Errata for ’02 VDOT DRAINAGE MANUAL
Note: The errata information shown below will be incorporated into the text of the manual the next time it is revised.

Posted 03/03:

Chapter 6, Section 6.4.1, equation 6.2, page 6-9 of 51: The units for t_c should be “hours (hr)” instead of “minutes (min)” as shown

Chapter 7, Section 7.4.4.2.8, equation 7.5, page 7-14 of 52: The Continuity Equation should read $Q = A_1 \cdot V_1 = A_2 \cdot V_2$ instead of the way it has been shown.

Chapter 7, Section 7.5.5.2, Table 7-1, page 7-46 of 52: The Manning’s “n” for depths of flow of 0-0.5 ft. should be changed from 0.04 as currently shown to 0.104.

Chapter 11, Appendix 11F-1: The latest edition of Location & Design Instructional & Informational Memorandum IIM-LD-195 has voided the entire existing DDM-2.

Posted 04/03:

Chapter 6, Section 6.3.1.2, Table 6-1, page 6-7 of 51: The criteria for culverts for Minor Arterial, Collector, Local Roads should be changed to read “10-Year (10%) Minimum”.

Chapter 8, Section 8.3.2.1, page 8-4 of 52: The criteria for Secondary Roadways should be changed to read “10-year (10%)”

Chapter 9, Section 9.3.4, page 9-5 of 55: Replace the fourth paragraph with – “To properly drain sag vertical curves, it is recommended practice to place flanking inlets on each side of the inlet located at the low point in the gutter grade. In addition to determining the spread of water resulting from the inlet in the low point of the gutter grade, the spread on the approach roadway just upgrade of the sag point should also be determined. A longitudinal slope of 0.1% should be used in determining the spread on the approach roadway. There are cases where special treatment of the gutter gradient is provided. In those instances, the flattest grade that will actually occur on the approach gradient should be used in lieu of 0.1%.”

Posted 05/03:

Chapter 6, Section 6.2.9, page 6-4 of 51, under the second bullet, the last sentence should be changed to read “The TR-55 method has been found best suited to drainage areas between 200 and 2000 acres.”

Chapter 6, Section 6.3.2, Figure 6-1, page 6-8 of 51, the chart should be revised to show the applicability of the TR-55 method as ranging from 200 to 2000 acres.

Posted 05/23/03

Chapter 7, Appendix 7D-1, page 2 of 2, the minimum value of roughness coefficient for "Medium to dense brush, in summer" should be changed from 0.700 to 0.070.

Posted 05/27/03

Chapter 8, Appendix 8D-1, change the suggested Manning's n value range for (corrugated metal) spiral rib metal pipe from 0.012-0.013 as shown to 0.011-0.012. Also "Note 2" at the bottom of the page needs to be changed from "HDS-5, page 163" to "HDS-5, Table 4".

Posted 09/16/03

Chapter 6, Appendix 6D-2, a table of Manning's "n" values appropriate for use with the Kinematic Wave procedure has been added as the second page of the appendix. This change will be incorporated into the next revision to the VDOT DRAINAGE MANUAL. However, until then, a copy of the revised appendix, complete with "n" value table, may be downloaded at the following location: http://www.virginiadot.org/business/locdes/drainage-design.asp. A note will also be added to the main body of the text of Chapter 6 to indicate that VDOT considers the Kinematic Wave method to be the most reliable procedure for determining overland flow time over impervious surfaces for very shallow depths of flow such as 0.25".

Posted 04/04

Chapter 6, Appendix 6H-3, "Runoff Curve Numbers for Urban Areas" - Scratch through the entire line about 3/4 of the way down the chart that reads "Idle lands (CNs are determined using cover types similar to those in Table 6 - 11)." When the original chart was taken from the AASTHO MODEL DRAINAGE MANUAL it referenced another chart for use with "idle lands" which was for "Arid or Semiarid Regions" which is totally inappropriate for Virginia.

Chapter 8, Section 8.5.2.1, page 8-40 of 50, Step 9 of the sample problem, the value shown for "HW_{oi}" needs to be changed from 2.5 to 2.6.

Chapter 8, Section 8.5.2.1, page 8-40 of 50, Step 12 of the sample problem, the second bullet should be changed to read "Enter 4.8 (400 x 0.012) on the horizontal, "Qn" scale". The fourth bullet should be changed to read "Read horizontally to the "Vn" scale and find a value of 0.37. Then divide this by the "n" value (0.012) and find a velocity of 30.8 fps."

Chapter 8, Section 8.5.2.1, page 8-41 of 50, Step 15 of the sample problem (Figure 8-11), the value for "OUTLET CONTROL" "HW" needs to be changed from 2.6 to 2.7.

Chapter 8, Appendix 8D-1, the "Manning's n" range for "Concrete Boxes" needs to be changed from 0.12-0.015 to 0.012-0.015. It needs to be changed for "Corrugated Metal Pipes and Boxes" for walls having "5 by 1 inch corrugations" from 0.25-0.026 to 0.025-0.026. It needs to be change for "Corrugate Metal" pipes having "2 2/3 by ½ inch corrugations" from 0.12-0.024 to 0.012-0.024.

Chapter 8, Appendix 8D-2, the description for Pipe, Concrete with Headwall or headwall and wingwalls Rounded (radius = 1/12D) the radius needs to be changed to (radius = D/12). Under "Box, Reinforced Concrete", under the category "Wingwalls at 10° to 25° or 30° to 75° to barrel", the category for "Rounded on 3 edges" needs to have the radius changed from "1/12 barrel" to "D/12 or B/12". Under the category for "Wingwalls a 30° to 75° to barrel", the "Crown edge rounded" needs to be changed from a radius of "1/12 barrel Dimension, or beveled top edge" to a radius of "D/12, or beveled top edge. The category for Box Culverts with Wingwalls at 30° to 75° to barrel with Square Edge at crown needs to have the K_e value changed from 0.7 to 0.4.

Chapter 9, Appendix 9C-12, "Grate Inlet Capacity in Sump Conditions (VDOT Version)" is incorrect as shown for all VDOT standard drop inlet grates. Do not use this nomograph for VDOT standard grate inlets in sag. Use instead, as appropriate for a given drop inlet, the nomographs provided in Appendices 9C-13 through 9C-16. These performance curves were predicated on actual physical model testing whereas the curves for VDOT drop inlet grates used on the nomograph in Appendix 9C-12 were predicated on the extrapolation of existing data.

Chapter 9, Section 9.4.9.3, Figure 9-10, the note at the top of the page should be changed to show that the VDOT recommended values for K can be found in Appendix 9B-3 instead of Appendix 11B-3 as is currently shown.

Chapter 11, Appendix 11C-3, page 2 of 4 the 24-hr., 100-yr. rainfall for Frederick County, Virginia should be 7.0 inches.

Posted 06/04

Chapter 8, Appendix 8G-1 (Low Flow Diversion For Multiple Line Culvert Installations), the scanned drawing is fuzzy and hard to read as shown. To be able to view, print, and/or download a legible copy, one must go to the on-line Instruction and Informational Index at the following Internet address http://www.virginiadot.org/business/locdes/rd-ii-memoranda-index.asp, click on the link marked Table of Contents, scroll down the list to IIM-LD-214 (Multiple Barrel Culverts), click on the link IIM-LD-214, scroll down to page 3, and click on the link isd 1588. This should display a legible copy of the insertable sheet for the drawing.

Posted 07/04

Chapter 6, Appendix 6B-7, Rainfall Intensity (IDF) curves for Frederick County, VA – Apparently when the original drawing was scanned the labels for the "Y" axis (Rainfall Intensity – in./hr.) was cut off. The labels for the "Y" axis should have appeared exactly the same as are shown for the immediately preceding curve for Fauquier County, VA (Appendix 6B-6) and the immediately following curve for Greensville County, VA (Appendix 6B-8), i.e. the bottom line should have read 1 and the top line have read 9 with each intermediate major grid line being for an increasing increment of 1". This will be corrected in the next manual revision.

Posted 10/04

Chapter 8, Appendix 8C-35, Chart 35, the description for the middle line representing "HEADWATER DEPTH IN TERMS OF ARCH RISE (HW/D)" should read "33.7° x 0.10 D" instead of "33.7° x 0.100" as currently shown.

Posted 05/05

Chapter 8, Section 7.3.1 – the reference to minor channel criteria should be changed to read "See Section 7.3.2". Section 7.3.1.2 – the reference to major channel criteria should be changed to read "See Section 7.3.3". Section 7.3.1.3 – the reference to natural channel criteria should be changed to read "See Section 7.3.4".

Posted 06/05

With the implementation of Hydraulic Design Advisory HDA 05-03 the following changes will need to be made:

Chapter 6, Section 6.4.2.5, page 6-12 of 51: The referenced IDF curves are now void. IDF values will be determined from the "B, D, & E" factors published in HDA 05-03 and subsequently in Appendix 6C-2 in the next revision to the manual.

Chapter 6, Section 6.4.2.5, Figure 2, page 6-13 of 51: The Intensity-Duration-Frequency for the city of Richmond is void.

Chapter 6, Section 6.4.4.1.6, page 6-17 of 51: The referenced IDF curves are now void. IDF values will be determined from the "B, D, & E" factors published in HDA 05-03 and subsequently in Appendix 6C-2 in the next revision to the manual.

Chapter 6, Section 6.4.5.1.3, page 6-32 of 51: The referenced IDF curves are now void. IDF values will be determined from the "B, D, & E" factors published in HDA 05-03 and subsequently in Appendix 6C-2 in the next revision to the manual.

Chapter 6, Section 6.4.5.1.5, page 6-33 of 51: The referenced "a and b factors" are now to be used for no other purpose than the process of estimating the critical storm duration.

Chapter 6, Section 6.5.2.1, Step 5, page 6-38 of 51: The referenced IDF curves are now void. IDF values will be determined from the "B, D, & E" factors published in HDA 05-03 and subsequently in Appendix 6C-2 in the next revision to the manual.

Chapater 6, Section 6.5.2.1.1, Step 5, page 6-40 of 51: The 10-yr. and 100-yr. IDF values are to be determined using the "B, D, & E" factors and the intensity equation presented in HDA 05-03.

Chapter 6, Section 6.5.2.3, Step 3b, page 6-43 of 51: The total point rainfall values are to be determined using the "B, D, & E" factors and the total point rainfall equation presented in HDA 05-03.

Chapter 6, Section 6.5.2.3.1, Step 3b, page 6-45 of 51: The 10-yr. and 100-yr. total point rainfall values are to be determined using the "B, D, & E" factors and the total point rainfall equation presented in HDA 05-03.

Chapter 6, Section 6.5.3.1.1, Step 3b, page 6-50 or 51: The 2-yr. IDF values are to be determined using the "B, D, & E" factors and the intensity equation presented in HDA 05-03

Chapter 6, Appendices: Appendices 6B-3 through 6B-18 are void. Appendices 6G-4 through 6G-12 are void.

Posted 07/05

With the implementation of Hydraulic Design Advisory HDA 05-04 the following changes will need to be made:

Chapter 6, Section 6.2.9, page 6-4 of 53: the following needs to be added at the end of the 2nd "bullet": When using any methodology predicated on the 24-hr. rainfall event (i.e. TR-55, TR-20, etc.) it will be necessary to use the values presented in Chapter 11, Appendix 11C-3 which have been revised to reflect NOAA's ATLAS-14 Rainfall Precipitation Frequency Data.

Chapter 11, Appendix 11-C3 needs to be replaced with that which is provided with HDA 05-04.

Posted 08/05

Chapter 7, Section 7.4.6.4.3, the wordage needs to be revised to reflect the highlighted changes shown below:

It is VDOT practice to place riprap over an appropriate bedding material. For geotextile bedding under the riprap being used for bridge spill slopes, a stone cushion layer consisting of VDOT No. 25 or 26 aggregate should be placed between the riprap and geotextile bedding in accordance with the following:

- In the case of Class AI and I riprap, the aggregate cushion layer should be 4 inches thick
- In the case of Class II, Class III, Type I, and Type II riprap, the aggregate cushion layer should be 6 inches thick

For other than bridge spill slope applications, riprap may be placed directly on the geotextile bedding for sizes up through Class II. Larger sizes will require an intermediate aggregate cushion material of a size, gradation, and thickness as recommended by the Materials Division.

Posted 09/05

Chapter 15, Section DDM2, page 1-12: Drainage Descriptions – new document – voids current DDM2 (Stormwater Management) located in Chapter 11 – Stormwater Management covered in IIM 195

Chapter 6, Appendix 6F-2, the label for the chart's "X" (horizontal) axis should be revised to read "LENGTH-SLOPE INDEX ($L / S^{0.5}$), L IN MILES, S IN FEET PER MILE"

Posted 10/05

Chapter 6, Section 6.4.5.2.6, equation 6.11, the equation needs to be changed to read as follows:

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S}$$

Posted 12/05

Chapter 6, Section 6.4.4.2.4 (Dan Anderson equation) and Section 6.5.2.2.1 (Dan Anderson sample problem) have been changed in accordance with Hydraulic Design Advisory HDA 05-05 which may be viewed, printed, and/or downloaded at the following web address: http://www.virginiadot.org/business/locdes/hydraulic-design-advisory.asp

Posted 09/06

Chapter 9, Section 9.5.6 (Hydraulic Grade Line Procedure), page 9-50, the equation referenced in Step 6 should read 9.20 (instead of 9.26) and the name of the circular slide rule is "Field's".

Posted 10/06

Chapter 15, DDM1, page DDM1-10, under the second bullet, the reference in the last sentence should be changed to read "(See IIM-LD-110 & General Note G-4)".

Chapter 15, DDM1, page DDM1-10, under the fifth bullet, the sentence should be changed to read "General Note D-12 (See IIM-LD-110) is to be included on the General Note Sheet in applicable project assemblies".

Chapter 15, DDM1, page DDM1-19, under the fourth bullet, the general note reference needs to be changed from D-18 to D-17. The text of the note is correct.

Chapter 7, Appendix 7D-1 – new Manning's "n" values have been added for VDOT's standard riprap sizes. See Hydraulic Design Advisory HDA 06-04.

Posted 01/07

Chapter 11, Section 11.5.6.1, equation 11.6, page 11-34 and Section 11.5.6.2, equation 11.7, page 11-37 – the equations are incorrect as shown and should read as follows:

$$S_2 + \frac{O_2}{2}\ \Delta T = S_1 - \frac{O_1}{2}\ \Delta T + \frac{I_1 + I_2}{2}\ \Delta T$$

Posted 03/07

Chapter 6, Section 6.3.1.1, page 6-6 of 51 (Factors Governing Frequency Selections), the third paragraph is replaced by the following:

"Inundation of the traveled way indicates the level of traffic service provided by the facility. The traveled way overtopping flood level identifies the limit of serviceability. Table 6-1 relates desired minimum levels of protection from traveled way (edge of shoulder) inundation to the functional classifications of roadways. For other specific design frequency criteria, the user is directed to the various design chapters for channels, culverts, storm drains, bridges, etc."

Chapter 6, Section 6.3.1, page 6-7 of 51, table 6-1, is replaced by the following:

TABLE 6-1 — Design Storm Selection Guidelines (For Traveled Way Inundation)

Roadway Classification	Exceedence Probability	Return Period
Rural Principal Arterial System	2%	50-yr
Rural Minor Arterial System	4% - 2%	25 yr - 50-yr
Rural Collector System, Major	4%	25-yr
Rural Collector System, Minor	10%	10-yr
Rural Local Road System	10%	10-yr
Urban Principal Arterial System	4% - 2%	25 yr - 50-yr
Urban Minor Arterial Street System	4%	25-yr
Urban Collector Street System	10%	10-yr
Urban Local Street System	10%	10-yr

Note: Federal law requires interstate highways to be provided with protection from the 2% flood. Facilities such as underpasses and depressed roadways, where no overflow relief is available, should also be designed for the 2% event.

Chapter 9, Section 9.4.6.7, Table 9-4, Page 9-23 of 55, Note 1 is replaced by the following:

"1. $x = (200dk)^{0.5}$, where x = distance from low point in feet and K=L/A where L = length of curve (ft) and A = algebraic difference of the approach grades (%)"

Chapter 9, Section 9.4.6.7, Table 9-4, Page 9-23 of 55, Note 2 is replaced by the following:

"2. See latest Policy on Geometric Design of Highways and Streets (American Association of State Highway and Transportation Officials) for maximum K value for various design speeds."

Chapter 9, Appendix 9B-3 (LD-347 Hydraulic Grade Line Computation form), the K values shown are to be replaced by the following:

90º K=0.70	50º K=0.50	20º K=0.25
80º K=0.66	40º K=0.43	15º K=0.19
70º K=0.61	30º K=0.35	10º K=0.13
60º K=0.56	25º K=0.30	5º K=0.06

Chapter 8, Appendix 8D-2 (Entrance Loss Coefficients), the Box, Reinforced Concrete section is replaced by the following:

Box, Reinforced Concrete

Wingwalls parallel (extension of sides)	
Square edge at crown	0.7
Wingwalls at 10º to 25º to barrel	
Square edge at crown	0.5
Wingwalls at 30º to 75º to barrel	
Square edge at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Side-or slope-tapered inlet	0.2
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 sides	0.5
Round on 3 sides to radius of D/12 or B/12 or beveled edges on 3 sides	0.2

Chapter 7, Appendix 7D-2, is amended with the addition of the following table:

Appendix 7D-2 Recommended Maximum Water Velocities and Manning's n as a Function of Soil Type and Flow Depth

USCS Classification	USCS Soil Description	Fortier and Scobey Soil Description	Maximum Water Velocity (ft/s)	Manning's n -Flow Depth 0.5-2.0 ft
	BROKEN ROCK and COBBLES	Cobbles and Shingles	5.5	0.030
GP, GW, SW, SP	Poorly graded gravel, well graded gravel, well graded sand, poorly graded sand	Coarse gravel, non-colloidal	4.5	0.025
		Fine gravel	3.5	0.020
SW	Well graded sand	Graded loam to cobbles when non-colloidal	4.0	0.030
GC, SC	Clayey gravel, clayey sand	Graded silts to cobbles when colloidal	4.5	0.030
SM	Silty sand	Sandy loam, non-colloidal	2.0	0.020
SP, SW	Poorly graded sand, well graded sand	Fine Sand, non-colloidal	1.5	0.020
ML	Silt	Silt loam, non-colloidal	2.3	0.020
CL	Lean clay	Alluvial silts, non-colloidal	2.3	0.020
ML, CL	Silt, lean clay	Ordinary firm loam	2.5	0.020
CL	Lean clay	Alluvial silts, colloidal	3.5	0.025
CH	Fat clay	Stiff clay, very colloidal	4.0	0.025

Note: Relationship between Unified Soil Classification System (USCS) classification and Fortier and Scobey description is loosely correlated.