

## QUALITY CONTROL HYDRO CHECKLIST FOR ROADWAY

QC Item	Checkbox	Reference
<b>Computer Models</b>		
Acceptable numerical models used for Hydrology and Hydraulics	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	RHDS p. 74
List computer models used: _____		
<b>Hydrologic Analysis</b>		
Accurate drainage area identified using topo maps and/or LiDAR	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	RHDS 2.1
Calculations for Tc. NRCS Velocity Method is recommended.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	NRCS Hydrology National Engineering Handbook Chapter 15; SC Unit Hydrograph Method Application Manual
Design year event for <u>Storm sewer and ditch design</u> - 10 % AEP (10-year event) for 0<DA<=40 acres; 4 % AEP (25-year event) for 40<DA<=500 acres; 2 % AEP (50-year event) for DA>500 acres	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	RHDS 2.2.3
Design year event for <u>Crosslines</u> - 4 % AEP (25-year event) for Secondary roads; 2 % AEP (50-year event) for Primary Routes and Interstates; Analyze 1 % AEP (100-year event) or overtopping flood for all routes	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	RHDS 2.2.2
Appropriate Methodology used for design	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	RHDS 2.2.15
<input type="checkbox"/> Rational		
Drainage area up to 100 acres	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	RHDS 2.2.15.1
Reasonable runoff coefficient being used for terrain	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	RHDS 2.2.15.1; Table 4
C <sub>f</sub> used for applicable design event	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	RHDS 2.2.15.1
Min Tc = 5 min	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	RHDS 2.2.15
Current SCDOT Rainfall Intensity Values used	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	SCDOT website; HDB 2019-2
Runoff factors being used	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	RHDS 2.2.15.1; Table 4
<input type="checkbox"/> NRCS WinTR-55 Method		
Drainage area 100-640 acres	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	RHDS 2.2.15.2
Accurate Peak Rate Factor (PRF)	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	RHDS 2.2.15.2; Table 6
Hydrologic Soil Groups determined	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	NRCS TR-55, Tables 2.2.a,b,c
Curve Number determined for corresponding land use and HSG	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	NRCS TR-55, Tables 2.2.a,b,c
<input type="checkbox"/> USGS Rural Regression equations		
Drainage area greater than 1 square mile in rural areas	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	RHDS 2.2.15.3; Table 7; USGS SIR 2009-5156
<input type="checkbox"/> USGS Urban Regression equations		
Drainage area greater than 1 square mile in urban areas	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	RHDS 2.2.15.4; USGS SIR 2004-5030
<input type="checkbox"/> Log Pearson Type III		
Gaged site with USGS gage	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	RHDS 2.2.15.5
<input type="checkbox"/> Hydrograph Methods		
Regression equations minimum drainage area exceeded	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	RHDS 2.2.15.6; USGS WRIR 89-4087; USGS WRIR 92-4040
<b>Closed Stormwater Drainage</b>		
Acceptable numerical model used from list on p. 74 of RHDS	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	RHDS p. 74
Pipe data table complete	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
Proper application of approved inlet type	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	719-000 Standard Drawings
Correct inlet spacing based on inlet spacing design aids. Type 16,17, 18 and 25 available.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	SCDOT website
Spread criteria met	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	RHDS 2.2.4 Table 2; **Design Variance**

Sags contain flanking inlets spaced max 100' from sag	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	RHDS 2.2.4
Manholes kept out travelway	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	
Pipe slope - min 0.3 %	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	RHDS 2.2.5
Pipe velocities - min 3 ft/sec	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	RHDS 2.2.5; Concrete Pipe Design Manual
Min cover pipes generally 1 ft. from pipe crown to bottom of subgrade. See pipe tables in Standard Drawings	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Std Dwg Section 714-000
Precast drainage structure used where depth is greater than 12.0 ft or where the flow line elevation of the inlet pipe is higher than the soffit of the outlet pipe. Extra depth items shown on plans.	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	RHDS 2.2.8; Std Dwg Section 719-300 and 719-400
Storm sewer pipes not in pressure flow (HGL <= 94%)	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	RHDS 2.2.9 <b>**Design Variance**</b>
Min 18" pipe except for yard drains and driveway pipes	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	RHDS 2.2.6
Correct Manning's roughness coefficient used for pipes	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	RHDS 2.2; Table 3
Min depth of drainage structure boxes met	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Specifications and Support Manual for Geopak Drainage
Profiles with HGL including junction losses shown for all pipes in system	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	RHDS 2.3 Step 5
Storm-sewer pipes shown in cross-sections	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Instructional Bulletin 2009-5
Standard drainage structure or designed interface used at connections between existing and new pipe	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Instructional Bulletin 2009-4

#### **Ditches**

Ditches have positive grade and do not trap water	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	RHDS 2.2.5
Design high water level 1 ft below the road subgrade in ditches	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	RHDS 2.3 Step 5B
Adequate hydraulic capacity	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	RHDS 2.3 Step 5B
Ditch stability analysis	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	RHDS 2.3 Step 5B
Bottom elevation labeled in plan cross-sections	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	
Sideline ditches kept out of wetland areas	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Clean Water Act - Section 404

#### **Outfall Ditches**

Labeled in plan sheets	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	
Profile and cross-sections shown in plans	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	
Adequate hydraulic capacity for 10% AEP (10- year event)	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	RHDS 2.2.12
Stability analysis for 10% AEP (10- year event)	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	RHDS 2.2.12.2
Outfalls that are natural watercourses left undisturbed where possible	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	RHDS - Section 2.2.12.2; Engineering Directive 27 - Drainage Outfalls
Pre vs Post flow analysis at each outfall for 10% AEP (10- year event)	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	RHDS 2.2.12.2
Determination that no violations to Drainage Regulations exist	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	RHDS 2.2.12.1
Determination that there is no anticipated damage caused to the property by comparing tailwater elevations for pre- and post-discharges. If potential for property damage exists, the channel is to be improved and/or detention is to be utilized.	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	RHDS 2.2.12.2

#### **Roadway Culverts (<20 ft)**

Headwater requirements for culverts met (HW/D <=1.2)	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	RHDS 2.3 Step 6 D
Design high water level 1 ft below the road subgrade in culverts	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	RHDS 2.2.1

HW<sub>post</sub> ≤ HW<sub>pre</sub> for design and 1% AEP (100-year event). No adverse impacts to property statement or CLOMR necessary for FEMA regulated crossings for non-compliance.  Yes  No  N/A RHDS 2.3 Step 6 D

Fill height requirements met  Yes  No  N/A **RCP** - Std Dwg 714-205-02 - Table 714-205B; **SRAP** - Std Dwg 714-605-02 - Table 714-605B; **HDPE** - Std Dwg 714-705-02 - Table 714-705B; Instructional Bulletin 2010-01

Determination whether culvert is in floodway or a flood hazard area  Yes  No  N/A RHDS 2.3 Step 6 A 5

Box culvert invert elevations set 1.0 ft below stream bed for natural streams  Yes  No  N/A RHDS 2.3 Step 6 D

Culvert slope - min 0.3 %  Yes  No  N/A RHDS 2.2.5

Culvert velocities - min 3 ft/sec  Yes  No  N/A RHDS 2.2.5; Concrete Pipe Design Manual

Hydro data shown for cross-lines greater than or equal to 48"  Yes  No  N/A RHDS 2.3 Step 6 G

Proper end treatment used  Yes  No  N/A Standard Drawing 719-600

Culverts labeled with length, size, type, and inverts  Yes  No  N/A

Cross-lines shown and labeled in roadway cross-sections  Yes  No  N/A Instructional Bulletin 2009-05

### **Stormwater Management**

Stormwater Management Design Study prepared  Yes  No  N/A RHDS 2.2.13

Stormwater Management Report references current RHDS and is sealed by a Professional Engineer  Yes  No  N/A RHDS 2.1, 2.5

Detention present where an increase in flow is determined to have negative impacts to property, but used as last resort  Yes  No  N/A RHDS 2.2.12.2

Analysis of outfall for 10 % AEP (10-year event) and 1 % AEP (100-year event)  Yes  No  N/A RHDS 2.2.12.2

Q<sub>post</sub> hydrograph peak ≤ Q<sub>pre</sub> peak. Demonstrate no negative impacts to downstream property for non-compliance.  Yes  No  N/A RHDS 2.2.12.2

### **Sediment & Erosion Control**

Appropriate outlet protection for all discharge outlets  Yes  No  N/A RHDS 2.3 Step 5 B; HEC 14; SCDOT Water Quality Manual; Std Dwgs 804-305-03 & 804-310-00

Erosion prevention and sediment control BMP's based on SCDOT Stormwater Quality Design Manual (SWQDM) used  Yes  No  N/A SWQDM

Temporary and permanent seeding quantities provided  Yes  No  N/A SWQDM; Supplemental Spec SC-M-810-4

Hydraulic Erosion Control Product (HECP) and type specified  Yes  No  N/A SWQDM; Supplemental Spec SC-M-815-11

Rolled Erosion Control Product (RECP) and type specified for ditches; Analysis of shear stress  Yes  No  N/A SWQDM; Supplemental Spec SC-M-815-9

ECB used for shear stress ≤ 1.75 lb/ft<sup>2</sup>;  Yes  No  N/A SWQDM; Supplemental Spec SC-M-815-9

TRM Type 1 used for shear stress up to 4.0 lb/ft<sup>2</sup> or slopes 2H:1V or less;  Yes  No  N/A SWQDM; Supplemental Spec SC-M-815-9

TRM Type 2 used for shear stress up to 8.0 lb/ft<sup>2</sup> or slopes 1.5H:1V or less;  Yes  No  N/A SWQDM; Supplemental Spec SC-M-815-9

<input type="checkbox"/> TRM Type 3 used for shear stress up to 12.0 lb/ft <sup>2</sup> or slopes 1.0H:1V	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	SWQDM; Supplemental Spec SC-M-815-9
Outfall channels needing stabilization - rip-rap and nonwoven geotextile filter fabric underneath riprap lined up to the 10 % AEP (10-year event)	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	SWQDM 4.2.2
Rip-rap placement specified at box culvert ends	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Std Dwg 804-205-00
Outlet protection at pipe outlets - Specify class and type of rip-rap and nonwoven geotextile filter fabric underneath rip-rap quantities	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Std Dwg 804-310-00; Instructional Bulletin 2009-2
Temporary slope drain on on vulnerable fill slopes	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Std Dwg 803-105-00
Temporary diversion dike used when a substantial amount of offsite is entering sideline ditch	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Std Dwg 815-605-10
Slope interruption device used on slopes greater than 50 ft in length	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Std Dwg 815-001-02; Supplemental Spec SC-M-815-8
Temporary sediment basin used with drainage areas greater than 10 disturbed acres	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Std Dwg 815-305-01 thru (06)
Floating skimmers used in sediment basins	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Std Dwg 815-305-02; Supplemental Spec SC-M-815-14
Porous baffle used in sediment basins	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Std Dwg 815-305-07; Supplemental Spec SC-M-815-16
Temporary sediment dam used for drainage areas less than 10 disturbed acres	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Std Dwg 815-405-01 & (02)
Sediment dam for pipe inlet used for drainage areas less than 2 acres	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Std Dwg 805-406-00
Perimeter control in place at fill slopes	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Std Dwg 815-605-00; Supplemental Spec SC-M-815-2 and SC-M-815-17
Double row silt fence place in wetlands	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Std Dwg 815-605-00; Supplemental Spec SC-M-815-2 and SC-M-815-17
Rock ditch checks placed in ditches when sediment dams can not be placed	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Std Dwg 815-105-00
Sediment tubes for ditch checks and/or stack enhanced ditch checks placed in ditches based on spacing charts	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Std Dwg 815-205-00; Supplemental Spec SC-M-815-12 & SC-M-815-19
Stabilized construction entrance used at all points where traffic will be entering and exiting construction site	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Std Dwg 815-505-00; Supplemental Spec SC-M-815-10
Inlet structure filters - Type A used for inlets with peak flows less than 1 ft <sup>3</sup> /sec; Placed on all inlet types; Figure 20 LF each for quantities	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Std Dwg 815-001-01; Supplemental Spec SC-M-815-8
Inlet structure filter - Type B used for inlets with peak flows less than 3 ft <sup>3</sup> /sec; Placed on all inlet types	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Std Dwg 815-002-00; Supplemental Spec SC-M-815-8
Inlet structure filter - Type D used for inlets with peak flows greater than 3 ft <sup>3</sup> /sec and for drainage areas up to 2 acres; Placed on Type 9 and DI's; D1 filters for median applications; D2 filters for sump applications	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Std Dwg 815-002-00; Supplemental Spec SC-M-815-8
Inlet structure filter - Type E used to protect CB Type 1, 16, 17, & 18 after surface coarse is placed; Can substitute Type F weighted ISF	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Std Dwg 815-005-00; Supplemental Spec SC-M-815-8

Inlet structure filter - Type F non-weighted used for CB Type 1, 16, 17, & 18 with drainage areas less than 1 ac; Non-weighted tubes placed on subgrade where stakes can be driven; Figure 8' for CB Type 1 and 16; Figure 12' for CB Type 17 and 18; Used for slope interruption device on slopes > 50 ft.; Measured LF

Yes  No  N/A

Std Dwg 815-006-00; Supplemental Spec SC-M-815-8

Inlet structure filter - Type F weighted used for all inlets with drainage areas less than 1 ac; Weighted tubes placed on hard surface where stakes can not be driven; Applicable as Type E ISF; Figure 8' for CB Type 1 and 16; Figure 12' for CB Type 17 and 18; Figure 20' for MH and DI's; Measured LF

Yes  No  N/A

Std Dwg 815-006-00; Supplemental Spec SC-M-815-8

Inlet structure filter - Type G used for CB Type 9, DI's, and MH's with drainage areas less than 1 ac and flow rates less than 3 ft<sup>3</sup>/sec; seldom used because of maintenance of sediment removal

Yes  No  N/A

Std Dwg 815-006-00; Supplemental Spec SC-M-815-8