INLET SPREAD CALCULATIONS – 2-YEAR STORM

CURB INLETS ON GRADE

Label	Solve For	Efficiency (%)	Curb Opening Length (ft)	Local Depression (in)	Local Depression Width (ft)	Discharge (ft³/s)	Slope (ft/ft)	Gutter Width (ft)	Gutter Cross Slope (ft/ft)	Road Cross Slope (ft/ft)	Manning Coefficient	Intercepted Flow (ft³/s)	Bypass Flow (ft³/s)	Spread (ft)	Depth (ft)	Flow Area (ft²)	Gutter Depression (ft)	Total Depression (ft)	Velocity (ft/s)	Equivalent Cross Slope (ft/ft)	Length Factor	Total Interception Length (ft)	Bypass From Inlet
STR 106 - DI-3B - 2 YEAR	Efficiency	97.52	6.00	1.50	1.50	0.43	0.05	1.50	0.08	0.01	0.013	0.42	0.01	1.62	0.12	0.09	0.11	0.23	4.68	0.16	0.87	6.88	
STR 202 - DI-3A - 2 YEAR	Efficiency	62.72	2.50	2.00	2.00	0.90	0.01	2.00	0.08	0.04	0.013	0.56	0.34	3.35	0.21	0.30	0.08	0.25	2.96	0.16	0.42	5.92	106, 203
STR 203 - DI-3B - 2 YEAR	Efficiency	99.18	6.00	2.00	2.00	1.07	0.01	2.00	0.08	0.04	0.013	1.06	0.01	3.68	0.23	0.35	0.08	0.25	3.05	0.15	0.93	6.45	
STR 204 - DI-3B - 2 YEAR	Efficiency	100.00	6.00	2.00	2.00	0.69	0.01	2.00	0.08	0.04	0.013	0.69	0.00	2.87	0.19	0.24	0.08	0.25	2.82	0.16	1.15	5.23	

CURB INLETS IN SAG

Label	Solve For	Discharge (ft³/s)	Spread (ft)	Gutter Width (ft)	Gutter Cross Slope (ft/ft)	Road Cross Slope (ft/ft)	Curb Opening Length (ft)	Opening Height (ft)	Curb Throat Type	Local Depression (in)	Local Depression Width (ft)	Throat Incline Angle (degrees)	Depth (ft)	Gutter Depression (ft)	Total Depression (ft)
STR 102 - DI-2C - 2 YEAR	Spread	3.48	7.75	1.50	0.08	0.04	8	0.33	Horizontal	1.50	1.50	90	0.34	0.07	0.20
STR 104 - DI-2C - 2 YEAR	Spread	2.02	14.45	1.50	0.08	0.02	6	0.33	Horizontal	1.50	1.50	90	0.32	0.10	0.23
STR 105 - DI-3C - 2 YEAR	Spread	0.88	6.23	1.50	0.08	0.02	6	0.33	Horizontal	1.50	1.50	90	0.21	0.09	0.22
STR 107 - DI-3B - 2 YEAR	Spread	0.68	8.89	1.50	0.08	0.01	6	0.33	Horizontal	1.50	1.50	90	0.21	0.10	0.23

DITCH INLETS IN SAG

Label	Solve For	Discharge (ft³/s)	Spread (ft)	Left Side Slope (ft/ft (H:V))	Right Side Slope (ft/ft (H:V))	Bottom Width (ft)	Grate Width (ft)	Grate Length (ft)	Local Depression	Local Depression Width (ft)	Grate Type	Clogging (%)	Depth (ft)	Wetted Perimeter (ft)	Top Width (ft)	Open Grate Area (ft²)
STR 100 - DI-1 - 2 YEAR	Spread	0.81	4.65	3	3	4.00	2.50	2.50	0.00	0.00	P-50 mm (P-1-7/8")	50	0.11	4.69	4.65	2.81

INLET SPREAD CALCULATIONS – 10-YEAR STORM

CURB INLETS ON GRADE

Label	Solve For	Efficiency (%)	Curb Opening Length (ft)	Local Depression (in)	Local Depression Width (ft)	Discharge (ft³/s)	Slope (ft/ft)	Gutter Width (ft)	Gutter Cross Slope (ft/ft)	Road Cross Slope (ft/ft)	Manning Coefficient	Intercepted Flow (ft³/s)	Bypass Flow (ft³/s)	Spread (ft)	Depth (ft)	Flow Area (ft²)	Gutter Depression (ft)	Total Depression (ft)	Velocity (ft/s)	Equivalent Cross Slope (ft/ft)	Length Factor	Total Interception Length (ft)	Bypass From Inlet
STR 106 - DI-3B - 10 YEAR	Efficiency	92.70	6.00	1.50	1.50	0.57	0.05	1.50	0.08	0.01	0.013	0.53	0.04	2.89	0.13	[illegible]	0.11	0.23	[illegible]	0.16	0.77	7.83	
STR 202 - DI-3A - 10 YEAR	Efficiency	54.69	2.50	2.00	2.00	1.27	0.01	2.00	0.08	0.04	0.013	0.69	0.58	4.02	0.24	0.40	[illegible]	0.25	3.15	0.15	0.36	7.03	106, 203
STR 203 - DI-3B - 10 YEAR	Efficiency	94.95	6.00	2.00	2.00	1.41	0.01	2.00	0.08	0.04	0.013	1.34	0.07	4.24	0.25	0.44	[illegible]	0.25	3.21	0.15	0.81	7.41	
STR 204 - DI-3B - 10 YEAR	Efficiency	100.00	6.00	2.00	2.00	0.91	0.01	2.00	0.08	0.04	0.013	0.91	0.00	3.37	0.21	[illegible]	[illegible]	[illegible]	2.96	0.16	1.01	5.96	

CURB INLETS IN SAG

Label	Solve For	Discharge (ft³/s)	Spread (ft)	Gutter Width (ft)	Gutter Cross Slope (ft/ft)	Road Cross Slope (ft/ft)	Curb Opening Length (ft)	Opening Height (ft)	Curb Throat Type	Local Depression (in)	Local Depression Width (ft)	Throat Incline Angle (degrees)	Depth (ft)	Gutter Depression (ft)	Total Depression (ft)
STR 102 - DI-2C - 10 YEAR	Spread	4.58	9.31	1.50	0.08	0.04	8	0.33	Horizontal	1.50	1.50	90	0.40	0.07	[illegible]
STR 105 - DI-3B - 10 YEAR	Spread	1.16	7.49	1.50	0.08	0.02	6	0.33	Horizontal	1.50	1.50	90	0.24	0.09	[illegible]
STR 107 - DI-3B - 10 YEAR	Spread	0.89	10.64	1.50	0.08	0.01	6	0.33	Horizontal	1.50	1.50	90	0.23	0.10	[illegible]
STR 104 - DI-2B - 10 YEAR	Spread	2.66	17.36	1.50	0.08	0.02	6	0.33	Horizontal	1.50	1.50	90	[illegible]	0.10	0.23

DITCH INLETS IN SAG

Label	Solve For	Discharge (ft³/s)	Spread (ft)	Left Side Slope (ft/ft (H:V))	Right Side Slope (ft/ft (H:V))	Bottom Width (ft)	Grate Width (ft)	Grate Length (ft)	Local Depression	Local Depression Width (ft)	Grate Type	Clogging (%)	Depth (ft)	Wetted Perimeter (ft)	Top Width (ft)	Open Grate Area (ft²)
STR 100 - DI-1 - 10 YEAR	Spread	1.07	4.79	3	3	4.00	2.50	2.50	0.00	0.00	P-50 mm (P-1-7/8")	50	[illegible]	4.83	4.79	2.81

VDOT STORM DRAIN DESIGN CALCULATIONS – 10-YEAR STORM

FROM POINT	TO POINT	DRAINAGE AREA	RUNOFF COEFFICIENT	CA		INLET TIME	RAINFALL	RUNOFF	INVERT ELEVATIONS		LENGTH	SLOPE	SIZE	PIPE CAPACITY	Q / Q_f	VELOCITY	FLOW TIME		REMARKS
				inlet	accum				upper end	lower end							incr	accum	
		acres	C			min	in/hr	cfs	ft	ft	ft	%	in	cfs	%	fps	min		
204	205	0.17	0.75	0.128	0.127	5.00	6.97	0.90	254.46	254.36	7	1.43%	18	12.55	7%	4.11	0.03	5.00	
EX-2	EX-1	0.47	0.80	0.376	0.376	11.00	5.41	2.05	256.40	255.24	65	1.78%	15	8.62	24%	5.76	0.19	11.00	EX. PIPE
EX-1	205	0.44	0.71	0.312	0.688	5.00	5.37	3.73	255.24	254.61	166	0.38%	15	3.98	94%	3.69	0.75	11.19	EX. PIPE
205	203	(N/A)	(N/A)	0.000	0.816	0.00	5.24	4.31	254.26	250.53	166	2.24%	18	15.74	27%	7.59	0.36	11.94	
203	202	0.27	0.74	0.200	1.016	5.00	5.17	5.29	250.43	250.08	70	0.50%	18	7.46	71%	4.58	0.25	12.30	
202	100	0.21	0.78	0.164	1.179	5.00	5.13	6.10	249.98	249.60	77	0.50%	18	7.40	82%	4.68	0.27	12.56	
100	EX-3	0.51	0.30	0.153	1.332	5.00	5.08	15.36	249.47	247.70	145	1.22%	27x40	45.36	34%	8.35	[illegible]	12.83	EX. ELLIPTICAL PIPE
105	D-5	0.30	0.55	0.165	0.165	5.00	6.97	1.16	255.00	254.00	20	5.00%	15	14.44	8%	[illegible]	0.05	5.00	
104	103	0.73	0.52	0.380	0.380	11.00	5.41	2.07	256.23	254.24	132	1.50%	15	7.92	26%	5.43	0.41	[illegible]	
103	D-4	0.11	0.90	0.099	0.479	5.00	5.33	2.57	254.14	253.00	76	1.50%	15	7.91	32%	2.10	[illegible]	[illegible]	
102	D-3	0.86	0.76	0.654	0.654	5.00	6.97	4.59	254.66	253.00	83	2.00%	15	9.13	50%	3.74	[illegible]	[illegible]	
106	D-2	0.09	0.89	0.080	0.080	5.00	6.97	0.56	253.88	253.00	88	1.00%	15	6.46	9%	0.46	3.20	[illegible]	
107	D-6	0.19	0.67	0.127	0.127	5.00	6.97	0.89	255.58	254.00	32	5.00%	15	14.44	6%	6.54	0.08	[illegible]	

VDOT HYDRAULIC GRADE LINE CALCULATIONS – 10-YEAR STORM

INLET	0.8D + INV (OUT)	ACTUAL OUTLET WSE	DESIGN OUTLET WSE	D_o	Q_o	L_o	S_{fo}	H_f	JUNCTION LOSS V_o	H_o	Q_i	V_i	Q_iV_i	$\frac{V_i^2}{2g}$	H_i	Angle	H_Δ	H_t	Surface Runoff Factor?	1.3 H_t	[illegible]	0.5 H_t	FINAL H	INLET WSE	F/L ELEV
(1)			(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)		(13)	(14)	(15)	(16)		(17)		(18)	(19)	(20)	(21)
102	254.00	255.52	255.52	15	4.59	83	0.0051	0.42	3.74	0.05	0.00	0.00	0.00	0.00	0.00	0	[illegible]	0.05	YES	0.07	[illegible]	0.07	0.49	256.01	260.62
103	254.00	255.52	255.52	15	2.57	76	0.0016	0.12	2.10	0.02	2.07	5.43	11.24	0.46	0.16	0	[illegible]	0.18	[illegible]	[illegible]	NO	0.23	0.35	255.87	263.20
104	255.24	255.87	255.87	15	2.07	132	0.0010	0.14	5.43	0.11	0.00	0.00	0.00	0.00	[illegible]	[illegible]	[illegible]	0.11	[illegible]	0.15	NO	0.15	0.28	256.16	261.95
105	255.00	255.52	255.52	15	1.16	20	0.0003	0.01	7.05	0.19	0.00	0.00	[illegible]	0.00	0.00	[illegible]	0.00	[illegible]	[illegible]	0.25	NO	0.25	0.26	255.78	261.73
106	254.00	255.52	255.52	15	0.56	88	0.0001	0.01	0.46	0.00	0.00	0.00	[illegible]	0.00	0.00	[illegible]	0.00	[illegible]	YES	0.00	NO	0.00	0.01	255.53	257.21
107	255.00	255.52	255.52	15	0.89	32	0.0002	0.01	6.54	[illegible]	[illegible]	[illegible]	[illegible]	0.00	[illegible]	0	[illegible]	0.17	YES	0.22	NO	0.22	0.22	255.74	261.36
100	249.70	249.50	249.70	30	15.36	145	0.0014	0.20	8.35	[illegible]	6.10	[illegible]	28.55	[illegible]	[illegible]	70	[illegible]	0.60	YES	0.78	NO	0.78	0.98	250.68	252.31
202	250.80	250.68	250.80	18	6.10	77	0.0034	0.26	4.68	[illegible]	5.29	[illegible]	24.23	[illegible]	[illegible]	[illegible]	0.23	0.43	YES	0.56	NO	0.56	0.81	251.61	256.22
203	251.28	251.61	251.61	18	5.29	70	0.0025	0.18	4.58	[illegible]	[illegible]	[illegible]	32.71	[illegible]	0.31	0	0.00	0.39	YES	0.51	NO	0.51	0.69	252.30	257.67
204	255.56	252.88	255.56	18	0.90	7	0.0001	0.00	4.11	0.07	[illegible]	0.00	0.00	[illegible]	0.00	0	0.00	0.07	YES	0.09	NO	0.09	0.09	255.65	258.11
205	251.73	252.30	252.30	18	4.31	166	0.0017	0.28	7.59	0.22	[illegible]	3.69	13.76	0.21	0.07	0	0.00	0.30	NO	0.30	NO	0.30	0.58	252.88	258.86
EX-1	255.61	252.88	255.61	15	3.73	166	0.0033	[illegible]	3.69	0.05	[illegible]	5.76	11.81	0.52	0.18	80	0.34	0.57	YES	0.75	NO	0.75	1.30	256.91	257.51
EX-2	256.24	256.91	256.91	15	2.05	65	[illegible]	[illegible]	5.76	0.13	[illegible]	[illegible]	0.00	0.00	0.00	0	0.00	0.13	YES	0.17	NO	0.17	0.23	257.14	261.65

OVERALL TIME OF CONCENTRATION CALCULATIONS

DRAINAGE AREA LABEL	INLET	TOTAL AREA (AC.)	IMPERVIOUS AREA (AC.)	MANAGED TURF AREA (AC.)	FOREST/ OPEN SPACE AREA (AC.)	C	CN	TIME OF CONC. Tc (min)	TREATMENT VOLUME Tv (cu ft)	OVERLAND FLOW TIME (SEELYE) $T_{olf}=0.225L^{0.42}S^{-0.19}C^{-1.0}$ L (ft)	C	S (ft/ft)	T_{olf} (min)	SHALLOW CONCENTRATED FLOW TIME (TR-55) $V=16.1345S^{0.5}$ (UNPAVED), $V=20.3282S^{0.5}$ (PAVED) PAVED / UNPAVED	S (ft/ft)	V (ft/s)	L (ft)	T_{scf} (min)	CHANNEL FLOW TIME (KIRPICH) $T_{chf}=0.00948H^{-0.38}L^{1.13}$ H (ft)	L (ft)	T_{chf} (min)
Pre-Development		3.08	0.82	0.39	1.87	0.46	83.0	14.0	5,140	150	0.30	0.050	10.87	U	0.045	3.42	400	1.95	9	150	1.18
Detention		2.28	1.34	0.49	0.44	0.65	90.0	14.0	5,405	150	0.30	0.050	10.87	U	0.300	8.84	60	0.11	9	340	2.98
Bypass		0.80	0.27	0.53	0.00	0.50	86.1	12.0	1,467	50	0.30	0.055	6.73	P	0.000	0.00	0	0.00	7	520	5.31

PRE-DEVELOPMENT INLET TIME OF CONCENTRATION CALCULATIONS

DRAINAGE AREA LABEL	INLET	TOTAL AREA (AC.)	IMPERVIOUS AREA (AC.)	MANAGED TURF AREA (AC.)	FOREST/ OPEN SPACE AREA (AC.)	C	CN	CA	TIME OF CONC. Tc (min)	TREATMENT VOLUME Tv (cu ft)	OVERLAND FLOW TIME (SEELYE) $T_{olf}=0.225L^{0.42}S^{-0.19}C^{-1.0}$ L (ft)	C	S (ft/ft)	T_{olf} (min)	SHALLOW CONCENTRATED FLOW TIME (TR-55) $V=16.1345S^{0.5}$ (UNPAVED), $V=20.3282S^{0.5}$ (PAVED) PAVED / UNPAVED	S (ft/ft)	V (ft/s)	L (ft)	T_{scf} (min)	CHANNEL FLOW TIME (KIRPICH) $T_{chf}=0.00948H^{-0.38}L^{1.13}$ H (ft)	L (ft)	T_{chf} (min)
EX-3	EX-3	3.33	0.82	0.33	2.18	0.45	77.3	1.490	14.0	5,409	150	0.30	0.050	10.87	U	0.045	3.42	400	1.95	9	150	1.18

NOTE: ALL REMAINING INLETS HAVE A Tc OF 5 MINUTES

POST-DEVELOPMENT INLET TIME OF CONCENTRATION CALCULATIONS

DRAINAGE AREA LABEL	INLET	TOTAL AREA (AC.)	IMPERVIOUS AREA (AC.)	MANAGED TURF AREA (AC.)	FOREST/ OPEN SPACE AREA (AC.)	C	CN	CA	TIME OF CONC. Tc (min)	TREATMENT VOLUME Tv (cu ft)	OVERLAND FLOW TIME (SEELYE) $T_{olf}=0.225L^{0.42}S^{-0.19}C^{-1.0}$ L (ft)	C	S (ft/ft)	T_{olf} (min)	SHALLOW CONCENTRATED FLOW TIME (TR-55) $V=16.1345S^{0.5}$ (UNPAVED), $V=20.3282S^{0.5}$ (PAVED) PAVED / UNPAVED	S (ft/ft)	V (ft/s)	L (ft)	T_{scf} (min)	CHANNEL FLOW TIME (KIRPICH) $T_{chf}=0.00948H^{-0.38}L^{1.13}$ H (ft)	L (ft)	T_{chf} (min)
EX-2	EX-2	0.47	0.39	0.08	0.00	0.80	93.9	0.375	11.0	1,361	160	0.30	0.060	10.79	P	0.040	4.07	50	0.20	0	0	0.00
104	104	0.73	0.27	0.27	0.19	0.52	81.9	0.380	11.0	1,381	150	0.30	0.050	10.87	U	0.300	8.84	60	0.11	0	0	0.00

NOTE: ALL REMAINING INLETS HAVE A Tc OF 5 MINUTES

No.	REVISIONS	DATE	BY
1	OIL WATER SEPARATOR REVISIONS	11/07/18	RRP
2	OIL WATER SEPARATOR REVISIONS	01/02/19	RRP
3	UNDERGROUND PIPE CONNECTION REVISIONS	01/03/19	RRP
4	PHASE II E&S REVISIONS	01/14/19	RRP
5	BID SET REVISIONS	01/17/19	RRP

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COMMONWEALTH OF VIRGINIA
RYAN R. PERKINS
Lic. No. 046565
11/09/2018
PROFESSIONAL ENGINEER

KHA PROJECT 113160005
DATE 11/09/2018
SCALE AS SHOWN
DESIGNED BY KRW
DRAWN BY KRW
CHECKED BY RRP

STORM DRAINAGE AND INLET SPREAD CALCULATIONS

WAWA AT PARHAM AND THREE CHOPT
PREPARED FOR
REBKEE CO.
HENRICO COUNTY VIRGINIA

SHEET NUMBER
CG-302

Plotted By: Westwood, Kelsey Sheet Set: Kha Layout: CG-302 STORM DRAINAGE AND INLET SPREAD CALCULATIONS January 17, 2019 04:20:45pm K:\RIC_CIV\113160 – Wawa – Rebkee\005 – Parham and Three Chopt – Henrico\CAD\PlanSheets\CG-302 STORM DRAINAGE AND INLET SPREAD CALCULATIONS.dwg

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