

WAKE COUNTY STORMWATER MANUAL

October 2013

*Submittal
and Design
Guidance*



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1.0 INTRODUCTION

The purpose of this document is to provide guidance for the management of stormwater runoff from development in Wake County's jurisdiction. This manual provides support to Article 9 of the Wake County Unified Development Ordinance (UDO) and applicable State regulations which establish minimum requirements to address impacts of stormwater runoff associated with new development and expansions.

Wake County uses a "volume-control" stormwater ordinance with target curve number (TCN) runoff volume limits for residential development. Wake County applies the Neuse Rules countywide in both the Neuse and Cape Fear River basins. The Jordan Lake Rules supersede the Neuse Rules in the Jordan Lake Nutrient Management Strategy area. Both residential and commercial developments must adhere to the Neuse Rules requirements for peak flow, nutrient management, and riparian buffer rules. The Neuse Rules were adopted by the North Carolina Environmental Management Commission (EMC) to support implementation of the Neuse River Nutrient Sensitive Waters Management Strategy. Proposed projects located within the Falls Lake watershed must adhere to the Falls Lake Nutrient Management Strategy (Falls Lake Rules) and projects in the Jordan Lake watershed must adhere to the Jordan Lake Nutrient Management Strategy (Jordan Lake Rules). Both were adopted by Wake County in January of 2011 as part of the State's staged nutrient management strategies.

Wake County requires the use of the Wake county Stormwater Hybrid Design Tool for all stormwater management submittals. Accurate use of this tool ensures compliance with the Neuse Rules, Wake County UDO and the Falls Lake and Jordan Lake Rules. Tool calculations are based on a combination of the Falls/Jordan Nutrient Accounting Tool developed by the State for nutrient loading and a Wake County Design Tool previously prepared for Wake County by Withers and Ravenel (2006) for volume control and peak flow compliance. The prior *Draft Stormwater Design Manual* developed by Withers and Ravenel was edited and incorporated into this manual. The purpose of the tool is to streamline the many different stormwater requirements and facilitate more timely review and approval of stormwater management plans. For each regulatory requirement, Wake County adheres to design standards readily accepted by the State of North Carolina.

2.0 STORMWATER PROCESS AND REQUIREMENTS IN WAKE COUNTY

Site plans within Wake County's planning jurisdiction must be submitted to Watershed Management Program for review and approval to ensure compliance with Article 9 of the Unified Development Ordinance and applicable State and Federal regulations.

Wake County also administers erosion and sediment control and floodplain regulations including related plan review, permit issuance and inspections. For erosion control and floodplain information, visit our [website](#). In addition, Wake County administers an urban stormwater ordinance adopted by the

Town of Rolesville, the Town of Wendell, and the Town of Zebulon that focuses on water quality and flood prevention. The stormwater ordinance is a result of recommendations made by a countywide Stormwater Task Force and approved by the Wake County Board of Commissioners in 2007. Note: This stormwater manual is only for development in Wake County (non-municipal planning jurisdictions). For stormwater process information specific to Rolesville, Wendell, or Zebulon, visit our [website](#) for details.

The Stormwater process in Wake County is composed of the following:

- pre-submittal Meeting
- preliminary Plan Review
- technical review committee (TRC)
- construction plan review
- construction plan approval
- preconstruction meeting
- permit issuance
- permit completion
- post-construction maintenance

Prior to initiating a stormwater application, the applicant should be familiar with The *Wake County Unified Development Ordinance, Article 9 Stormwater Management*.

2.1 Pre-submittal Meeting

All development proposals are required to schedule a pre-submittal meeting with the Wake County Land Development staff before any plan submittal process is initiated. County Watershed Management staff will provide guidance on floodplain management, erosion control and stormwater submittals and site plan design guidance, in coordination with the planning / zoning staff. Applicants should contact the Planning Department at 919-856-6621 to schedule a meeting with the County. Applicants shall complete a pre-submittal meeting request form ([See Appendix A](#)) and provide staff with the following:

- project name
- contact information
- PIN number
- approximate disturbed acreage (if available)
- summary
- sketch Plan

2.2 Preliminary Plan Review

After the pre-submittal meeting, the applicant will receive comments and/or request for additional information. Once comments are resolved, the applicant shall provide a preliminary subdivision plan or a Commercial Permit Application. Plans requiring Planning Board approval (regular

subdivisions, special use permits, planned compliance permits) will be reviewed by the **Technical Review Committee (TRC)**. See Wake County Planning [website](#) for fees and submittal requirements.

Note: Non-residential projects NOT requiring Planning Board approval may proceed to the [Construction Plan Process](#) after obtaining **zoning approval** (land use permit application).

The Preliminary Plan submittal for stormwater should include the following:

- Cover letter stating the purpose of the submission
- Two (2) copies of the Hybrid Stormwater Tool; digital submittal and hardcopy
- Wake County [Stormwater Submittal Checklist](#) (Preliminary Plan portion)
- Stormwater standards Checklist ([Wake County and if applicable Falls Lake or Jordan Lake](#))
- Site Plan - a concept plan drawn to scale showing the proposed location of structures, roads, parking and other impervious surfaces, environmental features and proposed BMP location(s); shall include PIN number
- Drainage Area Map (pre and post development areas for peak flow analysis – should match completed tool)
- Copy of USGS Quad Map and Wake County Soil Survey map with delineated project limits
- Flood Hazard Area impacts
- Any additional calculations available

2.3 Construction Plan Review

Following the TRC review process and Planning Board approval, regular subdivisions and non-residential development and redevelopment projects are required to obtain a Stormwater Permit through Wake County if the disturbance threshold is met. Disturbance thresholds are set by the location of the project (See Standards Checklists in [Appendix A](#)).

The applicant shall submit the following to Wake County for stormwater construction plan review:

- Cover letter stating the purpose of the submission
- [Erosion Control and Stormwater Joint Application](#) and Fees. Applicant shall adhere to the fee schedule for all resubmittals.
- [Wake County Stormwater Submittal Checklist](#) (Preliminary Plan and Construction Plan portion)
- Wake County Standards Checklist ([Falls Lake](#), [Jordan Lake](#), or [Wake County](#))
- Two (2) copies of the Stormwater Design Tool (All sheets) ; digital submittal and hard copy
- Two (2) copies of a complete set of construction drawings

- Drainage Area Map (pre and post development outfalls – should include offsite areas and match completed tool)
- Copy of USGS Quad map and Wake County Soil Survey with delineated project limits
- All supporting calculation documentation
- Flood Studies / Flood Hazard Soil Redelineations
- Buffer Impacts / stream delineations
- Nitrogen Payment Offset receipt (required prior to permit issuance)
- Fees (visit [website](#))

2.4 Pre-construction Meeting

Following approval of construction drawings by Wake County Environmental Services and Planning/Zoning, a pre-construction meeting must be scheduled prior to any land disturbance. At this time, applicants will obtain the Stormwater Permit as well as a Land Disturbance Permit (if applicable). Additionally, applicant shall receive two copies of the approved stormwater and/or erosion control plan. Applicant should bring the following to the preconstruction meeting:

- All associated permit fees
- Site contractor(s)
- Financially responsible representative
- Design Engineer (if requested)

2.6 Permit Issuance

Outstanding permit fees for erosion control and/or stormwater are due following the preconstruction meeting and prior to permit issuance. Permits are issued by the Plans Facilitator on the 1st floor, WCOB, 336 Fayetteville Street, Raleigh, NC 27602. Installation of required erosion control measures may proceed following permit issuance. Grading may begin after Wake County field inspection and approval of initial measures.

2.7 Stormwater Improvements

Stormwater Improvements typically refer to engineered stormwater devices required to meet Wake County or state requirements for plan approval. Improvements include but are not limited to wet ponds, dry detention, level spreaders, bioretention areas, swales, constructed wetlands and cisterns. See [BMP Design Principles](#) for additional information.

2.8 Permit Completion

All conditions of approval (COAs) outlined in the Wake County approval letter must be completed prior to permit completion. Additionally, regular subdivisions require record plats prior to selling lots. Plats are not approved until all COAs are met. Likewise, nonresidential development will not receive a Certificate of Occupancy until COAs are met.

2.8.1 Conditions of Approval

Conditions of Approval can include but are not limited to:

- Recorded [Stormwater Agreement](#) (provides assurance that improvements will be maintained)
- Recorded Operation and Maintenance Plan
- Engineer's Certification
- Covenants
- As-built Survey
 - Include [As-built Checklist](#) with all as-built submittals
 - As-built survey shall show required stormwater improvements (easements, impervious surface coverage, engineered stormwater devices, stream crossings, etc)
- Record Plat
 - Include and ensure completeness with [Final Plat Checklist](#) with all plat submittals
 - Plat shall show impervious limits for each lot and indicate the basis for the impervious limits
 - Stormwater agreement and Operation and Maintenance Plan shall be recorded concurrently (book and page numbers).
 - If the stormwater improvements were not completed prior to plat recordation or certificate of occupancy for a non-residential project, a performance guarantee shall be posted (see below).

2.8.2 Procedures for Posting a Financial Guarantee for Completion of Stormwater Improvements

The Wake County's Water Quality Division allows for the posting of a financial guarantee pending the completion of required stormwater devices. *[Wake County UDO, Article 9-31-1 Performance Guarantee] and [8-22-3 Form and Amount of Performance Guarantee]*

The performance guarantee (PG) process is as follows:

Step 1: Owner / Developer contacts the Wake County Watershed Manager to determine remaining work to be completed per the approved stormwater permit.

Step 2: Based on field inspection, engineer provides Wake County with an Engineer's sealed detailed estimate of the cost to complete the remaining stormwater work. Revisions may be required prior to its acceptance.

- The financial guarantee shall be 125% of the cost of the stormwater improvements.
- Hard and soft costs should be included (installation, stabilization, engineering, project management, surveying, project management etc.)

Step 3: Watershed Manager approves the amount of the financial guarantee.

Step 4: Owner / Developer furnishes the County with a draft financial guarantee and the [Stormwater Improvements Performance Guarantee](#) for the approved amount.

- PG shall be in the form of a performance bond, letter of credit, cash or cashiers/certified check

Irrevocable Letter of Credit Option

The letter of credit must be obtained from a bank doing business and having a location in Wake County. The expiration date on the letter of credit is to be at least one year from the date of execution. The letter of credit must be renewable for additional one-year terms, for so long as the stormwater improvements have not been completed.

- A [Stormwater Improvements Performance Guarantee Agreement](#) form should be submitted with the PG. ****Item #24 in the agreement should have a person's name, not the LLC alone.****

Note: As with any legal binding agreement, the Stormwater Improvements Performance Guarantee Agreement should be read over carefully before it is signed and notarized by the owner / developer. Changes to the typewritten text of the agreement are not permitted.

- A Disclosure Statement will be required on the Final Plat
- Copies of the Maintenance and Stormwater Agreement forms shall be submitted for review. The forms shall be recorded at the Register of Deeds concurrently with the Final Plat and the Stormwater Agreement shall be cross referenced on the Final Plat.

Step 5: Release of Performance Guarantee

- Once all of the required improvements have been certified by the applicant's licensed professional engineer or licensed professional surveyor or other professional as authorized by the North Carolina General Statutes that the improvements have been installed in accordance with all applicable standards, the financial guarantee may be released. Certification includes an as built survey, field inspection by Wake County staff, review and approval of maintenance documents and easement plat.
- Once all of the required improvements have been at least 50 percent certified, the financial guarantee may be reduced by the ratio that the completed improvements bear to the total improvements required, provided that no more than one such reduction may be permitted prior to releasing the performance guarantee.

- Owner / Developer and Watershed Management must sign the Release of Performance Guarantee form which will be supplied to the finance department.

Step 6: Project is ready for permit completion

2.9 Post-Construction Maintenance

Stormwater improvements shall be maintained by the entities identified on the record plat, owner's association document, and/or maintenance plan and agreement for the life of the project. The maintenance agreement outlines requirements for maintenance. Per the stormwater agreement, the parties responsible for maintenance of stormwater improvements agree to inspect and maintain these devices. In addition to regular maintenance, an annual inspection of each device is required. The responsible party shall submit an inspection report to the County each year.

3.0 WAKE COUNTY STORMWATER HYBRID DESIGN TOOL OVERVIEW

Engineers complete the Wake County Stormwater Hybrid Design Tool by inputting site information, site land uses and time of concentration data by drainage area for pre and post-development conditions.

Target Curve Number (TCN)

Developers must manage residential runoff for post- development to ensure the site will not exceed the designated curve numbers, in accordance with procedures specified in the *United States Department of Agriculture, Natural Resource Conservation Service, Technical Release 55, Urban Hydrology for Small Watersheds (TR-55) [Wake County UDO, Article 9]*. While land uses and hydrologic soil groups (HSGs) are input by engineers by drainage area, the tool calculates the target curve number and post development curve number for the site as a whole. The difference between the two numbers translates to a volume that must be detained for the site. The hybrid tool calculates and flags the volume that is the developer's responsibility to detain. For more information on TCN see Section 4, [Stormwater Design Principles](#).

Peak Flow

Engineers are responsible for inputting land use and time of concentration information and the Tool will calculate the associated peak flows for pre and post development. If runoff leaves the site at several locations, the engineer must conduct a separate analysis for each outfall and enter site information by individual drainage areas.

The hybrid tool calculates and flags peak flow increases requiring potential attenuation using the TR-55 Graphical Peak Discharge Method for Type II Distribution. The tool does not calculate and perform

routing for BMP design and engineers are required to provide their own drainage area maps, stormwater model and supporting calculations to show peak flow compliance with state rules. For more information on peak flow see Section 4, [Stormwater Design Principles](#).

Nutrient Loading

Nutrient loading calculations are directly from the Jordan/Fall Nutrient Accounting Tool and were reviewed and approved by the NC Department of Water Quality as part of Wake County's submittal for compliance with the Falls Lake and Jordan Lake Nutrient Strategies. For more information on nutrient loading see Section 4, [Stormwater Design Principles](#).

The following sections provide detailed design methodology, supporting data and further guidance on Wake County stormwater requirements.

4.0 STORMWATER DESIGN PRINCIPLES

4.1 TARGET CURVE NUMBER (TCN)

4.1.1 Concept

The Wake County Stormwater Ordinance (UDO Article 9) requires that the calculated composite curve number of the proposed development conditions meet a specific “target” curve number. The target curve numbers (TCN) are provided in Table 4.1.2 below. If the proposed development does not meet the “target” curve number then the difference in runoff volume for 3 inches of precipitation between the target curve number and the proposed development curve number must be retained and infiltrated or stored and drawn down over a period of 2 to 5 days.

Table 4.1.2 Wake County Target Curve Numbers

Zoning District	Maximum Composite Curve Number by Soil Group			
	A	B	C	D
R-80W and R-80	37	60	73	79
R-40W and R-40	41	62	75	80
R-30, R-20, R-15, R-10, R-5, Residential Highway, General Business and Office and Institutional	43	63	76	81

The curve number concept was developed by the Soil Conservation Service to estimate runoff volume for specific rainfall events. Curve number values are whole numbers ranging from 30 to 98 – lower values correspond to smaller runoff volumes and higher values correspond to larger runoff

volumes. The curve number (CN) is determined using two factors: hydrologic soil group (HSG) and land use.

Soil classifications are divided into four hydrologic soil groups (A, B, C, and D) according to their minimum infiltration rate. Soils that are 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. The hydrologic soil groups for the soil classifications found in Wake County are listed in [Table B-1](#) In Appendix B.

Land use is the second contributor to determining a curve number. The curve number for wooded area is lower and therefore corresponds to a smaller runoff volume than impervious surface which has a higher curve number. Curve number values for proposed development conditions in Wake County in all four hydrologic soil groups are provided in [Table B-2](#) in Appendix B.

4.1.2 Design Methodology

A composite curve number (CN) is calculated to represent the hydrologic characteristics of the site as a whole. To calculate a composite curve number – the soil types, proposed land uses, and the proposed acreage of each should be known. The land use types listed in [Table B-2](#) are representative of most developments in Wake County. The land uses types were chosen for simplicity and consistency with the Division of Water Resources’ land use categories used in the Jordan/Falls Stormwater Load Accounting Tool. The Wake County Hybrid Tool calculates the CN, TCN and required volume storage for the site. For Tool information, see [Wake County Hybrid Stormwater Design Tool](#) section. The below examples demonstrate the calculations used in the Tool.

Example 4.1.2a Composite Curve Number

The proposed R-40 development is a 10-acre site with the below land uses. Using [Table B-2](#), the curve number can be determined for each area of land use.

Proposed land uses:

- Woods, HSG B (CN = 55) = 4 acres
- Managed Pervious (Open Space), HSG B (CN = 61) = 1.5 acres
- Managed Pervious (Open Space), HSG C (CN = 74) = 2 acres
- Roof, HSG B (CN = 98) = 1.5 acres
- Roadway, HSG C (CN=98) = 0.5 acres
- Grassed ROWs, HSG C (CN=80) = 0.5 acres

Solution:

Multiply the acreage by the curve number and sum the products.

- 55 * 4 acres = 220
- 61 * 1.5 acres = 91.5
- 74 * 2 acres = 148
- 98 * 1.5 acres = 147
- 98 * 0.5 acres = 49
- 80 * 0.5 acres = 40

$$220 + 91.5 + 148 + 147 + 49 + 40 = 695.5$$

Divide the sum by the total site acreage to determine the composite curve number.

$$695.5 / (10 \text{ acres}) = 69.55$$

A curve number must be a whole number – therefore the composite curve number is 70.

Based on [Table 4.1.2](#), this site would have also have a TCN of **66** (See below solution):

Solution:

Multiply the HSG acreages by the **Maximum Composite Curve Number by Soil Group**, sum the products, and divide by the total site acreage.

$$\text{B Soils} = 7 \text{ acres} \Rightarrow 7 * 62 = 434$$

$$\text{C soils} = 3 \text{ acres} \Rightarrow 3 * 75 = 225$$

$$(434 + 225) = 65.9$$

$$\frac{\quad}{10}$$

The proposed development CN of 70 is greater than the TCN of 66.

TCN Volume Requirement - SCS Runoff Method

In cases where the proposed development composite CN is higher than the TCN for the site, the additional volume of runoff must be stored. Runoff volumes shall be calculated using the SCS runoff equation as follows:

Q* = Runoff depth (in)

P = Rainfall depth (in)

S = Potential maximum retention after rainfall begins (in)

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

$$S = \frac{1000}{CN} - 10$$

Example 4.1.2b Determination of Runoff Volume

In **Example 4.1.2a**, the proposed CN for the site was determined to be 70 and the TCN was determined to be 66. Using the proposed and target curve numbers –determine the volume to be stored on this site. This will be done by calculating the runoff in inches for each curve number and then multiplying the difference between the two runoff values by the acreage of the site.

Runoff for Proposed CN:

Determine the value of S first. Divide 1000 by the curve number and subtract 10.

$$S = \frac{1000}{CN} - 10$$

$$S = \frac{1000}{70} - 10 = 4.29 \text{ inches}$$

Now calculate the runoff by using the SCS runoff equation. Per the Wake County rules, P = 3 inches.

$$Q^* = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

$$Q^* = \frac{(3 - (0.2 * 4.29))^2}{(3 + (0.8 * 4.29))} = \frac{(2.14)^2}{(6.43)} = 4.45 / 6.43$$

$$Q^*_{\text{Proposed}} = \mathbf{0.71 \text{ inches}}$$

Runoff for TCN:

$$S = (1000 / CN) - 10$$

$$S = (1000 / 66) - 10 = 5.15 \text{ inches}$$

$$Q^* = (P - 0.2S)^2 / (P + 0.8S)$$

$$Q^* = (3 - (0.2*5.15))^2 / (3 + (0.8*5.15)) = (3 - (0.99))^2 / (3 + (3.94)) = (2.01)^2 / (6.94) = 4.04 / 6.94$$

$$Q^*_{\text{Target}} = \mathbf{0.55 \text{ inches}}$$

Runoff Volume to be Stored:

Subtract the runoff produced by TCN by the runoff produced by the proposed CN to determine the runoff in inches that exceeds the allowed amount.

$$Q^*_{\text{Proposed}} - Q^*_{\text{Target}} = 0.71 - 0.55 = 0.16 \text{ inches}$$

Convert the runoff to a volume

$$0.16 \text{ inches} * (1/12) \text{ feet/inches} = 0.01 \text{ feet}$$

Multiply the site acreage by the runoff to determine the volume required to be stored.

$$10 \text{ acres} * 0.01 \text{ feet} = 0.10 \text{ acre-feet}$$

Convert volume to cubic feet.

$$0.10 \text{ acre-feet} * 43,560 \text{ square feet} = 4,356 \text{ cubic feet}$$

Therefore the volume required to be stored by the Wake County Stormwater Ordinance is 4,356 cubic feet.

Note: The total volume required is for the site and can be spread across multiple drainage areas.

4.2 PEAK FLOW

4.2.1 Concept

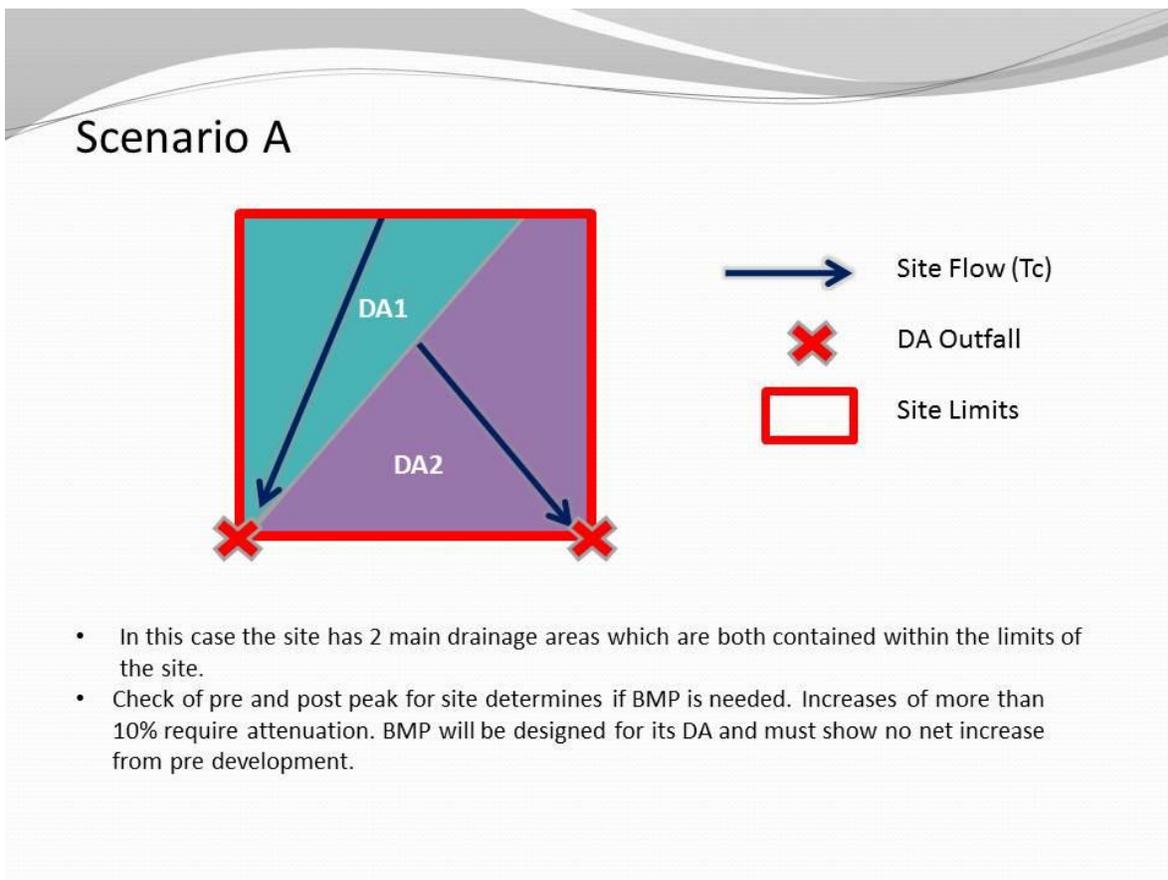
The Neuse Rules [15A NCAC 02B.0235 (4)(a)], the Falls Rules[15ANCAC 02B.0277, Section 4(f)] and The Jordan Rules[15ANCAC 02B.0265, Section 3(a)(iv)] all state "...new development shall not result in a net increase in peak flow leaving the site from the pre development conditions for the 1 yr-24hr storm event". The purpose of peak flow control for stormwater runoff from new development is to ensure that the integrity and nutrient processing function of receiving waters and associated riparian buffers are not compromised by erosive flows.

Engineers must calculate the pre- and post-development discharges for each point of discharge from the site (ie: by drainage area). If runoff leaves the site at several locations, the engineer must conduct a separate analysis for each point.

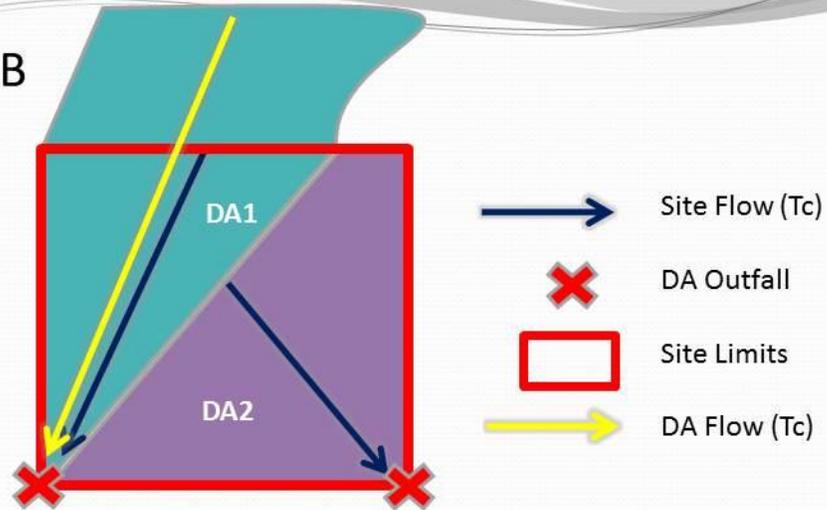
The hybrid tool calculates and flags peak flow increases requiring potential attenuation using TR-55 Graphical Peak Discharge Method for Type II Distribution. The tool does not calculate and perform routing for BMP design and engineers are required to provide drainage area maps, stormwater model and supporting calculations to show peak flow compliance.

- Development with a net change in peak flow in excess of 10% the pre-development peak will be required to provide mitigation in the drainage area showing an increase. Note: An increase in runoff rates less than 10% does not automatically mean that a project will not be required to provide detention or make drainage improvements.
- If a BMP is required, BMP must be designed for the actual drainage area coming to the device (existing conditions for offsite).
 - If BMP is designed to treat offsite as well, the engineer must provide calculations for Pre, Post, and Post BMP peak for the entire drainage area (including offsite).
 - Post BMP peak flow must be equal or less than Pre peak flow

The following scenarios are provided to clarify compliance with the intent of the Neuse/Falls/Jordan regulations:

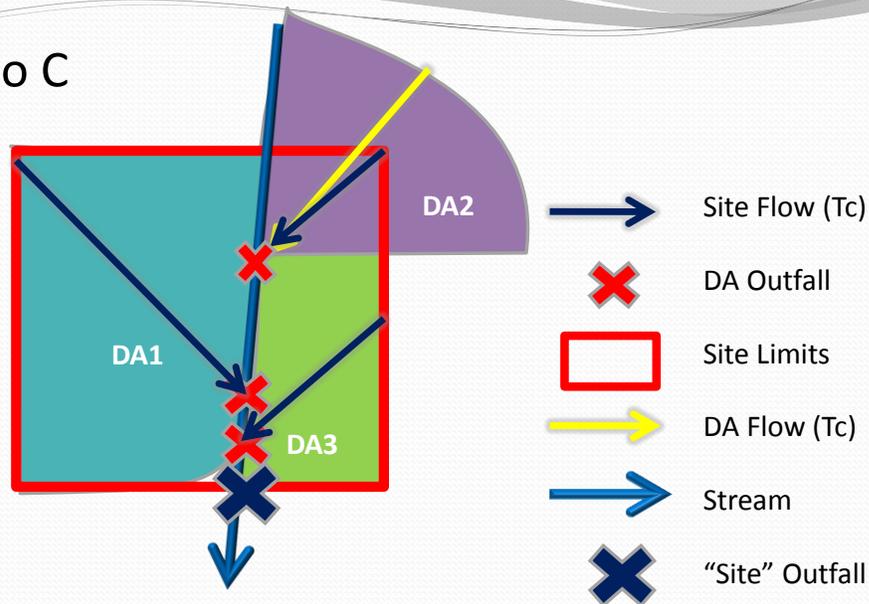


Scenario B



- In this case the site has 2 main drainage areas. DA1 takes in some offsite areas.
- Check of pre and post **site** peak determines if a BMP is needed. IF DA 1 needs a BMP then the engineer will need to size the BMP for its actual drainage area (using DA Flow).
- Development must show no net change in peak flow for the total drainage area to the BMP (pre to post BMP)

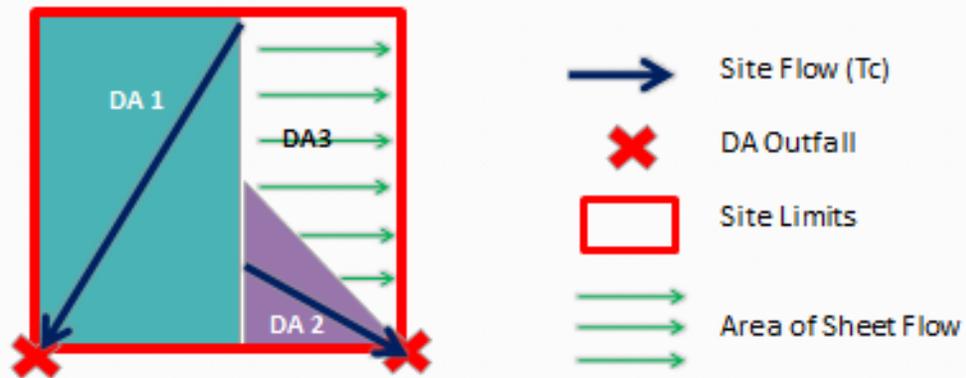
Scenario C



- In this case the site has 3 main drainage areas (one of which includes offsite drainage). A large stream feature bisects the site.
- Check of pre and post peak for site at each DA outfall determines if BMP is needed prior to entering the stream.

Note: There may be cases where Scenario C has other options. Site peak flow may be examined at the "Site" Outfall. This discharge point may significantly underestimate peak flow for the site when there is a large offsite drainage used in peak flow calculations. As a general rule, perform Scenario C as above. On a case by case basis, engineers may choose to provide further documentation to show compliance with the peak flow by performing a downstream impact analysis and/or providing additional information. Engineers must also ensure that internal streams are protected from erosive flows. In these cases, the burden of proof will rest on the submitting engineer to demonstrate compliance.

Scenario D



- In this case the site has 3 main drainage areas which are contained within the limits of the site.
- Check of pre and post for site determines if BMP is needed.
- In the case where one DA is composed of sheet flow areas (DA3), engineer must demonstrate compliance with peak flow.

The above scenarios by no means represent all possible situations and are intended to provide general guidance for peak flow calculations. For calculations in conflict with these scenarios, engineers may choose to provide supplementary documentation to show compliance with the peak flow. In these cases, the burden of proof will rest on the submitting engineer to demonstrate compliance.

4.2.2 Design Methodology

Time of Concentration

Time of concentration (T_c), as described by TR-55, is the time required for runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed. A higher T_c corresponds to a lower peak flow since the longer flow time stretches out the hydrograph and a lower T_c corresponds to a higher peak flow. T_c is computed by calculating the travel time for each type of flow (sheet, shallow, or channel) separately and then summing the calculations. As stated in TR-55, any flow over a lake or reservoir can be neglected since the travel time is very close to zero. The minimum value for a time of concentration is 5 minutes. The Wake County tool calculates T_c based on engineer inputs. Engineers may also compute and provide their own calculations for T_c but are required to input their calculated values into the tool.

$$T_c = T_t \text{ Sheet} + T_t \text{ Shallow} + T_t \text{ Channel}$$

Sheet Flow

Sheet flow occurs as flow over plane surfaces. Calculation of the travel time for sheet flow requires that the flow length, slope, and Manning's roughness coefficient for sheet flow be determined. The maximum flow length for sheet flow is 300 feet, as determined by the NRCS. The Manning's roughness coefficients (n values) are in Table 4.2.2. When selecting an n-value from the table, consider the cover to a height of about 0.1-foot since this is the only part of the plant that will obstruct sheet flow.

Table 4.2.1 Manning's Roughness Coefficients

SURFACE DESCRIPTION	Manning's roughness coefficient n
Paved, Gravel, or Bare Soil	0.011
Grass	0.24
Woods	0.40

Shallow Flow

After a maximum of 300 feet of sheet flow, the runoff usually becomes shallow concentrated flow. The average velocity of this flow should be determined using the equations below.

$$\text{Unpaved: } V = 16.1345(s)^{0.5}$$

$$\text{Paved: } V = 20.3282(s)^{0.6}$$

V = Average Velocity (ft/s)

s = slope of hydraulic grade line (watercourse slope, ft/ft)

$$T_t = \frac{L}{3600V}$$

T_t = travel time (hr)

L = flow length (ft)

V = average velocity (ft/s)

3600 = conversion factor from seconds to hours

Channel Flow

Open channels include, but are not limited to channels that are assumed to begin where surveyed cross section data has been obtained, where channels are visible on aerial photographs, or where blue lines appear on the United States Geological Survey (USGS) quadrangle sheets. Manning's

equation should be used to estimate average flow velocity. Average flow velocity is usually determined for the bank-full elevation.

Manning's equation is:

$$V = \frac{1.49r^{2/3}s^{1/2}}{n}$$

V=Average Velocity (ft/s)

r = hydraulic radius (ft)

s = slope of hydraulic grade line (channel slope, ft/ft)

n = Manning's roughness coefficient for open channel flow

$$r = \frac{a}{p_w}$$

$$T_t = \frac{L}{3600V}$$

a = cross sectional flow area (ft²)

p_w=wetted perimeter (ft)

T_t =travel time (hr)

L = flow length (ft)

V = average velocity (ft/s)

3600 = conversion factor (sec-hrs)

Table 4.2.2 Representative Manning's Roughness Coefficients for Open Channel Flow

CHANNEL LINING	n
Asphalt	0.016
Concrete, finished	0.012
Concrete, unfinished	0.014
Grass	0.035
Gravel Bottom/riprap sides	0.033
Weeds	0.040

Peak Flow Calculations

The Wake County tool uses the Discrete SCS Curve Number Method for runoff volume (the Simple Method is used for the loading calculations) and TR-55 Graphical Peak Discharge Method for Type II Distribution for peak flow. Offsite and site land uses are used to determine pre and post development runoff and peak flow. The [SCS Curve Number Method](#) for runoff was detailed previously in this manual. The Discrete runoff method is used in the tool for runoff calculations used in peak flow calculations (See below equation).

$$Q = Q^*_{(imp)} \times DA_{(imp)} + Q^*_{(pervious)} \times DA_{(pervious)}$$

$Q^*_{(imp)}$ = Runoff from Impervious Area (in)

$DA_{(imp)}$ = Drainage from impervious area (acre)

$Q^*_{(pervious)}$ = Runoff from pervious area (in)

$DA_{(pervious)}$ = Drainage from pervious area (acre)

Once the runoff and Tc have been determined, the peak flow can be calculated.

TR-55 Graphical Peak Discharge Method for Type II Distribution

$$Q_p = q_u A_m Q^* F_p$$

Where:

Q_p = Peak Discharge (cfs)

q_u = Unit peak discharge (csm/in)

TR-55 Appendix F

A_m = Drainage Area (mi²)

Q^* = runoff (inches)

F_p = pond adjustment factor

$$\log(q_u) = C_0 + C_1 \log(T_c) + C_2 [\log(T_c)]^2$$

Where:

C_0, C_1, C_2 = coefficient from Table F-1

T_c = time of concentration (hr)

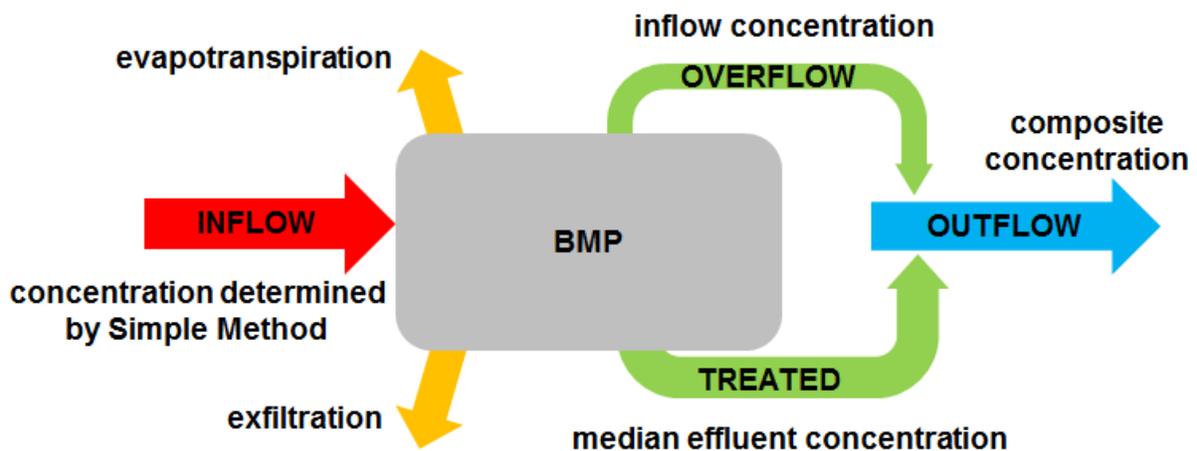
4.3 NUTRIENT LOADING

4.3.1 Concept

Depending on the location of a project, development must not show a nitrogen export in excess of State limits (Ex: A development in the Neuse may not export more than 3.6 lbs/ac/yr of nitrogen for post development and must provide mitigation/offset for any overage). In Falls and Jordan Lake Watersheds, phosphorus export is also regulated. While land uses are input into the Wake County Tool by engineers by drainage area, the tool calculates the pre and post development and post BMP nitrogen for the site as a whole. Nutrient calculations in the Wake County Hybrid Tool were reviewed and approved by NCDENR, DWR as part of local government compliance with the Falls and Jordan Rules.

Nutrient calculations performed within the hybrid stormwater tool are governed by two basic principles: Simple Method (for runoff volume and pollutant loading calculations) and the median effluent concentration BMP efficiency metric (for BMP reduction calculations). Each of these principles is described below and is based on the methodology found in the Jordan and Falls Lake New Development Accounting Tool. *The Jordan Lake Stormwater Load Accounting Tool User's Manual* (Version 1.1 - revised 11-29-11), *Model Documentation* section provides in-depth discussion on the basis for all calculations in the Wake County Hybrid Tool. Figure 5.3 visually shows the governing principle behind nutrient loading calculations.

Figure 4.3 BMP Treatment Schematic



Note: A newer version of the The Jordan Lake Stormwater Load Accounting Tool User's Manual and accounting tool was released this year. This manual and the Wake County tool will be modified early 2014 to conform to the State's updates. Updates will include modifications such as BMP hydrologic soils, additional BMPs, and increased visibility of calculations.

4.3.2 Design Methodology

Simple Method

The Simple Method is used in the Wake County Tool to calculate pollutant load. The impervious cover of a catchment is represented by the runoff coefficient R_v :

$$R_v = 0.05 + (0.009 * I) \quad (1)$$

Where R_v = Simple Method runoff coefficient; and
 I = percent impervious cover of the catchment (%).

The Wake County Tool breaks the catchment into discrete land use types. Each land use type is either impervious ($I=1$) or pervious ($I = 0$). This results in R_v for impervious areas of 0.95 and 0.05 for pervious areas.

Volume is a function of the runoff coefficient, R_v , the area of the catchment and the annual rainfall amount. To estimate the mass of pollutant that leaves the catchment on an annual basis,

$$L = [(P * P_j * R_v) \div 12] * (C * A * 2.72)$$

Which can be reduced to:

$$L = (P * P_j * R_v) * (C * A * 0.226)$$

Where L = average annual pollutant load (lbs),

P = annual runoff in inches, 45.41 inches used in Wake County

P_j = fraction of rainfall events that produce runoff (use a value of 1)

C = event mean concentration of the pollutant (mg/L)

The event mean concentrations used in the Wake County tool for land uses are discussed in detail in the “Watershed Characteristics” section of the *JLSLAT User’s Manual*, version 1.1. All residential land uses use the custom lot option instead of the general lot sizing method because detailed breakdown of residential land use is required by Wake County UDO for Target Curve Number (TCN) requirements.

- Additional land uses were added to comply with Wake County TCN requirements: Transportation-High Density Grassed ROWs, Transportation-Low Density Grassed ROWs and Residential Grassed ROWs.
- Under other state stormwater programs the grassed right of way is not treated as impervious area. However, the Jordan/Falls Tool does not allow for the differentiation of ROWs from the associated impervious roadways. As a temporary fix to the Jordan/Falls tool, engineers that submit plans include the surface area of a proposed road under one of the transportation land uses and the grassed portion of the ROW as a “managed pervious” land use. This approach will be changed at a later date according to NCDENR as EMC values are determined for these areas. The Wake County

tool does differentiate the grassed ROWs but assigns the “managed pervious” values for nutrient loading. Once EMC values are developed for grassed ROWs, the Wake County tool will be updated to reflect more appropriate values.

Volume Reduction Can Play a Significant Role in Pollution Reduction

Percent removals do not adequately reflect the effect of volume reductions. Volume reductions are an integral part of calculating effluent loads from a given BMP. The volume reduction values assigned to each BMP type vary based upon the physiographic region. These assignments are displayed in the JLSLAT manual and are expressed as percent of the inflow volume. The JLSLAT accounts for volume reductions by the BMP in determining how much nutrient reduction is achieved by the BMP (See **Table 5.3.2** below). Each BMP type has a Treated Outflow (%), a Bypass (Overflow) (%), and a Volume Reduction (%).

Table 4.3.2 BMP Details

BMP DETAILS
(Figure 7, Jordan/Falls Lake Stormwater Load Accounting Tool User's Manual)

BMPs	TN Mass Removal %	TN EMC (mg/L)	TP Mass Removal %	TP EMC (mg/L)
Bioretention with IWS	0.55	0.95	0.6	0.12
Bioretention without IWS	0.55	1	0.6	0.12
Dry Detention Pond	0.15	1.2	0.1	0.2
Grassed Swale	0	1.21	0.5	0.258
Green Roof	0.2	1.08	0.2	0.15
Level Spreader, Filter Strip	0.6	1.2	0.45	0.154
Permeable Pavement	0.4	1.44	0.7	0.39
Sand Filter	0.4	0.92	0.45	0.14
Water Harvesting	0	1.08	0	0.15
Wet Detention Pond	0.28	1.01	0.45	0.113
Wetland	0.5	1.08	0.65	0.117

For more information regarding nutrient loading calculations, please refer to most current version of the JFSLAT.

4.3.3 Mitigation/Banking

In nutrient strategy areas, a developer not meeting the loading rate targets on their site has the option to ‘buy down’ a portion of their nutrient load from a DWR approved nutrient offset provider to meet loading rate targets. While rules vary by watershed, they allow developers not meeting the nutrient requirements on their site to have the option of offsetting nutrient loading. Onsite reductions required before buy down are also specified by watershed.

Using the Wake County Hybrid Tool, the developer calculates their new development nutrient loading. For the development to proceed, the loading rate targets or, at a minimum, the offsite threshold requirements must be met for their watershed (see [Table 4.3](#)). Once that obligation is met, they may buy down the remainder of their nutrient loads to meet the loading rate targets. Developers are encouraged to visit NCDENR’s website for the most up to date buy down information.

Based on the developers approved proposal, Wake County will issue a letter to the developer authorizing that they are allowed to purchase offsite offsets. Once payment is made to the approved nutrient offset provider, a receipt is issued documenting the amount of offset credit purchased. In turn, that receipt must be provided to Wake County to demonstrate the developer's compliance with meeting the loading rate targets for the development site prior to permit issuance.

In the Cape Fear River Basin (outside of Jordan Lake Watershed, a buy-down system only exists for Jordan Lake Watershed. Therefore, demonstration should be made that BMPs have been incorporated to a reasonable extent with a goal of 3.6 lbs/ac/yr.

Table 4.3 Current Nutrient Targets (2013)

Nutrient Strategy Area	Nutrient Reduction Goal	Offsite Thresholds
<u>Neuse</u>	3.6 N lb/ac/yr & No P goal	6 N lbs/ac - Single-family, detached, duplex dev't (1 acre minimum); 10 N lbs/ac – Commercial, multi-family residential, industrial (1/2 acre minimum)
<u>Jordan Lake Watershed</u>		
Upper New Hope	2.2 N lb/ac/yr & 0.82 P lb/ac/yr	
Lower New Hope	4.4 N lb/ac/yr & 0.78 P lb/ac/yr	
Haw River	3.8 N lb/ac/yr & 1.43 P lb/ac/yr	

<u>Falls Lake Watershed</u>	2.2 N lb/ac/yr & 0.33 P lb/ac/yr	30% of N & P reduction need onsite for projects less than one acre or expansions; 50% of N & P reduction need onsite for projects over one acre
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Example: Calculation of Buy-down Amount for Nitrogen

Project :

A 20-acre residential development in the Neuse River Basin has a stormwater management plan yielding a final nitrogen loading of 5.8 lbs/ac/yr.

The developer needs an additional 2.2 N lbs/ac/yr to meet the loading rate targets for the Neuse (6 N lbs lbs/ac/yr – 3.6 N lbs/ac/yr).

The developers final nutrient obligation:

20 acres * (2.2 lbs/ac/yr) * 30 years = 1,320 lbs of N

References:

Rule 15A NCAC 0.2B .0240 and Session Laws [2009-337](#) and [2011-343](#).

Jordan Lake Stormwater Load Accounting Tool User’s Manual, (most current version)

4.3.4 Project Expansions

Nutrient management for existing developments varies by watershed. In the Neuse Basin, expansion projects with increases in built upon area may address nutrient loading using the Apportioning Method which re-defines the project area as the new impervious area and a portion of the open space allocated in the ratio of new impervious to total impervious. Offset fees are based on this new “site expansion area”. This technique is best described through example.

Given:

- 10 acre site with existing, approved 5 acres of impervious surface
- Expansion to add an additional 3 acres of impervious surface for a total of 8 acres of impervious and 2 acres pervious.
- Using the apportioning system, the existing development gets credit for 5/8 of the 2 acres of the remaining open space for 1.25 acres pervious.
- The new development gets 3/8 credit of the 2 acres for 0.75 acres.

Assuming the open space is managed, the nitrogen load calculations would look like this:

$$(5 \text{ acre} \times 21.2 \text{ lb/acre}) + (1.25 \text{ acre} \times 1.2 \text{ lb/acre}) = 106 \text{ lb} + 1.5 \text{ lb} = 107.5 \text{ lb (existing)}$$

$$(3 \text{ acre} \times 21.2 \text{ lb/acre}) + (0.75 \text{ acre} \times 1.2 \text{ lb/acre}) = 63.6 + 0.9 \text{ lb} = 64.5 \text{ lb (new)}$$

$$\text{Total TN export} = 107.5 + 64.5 = 172 \text{ lb}$$

-Or -

$$172 \text{ lb} / 10 \text{ acres} = 17.2 \text{ lbs/ac/yr}$$

The expansion site is defined as 3 acres impervious plus 1.25 acres pervious = 4.25 acres. Basically, expansions meet the target but using a smaller site area to determine load (lbs/yr).

5.0 STORMWATER CREDITS

Land use practices involve stormwater management strategies to reduce the volume of runoff without the use of structural controls. Practices such as wooded area preservation and disconnected impervious area increases opportunities for infiltration and stormwater runoff absorption. Land use practices help to decrease the proposed curve number of a site therefore reducing hydrological impacts, as well as achieving additional environmental benefits.

5.1 Preservation of Wooded Areas and Reforestation

The preservation of wooded areas or creation of woods by reforestation is an important management tool to lower the proposed curve number of a site. Wooded areas are assigned a lower curve number than any other land use (See [Table B-2](#)). Therefore, when determining a composite curve number for a proposed site, increasing the area of woods decreases the proposed curve number. Preserving existing wooded areas is recommended over creation of woods by reforestation. Effort should be made to maintain existing woods in a proposed subdivision.

5.1.1 General Design Criteria

In order for a wooded area to contribute as woods in the calculation of the proposed site curve number, it must be designated as preserved woods or reforested area, or as a Neuse River Buffer or Wake County Watercourse Buffer. Preserved or reforested wooded areas should be designated in common open space areas. At the construction plan phase the house, driveway, and septic field location is largely unknown. Due to this – the recordation of a boundary of preserved or reforested wooded areas may not be practical. Therefore - preserved or reforested wooded areas on lots do not need to be designated as preserved unless the percentage of woods which is being claimed as woods in the proposed curve number calculation on the lots exceeds the values listed in Table 5.1.

Table 5.1 Maximum Assumption of Wooded Areas on Lots for Determination of Proposed CN

Zoning District	Maximum Assumption of Woods on Lots without Designation
R-80W and R-80	30%
R-40W and R-40	20%
R-30	15%
R-20, R-15, R-10, R-5, Residential Highway, General Business and Office and Institutional	0%

If the area claimed as woods for proposed curve number calculation on the lots exceeds the maximum assumption allowed by the table above, then the entire area claimed as woods on the lots must be designated by a boundary on the construction plan and recorded plat. This is required so that the developer, builder, and homeowner are all aware of the area that cannot be disturbed or must remain reforested. This boundary may be moved by the builder or homeowner provided that an equivalent area of existing woods or reforested area is provided and the plat is modified and recorded to reflect the new boundary. Areas that are within the Neuse River Buffer or Wake County Watercourse Buffer and areas that are designated in common open space areas are counted separately and are not included in the maximum allowed assumption of wooded area on lots.

5.1.2 Reforestation Design Criteria

In areas that are not naturally wooded, the creation of wooded areas by reforestation is allowed. The reforested area counts as woods in the proposed curve number calculation. Areas that are reforested must be planted with trees and/or shrubs and mulched properly as specified in the following standards.

- **Tree/shrub Density and Spacing**
Planted trees or shrubs must meet the minimum density and spacing standards of the Natural Resources Conservation Service. Existing trees or shrubs may be used towards meeting the planting standard. Standards regarding seedling quality and planting instructions and considerations are included in the Field Office Technical Guide, Code 612 (December 2011) published by the Natural Resources Conservation Service which is attached in [Appendix C](#) of this manual.
- **Mulching**
An initial application of mulch is required for the area designated for reforestation. Existing groundcover may be used towards meeting the mulching standard. The site should be prepared and mulch spread and anchored per the standards included in the Field Office Technical Guide, Code 484 (January 2013) published by the Natural Resources Conservation Service and attached in [Appendix C](#) of this manual.

5.2 Disconnected Impervious

Disconnected impervious is a term used to describe runoff from an impervious area that has been directed over a pervious surface, such as lawn or woods, as sheet flow to allow infiltration. Connected impervious describes an impervious area in which the runoff is directed on to another impervious surface, a pipe, or a channel without an opportunity for infiltration or absorption. TR-55 recognizes that disconnected impervious areas produce less runoff than connected impervious area when the total impervious area is less than 30 percent. Once over 30 percent impervious, the absorptive capacity of the remaining pervious areas will not significantly affect runoff. TR-55 gives credit for this practice by reducing the composite curve number and provides an equation to determine the composite curve number when using disconnected impervious. This equation is incorporated into the Wake County Tool and is as follows:

$$CN_{adjusted} = CN_p + [(P_{imp}/100)*(98-CN_p)*(1-(0.5*R))]$$

Where:

CN_{adjusted} = Composite Curve Number

CN_p = Pervious runoff curve number

P_{imp} = Percent Imperviousness % (expressed as whole number)

R = ratio of unconnected impervious area to total impervious area (decimal)

This equation reduces the curve number by counting half of the disconnected impervious area as pervious. Therefore if considering the effects on a single lot in which the entire roof was disconnected impervious, half of the roof would be assigned a curve number of 98 and half of the roof would be assigned the curve number for the pervious portion of the lot.

Each subdivision has a maximum allowable assumption of disconnected impervious for the whole site based on zoning as shown in Table 5 2. The maximum assumption is the percent of the total impervious surface of the site that is considered disconnected.

Table 5-2. Maximum Allowable Assumption of Disconnected Impervious Surface

Zoning District	Maximum Assumption of Disconnection without Designation
R-80W, R-80, R-40W, R40, R-30	50%
R-20, R-15, R-10, R-5, Residential Highway, General Business and Office and Institutional	25%

If this maximum allowable assumption is exceeded, then details must be provided showing that each impervious surface that is considered disconnected meets the design criteria as described below.

Rooftop Disconnection Design Criteria:

- No more than 500 square feet of roof area should contribute to one downspout.
- Downspout must be installed with a splashblock or equivalent length and width of gravel to establish sheet flow.

- From downspout, a minimum of 50 feet should be provided in the direction of flow across a vegetated surface before intercepted by a grassed channel, pipe, or another impervious surface.

Non-Rooftop Disconnection Design Criteria:

- Maximum length of flow across the impervious surface is 75 feet.
- A flow length across a vegetated surface should be provided that is equal to or greater than the flow path across the contributing impervious surface.
- The maximum slope for the vegetated surface is 5%.
- Pervious pavers are automatically disconnected and do not need to meet the additional criteria above. See Section 6.0 of this manual and the most current version of the *NC DENR DWR Stormwater Best Management Practices Manual* for pervious pavement requirements.

6.0 BMP DESIGN PRINCIPLES

Wake County reviews and permits Best Management Practices (BMPs) designed for Target Curve Number volume control, peak flow management, diffuse flow and nutrient load mitigation. All BMPs are required to be designed according to design specifications noted in the most current version of the *NC DENR DWR Stormwater Best Management Practices Manual*.

In addition, Wake County requires the following:

- All items listed on the [Stormwater Submittal Checklist](#) in Appendix A
- BMPs should be designed to treat rainfall events for all associated governing rules (i.e. if a BMP is designed for TCN matching and nutrient mitigation, it must be designed to detain both the water quality 1" storm and the 1-year, 24-hour 3" storm).
- DWR Supplemental Worksheets may be required
- All stormwater BMP's should be installed at least 25 feet from septic lines.

The current version of the *NC Division of Water Quality Stormwater Best Management Practices Manual* provides design standards and regulatory credit for a variety of permeable pavement practices. Wake County now allows permeable pavers that comply with the standards and specifications for design, construction and maintenance of permeable pavers in compliance with the most recent and current version of the State BMP Manual. In addition, the following requirements must be met:

- If there is no foundation drain on a structure then a 5 foot setback is required.
- If there is a foundation drain then the setback is determined by slope.
- If the BMP is down slope from structure then a 10 foot setback is required.
- If the BMP is on an even slope then a 15 foot setback is required.

- If the BMP is above slope then a 25 foot setback is required.
- Certification by an engineer will include a statement that pervious pavement does not affect structural foundations.

6.1 Example BMP Photos



Grass Swale



Infiltration Trench



Dry Well



Level Spreader



Wet Detention Pond



Constructed Wetland



Dry Detention Pond

7.0 WAKE COUNTY HYBRID STORMWATER DESIGN TOOL

Wake County is unique in that it has its own volume control SW ordinance, local and state water supply watershed regulations and is subject to three state nutrient management strategies in addition to the Swift Creek Land Management Plan. The complexity of applying multiple and overlapping regulations necessitates a streamlining of development submittal and review processes through the use of a single hybrid stormwater tool.

For stormwater submittals, engineers are required to complete the Wake County Stormwater Hybrid Design Tool, which incorporates the Neuse, Falls Lake and Jordan Lake Nutrient Strategy requirements. The tool calculates pre and post development runoff, peak flow, nitrogen loading, and target curve number volume requirements. All nutrient load calculations for this tool use the same methods used in the Jordan/Falls Nutrient Accounting Tool.

7.1 Wake County Hybrid Tool Contents

The hybrid tool is comprised of the following calculation sheets:

- Site Data worksheet
- DA worksheets
- Site Summary worksheet
- DA BMP worksheets
- BMP Summary worksheet
- Calculations sheet

Note: Required engineer inputs are denoted by cells highlighted in blue.

Site Data Worksheet

The Site Data Worksheet contains project information including but not limited to:

1. Engineer contact information
2. Site Location (regulatory watershed, geologic region)
 - a. Used to determine target N and P Loads and BMP removal rates
3. Development Type (Residential/Nonresidential) and Zoning
 - a. Development type is used to determine Target Curve Number (TCN) applicability and zoning assumptions
4. Precipitation Amounts
5. Residential SW Details for subdivisions
6. Stormwater Narrative
 - a. Stormwater narrative should describe the site conditions pre and post development including a description of site improvements and proposed stormwater BMPs (number, type and purpose – volume, nutrient removal, peak flow, etc.)

DA1-6 Worksheets

DA worksheets are designed to account for project requirements per Wake County UDO standards as well as the Neuse, Falls Lake and Jordan Nutrient Strategies. All project information is entered by drainage area. The tool allows for up to six drainage areas for the project. See [FAQs](#) for projects with more than six drainage areas. **DA** worksheets calculate runoff, time of concentration, peak flow, and volume to be managed per drainage area (if applicable). Inputs are also used to calculate the site composite curve numbers for pre and post development and total nitrogen (TN) and phosphorus (TP) loading calculations by drainage area.

Notes and Assumptions for DA1-6 worksheets:

- Land uses are assigned curve numbers (CNS) adapted from TR-55 as well as Event Median Concentrations (EMCs) as defined by the *Jordan/Falls Lake Stormwater Nutrient Load Accounting Tool User Manual*.

- The following additional land uses have been added to comply with Wake County TCN requirements: Transportation-High Density (right-of-ways, grassed), Transportation-Low Density (right-of-ways, grassed) and Residential-Roadway (right-of-ways, grassed). Per NCDWR, these grassed areas have the same EMCs as “managed pervious” and are treated as pervious. The impervious portions of the roadways have differing CNs and EMCs.
- Offsite and site land uses are used to determine pre and post development runoff and peak flow. Site peak flow is calculated per drainage area to determine the need for a BMP. Post development peak flow exceeding more than 10% of the pre development is flagged for a BMP.
- Time of concentration (Tc) is calculated on this sheet but is also highlighted in blue signifying that the user may override the value. Supporting calculations must be provided if overridden.
- The Wake County tool uses the Discrete SCS Curve Number Method for runoff volume (the Simple Method is used for the loading calculations) and TR-55 Graphical Peak Discharge Method for Type II Distribution for peak flow.
- Peak flow and adjusted CNs are shown for both the site and for the DA. Site peak flow is used for BMP determination. DA peak flow is used to ensure compliance from pre development (i.e. post-BMP peak includes any offsite drainage to the BMP and must be less than the pre development peak flow.)

Site Summary Worksheet

SITE SUMMARY worksheet summarizes the pre and post runoff and peak flow per drainage area based on inputs from **DA1-6** worksheets. TCN and peak flow for pre and post development are also calculated and summarized. If the TCN is exceeded, this worksheet calculates total volume to be managed for the entire site based on TCN requirements.

Nutrient loading rates for the site are compiled and calculated from **DA1-6** worksheets. Target rates for nutrients are also summarized based on regulatory watershed.

Notes and Assumptions for SITE SUMMARY worksheet:

- There is only one engineer input on this sheet. Disconnected Impervious - this area will be used to provide an adjusted post development composite curve number ($CN_{adjusted}$) to allow a credit for the use of disconnected impervious per Wake County stormwater ordinance. See the [Stormwater Credits](#) section of this manual for addition details.

DA BMP Worksheets

DA BMP1-6 worksheets require engineers to input proposed BMP information. BMPs are characterized by sub-basins within the drainage area. Engineers input BMP sub-basin land uses, BMP device name, type, volume managed by device, and post-BMP peak flow.

Notes and Assumptions for DA BMP worksheets:

- Engineers shall input site land uses by sub-basin. Off-site drainage to the sub-basin is also required (if said drainage is routed through the BMP). Loading calculations are only based on site land uses/volume. Offsite values are used in addition to onsite values to calculate the required water quality volume (1" runoff). Consequently, while site loading is based on onsite land uses only, required BMP storage volume includes offsite drainage to obtain BMP removal credits.
- BMPs within a sub-basin are assumed to be in a series with the same drainage area. Engineers may specify if sub-basins contribute to other sub-basins within the drainage area.
- This tool does not calculate Post BMP peak flow. Post BMP discharge is marked as an engineer input on these sheets. Engineer shall provide corresponding calculations/documentation for the entered discharge.

BMP SUMMARY Worksheet

BMP SUMMARY worksheet summarizes the post development and post BMP runoff and peak flow per drainage area based on inputs from **DA BMP** worksheets. Nitrogen and Phosphorus loading for the site is calculated based on the results from **DA1-6 BMP** worksheets. Project compliance with the Wake County UDO, Falls Lake Nutrient Strategy, and/or the Jordan Lake Nutrient Strategy is presented on this sheet.

- There are no engineer inputs on this sheet.

CALCULATIONS Worksheet

All calculations and table references are included on this worksheet.

- There are no engineer inputs on this sheet.
-

8.0 FREQUENTLY ASKED QUESTIONS (FAQs)

Q. How are grassed ROWs treated differently in the Wake County tool?

- A.** Wake County’s policy regarding the right-of-way areas includes an assumption of compaction of these areas. Therefore, the grassed portion of the right-of-way is assigned the curve number for open space in D soils (75) to account for this assumption of compaction.

However, the Jordan/Falls Tool does not allow for the differentiation of ROWs from the associated roadways. As a temporary fix to the Jordan/Falls tool, engineers that submit plans include the surface area of a proposed road under one of the transportation land uses and the grassed portion of the ROW as a “managed pervious” land use. This approach will be changed at a later date according to NCDENR as EMC values are determined for these areas. The Wake County tool does differentiate the grassed ROWs but assigns the “managed pervious” values for nutrient loading. Once EMC values are developed for grassed ROWs, the Wake County tool will be updated to reflect more accurate values.

Q. When placing BMPs in a series, how does the tool calculate total volume storage?

- A.** The goal of the curve number method is to release the runoff volume at a sufficiently slow rate so that it does not contribute to the peak discharge rate of the site or downstream erosion of stream banks. The storage of this volume is similar to the storage of the first flush volume for water quality purposes that is currently required by the Division of Water Quality for nutrient removal credits.

The assumption is that one device in a series is credited with the volume. The tool requires the user to input one figure as the storage volume for a sub drainage area, whether it is a single BMP or a series. If the applicant desires to justify crediting more than one device in a series, supporting information is required.

Q. My site has more than 6 drainage areas. How should that be handled?

- A.** For the purposes of demonstrating compliance with the peak flow requirement, an applicant should submit 2 tools in order to capture and characterize all the drainage areas. For volume and nutrient requirements, since they are determined by site, you may combine drainage areas that *are not* going to be treated by a BMP. Any drainage area that goes to a BMP should stand alone in the tool.

Q. Do I have to use the Wake County Hybrid Accounting Tool?

- A.** Wake County requires all applicants to use its tool since it has been approved by the Division of Water Quality and accounts for various county ordinance nuances. However, any applicant that has differing results or exceptions may submit supporting documents with the completed tool.

Q. What if my version of Excel is not 2010 or greater?

- A.** While Microsoft provides compatibility packs

(<http://www.microsoft.com/en-us/download/details.aspx?id=3>) to help bridge the different versions, it may not completely fix bugs that may occur with older versions. We encourage applicants to upgrade their software. If that is not an option, we can provide a kiosk at the Wake County Office Building on an appointment only basis.

Q. Do I need to use the Wake County Hybrid Accounting Tool for any single lot deviation?

A. No. Please refer to the [Single Lot](#) Deviation section of this manual for design and process guidance.

Q. Do projects in Wendell, Rolesville, & Zebulon jurisdictions have to now use the Wake County Hybrid Accounting Tool?

A. No. Applicants will continue to use the *Wake County Municipal Stormwater Design Tool* located on Wake County's [website](#).

9.0 SINGLE LOT DEVELOPMENT (DEVIATION PROCESS)

9.1 Concept

The purpose of this manual is to provide guidance for the management of stormwater runoff from development in Wake County's jurisdiction. The Stormwater deviation process was developed to allow individual lot owners a means to increase impervious surface area on lots where allowable.

Impervious allotments can be a result of a recorded limit to comply with a number of State and local stormwater and or Watershed Water Supply Watershed rules. Each zoning district will have a maximum allowable impervious surface limit which ranges from 6% to 30%. (The limit may not always be recorded on the lot but implied from zoning districts.)

To qualify for the deviation process, the lot or subdivision must not have been recorded with a "perpetuity statement" (i.e. *Maximum Impervious area square footage on each Individual Lot will be stringently enforced with no exceptions into perpetuity*). Generally, subdivision lots recorded post 2006 have a perpetuity statement. Lots with a perpetuity statement are not allowed to deviate from the approved impervious limits on an individual lot basis. A quick check of the subject plat on the Wake County Register of Deeds will determine if the perpetuity statement applies.

If there is no perpetuity statement, individual lot stormwater management may be permitted by the installation of approved stormwater treatment device(s). All applications to deviate are reviewed by the stormwater staff (Watershed Managers). Applicants will supply (with the building permit) a to-scale plot plan showing the lot and existing and proposed impervious features (driveway, sidewalk, house, patios, porches, outbuildings, etc.). Watershed managers will contact the applicant to allow for plan revision or to initiate the deviation process.

A treatment volume will be calculated by the permit reviewer. Volume will be based upon capturing the 1- yr, 24-hr storm event (approximately 3”) for projects in Wake County’s jurisdiction and subject to the Neuse River Stormwater Rules and or any combination of other applicable stormwater requirements. Projects located in the Swift Creek Watershed must meet state stormwater rules and the *Swift Creek Land Management Plan*. See [Appendix D](#) for a copy of the *Swift Creek Land Management Plan* and a chart summarizing Swift Creek requirements.

Note: This guidance is meant for individual subdivision lot land owners with small drainage areas only. The Wake County Stormwater Tool and Municipal Stormwater tool are not to be utilized for Single lot stormwater submittals.

9.2 Single Lot Deviation Process

1. Submit building permit application and site plan. IDPP flags project for exceeding maximum impervious surface area (MISA), collects \$50 fee for Stormwater Certification review and routes permit to the Watershed Manager responsible for the project
2. Watershed Manager confirms MISA and proposed plan and sends a memo to owner with the requirements to deviate from the recorded MISA
3. The building permit is placed on H-hold pending receipt of deviation application
4. Submit [deviation application](#), \$400 stormwater permit fee and proposed stormwater management plan. See [Submittal Requirements](#) for details.
5. Watershed Manager reviews plan and provides comments or conditional approval letter with requirements for CO
6. Building permit CO is placed Z-hold pending receipt of final as built plan and maintenance documents.

****No Certificate of Occupancy shall be issued until
Stormwater Management Plan is approved and implemented****

9.3 Submittal Requirements

A stormwater management plan is required before any building permits are issued. A final (as-built) site plan will be required prior to the issuance of a Certificate of Occupancy (CO). A good resource for a site plan is a survey issued for a recent mortgage or refinance closing. *An applicant may print plot plan from IMAPs to scale or go to Wake GIS Department.*

The Deviation process in Wake County is composed of the following:

- Site plan submittal
- Plan approval and building permit release
- Applicant notification of BMP construction

- As-built and other conditions of approval submittals
- As-built inspection by Watershed Manager
- Watershed Manager releases Z-hold (CO) on building permit

The stormwater management plan must include:

- Volume calculations of stormwater to be managed.
- Stormwater device plan and profile views detailing proposed elevations, slopes, vegetation, orifice sizing, weirs, and other elements that meet minimum device standards (see***).
- A site plan which includes the entire lot, drawn to scale, with the following:
 - Location, type and relevant dimensions and capacities of stormwater management structures and other devices
 - All existing and proposed impervious surfaces shall be clearly delineated and listed in sq. ft. and as a percentage of the total net lot size listed.
 - Delineate area of impervious surface to be directed to the stormwater device.
 - Show how the stormwater will reach device; pipe network or swale. Show discharge point from device to swale, rear of property, etc.
 - Lot lines with dimensions and road frontage delineated; existing or proposed driveways, parking spaces and walkways, with width and surface material described.
 - All existing and proposed buildings or other structures, with overall dimensions given and their setback(s) from nearest property lines clearly delineated.
 - Existing or proposed well, septic tank and drain field location(s) or sewer and water easements and proposed connection location(s).
 - All surface waters; FEMA 100-year flood fringe and floodway lines (or approximate 100-year flood line in unnumbered A Zones); flood hazard soils areas (adjust flood hazard soils to Wake County topography or field surveyed low points as appropriate); wetlands; reserved open spaces; the location, dimensions and arrangements of all drainageway, watershed, riparian, and other buffers and their associated required setbacks; the location of any existing or proposed easements (widths listed).
 - A title block indicating parcel identification number (PIN), north arrow and scale of the site plan, bar scale (for preliminary plans, indicate that it is a preliminary plan), name of Professional Land Surveyor, Landscape Architect, Professional Engineer, the landowner or his authorized agent's, signature, and for licensed professionals, seal of the person who prepared the plan, date map prepared (and any revision dates).

- For as-built final plans, indicate that it is an as-built plan and provide name of the Professional Land Surveyor who prepared the plan, his signature and seal and date map prepared (and any revision dates).
- If parcel is less than 5 acres, scales of 1" = 30', 40', 50', 60' or 100' are acceptable.

9.4 Example Single Lot Photos



Rain Barrels with Roof Drains



Raingarden (Bioretention)

APPENDIX A
Stormwater Forms

Presubmittal Meeting Request Form



Wake County Planning, Development, and Inspections

Wake County Office Building
336 Fayetteville Street, Suite 101
PO Box 550, Raleigh, NC 27602-0550
Phone: 919-856-6335
Fax: 919-856-5824

<http://www.wakegov.com/planning/default.htm>

PRE-SUBMITTAL MEETING REQUEST FORM

Prior to submitting your project application(s), the Wake County Land Development departments may require that you meet with applicable staff to discuss your request. Based upon your answers to the questions below (check all that apply), a Pre-Submittal meeting may be scheduled. Will your project:

- Involve phased development or construction
- Building equal to or greater than 2500 Sq Ft
- Require use of a new or existing septic tank system
- Require use of a new or existing well
- Meet or exceed an occupancy load of 50
- Require land disturbance of 1/2 acre or more
- Be developed or built without a design professional
- Meet or exceed the allowed impervious surface limit
- Be located in a water supply watershed critical area
- Involve a driveway or road crossing a drainage-way or stream
- Include a request by the applicant for a Pre-Submittal Meeting

Meetings are scheduled for 45 minutes and occur on Thursdays between 9am and 12 noon.

If a Pre-Submittal meeting is desired or required, please provide the following information (* = Required):

PRIMARY CONTACT (Individual proposing development or is responsible for managing the project):

First Name*	M.I.	Last Name*
<input type="text"/>	<input type="text"/>	<input type="text"/>

Project Affiliation (Ex. Owner, Architect, Religious Leader, Engineer, Developer, Manager, etc.)*

Address1*	Address2
<input type="text"/>	<input type="text"/>

City*	State*	Zip*	Email Address*
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Phone Number*

Cell Number

Fax Number*

PROJECT DETAILS (Information about the development or construction project proposal):

Description (Scope of proposed work – Describe what will be developed or constructed once complete)*

Occupancy Type
(Proposed Land Use)*

PIN
(Parcel ID Number)*

Map Attached?
Yes No

Site Plan Draft Attached?
Yes No

Parcel Address (Project Location)*

Current Date*

I agree that all information provided is accurate to the best of my knowledge.

Signature: _____ Date: _____

FOR OFFICE USE ONLY

Accepted By: _____ Date: _____

Tracking Number: _____

Meeting Date: _____

Date Meeting
Notification Sent: _____

Construction Plan Application



Construction Plan Application for Stormwater, Floodplain Management, Sedimentation & Erosion Control

I. PROPERTY INFORMATION

- 1. Project Name: 2. Address: 3. Wake County Pin #: 4. Jurisdictional Area: 5. Zoning District 6. River Basin: 7. County Watershed: 8. Total area in acres: 9. Total property area to be disturbed in acres: 10. Present Land Use (Check): 11. Proposed Land Use/Project Type (Check): 12a. Water Source (I / C / P): 12b. Wastewater Type (I / C / P): 13. Recorded: Book of Maps No. Page No. 14. Property w/i FEMA Flood Zone: 15. Zone: 16. FIRM Panel No.: 17. FIRM Effective Date: 18. Existing Impervious (sq.ft) 19. New or Proposed Impervious (sq.ft) 20. Impervious Surface of Well Lot and Access Road (sq.ft)

II. DOCUMENT SUBMITTED WITH THIS REQUEST:

Copies of this application () Sets of Construction Plans (5) Fees: (See attached fee schedule) Subdivision Preliminary Approval Document Wake County Hybrid Stormwater Tool (.xls)

A. Stormwater Review:

Stormwater Narrative Stormwater Checklist: SW Calculations () Nitrogen Export Load Calculations Deed Restrictions and Protective Covenants Application Form Operations, Maintenance, Inspection and Budget Manual Soil Scientist Soils Evaluation Stream Determination Letter

B. Flood Study Review:

Floodstudy Narrative Flood Study Checklist HEC/RAS Checklist Floodstudy Calculations ()

C. For Sedimentation & Erosion Control Review:

Erosion Control Narrative Sedimentation & Erosion Checklist Financial Responsibility/Ownership Form: S&E Calculations () DWQ, 404 and/or 401 approval document NC DOT Driveway Encroachment Agreement: Other Documents Submitted with this request:

III. GENERAL INFORMATION

1. **Property Owner** (s) (specify the name of the corporation, individual, etc., who owns the property):

Name: _____
 Street Address: _____
 Mailing Address: _____
 E-Mail Address: _____
 Phone#:(____) _____ Cell#:(____) _____ Fax#: (____) _____

2. **Applicant/Engineer/Architect/Surveyor** * (Person to whom all correspondence will be sent):

Name: _____
 Firm/other: _____
 Street Address: _____
 Mailing Address: _____
 E-Mail Address: _____
 Phone#: (____) _____ Cell#: (____) _____ Fax#: (____) _____
 Relationship to Owner: _____

**If not a resident of North Carolina, a North Carolina agent must be designated for the purpose of receiving correspondences.*

IV. APPLICANT'S CERTIFICATION:

PRINT NAME _____

SIGNATURE _____ **DATE** _____

OWNER/PERSON FINANCIALLY RESPONSIBLE

V. Residential Construction Plan Review Fees:

S&E _____ x \$250.00 = _____
 Exact disturbed acres (No Cap) round to nearest dollar

SW _____ x \$250.00 = _____
 Exact disturbed acres round to nearest dollar
 (10-Acre Cap or minimum of \$250.00)

Subdivision Review Fee = \$275.00

**Minor Flood Study please add \$500.00/ each crossing _____ x 500.00 = _____

**Major Flood Study please add \$1,000.00/ each crossing _____ x 1,000.00 = _____

Total Fees Due

VI. Non-Residential Construction Plan Review Fees:

S&E _____ x \$250.00 = _____
 Exact disturbed acres (No Cap) round to nearest dollar

SW _____ x _____ = _____
 Exact disturbed acres (50 Acre Cap) round to nearest dollar
 \$250 (0-9 acres)
 \$375 (10-19 acres)
 \$435 (20-29 acres)
 \$470 (30-39 acres)
 \$485 (40-50 acres)

**Minor Flood Study please add \$500.00/ each crossing _____ x 500.00 = _____

**Major Flood Study please add \$1,000.00/ each crossing _____ x 1,000.00 = _____

Total Fees Due

****Applies only to Wake County Jurisdictional Projects**

(form updated September 2012)

OFFICIAL USE ONLY				
Date Received	S&E	Stormwater	Subdivision	Flood Major____, Minor____
S permit #	S	S	S	S

Stormwater Agreement Form

STATE OF NORTH CAROLINA
WAKE COUNTY

STORMWATER AGREEMENT

THIS AGREEMENT, made and entered into this the ____ day of _____, _____, by and between Wake County, hereinafter referred to as County, and _____, hereinafter referred to as Owner;

WITNESSETH

THAT WHEREAS, Owner is this day accepting responsibility for the stormwater device(s) installed on that certain real property known as _____, as shown on the plat thereof recorded in the Book of Maps _____, Page _____, Wake County Registry; and

WHEREAS, as a part of the construction of the residence/development the Wake County Environmental Services – Flood and Stormwater Section required that a stormwater device(s) be constructed; and

WHEREAS, the Owner accepts responsibility for the maintenance of the stormwater device(s) as prescribed in the Maintenance Agreement signed and notarized, dated _____, 20____; and

WHEREAS, the Owner grants access to Wake County to inspect the stormwater device(s); and

WHEREAS, the Owner understands that this Agreement shall endure to the benefit of his successors in title, whomsoever they may be in the future.

NOW, THEREFORE, it is understood and agreed by and between the parties:

1. The maintenance of the stormwater device(s) shall be the sole responsibility of the Owner.
2. The responsibility for the maintenance of the stormwater device shall pass in the chain of title to the Owner's successor in interest.
3. Access is granted to Wake County to inspect the stormwater device(s).
4. Annually, The Owner shall provide an inspection report from to occur each year beginning one year after _____(07/31/20xx) and each successive year by the 07/31 thereafter.

The report should be faxed to (919) 856-7407 Attention: Environmental Services –Flood and Storm Water Section.

Owner: _____

Date: _____

I, _____ THE UNDERSIGNED notary Public of the County and State aforesaid, certify that _____ personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

WITNESS my hand and notarial seal, this the _____ day of _____, _____.

Notary Public

My Comm. Exp. _____

After recording return to:
Floodplain and Stormwater Management
336 Fayetteville St. PO Box 550
Raleigh, NC 27602

Wake County Stormwater Submittal Checklist



WAKE COUNTY STORMWATER CHECKLIST

Under the municipality ordinance, most development is required to obtain a stormwater permit. A stormwater management plan is designed to protect downstream water resources and property owners from water pollution, flooding and other damage caused by urban runoff after a development is complete. This checklist shows what information needs to be provided and what issues need to be addressed when preparing a stormwater management plan. All items listed may not be applicable to each site, nor is the list all-inclusive. It is meant to serve as a guide for the stormwater planner.

_____ **Stormwater Plan Review Fee**
_____ **Stormwater Permit Fee**

Master/Preliminary Plan Submittal.

Delineate and Label On Map (1"=equals no more than 100') & Drawings

	North arrow, graphic scale, drafting version/date and designation of source documents for all map features
	Existing and proposed watershed, sub-watershed, and land use boundaries. <i>(contributing watersheds that extend beyond the site boundaries may be delineated on a separate map.)</i>
	Delineate any required Riparian Buffers and/or provide documentation of buffer reductions Note – Neuse buffers are required County-wide; Jordan Lake buffers effective August 2011
	Delineation of all proposed impervious surfaces, roads, well lots, recreation sites, including single family residences.
	Clearly delineate flood hazard boundaries, including FEMA series J maps and flood hazard soils. Differentiate between floodplain and open space. Indicate lots which will require flood permits.
	Delineate all flood hazard soils and/or provide documentation of soils redelineations.
	Stormwater Hybrid Design Tool Worksheets: Site Data Sheet, DA sheets, Site Summary, and BMP sheets (2 copies)
	Proposed stormwater discharge points <i>(where water leaves site by surface or subsurface flows).</i>
	Proposed drainage easements and widths <i>(in Feet).</i>
	Type, size location and cross-section of all proposed stormwater management conveyance systems <i>(grass swale, lined channel, storm culvert, etc.).</i>
	Location and type of all proposed stormwater management structures <i>(wet/dry detention basin, filtering/infiltration basin, bioretention, etc.).</i>
	Proposed easement access lanes and sediment disposal areas for future maintenance of stormwater management facilities.
	Indicate whether 401/404 permits are required and applied for.

Construction Plan Submittal (in addition to preliminary list)

	Joint application for plan approval (Complete Sediment and Erosion Control if applicable)
	Plan narrative describing site drainage, stormwater management objectives, and how the

	proposed stormwater management plan will meet the objectives and be implemented.
	Complete set of Stormwater Design Worksheets – hydrid tool (2 copies)
	Support data for all stormwater practice designs, such as drainage area boundaries, Tc/Tt values, inflow/outflow rates, stage/storage data, hydrographs, outlet designs, infiltration rates, water elevations, design output, summary, etc.
	Nitrogen Export Load Calculations – DWQ Form (Neuse, Falls, Jordan ,etc.)
	Required flood study approvals
	Backwater easements
	Draft Stormwater Agreement
	Draft Maintenance Agreement
	Draft Deed Restrictions / Protective Covenants Proposal
	Draft As Built Plan or performance guarantee paperwork.
	Other hydraulic and hydrologic computations critical to the plan/designs.
	401/404 approvals
	Impact assessment for discharges to wetlands.
	Planting and landscaping plans critical to the stormwater designs.
	Signature, Date And Professional Seal: for all Stormwater design management proposals, i.e. calculations, BMP designs, operations/maintenance/budget/as-built/inspections/manuals.

Final Plat Submittal

	Table with impervious calculations
	Perpetuity statement (residential)
	Show impervious limit on each lot rounded to nearest whole number
	Asterisk lots requiring flood permits (residential)
	Show finished floor elevations as required
	Show required buffers, flood hazard areas, drainage easements, ...
	Show specific locations of permanent stormwater devices with maintenance easements; label as permanent stormwater detention and maintenance easement.
	Show required statements in support of design calculations such as tree preservation areas and disconnected impervious.
	Receipt from private mitigation bank or NC EEP for nutrient offset
	Completed Stormwater Agreement
	Completed Maintenance Agreement
	Deed Restrictions / Protective Covenants Proposal
	As Built plans for stormwater devices (see as built checklist)
	Performance guarantee in lieu of as-built plans
	Required notes for floodplain, buffers, drainage easements, etc.

Updated 10/8/12

Wake County Standards Checklist

WAKE COUNTY CHECKLIST OF APPLICABLE STANDARDS FOR NEW DEVELOPMENT: (EXCEPT FALLS AND JORDAN WATERSHEDS)		STAFF USE ONLY	
PROJECT NAME:		FILE #:	
DEV'R: √ or X	APPLICABLE STANDARD [Rule Reference]	STAFF: √ or X	COMMENTS/CONDITIONS
STANDARDS FOR NEW DEVELOPMENT			
1	An Approved Stormwater Management Plan –shall be required for all proposed new development disturbing one acre or more for residential development, and one-half acre or more for commercial, industrial, multifamily residential, local government property and other non-residential uses.[15A NCAC 02B.0235]; Neuse Rules apply County-wide [Wake County]		
2	Stormwater Permit – is required for all development and redevelopment unless exempt pursuant to the Unified Development ordinance. A permit may only be issued subsequent to a properly submitted, reviewed and approved stormwater management plan and permit application. [Wake County]		
3	Nitrogen Load- contributed by the proposed new development activity shall not exceed the unit area mass loading rate for nitrogen of 3.6 of pounds per acre per year: nitrogen loading shall be calculated using the Wake County Hybrid Stormwater Tool. Nitrogen loading is calculated using the Simple Method consistently with the State's Accounting Tool [15A NCAC 02B.0235 (4)(a)]; [Wake County]		
4	Compliance Other Stormwater Regulations - proposed new development subject to NPDES, water supply, Swift Creek Land Management Plan and other state and local mandated regulations shall comply with those regulations in addition to the other requirement of 15A NCAC 02B.0277. [15A NCAC 02B.0277(4)(d)]		
5	Volume Management – shall be required for RESIDENTIAL regular subdivisions when the post development curve number exceeds the pre development curve number using the Wake County Hybrid Stormwater Tool. Minor subdivisions have the option of limiting impervious to 15%.		
5	Runoff Treatment –Stormwater systems shall be designed to control and treat <u>at a minimum</u> , the runoff generated from all surfaces by one inch of rainfall. The treatment volume shall be drawn down pursuant to each practice as provided in the July 2007 version of the <i>Stormwater Best Management Practices Manual</i> published by DENR or other technically equivalent standards acceptable to DENR. Item 5 Runoff Treatment above. [15A NCAC 02B.0277(4)(e)]		
6	Peak Flow – new development shall not result in a net increase in peak flow leaving the site from the pre development conditions for the 1 yr-24hr storm. Treatment volume shall be drawn down pursuant to standards specific to each practice as provided the NC Stormwater Best Management Practices Manual or technically equivalent standards acceptable to NCDENR. Peak flow control for the 1-year, 24-hour storm is required when the net increase in peak flow between pre- and post-development exceeds 10%. [15A NCAC 02B.0235 (4)(a)]		
7	Replacement or Expansion w/No Net Increase in BUA – proposed development that would replace or expand structures or improvements that existed as of July 2001, <u>and that would not result in a net increase in built-upon area</u> shall not be required to meet nitrogen loading targets except to the extent that the developer shall provide stormwater control at least equal to the previous development.		

8	<p>Replacement or Expansion with Net Increase in BUA proposed development that would replace or expand structures or improvements and that would result in a net increase in built-upon area shall meet the target of 3.6 lbs/ac/yr for the entire site OR achieve a 30% reduction in nitrogen loading and no increase in phosphorus loading.</p>		
9	<p>Riparian Buffers – new development shall comply with the riparian buffer protection requirements of 15A NCAC 02B.0233 and .0242 or subsequent amendments or replacements to those requirements. [15A NCAC 02B.0235]</p>		
10	<p>Nutrient Offset Option- Developers shall have the option of offsetting part of their nitrogen load by funding offsite management measures by making payment to the NC Ecosystem Enhancement Program or to another seller of offset credits approved by the Division or may implement other offset measures contingent upon approval by the Division. Prior to accessing the Ecosystem Enhancement Program (EEP) Nutrient Offset Program, all applicants are now required by law to comply with Session Law 2009-337 An Act to Promote the Use of Compensatory Mitigation Banks and also with SL 2011-343. Please refer to DENR’s Implementation Policy for more detailed guidance. However, before using offset payments, the development must attain, at a minimum, a nitrogen export that does not exceed 6 pounds/acre/year for residential development and 10 pounds/acre/year for commercial or industrial development. [15A NCAC 02B.0235 (4)(a)]</p>		
11	<p>Stormwater Improvements – The developer shall complete all stormwater improvements (drainage culverts, BMPs, et. al.) prior to CO or record plat OR shall post a performance guarantee. The developer shall submit a plan to ensure maintenance, enforcement and compliance of Best Management Practices (BMPs) for the life of the new development. [Wake County]</p>		
12	<p>Plan Submittal – preliminary and construction plans shall be submitted along with the Wake County Hybrid Stormwater Tool and stormwater submittal checklist; Presubmittal meetings shall be scheduled through the Planning Department.</p>		

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Falls Lake Standards Checklist

WAKE COUNTY CHECKLIST OF APPLICABLE STANDARDS FOR NEW DEVELOPMENT: FALLS LAKE NUTRIENT MANAGEMENT STRATEGY		STAFF USE ONLY	
PROJECT NAME:		FILE #:	
DEV'R: √ or X	APPLICABLE STANDARD [Rule Reference]	STAFF: √ or X	COMMENTS/CONDITIONS
STANDARDS FOR NEW DEVELOPMENT			
1	An Approved Stormwater Management Plan –shall be required for all proposed new development disturbing one-half acre or more for single family and duplex residential development, and 12,000 square feet or more for commercial, industrial, multifamily residential, local government property and other non-residential uses.[15A NCAC 02B.0277(3)(a)]		
2	Stormwater Permit – is required for all development and redevelopment unless exempt pursuant to the Unified Development ordinance. A permit may only be issued subsequent to a properly submitted, reviewed and approved stormwater management plan and permit application. [Wake County]		
3	Nitrogen and Phosphorus Loads- contributed by the proposed new development activity shall not exceed the unit area mass loading rate for nitrogen and phosphorus, respectively, expressed in units of pounds per acre per year: 2.2 N and 0.33 P. [15A NCAC 02B.0277(4)(a)]		
4	Compliance Other Stormwater Regulations - proposed new development subject to NPDES, water supply and other state and local mandated regulations shall comply with those regulations in addition to the other requirement of 15A NCAC 02B.0277. [15A NCAC 02B.0277(4)(d)]		
5	Runoff Treatment –Stormwater systems shall be designed to control and treat at a minimum, the runoff generated from all surfaces by one inch of rainfall. The treatment volume shall be drawn down pursuant to each practice as provided in the July 2007 version of the <i>Stormwater Best Management Practices Manual</i> published by DENR or other technically equivalent standards acceptable to DENR. Item 5 Runoff Treatment above. [15A NCAC 02B.0277(4)(e)]		
6	Peak Flow – new development shall not result in a net increase in peak flow leaving the site from the predevelopment conditions for the 1 yr-24hr storm. Treatment volume shall be drawn pursuant to standards specific to each practice as provided the NC Stormwater Best Management Practices Manual or technically equivalent standards acceptable to NCDENR. [15A NCAC 02B.0277(4)(f)]		
7	Compliance Alternative – new development may satisfy the requirements of 15NCAC 02B.0277 by meeting the post-development hydrologic criteria set out in Chapter 2 of the <i>NC Low Impact Development Guidebook</i> dated June 2009, or the hydrologic criteria in the most recent version of that guidebook. -[15A NCAC 02B.0277(4)(g)]		

7	<p>Replacement or Expansion w/No Net Increase in BUA – proposed development that would replace or expand structures or improvements that existed as of December 2006, the end of the baseline period, <i>and that would not result in a net increase in built-upon area</i> shall not be required to meet nutrient loading targets or high-density requirements except to the extent that the developer shall provide stormwater control at least equal to the previous development. [15A NCAC 02B.0277(4)(a)]</p>		
8	<p>Replacement or Expansion with Net Increase in BUA proposed development that would replace or expand structures or improvements and <i>that would result in a net increase in built-upon area</i> shall have the option either to achieve at least the percentage loading reduction objectives stated in 15A NCAC 02B.0275 as applied to nitrogen (40%) and phosphorous (77%) loading from the previous development for the entire project site, or to meet the loading rate targets expressed in lbs/ac/yr of nitrogen 2.2 and phosphorous 0.33. [15A NCAC 02B.0277(4)(a)]</p>		
9	<p>Riparian Buffers – new development shall comply with the riparian buffer protection requirements of 15A NCAC 02B.0233 and .0242 or subsequent amendments or replacements to those requirements. [15A NCAC 02B.0277(4)(h)]</p>		
10	<p>Nutrient Offset Option- Developers shall have the option of offsetting part of their nitrogen and phosphorus loads by implementing or funding offset management measures. Before using the offsite offset option, a development shall implement onsite structural controls that achieve one of the following levels of reduction:</p> <ul style="list-style-type: none"> (i) Proposed new development activity disturbing at least one-half acre but less than one acre of land for single family and duplex residential property and recreational facilities, except as stated in (iv) below, shall achieve 30 percent or more of the needed load reduction in both nitrogen and phosphorus loading onsite and shall meet any requirements for engineered stormwater controls described in Item 5 Runoff Treatment above; (ii) Proposed new development activity disturbing at least 12,000 but less than one acre of land for commercial, industrial, institutional, multifamily residential, or local government property and other non-residential property, except as stated in (iv) below, shall achieve 30 percent or more of the needed load reduction in both nitrogen and phosphorus loading onsite and shall meet any requirements for engineered stormwater controls described in Item 5 Runoff Treatment above; (iii) Except as stated in (iv) below, proposed new development activity that disturbs one acre of land or more shall achieve 50 percent or more of the needed load reduction in both nitrogen and phosphorus loading onsite and shall meet any requirements for engineered stormwater controls described in Item 5 Runoff Treatment above; or (iv) Proposed development that would replace or expand structures or improvements that existed as of December 2006 and that increases impervious surface within a local government's designated downtown area, regardless of area disturbed, shall achieve 30 percent of the needed load reduction in both nitrogen and phosphorus onsite, and shall meet any requirements for engineered stormwater controls described in Item 5 Runoff Treatment above. <p>[15A NCAC 02B.0277(4)(b)(i-iv)]</p>		

11	Offsite Offsetting Measures – Developers shall meet onsite reduction requirements outlined in Item 10 Nitrogen Offset Option above before using the offsite offset option [15A NCAC 02B.0277(4)(b)]. Offsite offsetting measures shall achieve at least equivalent reductions in nitrogen and phosphorus loading to the remaining reduction needed onsite to comply with the loading target rates. A developer may use any measure that complies with 15A NCAC 02B.0240 and 15A NCAC 02B.0282. [15A NCAC 02B.0277(4)(c)]		
12	Maintenance Plan – A plan to ensure maintenance, enforcement and compliance of Best Management Practices (BMPs) for the life of the new development. [15A NCAC 02B.0277(3)(b)–(c)]		

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Jordan Lake Standards Checklist

CHECKLIST OF APPLICABLE STANDARDS FOR NEW DEVELOPMENT: JORDAN LAKE NUTRIENT MANAGEMENT STRATEGY (DRAFT)		STAFF USE ONLY	
PROJECT NAME:		FILE #:	
DEV'R: √ or X	APPLICABLE STANDARD [rule reference]	STAFF: √ or X	COMMENTS/CONDITIONS
STANDARDS FOR NEW DEVELOPMENT			
	1 An Approved Stormwater Management Plan –shall be required for all proposed new development disturbing 1 acre or more for single family and duplex residential development, and one-half acre or more for commercial, industrial, multifamily residential, local government property and other non-residential uses.[15A NCAC 02B.0265(3)(a)]		
	2 Stormwater Permit – is required for all development and redevelopment unless exempt pursuant to the Unified Development ordinance. A permit may only be issued subsequent to a properly submitted, reviewed and approved stormwater management plan and permit application. [Wake County]		
	2 Nitrogen and Phosphorus Loads- contributed by the proposed new development shall not exceed the unit area mass loading rate applicable to that subwatershed as follows for nitrogen and phosphorus, respectively, expressed in units of pounds per acre per year: 2.2 N and 0.82 P in the Upper New Hope, 4.4 N and 0.78 P in the Lower New Hope; and 3.8 and 1.43 in the Haw. [15A NCAC 02B.0265(3)(a)(i)]		
	3 Compliance Other Stormwater Regulations - proposed new development subject to NPDES, water supply and other state and local mandated regulations shall comply with those regulations in addition to the other requirements of NCAC 02B.0265. [15A NCAC 02B.0265(3)(a)(iii)]		
	4 Runoff Treatment –Stormwater systems shall be designed to control and treat the runoff generated from all surfaces by one inch of rainfall. Treatment volume shall be drawn pursuant to standards specific to each practice as provided the NC Stormwater Best Management Practices Manual or technically equivalent standards acceptable to NCDENR. Stormwater flows from new development shall not contribute to degradation of waters of the State. [15A NCAC 02B.0265(3)(a)(iv)]		
-	5 Peak Flow – new development shall not result in a net increase in peak flow leaving the site from the predevelopment conditions for the 1 yr-24hr storm. [15A NCAC 02B.0265(3)(a)(iv)]		
	6 Total Suspended Solids – Per SL 2009-484, all impervious cover on the entire site shall be treated for 85% TSS removal.		
	7 Replacement or Expansion w/No Net Increase in BUA – proposed development that would replace or expand structures or improvements that existed as of December 2001, the end of the baseline period, <i>and that would not result in a net increase in built-upon area</i> shall not be required to meet nutrient loading targets or high-density requirements except to the extent that it shall provide stormwater control at least equal to the previous development. [15A NCAC 02B.0265(3)(a)(v)]		

8	<p>Replacement or Expansion with Net Increase in BUA proposed new development that would replace or expand existing structures or improvements and that would result in a net increase in built-upon area shall have the option either to achieve at least the percentage loading reduction objectives stated in 15A NCAC 02B.0262 as applied to nitrogen (35% UNH, 0% LNH and 8% Haw) and phosphorous (5% UNH, 0% LNH and 8% Haw) loading from the previous development for the entire project site, or to meet the loading rate targets expressed in lbs/ac/yr of nitrogen (2.2 UNH, 4.4 LNH, and 3.8 Haw) and phosphorous (0.82 UNH, 0.78 LNH, and 1.43 Haw) [15A NCAC 02B.0265(3)(a)(v)]. <i>Note: There is no reduction goal for redevelopment in the LNH for N or P; therefore the loading rate targets are not applicable only for replacements or expansions that result in a net increase in BUA.</i></p>		
9	<p>Riparian Buffers – new development shall comply with the riparian buffer protection requirements of 15A NCAC 02B.0267 and .0286 [15A NCAC 02B.0265(3)(a)(vi)]</p>		
10	<p>Nutrient Offset Option- Developers shall have the option of offsetting part of their nitrogen and phosphorus loads by implementing or funding offset management measures as follows: Before using the offset options, a development shall attain a maximum nitrogen loading rate onsite of 6 lbs/ac/yr for single-family detached and duplex residential development and 10 lbs/ac/yr for other development including multi-family residential, commercial and industrial and other non-residential property and shall meet any requirements for engineered stormwater controls described in NCAC 02B.0265(3)(a)(iii).</p>		
11	<p>Offsite offsetting measures – shall achieve at least equivalent reductions in nitrogen and phosphorus loading to the remaining reduction needed onsite to comply with the loading target rates. [NCAC 02B.0265 (3) (a) (vii)].</p>		
12	<p>Offset Payments - A developer may make offset payments to the NC Ecosystem enhancement Program contingent upon acceptance of payments by that program or may propose the use other offsite offset measures to the local government or utilize a private seller. All offset measures shall meet the requirements of 15A 02B .0273(2) through (4). [NCAC 02B.0265 (3) (a) (vii)].</p>		
13	<p>Maintenance Plan – A plan to ensure maintenance, enforcement and compliance of BMPs for the life of the development [NCAC 02B.0265 (3) (b) and (c)].</p>		
END			

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As-Built Checklist



Wake County As-Built Checklist

Under county ordinance, projects requiring stormwater management devices require Assurance that Improvements will be Completed and Maintained per Article 9, Stormwater Management, of the Unified Development Ordinance (UDO). Upon completion of required improvements, the developer must submit as-built plans of required stormwater improvements to the Wake County Department of Environmental Services. These plans must indicate whether stormwater improvements were constructed in accordance with the county approved stormwater plan. This checklist shows what information needs to be provided and what issues need to be addressed when preparing an as-built plan. All items listed may not be applicable to each site, nor is the list all-inclusive. It is meant to serve as a guide for the engineer preparing an as-built plan.

As-Built Certification. Two copies of as-built, field-verified plans must be signed and sealed by a registered Professional Engineer and/or a Registered Land Surveyor, both licensed to practice in the State of North Carolina, showing contours, elevations, grades, locations, drainage and hydraulic structures, and detention basin volumes.

Vicinity map on plan sheet.
Profile along the centerline of the embankment.
Profiles and/or cross sections of the stormwater management facilities with associated details.
Elevations of the "water quality", 10, and 100 year storms as appropriate.
Profile along the centerline of the principal spillway/outfall pipe extending below the protected outfall or to the downstream manhole structure
As-Built topography and/or dimensions of the stormwater management facility with computations to verify conformance with the approved plan.
Establishment of a benchmark on the riser/control structure or inlet headwall to the nearest 0.1-foot.
Profile along the centerline of the emergency spillway.
Design and As-Built stage-storage table on the plan view sheet.
Storage deviation verification (i.e. TR-20 computer run to show adequate storage if the available storage does not agree with the original design storage.
The dimensions and type of material for the riser/control structure.
The diameter, length, and type of material for the principal spillway, underdrains, and observation/cleanout wells.
The size, location and type of trash rack device(s).
The number, size and location of the anti-seep collars, precast collars, and cradles as appropriate.
Invert, size and length of any low stage orifices and high stage weir crests.
Flow splitter diversion pipe/weir invert, size, and location.
Incoming and outgoing storm drain sizes, inverts, and outfall dimensions.
Thickness and type of coarse/fine aggregates and planting soil.
Filter fabric/geotextile type and location.
Landscape/wetland plantings number and location. Include landscape plan with as-built plan set.
Certification statement and seal by a Professional Engineer indicating, "This record drawing is accurate and complete, the stormwater management facilities are constructed per the approved stormwater management plan or subsequent approved revisions, and stormwater management is provided per the approved design computations".
Verify easements, covenants, and any other legal agreements are recorded and in the file.
Verify that the stormwater management facility was constructed within the recorded easement area.
Provide proof of recordation of stormwater agreement / provide copy
Provide signed maintenance agreement

Final Plat Checklist



Environmental Services

TEL 919 856 7400
 FAX 919 856 5855
 Floodplain & Stormwater Management
 336 Fayetteville St. P.O. Box 550
 Raleigh, NC 27602

Final Plat Submittal

Table with impervious calculations
Perpetuity statement (residential)
Show impervious limit on each lot rounded to nearest whole number
Asterisk lots requiring flood permits (residential)
Flood hazard areas (flood hazard soils and FEMA flood zones)
Drainage easements
Backwater areas / easements
Show finished floor elevations as required for lots with flood backwater or FEMA encroachment.
Show required buffers, flood hazard areas, drainage easements, ...
Show specific locations of permanent stormwater devices (including level spreaders) with maintenance easements; label as permanent stormwater detention and maintenance easement.
Show required statements in support of design calculations such as tree preservation areas and disconnected impervious.
Floodplain Notes
Buffer Notes
If flood study required, as built survey for flood crossings.
Receipt for required NC EEP offset fee.
Stormwater permit fee paid / permit issued.
Completed Stormwater Agreement
Completed Maintenance Agreement
Deed Restrictions / Protective Covenants
As Built survey for stormwater devices (see as built checklist)
Performance guarantee in lieu of as-built plans
Stormwater signature block

Plan Notes:

Perpetuity Statement – Maximum Impervious Area Square Footage on each Individual Lot will be Stringently Enforced with no Exceptions into Perpetuity. Plans approved limiting the maximum impervious surface to XX square feet per lot.

Stormwater BMPs to be maintained by the homeowners association per stormwater agreement recorded in DB___ PG___.

Reference the maintenance manual for the Stormwater BMP.

Performance Guarantee disclosure (if one has been posted)



Environmental Services

TEL 919 856 7400

FAX 919 856 5855

Floodplain & Stormwater Management

336 Fayetteville St. P.O. Box 550

Raleigh, NC 27602

Drainage Easement Notes:

It shall be the responsibility of the property owners to maintain the drainage easements and any drainage structures therein, so as to maintain the integrity of the drainage system and ensure positive drainage.

Easements may not be piped without receiving plan approval from Wake County.

Stormwater Improvements Performance Guarantee Agreement

STORMWATER IMPROVEMENTS PERFORMANCE GUARANTEE AGREEMENT (Draft)

1. **Purpose:** This Stormwater Improvements Performance Guarantee Agreement ("Agreement") is intended to help ensure that developers properly install all required subdivision improvements in a timely manner, in accordance with approved plats and construction plans. This agreement is not executed for the benefit of persons providing services or material to the subdivision/project, or for the benefit of persons buying lots or homes in the subdivision, or other possible third party beneficiaries.
2. **Parties:** This Agreement is between the County of Wake, North Carolina (the "County") and _____
[Name of "Developer"]
3. **Term:** The term of this Agreement is _____ *[insert duration; may not exceed 2 years]* from the date of execution signified below.
4. **Subdivision/Project:** This Agreement applies to property the Developer is developing as _____ *[Insert Project Name], Phase(s) _____,* recorded in Book(s) of Maps and Page(s) to be provided upon plat recordation.
5. **Improvements:** The Developer is responsible for the construction and installation, at the Developer's sole expense, of the following improvements:
 - a. drainage facilities and easements;
 - b. stormwater management devices;
 - c. removal of erosion and sedimentation control devices; and
 - d. any other on- or off-site improvements required by county ordinance or subdivision plat approval.
6. **Standards:** The Developer will construct and install improvements required in Section 5 in accordance with all applicable County subdivision regulations and any other applicable federal, state, county or municipal standards in effect at the time of subdivision plat approval.
7. **Estimate of Probable Costs:** The Developer hereby agrees and states that the following estimates of the probable costs of subdivision improvements include the cost of design, engineering and construction and project management and supervision. The Developer further represents that the Developer's estimates of such costs represent the Developer's good-faith efforts to accurately predict the probable total costs of such improvements. The Developer hereby agrees that the construction of the improvements will be completed on or prior to _____ *[insert "Construction Completion Date"]*, which date shall not exceed two years from the date of execution of this Agreement. The Developer estimates, based on the certified formal cost estimate(s) attached hereto, that the total cost of the construction of the improvements will be as follows:

Improvement	Estimate of Probable Cost	Construction Completion Date
a.	\$	
b.	\$	
c.	\$	
d.	\$	

e.	\$	
f.	\$	
Subtotal; Estimated Supervision/General Contractor and Project Management Costs (for all above-listed improvements)	\$	
Plus 25% of Total Estimated Cost	+	
	\$	
TOTAL AMOUNT OF FINANCIAL SECURITY REQUIRED >>>>>		

Note: Pursuant to Wake County subdivision regulation standards, estimated probable costs must be itemized by improvement type and certified by the applicant's engineer. In the case of minor subdivisions, the applicant's engineer or surveyor may provide the itemized cost estimate. Cost estimates must be based on industry norms within Wake County. Itemized costs estimates must be attached to this Agreement.

- 8. Security:** To secure the performance of the Developer's obligations under this Agreement, the Developer will provide the County either an irrevocable letter of credit, performance bond or a cash escrow account in the amount of \$ _____ [*insert total amount of financial security required, from above*].
- a. **Letter of Credit:** If the Developer provides a letter of credit, it must be valid for at least the term of this Agreement and be payable to the County at any time upon presentation of (a) an affidavit executed by an authorized County Official stating that the Developer is in default under this Agreement, and (b) the original or copy of the letter of credit. The letter of credit will be issued by a financial institution approved by the County and located within Wake County, North Carolina, and must be irrevocable. An authorized county official for purpose of this subsection shall include the County Manager, the Planning Director, or their designees.
 - b. **Performance Bond**
 - c. **Cash Escrow:** a cash escrow account shall be established at a local bank
 - d. **Certified Check**
- 9. Release of Security:** The County will release the security when all required Stormwater Improvement Completion Certification Forms have been provided and any required maintenance guarantee has been provided. Once all of the required improvements are at least 50 complete, as certified by a North Carolina Registered Professional Engineer, the County may reduce the total financial security by the ratio that the completed improvements bear to the total estimated cost of improvements required, provided that no more than one such reduction may be permitted prior to releasing the performance guarantee.
- 10. Events of Default:** The following conditions, occurrences, omissions or actions will constitute a default by the Developer:
- a. Developer's failure to, at least 15 days before this Agreement expires, either (1) provide the County a properly executed Subdivision Improvement Completion Certification Form certifying that all required subdivision improvements have been constructed or installed or (2) renew this Agreement under Section 12, below;
 - b. Developer's insolvency, the appointment of a receiver for the Developer, or the filing of a voluntary or involuntary petition in bankruptcy respecting the Developer; or

- c. Foreclosure of any lien against the Subdivision property or a portion of the property, or assignment or conveyance of the Subdivision property in lieu of foreclosure.
11. **Notice of Default:** At least 60 days before this Agreement expires, the County may give the Developer written notice of the Agreement's upcoming expiration and of the County's intent to declare a default under Section 10a unless the public road Improvements are accepted or the Agreement renewed. The County need not provide any further notice before declaring a default under Section 10a. Within 10 days after any appointment of a receiver for the Developer, filing of a bankruptcy petition respecting the Developer, foreclosure against the Subdivision property, or conveyance of the Subdivision property in lieu of foreclosure, the Developer will give the County written notice of such event.
12. **Renewal of Agreement:** If agreed to in writing by the County and Developer, this Agreement may be extended no more than twice and for no more than one year per extension.
13. **County's Rights Upon Default:** When any event of default occurs, the County may draw on the financial security to the extent of its face value. The County will have the right to use the drawn funds to construct, install or arrange for the construction or installation of any subdivision improvements. The County will have the right to conduct such work itself, or to contract with a third party to do so. The Developer grants the County, its successors, assigns, agents, contractors, and employees, a nonexclusive right to enter the Subdivision property for the purposes of constructing or installing subdivision improvements.
14. **Indemnification:** The Developer expressly agrees to indemnify and hold the County harmless from and against any claims, cost, and liability for injury or damage received or sustained by any person or entity in connection with work performed under this Agreement. The Developer further agrees to aid and defend the County if the County is named as a defendant in an action concerning work performed under this Agreement except where the action is brought by the Developer. The Developer is not an agent or employee of the County.
15. **No Waiver:** No waiver of any provision of this Agreement will constitute a waiver of any other provision, nor will it constitute a continuing waiver, unless expressly provided for by a written amendment to this Agreement. Nor will any waiver of any default under this Agreement constitute a waiver of any subsequent default of defaults of the same type. The County's failure to exercise any right under this Agreement will not constitute the approval of any wrongful act by the Developer. The County's exercise of any right under this Agreement will not relieve the Developer from any obligation to construct or install subdivision improvements under the County's ordinances and will not constitute a waiver of the County's right to exercise any enforcement action under those ordinances.
16. **Amendment or Modification:** The parties to this Agreement may amend or modify this Agreement only by written instrument executed on behalf of the County by the County Attorney (or his designee) and by the Developer (or the Developer's authorized officer). An amendment or modification must be properly notarized before it is effective.
17. **Attorney's Fees:** Should either party be required to resort to litigation, arbitration, or mediation to enforce the terms of this Agreement, the prevailing party, whether plaintiff or defendant, will be entitled to costs - including reasonable attorney's fees and expert witness fees - from the opposing party.

- 18. **Third Party Rights:** No person or entity not a party to this Agreement will have any right of action under this Agreement.
- 19. **Scope:** This Agreement constitutes the entire agreement between the parties, and no statement, promise, or inducement not contained in this Agreement will be binding on the parties.
- 20. **Time:** For the purpose of computing time periods under this Agreement, times in which war or civil or natural disasters occur will not be included if such occurrences reasonably prevent the Developer or County from performing this Agreement.
- 21. **Severability:** If the courts hold any part of this Agreement to be illegal or otherwise unenforceable, such illegality or unenforceability will not affect the validity of any other part, and the rights of the parties will be construed as if the part was never a part of the Agreement.
- 22. **Notice:** Any notice required by this Agreement will be considered effective when personally delivered in writing, or 3 days after being deposited with the U.S. Postal Service, postage prepaid, and addressed as follows:

if to the Developer: _____

if to the County:

Wake County Environmental Services
 Wake County Office Building-Suite 101
 P.O. Box 550
 Raleigh, NC 27602

- 23. **Immunity:** Nothing contained in this Agreement constitutes a waiver of the County's sovereign, governmental or public official immunities under state law.

[For one or more individuals]

Dated this ____ day of _____, 20 ____.

By: _____

Name(s) of Developer (s)

North Carolina

_____ County

I, _____, a Notary Public for said County and State, do hereby certify that _____ personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and official seal, this the _____ day of _____, 20____.

(Official Seal)

Notary Public

My commission expires _____, 20____.

[For a Corporation]

Dated this _____ day of _____, 20____.

by: _____
(Signature)

[Title and name printed]

North Carolina

_____ County

I, _____, a Notary Public for said County and State, do hereby certify that _____, personally appeared before me this day and stated that he is _____ of _____ and acknowledged, on behalf of _____, the due execution of the foregoing instrument.

Witness my hand and official seal, this _____ day of _____, 20____.

(Official Seal)

Notary Public

My commission expires _____, 20____.

Release of Performance Guarantee

Place Holder for ***Release of Performance Guarantee*** (To be added at a later date)

Deviation Application



Request to Deviate from Impervious Surface Allotment on Individual Residential Lot

Purpose: The request to deviate form is required to initiate an increase in impervious surface area greater than the deeded impervious limit and less than the zoning limit. To qualify, the lot or subdivision must not have been recorded with a “perpetuity statement”, i.e. Maximum Impervious Area Square Footage on each Individual Lot will be stringently enforced into perpetuity.

Please complete all spaces below

S# _____

Site Information				
Subdivision Name / Lot				
Project Street Address			City	State Zip
Date Recorded (Book of Maps, pg)	Lot #	Building Permit #	Pin #	
1. Maximum Impervious Surface Allotted (MISA) on Lot–(Recorded or Interpreted)				sf
2. Existing Impervious Area				sf
3. Total Impervious Area of Site Plan (Existing and/or Proposed plus additional)				sf
4. Specify Total Requested - Existing and/or Additional Impervious Surface Above MISA				(#3-#1) sf
Applicant Information -Contact Person				
Applicant Prepared By (Name and Title)			Company	
Street Address			City	State Zip
Telephone Number (Desk/Cell)	Fax Number		Email Address	
Property Owner Information				
Property Owner, if different than applicant (Name and Title)			Company	
Street Address			City	State Zip
Telephone Number (Desk/Cell)	Fax Number		Email Address	
Designer for Stormwater Device Information				
Contractor if different than above (Name and Title)			Company	
Street Address			City	State Zip
Telephone Number (Desk/Cell)	Fax Number		Email Address	

This request for Wake County to approve a deviation from the impervious surface allotment as recorded on the record plat does not relieve the applicant from her or his responsibility to meet all applicable State and Federal Laws, including, but not limited to necessary approvals from Federal Emergency Management Area flood regulations/requirements, Division of Water Quality stormwater or other water quality regulations/requirements, U.S. Army Corps of Engineers Article 404/401 (Wetlands/Streams) jurisdiction/requirements, and/or any Federal, State, County and Local regulations or permit requirements. The approval issued in this letter cannot supersede any other required permit or approval.

II. APPLICANT’S REQUIREMENTS TO COMPLETE PERMIT

1. **Application to Deviate** *(all inspections on hold, until this form is received by Wake County)*
 - Complete and submit **deviation application** *(this form)* with **\$400** permit fee.
2. **Plan Submittal, Review, and Approval** *(foundation inspection on hold- electrical final for pools, until Wake County Water Quality Director approves plan)*
 - Submit a **Stormwater Management Plan (SMP)**. Plan shall comply with the current Wake County stormwater regulations outlined in Article 9 Stormwater Management of the Wake County Unified Development Ordinance (UDO) and designed according to the Stormwater Design Manual. Plan should include same elements of “**As Built**” survey below.
 - The stormwater planning process can occur in parallel with the on-site wastewater design. Stormwater devices shall meet all setback requirements from well, septic or repair areas. On-site approval shall preclude the stormwater plan approval.
 - After your **SMP** has been approved Environmental Services will prepare a **Letter of Conditional Approval** and place the building permit on a final hold for a CO pending conditions of approval.
3. **Installation, “As-Built” and Agreements** *(Upon receipt of the “As Built” survey along with both Maintenance and Stormwater Agreements, you may call IDPP (919) 856-6060 for a certificate of occupancy; if all other permit requirements have been met)*
 - Comply with approved plan & implement the SMP: Install stormwater device(s).
 - Submit a final “**As-Built**” survey on 8.5”x14” prepared by a Professional Land Surveyor.

The survey shall include:

- A detailed impervious summary for the lot: see UDO 21-11 “Impervious Surface”
- Location of the stormwater devices and access easement
- Indicate impervious areas from which stormwater is collected and
- Conveyance system for routing stormwater from impervious area to device.
- Location of wells, septic and repair areas
- Property setbacks, buffers, flood zones or any existing easements
- Plan and profile views of the stormwater device(s), with supporting calculations
- Sign /notarize Maintenance and Stormwater Agreements.
- Record both Agreements and “As Built” with Wake County Register of Deeds.

III. APPLICANT’S CERTIFICATION:

I, certify that the information included on this form is, to the best of my knowledge and belief true, accurate, complete, correct and that the proposed lot complies with the requirements of the *Wake County Unified Development Ordinance*.

NAME: _____

SIGNATURE: _____

Owner/Owners Agent

DATE: _____

WAKE COUNTY USE ONLY				
Disposition	S.W. Manager	Date	Dir. Water Quality Division	Date
Accepted				
Denied				
Recommended to Board of Adjustment				
Zoning District/Limit				

TABLE 1 (Please perform the following exercise to determine required information in item #1, on page 1.)

Date Residential Lot Created:											
Watershed (circle)											
Neuse	Cape Fear	Swift Creek	Little River	Other Specify:				(See Attached Tables A&B , Note: Date Lot was Created)			
Specify Zoning District: (circle)											
R-80W	R-80	R-40W	R-40&R-30	R-20	R-15	R-10	R-5	WSII	WCAO	WMAO	
Highway District	WPAO-2	Airport Dist.	RCO	EDD	O&I	PD	MH	GB	HC	I-1, I-2	

State law reference: **Authority to regulate stormwater G.S. 143-214.7(c) and 1989 Session laws Chapter 1043.**

Table A

**IMPERVIOUS SURFACE LIMITATIONS FOR EXISTING LOTS AND LOTS
CREATED/ACCEPTED FOR SUBDIVISION APPROVAL PRIOR TO JULY 2, 2001**

Zoning District	Residential Impervious Surface Limitations (percentage)
R-80W	30%, see Note 1, below
R-80	30%
R-40-W	30%, see Note 1, below
R-40 and R-30	30%
R-20, R-15, R-5	30%
WSII and WCAO	12%* see Note 1, below
WMAO	24%* see Note 1, below
WPAO	24% (with curb and gutter)*; 30% (no curb and gutter)*
WPAO-2	30%*
RCO	Underlying Zoning Controls
Highway District	30% without Stormwater Management 100% with Stormwater Management
EDD	50% without Stormwater Management 100% with Stormwater Management
Airport District, O&I, PD, MH, GB, HC, I-1 and I-2	No Maximum

Note 1:

- R-80W and R-40W development in the Little River water-supply watershed is limited to 6% and 12% respectively, without exception.
- Development in the Swift Creek water-supply watershed is subject to the requirements of the Swift Creek Land Management Plan.
- R-40W development in other water supply watersheds may be increased to 24%, provided stormwater management is provided.

Asterisks (*) denote that underlying zoning may be more restrictive.

- All Residential and Commercial properties require a preliminary site plan prepared by a Professional Land Surveyor, Landscape Architect, Professional Engineer, the landowner or his authorized agent in order to initiate the permit process effective July 2, 2001.
- An as-built plan prepared by at Professional Land Surveyor is required before a Certificate of Occupancy may be issued.

(Contact Wake County Zoning and Subdivision to verify impervious surface allowed 919-856-6216)

Table B

**IMPERVIOUS SURFACE LIMITATIONS FOR APPROVED SUBDIVISION LOTS
CREATED AFTER JULY 2, 2001**

Zoning District	Residential Impervious Surface Limitations (percentage)
R-80W	15% without Stormwater Management* . See Note 1.
R-80	15% without Stormwater Management*
R-40-W	15% without Stormwater Management* . See Note 1.
R-40 and R-30	15% without Stormwater Management*
R-20, R-15, R-5	15% without Stormwater Management*
WSII and WCAO	12%* see Note 1, below
WMAO	15% without Stormwater Management* . See Note 1.
WPAO	15% without Stormwater Management*
WPAO-2	15% without Stormwater Management*
RCO	15% without Stormwater Management*
Highway District	15% without Stormwater Management*
EDD	15% without Stormwater Management*
Airport District, O&I, PD, MH, GB, HC, I-1 and I-2	15% without Stormwater Management*

Note 1:

- R-80W and R-40W development in the Little River water-supply watershed is limited to 6% and 12% respectively, without exception.
- Development in the Swift Creek water-supply watershed is subject to the requirements of the Swift Creek Land Management Plan.
- R-40W development in other water supply watersheds may be increased to 24%, provided stormwater management is provided.

Asterisks (*) denote nitrogen export check required and is limited to 3.6 lbs./ac./yr. without Best Management Practices or payments made to the N.C. Ecosystem Enhancement Program(NCEEP).

- Building permits for all Residential and Commercial properties require a preliminary site plan prepared by a Professional Land Surveyor, Landscape Architect, Professional Engineer, the landowner or his authorized agent in order to initiate the permit process.
- An as-built certification by a Professional Land Surveyor is also required prior to issuance of a certificate of occupancy.

(Contact Wake County Zoning and Subdivision to verify impervious surface allowed 919-856-6216)

Maintenance Agreement Examples

Bioretention

**STORMWATER CONTROL STRUCTURE
BIORETENTION MAINTENANCE AGREEMENT**

PROJECT: _____

RESPONSIBLE PARTY: _____ **PHONE #:** _____

ADDRESS: _____

I. Monthly or after every runoff producing rainfall, whichever comes first:

- a. Remove debris from bioretention area.
- b. Inspect for ponding, washed-out areas, and soil conditions.
- c. Check for eroded areas of bioretention area and repair before next rainfall.
- d. Check vegetation conditions within the bioretention area and replace if necessary any damaged plant materials.

II. Quarterly

- a. Inspect the collection system (i.e., catch basin, piping, grassed swales) for proper functioning. Clear accumulated trash from basin grates, and basin bottoms, and check piping for obstructions.
- b. Check bioretention inlet pipes for undercutting. Repair if necessary.
- c. Repair any broken pipes.
- d. Re-mulch any void areas by hand whenever needed.
- e. Replace riprap at outlet pipe that is choked with sediment.

III. Semi-Annually

- a. Reseed grass swale or border twice yearly.
- b. Apply new mulch twice yearly.

IV. General

- a. All components of bioretention area to be kept in working order.
- b. This property and bioretention area is also subject to the Stormwater Agreement filed in relation to this project.
- c. In case the ownership of the bioretention transfers, the current owner shall, within thirty (30) days of transfer of ownership, notify the Wake County Environmental Services, Flood and Stormwater Section of such ownership transfer.

I, _____, hereby acknowledge that I am the financially responsible party for maintenance of this stormwater device. I will perform the maintenance as outlined above, as part of the Certificate of Compliance with Stormwater Regulations received for this project.

Signature: _____ Date: _____

I, _____, a Notary Public for the State of _____, County of _____,

do hereby certify that _____ personally appeared before me this _____ day of _____, 20____ and acknowledge due execution of the foregoing instrument. Witness my hand and official seal,

Seal _____

My commission expires: _____

Cistern

**STORMWATER CONTROL STRUCTURE
CISTERN MAINTENANCE AGREEMENT**

PROJECT: _____

RESPONSIBLE PARTY: _____ **PHONE #:** _____

ADDRESS: _____

- I. Monthly** *or after every runoff producing rainfall, whichever comes first:*
 - a. Make sure downspouts are draining into cistern.
 - b. Check and clear inlet, gutters, or downspouts of any obstructions.
 - c. Check tank for water, tank should be empty in 5 days after rainfall event. Fix as needed.

- II. Semi-Annually**
 - a. Inspect drawdown lines. Repair/replace as necessary.
 - b. Repair any broken pipes.
 - c. Inspect tank for accumulated sediment-debris clean as necessary.

- III. General**
 - a. All components of stormwater cistern are to be kept in working order.
 - b. In case the ownership of the Property/Cistern Transfers, the current owner shall, within thirty (30) days of transfer of ownership, notify the Wake County Environmental Services, Flood and Stormwater Section of such ownership transfer.

I, _____, hereby acknowledge that I am the financially responsible party for maintenance of this stormwater device. I will perform the maintenance as outlined above, as part of the Certificate of Compliance with Stormwater Regulations received for this project.

Signature: _____ Date: _____

I, _____, a Notary Public for the State of _____, County of _____, do hereby certify that _____ personally appeared before me this _____ day of _____, 20__ and acknowledge due execution of the foregoing instrument. Witness my hand and official seal,

Seal _____

My commission expires: _____

Dry Detention

**STORMWATER CONTROL STRUCTURE
DRY DETENTION MAINTENANCE AGREEMENT**

PROJECT: _____

RESPONSIBLE PARTY: _____ **PHONE #:** _____

ADDRESS: _____

- I. Monthly** *or after every runoff producing rainfall, whichever comes first:*
- a. Remove debris from trash rack.
 - b. Check and clear orifice of any obstructions.
 - c. Check pond side slopes; remove trash, repair eroded areas before next rainfall.
- II. Quarterly**
- a. Inspect the collection system (i.e., catch basin, piping, grassed swales) for proper functioning.
 - b. Clear accumulated trash from basin grates, and basin bottoms, and check piping for obstructions.
 - c. Check impoundment inlet pipes for undercutting. Repair if necessary.
 - d. Repair any broken pipes.
 - e. Replace rip rap that is choked with sediment.
- III. Semi-Annually**
- a. Remove accumulated sediment from bottom of outlet structure.
 - b. Check pond depth at various locations. If depth is reduced to 75% of original design depth, remove sediment to original design depth.
 - c. Reseed grassed swales twice yearly. Repair eroded areas immediately.
- IV. General**
- a. Mow side slopes according to the season. Maximum grass height to be six (6) inches.
 - b. All components of impoundment system to be kept in good working order.
 - c. The responsibility for the maintenance of the stormwater device shall pass in the chain of title to the Owner's successor in interest.

I, _____, hereby acknowledge that I am the financially responsible party for maintenance of this stormwater device. I will perform the maintenance as outlined above, as part of the Certificate of Compliance with Stormwater Regulations received for this project.

Signature: _____ Date: _____

I, _____, a Notary Public for the State of _____, County of _____, do hereby certify that _____ personally appeared before me this _____ day of _____, 20____ and acknowledge due execution of the foregoing instrument. Witness my hand and official seal,

Seal _____

My commission expires: _____

Dry Well

**STORMWATER CONTROL STRUCTURE
DRY WELL DEVICE MAINTENANCE AGREEMENT**

PROJECT: _____
RESPONSIBLE PARTY: _____ **PHONE #:** _____
ADDRESS: _____

- I. **Monthly** or after every runoff producing rainfall, whichever comes first:
 - A. Remove debris from grates and detention device.
 - B. Check and clear orifice of detention device of any obstructions.
 - C. Inspect the discharge outlets for erosion, debris, etc....replace cover as needed

- II. **Quarterly**
 - A. Inspect the collection system (i.e., catch basin, piping, grassed swales) for proper functioning.
 - B. Clear accumulated trash from basin grates, and basin bottoms, and check piping for obstructions.
 - C. Repair any broken pipes or defective joints.

- III. **Semi-Annually**
 - A. Inspect monitoring well to ensure dry well drawdown.

- IV. **General**
 - A. All components of sub-surface storm water detention device are to be kept in working order.
 - B. This property and sub-surface storm water detention device are also subject to the Stormwater Agreement filed in relation to this project.
 - C. In case the ownership of the detention device transfers, the current owner shall, within thirty (30) days of transfer of ownership, notify the Wake County Environmental Services, Flood and Stormwater Section of such ownership transfer.

I, _____, hereby acknowledge that I am the financially responsible party for maintenance of this impoundment. I will perform the maintenance as outlined above, as part of the Certificate of Compliance with Stormwater Regulations received for this project.

Signature: _____ Date: _____

I, _____, a Notary Public for the State of _____, County of _____, do hereby certify that _____ personally appeared before me this _____ day of _____, 20____ and acknowledge due execution of the foregoing instrument. Witness my hand and official seal,

Seal _____

My commission expires: _____

Grass Swale

**STORMWATER CONTROL STRUCTURE
GRASS SWALE MAINTENANCE AGREEMENT**

Project: _____
Responsible Party _____
Phone #: _____
Address: _____

I. Monthly, or after ever runoff producing rainfall, whichever comes first:

- a. Remove all accumulated litter, debris, and sediment from the grass swale.
- b. Inspect grass swale for any damage due to erosion or failure of the vegetative lining. Reseed any denuded areas with permanent grass seed of the Owner's choice. Eroded rills and gullies should be filled with topsoil, compacted and then reseeded.

II. Quarterly:

- a. Thoroughly inspect the stormwater drainage system and grass swale for proper functioning.
- b. Perform all required maintenance for the Monthly Inspection.

III. General:

- a. All components of the grass swale are to be kept in good working order.
- b. In case the ownership of the abovementioned property transfers, the current owner shall, within thirty (30) days of transfer of ownership, notify the Wake County Environmental Services, Flood and Stormwater Section of such ownership transfer.

I, _____, hereby acknowledge that I am the financially responsible party for maintenance of this structure. I will perform the maintenance as outlined above, as part of the Certificate of Compliance with Stormwater Regulations received for this project.

Signature: _____ Date: _____

I, _____, a Notary Public for the State of _____, County of _____, do hereby certify that _____ personally appeared before me this _____ day of _____, 20____ and acknowledge due execution of the foregoing instrument. Witness my hand and official seal,

Seal _____

My commission expires: _____

Infiltration Device

**STORMWATER CONTROL STRUCTURE
INFILTRATION DEVICE MAINTENANCE AGREEMENT**

PROJECT: _____

RESPONSIBLE PARTY: _____ **PHONE #:** _____

ADDRESS: _____

I. **Monthly** or after every runoff producing rainfall, whichever comes first:

- a. Remove debris from surface of device.
- b. Check and clear inlet or downspout of any obstructions.
- c. Check the observation well for standing water.

III. **Semi-Annually**

- a. Checks filter fabric under top layer of gravel. Replace filter fabric and top layer of gravel if sediment build-up or rips are found.
- b. Sediment deposits should be removed from any pre-treatment devices and re-seeded as necessary to avoid any bare spots.

IV. **General**

- a. All components of storm water infiltration device are to be kept in working order.
- b. If infiltration rates of the device drop to unacceptable levels, the device should be reconstructed.
- c. This property and storm water infiltration device is also subject to the Stormwater Agreement filed in relation to this project.
- d. In case the ownership of the infiltration device transfers, the current owner shall, within thirty (30) days of transfer of ownership, notify the Wake County Environmental Services, Flood and Stormwater Section of such ownership transfer.

I, _____, hereby acknowledge that I am the financially responsible party for maintenance of this stormwater device. I will perform the maintenance as outlined above, as part of the Certificate of Compliance with Stormwater Regulations received for this project.

Signature: _____ Date: _____

I, _____, a Notary Public for the State of _____, County of _____,

do hereby certify that _____ personally appeared before me this _____ day of _____, 20____ and acknowledge due execution of the foregoing instrument. Witness my hand and official seal,

Seal _____

My commission expires: _____

Maintenance Agreement

Underground Detention

**STORMWATER CONTROL STRUCTURE
UNDERGROUND DETENTION DEVICE MAINTENANCE AGREEMENT**

PROJECT: _____
RESPONSIBLE PARTY: _____ **PHONE #:** _____
ADDRESS: _____

- I. **Monthly** or after every runoff producing rainfall, whichever comes first:
 - A. Remove debris from grates and detention device.
 - B. Check and clear orifice of detention device of any obstructions.
 - C. Inspect the discharge outlets for erosion, debris, etc...
 - D. replace cover as needed

- II. **Quarterly**
 - A. Inspect the collection system (i.e., catch basin, piping, grassed swales) for proper functioning.
 - B. Clear accumulated trash from basin grates, and basin bottoms, and check piping for obstructions.
 - C. Repair any broken pipes or defective joints.

- III. **Semi-Annually**
 - A. Remove accumulated sediment from bottom of outlet structure.

- IV. **General**
 - A. All components of sub-surface storm water detention device are to be kept in working order.
 - B. This property and sub-surface storm water detention device are also subject to the Operations and Maintenance Manual filed in relation to this project.
 - C. In case the ownership of the detention device transfers, the current owner shall, within thirty (30) days of transfer of ownership, notify the Wake County Environmental Services, Flood and Stormwater Section of such ownership transfer.

I, _____, hereby acknowledge that I am the financially responsible party for maintenance of this impoundment. I will perform the maintenance as outlined above, as part of the Certificate of Compliance with Stormwater Regulations received for this project.

Signature: _____ Date: _____

I, _____, a Notary Public for the State of _____, County of _____, do hereby certify that _____ personally appeared before me this _____ day of _____, 20____ and acknowledge due execution of the foregoing instrument. Witness my hand and official seal,

Seal _____

My commission expires: _____

Wet Detention Pond

**STORMWATER CONTROL STRUCTURE
WET DETENTION MAINTENANCE AGREEMENT**

PROJECT: _____

RESPONSIBLE PARTY: _____ **PHONE #:** _____

ADDRESS: _____

- I. Monthly or after every runoff producing rainfall, whichever comes first:**
 - a. Remove debris from trash rack.
 - b. Check and clear orifice of any obstructions.
 - c. Check pond side slopes; remove trash, repair eroded areas before next rainfall.

- II. Quarterly**
 - a. Inspect the collection system (i.e., catch basin, piping, grassed swales) for proper functioning.
 - b. Clear accumulated trash from basin grates, and basin bottoms, and check piping for obstructions.
 - c. Check impoundment dam and inlet pipes for undercutting / critter holes. Repair if necessary.
 - d. Repair any broken pipes.
 - e. Replace rip rap that is choked with sediment.

- III. Semi-Annually**
 - a. Remove accumulated sediment from bottom of outlet structure.
 - b. Check pond depth at various locations. If depth is reduced to 75% of original design depth, remove sediment to original design depth.
 - c. Reseed grassed swales twice yearly. Repair eroded areas immediately.

- IV. General**
 - a. Mow side slopes according to the season. Once per year sufficient to discourage woody vegetation. Avoid "lawn" type maintenance to reduce geese populations.
 - b. Wetland plants are encouraged along pond perimeter. Invasive species such as cattails shall be removed.
 - c. All components of impoundment system to be kept in good working order.
 - d. In case the ownership of the Impoundment Transfers, the current owner shall, within thirty (30) days of transfer of ownership, notify the Wake County Environmental Services, Flood and Stormwater Section of such ownership transfer.
 - e. This property and impoundment is also subject to the Operation and Maintenance Manual filed with the register of deeds.

I, _____, hereby acknowledge that I am the financially responsible party for maintenance of this stormwater device. I will perform the maintenance as outlined above, as part of the Certificate of Compliance with Stormwater Regulations received for this project.

Signature: _____ Date: _____

I, _____, a Notary Public for the State of _____, County of _____, do hereby certify that _____ personally appeared before me this _____ day of _____, 20__ and acknowledge due execution of the foregoing instrument. Witness my hand and official seal,

Seal _____

My commission expires: _____

APPENDIX B

Table B-1 Wake County Hydrologic Soil Groups

MAP SYMBOL	SOIL SERIES & DESCRIPTION	HYDROLOGIC SOIL GROUPS (HSG)
AfB	Altavista fine sandy loam, 0 to 6 percent slopes, rarely flooded	C
AgB	Appling gravelly sandy loam, 2 to 6 percent slopes	B
AgB2	Appling gravelly sandy loam, 2 to 6 percent slopes, moderately eroded	B
AgC	Appling gravelly sandy loam, 6 to 10 percent slopes	B
AgC2	Appling gravelly sandy loam, 6 to 10 percent slopes, moderately eroded	B
ApB	Appling sandy loam, 2 to 6 percent slopes	B
ApB2	Appling sandy loam, 2 to 6 percent slopes, moderately eroded	B
ApC	Appling sandy loam, 6 to 10 percent slopes	B
ApC2	Appling sandy loam, 6 to 10 percent slopes, moderately eroded	B
ApD	Appling sandy loam, 10 to 15 percent slopes	B
AsB	Appling fine sandy loam, 2 to 6 percent slopes	B
AsB2	Appling fine sandy loam, 2 to 6 percent slopes, moderately eroded	B
AsC	Appling fine sandy loam, 6 to 10 percent slopes	B
AsC2	Appling fine sandy loam, 6 to 10 percent slopes, moderately eroded	B
AuA	Augusta fine sandy loam, 0 to 2 percent slopes, occasionally flooded	B/D
BuB	Buncombe loamy sand, 0 to 5 percent slopes, frequently flooded	A
CaB	Carbonton-Brickhaven complex, 2 to 6 percent slopes	D
CaC	Carbonton-Brickhaven complex, 6 to 10 percent slopes	D
CaD	Carbonton-Brickhaven complex, 10 to 15 percent slopes	D
CeB	Cecil sandy loam, 2 to 6 percent slopes	A
CeB2	Cecil sandy loam, 2 to 6 percent slopes, moderately eroded	B
CeC	Cecil sandy loam, 6 to 10 percent slopes	A
CeC2	Cecil sandy loam, 6 to 10 percent slopes, moderately eroded	B
CeD	Cecil sandy loam, 10 to 15 percent slopes	A
CgB	Cecil gravelly sandy loam, 2 to 6 percent slopes	B
CgB2	Cecil gravelly sandy loam, 2 to 6 percent slopes, moderately eroded	B
CgC	Cecil gravelly sandy loam, 6 to 10 percent slopes	B
CgC2	Cecil gravelly sandy loam, 6 to 10 percent slopes, moderately eroded	B
ClB3	Cecil clay loam, 2 to 6 percent slopes, severely eroded	B
ClC3	Cecil clay loam, 6 to 10 percent slopes, severely eroded	B
CmA	Chewacla sandy loam, 0 to 2 percent slopes, frequently flooded	B/D

MAP SYMBOL	SOIL SERIES & DESCRIPTION	HYDROLOGIC SOIL GROUPS (HSG)
CnA	Colfax sandy loam, 0 to 3 percent slopes	C/D
CoA	Congaree fine sandy loam, 0 to 2 percent slopes, frequently flooded	C
CpA	Congaree silt loam, 0 to 2 percent slopes, frequently flooded	C
CrB	Creedmoor sandy loam, 2 to 6 percent slopes	D
CrB2	Creedmoor sandy loam, 2 to 6 percent slopes, moderately eroded	D
CrC	Creedmoor sandy loam, 6 to 10 percent slopes	D
CrC2	Creedmoor sandy loam, 6 to 10 percent slopes, moderately eroded	D
CrE	Creedmoor sandy loam, 10 to 20 percent slopes	D
CtB	Creedmoor silt loam, 2 to 6 percent slopes	D
CtC	Creedmoor silt loam, 6 to 10 percent slopes	D
DuB	Durham loamy sand, 2 to 6 percent slopes	C
DuB2	Durham loamy sand, 2 to 6 percent slopes, moderately eroded	C
DuC	Durham loamy sand, 6 to 10 percent slopes	C
DuC2	Durham loamy sand, 6 to 10 percent slopes, moderately eroded	C
EnB	Enon fine sandy loam, 2 to 6 percent slopes	C
EnB2	Enon fine sandy loam, 2 to 6 percent slopes, moderately eroded	C
EnC	Enon fine sandy loam, 6 to 10 percent slopes	C
EnC2	Enon fine sandy loam, 6 to 10 percent slopes, moderately eroded	C
EnD2	Enon fine sandy loam, 10 to 15 percent slopes, moderately eroded	C
FaB	Faceville sandy loam, 2 to 6 percent slopes	B
FaB2	Faceville sandy loam, 2 to 6 percent slopes, moderately eroded	B
FaC2	Faceville sandy loam, 6 to 10 percent slopes, moderately eroded	B
GeB	Georgeville silt loam, 2 to 6 percent slopes	B
GeB2	Georgeville silt loam, 2 to 6 percent slopes, moderately eroded	B
GeC	Georgeville silt loam, 6 to 10 percent slopes	B
GeC2	Georgeville silt loam, 6 to 10 percent slopes, moderately eroded	B
GeD2	Georgeville silt loam, 10 to 15 percent slopes, moderately eroded	B
GoA	Goldsboro sandy loam, 0 to 2 percent slopes	B
GrB	Granville sandy loam, 2 to 6 percent slopes	B
GrB2	Granville sandy loam, 2 to 6 percent slopes, moderately eroded	B
GrC	Granville sandy loam, 6 to 10 percent slopes	B
GrC2	Granville sandy loam, 6 to 10 percent slopes, moderately	B

MAP SYMBOL	SOIL SERIES & DESCRIPTION	HYDROLOGIC SOIL GROUPS (HSG)
	eroded	
GrD	Granville sandy loam, 10 to 15 percent slopes	B
HeB	Helena sandy loam, 2 to 6 percent slopes	D
HeB2	Helena sandy loam, 2 to 6 percent slopes, moderately eroded	D
HeC	Helena sandy loam, 6 to 10 percent slopes	D
HeC2	Helena sandy loam, 6 to 10 percent slopes, moderately eroded	D
HeD	Helena sandy loam, 10 to 15 percent slopes	D
HrB	Herndon silt loam, 2 to 6 percent slopes	B
HrB2	Herndon silt loam, 2 to 6 percent slopes, moderately eroded	B
HrC	Herndon silt loam, 6 to 10 percent slopes	B
HrC2	Herndon silt loam, 6 to 10 percent slopes, moderately eroded	B
HrD2	Herndon silt loam, 10 to 15 percent slopes, moderately eroded	B
LdB2	Lloyd loam, 2 to 6 percent slopes, moderately eroded	B
LdC2	Lloyd loam, 6 to 10 percent slopes, moderately eroded	B
LdD2	Lloyd loam, 10 to 15 percent slopes, moderately eroded	B
LoB	Louisburg loamy sand, 2 to 6 percent slopes	B
LoC	Louisburg loamy sand, 6 to 10 percent slopes	B
LoD	Louisburg loamy sand, 10 to 15 percent slopes	A
LwB	Louisburg-Wedowee complex, 2 to 6 percent slopes	B
LwB2	Louisburg-Wedowee complex, 2 to 6 percent slopes, moderately eroded	B
LwC	Louisburg-Wedowee complex, 6 to 10 percent slopes	B
LwC2	Louisburg-Wedowee complex, 6 to 10 percent slopes, moderately eroded	B
LyA	Lynchburg sandy loam, 0 to 2 percent slopes	A/D
MdB2	Madison sandy loam, 2 to 6 percent slopes, moderately eroded	B
MdC2	Madison sandy loam, 6 to 10 percent slopes, moderately eroded	B
MdD2	Madison sandy loam, 10 to 15 percent slopes, moderately eroded	B
MdE2	Madison sandy loam, 15 to 25 percent slopes, moderately eroded	B
MeA	Mantachie sandy loam, 0 to 2 percent slopes, rarely flooded	B/D
MfB	Mayodan sandy loam, 2 to 6 percent slopes	B
MfB2	Mayodan sandy loam, 2 to 6 percent slopes, moderately eroded	B
MfC	Mayodan sandy loam, 6 to 10 percent slopes	B
MfC2	Mayodan sandy loam, 6 to 10 percent slopes, moderately eroded	B
MfD2	Mayodan sandy loam, 10 to 15 percent slopes, moderately	B

MAP SYMBOL	SOIL SERIES & DESCRIPTION	HYDROLOGIC SOIL GROUPS (HSG)
	eroded	
MfE	Mayodan sandy loam, 15 to 25 percent slopes	B
MgB	Mayodan gravelly sandy loam, 2 to 6 percent slopes	B
MgB2	Mayodan gravelly sandy loam, 2 to 6 percent slopes, moderately eroded	B
MgC	Mayodan gravelly sandy loam, 6 to 10 percent slopes	B
MgC2	Mayodan gravelly sandy loam, 6 to 10 percent slopes, moderately eroded	B
NaE	Nanford silt loam, 15 to 25 percent slopes	B
NoA	Norfolk loamy sand, 0 to 2 percent slopes	A
NoB	Norfolk loamy sand, 2 to 6 percent slopes	A
NoB2	Norfolk loamy sand, 2 to 6 percent slopes, moderately eroded	B
NoC	Norfolk loamy sand, 6 to 10 percent slopes	A
NoC2	Norfolk loamy sand, 6 to 10 percent slopes, moderately eroded	B
OrB	Orangeburg loamy sand, 2 to 6 percent slopes	A
OrB2	Orangeburg loamy sand, 2 to 6 percent slopes, moderately eroded	B
OrC2	Orangeburg loamy sand, 6 to 10 percent slopes, moderately eroded	B
PaF	Pacolet sandy loam, 15 to 45 percent slopes	B
PcE3	Pacolet clay loam, 10 to 20 percent slopes, severely eroded	B
PgF	Pacolet-Gullied land complex, 4 to 25 percent slopes	B
PkC	Pinkston sandy loam, 0 to 10 percent slopes	B
PkF	Pinkston sandy loam, 10 to 45 percent slopes	B
PsA	Plummer and Osier soils, 0 to 2 percent slopes	A/D
PtD3	Polkton-White Store complex, 2 to 15 percent slopes, severely eroded	D
RaA	Rains fine sandy loam, 0 to 2 percent slopes	B/D
RoA	Roanoke loam, 0 to 2 percent slopes, occasionally flooded	C/D
UdD	Udorthents loamy, 0 to 15 percent slopes	C
VaB	Vance sandy loam, 2 to 6 percent slopes	C
VaB2	Vance sandy loam, 2 to 6 percent slopes, moderately eroded	C
VaC2	Vance sandy loam, 6 to 10 percent slopes, moderately eroded	C
WaA	Wagram loamy sand, 0 to 2 percent slopes	B
WaB	Wagram loamy sand, 2 to 6 percent slopes	A
WaC	Wagram loamy sand, 6 to 10 percent slopes	A
WgA	Wagram-Troup sands, 0 to 4 percent slopes	B
WhA	Warne fine sandy loam, 0 to 2 percent slopes, occasionally flooded	C/D

MAP SYMBOL	SOIL SERIES & DESCRIPTION	HYDROLOGIC SOIL GROUPS (HSG)
WkC	Wake-Saw-Wedowee complex, 2 to 10 percent slopes, rocky	D
WkE	Wake-Wateree complex, 10 to 25 percent slopes, very rocky	D
WmB	Wedowee sandy loam, 2 to 6 percent slopes	B
WmB2	Wedowee sandy loam, 2 to 6 percent slopes, moderately eroded	B
WmC	Wedowee sandy loam, 6 to 10 percent slopes	B
WmC2	Wedowee sandy loam, 6 to 10 percent slopes, moderately eroded	B
WmD2	Wedowee sandy loam, 10 to 15 percent slopes, moderately eroded	B
WmE	Wedowee sandy loam, 15 to 25 percent slopes	B
WnA	Wehadkee silt loam, 0 to 2 percent slopes, frequently flooded	B/D
WoA	Wehadkee and Bibb soils, 0 to 2 percent slopes, frequently flooded	A/D
WpA	Wehadkee loam, 0 to 2 percent slopes, ponded	B/D
WsB	White Store sandy loam, 2 to 6 percent slopes	D
WsB2	White Store sandy loam, 2 to 6 percent slopes, moderately eroded	D
WsC	White Store sandy loam, 6 to 10 percent slopes	D
WsC2	White Store sandy loam, 6 to 10 percent slopes, moderately eroded	D
WsE	White Store sandy loam, 10 to 20 percent slopes	D
WtB	White Store silt loam, 2 to 6 percent slopes	D
WwC	Wilkes loam, 2 to 10 percent slopes	D
WwE	Wilkes loam, 10 to 20 percent slopes	D
WwF	Wilkes loam, 20 to 45 percent slopes	D
WxE	Wilkes cobbly loam, 15 to 25 percent slopes, very stony	D
WyA	Worsham sandy loam, 0 to 3 percent slopes	D

Note: Web Soil Survey(series info) <http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>

Table B-2 Wake County Proposed Development Curve Numbers

LAND USE	Curve Numbers by Hydrolic Soil Group			
	A	B	C	D
COMMERCIAL				
Parking lot	98	98	98	98
Roof	98	98	98	98
Open/Landscaped	39	61	74	80
INDUSTRIAL				
Parking lot	98	98	98	98
Roof	98	98	98	98
Open/Landscaped	39	61	74	80
TRANSPORTATION				
High Density (interstate, main)	98	98	98	98
High Density Grassed Right-of-ways	80	80	80	80
Low Density (secondary, feeder)	98	98	98	98
Low Density Grassed Right-of-ways	80	80	80	80
Rural	98	98	98	98
Rural Grassed Right-of-ways	80	80	80	80
Sidewalk	98	98	98	98
MISC. PERVIOUS				
Managed pervious (Open Space)	39	61	74	80
Unmanaged (pasture)	39	61	74	80
Woods	30	55	70	77
RESIDENTIAL				
Roadway	98	98	98	98
Grassed Right-of-ways	80	80	80	80
Driveway	98	98	98	98
Parking lot	98	98	98	98
Roof	98	98	98	98
Sidewalk	98	98	98	98
Lawn	39	61	74	80
Managed pervious (Open Space)	39	61	74	80
Woods	30	55	70	77
LAND TAKEN UP BY BMP	39	61	74	80
JURISDICTIONAL LANDS				
Natural wetland	30	55	70	77
Riparian buffer	39	61	74	80
Open water	0	0	0	0

Note: Wake County’s policy regarding the right-of-way areas includes an assumption of compaction of these areas. Therefore, the grassed portion of the right-of-way is assigned the curve number for open space in D soils to account for this assumption of compaction.

APPENDIX C

NRCS Conservation Practice Standard, Tree/Shrub Establishment Code 612

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD
TREE/SHRUB ESTABLISHMENT**

(Ac.)

CODE 612

DEFINITION

Establishing woody plants by planting seedlings or cuttings, direct seeding, or natural regeneration.

PURPOSE

Establish woody plants for:

- forest products such as timber, pulpwood, etc.
- wildlife habitat
- long-term erosion control and improvement of water quality
- treating waste
- storing carbon in biomass
- reduce energy use
- develop renewable energy systems
- improving or restoring natural diversity
- enhancing aesthetics.

CONDITIONS WHERE PRACTICE APPLIES

Tree/shrub establishment can be applied on any appropriately prepared site where woody plants can be grown.

Utilize other practice standards for specialized tree/shrub establishment situations, e.g., [Riparian Forest Buffer \(391\)](#), [Windbreak/Shelterbelt Establishment \(380\)](#); [Critical Area Planting \(342\)](#) .

CRITERIA

General Criteria Applicable to All Purposes

Composition of species will be adapted to site conditions and suitable for the planned purpose(s).

No plants on the Federal or state noxious weeds list shall be planted.

Planting or seeding rates will be adequate to accomplish the planned purpose for the site.

Planting dates, and care in handling and planting of the seed, cuttings or seedlings will ensure that planted materials have an acceptable rate of survival.

Only viable, high-quality and adapted planting stock or seed will be used.

Appropriately prepared sites are a precondition for successful tree/shrub establishment. Refer to [Windbreak/Shelterbelt Establishment Tree Planting Procedures \(380TPP\)](#) for preparation of planting sites.

Adequate seed sources or advanced reproduction needs to be present or provided for when using natural regeneration to establish a stand.

Selection of planting technique and timing will be appropriate for the site and soil conditions.

The acceptability and timing of coppice regeneration shall be based on species, age and diameter.

The planting will be protected from plant and animal pests and fire. Refer to standard [Integrated Pest Management \(595\)](#) to assist with site-specific strategies for pest prevention, pest avoidance, pest monitoring, and pest suppression.

Each site will be evaluated to determine if mulching, supplemental water or other cultural treatments (e.g., tree protection devices,

TREE/SHRUB ESTABLISHMENT (612) - 2

shade cards, brush mats) will be needed to assure adequate survival and growth.

Additional Criteria for Treating Waste

Species used to treat waste shall have fast growth characteristics, extensive root systems, high nutrient uptake capacity and tolerance of the planned effluent.

Additional Criteria for Improving or Restoring Natural Diversity

Composition of species selected for planting or those favored for natural regeneration will be native to the site and create a successional stage or state that can progress to the potential natural plant community. Refer to [Restoration of Rare and Declining Habitats \(643\)](#) for guidelines for restoring declining forest habitats.

Additional Criteria for Storing Carbon in Biomass

The species and plant communities that attain biomass more quickly will sequester carbon faster. The rate of carbon sequestration is enhanced as trees and/or shrubs mature and soil organic matter increases. Select plants that have higher rates of growth and potential for carbon sequestration in biomass and are adapted to the site. Plant species at the appropriate stocking rate for the site.

Additional Criteria for Developing Renewable Energy Systems

Select plants that can provide adequate kinds and amounts of plant biomass to supply identified bioenergy needs.

Intensity and frequency of energy biomass removals will be managed to prevent long-term negative impacts on the system.

The harvesting of energy biomass shall be accomplished in a manner that will not compromise the other intended purpose(s) and functions.

Additional Criteria to Reduce Energy Use

Orient trees to shade a building to reduce summer energy usage. The first priority is placement on the building's west side where the greatest daily heat gain occurs. The second priority is the east side.

Select plants with a potential height growth that will be taller than the structure or facility being protected.

Use proper plant densities to optimize the shade produced and meet energy reduction needs.

Trees planted within 30 to 50 feet of the building generally provide effective shade to windows and walls depending on tree height potential.

Keep trees at least 10 feet or further from the structure, depending on mature crown spread, to avoid damage to foundations or restrict maintenance access to windows and walls.

CONSIDERATIONS

Priority should be given to plant materials that have been selected and tested in tree/shrub improvement programs. All plant materials should comply with minimum standards such as those as established by the American Nursery and Landscape Association, Nebraska Forest Service, or state-approved nursery.

Plans for landscape and beautification plantings should consider foliage color, season and color of flowering, and mature plant height.

Consider using diverse species combinations which best meet locally native wildlife and pollinator needs.

Consider the invasive potential when selecting plant species.

Tree/shrub arrangement and spacing should allow for and anticipate the need for future access lanes for purposes of stand management.

Residual chemical carryover should be evaluated prior to planting and alter species selection and/or timing of planting/seeding.

When underplanting, trees should be planted sufficiently in advance of overstory removal to ensure full establishment.

Consider establishing trees/shrubs through natural regeneration when seed or current tree/shrub reproduction is adequate to establish an acceptable stand in the time frame desired. Trees/shrubs must be desirable and meet the objectives of the customer and

TREE/SHRUB ESTABLISHMENT (612)-3

the appropriate criteria and considerations in this standard. Contact your local forester for assistance.

Existing or expected regeneration needs to be protected from domestic and/or wild animals, fire, logging, herbicide damage, etc.

Use locally adapted seed, seedlings or cuttings. Give priority to plant materials that have been selected and tested in tree/shrub improvement programs.

Where multiple species are available to accomplish the planned objective, consideration should be given to selecting species that best meet wildlife needs.

To minimize adverse offsite effects avoid designing tree cover that causes habitat fragmentation of intact grasslands needed by grassland nesting birds and other wildlife dependent on large expanses of contiguous grass habitat.

Species considered locally invasive or noxious shall not be used.

Species used to treat waste should have fast growth characteristics and extensive root systems, be capable of high nutrient uptake, and have the characteristic of producing wood/fiber products in short rotations.

For optimal carbon storage, select plant species that are adapted to the site to assure strong health and vigor and plant the full stocking rate for the site.

PLANS AND SPECIFICATIONS

Specifications for applying this practice shall be prepared for each site and recorded using approved specification sheets, job sheets, technical notes, and narrative statements in the conservation plan, or other acceptable documentation.

Specifications/practice design will be based on this practice standard (612) and procedures found in the [Tree/Shrub Design Procedures \(612DP\)](#), [Windbreak/Shelterbelt Establishment - Tree/Shrub Planting Procedures \(380TPP\)](#), and Tree and Shrub Planting Plan Job Sheets ([NE-CPA-15](#) and [NE-CPA-15B](#)).

As a minimum, specifications will contain the following data per the [NE-CPA-15](#) and [NE-CPA-15B](#):

- Operator name, address, phone number
- NRD, county location, type of planting
- Conservation Tree/Shrub Suitability Group and soil name, based on soils on the site
- Area to be planted
- Planned weed control within and between tree/shrub rows
- Planned planting method(s) and date(s)
- The type of fabric mulch to be installed if fabric mulch is being used
- Planned site preparation, including method utilized to eliminate aggressive dense sod-forming grasses
- Planned species to be planted in each row
- Spacing within and between each row planted
- Estimated number of each plant needed
- Actual number of plants planted
- Maps or drawings as needed to show location and site layout
- Who installed the plantings
- Signature and date(s) planted

Specifications for direct seeding methods will contain information detailed in [Tree Planting Procedures \(380TPP\)](#) and Tree and Shrub Establishment, Direct Seeding Job Sheet ([NE-CPA-15B](#)).

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance). Refer to [Tree/Shrub Planting Procedures \(380TPP\)](#) for detailed care and maintenance requirements.

Access by vehicles or equipment during or after tree/shrub establishment shall be

TREE/SHRUB ESTABLISHMENT (612) - 4

controlled to protect new plants and minimize erosion, compaction and other site impacts. Refer to the standard [Access Control \(472\)](#).

The trees and shrubs will be inspected periodically and protected from adverse impacts including insects, diseases or competing vegetation, fire and damage from livestock or wildlife.

If needed, competing vegetation will be controlled until the woody plants are established. Noxious weeds will be controlled. Refer to standard [Integrated Pest Management \(595\)](#).

Replanting will be required when survival is inadequate. Refer to [Nebraska Forestry Technical Note No. 63](#) for detailed replanting requirements.

Supplemental water will be provided as needed.

Periodic applications of nutrients may be needed where soil tests indicate nutrient deficiency. If nutrients are applied, refer to [Nutrient Management \(590\)](#).

After trees and/or shrubs are established, refer to the standards [Forest Stand Improvement](#)

[\(666\)](#) and [Tree/Shrub Pruning \(660\)](#) for subsequent management.

REFERENCES

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Talbert, Cheryl. 2008. Achieving establishment success the first time. Tree Planters Notes, Vol. 52 No. 2 pages 31-37.

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NRCS Conservation Practice Standard, Mulching Code 484

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

MULCHING

(Ac.)

CODE 484

DEFINITION

Applying plant residues or other suitable materials produced off site, to the land surface.

PURPOSE

- Conserve soil moisture
- Reduce energy use associated with irrigation
- Moderate soil temperature
- Provide erosion control
- Suppress weed growth
- Facilitate the establishment of vegetative cover
- Improve soil quality
- Reduce airborne particulates

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all lands that need mulch. Plan and apply this practice alone or in combination with other conservation practices.

CRITERIA

General Criteria Applicable to All Purposes

The selection of mulching materials depends on site conditions and mulch material availability. Mulch materials shall consist of natural and/or artificial materials that are environmentally safe such as plant residues, wood bark or chips, gravel, plastic, fabric, rice hulls, or other equivalent materials of sufficient dimension (depth or thickness) and durability to achieve the intended purpose for the required amount of time.

Prepare the soil surface to achieve the intended purpose, prior to mulching.

Evenly apply and if necessary, anchor the mulch material to the soil. Use tackifiers, emulsions, pinning, netting, crimping and or other acceptable methods of anchoring as needed, to hold the mulch in place for specified periods.

As a minimum, apply manufactured mulches according to the manufacturer's specifications.

Mulching operations shall comply with federal, state and/or local laws and regulations during the installation, operation and maintenance of this practice.

Mulch material shall be relatively free of disease, pesticides, chemicals, noxious weed seeds, and other pests and pathogens.

Additional Criteria to Conserve Soil Moisture and/or Reduce Energy Use Associated with Irrigation

Mulch materials applied to the soil surface shall provide at least 60 percent surface cover to reduce potential evaporation.

Additional Criteria to Moderate Soil Temperature

Selected and apply mulch materials to obtain 100 percent coverage over the area treated. The material shall be of a significant thickness to persist for the period required for temperature modification.

Additional Criteria to Provide Erosion Control

When mulching with cereal grain straw or grass hay, apply at a rate to achieve a minimum 70 percent ground cover. Determine the appropriate mulch application rate to reach the soil erosion objective using current erosion prediction technology.

When mulching with wood products such as wood chips, bark, shavings or other wood materials, apply a minimum 2-inch thickness.

When mulching with gravel or other inorganic material apply a minimum 2-inch thickness and shall consist of pieces 0.75 to 2 inches in diameter.

Additional Criteria to Suppress Weed Growth

Determine the depth of mulch needed by the size of the plants needing mulch. Keep mulch materials clear of the stems of plants where disease is likely to occur. Mulches applied around growing plants or prior to weed seedling development shall have 100 percent ground cover. Thickness of the mulch shall be adequate to prevent emergence of targeted weeds. Plastic mulches may be used.

Additional Criteria to Facilitate the Establishment of Vegetative Cover

Apply mulch at a rate that achieves a minimum of 70 percent ground cover to provide protection from erosion and runoff and yet allow adequate light and air penetration to the seedbed to ensure proper germination and emergence.

Irrigated sites

Perennial grass seedings generally do not require mulch on sites that have an irrigation system and adequate irrigation water supplies to ensure rapid, uniform germination and stand establishment. If mulching is planned for an irrigated perennial grass seeding, do not apply mulch materials such as brome grass hay or small grain straw that include viable seed, which can germinate and suppress the establishment of perennial grasses.

Additional Criteria to Improve Soil Quality

Apply mulch materials with a carbon to nitrogen ratio (C:N) less than 30 to 1 so that soil nitrogen is not immobilized by soil biota. Do not apply mulch with C:N ratios less than 20:1 to an area of designed flow in watercourses.

Use the NRCS Soil Conditioning Index procedure to assess soil quality impacts and to determine the needed type and application rate of the mulching material.

Additional Criteria to Reduce Airborne Particulates

Determine the mulch application rate using current wind erosion prediction technology to reach the soil erosion (movement of particulates offsite) objective.

CONSIDERATIONS

Mulch material may affect microbial activity in the soil surface, increase infiltration, and decrease runoff, erosion and evaporation.

Mulching may decrease the temperature of the surface runoff.

Mulch material used to conserve soil moisture should be applied prior to moisture loss.

Prior to mulching, ensure soil under shallow rooted crops is moist, as these crops require a constant supply of moisture.

Mulch materials with a high water holding capacity and/or high impermeability to water droplets may adversely affect water availability for plants.

Fine textured mulches (e.g. rice hulls) which allow less oxygen penetration than coarser materials should be no thicker than 2 inches.

Organic materials with C:N ratios of less than 20:1 will release nitrate-nitrogen which can cause water quality impairments off-site.

Mulching may provide habitat for beneficial insects and provide pest suppression.

Clear and infra-red transmissible (IRT) plastics have the greatest warming potential. They are transparent to incoming radiation and trap the longer wavelengths radiating from the soil. Black mulches are limited to warming soils by conduction only and are less effective.

Clear mulches allow profuse weed growth and may negate the benefits of soil warming. Black mulches provide effective weed control. Wavelength selective (IRT) plastic provides the soil warming characteristics of clear mulch with the weed control ability of black mulch.

Low permeability mulches (e.g. Plastic) may increase concentrated flow and erosion on un-mulched areas.

Consider potential toxic allelopathic effects that mulch material may have on other organisms. Animal and plant pest species may be incompatible with the site.

Consider the potential for increased pathogenic activity within the applied mulch material.

Keep mulch 3 to 6 inches away from plant stems and crowns to prevent disease and pest problems. If needed, apply additional weed control measures around the plant base area.

Deep mulch provides nesting habitat for ground-burrowing rodents that can chew extensively on tree trunks and/or tree roots. Light mulch applied after the first cold weather may prevent rodents from nesting.

Some mulch material may adversely affect aquatic environments through changes in water chemistry or as waterborne debris. Consider placing mulch in locations that minimizes these risks.

Consider potential effects of soil physical and chemical properties. Refer to soil survey data as a preliminary planning tool for assessment of areas. Consult the Web Soil Survey at:

<http://websoilsurvey.nrcs.usda.gov/app/> to obtain Soil Properties and Qualities information.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for each field or treatment unit according to the Criteria and Operation and Maintenance sections of this standard. Specifications shall describe the requirements for applying this practice to meet the intended purpose.

Record practice specifications on specification sheets, job sheets, narrative statements in the conservation plan, or other acceptable documentation.

Include the following items in the Specification, as a minimum.

- Purpose
- Type of mulch material used
- The percent cover and/or thickness of applied mulch material
- Timing of application
- Site preparation
- Netting, tackifiers, crimping or other methods of anchoring
- Operation and maintenance

OPERATION AND MAINTENANCE

Periodically inspect mulched areas and reinstall or repair as needed, to accomplish the intended purpose.

Evaluate mulch effectiveness (application rate, cover, durability, etc.) and adjust the management and or type of mulch, to meet the intended purpose(s).

Removal or incorporation of mulch materials shall be consistent with the intended purpose and site conditions.

Operation of equipment near and on the site shall not compromise the intended purpose of the mulch.

Prevent or repair any fire damage to the mulch material.

Properly collect and dispose of artificial mulch material after intended use.

Monitor and control undesirable weeds in mulched areas.

REFERENCES

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APPENDIX D

Swift Creek Watershed Land Management Plan

MEMORANDUM

88/1.1.1

TO: Charles Wakild, NRCD, Division of Environmental Management Water Quality Section Chief

FROM: Mayor Larry M. Jordan, Apex
Mayor Koka Booth, Cary
Mayor Joe G. Creech, Garner
Mayor Avery C. Upchurch, Raleigh
Chairman M. Edmund Aycok, Wake County
Steven E. Stewart, Apex Town Manager
Jim Westbrook, Cary Town Manager
Gus M. Ulrich, Garner Town Manager
Dempsey E. Benton, Raleigh City Manager
Richard Y. Stevens, Wake County Manager

SUBJ: Swift Creek Watershed Land Management Plan

DATE: September 8, 1988

BACKGROUND

On February 8, 1988, elected officials and staff from Apex, Cary, Garner, Raleigh and Wake County agreed to prepare a land management plan for the Swift Creek watershed west of Highway 50. A technical committee (Swift Creek Planning Committee) including planners from Apex, Cary, Garner, Raleigh and Wake County, and staff from the North Carolina Department of Natural Resources and-Community Development, Division of Environmental Management (DEM), Water Quality Planning Section was formed to prepare this plan. The attached land management plan was designed to enable the Swift Creek watershed to attain a WS-II classification.

The attached plan 1) proposes minimum critical areas and stream buffers, 2) recommends performance standards for different types and densities of development, and 3) outlines a scenario for future land use patterns in the watershed. The scenario illustrates each local government's land use plans or policies for its existing jurisdiction within the watershed, and proposes land use patterns for future municipal jurisdiction expansion into the Swift Creek watershed.

Guidance Requested

Guidance is needed from DEM and the Environmental Management Commission Water Quality Planning Committee as to whether or not the land management plan could qualify the Swift Creek Watershed for a WS-II classification. We request that you review the attached plan and forward any comments you may have to Jackie Stewart, Planner, Wake County Planning Department, P.O. Box 550, Raleigh, N.C. 27602, (755-6820).

COMPETING OBJECTIVES

It is believed that there are two competing objectives which affect land use patterns and development standards within the Swift Creek watershed; the protection of water quality, and the logical extension of urban development.

LEVEL OF WATER QUALITY PROTECTION

A request has been made by the City of Raleigh to NRCDD-DEM to designate the Swift Creek Watershed as a WS-II watershed. The practical result of this designation would be that the State would prohibit industrial wastewater discharges into the watershed. In order to attain the WS-II designation, each local government involved would need to adopt appropriate water quality protection measures through a land management plan and implementing ordinances.

URBAN DENSITIES

Delineation of the Watershed

The Swift Creek watershed, located in southern Wake County, is comprised of approximately 40,174 acres. Lakes Benson and Wheeler are the primary bodies of water within the watershed. Local governments have jurisdiction in the watershed as follows (refer to Map A, Jurisdictions within Swift Creek Watershed):

Apex	1,976 acres	5%
Cary	11,126 acres	28%
Garner	7,071 acres	18%
Raleigh	3,290 acres	8%
Wake County	16,771 acres	41%
TOTAL	40,174 acres	100%

Approximately 59% of the watershed is within municipal jurisdictions. In addition, expansion within the watershed is planned by municipalities. Cary and Garner plan to extend their jurisdictional boundaries southward through the Swift Creek watershed. Cary is constructing a wastewater treatment plant in the Middle Creek watershed, and will run wastewater lines from their Middle Creek treatment plant through the Swift Creek watershed to provide service to Cary. Garner also plans to run wastewater trunk lines through the Swift Creek watershed critical area (defined below) in order to provide services to an area in the non-critical portion (defined below) of the watershed on the south side of Swift Creek.

Given municipal interest in the area, the committee studied whether residential development greater than one dwelling unit per acre, with greater than 12% impervious surface area, and non-residential development should be recommended in the non-critical area of the

watershed, subject to land use regulations designed to protect the quality of the water.

DEVELOPMENT REGULATIONS

Definition of Critical Area and Stream Buffers

For a water supply watershed WS-II classification, the following minimum critical areas and stream buffers are proposed for the Swift Creek watershed (refer to Map B):

AREA OF WATERSHED	MINIMUM CRITICAL AREA WIDTH	MINIMUM VEGETATIVE BUFFER WIDTH
Lake Benson	North side 2000 feet, south side 2640 feet measured from lake conservation pool level	100 feet measured from lake conservation pool level
Swift Creek	500 ft from the center of creek along both sides of creek	100 ft measured from creek bank
Lake Wheeler	1000 ft measured from lake conservation pool level	100 ft measured from lake conservation pool level
Swift Creek	500 ft from the center of creek along both sides of creek above Lake Wheeler to Holly Springs Rd. (S.R 1152)	50 ft measured from creek bank
Little Swift Creek (LSC) and Yates Mill Creek (YMC)	None	100 ft measured from creek bank, measured to Yates Mill Pond Dam for YMC, and measured to the dam located southeast of S.R. 1371 and S.R. 1152 for LSC
Drainageways	none	0 ft if area drained is less than 5 acres, 25 ft if 5 to less than 25 acres, 50 ft if 25 or more acres; measured from creek bank or center of a drainageway

Performance Standards

Table 1, on page 5, summarizes minimum performance standards which could be applied to the entire watershed and are designed, with appropriate development densities and stream and vegetative buffers, to attain a WS-II classification. These standards are recommended to be applied to new development throughout the watershed. They are not proposed to affect existing or already approved development. The proposed impervious

surface limit is 6% in the critical area and 12% in the non-critical area for areas without stormwater control measures. The proposed maximum impervious surface limit is 30% except for those areas designated as (a) critical: urban limited residential, or (b) non-critical: new urban residential and non-residential, or existing urban (refer to Table 1). It should be noted that stormwater impoundments are required when proposed impervious surface limits exceed 6% in the critical area and 12% in the non-critical area, and that as the amount of impervious surface increases, the size of the proposed impoundment must also increase. All impoundments are proposed to be constructed according to DEM standards. It is believed that private maintenance of impoundments is sufficient to maintain water quality protection, but that periodic public inspection according to DEM guidelines should be required, to monitor impoundment effectiveness, and that public maintenance should be required when private maintenance fails.

As a further enhancement of water quality protection, it is also proposed that point source discharges be prohibited within the watershed. A WS-II classification would prohibit industrial discharges within the watershed. The performance standards in Table 1 would also require domestic dischargers, such as public and community sewer systems, to pump their effluent out of the watershed. It should also be noted that in the critical portion of the watershed public sewer is required for limited residential uses which exceed an impervious surface ratio of 6%. In addition, in the non-critical portion of the watershed public sewer is proposed to be required for residential and non-residential uses which exceed an impervious surface ratio of 12%. These requirements for public sewer would need to be implemented and enforced by local governments through local ordinances.

LAND USES

Existing Land Use Patterns

The existing land use patterns were identified and mapped for each local government jurisdiction in the watershed (refer to Map C, Existing Land Use Patterns, Swift Creek Watershed). In general it was found that the highest intensity of land use in the watershed is north of Lake Benson, within Garner's jurisdiction, and in areas west of Holly Springs Road within Apex's and Cary's jurisdictions. These areas were developed primarily for small lot residential uses, but also have some business and commercial uses. The lowest intensity of land use in the watershed surrounds Lake Wheeler and the south side of Lake Benson, and is in Wake County's jurisdiction. This area is zoned by Wake County to allow about one dwelling unit per two acres in the critical area (defined by the County as the area within 1,200 feet of Lakes Benson and Wheeler, measured from the lake conservation pool level, and within 600 feet of Swift Creek between the two lakes and upstream of Lake Wheeler, measured from the floodway center), and about one dwelling unit per acre in the non-critical area. Much of this area is undeveloped. Most of the remainder of the watershed, the areas north and west of Holly Springs Road, are developed at a residential density averaging 2.5 dwelling

units per acre, and at an impervious surface area of approximately 30%. The exceptions are those central portions of Cary which exceed 2.5 dwelling units per acre and have no impervious surface limit. Although some existing development has been constructed to a 30% or greater impervious surface level, Cary staff estimates that existing impoundments and lakes meet the size requirements for collecting stormwater runoff as recommended by DEM. Therefore, Cary staff estimates that these areas were developed in a manner which could meet recommended water quality protection measures.

Potential Future Land Use Patterns

The scenario outlined below represents the potential future land use pattern of the Swift Creek watershed as municipal jurisdictions expand. Differences among land use patterns reflect the extent of planned water and sewer line extensions into the watershed. In general, Apex, Cary and Garner plan to extend sewer trunk lines in the watershed, which could create the potential for urban development. Raleigh and Wake County do not plan to extend sewer trunk lines in the watershed.

The general land use patterns in the scenario, and the recommended performance standards described in Table 1, are designed to enable the Swift Creek watershed to attain a WS-II classification. It should be noted that the checkered areas on Map D represent areas which were developed prior to the establishment of water quality protection standards, and may not meet the standards proposed in Table 1.

The performance standards discussed in Table 1 above, are recommended to be applied to the scenario discussed below.

Land Use Scenario

Vegetative Buffers

Vegetative buffers would be maintained along all streams which drain into Swift Creek, and Lakes Wheeler and Benson. DEM requires that vegetative buffers be maintained for water quality protection to attain a WS-II classification. These buffers would remain undisturbed so that they could function to filter stormwater runoff.

Critical Area

Limited residential development would be permitted within the critical area of the watershed. Limited residential development would prohibit institutional uses such as colleges, places of worship, schools, public libraries and museums, and art galleries. In order to curb the potential for future urban development in the critical portion of the watershed, public sewer trunk line tap-ons also would be prohibited in the critical area.

Garner and Wake County are the only local governments which maintain jurisdiction in the critical area of the Swift Creek watershed as defined in this report. A portion of Garner's jurisdiction within the critical area of the watershed is already developed to urban residential

densities, and part of this area was developed prior to the establishment of water quality protection standards. For the undeveloped remainder of the critical area within Garner's jurisdiction, Garner allows only limited residential, agricultural, recreational and public uses, and enforces watershed protection standards which fall within DEM's guidelines for adequate water quality protection. In order to allow development patterns in the undeveloped portion of Garner Is jurisdiction within the critical area to be consistent with previous development in that area, limited residential uses at a maximum density of 2.5 dwelling units per acre with an impervious surface ratio of over 6% but no greater than 35% would be allowed provided the first 1 inch of runoff is captured and public sewer is provided.

The portion of the critical area located within Wake County's jurisdiction is partially developed to a maximum density of 0.5 dwelling units per acre with limited residential uses (prohibiting all commercial and institutional uses other than recreational uses). Because Wake County's, like Garner's, portion of the critical area is adjacent to the water take-out point, but unlike Garner's remains largely undeveloped, this area would be maintained at a maximum residential density of 0.5 dwelling units per acre, yielding an impervious surface ratio of about 6%.

Non-Critical Area: Current Jurisdictions

The area east of Lake Wheeler Road is within Garners, Raleigh's and Wake County's jurisdictions. Much of the area within Garner's jurisdiction was developed prior to the establishment of water quality protection measures. However, Garner requires that water quality protection measures be met for all new development in the watershed. For a portion of those undeveloped areas in the watershed at the intersection of S.R. 1010 and U.S. 401, and at the intersection of U.S. 401 and the proposed Vandora Springs Road extension, Garner plans to allow residential development densities of up to 6 dwelling units per acre. The areas which are planned to be maintained at a maximum density of 1 dwelling unit per acre are the portion of the NCSU Research Farm designated as major open space, and those areas east of and adjacent to the NCSU Research Farm, and between Lake Benson and N.C. 50.

For the portion of Raleigh's jurisdiction within the watershed east of Lake Wheeler Road, residential use densities of up to 6 dwelling units per acre are proposed. New urban areas are proposed in the area south of Tryon Road and east of the NCSU Research Farm adjacent to existing developed urban areas where public utilities exist or can be easily extended. The remainder of this area is planned to be maintained as major open space or to be developed to a maximum residential density of 1 dwelling unit per acre. It should be noted that some of the area east of Lake Wheeler Road within Raleigh's jurisdiction was developed prior to watershed protection standards.

The majority of the area east of Lake Wheeler Road within Wake County's jurisdiction is designated as rural residential which allows for a

maximum density of up to 1 dwelling unit per acre. However, a portion of this area north of Swift Creek was developed with non-residential uses prior to the establishment of water quality protection standards.

Within the non-critical portion of the watershed east of Holly Springs and Jones Franklin Roads, and west of Lake Wheeler Road, residential development and a limited amount of non-residential development would be permitted. This area is largely within Wake County's jurisdiction except for smaller areas in Cary's and Raleigh's jurisdictions. The majority of this area within Wake County's jurisdiction is rural residential, with an average density of one dwelling unit per acre. The exceptions are those portions which are developed to allow non-residential uses necessary to serve the daily needs of area residents, such as convenience stores and elementary schools. The area within Wake County would be maintained at a maximum residential density of 1.0 dwelling unit per acre with a limited number of non-residential uses allowed, and would not be severed because of the increased potential, once developed, to adversely affect the water quality of Lakes Benson and Wheeler. This type of development would yield an impervious surface area of about 12%, and would be able to maintain an adequate level of water quality protection without structural devices.

For the area within Cary's jurisdiction east of Holly Springs Road and west of Campbell Road, residential development would be allowed at a density of up to 6.0 dwelling units per acre. Municipal sewer extensions are planned for this area which is designated by Cary on Map D for new urban development. Cary proposes to restrict their impervious surface limits to a maximum of 30% in this area.

For the area within Raleigh's jurisdiction east of Jones Franklin and Holly Springs Roads, and north of the NCSU Research Farm, residential development would be allowed at a density of up to 6.0 dwelling units per acre. Although Raleigh does not plan to extend sewer trunk lines into this portion of the Swift Creek watershed, Raleigh could extend sewer trunk lines into this area, but would restrict their impervious surface limits to a maximum of 30%.

Because these areas within Cary's and Raleigh's jurisdictions are at the periphery of the watershed, it is not believed that a limited amount of residential development at a maximum density of 6.0 dwelling units per acre would significantly increase the potential to adversely affect water quality. (As specified in Table 1, impervious surface limit may be increased to 30%, and 70%, provided that the first one-half inch or one inch of rainfall run-off is retained, respectively.)

The remainder of the watershed, the area west of Holly Springs and Jones Franklin Roads, lies within Apex's, Cary's and Wake County's jurisdictions. Much of the area within Apex's and Cary's jurisdictions is developed or has site plans which have already been approved at a residential density averaging 2.5 dwelling units per acre and result in impervious surfaces of approximately 30%. The exceptions are those residential portions of Apex and Cary which exceed 2.5 dwelling units

per acre, and those non-residential portions which have no impervious surface limit. Since these areas are located at the periphery of the watershed, and because the recommended performance standards are not proposed to affect existing or approved development, these areas would be allowed to develop at these densities.

The area within Wake County's jurisdiction west of Holly Springs Road remains largely undeveloped, but has some large lot single family subdivisions. Residential uses with a maximum density of 1 dwelling unit per acre would be allowed for the undeveloped portion.

Non-critical Area: Municipal Jurisdiction Expansion

The potential future land use patterns, (described, below) would be applied as municipal jurisdictions expand in the watershed. As proposed above, vegetative buffers would remain undisturbed, and proposed critical areas would be maintained according to the recommended performance standards in Table 1.

Within the non-critical portion of the watershed, new suburban areas with a maximum average density of 2.5 dwelling units per acre and non-residential uses with a maximum impervious surface limit of up to 30% would be allowed in municipal jurisdictions. Portions of these areas, which are currently in Wake County's jurisdiction, are proposed to be developed to suburban densities by municipalities.

In the non-critical portion of the watershed east of Holly Springs and Jones Franklin Roads, residential uses with an average density of 6 dwelling units per acre also would be allowed in municipal jurisdictions. Existing areas within Cary's and Raleigh's jurisdictions are already proposed to be developed at an average of 6 dwelling units per acre in this area. Other new urban areas proposed to allow up to 6 dwelling units per acre, and non-residential uses with a maximum impervious surface of up to 70% would be located along the north shore of Lake Benson and along U.S. 401 in Garner's jurisdiction.

In the non-critical portion of the watershed west of Jones Franklin and Holly Springs Roads, residential uses with a density exceeding 6 dwelling units per acre and non-residential uses with a maximum impervious surface of up to 70% also would be allowed in municipal jurisdictions. New urban areas proposed to allow greater than 6 dwelling units per acre are proposed to be located adjacent to existing central business districts in Apex and Cary, and on portions of other sites within Cary's jurisdiction.

ISSUES FOR ADDITIONAL STUDY

During discussions, several issues were brought up which could have an effect on the implementation of future land use regulations in the watershed. No conclusions were reached for these issues. However, it is believed that these issues should be considered as the land management plan for the Swift Creek watershed is refined.

Impoundments Serving Multiple Properties: Impoundments serving multiple properties are proposed to be allowed. This method is used within individual Planned Unit Developments (PUDs) built within Cary's jurisdiction and should be expanded to apply to a runoff impoundment serving more than one development. It is believed that large impoundments serving multiple properties are more effective and easier to maintain than small impoundments serving individual properties.

Removal of Existing Point Source Discharges in the Watershed: The ability to attain a WS-II classification for the watershed may be improved if public sewer improvements or land use controls can be utilized to remove existing point source discharges from the Swift Creek watershed. There are approximately 7 existing discharges within the watershed.

Sewer Lines Passing Through Critical Areas: The proposed regulations specify that the critical area of a water supply watershed (except for areas already urban) should not be served with public sewer. Garner's future growth patterns include the area around and to the south of Lake Benson. In order to provide sewer service, which is required by State law for areas within corporate limits, it would be most economical to run main sewer lines through the critical area rather than around the critical area. Garner staff believes that the Town could successfully prohibit trunk line tap-ons in the critical area. There is a concern, however, that if sewer mains were allowed to run through the critical area, Garner could be pressured into allowing trunk line tap-ons to provide service to those properties in the immediate area of the lines.

General Enabling Legislation: General enabling legislation is needed to allow municipalities to annex within water supply watersheds without the requirement that they extend water and sewer lines (G.S. 160A-35 (3) b. and G.S. 160A-47 (3) b.), thereby allowing municipal expansion while also protecting the water quality.

Low Pressure Wastewater Disposal Systems: Because of the recent failure of a low pressure wastewater disposal system in the Swift Creek watershed, it was discussed whether or not these systems should continue to be allowed in a water supply watershed, and, if so, whether public maintenance should be required if they fail.

Road Construction Standards: Road construction standards were discussed briefly.

Amount of Non-Residential Development to be Allowed: The land use plans represented in this report (Map D) concentrate on residential uses as the predominant use. The amount and nature of proposed non-residential use areas needs to be further refined. The non-residential areas are not intended to be major commercial or employment areas. The intensity of non-residential development could be allowed to increase as the distance from the critical area increases.

CONCLUSION

It is believed that good water quality management practices can be enforced by limiting the types and densities of future growth, controlling point source discharges, and applying water quality regulations which meet or exceed those recommended by DEM staff to maintain a WS-II classification. The performance standards outlined in Table 1 and the watershed critical areas and buffers defined above are proposed to meet these water quality management objectives, while permitting municipal growth. The scenario attempts to present land use patterns which could be applied to the watershed to attain a WS-II classification.

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Swift Creek Requirements

TABLE 1 RECOMMENDED PERFORMANCE STANDARDS SWIFT CREEK WATERSHED

Standards	Area											
	Critical				Non-Critical ¹							
	Rural	Urban	Rural	Suburban - New	Urban - New	Existing Urban	Rural		Suburban - New		Urban - New	
Ltd. Res. *	Ltd. Res. *	Residential	Non-Res.	Residential	Non-Res.	Residential	Non-Res.	Residential	Non-Res.	Residential	Non-Res.	Res. & Non-Res.
Maximum density	.5 du/ac	2.5 du/ac	1 du/ac	n/a	2.5 du/ac	n/a	n/a	6 du/ac east of Holly Springs Road; may exceed 6 du/ac west of Holly springs Rd.	n/a	n/a	n/a	Res.-controlled by underly. zon.
Impervious surface limit	6%	6% ¹	12% ²	12% ²	12% ³	12% ³	12% ⁴	12% ⁴	12% ⁴	12% ⁴	12% ⁴	12% ⁴
Impoundments and maintenance ⁵	Allowed	Required if over 12% impervious, pbl. or prv. maintained	Required if over 12% impervious, pbl. or prv. maintained	Required if over 12% impervious, pbl. or prv. maintained	Required if over 12% impervious, pbl. or prv. maintained	Required if over 12% impervious, pbl. or prv. maintained	Required if over 12% impervious, pbl. or prv. maintained	Required if over 12% impervious, pbl. or prv. maintained	Required if over 12% impervious, pbl. or prv. maintained	Required if over 12% impervious, pbl. or prv. maintained	Required if over 12% impervious, pbl. or prv. maintained	Required if over 12% impervious, pbl. or prv. mthd.
Municipal sewer ⁶	Prohibited ⁷	Required if over 6% impervious	Prohibited ⁷	Prohibited ⁷	Required if over 12% impervious	Required if over 12% impervious	Required if over 12% impervious	Required if over 12% impervious	Required if over 12% impervious			
Private sewer ⁸	Prohibited	Prohibited	Allowed	Allowed	Allowed if under 12%	Allowed if under 12%	Allowed if under 12%	Allowed if under 12%	Allowed if under 12%			

1 Limit may be increased to 35%, provided first 1" of rainfall runoff is retained
 2 Limit may be increased to 30%, provided that first 1/2" of rainfall runoff is retained
 3 Limit may be increased to 30%, provided that first 1" of rainfall runoff is retained
 4 Limit may be increased to 30% and 70% provided that first 1/2" or 1" of rainfall runoff is retained, respectively
 5 Refer to minimum State construction standards and inspection requirements
 6 Point source discharge is prohibited in basin
 7 Municipal sewer is allowed to protect public health when private systems fail except as provided under Issues for Additional Study
 8 Limited residential uses exclude institutional uses such as colleges, schools, public libraries, museums and art galleries
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