

NC STATE UNIVERSITY

Stormwater and Nutrient Management Requirements



Stormwater Management

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SECTION ONE

INTRODUCTION

1.0 Purpose

In accordance with the North Carolina State University's (NCSU) current National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit NCS000376 and associated Management Plan, the University requires stormwater management techniques be applied to all development projects in the form of structural and non-structural Best Management Practices (BMPs). Stormwater management involves an integrated approach that addresses the environmental issues of pollutant control, capture and treatment affecting both water quality and quantity associated with urban development.

1.1 Scope and Applicability

This document was developed as a guidance document for the environmental planning and design of stormwater management plans applicable to all development projects on the campuses of North Carolina State University. Any project that disturbs greater than 0.10 acre of land, whether previously undisturbed land or existing impervious surface shall be required to submit a stormwater management plan.

This document presents a set of minimum environmental standards that must be incorporated at the onset of the initial planning and design phase for each project. Additional design and documentation requirements may be required by the Environmental Affairs Office, as deemed necessary to maintain compliance with the MS4 Permit. The Environmental Affairs Office will notify the University project manager through the plan review process of additional environmental design and permit requirements, based on the available information. It is the responsibility of the University project manager to ensure that all permits have been obtained prior to beginning construction.

Stormwater infrastructure issues, including system capacity and erosion potential, are briefly addressed in this document and may be addressed in reviews. References to stormwater infrastructure issues are as necessary to maintain conformance with environmental standards. Additional on- or off- site measures may need to be implemented to meet the site conditions and local standards of performance. Stormwater infrastructure issues remain the responsibility of the designer.

For the purpose of these guidelines, the following definition shall apply.

- 1) **Development:** Any activity that disturbs greater than 0.10 acre of land in order to establish, expand or modify a multifamily residential development, commercial, industrial or institutional facility.

- 2) **De minimis Activity:** Development projects that disturb less than 0.1 acre (approximately 4,500 square feet) are not subject to the design requirements.

For the purpose of recordkeeping and reporting, projects meeting the deminimis activity determination are still required to submit a copy of final construction drawings to the Stormwater Program Manager. The Stormwater Program Manager will provide the University Project Manager with a letter stating the project is exempt from the guidelines. This, however, does not exempt the project from obtaining any other necessary permits and approvals and meeting those requirements.

- 3) **Apportionment:** A means of distributing open space credit within the project limits of a development project. The method includes the proportional distribution of claimed open space based on the ratio of proposed impervious area to the sum of proposed and existing impervious areas.
- 4) **Outfall:** Outfalls are identified as any existing or proposed points from which stormwater passes outside the project limits defined on the project plans.

1.2 Stormwater Management Program Contact Information

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SECTION TWO

REFERENCES

15A North Carolina Administrative Codes (NCAC) 2H .1000 (Entire Section)
Stormwater Management: Stormwater Requirements

15A North Carolina Administrative Codes (NCAC) 2B .0235
Neuse River Basin: Nutrient Sensitive Waters Management Strategy: Basinwide
Stormwater Requirements

15A North Carolina Administrative Codes (NCAC) 2B .0233
Neuse River Basin: Nutrient Sensitive Waters Management Strategy: Protection and
Maintenance of Existing Riparian Buffers

North Carolina State University National Pollution Discharge Elimination System
(NPDES) Municipal Separate Storm Sewer System (MS4) Permit # NCS000376 and
associated Management Plan

North Carolina Department of Environment and Natural Resources Division of Water
Quality – Water Quality Section
Stormwater Best Management Practices Design Manual, July 2007

SECTION THREE

STORMWATER MANAGEMENT PLAN

The stormwater management plan (SWMP or Plan) must ensure that the requirements and criteria in the NPDES MS4 Permit, the associated Management Plan and this document are being fully incorporated and that opportunities are being taken to minimize adverse stormwater runoff impacts during construction and post-development.

All proposed projects (unless the project meets the de minimus determination criteria) must submit a SWMP regardless of whether the project proposes increases or decreases to total impervious surface area. No project shall begin any phase of construction prior to receiving written stormwater management plan approval. The Stormwater Program Manager may require copies of other applicable documentation, permits and/or approvals before Plan approval can be granted.

In all cases, compliance with this document does not preclude the requirement to comply with all other applicable federal and state regulations and laws.

3.0 Plan Review and Approval Process

For subject projects, the University project manager is responsible for submitting to the Stormwater Program Manager all required information (i.e. calculations and plan sheets) relating to the design of the stormwater management system. The Plan must be sealed by a Professional Engineer (PE) licensed in the state of North Carolina. A Stormwater Management Plan Submittal Checklist, which is included in the Appendix of this document, must accompany the submittal packet.

The Stormwater Program Manager is responsible for reviewing the SWMP and providing each project with formal written plan approval. Plan review comments and subsequent approval will be provided to the University project manager and the Plan designer/engineer.

The official design review process will not commence until the Stormwater Program Manager has received all components of the SWMP listed on the submittal checklist. The review period will not exceed 30 working days from the date the Stormwater Program Manager receives the complete SWMP packet. Incomplete submittals will not be included as part of the 30 day review period.

If the design is acceptable and all other required documentation has been received, the Stormwater Program Manager will provide a formal written approval letter to the University project manager and Plan designer/engineer. If the design is not acceptable, the University project manager will receive a written evaluation citing the plan's deficiencies and/or areas of concern. All comments, question and/or concerns must be sufficiently addressed in writing then resubmitted to the Stormwater Program Manager for final review.

Plan approvals are based solely on the information provided and are only valid for the purpose and design described in the stormwater management plan. Should the project have significant changes, the University project manager must submit updated information and plans to the Stormwater Program Manager for review.

3.1 Pre-Design Meeting

For large projects, sensitive projects or those projects that may exhibit special consideration, it is recommended, but not required, that the University project manager and Plan designer/engineer meet with the Stormwater Program Manager to discuss the proposed stormwater management plan concept. Design requirements, additional parameters, feasibility of the design concept, innovative approaches, calculation methodologies, and submittal requirements will be discussed at the pre-design meeting. No form of final approval will be obtained at the pre-design meeting.

Projects proposing complex stormwater management systems and/or include impacts outside the project limits may be subject to review and approval by the Stormwater Committee. University project managers will be notified when Committee review/approval is required.

In either case, the following information should be submitted to the Stormwater Program Manager at least one week prior to a scheduled meeting:

A. Existing Conditions / Proposed Site Plans

Existing conditions and proposed site layout sketch plans, which illustrate at a minimum: existing and proposed topography; perennial and intermittent streams; buffer limits; floodplain limits; setback limits; mapping of predominant soils from soil surveys (when available); boundaries of existing predominant vegetation and proposed limits of clearing and grading; and location of existing and proposed roads, stormwater outfalls, utilities, buildings, parking areas and other impervious surfaces.

B. Natural Resources Inventory

A written or graphic inventory of the natural resources at the site and surrounding area as it exists prior to the commencement of the project. This description should include a discussion of soil conditions, forest cover, topography, wetlands, and other native vegetative areas on the site, as well as the location and boundaries of other natural feature protection and conservation areas such as wetlands, lakes, ponds, floodplains, stream buffers and other setbacks (e.g., drinking water well setbacks, septic setbacks, etc.). Particular attention should be paid to environmentally sensitive features that provide particular opportunities or constraints for development. Documentation shall include partial copies of the USGS quad maps, soil survey maps, and watershed basin topography maps depicting the site limits.

C. Stormwater Management System Concept Plan

A written or graphic concept plan of the proposed stormwater management plan including: preliminary selection and location of proposed structural stormwater controls; location of existing and proposed conveyance systems such as grass

channels, swales, and storm drains; flow paths; location of floodplain/floodway limits; relationship of site to upstream and downstream properties and drainages; and preliminary location of proposed stream channel modifications, such as bridge or culvert crossings. Approximately scaled limits of stormwater control devices and BMPs, including approximate 25-year storm backwater elevations, shall be included on the plans.

3.2 Stormwater Management Plan Components

The stormwater management plan shall detail how stormwater runoff during construction and post-development will be controlled or managed and how the proposed project will meet the requirements of this document.

All projects must incorporate into the stormwater management plan Best Management Practices for nutrient reduction. If it is not possible to include BMPs in the design then a written “No Practical Alternatives” summary must be submitted with the plan. The summary should include a detailed investigation as to why BMPs cannot be practically configured or designed and utilized in the design.

The stormwater management plan shall consist of maps, narratives and supporting design calculations (hydrologic and hydraulic) for the proposed stormwater management system. The SWMP shall include, at a minimum, the information listed below. A submittal checklist is provided in the Appendix of this document and should be completed and attached to the submittal packet.

3.2.1 Common address and legal description of the site

3.2.2 Vicinity Map

3.2.3 Narrative & Scaled Drawings

The description and scaled drawings for the proposed stormwater management plan, which shall include the following:

- a) A map and/or drawing or sketch of the stormwater BMPs, including the location of non-structural site design features and the placement of existing and proposed structural stormwater controls, including design water surface elevations, storage volumes available from zero to maximum head, location of inlet and outlets, location of bypass and discharge systems, and all orifice/restrictor sizes;
- b) A narrative describing how the selected structural stormwater controls will be appropriate and effective. The narrative shall include summaries of pre- and post- peak flow rates and statements of compliance for each design requirement.
- c) Cross-section and profile drawings and design details for each of the structural stormwater controls in the system, including supporting calculations and summaries to show that the BMPs are designed according to the applicable design criteria.

3.2.4 Existing Conditions Hydraulic and Hydrologic Analyses

The existing conditions hydrologic analysis for stormwater runoff rates, volumes and velocities, which shall include:

- a) A topographic map of existing site conditions with the drainage basin boundaries and outfalls indicated; flow paths and travel time estimation parameters; acreage, soil type and land cover of areas for each subbasin affected by the project;
- b) All perennial and intermittent streams, buffers, floodplains, and other surface water features;
- c) All existing stormwater conveyances and structural controls, direction of flow and exits from the site; Slopes, pipe sizes, channel cross sections, and impoundment depths;
- d) Analysis of runoff provided by off-site areas upstream of the project site; and
- e) Methodologies, assumptions, site parameters and supporting design calculations used in analyzing the existing conditions site hydrology. The NRCS (TR-55) method, with a Type II storm distribution, shall be utilized for routing models. Computer generated models will be accepted, provided documentation verifying the models were based on the NRCS method is provided.
- f) For redevelopment sites, pre-development conditions shall be modeled using the established guidelines for the entire site.

3.2.5 Post-Development Hydraulic and Hydrologic Analyses

The post-development hydrologic analysis for stormwater runoff rates, volumes, and velocities, which shall include:

- a) A topographic map of developed site conditions with the post-development drainage basin boundaries and outfalls indicated; flow paths and travel time estimation parameters;
- b) All existing and proposed stormwater conveyances and structural controls, direction of flow and exits from the site; Slopes, pipe sizes, channel cross sections, and impoundment depths;
- c) Inlet contributing area maps, including areas and runoff coefficients; Applicable V10 and V25 velocities, stage heights, shear stress calculations and channel linings for conveyances and dissipaters;
- d) Total area of post-development impervious surfaces and other land cover areas for each subbasin affected by the project; Stormwater management device contributing area maps;
- e) Calculations for determining the runoff volumes that need to be addressed for each subbasin for the development project to meet the post-development stormwater management performance criteria; Treatment volume and drawdown calculations; Downstream capacity analysis in accordance with local infrastructure design standards;

- f) Location and boundaries of proposed natural feature protection and conservation areas;
- g) Documentation and calculation for any applicable site design credits that are being utilized; Plans, cross-sections, details and Operation and Maintenance manuals for each stormwater management technique or device;
- h) Methodologies, assumptions sited parameters and supporting design calculations used in analyzing the proposed conditions site hydrology. The NRCS (TR-55) method, with a Type II storm distribution, shall be utilized for routing models. Computer generated models will be accepted, provided documentation verifying the models were based on the NRCS method is provided.

3.2.6 Hydraulic and Hydrology Calculations

All projects constructed on Main Campus and the Centennial Biomedical Campus shall have no net increase in peak flow leaving the site from pre-development conditions for the 1-year, 24-hour storm. Additionally, projects constructed on Centennial Campus and within the Spring Hill District shall meet the pre-development conditions for the 2-year and 10-year design storms.

Peak runoff rate attenuation is subject to calculations based on the immediate project limits only. The designer is responsible for addressing any project-related downstream effects.

Projects meeting both of the conditions below do not have to meet the peak flow requirements. However, the Stormwater Program Manager and/or Stormwater Committee will make final decisions regarding exemptions.

- a) The increase in peak flow between pre- and post-development conditions does not exceed ten percent.
- b) The proposed new development meets the following criteria:
 - i. Overall impervious surface is less than fifteen percent, **and**
 - ii. The remaining pervious portions of the site are utilized to the maximum extent practical to convey and control the stormwater runoff

The following model methodologies are preferred to calculate peak flow; however, alternative approaches may be used if they can be demonstrated to be equivalent.

- The Rational Method
- The Peak Discharge Method as described in USDA Soil Conservation Service's Technical Release Number 55 (TR-55).

- The Putnam Method

The same method must be used for both the pre- and post-development conditions. The average rainfall depth for the 1-year, 24-hour storm for the Raleigh area is 3 inches.

Impact design data for the rainfall depth and intensities are as follows:

1 year – 24-hour storm depth (TR-55)	3.00 inches
1 year – 6-hour storm depth (Malcolm)	2.10 inches

1 year intensity $I = g/(h+t)$

where: I = intensity in inches/hour

t = time of concentration in minutes

g = 104

h = 18

Routing and storage calculations shall be performed as described in USDA Soil Conservation Service's Technical Release Number 55 (TR-55). Computer generated models will be accepted, provided documentation verifying the models were based on the NRCS method is provided. All calculation worksheets and details must be submitted with the SWMP packet. Additional information shall be supplied as necessary to support the information provided.

3.2.7 Nutrient Management Requirements

- Development projects shall provide 85% removal of Total Suspended Solids (TSS) by implementing planning considerations and best management practices.
- Development projects shall meet the 30% nitrogen reduction goal by implementing planning considerations and best management practices.
- All construction shall meet the nitrogen-loading limit of 3.6 pounds per acre per year (lbs/ac/yr).
- Development projects shall detain and treat the stormwater runoff generated by the first inch of rainfall, as calculated by the Simple Method.
- Development project will be granted an allowance for the replacement of existing impervious surface area. When impervious surface area exists within the project limits of a proposed development site, the project is required to include the existing impervious surface area on the calculation worksheet.

3.2.8 Approved Best Management Practices (BMPs)

- a) Table 1 provides a list of approved BMPs. Any deviation from these design standards will result in the burden of the designer to prove the design is sufficient. The designer will incur any additional cost to the university for review of designs not based on this standard.

Table 1. BMP Types, Removal Rates and Design Standards

BMP Type	Quality Control	TSS Removal Efficiency	TN Removal Efficiency	TP Removal Efficiency	Fecal Removal Ability	High Temperature Concern
Bioretention Area (Rain Garden)	Possible	85%	40%	45%	High	Med
Stormwater Wetland	Yes	85%	40%	35%	Med	High
Wet Detention Basin	Yes	85%	25%	40%	Med	High
Sand Filter	Possible	85%	35%	45%	High	Med
Filter Strip	No	25-40%	20%	35%	Med	Low
Grassed Swale	No	35%	20%	20%	Low	Low
Restored Riparian Buffer	No	60%	30%	35%	Med	Low
Infiltration Device	Possible	85%	30%	35%	High	Low
Dry Extended Detention Basin	Yes	50%	10%	10%	Med	Med
Permeable Pavement System	No	0%	0%	0%	Low	Med
Rooftop Runoff Management	Possible	0%	0%	0%	Low	Med

- b) If the project contributes greater than 3.6 lbs/ac/yr of nitrogen, but less than 10.0 lbs/ac/yr (6.0 lbs/ac/yr for residential), the following options are available.
- i. Install BMPs to remove enough nitrogen to bring the development down to 3.6 lbs/ac/yr.
 - ii. Do a combination of BMPs and offset payment to achieve a 3.6 lbs/ac/yr export.
 - iii. Submit a “No Practical Alternatives” summary stating why BMPs could not be configured and incorporated into the design and pay a one time nutrient offset fee.
- c) If the computed export is greater than 10.0 lbs/ac/yr (commercial, industrial) or 6.0 lbs/ac/yr (residential) then the owner must use on-site BMPs to bring the development’s export down to 10.0 lbs/ac/yr or 6.0 lbs/ac/yr. Then, the project may use on of the three options above to achieve the reduction from 10.0 or 6.0 to 3.6 lbs/ac/yr.
- d) If more than one BMP is installed in series on a development, then the removal rate shall be determined through a serial calculation. For example, if a wet detention pond discharges through a riparian buffer, then the removal rate shall be estimated to be 47.5%. The pond removes 25% of the nitrogen and discharges 75% to the buffer. The buffer then removes 30% of the nitrogen that discharges from the pond, which is 22.5%. The sum of the percent removed by the pond (25%) and the percent removed by the buffer (22.5%) is 47.5%.

- e) Diffuse flow of runoff shall be maintained in the riparian buffer by dispersing concentrated flow and reestablishing vegetation. Concentrated runoff from ditches or manmade conveyances shall be converted to diffuse flow before the runoff enters Zone 2 of the riparian buffer. More than one device may be required to maintain diffuse into the buffer. If diffuse flow cannot be achieved, the stormwater must pass through an approved best management practices for a total nitrogen reduction of 30% or greater.

3.2.9 Computing Total Nitrogen Export and Offset Payments

In order to determine the required level of water quality control, the nitrogen export from the development must be calculated. The total nitrogen (TN) export will be calculated in pounds per acre per year (lbs/ac/yr). The method described below shall be used for residential, commercial and industrial developments based upon the entire footprint and any other built-upon area shown on the site plans. All calculations and details must be submitted with the SWMP packet.

North Carolina State University was granted authority by NC DENR to collect internal offset payments. An invoice for the applicable offset payment will be included with the SWMP approval letter. Nutrient offset payments shall be payable to the North Carolina State University Offset Payment Fund.

Total Nitrogen Export and the Offset Payment can be calculated using the “TN Export and Offset Payment Calculation Worksheet”.

Step 1:

Downloaded the “Calculation Worksheet” from the following website:

<http://www.ncsu.edu/ehs/environ/Stormwater.htm>

Step 2:

Fill in the **YELLOW** blanks with the appropriate information.

Step 3:

Print out completed worksheet and include with SWMP packet.

A sample is provided on the following pages.

TN Export and Offset Payment Calculation Worksheet

Complete the **YELLOW** fields on both pages according to the directions. Calculations will be made automatically.

Project Name:

EHS Renovations

Date:

7/16/2007

CALCULATING TOTAL TN EXPORT FROM SITE

Determine the **Total TN Export from Site** by entering the area for each type of land use in Column 2.

NOTE: Additional Impervious Surface Area (ISA) is the difference between Existing Conditions ISA and Post-Construction ISA. If the difference is negative, then enter ZERO for Additional ISA.

Column 1	Column 2	Column 3	Column 4	Column 5
Type of Land Cover	Site Area (acres)	TN Export Coeff. (lbs/ac/yr)	TN Export by Land Use (lbs/yr)	TN Export from Site (lbs/ac/yr)
Permanently Preserved Undisturbed Open Space (forest, unmown meadow, etc.)	1.20	0.60	0.72	
Permanently Preserved Managed Open Space (grass, landscaped areas, etc.)	0.05	1.20	0.06	
Existing Conditions - Impervious Surface Area (roads, parking lots, roofs, driveways, etc.)	0.38	10.60	4.03	
Additional Impervious Surface Area (See NOTE above)	0.78	21.20	16.54	
TOTAL	2.41		21.34	8.86

3.2.11 Technical Specification for Structural BMPs

Technical specifications for the proper design, installation and maintenance of structural BMPs can be found in the July 2007 edition of the *NC DENR Stormwater BMP Manual* and can be viewed and/or downloaded at the following website:

http://h2o.enr.state.nc.us/su/bmp_manual.htm

3.3 Green Space Apportionment for Multi-Parcel Development

For individual projects developed on larger tracts of land or multiple parcels with an existing Master Plan Build-Out, it is acceptable to design a stormwater management plan based on apportionment of available green space for the entire tract. For this situation, each Plan will be required to show compliance at full build-out conditions with the nutrient management requirements given in Sections 3.3.6 and 3.3.9.

Apportionment of green space distributes credit to each proposed project within the entire tract. This method includes the proportional distribution of claimed open space based on the ratio of proposed impervious to the sum of proposed and existing impervious areas.

It is also acceptable to develop a master stormwater plan for the entire tract utilizing individual and regional stormwater management devices in coordination with the existing Master Plan for the tract.

The Stormwater Program Manager should be informed as early in the design phase as possible when a project will be designing a stormwater management plan utilizing apportionment or master stormwater planning. In either case, the Plan will need to be reviewed and approved by the Stormwater Committee.

3.4 Stormwater Management Plan Review Fees

The average cost of the Plan review is between \$1,000.00 and \$1,500.00 depending on the project. Project managers should include this cost in the project's budget. Additional fees may be charged for services such as multiple on-site visits and excessive re-submittals, which may be beyond the original scope of work.

3.5 Final Inspection and As-Built Plans

The University project manager shall notify the Stormwater Program Manager when the project is ready for final inspection prior to final acceptance by the University. The Stormwater Program Manager will inspect the construction site and provide the project manager with either written notification of acceptance or specific comments and/or questions, which will need to be addressed prior to written acceptance.

One set of As-Built drawings of the final approved stormwater management system must be submitted to the Stormwater Program Manager as soon as they become available.

Additional copies of the approved Operations and Maintenance (O&M) Manuals for each stormwater management device will need to be submitted with the As-Built drawings. At a minimum, O&M manuals shall include all information needed to completely reconstruct the device, inspection sheets, and guidance for the maintenance budget for the life of the device.

SECTION FOUR

APPENDIX

4.0 Stormwater Management Plan Submittal Checklist

Stormwater Management Plan Submittal Checklist

Project Name:	Date:
University Project Manager:	Designer/Engineer:

Pre-Design Meeting

No Meeting Scheduled
 Date of Meeting: _____
Attendees: _____

Stormwater Management Plan Components

Common Address and Legal Description	Landscaping and Open Space Plan
Vicinity Maps	Inspection and Maintenance Procedures
Narrative and Scaled Drawings	Technical Specifications for Best Management Practices
Existing Conditions Hydrologic Analysis	No Practical Alternatives summary
Post-Development Hydrologic Analysis	Other:
TN Export Offset Payment Calculation Worksheet	
Hydraulic and Hydrology Calculations	

Comments:

Administrative Use Only

Draft Plan Received/By:	Packet Complete: YES NO	To Consultant:	Review Comments Received:
Re-submittal:	Plan Approved:	Comments:	