an additional one hundred (100) feet.
- If the land use or activity involves solid waste landfills or junkyards, the buffer area width must be adjusted to include an additional two-hundred (200) feet. However, see also section 26-187 (g) (10) below.
- If all on-site storm water runoff is captured and routed through a permanent water quality basin, and there is no sheet flow discharging into the buffer, the buffer area may be reduced to twenty-five (25) feet. This is intended to apply in limited situations, such as small commercial developments.
- If the applicant satisfactorily demonstrates that there will be no degradation of the receiving water body by implementing the proposed storm water quality controls, then the established buffer may be reduced on a case by case basis upon approval by the Public Works Department.

Water Quality Buffer Averaging Option

This subsection outlines the criteria for buffer averaging on new and redevelopment sites. Buffer averaging can be utilized to adjust the required buffer width, allowing some flexibility for site development. Using buffer averaging, the width of the buffer can be varied with the criteria stated below, as long as a minimum average width of fifty (50) feet from the jurisdictional line are maintained.

The following criteria must be met in order to utilize buffer averaging on a development site:

- An overall average buffer width of fifty (50) feet, depending on the water quality buffer requirement, must be achieved within the boundaries of the property to be developed.
- The average width must be calculated based upon the entire length of the stream bank or shoreline that is located within the boundaries of the property to be developed. When calculating the buffer length, the natural stream channel should be followed.
- Stream buffer averaging shall be applied to each side of a stream independently. If the property being developed includes both sides of a stream, buffer averaging can be applied to both sides of the stream, but must be applied to both sides of the stream independently.
- That portion of buffers in excess of one hundred (100) feet will not be credited toward the
- buffer averaging formula within the boundaries of the property to be developed. The total width of the buffer shall not be less than forty (40) feet, or the width of the floodway at any
- location, except at approved stream crossings.
- Those areas of the buffer having a minimum width of forty (40) feet (or less at approved stream

crossings) can comprise no more than fifty percent (50%) of the buffer length.

Buffer width averaging is prohibited in developments that have, or will have after development, the Land-uses listed below:

- Developments or facilities that include on-site sewage disposal and treatment systems (i.e., septic systems), raised septic systems, subsurface discharges from a wastewater treatment plant, or land application of bio-solids or animal waste;
- Landfills (demolition landfills, permitted landfills, closed-in-place landfills);
- Junkyards;
- Commercial or industrial facilities that store and/or service motor vehicles;
- Commercial greenhouses or landscape supply facilities;
- Developments or facilities that have commercial or public pools;
- Animal care facilities, kennels, and commercial/business developments or facilities that provide short-term or long-term care of animals;
- Other land uses deemed by the Public Works Department to have the potential to generate higher than normal pollutant loadings.

Water Quality Buffer Plan and Plat Requirements

All preliminary, bonded and final plats prepared for recording and all right-of way-plats shall clearly:

- Show the extent of any stream or shoreline buffer on the subject property by metes and bounds;
- Label the stream and shoreline buffer;
- Provide a note to reference all buffers stating: “There shall be no clearing, grading, construction or disturbance of vegetation except as permitted by the Public Works Department”;
- Provide a note to reference any protective covenants governing all buffer areas stating: “Any buffer shown on the plat is subject to protective covenants which may be found in the land records and which restrict disturbance and use of these areas”;
- If the buffer area will not be part of an individual lot, then ownership must be stated by identifying who is the responsible party; and provide the location of permanent boundary marker signs.

The buffer plan must be submitted in conjunction with the sediment and erosion control plan, SWPMP document, and all applicable calculations for a land disturbance permit.

It is a requirement that the buffer be marked off with a warning barrier (orange safety fence) to show that no disturbance is allowed in the buffer area.

The following steps shall be taken during the site plan development and site construction process to protect water quality buffers during construction:

- Water quality buffers must be clearly identified on all stormwater management plans and construction drawings and marked with the statement "Water Quality Buffer. Do Not Disturb".
- Water quality buffers cannot be encroached upon or disturbed during project construction unless in accordance with Section 26-187 (b), Section 26-187 (k) or unless they are being established, restored, or enhanced in accordance with an approved Buffer Enhancement Plan.
- Water quality buffers must be clearly marked with a warning barrier before the preconstruction conference. The marking shall be maintained until completion of construction activities. All contractors and others working on the construction site must be made aware of the existence of the buffer(s) and the restrictions on disturbing the buffer(s).
- All areas of the water quality buffer, including stream banks, must be left in the existing condition upon completion of construction activities. Should construction activities associated with development cause degradation to stream banks, all eroding, bare or unstable stream banks shall be restored to existing conditions.
- If any trees are allowed to be removed, the tree location shall be shown and a note shall be provided stating that the tree must be hand cleared.
- The locations of all signage must be clearly shown on plans.
- A narrative stating the extent of the buffer areas, including any allowed disturbance in the buffer areas (this should be in the narrative as well as in the SWPMP document), must be included with the plans.
- A double row of silt fence (with metal posts and wire backing) shall be shown on the upstream side of applicable buffer area(s) that are adjacent to a land disturbance.
- The stream buffer shall be shown and labeled on the engineering plans, preliminary, bonded and final plat.
- If the stream buffers are dedicated to Richland County, placed in a conservation easement, or turned over to a Homeowners Association (HOA), the buffers shall be maintained in accordance with the maintenance and inspection requirements for permanent storm water management structures.

If the buffer is dedicated to viable third-party:

- All property lines shall terminate at the water quality buffer.
- Access easements shall be a minimum twenty (20) foot wide to allow maintenance of the buffer.
- Access points for these easements will be coordinated with storm drainage easements during the plan review process.

If placed in a conservation easement or if the easement is held by a viable third party, such as a land trust, land management company, or utility, the organization shall:

- Have the legal authority to accept and maintain such easements;
- Be bona fide and in perpetual existence; and
- Have conveyance instruments that contain an appropriate provision for retransfer in the event the organization becomes unable to carry-out functions.

If given to an HOA, the following criteria must be met:

- Membership in the HOA is mandatory and automatic for all homeowners for the subdivision

and their successors;
- The HOA shall have lien authority to ensure the collection of dues from all members; and
- The HOA assumes the responsibility for protecting, monitoring and maintaining the area as an undisturbed natural area, in perpetuity.

Shoreline buffers shall be shown and labeled on the engineering plans. Shoreline buffers shall be maintained by the owner in accordance with the maintenance and inspection requirements for permanent storm water management structures outlined in this chapter. Shoreline buffers may be placed in a conservation easement or deeded to the HOA.

Water Quality Buffer Signage Requirements

Permanent boundary marker signs are required for stream buffers prior to bonding of the subdivision and/or finalizing the subdivision with the intent to transfer property. Permanent boundary markers are required to ensure that property owners are aware of the buffer. Permanent boundary markers are recommended, but not required, in shoreline buffers. The Public Works Department has the authority to require the person or entity responsible for permanent maintenance of the buffer to replace boundary markers that have been removed or destroyed. The following general requirements shall apply to buffer boundary markers:

- Generally, buffer boundary markers shall be located on the landward edge of the buffer, and at other locations which will approximately delineate the buffer boundary. For commercial developments, markers shall be posted every one hundred (100) feet along the buffer boundary. For subdivisions where multiple lots are located along the buffer, it is recommended that a buffer boundary marker be located at the intersection of every other lot line with the landward edge of the buffer.
- Buffer boundary markers shall include the statement “Water Quality Buffer – Do Not Disturb”. Where possible, the markers should be mounted to a tree larger than three (3) inches in diameter. Where it is not possible to mount the marker to a tree, a treated wood or metal signpost must be used. The post must extend below the ground surface at least twenty-four (24) inches.
- The boundary markers must be mounted between four (4) and six (6) feet above the ground surface.
- The boundary markers must be at least twelve by eighteen inches (12”x 18”).

Water Quality Buffer Restoration and Enhancement Plan Requirement

Buffer Restoration and Enhancement Plans. Buffer restoration is required when a buffer is disturbed without prior approval from the Public Works Department. A developer or property owner may also wish to enhance a buffer to bring it closer to an optimal, undisturbed native forest condition. Prior to reestablishing or planting the buffer, a restoration or enhancement plan must be submitted to and approved by the Public Works Department. Buffer restoration and/or enhancement plans must include

the following:

- A drawing or plan that shows the location of the buffer in relation to the existing or planned development and to the buffered waterway; the disturbance limits for the planned buffer restoration; direction of flow of runoff from the site and flow within the water feature; erosion prevention and sediment control measures to be installed to protect the waterway; any existing or proposed stream crossings; existing or proposed stream bank stabilization measures; access to a water source for the purposes of watering vegetation; and other pertinent information. For large scale restoration and enhancement projects the plan(s) must be stamped by a registered landscape architect.
- A visual plan and a narrative that describe the vegetation plan for the buffer: stream buffers must be planted with native trees, shrubs, and grasses that will not be mowed. Suitable native plants can be chosen from the recommended plant species, as listed in the "Stormwater Design Manual". Species of plants other than those listed on the pre-approved list shall be approved by the Public Works Department prior to planting.
- The schedule for when plantings will occur and a two (2) year survival guarantee provided by the responsible party.

Water Quality Buffer Waiver Option

No waiver shall be granted to alter a buffer unless the Community Planning & Development Department (or the Planning Commission, in the event of an appeal) determines that a hardship exists and relief meets the general purpose and intent of this Section. Within Water Quality Protection Areas, no waiver shall be granted unless the applicant demonstrates that alternative protection measures can be provided that exceed the protection afforded by the established buffer.

In granting a request for a waiver, the Community Planning & Development Department or Planning Commission may require site design, landscape planting, fencing, the placement of signs, and the establishment of water quality best management practices in order to reduce adverse impacts on water quality, streams, wetlands, and floodplains.

Waiver requests shall only be considered if a request meets any of the criteria listed below:

- The project involves construction of one (1) single-family home for residential use by the owner of the property; and
- The property has an unusual shape or topography and there is no opportunity to develop under any reasonable design configuration.

The project involves the construction or repair of a structure which, by its nature, must be located within the buffer:

- Dams;
- Public water supply intakes;

- Waste water discharges;
- Docks, and boat launches;
- Stabilization areas of public access to water;
- Buffer intrusion is necessary to provide access to the property;
- Project will: [a] Require a Wetland Permit from USACE for impacts to jurisdictional wetlands; and [b] The USACE has approved a mitigation plan; and [c] Implementation of the plan in a 404 permit condition.

Buffer Waiver Submittal Requirements

The applicant shall submit a written request for a waiver to the Community Planning & Development Department (Engineering Services). The request shall include specific reasons justifying the waiver and any other information necessary to evaluate the proposed waiver request. The Community Planning & Development Department may require an alternative analysis that clearly demonstrates that no other feasible alternative exist and that minimal impact will occur as a result of the project or development.

The Community Planning & Development Department shall make a determination and decision concerning the waiver request. An appeal may be made to the Planning Commission. An appeal of the Community Planning & Development Department's decision shall be filed in writing within thirty (30) days after the final decision. The Planning Commission shall make all final determinations and decisions.

Chapter 5: Floodplain Management

The National Flood Insurance Program (NFIP) provides federally backed flood insurance within Richland County. To qualify for the NFIP, the County has adopted and enforces a Floodplain Management Ordinance to regulate development in flood hazard areas, protect human life and health, minimize property damage, and encourage appropriate construction practices to minimize the potential for flood damage to future development. Under the NFIP, Richland County is required to regulate all land development activities within the identified Special Flood Hazard Area (SFHA), which are subject to a 1-percent annual chance of flooding, formerly called the 100-year floodplain.

Development is defined by the Federal Emergency Management Agency (FEMA) as any manmade change to improved or unimproved property including, but not limited to, buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations. Development and/or land uses permitted within the SFHA of Richland County shall be in accordance with Richland County's Land Development Code Chapter 26 Section 106 – FP Floodplain Overlay District. The Richland County Floodplain Manager may also refer to the State of South Carolina and FEMA publications, policies and guidelines to assist in the implementation of these regulations.

Overview of Floodplains

The SFHA is comprised of the floodway and flood fringe (See Figures 11-1 and 11-2). The floodway is the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to pass the base flood discharge without increasing flood depths. The figures on the following page present the special flood hazard area in a cross-sectional view and on a sample Flood Insurance Rate Map. The "South Carolina Quick Guide for Riverine Floodplains, Development, and Maps" is a recommended source for basic information on watersheds and riverine floodplains. The Guide also provides an overview of the methods used to develop and maintain flood maps. The Guide is available for download from the South Carolina Department of Natural Resources website.

The SFHA for Richland County is identified by FEMA in a scientific and engineering report entitled "Flood Insurance Study for Richland County, South Carolina, and Incorporated Areas" with an accompanying Flood Insurance Rate Map (FIRM). The current Flood Insurance Study and the effective FIRM are available at FEMA's website, on the County's website, or at the Floodplain Manager's office at 2020 Hampton Street, 1st Floor, Columbia, SC 29204.

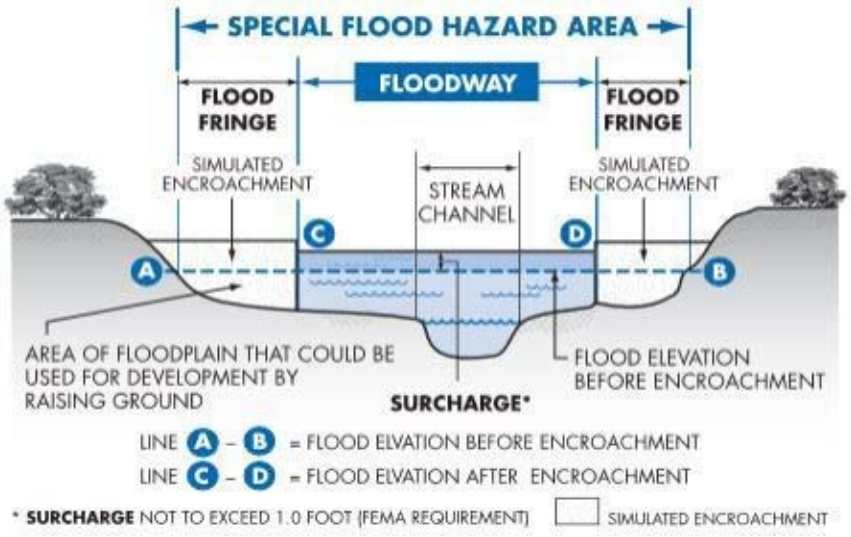

Figure 4: Cross Section of the Special Flood Hazard Area. (Source: SCDNR)

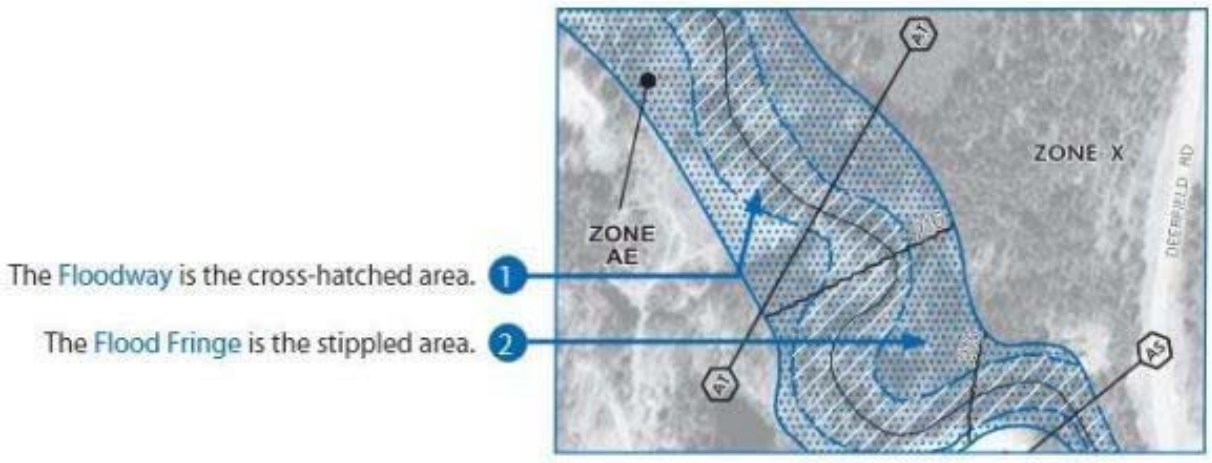

Figure 5: Special Flood Hazard Area. (Source: SCDNR)

Floodplain Development

Before construction or development begins within the SFHA, a building permit shall be attained by first submitting the application forms furnished by the Community Planning & Development Department or through the county's electronic permitting system. If the application or the construction documents indicate construction or development within the SFHA, the applicant shall be referred to the Richland County Floodplain Manager within the Community Planning & Development for further consultation.

The Richland County Floodplain Manager will inform the applicant of the floodplain regulations and

provide guidance on residential and commercial construction within the SFHA. The Richland County Floodplain Manager will require scaled plans which shall include, but are not limited to: the nature, location, dimensions, and elevations of the project area; existing and proposed structures; and the location of fill and compensatory areas. Specifically, the following information is required:

1. A plot plan that shows the 100-year floodplain contour or a statement that the entire lot is within the floodplain must be provided by the applicant when the lot is within or appears to be within the floodplain as mapped by the Federal Emergency Management Agency. The plot plan must be prepared by or under the direct supervision of a South Carolina licensed registered land surveyor or professional engineer and certified by such professional. The plot plan must show the floodway, if any, as identified by the Federal Emergency Management Agency (FEMA).
2. When base flood elevation data is available, plan submittal for a development permit within the flood hazard area shall show:

    - The elevation (in relation to mean sea level) of the lowest floor of all new and substantially improved structures, and
    - If the structure will be flood-proofed in accordance with the Non-Residential Construction requirements, must include the elevation to which the structure will be flood-proofed.

3. When base flood elevation data is not available, the provisions in the standards for streams without estimated base flood elevations and floodways must be met. (Section 26-106(e) of the Richland County Land Development Code)

The information submitted for the permit shall be certified by a South Carolina licensed registered land surveyor, engineer, or architect authorized by law to certify the required information and plans.

The Richland County Floodplain Manager shall review all applications for a flood development permit and approve or deny such applications. Approval or denial of a flood development permit shall be based on all applicable provisions of this chapter and the following relevant factors:

- The danger to life and property due to flooding or erosion damage;
- The susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owner;
- The danger that material may be swept onto other lands to the injury of others;
- The compatibility of the proposed use with existing and anticipated development;
- The safety of access to the property in times of flood for ordinary and emergency vehicles;
- The costs of providing governmental services during and after flood conditions, including maintenance and repair of roads and bridges and public utilities and facilities such as sewer, gas, electrical and water systems;
- The relationship of the proposed use to any comprehensive planning document for that area.

A floodplain development permit is required in conformance with the provisions of the Richland County Land Development Code (particularly Section 26-106) prior to the commencement of any development

activities in the FP Floodplain Overlay District. The purpose of this permit is to ensure that compliance with all regulations concerning floodplain development is achieved.

Chapter 6: Street Drainage and Easements

Storm Sewer Design Criteria

Pipes that are part of a storm sewer system consisting of catch basins, junction boxes and connecting pipes are to be sized for a discharge at full pipe flow.

The minimum allowable velocity to reduce sedimentation in the storm sewer system is 2 feet per second.

Avoid junctions that create excessive energy loss.

Minimum slopes for storm drainage pipes that will be conveyed to Richland County in a dedicated easement is 0.5%.

Maximum slope is 12.0%**.** Greater slopes may be approved by the County Engineer upon submittal of appropriate detailed structural designs and other supporting documentation.

Richland County will accept commonly used computers models or methodologies capability of analyzing the hydraulic capacity of proposed storm drain pipelines and systems.

Pressure Flow

Storm drainage systems may be designed to flow under pressure flow. In these instances, the hydraulic grade line is to be calculated and plotted on the storm drain profiles and submitted with the drainage plans and calculations. In these cases, the pipes are to be sized such that the hydraulic grade line remains a minimum of 1.0 feet below the ground surface at all inlets and junction boxes.

Discharge Velocity

Appropriate velocity dissipation devices and/or erosion prevention BMPs must be placed at culvert discharge locations and along the length of any outfall channel to provide non-erosive flow from the culvert to a water course so that the natural physical and biological characteristics and functions are maintained and protected. Outlet protection measures, such as reinforced vegetation or riprap, may be required to minimize erosion and scour potential. Provide calculations or procedures utilized to select the proper outlet protection and protection dimensions.

Materials

Reinforced concrete pipe, HDPE, and Polypropylene pipe respectively are acceptable.

Minimum Size

The minimum acceptable storm sewer pipe diameter is 15-inches.

Catch Basins, Junction Boxes and Manholes

A catch basin, junction box, or manhole shall be required at all changes of grades, size, or direction of a pipe and at junctions of two or more pipe. They may be constructed of reinforced concrete or concrete brick masonry. Precast concrete junction boxes, either round or rectangular, are also acceptable. Cast in place or precast concrete junction boxes are required for pipe sizes larger than 36-inches in diameter. Shop drawings must be provided for all precast concrete junction boxes. Construction plans must be provided for all cast-in-place junction boxes.

Prefabricated Bends

Prefabricated reinforced concrete or corrugated metal pipe bends are acceptable when the pipe size remains constant. The design of the bend should provide for the addition of a catch basin or manhole for surface access. Shop plans must be provided for all such installations.

Invert Elevations

Invert elevations for incoming and outgoing pipes shall be set such that the elevation drop across a junction box, manhole or catch basin equals or exceeds the energy loss across it or the change in pipe diameter, whichever is larger.

Catch Basins Placement

Catch basins are to be placed at close enough intervals along a street so that the curb and gutter are not overtopped during the 10-year rainfall event. A sufficient number of catch basins should be provided so that the peak discharge delivered to each one does not exceed its calculated inlet capacity for this condition.

Standard Catch Basins

Where Richland County is to accept maintenance responsibility for the streets and drainage system, Richland County standard catch basins are to be used. Standard details for catch basin types A, B, and C may be obtained from the County Engineer's office. Calculated inlet capacities for these catch basins, when located in a sump, are as follows:

Table 17: Inlet Capacity for Richland County Standard Catch Basins

Catch Basin Type	Inlet Capacity (cfs)
A	12.1
B	10.6
C	9.4

Access

When the depth of a catch basin, junction box, or manhole exceeds 4-feet, metal rungs or a suitable alternative will be provided for safe ascent and descent.

Headwalls

Reinforced concrete headwall, similar or identical to one of Richland County's standard headwalls or a "flared end section" shall be placed at the ends of any culvert or closed storm sewer system. Precast or cast-in-place concrete headwalls are acceptable. Richland County's standard headwall details may be obtained from the County Engineer's office.

Open Channels

Open channels may be used instead of closed storm sewers when the channel is designed as part of the stormwater water quality management plan. The County Engineer for environmental or aesthetic purposes may require the use of open channels for stormwater conveyance and water quality on a case-by-case basis.

Design Considerations

The following factors should be considered in the design of open channels:

- Hydraulic capacity,
- Erosion potential,
- Future maintenance requirements,
- Safety,
- Aesthetics,
- Minimum slope is 1.0%,
- Side slopes for vegetated open channels in residential areas should be no greater than 3:1 for stability, safety, and ease of maintenance, and in no case will open channel side slopes steeper

than 2:1 be approved.

In the interest of preserving existing vegetation (helps to stabilize banks) and to preserve the aesthetics of natural channels, not all open channels have to be altered to protect them from erosion. However, existing channels which are an integral part of the development and storm drainage system should be evaluated for the need for additional erosion protection. In addition, those existing channels which will be subject to peak flow increases of 100% or more as the result of complete build-out of the contributing watershed and those existing channels with sharp bends should also be evaluated for the need for additional erosion protection.

Capacity

Open channels shall be designed to contain the design discharge within the banks with 0.5 feet of freeboard. Richland County will accept the use of the Manning's Equation or other commonly accepted computer models for open channel design. The designer shall select the proper Manning's roughness coefficient based on channel type and permanent channel lining.

Analyze outlet conditions to confirm that the channel can discharge the peak design flow at the computed normal depth. For conditions in which the capacity of the channel to discharge the design flow is governed by conditions on the outlet (high tailwater condition) or the channel is traversed by one or more stream crossings, either bridge or culvert, then analysis of these conditions using acceptable computer models (HEC-RAS) must demonstrate that the channel can contain the design discharge within the channel banks.

Erosion Protection

The allowable velocities and shear forces for non-vegetated (erodible) open channels are relatively small and the design typically requires wide, shallow channels to carry the design flow rates. In all situations, permanent open channel banks and bottom must be stabilized with vegetation or other applicable erosion prevention measures, bare soil open channels will not be accepted.

Vegetated Channels

The design of stabilized open channels must address both peak flow velocity and peak shear stress and may be done by using computer software that is capable of designing open channels for stability and capacity.

Vegetation or other erosion prevention measures protect the channel from the erosive action of design flows and binds the channel material together. Vegetated channels can be used to carry stormwater runoff but are generally not recommended to carry sustained base flows because most vegetation cannot survive continual submergence or saturation of the root zone.

The design of vegetated channels is more complex than a basic earth lined, or structurally lined channel. The additional design consideration for vegetated channels involves a variation in roughness (Manning's n) with the height and type of vegetation. Generally, a tall grass provides much resistance when flow in the channel is shallow. As the flow depth increases, the resistance of some vegetation may decrease. In many cases, the vegetation will lay over in the direction of the flow when the flow reaches a sufficient depth. When vegetation lies over, the resistance produced by the vegetation is considerably less than it is during shallow flow conditions. The design of vegetated channels shall be performed for the following two design conditions:

- Stability/Permissible Velocity: This design process involves evaluating how the channel will respond under low vegetation retardance conditions. This condition is defined when vegetation is cut low or lies down, producing a lower Manning's n value, lower flow depths, and higher flow velocities. The limiting factor for stability design is the permissible velocity of the flow in the vegetated channel.
- Capacity: This design process involves evaluating how the channel will respond under high vegetation retardance conditions. This condition is defined when vegetation is not maintained or is very long and rigid, producing a higher Manning's n value, higher flow depths, and lower flow velocities. The limiting factor for capacity design is the cross sectional area of the vegetated channel.

The design of stabilized open channels must address both peak flow velocity and peak shear stress and may be done by using computer software that is capable of designing open channels for stability and capacity.

Vegetation only channel bottom and bank protection measures are limited to:

- Channel bottom must be established by sodding,
- Channel banks established with double netted temporary erosion control blanket,
- Maximum flow velocities of 5 feet per second,
- Maximum shear stress of 1.0 pounds per square foot, and
- Maximum channel slope of 5%.

Erosion Protection Measures

The designer shall provide all calculations and procedures utilized to select the proper outlet protection and protection dimensions. Acceptable bank and channel protective measures include but are not limited to:

- Vegetation Only,
- Vegetated Turf Reinforcement Matting (TRM),
- Maximum unvegetated velocity of 9 feet per second.
- Maximum unvegetated shear stress of 3 pounds per square foot.
- Geogrid or similar structural erosion control measures,

- Transition Mats or Flexible Revetment Systems,
- Bio-engineered or other stream stabilization measures,
- Riprap,
- Articulated concrete block (ACB),
- Articulated concrete block (ACB) mats,
- Reinforced concrete or concrete cloth, and
- Other protective measures acceptable to County Engineer.

Discharge Velocity

Appropriate velocity dissipation devices and/or erosion prevention BMPs must be placed at discharge locations and along the length of any outfall channel to provide non-erosive flow from the structure to a water course so that the natural physical and biological characteristics and functions are maintained and protected. Outlet protection measures, such as reinforced vegetation or riprap, may be required to minimize erosion and scour potential. Provide calculations or procedures utilized to select the proper outlet protection and protection dimensions.

Culverts

A culvert is a relatively short conduit conveying stormwater through an embankment. Its capacity depends on, among other things, the depth to which headwater is allowed to pond at its inlet. The headwater depth will be different depending on whether the culvert is functioning under "inlet control" or "outlet control" conditions. In designing the culvert, both conditions must be investigated.

Analysis of Inlet and Outlet Control Conditions

Inlet control occurs when the capacity of the culvert barrel exceeds the capacity of the entrance. Under this condition, the culvert flows only part full. The configuration and size of the inlet and the headwater elevation determine its capacity.

Outlet control occurs when the capacity of the culvert entrance exceeds the capacity of the barrel. Under this condition, the culvert flows full. The capacity is dependent on the tailwater depth, the slope, length, roughness and size of the barrel, the inlet configuration and the hydraulic head available.

A thorough assessment of culvert hydraulics is presented in FHWA Hydraulic Design Series No. 5 (HDS-5), Hydraulic Design of Highway Culverts (1985) is. HDS-5 includes nomographs for analysis of culvert hydraulics under inlet control and outlet control and culvert barrel capacity, which are incorporated in the Richland County design standards. Use of the FWHA culvert analysis program HY-8, or other computer model based on FHWA procedures, is acceptable.

Design Requirements

The headwater required to convey the design discharge must be determined under both inlet and outlet control conditions. The control requiring the highest headwater governs. The culvert should be designed such that:

- The headwater at the design discharge does not exceed an elevation one-foot below the top of curb or edge of road shoulder at the lowest point.
- The headwater depth at the design discharge does not exceed the culvert diameter by a factor greater than 2.0 or by 4.0 feet, whichever is smaller.
- The headwater depth at the design discharge does not cause water to rise above the top of approach channels or beyond established flooding easements.
- The headwater at the 100-year discharge does not exceed an elevation two feet below the elevation of adjacent building sites.
- Minimum allowable velocity to reduce sedimentation in the storm sewer system is 2 feet per second.
- Minimum slope is 0.5%
- Maximum slope is 12.0%**.** Greater slopes may be approved by the County Engineer upon submittal of appropriate detailed structural designs and other supporting documentation.

Discharge Velocity

Appropriate velocity dissipation devices and/or erosion prevention BMPs must be placed at culvert discharge locations and along the length of any outfall channel to provide non-erosive flow from the culvert to a water course so that the natural physical and biological characteristics and functions are maintained and protected. Outlet protection measures, such as riprap, may be required to minimize erosion and scour potential. Provide calculations or procedures utilized to select the proper outlet protection and protection dimensions.

Plans and Calculations

Culvert drainage calculations shall include headwater calculations for both the design storm and the 100-year storm. These depths shall be plotted on profiles and the corresponding floodplains delineated on the topographic map of the project.

Materials

Culverts and closed storm drainage systems may be constructed using any of the materials listed in this section. In selecting the culvert material, consider structural requirements and corrosion potential at the site as well as hydraulic requirements. Design culverts to support a minimum of an AASHTO HL-93 live load together with the appropriate dead load. Heavier live loads may be required if conditions

dictate. Bury depths greater than 15 feet shall have written approval by the County Engineer or County appointed designee. Minimum life expectancy for all culvert materials is 75 years.

All excavations and trenches shall be clean, dry and free of debris before placing pipe. Minimum compaction shall be 90% SPD for all pipes and structures, unless higher compaction levels are required by the design engineer. Verification of compaction throughout the pipe's backfill zone trench shall be provided by a registered geotechnical engineer. Open graded backfill such as washed stone, shall be wrapped with a minimum 8-ounce non-woven geotextile to prevent migration of fines into the backfill. Fabric design shall be verified by a registered geotechnical engineer. A 24-hour notice is required prior to installation.

Reinforced Concrete Pipe (RCP)

RCP pipe culverts and storm drainage systems are acceptable and shall meet ASTM C76 and be Class III or greater. Joints shall meet ASTM C443 or ASTM C1628 and use gaskets that meet ASTM F477. Nitrile gaskets are allowed if required by onsite conditions, per the project design engineer's recommendation. Mastic style joints shall not be used. The pipe shall be installed following an ASTM C1479 Type 2 installation in the right-of-way and a Type 3 installation outside the right-of-way. Fill heights shall comply with Manufacturer's published standards. Fill heights requiring a special design shall be signed and sealed by a competent licensed professional engineer in the State of South Carolina. Joints shall be capable of passing an ASTM C969 test when required by project engineer. Pipes provided to the County shall comply with the Q-cast or NPCA quality certification program. Pipe velocity shall not exceed 10 feet per second unless approved by the County Engineer.

Concrete Box Culverts

Cast in place or precast concrete box culverts are acceptable. Project plans should include structural details for cast in place concrete, or shop plans for precast that have been signed and sealed by a competent licensed professional engineer in the State of South Carolina. Joints shall be capable of passing an equivalent ASTM C969 test when required by project engineer.

Prefabricated Structures

Prefabricated culvert structures such as CONSPAN® or similar structures are acceptable if designed and installed in accordance with the manufacturer's recommendations. Project plans should include structural details and shop plans that are signed and sealed by a competent licensed professional engineer in the State of South Carolina.

High Density Polyethylene (HDPE) Pipe

HDPE pipe culverts and storm drainage systems are acceptable when designed and constructed in accordance with the manufacturer's recommendation, and County Standards. HDPE pipe culverts and

storm drainage systems shall meet AASTHO M294 (Type S) pipe. Joints shall comply with ASTM D3212 and have gaskets that meet ASTM F477. Nitrile gaskets are allowed if required by onsite conditions as verified by the engineer or record. The pipe shall be installed following an ASTM D2321 with minimum and maximum fill heights complying with manufacturers published fill height standards. Backfill shall be an ASTM D2321 Class II or better. Pipe velocity shall not exceed 15 feet per second unless approved by the County Engineer.

Polypropylene (PP) Pipe

PP pipe culverts and storm drainage systems are acceptable and shall meet ASTM F2881 or F2764. Joints shall comply with ASTM D3212 and have gaskets that meet ASTM F477. Nitrile gaskets are allowed if required by onsite conditions as verified by the engineer or record. The pipe shall be installed following an ASTM D2321 with minimum and maximum fill heights complying with manufacturers published fill height standards. Backfill shall be an ASTM D2321 Class III or better. Pipe velocity shall not exceed 15 fps unless approved by the County Engineer.

Minimum Size

The minimum acceptable pipe culvert diameter is 15-inches.

End Treatments and Transitions

Acceptable end treatments may consist of, but are not limited to plan end pipe with riprap, concrete headwalls, concrete or metal flared end sections, DOT approved safety ends, and any other end treatment that is approved by the County Engineer or County appointed designee. HDPE flared end treatments are not allowed.

Transition from pipe of dissimilar materials shall requires a Dissimilar Materials Adapter incorporating a geotextile coupler with mastic coating and stainless steel straps that is properly backfilled per general pipe installation instructions.

Post Installation Inspection

All newly constructed pipe systems shall be visually inspected, with 10% of the pipe runs video inspected. Joints shall all be panned and inspected and any visible issues such as joint separation, cracking, holes in pipe, or excessive deflection shall be noted. At the County's discretion, where evidence of poorly installed or damaged pipe is found, 100% of the pipe system may be inspected.

Chapter 7: Roadway Design Requirements

All new roads and storm drainage, or improvements and upgrades shall be installed or constructed by the developer at no cost to the county, except as may otherwise be specifically provided. The developer shall be responsible for obtaining all permits. Required improvements under this section shall not be installed or constructed until required site plans have been approved by the Community Planning and Development Department; and an order to proceed has been issued.

Development may be designated to be constructed and/or platted in phases and the Community Planning and Development Department may not approve a phasing plan when in its opinion such phasing will not provide for adequate roadway facilities to support any such phase(s) independent of the overall development plan. In approving phases, the Community Planning and Development Department may require that additional roads be constructed as part of the phase or phases in order to ensure that sufficient public facilities will be in place to support such phase(s) independent of any future development.

Road Classification

- Local Street
- Collector (Minor) *Commercial*
- Collector (Minor) *Residential*
- Collector (Major)
- Arterial (Minor)
- Arterial (Major)
- Industrial
- Rural Road
- Alleyway

Local Street (Residential)

Provides direct access to lots and which does not provide connectivity to properties other than those served. Access streets shall be designed so no road section conveys an ADT greater than 250 within residential areas.

Minor Collector (Residential)

Provides direct access to lots and carries traffic of local streets. Designed to carry higher traffic than local streets with traffic limited to motorists having origin or destination within the immediate neighborhood or between adjoining neighborhoods. Sub-collectors shall be designed so that no road section conveys an ADT greater than 1000 within residential areas. If proposed ADT exceeds this threshold, then an increase in pavement traffic classification is required. Example: If pavement design is calculated to be a Traffic Class 2 but the ADT exceeds 1000 then, a Traffic Class 3 pavement would be required.

Minor Collector (Commercial)

Provides direct access to lots and carries traffic of adjoining access streets. This road is designed to carry large traffic volumes at low to moderate speeds. Designed with traffic limited to motorists having origin or destination within the immediate development. The road shall be designed so that they do not promote use as a shortcut by non-development traffic. Sub-collector shall be designed so that no road section conveys an ADT greater than 1500 within commercial areas. If proposed ADT exceeds this threshold, then an increase in pavement traffic classification is required. Example: If pavement design is calculated to be a Traffic Class 2 but the ADT exceeds 1500 then, a Traffic Class 3 pavement would be required.

Major Collector

Conducts and distributes traffic between access/sub-collector and arterial streets. Carries large traffic volume at high speed. Function is to promote free traffic flow; therefore, parking and direct access to homes from this level of street shall be prohibited. Collectors shall be designed so that they do not promote use as a shortcut by non-neighborhood traffic. Collectors shall be designed so that no road section conveys an ADT greater than 2000. If proposed ADT exceeds this threshold, then an increase in pavement traffic classification is required. Example: If pavement design is calculated to be a Traffic Class 2 but the ADT exceeds 2000 then, a Traffic Class 3 pavement would be required.

Arterial-Minor

Principal traffic artery within residential or commercial areas that carry relatively high traffic volumes and convey traffic from arterial streets access, sub-collector and collector streets. Its function is to promote the free flow of traffic; as such, no parking or residences shall be permitted along or have direct access to such roads. Minor arterial shall be designed and constructed according to most current SCDOT standards.

Arterial-Major

Principal traffic artery within residential or commercial areas that carry relatively high traffic volumes and convey traffic from arterial streets to collector streets. Its function is to promote the free flow of traffic; as such, no parking or residences shall be permitted along or have direct access to such roads. Minor arterial shall be designed and constructed according to most current SCDOT standards.

Rural

A road serving development in low density, primarily rural areas and which would not be classified as a

collector or arterial road.

Alleyway

A private road primarily designed to serve as a secondary access to the side or rear of those properties whose principal frontage is on another road, either public or private, meeting minimum county requirements.

Road Right-of-Way Widths

Minimum rights-of-way and pavement widths shall be as follows, unless reduced by the development review team during land development or subdivision review and approval:

Local Residential

Width	
A. Right of Way Width	50’
B. Back-of-curb to back-of-curb	25’
Streetscape	
C. Utility placement easement (min)	5’ (one side)
D. Maintenance strip (min)	2’ (each side)
E. Sidewalk (min)	4’ (one side)
F. Planting area	6’ (each side)
Travelway	
G. Travel lane	12.5’
General	
Walkway type	Sidewalk
Planting Type	Tree lawn
Tree Spacing	40’ o.c. avg.
Parking Type	N/A
Mailboxes	N/A

Engineering Specifications	
Design Speed (mph)	25 mph
Design Vehicle	Passenger Vehicle
Driveway Spacing	As needed
Median Opening Distance	N/A
Cul-de-sac Island	N/A
Partial Medians/Island	No
Curb Radii	25’
Lighting	Required on all public streets for new development, pedestrian scale optional

Access Road

Width	
A. Right of Way Width	50’
B. Pavement Edge to Pavement Edge	22’
Streetscape	
C. Utility placement easement (min)	5’ (one side)
D. Maintenance strip (min)	3’ (each side)
E. Sidewalk (min)	5’ (one side)
F. Planting area	6’ (each side)
Travelway	
G. Travel lane	11’
General	
Walkway type	Sidewalk
Planting Type	Tree lawn
Tree Spacing	40’ o.c. avg.

Engineering Specifications	
Design Speed (mph)	25 mph
Design Vehicle	Passenger Vehicle
Signalized Intersection Density	As warranted
Driveway Spacing	As needed
Median Opening Distance	N/A
Partial Medians/Island	No
Curb Radii	5-10’
Lighting	Required on all public streets for new development, pedestrian scale optional and responsibility of developer
Permitted Furniture	Bicycle racks, benches, parking meters

Loop Road – One Way

Width	
A. Right of Way Width	Radius Max 40’
B. Back-of-curb to back-of-curb	16’
Streetscape	
C. Utility placement easement (min)	5’ (one side)
D. Maintenance strip, easement (min)	1’ (each side)
E. Sidewalk, easement (min)	5’ (one side)
F. Planting area (min)	6’ (each side)
Travelway	
G. Travel lane	11’
General	
Walkway type	Sidewalk
Planting Type	Tree lawn
Tree Spacing	40’ o.c. avg.
Parking Type	Parallel, head in, 60 degree angular

Engineering Specifications	
Design Speed (mph)	20 mph
Design Vehicle	Passenger Vehicle
Signalized Intersection Density	As Warranted
Driveway Spacing	As needed
Median Opening Distance	N/A
Partial Medians/Island	No
Curb Radii	25’
Lighting	As needed
Permitted Furniture	Bicycle racks, benches, parking meters

Collector

A roadway which provides connection between the arterial road system and local roads as well as traffic circulation within residential, commercial and industrial areas. (Ord. 038-09HR; 7-21-09)

Width	
A. Right of Way Width	66’
B. Back-of-curb to back-of-curb	37’
Streetscape	
C. Utility placement easement (min)	5’ (one side)
D. Maintenance strip (min)	3.5’ (each side)
E. Sidewalk (min)	5’ (one side)
F. Planting area (min)	6’ (each side)
Travelway	
G. Travel Lane	18.5’
General	
Walkway type	Sidewalk
Planting Type	Tree lawn
Tree Spacing	40’ o.c. avg.

Engineering Specifications	
Design Speed (mph)	40 mph
Design Vehicle	All Vehicles
Signalized Intersection Density	As warranted
Driveway Spacing	As needed
Median Opening Distance	N/A
Partial Medians/Island	No
Curb Radii	5-10’
Lighting	Required on all public streets for new development, pedestrian scale optional and responsibility of developer
Permitted Furniture	Bicycle racks, benches, parking meters

Park Road

Width	
A. Right of Way Width	41’
B. Back-of-curb to back-of-curb	17’
Streetscape	
C. Utility placement easement (min)	5’ (one side)
D. Maintenance strip, easement (min)	1’ (each side)
E. Sidewalk, easement (min)	5’ (one side)
F. Planting area (min)	6’ (each side)
General	
Walkway type	Sidewalk
Planting Type	Tree lawn
Tree Spacing	40’ o.c. avg.

Engineering Specifications	
Design Speed (mph)	20 mph
Design Vehicle	Passenger Vehicle
Signalized Intersection Density	As warranted
Driveway Spacing	As needed
Median Opening Distance	N/A
Partial Medians/Island	No
Curb Radii	5-10’
Lighting	--
Permitted Furniture	Bicycle racks, benches, parking meters

Pavement Width

Pavement width for rural roads shall be measured from pavement edge to pavement edge. Residential, commercial, collector, and industrial roads shall measure pavement width from back-of-curb to back-of- curb or from low-point-of-valley to low-point-of-valley.

The mixing of rural and any other road classification is prohibited. Curb and gutters shall be installed on all paved roads unless the county engineer determines that another system is acceptable. Roads without curb and gutter shall have a minimum right-of-way of sixty-six (66) feet; provided, however, when Stormwater swales or other Stormwater features are located along the roadside and specifically outside of the right-of-way, then the right-of-way may be reduced to fifty (50) feet. The Stormwater swales or other Stormwater feature must be within a minimum eight (8) foot drainage easement or conservation easement, with clearly defined maintenance by a private owner or homeowners' association.

In the event the development of property includes or abuts an existing platted county road that does not conform to the minimum requirements set forth in this chapter, or in the event that the development will result in an increase in the average daily traffic using the road to the extent that the classification of the road will change under these regulations, or the road is shown on the county's thoroughfare plan, the preliminary land development (land development or subdivision) plan must provide for sufficient right-of-way to increase the size of the right-of-way to the width needed under the new classification. In the event that the development abuts only one (1) side of such a road, the additional right-of-way reserved shall not exceed one-half (½) of the additional right-of-way required under the new classification, measured from the centerline of the existing right-of-way. The plat shall clearly denote that any subject right-of-way described above is reserved for future road widening. Lot area requirements and setback requirements shall not use the reserved right-of-way area in their measurements.

Road Geometric Design

Unless specifically addressed in these regulations, all geometric elements of roadway design for streets and roads in the County Road System will be in accordance with the AASHTO Policy on Geometric Design of Highways and Streets.

Horizontal Curves

Horizontal curves are to be introduced at all changes of direction on collector, local commercial and industrial service streets and at changes of direction on residential streets where the deflection angle exceeds 10^0. The minimum radii of curvature are to be in accordance with Table II. Speed limits on each street will be determined according to the shortest curve radius on the street. For streets with 2% cross slopes (1/4" per ft. crown) the maximum acceptable speed limits are:

Table 18: Maximum Acceptable Speed Limits

Radius (ft.)	Speed Limit (mph)
150-179	20
180-299	25
300-459	30
460-674	35
675-939	40

Vertical Curves

Crest vertical curves are to be of sufficient length to provide the minimum stopping sight distance at the design speed. The lengths required are as shown in Table III. The lengths are calculated using the formulas:

$L = S^2A/1400$ where $S<L$ and
$L = 2S - 1400/A$ where $S>L$ in which:
S = Stopping site distance in ft.
L = Length of vertical curve in ft.
A = Algebraic difference in grades.

Intersections

The centerlines of no more than two streets shall intersect at any one point. Whenever possible, the centerlines of intersecting streets are to be perpendicular but in no case is the angle of intersection to be less than 60 degrees. All angles and distances are measured relative to the intersection of a street centerline.

Intersections in Curves

Intersections within a horizontal curve are permitted provided that the intersecting street has a 100-foot minimum tangent at the intersection and the required corner sight distance is maintained. Whenever possible, the tangent of the intersecting street is to be radial to the curve but in no case will

it be more than 30 degrees from radial.

Reverse Curves

Reverse curves are permissible provided that applicable sight distances are maintained.

Curb Radius

The minimum acceptable curb radius at intersections is 25 feet. Larger radii must be provided in accordance with the AASHTO Policy on Geometric Design of Highways and Streets when significant tractor-trailer, or other large vehicle, traffic is expected.

Medians

Natural or planted medians separating opposing traffic lanes are acceptable. The minimum width of pavement on either side of the median is to be in accordance with the minimum lane widths contained in Table I. Barrier type curbs or adequate lateral clearance, however, must be provided on the median. Painted medians are required on collectors, local commercial and industrial service streets.

Islands

A natural or planted island may be used in the center of cul-de-sacs on residential and rural streets provided that a minimum pavement width of 18 feet is maintained around the island.

Cul-de-Sacs

Cul-de-sacs shall not be used to avoid connection with an existing road or to avoid connection to adjoining property. Cul-de-sacs shall not be used to provide access to development on the boundary of the development except where a cul-de-sac is necessitated by topography or property accessibility, or is appropriate for land use separation.

Cul-de-sac Length

Cul-de-sacs shall not exceed one thousand two hundred (1,200) feet in length unless necessitated by topography or property accessibility, and are approved by the development review team. Measurement shall be from the point where the centerline of the dead end road intersects with the centerline of a general circulation road to the center of the turnaround of the cul-de-sac. Where one cul-de-sac extends from another cul-de-sac, the end of each cul-de-sac shall be no more than one thousand two hundred (1,200) feet from a general circulation road as measured by the centerline of the roads.

Cul-de-sac Design

Cul-de-sacs shall terminate in a circular turnaround having a minimum right-of-way of at least one hundred (100) feet in diameter and a paved turnaround with a minimum outside diameter of eighty (80) feet, or other approved type of turn around, including T's, Y's or landscaped islands with a minimum right-of-way sufficient for county maintenance. In addition, all cul-de-sacs must have a landscaped interior island, at least forty (40) feet in diameter. The minimum pavement width around a cul-de-sac island shall be sixteen (16) feet, and this portion of the pavement shall be designated as a one-way for traffic purposes. A provision for adequate drainage must be designed for the island; and a provision for maintenance of landscaping on the island must be included in the recorded restrictive covenants for the subdivision.

Temporary Dead-end Road and Half Roads

Dead-end Roads

Temporary dead-end roads shall be provided with a temporary turnaround having a roadway surface diameter of eighty (80) feet, or other type of approved turnaround.

Half Roads

Half roads of less than two (2) lanes are prohibited. Whenever a road is planned adjacent to the proposed development tract boundary, the entire road right-of-way shall be platted within the proposed development, or a portion of the road may be platted and reserved with adequate provision for the concurrent dedication of the remaining portion of the right-of-way by the adjacent landowner, evidence of which shall be furnished by the developer through an acquired and recorded easement.

Visibility at Intersections

All roadways are to be designed so that adequate corner sight distance is provided at all intersections. Corner sight distance at an intersection is measured from a point on the intersecting street 15 feet from the edge of pavement on the through street and 3.75 feet above the street surface to an object 4.5 feet high on the through street. The minimum corner sight distance is equal to the stopping distance shown in section 5.2.4 at the design speed, or posted speed limit, on the through street.

(1) Sight clearance to be maintained. At each corner of each road or driveway/road intersection, a sight area shall be maintained. Within the sight area, no fence, wall, sign, slope, embankment, parked vehicle,

hedge, foliage, planting, object, or structure shall be placed, erected, or maintained that will obstruct visibility within the sight area.
(2) Dimensions of the sight area. The horizontal dimensions of sight areas are defined as triangular

areas formed by the intersecting right-of-way lines and a straight line joining the right-of-way lines at points that are measured along the right-of-way lines as follows:

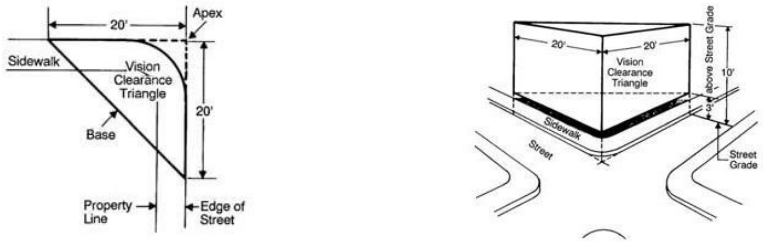

Figure 6: Horizontal Dimensions of Sight Areas

Fifteen (15) feet distant from the point of the intersection of the right-of-way lines in commercial and industrial districts.

Twenty-five (25) feet distant from the point of the intersection of the right-of-way lines in residential districts. Those sight areas shall be established regardless of the angle of intersection of the right-of-way lines. For the intersection of a driveway and a road, the triangular area is that formed by the right-of- way and the edge of the driveway and a straight line joining the right-of-way and driveway edge at points that are fifteen (15) feet distant from the point of intersection.
The vertical dimensions (cross-visibility) of sight areas are defined as the vertical space between the heights of two and one-half (2½) feet and ten (10) feet in elevation above the nearest edge of the road pavement of a paved road or above the nearest edge of the riding surface of an unpaved road. Trees having limbs and foliage trimmed so that the cross-visibility within the triangle is not obscured shall be allowed to overhang the sight triangle, provided the location of any tree does not create a traffic hazard. NOTE: The profile of existing streets on either side of a proposed intersection shall be provided to insure that adequate site distances are available.

Lateral Clearance

A minimum lateral clearance as shown below shall be maintained from the edge of pavement or from the back of curb or valley gutter:

- Rolled curb and gutter……6.0'
- Barrier type curb……4.0'
- Valley gutter……6.0'
- Flat pavement.....10.0'

No entrance gates or other obstructions, with the exception of traffic control and street name signs and mailboxes, are to be placed within these distances from the edge of the street.

Trees are allowed within the lateral clearance only if they are selected from the following list of species; or utilize a root barrier.

It should be noted that the above setbacks are minimums based on the obstruction being located on a tangent. When an obstruction is located within a horizontal curve, the setback must be calculated using the equation:

Formula:

Where:
R = the radius of curvature at the centerline of the lane closest to the obstruction in ft. M = Distance from the centerline of the lane to the obstruction in ft.
S = Stopping sight distance in ft.

Provided the above setbacks and sight distance requirements are met, trees may be retained or planted within the right-of-way for aesthetic or environmental purposes.

Road Subgrade and Pavement Structure Requirements

Table 19: Traffic Classes

Class 1	Class 2	Class 3	Class 4
• Access Street • Park Road • Alleyways AOT < 250	• Minor Collector (Residential) • Commercial	• Minor Collector (Residential) • Major Collector (Commercial)	• Major Arterial • Local Street • Local Industrial • Major Service Drives or Entrance

*Note - Refer to Chapter 7.1 Road Classifications

Table 20: Subgrade Categories

	Poor	Medium	Good
Description	• Becomes soft and plastic when wet. • Clay and fine silts o ≥ 50% passing No. 200 • Coarse silts and sandy loans o Deep frost penetration o High water table	• Retains a moderate degree of firmness under adverse conditions • Loams, silty sands and sandy-gravels containing moderate amounts of fine silts.	• Retains a substantial amount of load-supporting capacity when wet. • Clean sands, sand-gravels and those free of detrimental amounts of plastic fines. o ≤ 10% passing No. 200

			• Relatively unaffected by moisture or frost.
Typical Properties	CBR < 6 LL > 40 PI > 10 GI > 4	CBR: 6-9 LL: 25-40 PI: 6-0 GI: 2-4	CBR ≥ 10 LL < 25 PI < 6 GI < 2

$$GI = (F_{200} - 35)[0.2 + 0.005\,(LL - 40)] + 0.01\,(F_{200} - 15)\,(PI - 10)$$

where,
F_{200} = Percent of subgrade soil passing the No.200 sieve
LL = Liquid limit of subgrade soil
PI = Plastic index of subgrade soil

A Geotechnician needs to provide design plans, reports and/or details.

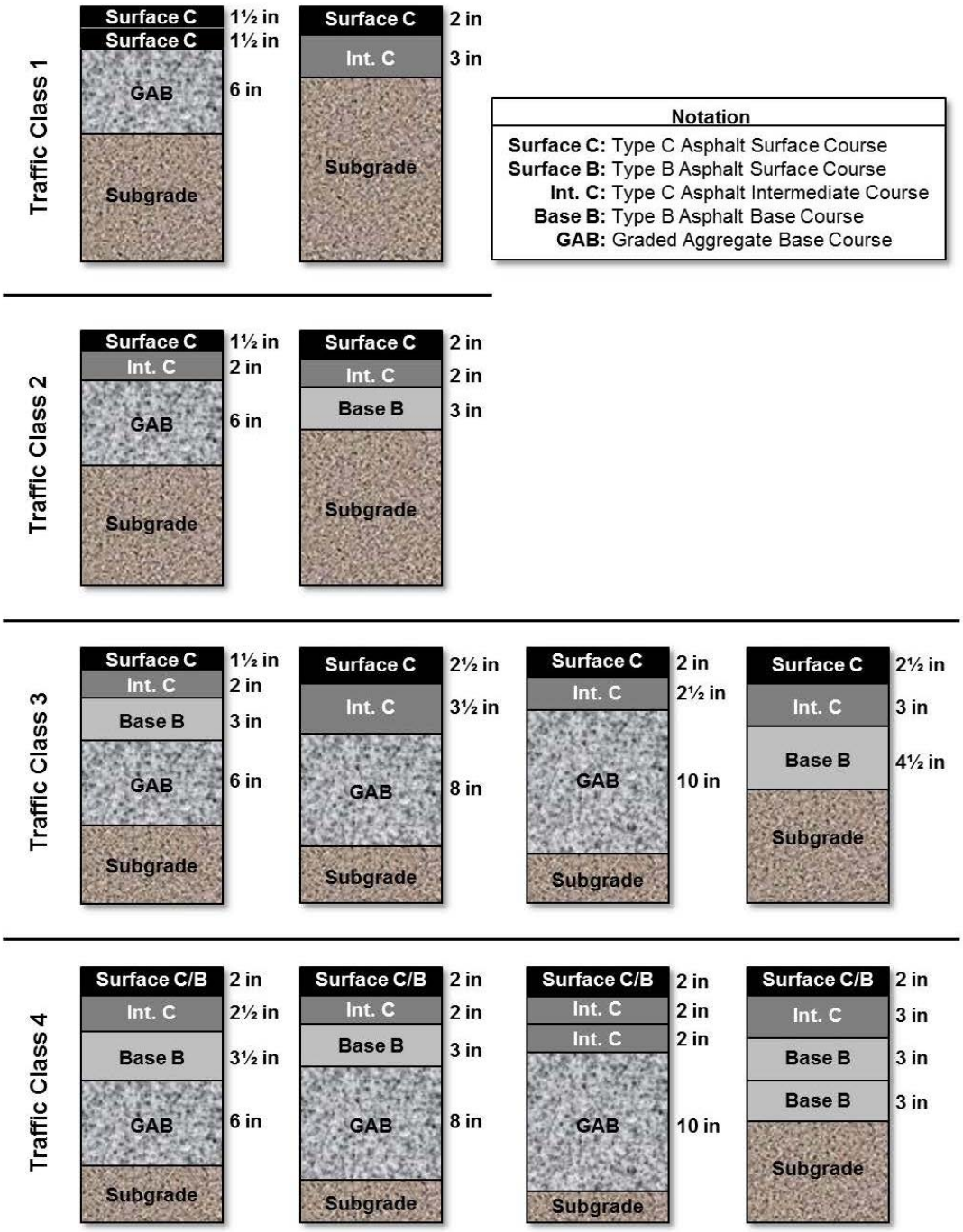

Figure 7: Poor Subgrade

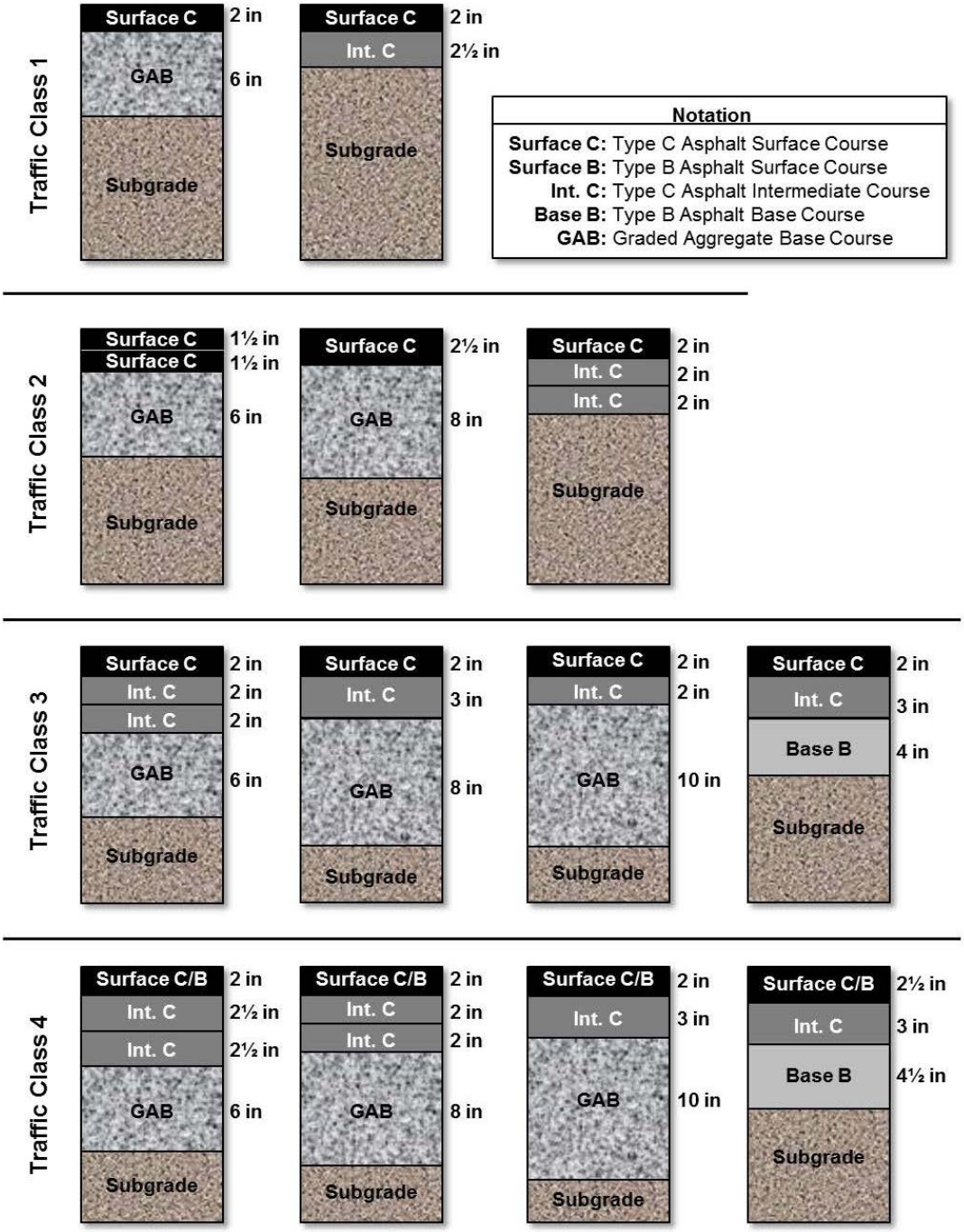

Figure 8: Medium Subgrade

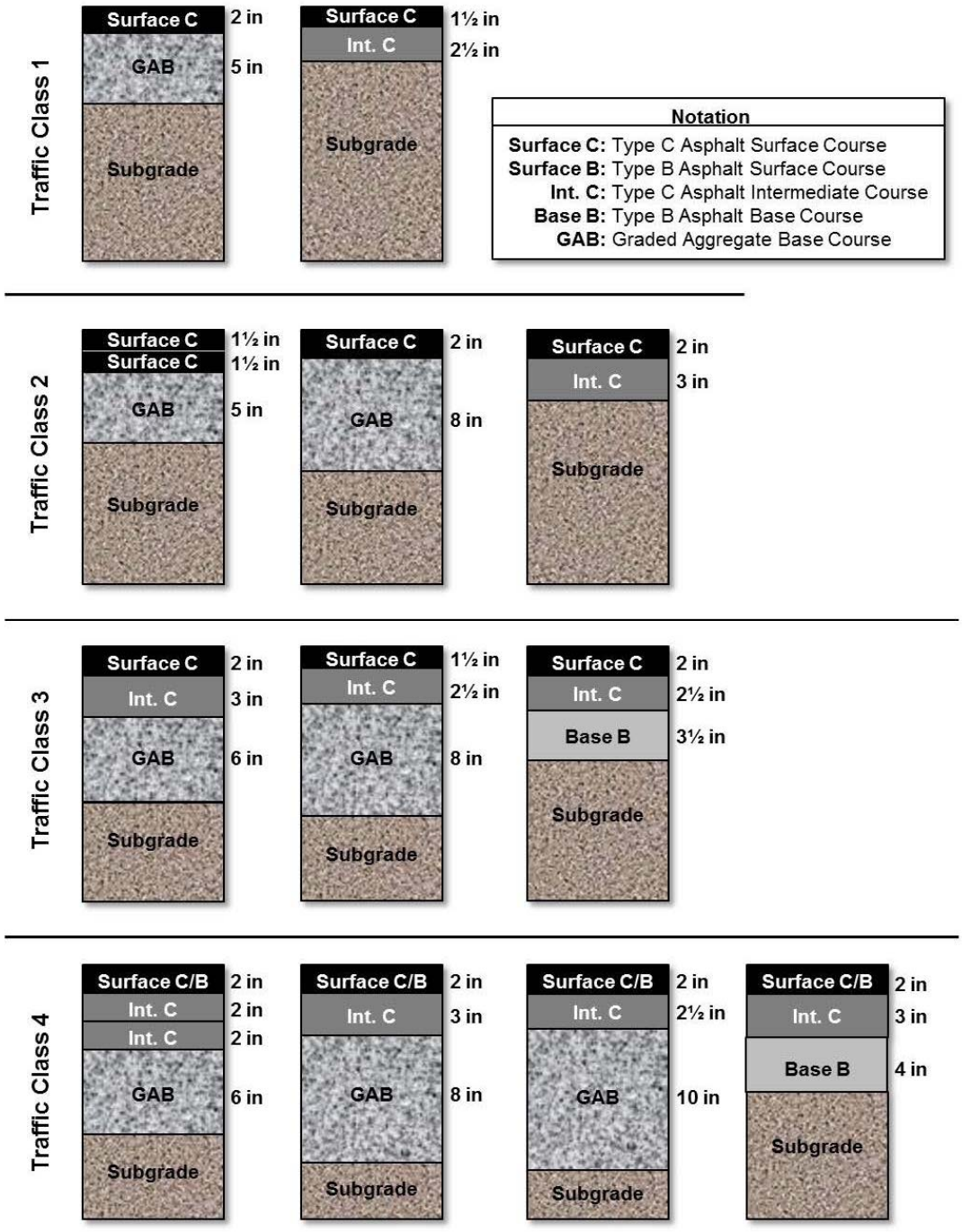

Figure 9: Good Subgrade

Road Connectivity

The arrangement of roads in a subdivision shall provide for the alignment and continuation or extension of existing roads in adjoining areas in compliance with the standards set forth in this section. Greater widths may be required if the existing road is identified for widening in the county's thoroughfare plan.

Where it is deemed necessary to the development of a logical road pattern and transportation network, roads and rights-of-way shall be extended to the boundary of adjoining property. Incompatible characteristics of adjoining property shall be given due consideration in making a determination of what shall constitute a logical road pattern. Reserve strips adjoining road rights-of-way for the purpose of preventing access to adjacent property shall not be permitted.

Construction of Dead End Roads

Temporary dead end roads shall be provided with a temporary turnaround having a roadway surface diameter of eighty (80) feet, or other approved type of turnaround.

Reservation of Road Connections

In certain situations, the development review team may permit a platted lot to be "reserved for future connection" in lieu of construction of the road connection. In the event the connection is constructed, any remaining property shall be conveyed to adjoining property owners.

In the event that the adjoining property is later developed in such a manner that it is determined that the connection is not required or desirable, the reservation will be terminated, ownership of the lot will remain with the developer and the escrow account refunded to the developer. If the extension has not been constructed within the ten (10) year period, the development review team will determine the continued necessity of the extension and either extend the time of the escrow account or recommend that the reservation be terminated, with ownership of the lot remaining with the developer and the escrow account being refunded to the developer.

Conservation Area Access

One (1) private access easement shall be allowed across a conservation area, provided that such access is at least twenty (20) feet in width and provides access to no more than one (1) parcel.

Chapter 8: Road Construction and Testing

Clearing and Grubbing

All work associated with clearing and grubbing of all debris, vegetative matter, trees, stumps and obstructions within the limits of disturbance such as roadway, right-of-way, easement areas, ditches and etc., unless otherwise stated to remain in accordance to the approved set of plans. All clearing and grubbing work shall be authorized under a Richland County issued land disturbance permit. The Contractor shall confirm all organic, vegetative matter (roots, stumps, logs and etc.) have been removed from the roadway area and document any unsuitable soil conditions with the right-of-way. The report shall be submitted to the County Engineer's office for review and approval. **(sample form needed)**

Road Embankment

All stumps and large roots must be removed from the roadbed prior to placement of fill for embankments regardless of fill height. All roadway embankment and embankment fill must be approved by and signed off on by the geotechnical engineer. Roadway embankments fill to be placed and compacted in lifts not exceeding 8". The contractor is responsible for providing geotechnical testing and documentation that the embankment material has been compacted to 95% of maximum proctor density. Density testing of embankment fills to be performed every 1ft. of fill every 250 ft. alternating lanes with a minimum of 2 tests per road, per 1ft. of fill. Community Planning and Development's office is to be copied on all testing. No proof-roll of the sub grade will be scheduled until the compaction has been documented.

Road Embankment Modifications

Any roadway embankment modifications (extra stone, soil cement, lime treatment, geo grid, etc.) must be approved by the geotechnical engineer and the Community Planning and Development's office notified of such modifications.

Materials and Equipment

Materials and Equipment used for all Roadway Courses shall be in accordance to the latest edition of the SCDOT Standard Specifications and in working condition necessary for the construction, application, placement and maintenance.

Road Construction Requirements

The typical flexible pavement structure consists of: subgrade course, base course and surface course

and shall be in conformance with lines, grades, dimensions and cross-sections shown on approved construction plans:

Subgrade Course

The following subgrade types are acceptable to Richland County:

- Cement Modified Subgrade can be used in the modification of an existing subgrade by adding Portland cement, pulverizing the in-place soil, mixing, shaping, compacting, curing and finishing the mixed material to form a sub base for a pavement structure.
- Soil Aggregate Subgrade can be used for the increasing the strength of the subgrade or sub base by adding aggregate, crushed stone and the construction of a soil-aggregate sub base on a properly prepared foundation course (subgrade or sub base) for pavement structure.

Native Soils Subgrade can be used as a subgrade and must be properly prepared for construction and pavement structure.

Construction of Subgrade Courses

Cement Modified and Soil Aggregate Subgrade Courses shall include roadbed preparation, pulverization, cement application, mixing, compacting, curing and surface smoothness shall be in accordance in the latest edition of the SCDOT Standard Specifications.

Prior to placement of these subgrade courses, the subgrade shall be prepared in accordance to the latest edition of the SCDOT Standard Specifications.

Curing, opening to traffic, reconstruction process shall be in accordance with the latest edition of the SCDOT Standard Specifications.

Maintenance of Subgrade Courses

Cement Modified and Soil Aggregate Subgrade Courses shall be maintained in good condition until all work is complete and accepted. Any defects that may occur must be repaired immediately. Any repairs made shall be to the full depth of the sub base.

Mix Design Requirements

Prior to field installation of Cement Modified Subgrade or at the time of design construction plans submittal, a proposed mix design shall be submitted to the Community Planning and Development's office for review and approval. The geotechnical engineer or design professional shall submit the proposed mix design. The mix design shall include the following:

- aggregate gradation data
- liquid limit
- plastic limit and plasticity index of soils,
- cementitious materials
- compressive strength
- standard proctor Moisture Density relationship curve
- auger boring data

The subgrade will need to be maintained in a smooth, rut free, fully compacted condition. The subgrade must remain adequately drained and free from depressions and deleterious materials.

Under no circumstances, can any base, surface course or pavement be placed on the subgrade before it is inspected and approved by the Community Planning and Development Division.

Under no circumstances, can materials be stockpiled or stored on the subgrade without prior approval of the Community Planning and Development Division.

Under no circumstances, can any base, surface course or pavement be placed on the subgrade that is muddy, frozen or unstable.

Table 21: Subgrade Course Testing Requirements

Cement Modified	Mix Design Required	Staggered Intervals not to Exceed 500 Feet for two (2) Lane Roads	
Soil Aggregate	Mix Design Required	Staggered Intervals not to Exceed 500 Feet for two (2) Lane Roads	Prime Coat to be Applied

- Sand Clay Base Course
- Soil Aggregate Base Course
- Graded Aggregate Base Course: Macadam Base Course and Recycled Portland Cement Concrete
- Base Course
- Stabilized Aggregate Base Course or Graded Aggregate Base Course
- Cement Modified Recycled Base Course
- Cement Stabilized Earth Base Course (Soil Cement**)**

Sand Clay

- Staggered intervals not to exceed 250 foot for 2 lane roads
- Prime coat to be applied

Soil Aggregate

- Staggered intervals not to exceed 250 foot for 2 lane roads
- Prime coat to be applied

Stabilized Aggregate

- Staggered intervals not to exceed 250 foot for 2 lane roads
- Prime coat to be applied

Cement Modified Recycled

- Staggered intervals not to exceed 500 foot for 2 lane roads

Cement Stabilized Earth (Soil Cement)

- Mix design required
- Staggered intervals not to exceed 250 foot for 2 lane roads
- 300 psi required comprehensive strength

Macadam

- Staggered intervals not to exceed 250 foot for 2 lane roads
- Prime coat to be applied

Recycled Portland Cement Concrete

- Mix Design Required
- Staggered intervals not to exceed 250 foot for 2 lane roads
- Prime coat to be applied

Figure 10: Subgrade Course Testing Requirements

Binder | Intermediate Course

The following Binder and Intermediate Course types are acceptable to Richland County:

- Asphalt Concrete Binder Course
- Asphalt Concrete Intermediate Course

Construction of Binder | Intermediate Course

Asphalt Concrete Binder or Intermediate Course shall be constructed in accordance to the latest edition of the SCDOT Standard Specifications.

Maintenance of Binder | Intermediate Course

Asphalt Concrete Binder or Intermediate Courses shall be maintained in good condition until all work is complete and accepted. Any defects that may occur must be repaired immediately. Any repairs made shall be to the full depth of the intermediate course.

If asphalt concrete binder or intermediate course is in place for nine (9) months without surface course, the binder course is subject to an inspection. A proof roll inspection and geotechnical engineering evaluation will be required to assess the condition of the course. If the proof roll fails, then a geotechnical recommendation must be submitted for review within ten (10) days of the proof roll. Repairs, according to the approved geotechnical evaluation, must be completed within thirty (30) of the approval by Richland County. The intermediate I binder course is subject to a proof roll and geotechnical evaluation every six (6) months until the surface course is installed.

Surface Course

The following Surface Course types are acceptable to Richland County:

- Asphalt Base Course Type C
- Asphalt Base Course Type D

Construction of Surface Course

Compacting, rolling, finishing and opening to traffic shall be in accordance with the latest edition of the SCDOT Standard Specifications.

Maintenance of Surface Course

Asphalt Base Course Type C and D shall be maintained in good condition until all work is complete and accepted. Any defects that may occur must be repaired immediately. Any repairs made shall be to the full depth of the surface course.

Weather Restrictions

Asphalt Base Course Type C and Asphalt Base Course Type D cannot be applied on a wet surface or when the ambient temperature is below 45^{O}F.

Asphalt Mixture Placement Quality Control Verifications

During all asphalt mixture placement and compaction operations, a density gauge shall be in use. Asphalt roadway quality control verifications shall be documented by a certified Asphalt Roadway Technician. The rolling and compacting roadway verification shall include the following:

- Proper number and type of rolling and compacting equipment
- Rolling equipment meet the SC-T-65 procedure for SCDOT specifications.
- Establish a roller pattern
- Identify asphalt type, depth thickness, mixture placement and compaction during production
- Document ambient air and temperature

Materials, mixture composition, equipment and construction of Hot Mixed Asphalt Surface Courses (Types 1, 2, 3 and 4 or latest equivalent approved by SCDOT may be used with prior approval of the County Engineer's Office and in accordance with the latest edition of SCDOT Standard Specifications and AASHTO standards.

If the County Engineer's Office determines that the asphalt surface course has areas of non-uniformity

between coarse and fine aggregate particles within the compacted surface course pavement. The contractor and developer are responsible for correcting all segregated areas. These areas are to be removed and replaced for the full depth of the surface course with 10 feet on either side of the segregated areas for the full width of the paving lane.

Table 22: Road Way Course Requirements

Roadway Courses	Mix Design Required	Testing Frequency[1]	Prime Coat Required[2]
Subgrade Course			
Cement Modified	yes	500 ft per 2 lane roadway	-
Soil Aggregate		250 ft per 2 lane roadway	yes
Base Course			
Sand Clay		250 ft per 2 lane roadway	yes
Soil Aggregate		250 ft per 2 lane roadway	yes
Stabilized Aggregate		250 ft per 2 lane roadway	-
Cement Modified Recycled		500 ft per 2 lane roadway	-
Cement Stabilized Earth (Soil Cement)	yes	250 ft per 2 lane roadway	yes
Macadam		250 ft per 2 lane roadway	yes
Recycled Portland Concrete Cement	yes	250 ft per 2 lane roadway	yes
Cement Stabilized Aggregate	yes	250 ft per 2 lane roadway	
Asphalt Binder/Intermediate		500 ft per 2 lane roadway	Yes (tack coat)
Surface Course			
Asphalt Base Course Type C	yes	500 ft per 2 lane roadway	Yes (tack coat)

Proof Rolling

A proof roll inspection involves the following components: the specifications for equipment, construction and requirements of testing the roadway embankment and subgrade for compaction uniformity and stability through a proof roll inspection.

Equipment

The contractor shall ensure that the equipment used is in acceptable working condition necessary for the construction and testing in areas subject to proof roll inspections. A fully loaded tandem axle dump truck or an approved equivalent by the County Engineer's Office is accepted for proof rolling. The approved equipment shall only have air-filled pneumatic tires with a pressure between 70 and 90 psi while proof rolling.

Special Condition | A motor grader can be used for proof rolling concrete curb and gutter only as an alternative to a fully loaded tandem axle dump truck.

Proof Roll Types

- Concrete Curb and Gutter
- Cement Stabilized Earth (Soil Cement)
- Subgrade
- Embankment
- Base Course
- Existing Base Courses (in some cases)
- Existing Surface Courses (in some cases)

Proof Rolling Method

Each lift of embankment and subgrade below the finished subgrade elevation before placement of subsequent lifts shall be proof rolled. Prior to scheduling any proof roll inspections, all density testing data must be submitted to and approved by the Community Planning and Development Division.

All proof rolls are to be performed in the presence of the County Engineer's Office representative or a certified earthwork, drainage and base inspector designated by the Community Planning and Development Division, geotechnical engineer and contractor.

Concrete Curb and Gutter Proof Roll and Soil Cement

Proof rolls may be performed for concrete curb & gutter and soil cement at the request of the contractor. No proof roll inspection can be conducted without prior Richland County approval of the submitted density and subgrade condition reports. Proof roll inspection shall use a fully loaded tandem axle dump truck or full sized motor grader (for concrete curb & gutter only).

The contractor shall schedule this inspection with the Community Planning and Development Division.

The geotechnical engineer, Richland County Engineer's office and contractor shall be represented and in attendance for the proof roll inspection. The County Engineer's Office reserves the right to conduct or require additional testing at any time.

At the request of the contractor, Concrete Curb & Gutter Proof Roll can be conducted with soil cement proof rolls simultaneously with prior approval from the Community Planning and Development Division. A proof roll geotechnical engineer's inspection/observation report shall be submitted to the Community Planning and Development Division.

Embankment, Subgrade and Base Course Proof Rolls

Proof rolls may be performed for embankment, subgrade and base course at the request of the contractor. No proof roll inspection can be conducted without prior Richland County approval of the submitted density and subgrade condition reports. Proof roll inspection shall use a loaded tandem axle dump truck only. The contractor shall schedule this inspection with the Community Planning and Development Division. The geotechnical engineer, Richland County Engineer's office and contractor shall be represented and in attendance for the proof roll inspection. The Community Planning and Development Division reserve the right to conduct or require additional testing at any time. A proof roll geotechnical engineer's inspection/observation report shall be submitted to the Community Planning and Development Division.

Existing Binder Course Proof Roll

Proof rolls may be performed for existing base course that has been in place for # period of time at the request of the contractor. No proof roll inspection can be conducted without prior Richland County approval of the submitted density and subgrade condition reports. Proof roll inspection shall use a fully loaded tandem axle dump truck only. The contractor shall schedule this inspection. The geotechnical engineer, Richland County Engineer's office and contractor shall be represented and in attendance for the proof roll inspection. The County Engineer's Office reserves the right to conduct or require additional testing at any time. A proof roll geotechnical engineer's inspection/observation report shall be submitted to the County Engineer's Office.

Existing Surface Course Proof Roll

Proof rolls may be performed for existing surface course that has been in place for **#** period of time at the request of the contractor. No proof roll inspection can be conducted without prior Richland County approval of the submitted density and subgrade condition reports. Proof roll inspection shall use a fully loaded tandem axle dump truck only. The contractor shall schedule this inspection. The geotechnical engineer, Richland County Engineer's office and contractor shall be represented and in attendance for the proof roll inspection. The County Engineer's Office reserves the right to conduct or require additional testing at any time. A proof roll geotechnical engineer's inspection report shall be submitted to the County Engineer's Office.

Flowable Fill

Flowable fill is acceptable to Richland County for the use of backfilling for abutments, bedding and encasement of pipes, catch basins, manholes, drop inlets, utility trenches and etc. The materials, equipment, construction, preparation and placement of Flowable Fill shall be in accordance to the latest edition of the SCDOT Standard Specifications.

Roadway Repairs

All roadway repairs must be approved by the Community Planning and Development Division prior to repair work. A geotechnical roadway repair recommendation must be submitted to the Community Planning and Development Division for review and approval. A geotechnical observation report of the repair must be submitted to the Community Planning and Development Division once work is complete.

Full Depth Asphalt Pavement Patching

Full Depth Asphalt Pavement Patching removes the material in the failed area and is replaced with fresh asphalt mixture. The approved method of full depth asphalt pavement patching shall include excavation or removal of damaged/failed area as determined by the County Engineer's office with straight and vertical cuts. The excavation or removal of the pavement shall be as much pavement as necessary, including granular base and subgrade, until a firm foundation is reached. The foundation shall be at least strong as the original pavement.

The minimum patch size shall be of 6 feet x 6 feet with at least 25 feet between patches. If unsuitable material is encountered during excavation, remove additional material as directed by the County Engineer's office. The faces of excavation or removal should be straight, vertical and solid. The sides of the existing asphalt pavement before placing the asphalt patch material shall be thoroughly tacked. The asphalt patch material shall be backfilled in layers not exceeding 3 inches. The asphalt patch material shall be carefully to avoid segregation in the mix. Each layer shall be thoroughly compacted with a vibratory roller. After compaction, ensure that enough material is at grade with the surrounding existing pavement.

All full depth asphalt pavement patching work shall be conducted so that the removal and repair work is conducted within the same day and open to traffic within the same day. Ensure that the finished patch surface is smooth. Full depth asphalt pavement patching work shall not be conducted when the existing surface is wet or frozen.

Milling Existing Asphalt Pavement

Existing asphalt pavement is to be milled according to the specified width, depth and cross-slopes at

locations shown on the approved set of construction plans or roadway repair recommendations. Existing Asphalt Pavement can be milled as directed by the County Engineer. The milled surface shall be smooth, clean and free from of all loose particles. All milled material shall be disposed. Existing drives and intersections are to be tied to milled surfaces.

Removal of Existing Asphalt Pavement before Patching

Damaged asphalt pavement shall be removed to the width and depth as approved by the County Engineer's office based on a signed, sealed geotechnical engineer recommendation. Patching cannot occur when the existing surface is wet or frozen. Ensure that the finished patch is smooth riding surface. The minimum patch size shall be of 6 feet x 6 feet with at least 25 feet between patches. If unsuitable material is encountered during excavation, remove additional material as directed by the County Engineer's office. The faces of excavation or removal should be straight, vertical and solid.

Removal of Existing Concrete Curb and Gutter, Sidewalk or Driveway

The removal of existing Concrete Curb and Gutter, Sidewalk or Driveway shall include excavation or removal of damaged/failed area as determined by the County Engineer's office with straight and vertical cuts. The excavation or removal of the pavement shall be as much pavement as necessary. The foundation shall be at least strong as the original pavement.

Ensure that the manner of construction, mixing and placing of concrete, expansion and contraction joints, final finish, protection and curing shall be in accordance with the latest edition of the SCDOT Standard Specifications. If unsuitable material is encountered during excavation, remove additional material as directed by the Community Planning and Development's office. Suitable material shall be placed as directed by the Community Planning and Development's office.

Roadway Signs/Traffic Control Devices

Road signs, in conformance with the requirements of the Federal Highway Administration's Manual on Uniform Traffic Control Devices 2012 Edition with Revisions 1 and 2 incorporated; provided, however, if a later edition is published, this latest edition shall be used; and with the addressing coordinating specialist, shall be located at all intersections in a manner approved by the county engineer.

Roadway Signs

Any sign within a new development shall be installed by the developer at his/her own expense. Signs will be aluminum blanks on metal posts fabricated and mounted in a standard design established by the director of public works. Such signs shall have white reflective lettering a minimum of six (6) inches in height on a reflective background. Signs located on multi-lane roads with a speed limit of 40 mph or greater shall have lettering a minimum of eight (8) inches in height. A green background shall denote

a public road and a blue background shall denote a private road.

Unless directed otherwise by the County Engineer, speed limits shall be posted at the maximum allowable design speed based on the

geometric design criteria of the road defined in this chapter and based on the current legal speed limit

Traffic Control Devices

All traffic control devices required by the Federal Highway Administration's Manual on Uniform Traffic Control Devices 2003 Edition with Revisions 1 and 2 incorporated shall be installed by the developer at his/her own expense. All devices shall conform to the required size and reflectivity found in the Manual on Uniform Traffic Control Devices 2003 Edition with Revisions 1 and 2 466 incorporated. Provided, however, if a later edition of the "Manual on Uniform Traffic Control Devices" is published, this latest edition shall be used.

Chapter 9: Inspections and Enforcement

Inspections Authority

Land Development Division Inspectors are authorized by Richland County to inspect and enforce the requirements of the Land Development Ordinance. The inspectors shall be:

- Authorized to conduct inspections and file reports for periodic inspections as necessary during construction to assure compliance with the approved plans.
- Authorized to furnish the permittee or agent the results of inspections in a timely manner after the completion of each required inspection.
- Authorized to issue a "Notice of Violation (NOV)" to the permittee or agent when any portion of the work does not comply with the approved plans.
- Authorized to issue a "Stop Work Order (SWO)" to the permittee or agent when any portion of the work does not comply with the approved plans.
- Authorized to pursue Civil Litigation as a result of unsafe conditions, working without a permit, unsatisfactory work progress, or other non-compliance.
- Authorized to conduct a final inspection upon the completion of the project to determine if the completed work is constructed in accordance with the approved set of design plans and/or As- built plan certified by the permittee's registered professional engineer.

Inspections Responsibility

Richland County Inspectors shall conduct periodic site inspections on all land disturbing activities. The person responsible for the land disturbing activity must arrange for the appropriate representatives to attend a Richland County pre-construction meeting and shall notify the Richland County Inspector before the initiation of construction and upon project completion. After the project completion is certified by a design professional, a final inspection will be conducted to ensure compliance with the approved Land Disturbance Permit. Richland County Inspectors shall enforce the following inspection items:

- Ensure that the approved set of plans and associated (onsite) stormwater pollution prevention plan are located on the project site and are properly being followed and implemented.
- Ensure that active construction sites are inspected for compliance with the approved plans on a regular basis.
- Provide the person financially responsible (or designee) for the land disturbing activities a written report after every inspection.
- Date and Location of the site inspection
- Compliance status of "Pass" or "Fail"
- List of all deficiencies and time-frames by which to correct
- Pictures on the report for some of the urgent deficiencies
- Notify the person financially responsible (or designee) for the land disturbing activities in

writing within seven (7) working days after the issuance of a violation (posted card) order.

Sediment & Erosion Control Inspections

Upon the issuance of a Land Disturbance Permit, construction can commence. Projects disturbing more than an acre are required by DHEC to hire an inspector to conduct sediment & erosion control inspections weekly until the project is complete, per the local jurisdiction, and coverage has been terminated by DHEC. Richland County Inspections will conduct their own compliance inspections which includes making sure third-party inspections are being conducted and are accurate.

Roadway Inspections

Richland County Inspectors shall conduct periodic site inspections on roadway construction inspections. Richland County Inspectors shall enforce the following inspection items and ensure that the road is built with quality construction materials, the best practices and the roadway is being built according to approved set of plans are followed.

Final Inspections

Upon completion of a project, a Final Inspection can be requested. All final inspection (and follow-up) requests must be sent to pwinspections@rcgov.us with "FINAL INSPECTION REQUEST" in the subject line. The email will be acknowledged within 24 hours and an inspection can be scheduled within 5-7 business days due to the necessary coordination among departments. The Engineer Certification (.pdf) must be attached to the request. Partial inspections are not granted. Prior to requesting a final inspection, the engineer will certify the following:

- All infrastructure is in and functioning according to the design.
- All temporary controls have been removed (unless special exception is granted)
- All ponds are in their permanent state which includes being stabilized, sediment removed, skimmers and baffles removed, and fore-bay removed and restored.
- Etc. (remainder on certification)

Sidewalks

All sidewalks within future or Richland County Right-of Way must be installed prior to the final inspection of streets and storm drainage and formal street acceptance.

Special Investigations

Richland County Inspectors shall conduct investigations on any related land disturbing activities or project sites. The inspector will ensure that best management practices are being used and proper

permitting and authorization has been followed.

Issuing Violations

The Land Development Division shall issue a 'Notice of Violation' and 'Stop Work Order' upon non-compliance of the Richland County Land Development Ordinance. In most cases, the 'Notice of Violation' is used as the first offense for ignoring a failed report. Subsequent non-compliance with the Ordinance or failure to take corrective action within the specified time period may result in a 'Stop Work Order.'

For violations that involve the safety of life, or an imminent threat of serious damage to the environment and public or private property, 'Notice of Violations' and 'Stop Work Orders' may be issued for, but not limited to the following:

- Construction not in accordance with the approved plans
- Failure to have third-party inspections conducted
- Working without grading, building, or other applicable permits
- Failure to have sediment and erosion control measures in place, improper installation and/or improper maintenance of BMPs.
- Failure to have the required documentation onsite.
- Adverse/offsite impact to any adjacent property, environmental feature, water body or storm water system.

Notice of Violation

The purpose of this correction order is to notify the owner/permittee and or contractor/developer of deficiencies noted during specific inspections. Construction can commence but the contractor 'must' work towards corrective actions. Notice of Violations shall be submitted in writing, and a card posted onsite if it shall result in immediate compliance as the work is being completed. The Division shall give written notice to the violator within seven (7) working days of the inspection.

The inspectors will consider the following criteria when determining a proper response:

- Magnitude of the violation
- Duration of the violation
- Effect of the violation on the receiving water body
- Effect of the violation on the storm water system
- Compliance history of the violator
- Good faith of the violator

Stop Work Order

The purpose of this correction order is to 'stop' the owner/permittee and or contractor/developer from all land-disturbing activity. Stop Work Orders shall be submitted in writing and a card posted onsite immediately. The Division shall give written notice to the violator within seven (7) working days of the inspection.

The inspectors will consider the following criteria when determining a proper response:

- Response to any previous order or failed report
- Magnitude of the violation
- Duration of the violation
- Effect of the violation on the receiving water body
- Effect of the violation on the storm water system
- Compliance history of the violator

Third Party Inspections

Third-party inspectors shall conduct inspections for compliance of the approved set of plans and approved storm water pollution prevention plan during the construction phase (until Notice of Termination is processed by Richland County) of a project:

- Every seven calendar days and within 24-hours after each rainfall event that produces ½-inches or more of precipitation.
- At the request of Richland County
- At request of the permittee, and
- Due to a complaint of any construction impacts

Reports must be placed in the construction box onsite within 72-hours of completion and must be emailed to pwconstructionreports@rcgov.us within 72-hours of completion.

Civil Citations

The issuance of Civil Citations by the Inspector may be made for the following situations:

- When a 'Notice of Violation' and/or 'Stop Work Order' has not been complied with or there has no substantial progress in complying with the 'Notice of Violation' or 'Stop Work Order.'
- When a Stop Work Order has been issued, and work still continues in defiance of the order. Under such circumstances, the Civil Citation shall be issued for the storm water management violation.
- When repeated, reoccurring violations take place at the same development site or when repeated reoccurring violations take place by the same responsible party. Each day that a violation remains uncorrected constitutes a separate applicable violation.
- Citations will be sent by Certified Mail. Owners, agents, permittees, lessees, builders, contractors,

developers, firms, corporations, or partnerships listed on the permit application or tax record may be cited under this provision

Criminal Penalties

The County has the authority to charge any person violating any provision of this ordinance with a misdemeanor punishable within the jurisdictional limits of magistrate's court. Each day of a violation shall constitute a new and separate offense.

Chapter 10: Project Closeout & Dedication

Closeout (Project Completion)

All Projects that have been submitted, approved and received Land Disturbance Permits will require a Closeout Package to be submitted. This package needs to include at a minimum:

1. Surveyed as-built drawings
2. As-built calculations
3. PTOs for applicable utilities
4. Notice of Termination.
5. Engineer's Certification

For Residential Projects, roadways and associated storm drainage constructed according to the approved set of plans may be dedicated to Richland County for ownership and maintenance. This is accomplished through the County's Closeout Process and the County reserves the right to deny acceptance of any project petitioned to be turned over to the County.

Upon being granted an approved final inspection, a Closeout Package can be submitted to the Department of Public Works for review. The package must include the above-referenced items and items in Steps (1) & (2) can be submitted simultaneously. All information must be submitted through the Trakit system and the applicant should choose "Closeout Permit" when applying for the permit and should include the following:

- Record Drawings – The drawings must include "ALL" improvements and final road & storm drainage profiles.
- Record Drawings (CAD) – The digital submission should be a (.dwg) or (.dxf) file and must include all layers.

Also, as a condition for acceptance of infrastructure into the County system, Richland County requires a one-year warranty accompanied by a bond in the amount of 100% of the construction cost. The warranty will pertain to the design and construction of the streets and accompanying drainage system in accordance with the Road Design Standards and their satisfactory performance during the warranty period. The warranty period begins with the County's execution of the deed.

All pavement failures and other structural defects that are detected during the warranty period are to be corrected by the grantor upon official notification by the Department of Public Works.

Dedication of Infrastructure

Upon receipt of the dedication package, the Department will review all information for accuracy. If all information is accounted for and accurate, a recommendation will be submitted to the County Engineer for acceptance of the project into the County inventory within three (3) days of receipt of a complete package. The dedication package must include the following:

- Certificate of Title
- Deeds (Road Right-of-Way)
- Deeds (Storm Drainage Easements)
- Affidavit (For Department of Revenue)
- Final Plat (Last Revised)
- Memorandum of Understanding

Chapter 11: Bond, Warranties and Agreements

Financial Surety

For purposes of these Standards, "Financial Surety" shall refer to a County approved instrument and arrangement undertaken by and at the expense of the developer, established to provide a financial guarantee in favor of the County. In the event of default or failure by the developer, the Financial Surety shall be seized upon so as to provide funds for the completion of all required infrastructure improvements.

In lieu of the completion of a subdivision (infrastructure improvements), prior to final plat approval, the developer can provide financial surety in an amount with surety and conditions satisfactory to it, providing for and securing to the county the actual construction and installation of all improvements within a specified time period as expressed in the financial documents. The following types of bonds shall be acceptable to the county, subject to review and approval by the Richland County Legal Department and/or the County Engineer or his/her authorized representative:

Surety Bond

A surety bond issued by an insurance company licensed to do business in the State of South Carolina in an amount equal to one hundred twenty-five percent (125%) of the estimated cost of improvements. The county engineer or his/her authorized representative will validate the remaining scope of work presented and the estimated cost of improvements.

Escrow Funds

A Certified Check may be accepted in an amount equal to one hundred twenty-five percent (125%) of the estimated cost of improvements. The county engineer or his/her authorized representative must validate remaining scope of work presented along with the estimated cost of improvements. The contract may authorize a reduction of the escrow account upon completion of a portion of the improvements, but at no time shall the escrow account be less than one hundred twenty-five percent (125%) of the remaining improvements.

Stocks or Bonds

Stocks and Bonds may be accepted as securities in the form of negotiable stocks or bonds in favor of the county in an amount at least two (2) times the estimated cost of improvements. The county engineer or his/her authorized representative must validate remaining scope of work presented along with the estimated cost of improvements.

Letter of Credit

An Irrevocable Letter of Credit may be accepted by a lending institution/bank licensed to do business in the State of South Carolina in an amount equal to one hundred twenty-five percent (125%) of the estimated cost of improvements. The county engineer or his/her authorized representative must validate remaining scope of work presented along with the estimated cost of improvements.

Financial Surety Security Period

All Financial Security instruments shall be posted with the County Engineer or his/her authorized representative for and on behalf of the County of Richland. The initial agreement will be in effect for one year, subject to conditions specified by the County and all subsequent extensions will be reviewed for eligibility to extend.

If requested by the developer, the Department, in its sole discretion, can extend the Financial Surety for a maximum of one year. Prior to granting an extension, the County Engineer or his/her authorized representative shall review actual cost estimates and work to be completed to ensure that the extended security is adequate to cover the remaining work.

Financial Surety Submissions

The Financial Surety Package shall be submitted directly to the Department, 2020 Hampton Street, 1st Floor, Columbia, SC 29202, Attention: Engineering Land Development Manager. A complete financial surety package shall include the following:

- Engineers Cost Estimate (Prepared by Engineer) Sealed and Signed. The cost estimate must include a breakdown of work to be completed to include unit cost and totals.
- Statement of Conditions (SOC) (Prepared by Developer or Representative). The SOC is the formal agreement between the County and Developer. This document will specify the terms of the agreement and specify an expiration date of the agreement.
- Bond, Letter-of-Credit or Certified Check (Prepared by Bank or Insurance Company)
- Memorandum of Understanding (Prepared by Richland County). The memorandum of understanding is an agreement between the Bank/Insurance Company and the County which describes the terms of the surety agreement between the Developer and County.
- The Bonded Plat should be submitted directly to the Planning Department electronically.

Financial Surety Tracking

Bonds are tracked for the benefit of Richland County. The Developer should not reply upon reminders from Richland County to manage the terms of the surety instrument, however, the County will take an active role in the process and establish a relationship with the bank or insurance company.

The County will also require the bank or insurance company to sign a memorandum of understanding as it relates to the agreement between the developer and the County.

The tracking process includes sending letters, at specified times prior to expiration, to all relevant parties. The following criteria apply:

- 90-Day Letter (Sent to Developer)
- 45-Day Letter (Sent to Developer & Lending Institution) ***CERTIFIED***
- 30-Day Letter (Series of call made to the Developer & Surety Institution)
- 15-Day Letter (Claims Letter Sent to Lending Institution – Developer Cc'd) ***CERTIFIED***

Financial Surety Reductions

Developers may apply for a reduction in the amount in the amount of the Financial Surety posted based on completed infrastructure improvements. In order to qualify for the reduction, a significant portion of any one of the following items must be installed in accordance with the approved plans: storm drainage, base, asphalt, curb and gutter, and sidewalks.

Richland County Inspections will verify completed work certified by the developer or the developer's engineer of record. Developers should be advised that they must ensure relevant work is complete and in accordance with the approved construction plans prior to making the reduction request.

Financial Surety Termination

Financial Surety must be kept current and in effect until such time a final inspection is performed, outstanding items are addressed, and the County Engineer or his/her authorized representative have made final acceptance of the project.

Upon final acceptance of the project, the County Engineer or his/her authorized representative will release the Financial Surety instrument within three (3) days of acceptance. A certified release letter will be sent to the developer and bank/lending institution of the release.

Definitions

Access point. An intersection, driveway, or any entry point on the right hand side of a road. An entry point on the opposite side of a road or a median opening may be considered an access point, if it is expected to influence traffic flow in the direction of interest. (Ord. 038-09HR; 7-21-09)

Alley. A private road primarily designed to serve as a secondary access to the side or rear of those properties whose principal frontage is on another road, either public or private, meeting minimum county requirements.

Americans with Disabilities Act (ADA). A federal law enacted in 1990 to protect the civil rights of individuals with physical or mental disabilities from intentional or unintentional discrimination in housing, employment, education, access to public services and telecommunications and to ensure that persons with disabilities have equal access to same. (Ord. 033-11HR; 6-21-11)

Annual Average Daily Trips (AADTs). The average twenty-four (24) hour traffic volume on a given roadway segment over a three hundred sixty-five (365) day period. (Ord. 038-09HR; 7-21-09)

Area of special flood hazard. The land in the floodplain subject to a one percent (1%) or greater chance of flooding in any given year. This term also includes all wetlands within a community. For purposes of these regulations, the term "area of special flood hazard" is synonymous in meaning with the phrase "special flood hazard area."

Arterial road - minor. A SCDOT designated roadway, as depicted on their "Functional Classification Map for the Columbia Urbanized Area", that carries a mix of local and through traffic and which links collector roads, and sometimes local streets, with principal arterials. (Ord. 038-09HR; 7-21-09)

Arterial road - principal. A SCDOT designated roadway, as depicted on their "Functional Classification Map for the Columbia Urbanized Area" that is primarily intended to provide traffic service between urban areas. (Ord. 038-09HR; 7-21-09)

Base flood or regulatory flood. The flood having a one percent (1%) chance of being equaled or exceeded in any given year.

Best Management Practices (Stormwater Management). A structural or nonstructural management-based practice used singularly or in combination to reduce nonpoint source inputs to receiving waters in order to achieve water quality and quantity protection goals.

BMPs. Best Management Practices (stormwater management); an acronym used to describe a structural or nonstructural management-based practice used singularly or in combination to reduce nonpoint source inputs to receiving waters in order to achieve water quality and quantity protection goals. (Ord.
006-10HR; 1-19-10)

BMPs Design Manual (stormwater management). The manual of design, performance and review standards for stormwater management BMPs to be used in Richland County. The requirements established by the BMPs Design Manual are mandatory. (Ord. 006-10HR; 1-19-10)

Borrow pits. An excavated area where naturally occurring earthen materials are to be removed for use as ordinary fill at another location.

Capital Improvement Plan (CIP). A general description of all existing public facilities and their existing deficiencies within the service area or areas of the governmental entity, a reasonable estimate of all costs, and a plan to develop the funding resources including existing sources of revenues related to curing the existing deficiencies including, but not limited to, the upgrading, updating, improving, expanding, or replacing of these facilities to meet existing needs and usage; and otherwise complies with the requirements of Section 6-1-960 (B) of the S.C. Code of Laws. (Ord. 038-09HR; 7-21-09)

Central Midlands Council of Governments (CMCOG). An association of local governments in Fairfield, Newberry, Lexington, Richland and portions of Kershaw and Calhoun counties to address multi-jurisdictional problems and opportunities. (Ord. 038-09HR; 7-21-09)

Clean Water Act. The Federal Water Pollution Control Act, as amended, codified at 33 U.S.C. §§ 1252 et seq. (Ord. 006-10HR; 1-19-10)

Collector Road. A roadway which provides connection between the arterial road system and local roads as well as traffic circulation within residential, commercial and industrial areas. (Ord. 038-09HR; 7-21-09)

Collocate. The act of using a single support structure and/or site by more than one (1) communication (i.e., wireless) provider.

Common Area. Land within a development, not individually owned or dedicated for public use, which is designed and intended for the common use or enjoyment of the residents of the development.

Conservation Area. Any parcel or area of undeveloped land conserved in its natural state for perpetuity through deeds or other legal measures. (Ord. 035–08HR; 6-17-08)

Controlled Access Zone. The area of an intersection that requires controlled traffic movement to preserve the safety of pedestrians, drivers, and other intersection users. (Ord. 018-10HR; 4-20-10)

Critical Root Zone. An area on the ground and adjacent to a protected tree that encompasses a distance of one (1) foot of space for every one (1) inch of the tree DBH measured outward from the center of the tree in all directions. (Ord. 055-12HR; 10-16-12)

Cross-Access Easement. An easement wherein a grantor conveys to a grantee, his/her/its heirs, successors in interest, and/or assigns, a perpetual nonexclusive easement that may include such matters as: vehicular and pedestrian access, ingress, egress; the location and amount of parking of

vehicles;
and/or landscaped areas; and/or any shared maintenance responsibilities. (Ord. 014- 10HR; 3-16-10)

Cul-de-sac. A road having one end open to traffic and the other end terminated by a vehicular turnaround; a dead-end street.

Design Capacity. The volume of annual average daily trips (AADTs) of a given roadway segment at which traffic flows with minimal delay. The design capacity is based on the geometry of the roadway segment and its functional classification. (Ord. 038-09HR; 7-21-09)

Designated Water Resource. A perennial surface water body that normally flows or contains water throughout the year, except during extreme droughts. These water bodies typically have a defined channel or shoreline and support a diverse population of aquatic insects, including some with life cycles that require permanent water. Those water bodies with channels are able to sort and move channel materials.

Developer. Any person acting on his own behalf as a property owner, or as an agent for a property owner, who makes application for development plan approval as set forth in this chapter.

Development. Any of the following actions undertaken by a public or private individual or entity: (a) any land altering activities associated with the division of a lot, tract, or parcel of land into two (2) or more lots, plots, sites, tracts, parcels, or other divisions by plan or deed; or (b) any human-made change to improved or unimproved real estate, including, but not limited to, buildings or other structures, clearing, mining, dredging, filling, grading, paving, berming, diking, excavation or drilling operations, or storage of equipment or materials.

Development with Open Space Design. A development pattern that arranges the layout of buildings in a compact area of the site which reserves a portion of a site for open space preservation and is protected in perpetuity. (Ord. 045-13HR; 9-10-13)

DHEC. The South Carolina Department of Health and Environmental Control.

Drainage. A general term applied to the outflow of water or other fluid from a given area, whether by natural means (surface water runoff) or artificial means (drains, grading, etc.).

Drainage Channel. Any natural or man-made conveyance for surface water, including open channels, enclosed storm sewers, streams, rivers, lakes, ponds, or marshes.

Drainage System. The surface and subsurface system for removal of water from the land, including both the natural elements of streams, marshes, swales, and ponds, whether of an intermittent or continuous nature; and the manmade elements such as improved open channels, culverts, retention facilities, and enclosed storm sewers.

Easement. A grant or reservation by the owner of land for the use of such land by others for a specific

purpose or purposes.

Erodible soils. Soils that can erode at excessive rates, such as Hydrologic Groups B and C. (Ord. 045-13HR; 9-10-13)

Encroachment (floodplain overlay district standards). The advance or progression of uses, fill, excavation, buildings, structures, or developments into a floodplain or floodway.

Encroachment permit. A permit issued by the County on county maintained roadways or by SCDOT on state maintained roadways to use a public right-of-way for any purpose. (Ord. 038- 09HR; 7-21-09)

Engineer. A person practicing engineering and licensed in the State of South Carolina pursuant to the requirements of Section 40-22-10, et seq., of the South Carolina Code of Laws, as amended.

Entitled Property. Any property that, prior to January 19, 2010 has been subject to either "Permitted Development Activity" or a "Valid Government Approval." If a Permitted Development Activity or Valid Governmental Approval has occurred with respect to any tract and such tract was subsequently subdivided, or in the future is subdivided, by an approved subdivision plat, then all subdivided parcels that were part of the original tract shall be considered Entitled Property. (Ord. 006-10HR; 1-19-10)

Ephemeral stream. A stream or reach of a stream that flows briefly only in direct response to precipitation in the immediate locality and whose channel is at all times higher than the water table. (Ord. 006-10HR; 1-19-10)

Erosion. The general process by which soil and rock fragments are detached and moved by the action of wind, water, ice and gravity, either naturally or induced.

Erosion and sediment control plan. A plan which adequately describes necessary land management practices and control measures, including a timetable or schedule for their installation, which will effectively minimize soil erosion and sedimentation; prepared and approved as provided herein for application to a particular land area. This plan shall be incorporated into the Stormwater Pollution Prevention Plan (SWPMP). (Ord. 006-10HR; 1-19-10)

Federal Highway Administration (FWHA). The agency that administers federal surface transportation regulations and provides funding for federal roads and MPO activities. (Ord. 038- 09HR; 7-21-09)

FEMA. The Federal Emergency Management Agency.

Fill. The placement of fill material at a specified location to bring the ground surface up to a desired elevation.

Fill material. Natural sands, dirt, soil and rock. For the purposes of floodplain management, fill material may include concrete, cement, soil cement, brick or similar material as approved on a case-by-case basis.

FIRM. See "Flood Insurance Rate Map."

Flood or Flooding. A general and temporary condition of partial or complete inundation of normally dry land areas, caused by the overflow of a watercourse or the unusual and rapid accumulation or runoff of surface waters from any source.

Flood Insurance Rate Map (FIRM). An official map of a community on which the FEMA has delineated both the areas of special flood hazard and the risk premium zones applicable to the community.

Flood Insurance Study. An official report provided by FEMA. The report contains flood profiles, as well as the Flood Boundary Floodway Map and the water surface elevation of the base flood. A Flood Insurance Study may include a study using detailed hydrologic and hydraulic analyses to model the base flood, determine base flood elevations, and designate floodways and risk zones (Zones AE, A1-30, AH and AO).

Floodplain. The areas adjoining a river, stream, watercourse, lake, or other body of standing water that have been or may be covered by floodwater.

Floodplain Development Permit. A document issued by the county authorizing the applicant to undertake development and related activity in a regulated floodplain.

Flood Prone Area. The area of land susceptible to being inundated by a flood (see definition of "flood").

Floodproofing. Design and construction of nonresidential structures and attendant utility and sanitary facilities that are watertight to at least two (2) feet above the base flood elevation. Walls are Current through 3-15-2016 23 substantially impermeable to the passage of water and have structural components capable of resisting hydrostatic and hydrodynamic loads and the effects of buoyancy.

Flood Resistant Materials. Any building material capable of withstanding direct and prolonged contact with flood waters without sustaining significant damage. The term "prolonged contact" means at least seventy-two (72) hours, and the term "significant damage" means any damage requiring more than low- cost cosmetic repair (such as painting).

Floodway. The channel of a river or other watercourse and the adjacent land areas which must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one (1) foot.

Functional Classification. An FHWA process, adopted by SCDOT and the MPO, by which roads are grouped into classes, or systems, according to the character of the service they are intended to provide. The MPO classifies roads as interstate, principal arterial, minor arterial or collector. (Ord. 038-09HR; 7-
21-09)

Grading. Any displacement of soil by stripping, excavating, filling, stockpiling, or any combination thereof, and shall include the land in its excavated or filled state.

Hazardous Material. Any substance that, because of its quantity, concentration, or physical or chemical characteristics, poses a significant present or potential hazard to human health and safety or to the environment if released into the workplace or the environment.

Highest Adjacent Grade. The highest natural elevation of the ground surface, existing prior to construction, next to the proposed walls of the structure.

Illegal Discharge. Any activity that results in a discharge to a stormwater system or receiving waters that is not composed entirely of stormwater; provided, however, this does not include: (a) discharge pursuant to an NPDES permit (other than the NPDES permit issued for the Richland County stormwater system and its co-permittees), (b) discharges resulting from fire-fighting activities, and (c) any activity specifically addressed in this Code of Ordinances or by Richland County as not being significant sources of pollution. (Ord. 006-10HR; 1-19-10)

Illegal Dumping. The disposal of waste in an unpermitted area or the pouring of liquid wastes or trash into stormwater drains. (Ord. 006-10HR; 1-19-10)

Illicit Connection. A connection to a stormwater system that results in a discharge that is not composed entirely of stormwater run-off; provided, however, this does not include discharges pursuant to an NPDES permit (other than the NPDES permit issued for the Richland County stormwater system and its co-permittees). (Ord. 006-10HR; 1-19-10)

Illicit Discharge Detection and Elimination (IDDE) Program. The third Minimum Control Measure of the Stormwater Phase II Rule; it is a program, employing a plan that should include procedures for locating priority areas likely to have illicit discharges, procedures for tracing the source of an illicit discharge, procedures for removing the source of the discharge, and procedures for program evaluation and assessment. (Ord. 006-10HR; 1-19-10)

Improper Disposal. Any disposal other than through an illicit connection that results in an illegal discharge, including, but not limited to, the disposal of used oil, toxic materials or other hazardous liquids or substances resulting from the improper management of these materials. (Ord. 006-10HR; 1-19-10) Current through 3-15-2016 26

Impede the free flow of water. Any change to water elevation or velocity due to obstructions, diversions, or retardation, including changes to the flow characteristics of the waters of the regulatory flood as they pass both the upstream and the downstream boundaries of the property.

Impervious Surface. Any hard-surfaced, man-made area that does not readily absorb or retain water, including, but not limited to, building roofs, parking and driveway areas, graveled areas, sidewalks and paved recreation areas.

Impervious Surface Ratio. The ratio between the surface areas of a lot that is covered by impervious surfaces compared to the total surface area of a lot. (Ord. 018-10HR; 4-20-10)

I**mprovements**. Pavements, curbs, gutters, sidewalks, paths, bikeways, sedimentation control facilities, re-vegetation, water mains, sanitary and storm sewers, drain ways, gas lines, electrical and telephone lines and appurtenances, street signs, trees and lights, and any other similar items required for compliance with the regulations of this chapter or the conditions of approval.

Industrial Road. A road for which the intended use is somewhat less than that of an arterial road and somewhat greater than that of a collector road. Such roads will generally be located in industrial/commercial areas or be used to provide access for heavy vehicles or heavy vehicular volumes to such areas.

Inflow and infiltration. Groundwater or Stormwater entering into a sanitary sewer system as a result of damaged collection lines or manholes or from direct stormwater connections, such as from catch basins or roof drains. (Ord. 006-10HR; 1-19-10)

Infrastructure. Facilities and services that are needed to sustain industry, residential, commercial, and all other land use activities, including water and sewer lines and other utilities, streets and roads, communications and public facilities, such as fire stations, parks, etc. (Ord No. 061-08HR; 10-21-08)

Irrigation. A permanent, underground watering system equipped with surface, subsurface or overhead emitters and which provides one hundred percent (100%) water coverage.

Jurisdictional Line. A line identified or approved by the United States Army Corp of Engineers (USACE) describing areas to be protected under the Federal Clean Water Act. (Ord. 006-10HR; 1- 19-10)

Land. Any ground, soil, or earth including marshes, swamps, drainage-ways and areas not permanently covered by water.

Land Development Permit. A document signed by an authorized county official, as required in this chapter, as a condition precedent to the commencement of a use or the erection, construction, reconstruction, restoration, alteration, conversion or installation of a structure or building, which Current through 3-15-2016 27 document acknowledges that such use, structure, or building complies with the provisions of this chapter or an authorized variance therefrom.

Land Development Review, Major. The review of projects, exclusive of residential and commercial subdivisions, involving one (1) or more of the following: one hundred thousand (100,000) or more square feet of nonresidential floor space; one hundred and fifty (150) or more multi-family residential units, lots or manufactured home spaces in a manufactured home district; and/or the dedication of new public road segments or the dedication to the county of land for open space or other public purposes.

Land Development Review, Minor. The review of projects, exclusive of residential and commercial

subdivisions, which do not meet the standards for applicability for "land development compliance review" or "major land development review." Land disturbance. Any activity involving the clearing, grading, transporting, filling, and/or any other activity which causes the land to be exposed to the dangers of erosion.

Land Disturbance Permit. A certificate issued by Richland County to perform work pursuant to an approved SWPMP prepared under the provisions of this chapter. It is issued after DHEC issues coverage under an NPDES General Permit for Large and Small Construction Activities. (Ord. 006- 10HR; 1-19-10)

Land Surveyor. A person currently licensed pursuant to the requirements of Section 40-22-10, et. seq., of the South Carolina Code of Laws, as amended.

Landscape Architect. A person practicing landscape architecture and licensed in the State of South Carolina pursuant to the requirements of Section 40-28-10, et. seq., of the South Carolina Code of Laws, as amended.

Levee. A man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding.

Level of Service (LOS). A qualitative term describing how the traffic flow on a given road segment is perceived by its users, i.e. good conditions = A or B; tolerable conditions = C or D; and intolerable conditions = E or F. This relationship is measured by its current traffic volume to its engineering designed traffic volume ratio (v/c): (Ord. 038-09HR; 7-21-09)

LOS A = a v/c ratio of 0.00 to 0.49 LOS D = a v/c ratio of 1.01 to 1.15
LOS B = a v/c ratio of 0.50 to 0.74 LOS E = a v/c ratio of 1.16 to 1.34
LOS C = a v/c ratio of 0.75 to 1.00 LOS F = a v/c ratio of 1.35 plus

Local Commercial Road. A road in a commercial area used primarily for access to abutting properties and to feed traffic to collector roads. This classification includes roads located parallel and adjacent to limited access roads or highways that provide access to abutting commercial properties and protection from through traffic.

Local Residential Road. A road in a residential area used primarily for access to abutting properties and to feed traffic to collector roads. This classification includes roads located parallel and adjacent to limited access roads or highways that provide access to abutting residential properties and protection from through traffic. Average daily traffic is less than two thousand (2,000) vehicles.

Loop Lane. A roadway that arches away from a road and re-intersects the same road at some distance away from the "first" intersection. (Ord. 055-12HR; 10-16-12)

Lot. A parcel of land clearly defined by plat or by metes and bounds description and held, or intended to be held, in separate lease or ownership.

Lot Coverage. A measure of intensity of land use that represents the portion of a site that is impervious (i.e., does not absorb water). This portion includes, but is not limited to, all areas covered by buildings, parked structures, driveways, roads, sidewalks, and any area of concrete asphalt.