University of North Carolina at Chapel Hill

Stormwater Performance Criteria, Design Standards, and Procedures

August 20, 2010 Version

About the this Document

The UNC-CH *Stormwater Performance Criteria, Design Standards, and Procedures* are maintained by the UNC Stormwater Engineer in Energy Services, Water, Wastewater and Stormwater. Stormwater personnel in Energy Services, Environment, Health and Safety, Grounds, and Facilities Planning have contributed directly and indirectly to this document.

UNC-CH stormwater guidelines resided in the University's *Design and Construction Guidelines* until the first release as a separate document in May 2010.

Performance criteria address regulatory requirements from NCDENR, Town of Chapel Hill, and the University's NPDES MS4 Phase II Permit. Design Standards reflect operation and maintenance conditions and draw on the standards from other agencies.

Document Revision History

Version	Summary of Revisions	Lead Staff	Reviewers
6/1/2010	First release of SW Guidelines as a separate document	Hoyt/Bingham	ES - Holton EHS -Keeney, Myers Grounds - Rigsbee
8/11/2010	Formatting; Reference to 2004 Plan	Hoyt	
8/20/2010	Info about redundant systems to prevent building flooding	Holton/Hoyt	

Table of Contents

Stormwater Performance Criteria, Design Standards, and Procedures

Designers beginning a project at UNC that involves any land disturbance should contact the UNC Stormwater Engineer and review the requirements in this document.

The following related UNC documents are also available:

- **Department of Facilities Planning and Construction Design Guidelines**
  Erosion and Sediment Control Guidelines (Chapter 3)
  http://www.fac.unc.edu/PlansPolicies/DesignGuidelines

- **Illicit Discharge Detection and Elimination Policy**
  http://ehs.unc.edu/environmental/stormwater/docs/discharge_policy.pdf

- **2010 Stormwater Capital Improvement Plan**
  This document will be released in Fall 2010. This document presents conceptual designs for structural repairs, flooding improvements, and water quality retrofits.

- **2004 Stormwater Plan**
  The 2004 Stormwater Plan effort guided the UNC stormwater program in the 2000's and is useful in understanding the University's general philosophy regarding low impact development and stormwater management.

  Design guidance from the 2004 Stormwater Plan has been replaced by this document. Capital Improvement Projects listed and described in the 2004 Stormwater Plan have either been completed or included in the 2010 Stormwater Capital Improvement Plan.

I. Stormwater Management Performance Criteria

Stormwater Management performance criteria establish the design objectives for Stormwater BMPs.

All projects at UNC, including those that do not increase the impervious area, are required to meet the University policy on implementation of the Jordan Lake Rules, which are further explained below.

Additionally, each project must meet the water quality, peak discharge, and volume reduction requirements that apply to in that jurisdiction. The applicable regulations are listed in Table I-1 below and the requirements are compared in Tables I-2 and I-3. Map 1 shows the areas where specific requirements apply. Additional State requirements apply to projects that impact wetlands, streams, stream buffers, or floodplains.

Table I-1 – Stormwater Management Performance Criteria by Jurisdiction

If your Project is located in….	***Then the following stormwater management performance criteria will apply…***
Town of Chapel Hill – Central Campus vicinity (see map) OI-4 Zoning	• Stormwater Management Performance Standards for Development and Redevelopment in the Office/Institutional-4 (OI-4) Zoning District, Adopted July 2, 2001 (see Appendix C) • UNC Policy to Implement Jordan Lake Rules
Town of Chapel Hill – Carolina North (see map) U-1 Zoning	• Carolina North Development Agreement, Article 5.6 *Stormwater Management* http://www.ci.chapel-hill.nc.us/Modules/ShowDocument.aspx?documentid=4284 • UNC Policy to Implement Jordan Lake Rules
Town of Chapel Hill – other	• Town of Chapel Hill Land Use Management Ordinance, Appendix A, Section *5.4.6. General Performance Criteria for Stormwater Management.* http://www.townofchapelhill.org/index.aspx?page=1222 • UNC Policy to Implement Jordan Lake Rules
Town of Carrboro	• Town of Carrboro's Land Use Ordinance http://www.ci.carrboro.nc.us/pzi/PDFs/LUO/Art-xvi.pdf • UNC Policy to Implement Jordan Lake Rules
Unincorporated Orange County or Chatham County	• State Stormwater Program http://h2o.enr.state.nc.us/su/bmp_forms.htm • UNC Policy to Implement Jordan Lake Rules
Other Locations	• State Stormwater Program and other watershed based state requirements.

A. UNC Policy to Implement Jordan Lake Rules

The UNC Policy to Implement Jordan Lake Rules will be met by every UNC project that creates land disturbance. In addition to implementing the new development and re-development rules as stated in 15A NCAC 02B .0271, the University will meet the existing development requirements of the Jordan Lake Rules by requiring additional treatment at redevelopment sites.

B. Summary of Water Quality Requirements

All stormwater management performance criteria listed above require an 85% reduction in Total Suspended Solids (TSS). The nutrient requirements listed below reflect UNC Policy to Implement the Jordan Lake Rules.

Table I-2 – Water Quality Performance Criteria

If your project is…	***The water quality performance criteria are…***		
	85% TSS Removal	**Nutrient Loading Rate:** 2.2 lb/ac/yr TN and 0.82 lb/ac/yr TP	**Percentage Nutrient Load Reduction:** 35% TN and 5% TP
New Development (Greenfield, no existing impervious)	x	x	
Re-development with no increase in Impervious Cover	x		x
Re-Development with increase in Impervious Cover	x	x*	x*

**In these situations, the designer can choose to meet either the Percentage Load Reduction OR the Loading Rate Target.*

85% TSS Removal – Post-construction stormwater treatment shall remove 85% of TSS for the volume of stormwater runoff resulting from the first 1" of precipitation. This requirement is in place across jurisdictions. There may be exceptions for sites in unincorporated Orange or Chatham Counties that meet the State definition for Low Density Development and do not meet require Diffuse Flow Plans. Treatment shall be designed according to the design standards listed in the subsequent section.

Nutrient Loading Rate – The nutrient loading rate, was applied to State entities under 15A NCAC 02B .0271. For new development, the site must export not more than 2.2 lb/ac/yr of Total Nitrogen (TN) and 0.82 lb/ac/yr Total Phosphorus (TP). Designers must use the calculation method approved by the State DWQ. As of the publishing of these guidelines, the Tar Pam Piedmont Worksheet is the approved method and can be downloaded here:

http://h2o.enr.state.nc.us/nps/documents/N-PCalcsheetPiedProtected10-04.xls

Percentage Nutrient Load Reduction – The requirement also comes from 15A NCAC 02B .0271 and is further defined by the University Policy to Implement the Jordan Lake Rules. The post- construction nutrient exports will be compared to the baseline (December 31, 2001) nutrient exports for that site. A 35% reduction of TN and 5% reduction of TP must be demonstrated based on the calculation method approved by the State DWQ. As of the publishing of these guidelines, the Tar Pam Piedmont Worksheet is the approved method. The University has calculated the 2001 baseline and can assist designers in locating this information for their site.

C. Summary of Quantity Requirements – Peak Discharge and Volume

The following table summarizes the volume and peak discharge control requirements for the various applicable performance criteria. A project designed to provide 2-year volume control and 1, 2, 5, 10, 25, and 50 year peak discharge control would meet or exceed the requirements from all the applicable criteria.
At some sites the quantity control requirements will be evaluated at one point. For sites where runoff discharges to multiple outlets from the UNC property, analysis must be conducted for each outlet. For example, if a site partly discharges to Battle Branch and partly to the Town of Chapel Hill storm drainage system along Franklin Street, at least two design points are required.

Table I-3 Volume and Peak Discharge Control Performance Criteria

	Volume Control	**Peak Discharge Control**					
	2-yr	**1-yr**	**2-yr**	**5-yr**	**10-yr**	**25-yr**	**50-yr**
OI-4 Performance Standards	**x**		**x**		**x**	**x**	**X**
Carolina North Development Agreement	**x**	**x**	**x**		**x**	**x**	**x**
Town of Chapel Hill Land Use Management Ordinance	**x**	**x**	**x**			**x**	
Town of Carrboro Land Use Ordinance		**x**	**x**	**x**	**x**	**x**	
State Stormwater Program							

Volume Control – The Town of Chapel Hill requires that the post-construction runoff volume for the 2-year, 24-hour storm does not exceed the existing condition runoff volume. The calculations will be based on the SCS (NRCS) Methodology.

Peak Discharge Control – Post-construction peak discharge (rate) for the required 24-hour design storms shall not exceed the existing conditions peak discharge (rate). The calculations must be based on a method acceptable to the Town and UNC.

II. Stormwater Management Design Standards

All stormwater management practices constructed at UNC must follow the NCDENR Best Management Practices Manual, as amended by the DENR, the Town of Chapel Hill, and UNC. BMPs shown in the NCDENR manual are acceptable unless otherwise noted.

A. NCDENR Stormwater Best Management Practices Manual and Amendments

The manual, supplements, and BMP forms can be found here:
http://portal.ncdenr.org/web/wq/ws/su/bmp-manual

The University expects stormwater designers to be familiar with this manual and its supplements.

B. Town of Chapel Hill Design Manual and Town Policies

The manual can be found here: http://www.townofchapelhill.org/index.aspx?NID=254

The UNC Stormwater Engineer will review current Town policies with the designer during schematic design.

C. UNC Amendments to the NCDENR Stormwater BMP Manual

The following amendments to the NCDENR manual are to be used for designs on UNC property:

1. Maintenance Considerations for All BMPs

- As the owner of the BMPs, UNC will review for maintenance and operation considerations as well as regulatory compliance. The UNC Stormwater Engineer may require changes to the design to improve safety, provide maintenance access, or control maintenance costs.
- All BMPs require access by maintenance personnel to all areas of the BMP.
- Access paths to inlets, outlets, and access maholes must be accessible by tractor towing a trailer with maintenance equipment.
- Forebays must be accessible by a backhoe or mini-excavator.
- See Underground BMPs for additional requirements.

2. All BMPs Designed for Infiltration

Infiltration BMPs may include underground infiltration vaults, permeable pavement, or bioretention.

- An in situ infiltration testing report shall be submitted to the University Stormwater Engineer. This testing shall follow the testing requirements given on page 16-7 of the DENR Manual (Section 16.3.5 In-Situ Soil Requirements).
- The potential impact of infiltration BMPs on existing or proposed utilities and structures in the area shall be considered. Analysis by a geotechnical or structural engineer may be required.

3. Bioretention

- Choking stone shall be used in lieu of geotextile between the soil media and the drainage stone. This is the alternate given on page 12-12 of the DENR Manual.
- An upturned elbow shall be included where the underdrain enters the overflow structure. See NCSU Stormwater Group recommendations.
- Flows higher than the design storm shall bypass the bioretention area. If this is not possible, the bioretention must be designed to safely convey a 100-year, 24-hour storm.
- Soil testing of the bioretention media must be included in the construction specifications.
- Soil tests for the bioretention media must be submitted to the UNC Stormwater Engineer.

- Bioretention variations may be acceptable if designed appropriately for the site. The following are examples, but others may be suitable.
    - Tree pits
    - Planter boxes
    - Behind retaining walls
    - Step pools
- Bioretention areas shall require underdrains unless the infiltration requirements are met.
- Bioretention cells can be contained in impermeable liner where infiltration is undesirable.

4. All Underground BMPs and Underground Stormwater Vaults

Underground BMPs and vaults include underground infiltration vaults, underground cisterns and detention, and underground water quality devices.

- A dewatering device shall be provided. The control for the dewatering shall be accessible when the facility is full.
- A staff gauge shall be permanently affixed to the inside of the BMP such that it is visible from the surface.
- An access manhole shall be provided to every chamber of the underground BMP, at every inlet and outlet, and at opposite ends of structures 15 feet or longer.
- All areas of the BMP shall be within 50 feet of an access manhole to facilitate the use of a tripod and winch for confined space entry.
- Access manholes shall be accessible to UNC's pump trailer which is towed by a tractor.
- Access manholes shall be located outside of roadway travel lanes and driveways.
- Access manholes shall have at least one small diameter opening (approx. 2") so that the lids can be opened with a metal hook. This opening shall be in addition to the standard notches on the side of the manhole lid.
- Each access point shall have steps to the bottom of the deepest elevation.
    - The first step shall be located 2' below the top of the structure.
    - Steps shall be placed at uniform intervals of either 12" or 15" on center.
    - Steps shall follow NCDOT Standard Drawing 840.66 "Drainage Structure Steps".
- If an access manhole is over 5 feet deep, a minimum of 15 feet of vertical clearance over the manhole shall be provided. This clearance will allow a tripod and winch to be set up for confined space entry, and also allow the vacuum truck's arm to be positioned properly for BMP cleaning.
- If an access manhole is over 5 feet deep, the interior diameter shall be 4 feet or greater. If over 10 feet deep, the interior diameter shall be 5 feet or greater. An eccentric cone may be used to transition from the manhole frame to a riser section of 4 feet or greater.
- All manhole lids or hatches shall be pre-cast with the following labels:
    - "Storm"
    - "Entry Permit Required" or "Confined Space Entry"
    - "Dump no Waste! Drains to Jordan Lake"

5. Cisterns

- Only year-round demand shall be considered to meet the stormwater performance criteria.
- The cistern may be designed with additional capacity for seasonal irrigation use.
- Cisterns may be designed to provide peak discharge control.
- Pre-treatment must be provided to remove trash, debris and sediment prior to flow entering the cistern. This pre-treatment shall be sized to allow an average of at least six months between clean outs.

6. **Proprietary Water Quality BMPs**
   - If a designer proposes the use of a proprietary BMP to meet water quality requirements, documentation of an independently verified pollutant removal rate shall be provided to the UNC Stormwater Engineer during schematic design.
   - Proprietary Water Quality BMP shop drawings shall be reviewed by the design engineer and the UNC Stormwater Engineer during construction.
   - The following are examples of acceptable independent verification agencies:
     - NJCAT
     - Washington State
     - State of Massachusetts

7. **Permeable Pavement**
   - Permeable pavement is acceptable only when used in applications accessible by the University street sweeper. The installation must be in a drive lane or a series of at least 8 continuous parking spaces.
   - Pervious areas adjacent to permeable pavement shall not drain onto the pervious pavement.
   - Drainage area to the permeable pavement must be stabilized prior to installation.
   - For permeable asphalt or concrete, the design engineer or designer's representative must be on-site full time when the concrete or asphalt is poured.
   - Construction or landscaping materials containing fines may not be stockpiled on permeable pavement.

8. **Green Roofs**
   - Plans must show the actual footprint of the green roof, considering set backs from walls and equipment.
   - If the green roof is a proprietary product, information of the components, including drainage layers, soil mix, and depth must be submitted.
   - The design engineer should consult the UNC Grounds Department regarding green roof plants which have been successful on the UNC Campus.
   - Access for maintenance and OSHA safety requirements must be incorporated into the design.

9. **Ponds/Wetlands**
   - No additional requirements at this time.

III. Storm Drainage System Performance Criteria

The purpose of the UNC drainage performance criteria is to safely convey flows through University property without causing flooding of buildings, roadways, pedestrian routes, or other facilities.

A. Piped Flow

Due to the extensive network of storm drainage piping maintained by the University on central campus, the University performance criteria are more specific and stringent than those for isolated building sites as presented by the State Construction Office or the Towns of Chapel Hill or Carrboro.

Site designs shall not subject any buildings to flooding at any time. This includes buildings downstream of the development site. The 100-year, 24-hour storm will be used to assess flooding.

1. Design Storm

a. The State Construction Office requires any site without an overland emergency flow route to design for the 24-hour, 100-year storm. See page 5 at the following link:

http://www.nc-sco.com/documents/guidelines/SitePrep2.pdf

An emergency flow route is a path for water to flow over the surface if the pipe capacity is exceeded. An emergency flow route may not be impeded by a building, embankment, or hill.

When a pipe passes under a building, no overland emergency flow route is available. Any pipes passing under a building(s) must be sized for the 100-year design storm.

b. Many roads on UNC property are maintained by NCDOT or the Town of Chapel Hill. Pipes under these roads must meet the following design standards:

- NCDOT – see Table 4-3 at the following link:
  http://www.ncdot.org/doh/preconstruct/highway/hydro/gl0399web/VI_hydrology.html#tab43
- Town of Chapel Hill – see Section 2.6.1 at the following link
  http://www.ci.chapel-hill.nc.us/Modules/ShowDocument.aspx?documentid=2645

c. Select design storms for piped flow on UNC property using the tables below. Flow for the design storm must be conveyed within the pipe. There shall be no surcharging in the drainage system for the applicable design storm.

Any site meeting more than one condition shall use the largest of the required design storms.

Table III-1 NCDOT Roads

If the pipe is….	Design Storm
WITHOUT overland emergency flow route	100-year
Downstream of pipes under a NCDOT-maintained interstate, US or NC highway, or major secondary road	50-year
Downstream of pipes under a NCDOT-maintained secondary road	25-year

Table III-2 Town of Chapel Hill Roads

If the pipe is….	Design Storm
WITHOUT overland emergency flow route	100-year
Downstream of pipes under a Town-maintained arterial or collector	25-year
Under or downstream of pipes under a Town-maintained local road	10 year

Table III-3 Other Areas on UNC Property

If the pipe is….	Design Storm
WITHOUT overland emergency flow route	100-year
Drainage area greater than 25 acres	50-year
Drainage area less than 25 acres, but greater than 3 acres	25 year
Drainage area less than 3 acres	10 year

d. The 100-yr, 24hr design storm shall be evaluated to determine flooding conditions. The 100-yr storm shall not cause flooding of any buildings or basements and shall be safely conveyed downstream via an overland emergency flow route.

If a non-gravity flow (pumping) design is proposed, the design team must meet with the UNC Stormwater Engineer and project team during the schematic design phase to discuss. In preparation for this meeting, the design team shall document the gravity solutions considered and shall evaluate the impacts to infrastructure and building interiors if the proposed pumps fail. The design will provide redundancy in the electrical and mechanical systems. The pump-failure impact analysis and redundancy measures shall be submitted for review in each design phase.

2. Extents of Analysis

Analyze storm drainage system for the appropriate design storm(s) from the site to one of the following downstream points:

- An open channel.
- Storm drainage system in the public ROW.
- University storm drainage system designed for the 50-year storm.
- Other point determined by the UNC Stormwater Engineer**.**

3. Boundary Conditions

- Tailwater conditions/depth shall be determined from the downstream conditions.
- If the discharge location(s) from the project site are located within 200 ft of a pipe of 42” in diameter or larger, the tailwater condition should be verified by the University Stormwater Engineer.
- The maximum water surface elevation of the receiving stream (if higher than the water surface in the outfall) or the water surface elevation in the junction used for tie into the existing storm drainage system for the design condition (see Table 1) shall be considered as the downstream hydraulic control.
- Additional boundary conditions explanation will be added in subsequent version of this document.

4. **Pipe Size**
   - A minimum pipe diameter of 15" will be used for conveyance pipes.
   - A minimum pipe diameter of 6" will be used for roof drains and underdrains.

5. **Acceptable Analysis Methods**
   - Hydraulic grade line calculations and plots shall be submitted.
   - If the hydraulic grade line is not contained within the pipe, the energy grade line must also be plotted.
   - Additional information on analysis methods will be added in subsequent version.

B. Inlet Analysis

Inlets located within NCDOT or Town of Chapel Hill roadways must follow the design standards of those agencies.

- Town of Chapel Hill Design Manual – Section 2.6.2
  http://www.ci.chapel-hill.nc.us/Modules/ShowDocument.aspx?documentid=2645

- NCDOT Storm Drainage System Design Guidelines
  http://www.ncdot.org/doh/preconstruct/highway/hydro/gl0399web/IX_stormdrainage.html

Inlets located on University property shall be designed as follows:

1. **Inlet Openings**
   - Inlets shall be hydraulically designed to capture 100% of the flow from the 10 year storm.
   - Inlets located in landscape low point or a roadway/driveway sag shall compensate debris blockage by providing twice the computed opening.
   - Inlets on a slope or grade do not need this factor of safety if spread limits are met.

2. **Spread**
   - Spread limits for roads and driveways shall follow Town of Chapel Hill Design Manual Section 2.6.2.
   - Flow spread must leave at least 36" free of water in sidewalks, pathways, plazas, courtyards, or other walking surfaces.

C. Open Channel Flow

1. **Lining and Velocity**
   Channels should be designed for non-erosive conveyance. Calculate the velocity of the channel at the 10-year design storm and compare that velocity to literature values for channel lining types.

2. **Capacity**
   Select design storms for open channel flow on UNC property using the tables below. Any site meeting more than condition shall use the largest of the required design storms.

Table III-4 Open Channels Downstream of NCDOT Roads

If the channel is….	Design Storm
Downstream of a pipe under a NCDOT-maintained interstate, US or NC highway, or major secondary road	50-year
Downstream of a pipe under a NCDOT-maintained secondary road	25-year

Table III-5 Open Channels Downstream of Town of Chapel Hill Roads

If the channel is….	**Design Storm**
Downstream of a pipe under a Town maintained arterial or collector	25-year
Downstream of a pipe under a Town maintained local road	10 year

Table III-6 Open Channels on UNC Property

If the channel serves….	**Design Storm**
Drainage area greater than 25 acres	100-year
Drainage area less than 25 acres, but greater than 3 acres	25 year
Drainage area less than 3 acres	10 year

D. Overland Flow

- All runoff from the site must be non-erosive.
- Maintain existing topography and undisturbed soils where possible.
- Slopes shall not exceed 3:1.
- Provide positive surface drainage away from buildings. The suggested minimum slopes are 2.5% for unpaved areas, 1% for paved areas.

IV. Storm Drainage System Design Standards

A. Existing Storm Drainage System

Sites with existing storm drain pipes and structures within the limit of disturbance of a project shall do one of the following:

- Remove or replace all storm drains and structures, especially terra cotta storm drains.
- Demonstrate the good condition of the storm drain pipes and structures to remain.

The University has assessed all storm drain pipes 48" and larger and a limited number of smaller storm drain pipes. Contact the UNC Stormwater Engineer to determine if the project site has been assessed. If the site has not been assessed, the lines shall be videoed and evaluated by the design engineer. The video and design engineer's recommendation shall be submitted to the UNC Stormwater Engineer for review.

B. Storm Drain Pipe Location

- Storm drain pipes shall be accessible for future maintenance including excavation. An accessible corridor shall be centered on the pipe alignment and its minimum width shall be calculated as the greater of the following:
  - 20 feet
  - {[10 feet]+ [the pipe diameter or total pipe width for multiple pipes] + [2* invert depth]}, rounded up to the nearest 5 feet.
- New storm drain pipes shall not be located under buildings or within a 1 to 1 slope from a building foundation.
- Storm drain pipes at redevelopment sites shall be relocated outside building footprints. Consult with the UNC Stormwater Engineer during schematic design if this is infeasible.
- Storm drain pipes should not be located under athletic or recreation fields. Consult with the UNC Stormwater Engineer during schematic design if this is infeasible.

C. Storm Drainage Structures

Note: For stormwater vaults larger than typical manholes, the design standards on pages 11-12 "All Underground BMPs and Underground Stormwater Vaults" also apply.

1. Location

- Storm drain pipes shall have surface-accessible structures at every junction and every change in slope, direction, and pipe size.
- The maximum distance between structures shall be 250 feet.
- When feasible, inlets should be located in landscaped areas rather than pedestrian paths. This allows for ponding outside the walkways and provides better ADA access.
- Inlets in landscaped areas shall be placed so that flow is captured before it reaches roads or major walkways, and so that no concentrated flow crosses over a pathway.
- Inlets in roads, driveways, or parking lots on a continuous grade shall be spaced to limit the spread of stormwater onto the pavement. Inlets shall be placed at intersections and at low points in the gutter grade. Inlets should be placed upstream of pedestrian crossings

2. Loading

All structures must be traffic rated, with a minimum of H20 loading. Exceptions may be considered for structures within bioretention areas.

3. **Details**
   - Designers may use Standard Details from NCDOT or the Town of Chapel Hill, with modifications to reflect the UNC Standards.
     - *NCDOT Drainage Structure Standard Drawings* http://www.ncdot.org/doh/preconstruct/ps/std_draw/06english/08/
     - *Town of Chapel Hill Storm Drainage Standard Details* http://www.ci.chapel-hill.nc.us/index.aspx?page=466

4. **Interior Dimensions**
   - Interior dimensions shall provide access for maintenance, with greater dimensions as depth increases.
   - Inside dimension for storm drainage structures shall be based on standard details from NCDOT or the Town of Chapel Hill. However, no structure shall be less than 3' by 2'.

5. **Grates and Lids**
   - All storm drain structures shall have a removable grate or manhole cover.
   - Access manholes and grates, shall have at least one small diameter opening (approx. 2") so that the lids can be opened with a metal hook. This opening shall be in addition to the standard notches on the side of the manhole lid.
   - All grates and lids located in sidewalks, pathways, plazas, courtyards, or other walking surfaces shall meet the current version of the Americans with Disability Act Accessible Guidelines (ADAAG) and the current edition of the North Carolina Building Code and their referenced standards.
   - Designers shall replace existing non-compliant grates within the construction limits with grates meeting the above guidelines and standards. The designer must evaluate the drainage area and grate inlet capacity to ensure storm drainage performance criteria are met by the proposed conversion. In the calculations, structures outside the construction limits should be considered to have compliant grates regardless of their current status. If needed, add additional structures to compensate for capacity reduction. Calculations for the proposed changes shall be submitted to the UNC Stormwater Engineer for review.
   - Grates in roads and driveways shall be placed with the long dimension of the opening perpendicular to the route of travel. This safety consideration for bicyclists prevents wheels from being caught in grates.

6. **Marking**
   - All manholes lids, grates, hoods, and covers installed or replaced shall be permanently labeled with the message "Dump no Waste! Drains to Jordan Lake".
   - All stormwater manhole lids shall be permanently labeled with the following additional labels:
     - "Storm", "Stormwater", or "Storm Drain"
     - "Entry Permit Required" or "Confined Space Entry"
   - If stormwater manhole lids within the construction limits are mislabeled as sanitary sewers or other utilities, the lids shall be replaced as part of the project.
   - Structures located in a Town or NCDOT right-of-way shall follow the Town of Chapel Hill Standard Details for markings.
   - Structures located on University Property shall NOT be marked "Town of Chapel Hill" but should otherwise follow the Town Standard Details for markings.

7. **Steps**
   - All structures deeper than 3.5' shall have steps to the deepest elevation.
   - The first step shall be located 2' below the top of the structure.
   - Steps shall be placed at uniform intervals of either 12" or 15" on center.
   - Steps shall follow NCDOT Standard Drawing 840.66 "Drainage Structure Steps".

8. Vertical Clearance
If an access manhole is over 5 feet deep, a minimum of 15 feet of vertical clearance over the manhole shall be provided. This clearance will allow a tripod and winch to be set up for confined space entry, and also allow the vacuum truck's arm to be positioned properly for inlet cleaning.

D. Acceptable Storm Drain Materials

All pipes must be traffic rated. Regardless of location, pipes may be subjected to heavy vehicle loading; therefore, pipe material shall meet manufacturer's minimum specifications for this load. Acceptable pipe materials are:

1. Conveyance Pipes 12" and greater:
- Reinforced Concrete Pipe (RCP) – Class III or higher

2. Conveyance Pipes 10" and smaller:
- Ductile Iron Pipe (DIP)
- Polyvinyl Chloride Pipe (PVC) Schedule 40 or SDR 26 or better

3. Underdrains
- Perforated Polyvinyl Chloride (PVC) Schedule 40 or SDR 26 or better

Flexible HDPE drain line is not allowed for storm drainage piping, or subsurface (foundation drainage) piping.

E. Illicit Discharge Prevention

1. **Illicit Discharge Detection and Elimination Policy**
Designers shall review the University's policy to avoid introducing illicit discharges to the storm drainage system.
http://ehs.unc.edu/environmental/stormwater/docs/discharge_policy.pdf

2. Dumpsters
Dumpster leakage or wash off is not allowed to drain to the storm system. Dumpsters shall drain to the sanitary sewer. The site shall be graded so that only the area beneath the dumpster discharges to the sanitary sewer. Clearly mark the drain as a sanitary sewer drain. Pre-treatment such as oil water separators may be required for dumpster pads with trash compactors or other equipment. Dumpster sites shall be reviewed with the University and OWASA.

V. Design and Construction Procedures

A. Programming

The designer meets with the UNC Stormwater Engineer to review the stormwater performance criteria, standards, and procedures.

B. Schematic Design

The following items shall be submitted to the UNC Stormwater Engineer for the Schematic Design Review. Both electronic (PDF) and hard copies shall be submitted.

1. Plans

The following plan sheets shall be submitted with the indicated items clearly shown:

- Existing Condition Plan
  - 50' Jordan Lake buffer
  - Town of Chapel Hill RCD buffer
  - Floodplains
  - Streams
  - Wetlands
  - Significant Natural Heritage Areas (NC Natural Heritage Program)
  - Existing Contours
  - Existing storm drain pipes and structures with location, size, and invert elevations
  - Existing storm drain pipe schedule
  - Existing BMPs, with their location, size, and type
  - Construction limits
- Demolition plan
  - Any storm drain or BMP being removed or abandoned
- Proposed Site Plan
  - 50' Jordan Lake buffer
  - Town of Chapel Hill RCD buffer
  - Flood plains
  - Streams
  - Wetlands
  - Significant Natural Heritage Areas (NC Natural Heritage Program)
  - Existing Contours
  - Proposed Contours
  - Proposed storm drain pipes, structures, and channels with location, size, and invert elevations
  - Existing storm drainage infrastructure to remain
  - Proposed BMPs, with their location, size, and type
  - Proposed other utilities and existing utilities to remain
  - Construction limits

2. Preliminary Stormwater Management Report

The report shall include the following:

- Short narrative (see Appendix A)
  - Address the manner in which applicable stormwater management requirements will be met
  - Types of BMPs proposed
  - Any changes to the storm drainage system
- Drainage Area map
  - Drainage area(s) shall cover the entirety of the project limits
  - A drainage area shall be defined for each pipe, channel, or other point where concentrated flow exits the project limits

  - Drainage areas entering the site from upstream areas shall be delineated and given separate designations.
  - All design points shall be clearly shown and labeled
  - All drainage areas shall be clearly labeled
- Table with existing and proposed land cover
- Tar Pamlico worksheets for nutrient removal
- Preliminary calculations for BMP sizes

3. In-Situ Infiltration Test Results for any Proposed Infiltration BMPs

C. Design Development Submittal

The following items shall be submitted to the UNC Stormwater Engineer for the Design Development Review. Both electronic (PDF) and hard copies shall be submitted.

1. Plans

The following plan sheets shall be submitted with the indicated items clearly shown:

- Existing Conditions Plan
  - Same components as schematic design
- Demolition Plan
  - Same components as schematic design
- Proposed Storm Plan
  - Same components as schematic design, with the following additions:
  - Proposed pipe schedule
  - Any proposed phasing of the project shall be clearly shown
- Storm Drain Profile Sheets
- Stormwater Detail Sheets
  - Storm Drainage System Details
  - BMP Details in plan, cross section, and profile views
  - BMP invert, weir, and orifice elevations
- Any landscape or architectural drawings related to BMPs (e.g. green roofs or planter boxes) shall be submitted along with the above items for review by the UNC Stormwater Engineer
- Existing and proposed land cover shall be included in the stormwater report, or shown VERY clearly on the plans.

2. Stormwater Management Report

The report shall include the following:

- Narrative
  - Same components as schematic design
  - Table summarizing the drainage areas, including label and acreage (see Appendix B for example)
  - Summary of each BMP, and its drainage area (see Appendix B for example)
  - Water Quality Table (see Appendix B for example)
  - Peak Discharge Table (see Appendix B for example)
  - Volume Table (see Appendix B for example)
  - Address the ways in which the Jordan Lake rules are satisfied
- Drainage Area map (same components as schematic, updated with any new relevant information)
- Table with existing and proposed land cover (updated with any new relevant information)
- Tar Pamlico worksheets for nutrient removal
- Hydrology and Hydraulics calculations
  - Curve number calculations

- Time of concentration calculations
- Water quality volume calculations
- If project is in the Town of Chapel Hill, include 2 year volume reduction calculations
- Peak discharge calculations, with input and output files
- If multiple drainage areas are in a project area, use proper hydrology and hydraulic routing methods
- Existing conditions modeling shall include existing de facto detention (e.g. storage behind a culvert in a roadway embankment and low points in the landscape)
- For detention structures and ponds/wetlands, include the following:
  - Stage/storage discharge curves
  - Summary of outlets and elevations
- For infiltration BMPs, include the infiltration calculations
- For cisterns, include the following:
  - Demand projection calculations
  - Include input/output from the NCSU rainwater harvester model

3. Specifications

Specifications for all BMP components shall be submitted and include:

- Soil testing for bioretention and soil specifications
- Permeable pavement specifications
- Green roof media specifications

4. Calculations for Storm Drainage System

- Calculations will be submitted for each proposed storm drainage pipe, inlet, and channel.
- Submitted calculations will follow the performance critieria in this document.

5. BMP Operation and Maintenance Plan

- The stormwater designer should use the procedures from the NCDENR BMP Operation and Maintenance forms as a starting point and adapt them to be site specific. The University's NPDES permit requires maintenance of all BMPs, so the agreement portion of the form should be deleted. The forms can be found here:
  http://portal.ncdenr.org/web/wq/ws/su/bmp-manual
- Non-standard and complex BMPs will require more detailed information.
- Proprietary BMPs shall submit product-specific operation and maintenance plans.
- BMPs with mechanical and electrical components, such as cisterns, shall submit preventative maintenance requirements for these components.

D. Construction Documents Submittal

All Design Development submittal documents and plans shall be updated and submitted to the UNC Stormwater Engineer for the Construction Documents Review. Both electronic (PDF) and hard copies shall be submitted.

E. During Construction

1. Submittals

- Shop drawings
- Manufacturer's Operation and Maintenance information for any proprietary BMPs

- Material test results for any permeable pavement
- Source of stone used for any underground storage or detention

2. Design Engineer Responsibilities

- The design engineer shall oversee BMP installation at critical points and sign off on the as-builts.

3. UNC Inspection

- The contractor and UNC Construction Manager shall notify the UNC Stormwater Engineer when a BMP is ready to begin construction so UNC can observe the installation.

F. Prior to Project Closeout

1. Video of Pipe and Structure Condition

- The project team shall submit video of the pipes and structures that is filmed near the end of construction. The appropriate timing of the video work will be project dependent, so the project team should coordinate the timing with UNC stormwater staff.
- The video shall include:
  - All storm drainage structures
  - All chambers and joints in an underground stormwater management vault
  - All existing storm drainage pipes 8" and larger that remained in place during construction.
  - All new storm drainage pipes 8" and larger
- The video segments shall be labeled using the structure labeling used in the construction documents.
- The purpose of this video is to demonstrate that pipes and structures:
  - Were installed correctly
  - Remain in good condition
  - Are free of debris and soil
- If the video depicts improper installation, structural deficiencies, or the presence of debris or other blockages, the project team shall either:
  - Correct the problem then submit a follow-up video.
  - Demonstrate that the condition was pre-existing with video submitted to UNC during the design phase.

2. Project Walk-Through

- The project team shall include the UNC Stormwater Engineer in the walk through(s) for all aspects of the project relating to stormwater, including:
  - Grading
  - Stormwater BMPs
  - Storm Drainage System (Pipes, Structures, Channels)

G. Project Closeout

1. As-built Plans

- As-builts shall be submitted to the UNC Stormwater Engineer.
- As-builts must include updated pipe schedules to reflect any changes made during construction.
- PDF and AutoCAD version of the as-builts shall be submitted.

2. Revised Calculations

- If any changes made during construction impact BMP performance, revised calculations shall be submitted to the UNC Stormwater Engineer.

3. Revised Operations and Maintenance Plans

- If any changes were made to BMPs during construction, revised operation and maintenance plans shall be submitted to the UNC Stormwater Engineer.
- 1 copy of the Operation and Maintenance Manuals for any mechanical or electrical equipment in the stormwater system shall be submitted to the UNC Stormwater Engineer. This is in addition to other copies required by the University.

VI. Buffers, Wetlands, Streams, and Floodplains

- Content to be added at future date.

Appendix A – Example Narrative

A short narrative needs to accompany the stormwater calculations. This can be less than 1 page. This is needed to help explain the calculations and how the stormwater requirements are being met. It will help clear up questions before they are asked. It needs to address the following:

Existing Conditions

- The project area used for the hydrologic and hydraulic calculations is _____ acres, which is shown on _____ (e.g. Map 1, or Sheet XXX as the Limit of Construction)
- The existing land cover is _____ (e.g. landscaped areas over , brick walkways, …). The existing land cover is shown on _____ (e.g. Sheet XXX) and summarized in Table X below.
- Under existing conditions runoff leaves the project area by _____ (e.g. "a 24" storm drain located south of the road" or "sheet flow to the ____ Road right-of-way" or "roof drains that tie into the 12" located ____")

Proposed Conditions

- The proposed project will remove _____ acres of _____ (land cover) and replace this area with _____. (e.g. The proposed ____ acre building addition will remove ___ acres of landscaped area, ___ acres of concrete patio, and….)
- The proposed land cover is shown on _____
- The net change in impervious cover is _____.
- Under proposed conditions, runoff will leave the project area by_____ (e.g. new xx" storm drains will convey flow from x new structure to ____)

Stormwater Requirements

- The water quality volume for the site was calculated to be _____ (cubic feet or acre-feet). OR Water quality volume was not calculated for this site because _____.
- A _____ (BMP) was designed to provide _____(units) water quality volume.
- Address peak discharge and volume – change (increase, decrease) and how requirements will be met

Appendix B – Sample Tables

Project Land Cover Summary

	Existing Land Cover (sf)	Proposed Land Cover (sf)	Change from Existing to Proposed (sf)
Impervious Area			
Landscaped Area			
Turf Area			
Wooded Area			

Summary of Project Drainage Areas

Project Drainage Area ID	Subwatershed or Sub-basin	Drainage Area (sf)
A		
B		
C		
D		

Curve Number Summary

Include TR-55 Worksheet 2 or equivalent for each drainage area

BMP Summary

BMP ID	Type	Project Drainage Area ID	BMP Drainage Area (sf) if different than Project Drainage Area
1	e.g. Bioretention		
2			
3			

Water Quality Summary

Volume Required for TSS Removal (cf)	Volume Provided (cf)			
	BMP 1	BMP 2	BMP 3	Total

Volume Summary

	2-yr Runoff Volume (cf)			Volume Reduction Provided (cf)		
Drainage Area ID	Pre-Development	Post-Development without BMP	Post-Development with BMP	BMP 1	BMP 2	BMP 3
A						
B						
C						
D						

Peak Discharge Rate Summary

Drainage Area ID _____ (This table to be repeated for each drainage area)

	Peak Discharge Rate (cfs)				
	1-yr	2-yr	10-yr	25-yr	50-yr
Pre-Development					
Post-Development without BMP					
Post-Development with BMP					