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Appendix F:
Rational Basin Calculations

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Project:	Carolina Crossroads D/B	**By:**	DPH	**Date:**	26-Jun-24
Location:	Richland & Lexington Counties, SC	**Checked:**		**Date:**	

Rational Basins - Composite C Values

Basin ID	20W-1		RCW-1	
	PRE	POST	PRE	POST
Zone Group 1 Area (ac)	4.53	4.53	0.70	0.70
Zone Group 1 C	0.55	0.55	0.55	0.55
Zone Group 2 Area (ac)	2.87	2.87	49.40	49.40
Zone Group 2 C	0.40	0.40	0.40	0.40
Zone Group 3 Area (ac)	7.07	7.07	35.36	35.36
Zone Group 3 C	0.80	0.80	0.80	0.80
Zone Group 4 Area (ac)	0.00	0.00	0.00	0.00
Zone Group 4 C	0.20	0.20	0.20	0.20
Impervious / Water Area (ac)	1.69	2.39	4.57	5.15
Impervious / Water Area C	0.90	0.90	0.90	0.90
Woods (ac)	2.33	0.18	2.98	0.77
Woods C	0.15	0.15	0.15	0.15
Open Space (ac)	1.17	2.57	1.06	2.59
Open Space C	0.25	0.25	0.25	0.25
Total Basin Area (ac)	19.66	19.60	94.07	93.97
Composite C	0.58	0.62	0.57	0.57

Time of Concentration, Discharges

Basin ID: **20W-1_Pre**

Sheet Flow (Applicable to Tc only)

1. Manning's roughness coefficient, n (table 3-1)		0.24			
2. Flow length, L (total L ≤ 300 ft)	276	ft			
3. Two-year 24-hour rainfall, P_2	3.7	in	4. Land slope, s	0.058	ft/ft
5. Travel time, $T_t = 0.007(nL)^{0.8}/((P_2^{0.5})(s^{0.4}))$		0.33	hr =	19.80	min

Shallow concentrated flow

6. Surface description (paved or unpaved)		Unpaved			
7. Flow length, L	319 ft		8. Watercourse slope, s	0.050	ft/ft
9. Average velocity, V (Figure 3-1)		3.61	ft/s		
10. Travel time, T_t = L / 60*V*60 =		0.02	hr =	1.47	min

Channel flow 1

11. Cross sectional flow area, a	2.5	ft^2	12. Wetted perimeter, p_w	8	ft
13. Hydraulic radius, r = a/p_w	0.313	ft	14. Channel slope, s	0.025	ft/ft
15. Manning's roughness coefficient, n		0.24			
16. V=1.49 $r^{2/3}$ $s^{1/2}$ / n =	0.45	ft/s	17. Flow length, L	161	ft
18. Travel time, T_t = L / 3600* V =		0.10	hr =	5.94	min

Pipe flow

19. Flow length, L	72 ft		20. Assumed Velocity, V	2	ft/s
21. Travel time, T_t = L / 60*V*60 =		0.01	hr =	0.60	min

Channel flow 2

22. Cross sectional flow area, a	2.5	ft^2	23. Wetted perimeter, p_w	8	ft
24. Hydraulic radius, r = a/p_w	0.313	ft	25. Channel slope, s	0.010	ft/ft
26. Manning's roughness coefficient, n		0.1			
27. V=1.49 $r^{2/3}$ $s^{1/2}$ / n =	0.69	ft/s	28. Flow length, L	606	ft
29. Travel time, T_t = L / 3600* V =		0.25	hr =	14.72	min
30. Watershed or subarea T_c or T_t, Total =		**0.71**	hr =	**42.53**	**min**

Intensity & Discharge Calculation

31. Q = $CIAC_f$ (Rational Equation)
32. intensity (i) = a/(b+tc)^c (in/hr)
33. A = Drainage Area (Acres) — 19.66
34. Rational C Value — 0.5829

Event	a	b	c	i (in/hr)	C_f	Q (cfs)
2-year	244.3449	34.9581	1.0316	2.75	1.00	31.50
5-year	258.5057	32.7568	1.0177	3.18	1.00	36.44
10-year	267.5425	31.3999	1.0090	3.48	1.00	39.88
25-year	279.7735	29.5904	0.9974	3.92	1.10	49.45
50-year	288.7131	28.2613	0.9888	4.28	1.20	58.82
100-year	296.6622	27.0486	0.9811	4.62	1.25	66.16

Time of Concentration, Discharges

Basin ID: **20W-1_Post**

Sheet Flow (Applicable to Tc only)

1. Manning's roughness coefficient, n (table 3-1)		0.24				
2. Flow length, L (total L ≤ 300 ft)	276	ft				
3. Two-year 24-hour rainfall, P_2	3.7	in	4. Land slope, s		0.058	ft/ft
5. Travel time, $T_t = 0.007(nL)^{0.8}/((P_2^{0.5})(s^{0.4}))$		0.33	hr	=	19.80	min

Shallow concentrated flow

6. Surface description (paved or unpaved)		Unpaved				
7. Flow length, L	319	ft	8. Watercourse slope, s		0.050	ft/ft
9. Average velocity, V (Figure 3-1)		3.61	ft/s			
10. Travel time, T_t = L / 60*V*60	=	0.02	hr	=	1.47	min

Channel flow 1

11. Cross sectional flow area, a	2.5	ft^2	12. Wetted perimeter, p_w		8	ft
13. Hydraulic radius, r = a/p_w	0.313	ft	14. Channel slope, s		0.025	ft/ft
15. Manning's roughness coefficient, n		0.24				
16. V=1.49 $r^{2/3}$ $s^{1/2}$ / n =	0.45	ft/s	17. Flow length, L		161	ft
18. Travel time, T_t = L / 3600* V =		0.10	hr	=	5.94	min

Pipe flow

19. Flow length, L	72	ft	20. Assumed Velocity, V		2	ft/s
21. Travel time, T_t = L / 60*V*60	=	0.01	hr	=	0.60	min

Channel flow 2

22. Cross sectional flow area, a	2.5	ft^2	23. Wetted perimeter, p_w		8	ft
24. Hydraulic radius, r = a/p_w	0.313	ft	25. Channel slope, s		0.010	ft/ft
26. Manning's roughness coefficient, n		0.1				
27. V=1.49 $r^{2/3}$ $s^{1/2}$ / n =	0.69	ft/s	28. Flow length, L		606	ft
29. Travel time, T_t = L / 3600* V =		0.25	hr	=	14.72	min
30. Watershed or subarea T_c or T_t, Total =		**0.71**	hr	=	**42.53**	**min**

Intensity & Discharge Calculation

31. Q = $CIAC_f$ (Rational Equation)

32. intensity (i) = a/(b+tc)^c (in/hr)

33. A = Drainage Area (Acres)	19.60
34. Rational C Value	0.6180

Event	a	b	c	i (in/hr)	C_f	Q (cfs)
2-year	244.3449	34.9581	1.0316	2.75	1.00	33.29
5-year	258.5057	32.7568	1.0177	3.18	1.00	38.51
10-year	267.5425	31.3999	1.0090	3.48	1.00	42.15
25-year	279.7735	29.5904	0.9974	3.92	1.10	52.27
50-year	288.7131	28.2613	0.9888	4.28	1.20	62.17
100-year	296.6622	27.0486	0.9811	4.62	1.25	69.93

Time of Concentration, Discharges

Basin ID: **RCW-1_Pre**

Sheet Flow (Applicable to Tc only)

1. Manning's roughness coefficient, n (table 3-1)		0.4				
2. Flow length, L (total L ≤ 300 ft)	300	ft				
3. Two-year 24-hour rainfall, P_2	3.7	in	4. Land slope, s		0.070	ft/ft
5. Travel time, $T_t = 0.007(nL)^{0.8}/((P_2^{0.5})(s^{0.4}))$		0.49	hr	=	29.40	min

Shallow concentrated flow

6. Surface description (paved or unpaved)		Unpaved				
7. Flow length, L	109	ft	8. Watercourse slope, s		0.092	ft/ft
9. Average velocity, V (Figure 3-1)		4.89	ft/s			
10. Travel time, T_t = L / 60*V*60	=	0.01	hr	=	0.37	min

Channel flow 1

11. Cross sectional flow area, a	2.5	ft^2	12. Wetted perimeter, p_w		6.5	ft
13. Hydraulic radius, r = a/p_w	0.385	ft	14. Channel slope, s		0.027	ft/ft
15. Manning's roughness coefficient, n		0.1				
16. $V=1.49\ r^{2/3}\ s^{1/2}\ /\ n$ =	1.29	ft/s	17. Flow length, L		1103	ft
18. Travel time, T_t = L / 3600* V	=	0.24	hr	=	14.20	min

Pipe flow

19. Flow length, L	492	ft	20. Assumed Velocity, V		2	ft/s
21. Travel time, T_t = L / 60*V*60	=	0.07	hr	=	4.10	min

Channel flow 2

22. Cross sectional flow area, a	10	ft^2	23. Wetted perimeter, p_w		14	ft
24. Hydraulic radius, r = a/p_w	0.714	ft	25. Channel slope, s		0.035	ft/ft
26. Manning's roughness coefficient, n		0.1				
27. $V=1.49\ r^{2/3}\ s^{1/2}\ /\ n$ =	2.23	ft/s	28. Flow length, L		113	ft
29. Travel time, T_t = L / 3600* V	=	0.01	hr	=	0.85	min
30. Watershed or subarea T_c or T_t, Total =		**0.82**	hr	=	**48.91**	**min**

Intensity & Discharge Calculation

31. Q = $CIAC_f$ (Rational Equation)

32. intensity (i) = a/(b+tc)^c (in/hr)

33. A = Drainage Area (Acres)	94.07
34. Rational C Value	0.5662

Event	a	b	c	i (in/hr)	C_f	Q (cfs)
2-year	244.3449	34.9581	1.0316	2.53	1.00	134.92
5-year	258.5057	32.7568	1.0177	2.93	1.00	155.91
10-year	267.5425	31.3999	1.0090	3.20	1.00	170.51
25-year	279.7735	29.5904	0.9974	3.61	1.10	211.20
50-year	288.7131	28.2613	0.9888	3.93	1.20	251.01
100-year	296.6622	27.0486	0.9811	4.24	1.25	282.14

Time of Concentration, Discharges

Basin ID: **RCW-1_Post**

Sheet Flow (Applicable to Tc only)

1. Manning's roughness coefficient, n (table 3-1)		0.4			
2. Flow length, L (total L ≤ 300 ft)	300	ft			
3. Two-year 24-hour rainfall, P_2	3.7	in	4. Land slope, s	0.070	ft/ft
5. Travel time, $T_t = 0.007(nL)^{0.8}/((P_2^{0.5})(s^{0.4}))$		0.49	hr =	29.40	min

Shallow concentrated flow

6. Surface description (paved or unpaved)		Unpaved			
7. Flow length, L	109	ft	8. Watercourse slope, s	0.092	ft/ft
9. Average velocity, V (Figure 3-1)		4.89	ft/s		
10. Travel time, T_t = L / 60*V*60 =		0.01	hr =	0.37	min

Channel flow 1

11. Cross sectional flow area, a	2.5	ft^2	12. Wetted perimeter, p_w	6.5	ft
13. Hydraulic radius, r = a/p_w	0.385	ft	14. Channel slope, s	0.027	ft/ft
15. Manning's roughness coefficient, n		0.1			
16. V=1.49 $r^{2/3}$ $s^{1/2}$ / n =	1.29	ft/s	17. Flow length, L	1103	ft
18. Travel time, T_t = L / 3600* V =		0.24	hr =	14.20	min

Pipe flow

19. Flow length, L	492	ft	20. Assumed Velocity, V	2	ft/s
21. Travel time, T_t = L / 60*V*60 =		0.07	hr =	4.10	min

Channel flow 2

22. Cross sectional flow area, a	10	ft^2	23. Wetted perimeter, p_w	14	ft
24. Hydraulic radius, r = a/p_w	0.714	ft	25. Channel slope, s	0.035	ft/ft
26. Manning's roughness coefficient, n		0.1			
27. V=1.49 $r^{2/3}$ $s^{1/2}$ / n =	2.23	ft/s	28. Flow length, L	113	ft
29. Travel time, T_t = L / 3600* V =		0.01	hr =	0.85	min
30. Watershed or subarea T_c or T_t, Total =		**0.82**	hr =	**48.91**	**min**

Intensity & Discharge Calculation

31. Q = $CIAC_f$ (Rational Equation)
32. intensity (i) = a/(b+tc)^c (in/hr)
33. A = Drainage Area (Acres) — 93.97
34. Rational C Value — 0.5729

Event	a	b	c	i (in/hr)	C_f	Q (cfs)
2-year	244.3449	34.9581	1.0316	2.53	1.00	136.37
5-year	258.5057	32.7568	1.0177	2.93	1.00	157.59
10-year	267.5425	31.3999	1.0090	3.20	1.00	172.34
25-year	279.7735	29.5904	0.9974	3.61	1.10	213.47
50-year	288.7131	28.2613	0.9888	3.93	1.20	253.71
100-year	296.6622	27.0486	0.9811	4.24	1.25	285.17