

## **STORMWATER DESIGN MANUAL**

The NC Department of Environment and Natural Resources- Division of Water Quality has created a draft manual of Stormwater Best Management Practices. The draft manual describes practices that treat or limit pollutants in stormwater runoff, encouraging nonstructural controls in reducing pollution. Where these controls are not viable or sufficient, other engineered controls are necessary to reduce pollution. Buncombe County supports this draft manual.

In addition, with our mountainous topography, controlling water quantity and the velocity of runoff is a necessary factor in design. Methods that control the velocity of stormwater and the requirement for considering the built-out potential of the watershed are incorporated in the County's ordinance.

The manual is meant to be a reference for basic components of a stormwater system. Other practices and engineered methods can be considered.

### **Low-Impact Development:**

Low-impact development (LID) site planning and techniques, or a combination of LID and conventional stormwater management practices, is encouraged. The goal is to implement site design techniques that store, infiltrate, evaporate, retain and detain runoff to more closely replicate pre-development runoff characteristics.

### **Pipe:**

Stormwater pipe for either culverts or closed systems shall be constructed of either reinforced concrete, corrugated steel, or aluminized pipe in conformance with North Carolina Department of Transportation (NCDOT) Standard Specifications or high density polyethylene corrugated pipe with smooth interior which meets the product specification of ASHTO M294.

- [1] Corrugated steel pipe shall be fully bituminous coated. In lieu of fully bituminous coated galvanized pipe, aluminized pipe without a bituminous coating may be used. Pipe which carries active stream flow shall be partially paved (paved invert) fully bituminous coated galvanized pipe. In lieu of fully bituminous coated partially paved galvanized pipe, aluminized pipe which has been half bituminous coated and partially paved may be used. Connecting bands shall conform to NCDOT Standard Specifications.

- [2] Minimum pipe diameter shall be eighteen (18) inches for open ended culverts and fifteen (15) inches for closed systems and driveway culverts. Minimum pipe diameter for portions of closed systems placed outside the public right-of-way and privately maintained shall be twelve (12) inches.
- [3] Depth of cover shall be appropriate for the pipe material, pipe wall thickness and anticipated loading. Minimum depth of cover shall be twelve (12) inches.
- [4] Down sizing of culverts within pipe systems is prohibited.
- [5] Storm drainage piping shall be placed in a straight alignment at uniform grade. No changes in alignment shall be allowed except at catch basins, manholes, or other junctions that provide appropriate clean out access.
- [6] Storm drainage structures, including inlet grates and frames, shall conform to NCDOT Standard Specifications.
- [7] No change in pipe material shall be allowed except at storm drainage structures.
- [8] Existing stormwater conveyance infrastructure on or through any site being considered for development or redevelopment may remain in place and active, subject to the following criteria:
- a. The conveyance system is certified by a licensed professional engineer to be properly sized with capacity to handle the applicable design storm. The engineer shall also provide a qualitative assessment of the system to include observations of visible signs of erosion, scour, corrosion, degradation, or other structural inadequacies, along with recommendations for any suggested improvements.
  - b. That the property owner will, at their expense, repair or replace the system or components thereof in the event that the system should fail to function at any time in the future. Any such repair or replacement shall be in accordance with all provisions of the ordinance.
- [9] The centerline of any culverts placed along a roadway shall be a minimum of 10 feet from the edge of pavement or edge of unpaved travel way. Due to the extreme topography or other unique features related to a specific driveway, it may not be practical to install the culvert at this location. Upon demonstration of adequate cause the permit issuing authority may allow deviations from this requirement. The applicant shall demonstrate that the proposed deviation will result in a culvert that adequately provides the drainage function and minimizes the chance that the ends of the culverts will be damaged.

### **Hydraulic Design:**

- [1] Design capacity headwater elevations for open ended culverts shall be below the roadway shoulder or finished site grade elevation.
- [2] Design capacity hydraulic grade line for closed pipe systems shall be at or below the inlet grate elevation.
- [3] The hydraulic design of culverts and pipe systems shall take into account the effect of tail water and allow for all energy losses within the system.
- [4] Drainage design calculations shall be submitted demonstrating compliance with these regulations. Minimum information required is a tabulation of the system which presents the type of each inlet, time of concentration, volume to the inlet, size of pipe, length of pipe, pipe inverts at both the high and low end, and hydraulic grade line for each pipe section.

### **End Treatments:**

- [1] Headwalls, flared end sections, or other adequate slope protection shall be provided at culvert ends.
- [2] Storm drain outlets shall be protected against erosion by providing energy dissipaters and/or other adequate channel lining.

### **Open Channels and Ditches:**

- [1] Design capacities for open channels and ditches shall be determined by the Manning Equation. The value of the roughness coefficient shall be appropriate for the material encountered and the condition of the channel.
  - [2] All ditch bottoms and side slopes shall be stabilized with pavement, stone, or vegetative linings adequate to withstand design velocities. Stone rubble linings shall be placed on filters of washed gravel and/or geotextile fabric.
- a) NCDOT Standard concrete curb or combination curb and gutter can be used for the direction and control of stormwater in parking lots. Alternate effective control measures can be used.
  - b) Use of drainage swales rather than curb and gutter with storm sewers in subdivisions is encouraged.
  - c) Building construction is prohibited from being horizontally closer than:
    - [1] Ten (10) feet, from the centerline of drainage culverts less than forty eight (48) inches in diameter, or

- [2] Ten (10) feet plus one half the culvert diameter, from the centerline of drainage culverts greater than forty eight (48) inches in diameter.

This restriction shall not apply to building roof, foundation drains, or incidental yard drains which originate closer than ten (10) feet to the building and convey stormwater immediately away from the building.

- d) Culverts or pipe systems which convey stormwater to or from existing enclosed drainage facilities shall be connected to the existing facility with an enclosed junction. Connections to existing facilities in public rights-of-way shall require the execution of an encroachment agreement with the NCDOT for state maintained roads.
- e) Where impoundment or detention facilities are included in the design of stormwater management installations, every effort shall be made to minimize the degree of maintenance required to ensure the continuing effectiveness of the facility.

**Additional Guidance and References:**

Additional guidance may be found in, but not limited to, the following:

- NCDENR Stormwater Best Management Practices Manual
- 15A NCAC 02H .1008 Design of Stormwater Management Measures
- USDA Technical Release 55- Urban Hydrology for Small Watersheds
- Center for Watershed Protection- stormwater management manuals and state handbooks