Review Comments and Resolution
Charlotte-Mecklenburg Storm Water Design Manual
November 6, 2013

<table>
<tr><th>REVIEWER COMMENT</th><th>RESOLUTION</th></tr>
<tr><td><u>Comment #1 – Section 2.6.2, page 2-11, “Rainfall” Section</u>
The revised paragraph is difficult to follow, please review and clarify.
Table reference doesn’t make sense.
Revision log (Ch 3, #27) doesn’t match edits to manual.</td><td>The language was updated in the manual – 12/6/2013
Table references in the Chapter are correct. Table numbering in the revision log was not correct. Updated the revision log to reflect this – 11/7/2013
Updated the revision log – 11/7/2013</td></tr>
<tr><td><u>Comment #2 – Section 2.6.2, page 2-16, Table 2-10</u>
Value 0.035 is wrong/out of order. See screenshot below.
Table 2-10
100-Year Precipitation Data
<u>100-Year, 6-Hour Balanced Storm Rainfall Distribution</u>
Time Interval 5 min 15 min 1 hour 2 hour 3 hour 6 hour
Rainfall depth (in) 0.83 1.77 3.34 4.12 4.56 5.34
<u>100-Year, 6-Hour Storm Event, 5-Minute Time Increment</u>
PI .000 .017 .017 .018 .018 .019 .020 .020 .020 .021
PI .022 .022 .023 .023 .024 .025 .026 .027 .028 .032
PI .034 .035 .037 .039 .041 .053 .056 .060 .035 .071
PI .078 .113 .126 .147 .226 .282 .555 .830 .386 .250
PI .160 .136 .119 .082 .074 .068 .063 .058 .055 .042
PI .040 .038 .036 .034 .033 .029 .027 .026 .025 .025
PI .024 .023 .022 .022 .021 .021 .020 .020 .019 .019
PI .018 .018 .017 .000</td><td>This value was in error. Changed to .065 – 12/3/2013</td></tr>
</table>

Comment #3 – Section 2.6.5.3, page 2-21, Equation 2.12 • Coefficient 2.68 can't be verified. According to our derivations, the coefficient should be either 2.56 or 2.59 (depending on rounding variables at every calculation step or carrying variables unrounded through to the end of the calculation). Coefficient 2.56 is what was used in previous CMSWS manual. Also this coefficient change wasn't listed in the Revision Log. $V = 2.68(S)^{0.4}(L)^{0.2}$ (2.12)	The coefficient value was in error. The coefficient has been changed to 2.56 to be consistent with the existing manual – 12/6/2013
Comment #4 – Section 2.6.5.3, page 2-22, Table 2-13 and Equations 2.11 and 2.12 • The Manning's n value for Smooth surfaces was updated from 0.011 to 0.016 in Table 2-13. • If this Manning's n is updated, then wouldn't equations 2.11 and 2.12 be updated to reflect the n value of 0.016, instead of 0.011? See below screenshot. Thus the final equations for paved and unpaved areas are: Paved (n = .011) $T_t = 0.0065\ [(L)^{0.8} / (S)^{0.4}]$ (2.11) $V = 2.68(S)^{0.4}(L)^{0.2}$ (2.12) Also, a comma is needed, and a closed parenthesis is needed in the "Smooth surfaces" description. See below screenshot. **Table 2-13** **Roughness Coefficients (Manning's *n*)[1] for Sheet Flow** **Surface Description** — **n** Smooth surfaces (concrete, asphalt, gravel, or bare soil — 0.016	• The Manning's number was inadvertently changed to 0.016. It should be 0.011. A revision to the manual has been made – 11/15/2013 • Grammar comment has been addressed – 11/8/2013

Comment #5 – Appendix 2B, page 2-27 through 2-32, Accumulated Precipitation Data Tables • The tables embedded into the PDF are not "selectable" as tables. They appear to just be images pasted in. If the tables could be reformatted such that the data could be selected and copied out for ease of use that would simplify chance of typographical error, other tables in the document are "selectable" within the PDF.	These tables have been completed as selectable tables. Comment addressed – 12/3/2013
Comment #6 – Section 3.3.3, page 3-5, Table 3-1 Formatting seems "off" in several of the sections for this table. "Minor Streams" and "Floodplains" should be at the same "level".	Comment addressed – 11/7/2013
Comment #7 – Section 4.1.3, page 4-2 Please clarify "concentrated runoff" in the following drainage system criteria: • No concentrated runoff flowing over City sidewalks except at driveways. What is "concentrated"? Direction, depth, type, or a change in flow? Please clarify	The determination of concentrated runoff is subject to engineering judgment and will be approved by the City Engineer. No revision to the manual has been made – 12/6/2013.
Comment #8 – Section 4.7.3, page 4-21, Equation 4.20 In the existing Stormwater Manual, Equation 5.20's coefficient was listed as 2.87, and the variable in the denominator of the equation was "S." In the Revised Stormwater manual, the Equation number was updated to 4.20, the coefficient was changed to 2.88, and the variable in the denominator was changed to "D." The variable change from "S" to "D" was correct. When this formula is derived from Manning's Equation, the coefficient turns out to be 2.875. Since 2.875 rounds to 2.88, we are ok with the coefficient change. However, we just want to note that this coefficient doesn't match other sources (see AASHTO's "2005 Model Drainage Manual" exerpt below) as compared to the new CMSWS. New CMSWS Manual:	The coefficient was rounded to three significant digits. No revision to the manual has been made – 12/6/2013

The Manning's equation can be written to determine friction losses for storm drain pipes as: $H_f = (2.88n^2V^2L)/D^{4/3}$ (4.20) The forumla appears in AASHTO's "2005 Model Drainage Manual" on page 13-69 as the following: Manning's Equation can also be written to determine friction losses for storm drains as follows: $H_f = 2.87\ n^2V^2L/D^{4/3}$ (13.36)	
Comment #9 - Section 2.1.2, Page 2-2, Table 2-1: Please review the section noted below and confirm that Dynamic Modeling software and associated 2D software are included with City approval as they are not comparable and not intended to be comparable to HEC-1/HEC-HMS and the software developers are very quick to inform you/us of that fact. Note that while not comparable they are approved by a third party (FEMA). If other methods are used, they must first be calibrated to local conditions and tested for accuracy and reliability by the user. Third party computer software not identified in this table must be independently verified and calibrated to the recommended methods by the professional prior to its use. If other software is used, it will be compared to HEC-1/HEC-HMS to make sure it reproduces equivalent results. In addition to verifying results, complete source documentation for the software must be submitted for approval.	Dynamic modeling is not supported by this manual. A dynamic modeling approach may be approved on a case by case basis by the City Engineer. No revision to the manual has been made – 12/3/2013
Comment #10 - General Consider allowing the use of the FHWA method of calculating inlet interception efficiency, as outlined in their publication HEC-22. This is by far the most widely-used method of spread analysis. It's the industry standard, and is the method used in the commonly-used software such as Civil3D, StormCAD,	This topic will require further analysis and discussion and may be considered for a future revision to the manual. No revision to the

Geopak Drainage, etc. In addition, because the equations are published (and the HEC-22 document is available for free download from FHWA website), most consultants already have spreadsheets set up to use this method.	manual has been made – 12/3/2013
Comment #11 - Revisions Log/List Page 9 – Chapter 7 - Item #7 - last sentence…. Should "Safe Dams Act" be "Dam Safety Act"?	Updated the manual globally in Chapter 6 to read "Dam Safety Law" – 11/7/2013
Comment #12 - Table of Contents - TC-7 – Chapter 6 heading should read "Storage and Detention" instead of "Storm Drainage Systems"	Comment addressed – 11/7/2013
Comment #13 - Chapter 1 – Introduction - Section 1.1 - There appears to be a pdf issue, the sentence appears to be cut-off where it reads "… methods may ___ required for approval".	Comment addressed – 11/8/2013
Comment #14 - Chapter 3 – Open Channel Hydraulics - Section 3.2.1 – Seems more appropriate to say "……minimum of 2:1" or "….slope shall be no steeper than 2:1", instead of "maximum of 2:1" - Section 3.2.2 – 2nd Paragraph, 1st sentence…. Word usage…. "for conditions or flow below the design frequency"… Should it read, "for conditions of flow below the design frequency"? - Section 3.2.3 – Last word of 1st sentence shows "flood plains"; for consistency should this be "floodplains"? - Section 3.2.3 – Item #3 – Should it read "…. build out of the contributing tributary drainage area." Instead of "…..build out of the tributary drainage area." ? - Section 3.6.2 – Item #4 – Last words of last sentence shows "flood plain"; for consistency should this be "floodplain"?	• 1st, 2nd and 4th comments addressed – 11/8/2013 • 3rd and 5th comments not addressed. Kept flood plain as two words for manual consistency unless referring to floodplain regulations - 11/8/2013
Comment #15 - Chapter 4 – Storm Drainage Systems - Section 4.2.8 – Just a general comment, we understand that a 1.0% minimum slope for roadside	• The minimum slope for roadside ditches is 1.0%, and

ditches is desirable so as not to create any ponding/spread issues on the roadway. However, on flatter roads/areas a minimum slope of 0.5% may be more needed considering that City of Charlotte roadway design allows for a minimum of 0.5% roadway grade; as long as ditch freeboard requirements are met and there are no ponding/spread issues. - Section 4.3.2 – Item #5 – General comment/consideration. Urban street design guidelines & City of Charlotte practice is to try and utilize normal crown in urban settings. In some cases, reverse crown is used. On thoroughfares, superelevation is used in which case the longitudinal grade of the gutter is different than the centerline. Possibly consider adding "In some instances the gutter grade may be different than the centerline due to superelevation rollover." - Section 4.4.2.2 – For clarity, consider changing title from "Grated Drop Inlet" to "Graded Drop Inlet (non-roadway or yard)" - Section 4.4.2.2 – NCDOT Standard 840.16 (2006) is shown. Why not reference the latest NCDOT Standards released in 2012?	variances to this are subject to approval by the City Engineer. No revision to the manual has been made – 11/8/2013 • Changed the language to read, "Generally, this is equivalent to the roadway centerline profile." - 11/8/2013 • The proper term for the inlet is Grated Drop Inlet. No revision to the manual has been made – 11/8/2013 • The reference to the 2012 NCDOT Standard to 840.16 was revised – 11/8/2013
<u>Comment #16 - Chapter 5 – Design of Culverts</u> - Section 5.3.2 – General Comment - Under Material selection, culvert skews are referred to; however there is no mention of culvert skews in Section 5.3.12 where Material Selection is discussed. - Section 5.3.6 – What is freeboard measured from? Consider specifying whether freeboard is measured from the edge of pavement, shoulder point, edge of travel lane, etc.	• Material selection, culvert skews and culvert sizes were put under Design Options to be consistent with the current manual – 12/3/2013 • This is subject to engineering judgment and approval by the City Engineer. No revision to the manual has been made – 11/8/2013
<u>Comment #17 - Chapter 6 – Storage and Detention</u> - Section 6.2.6 – 2nd sentence, NCDENR acronym is misspelled. - Section 6.2.8 – Possible missing word… "When off-site storm water detention…." Consider, "When using off-site storm water detention facilities".	All comments addressed – 11/7/2013

- Section 6.3.2 – Item #6, misspelling…. "Dame Safety Act" should be "Dam Safety Act".	
Comment #18 - Page 1-3, Definitions of Cross Drain and Culvert These definitions still seem unclear. The definition for culvert references cross drain, and the definition for cross drain references culvert. This leads me to believe that the intent of the manual is to establish the terminology as one and the same (i.e. culvert is the same as a cross drain). However, the definition for culvert seems to explicitly exclude closed systems, but the definition for cross drains seems to suggest that closed systems can be classified as cross drains.	This will require further discussion and will be considered for a future revision of the manual. No revision to the manual has been made – 11/8/2013
Comment #19 - Page 2-11, Section 2.6.2 Under Rainfall, the third sentence in the paragraph states, "To use this distribution for the one year storm event it is necessary for the user to obtain the 24-hour rainfall intensity from Table 2-2 and multiply by the 24-hour duration to obtain the depth (P24 in Figure 2-1) from Table 2-5". The 1-year intensities are not included in table 2-2.	The 1-year intensities are included in Table 2-5 as stated. The language has been updated as per comment #1 – 12/3/2013
Comment #20 - Page 2-14, Table 2-5 Formatting Table 2-5 to include similar headings as Table 2-6 through Table 2-10 might make the presentation of the time increment and storm depth more clear.	Comment addressed – 11/7/2013
Comment #21 - Page 2-19, Table 2-12 Curve numbers for pasture, grassland, or range as well as meadow were removed without notation in the revision log. Was this intentional?	The curve numbers for pasture, grassland or range and meadow were removed from Table 2-12. This level of detail was not included within the revision log. After discussion, curve numbers for pasture, grassland or range were added back into Table 2-12 to be consistent with the BMP Design Manual – 12/3/2013

Comment #22 - Page 4-1, Section 4.1.3 The manual defines sag inlets as those that do not have any available curb overflow. If overflow across the crown of the road a qualifying condition to "disqualify" an inlet as in a sag condition?	The manual defines a sag inlet as an inlet located at a low point and water enters from both directions. If overflow is provided it is still a sag; however, it is not required to meet the needs of a sag where relief by overflow for a typical roadway cross section is not provided. No revision to the manual has been made – 12/3/2013
Comment #23 - Page 4-4, Section 4.3.1 Using a rainfall intensity of 4in/hr is standard practice for gutter flow/spread calculations (i.e. no time of concentration considerations). When evaluating sag inlets for the 25-year or 50-year storm, if inlet flow times exceed 5 minutes, is accounting for reduced rainfall intensity acceptable? If so, this may be worth documenting.	Engineering judgment is to be utilized for these analyses. No revision to the manual has been made – 12/3/2013
Comment #24 - Page 4-7, Section 4.4 If the city has a preference for determining inlet capacity for on-grade, double catch basins (CLDS 20.03), it may be worth including here.	No revision to the manual has been made. This can be considered for a future revision of the manual – 12/3/2013
Comment #25 - Page 4-20, Section 4.7.2 Bullet #2 states, "The maximum discharge velocity at pipe outlets is 10fps except for pipes greater than 48 inches in diameter **unless velocity is further restricted for energy dissipation**." Please provide further clarification for the statement in bold.	The language was edited to read, "The maximum discharge velocity at pipe outlets is 10 fps except for pipes greater than 48 inches in diameter." – 12/3/2013