

Tc Calc Explanations

Column	Explanation
0	Subcatchment name from GIS model, Basin_8_sub_basins and Basin_7_sub_basins.shp
1	Drainage area of the sub-basin in acres
2	Precipitation from Gillette Stormdrainage Criteria Manual
3	Upland flow Manning's n from Gillette Stormdrainage Criteria Manual
4	Length of Upland Flow. 300 ft for unpaved surfaces, 150' for paved surfaces
5	Average slope of the subcatchment ground surface. USGS NED data (project_ned_1) was transformed to slope data (slope3) with the slope function in ESRI Spatial Analyst. The Hawth's Tool "Clip Raster by Polygon" for ESRI ArcMap was used to seperate the slope data into individual basins. The average slope of each basin was taken from the raster statistics calculated by ArcMap.
6	Travel time for upland flow $Tt = 0.007(nL)^{0.8}/((P_2)^{0.5} s^{0.4})$
7	An unpaved surface was assumed for all subcatchments in subdivisions of Basin 8 except those that were industrial sites. All of Basin 7 was assumed unpaved.
8	The shallow conc. flow length from GIS model, TC Length, TC_lengths.shp
9	Elevation at the top of the shallow concentrated flow
10	Elevation at the bottom of the shallow concentrated flow
11	Average slope along the concentrated flow length
12	Velocities were calculated using the equations provided in appendix F of TR-55. Unpaved: $V = 16.1345 (s)^{0.5}$, Paved: $V = 20.3282 (s)^{0.5}$
13	Travel time for Shallow Concentrated Flow $T2 = \text{Length}/\text{Velocity}/(3600\text{sec/hr})$
14	Channel type was assigned based on land use around the open channel. Channel geometry was determined based on channel type
15	Flow area based on a channel geometry of:

ID	Type	Bottom width (ft)	Side Slope_R	Side Slope_L	LF Depth (ft)	OB_R Length(ft)	OB_L Length(ft)	Side Slope_OR	Side Slope_OL	Note-1	Note-2
1	Agricultural	15	1.5	1.5							Agricultural
2	Suburban	0	2	4							Suburban
3	Urban	0	50	0	0.5	0	0	50	50	Street & Gutter	Urban
4	Conc. Rectangular	15	0	0							Conc Rectangular
5	Natural -1	23	2.3	5							Natural Stream -1
6	Natural -2	29	4	1.6							Natural Stream -2
7	Natural -3	33	3.6	22							Natural Stream -3
8	Natural -4	5	1.25	5.5							Natural Stream -4
9	Natural -5	9	5.5	7.8							Natural Stream -5
10	Natural Ephem -1	2.5	9	5							Natural Ephem Stream -1
11	Natural Ephem -2	3	2	2.7							Natural Ephem Stream -2
12	Natural Ephem -3	5	6.7	6							Natural Ephem Stream -3
13	Natural Ephem -4	3	175	21							Natural Ephem Stream -4
14	Natural Ephem -5	3	5.25	12.5							Natural Ephem Stream -5
15	Constructed 1	25	15	15							
16	Natural Ephem -6	0	25	25							
17	Constructed 2	5	4	4							
18	Natural Ephem -7	0	15	15							Natural Ephem Stream -7
19	Grass Channel	2.5	2	2							
20	Grass Channel 2	5	4	4							

16	Wetted perimeter based on a channel geometry of 5' bottom width, 5' flow depth and 2:1 side slopes.
17	Hydraulic radius, $r = a/p_w$
18	Length of open channel flow from GIS model, TC Length, TC_lengths.shp
19	Elevation at top of open channel flow
20	Elevation at bottom of open channel flow
21	Average slope along the open channel flow length
22	Mannings n for open channel flow was approximated based on the Gillette Design Criteria Manual
23	Velocity was calculated using eqn. 3-1 of TR-55. $V = 1.$ 1
24	Travel time for Open Channel Flow $T2 = \text{Length}/\text{Velocity}/(3600\text{sec/hr})$
25	Time of concentration using TR-55 method, $Tc = \text{sum of the travel times}$
26	Time lag = Time of Concentration * 0.6

Tc Calc Explanations																													
Basin	DONKEY CREEK	Upland (Sheet) Flow Travel Time							Shallow Concentrated Flow							Open Channel Flow												Tc	
	Basin Area	2yr 24 hr Rainfall, P2	Manning's n	Length, L	Slope, s		Slope, s	Upland T1	Surface*	Length	El @Top	El @Bot	Slope	Velocity	Shallow T2	Channel Type	Design Flow	Flow Depth	Flow Area, a	Wetted Perimeter,p _w	Hydraulic Radius, r	Length	El @ Top	El @ Bottom	Slope	Mannings n	Velocity		Travel Time, T3
	(ac)	(in)		(ft)	Slope, s Start	Slope, s End	pct	(hr)	P or U	(ft)	(ft)	(ft)	pct	(ft/s)	(hr)		(cfs)	(ft)	(ft ²)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	%			(ft/s)
0	1	2	3	4	Start	Slope, s End	5	6	7	8	9	10	11	12	13	14	15	16	15	16	17	18	19	20	21	22	23	24	25
1	3692	1.6	0.13	300	4865	4820	15.00	0.222	U	992	4820	4700	12.09	5.61	0.0491	Natural Ephem -3	1846	5.8	244.9	79.9	3.1	23287	4700	4535	0.71	0.035	8	0.86	68
1	3692															Natural -5	1846	6.4	329.6	95.1	3.5	8212	4535	4515	0.24	0.030	6	0.41	24
5	5658	1.6	0.13	300	4831	4823	2.67	0.442	U	516	4823	4776	9.12	4.87	0.0294	Natural Ephem -5	2829	4.7	209.4	86.9	2.4	4469	4776	4636	3.13	0.035	14	0.09	34
5	5658															Suburban	2829	9.9	296.1	63.2	4.7	4645	4636	4606	0.65	0.035	10	0.14	8
5	5658															Suburban	2829	8.5	218.7	54.3	4.0	4885	4606	4554	1.06	0.030	13	0.10	6
5	5658															Grass Channel 2	2829	8.9	362.1	78.5	4.6	16062	4554	4502	0.32	0.030	8	0.57	34
5	5658															Natural -3	2829	6.5	745.5	199.2	3.7	19806	4502	4482	0.10	0.030	4	1.45	87
6	14189	1.6	0.13	300	4950	4900	16.67	0.212	U	906	4900	4790	12.15	5.62	0.0447	Natural Ephem -3	7095	7.6	400.0	102.1	3.9	11113	4970	4656	2.83	0.035	18	0.17	26
6	14189															Natural Ephem -3	7095	7.6	404.0	102.6	3.9	5380	4756	4608	2.75	0.035	18	0.09	5
6	14189															Natural -3	7095	7.2	902.4	218.6	4.1	31012	4608	4490	0.38	0.030	8	1.10	66
6	14189															Natural -3	7095	8.6	1233.5	254.8	4.8	24292	4490	4450	0.16	0.030	6	1.17	70
7	5341	1.6	0.13	300	4870	4860	3.33	0.404	U	153	4860	4855	3.28	2.92	0.0145	Natural Ephem -3	2670	5.2	199.5	72.2	2.8	6051	4855	4700	2.56	0.035	13	0.13	33
7	5341															Natural -4	2670	8.4	280.7	65.5	4.3	33241	4700	4524	0.53	0.030	10	0.97	58
7	5341															Natural -5	2670	9.2	643.9	132.6	4.9	3520	4524	4521	0.09	0.030	4	0.24	14
8	1213	1.6	0.13	300	4722	4688	11.33	0.248	U	521	4688	4652	6.91	4.24	0.0341	Urban	607	1.3	54.7	102.1	0.5	2507	4688	4560	5.11	0.020	11	0.06	21
8	1213															Natural Ephem -2	607	4.7	66.4	27.1	2.4	2133	4560	4538	1.03	0.030	9	0.06	4
8	1213															Natural Ephem -2	607	5.4	84.2	30.5	2.8	8956	4538	4504	0.38	0.025	7	0.35	21
9	2035	1.6	0.13	300	4772	4750	7.33	0.295	U	732	4750	4696	7.38	4.38	0.0464	Natural Ephem -3	1018	4.1	125.0	57.2	2.2	11865	4696	4542	1.30	0.035	8	0.40	45
10	5507	1.6	0.13	300	4965	4920	15.00	0.222	U	1205.16	4920	4855	5.39	3.75	0.0893	Natural Ephem -3	2753	6.6	305.6	89.3	3.4	21892	4855	4664	0.87	0.035	9	0.68	59
10	5507															Natural Ephem -3	2753	7.5	394.6	101.4	3.9	20848	4664	4572	0.44	0.035	7	0.83	50
11	3539	1.6	0.13	300	4928	4910	6.00	0.320	U	1257.53	4910	4865	3.58	3.05	0.1144	Natural Ephem -3	1769	5.2	198.8	72.0	2.8	13199	4865	4715	1.14	0.035	9	0.41	51
11	3539															Natural Ephem -2	1769	8.5	196.2	46.6	4.2	8195	4715	4644	0.87	0.040	9	0.25	15
11	3539															Grass Channel	1769	7.9	143.8	37.7	3.8	3890	4644	4616	0.72	0.025	12	0.09	5
12	12711	1.6	0.13	300	4960	4900	20.00	0.197	U	3758.88	4900	4810	2.39	2.50	0.4182	Natural -3	6355	6.8	826.3	209.4	3.9	31542	4810	4644	0.53	0.035	8	1.14	105
12	12711															Natural -3	6355	8.0	1090.1	239.8	4.5	29553	4644	4570	0.25	0.035	6	1.41	84

Subcatchment ID	Upland (Sheet) Flow Travel Time																Shallow Concentrated Flow										Open Channel Flow														
	Basin Area	2yr 24 hr Rainfall, P2	Manning's n	Length, L	Slope, s			Upland T1	Surface*	Length	El @Top	El @ Bot	Slope	Velocity	Shallow T2	Channel Type	Design Flow	Flow Depth	Flow Area, a	Wetted Perimeter,p _w	Hydraulic Radius, r	Length	El @ Top	El @ Bottom	Slope	Mannings n	Velocity	Travel Time, T3	Tc												
	(ac)	(in)		(ft)	Slope, s	Slope, s	pct	(hr)	P or U	(ft)	(ft)	(ft)	pct	(ft/s)	(hr)		(cfs)	(ft)	(ft ²)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	%		(ft/s)	(hr)	(min)											
0	1	2	3	4	Start	End	5	6	7	8	9	10	11	12	13	14	15	16	15	16	17	18	19	20	21	22	23	24	25												
101	678	1.6	0.13	300	4865	4820	15.00	0.222	U	992	4820	4700	12.09	5.61	0.0491	Natural -5	339	2.6	69.1	44.2	1.6	9495	4700	4630	0.74	0.035	5	0.54	48												
102	896	1.6	0.13	300	4680	4665	5.00	0.344	U	6359	4685	4538	2.31	2.45	0.7201	Natural Ephem -3	448	3.3	85.9	47.5	1.8	7052	4538	4475	0.89	0.040	5	0.38	86												
103	430	1.6	0.13	300	4582	4575	2.33	0.466	U	1551.67	4575	4540	2.26	2.42	0.1779	Natural Ephem -4	215	0.9	79.7	176.8	0.5	3850	4540	4495	1.17	0.035	3	0.40	62												
104	609	1.6	0.13	300	4585	4565	6.67	0.306	U	1463	4565	4530	2.39	2.50	0.1629	Natural Ephem -5	304	2.0	41.5	38.8	1.1	1751	4530	4495	2.00	0.030	7	0.07	32												
104	609	1.6														Natural -5	305	2.1	48.6	37.4	1.3	3913	4495	4435	1.53	0.035	6	0.17	10												
105	216	1.6	0.13	300	4552	4550	0.67	0.770	P	425	4550	4544	1.41	2.42	0.0489	Suburban	108	2.3	16.5	14.9	1.1	4385	4544	4452	2.10	0.035	7	0.19	60												
105	216	1.6														Natural -4	108	2.7	37.5	24.2	1.5	2113	4452	4448	0.19	0.030	3	0.20	12												
106	177	1.6	0.13	300	4534	4530	1.33	0.583	U	1448	4530	4497	2.28	2.44	0.1652	Natural Ephem -3	88	1.0	10.6	17.3	0.6	896	4497	4448	5.47	0.030	8	0.03	47												
106	177															Natural -5	89	1.9	40.9	34.5	1.2	2898	4448	4442	0.21	0.035	2	0.37	22												
107	251	1.6	0.13	300	4525	4520	1.67	0.534	U	3675	4520	4440	2.18	2.38	0.4288	Natural -5	126	2.3	56.9	40.3	1.4	1818	4440	4438	0.11	0.030	2	0.23	71												
108	435	1.6	0.13	300	4550	4542	2.67	0.442	U	2995	4542	4510	1.07	1.67	0.4988	Natural Ephem -4	218	0.6	43.2	130.2	0.3	1305	4510	4430	6.13	0.035	5	0.07	61												
108	435															Natural -5	218	2.8	78.0	46.9	1.7	6830	4430	4419	0.16	0.030	3	0.68	41												

Subcatchment ID	Upland (Sheet) Flow Travel Time								Shallow Concentrated Flow							Open Channel Flow														
	Basin Area	2yr 24 hr Rainfall, P2	Manning's n	Length, L	Slope, s		Slope, s	Upland T1	Surface*	Length	El @ Top	El @Bot	Slope	Velocity	Shallow T2	Channel Type	Design Flow	Flow Depth	Flow Area, a	Wetted Perimeter,p _w	Hydraulic Radius, r	Length	El @ Top	El @ Bottom	Slope	Mannings n	Velocity	Travel Time, T3	Tc	
	(ac)	(in)		(ft)	Slope, s	End	pct	(hr)	P or U	(ft)	(ft)	(ft)	pct	(ft/s)	(hr)		(cfs)	(ft)	(ft²)	(ft)	(ft)	(ft)	(ft)	(ft)	%		(ft/s)			
0	1	2	3	4	Start	End	5	6	7	8	9	10	11	12	13	14	15	16	15	16	17	18	19	20	21	22	23	Calc.	24	25
101	103	1.6	0.13	300	4534	4524	3.33	0.404	U	2209	4524	4490	1.54	2.00	0.3065		-1								0	0.035	9	0	43	
102	155	1.6	0.13	116	4534	4522	10.32	0.120								Natural -3	78	0.6	24.8	48.7	0.5	2708	4522	4486	1.33	0.035	3	0.24	22	
103	199	1.6	0.13	300	4590	4568	7.33	0.295	U	1143	4568	4538	2.62	2.61	0.1215	Natural Ephem -1	99	1.5	18.4	23.0	0.8	1909	4538	4496	2.20	0.035	5	0.10	31	
104	384	1.6	0.13	300	4546	4522	8.00	0.285	U	1100	4522	4508	1.27	1.82	0.1679	Natural Ephem -6	192	1.5	59.5	77.2	0.8	5794	4508	4446	1.07	0.040	3	0.50	57	
105	49	1.6	0.13	300	4570	4554	5.33	0.335	U	607	4554	4530	3.95	3.21	0.0526	Natural ephem -7	24	0.7	8.0	22.0	0.4	1625	4530	4498	1.97	0.035	3	0.15	32	
106	123	1.6	0.13	300	4585	4578	2.33	0.466	U	940	4578	4541	3.94	3.20	0.0816	Suburban	62	1.9	10.9	12.1	0.9	2086	4541	4498	2.06	0.035	6	0.10	39	
107	139	1.6	0.13	300	4585	4570	5.00	0.344	U	1335	4450	4434	1.20	1.77	0.2098	Natural Ephem -1	70	1.0	9.4	16.6	0.6	1855	4570	4450	6.47	0.035	7	0.07	37	
108	55	1.6	0.13	291	4592	4574	6.19	0.308	U	289	4574	4556	6.23	4.03	0.0199	Suburban	28	1.3	5.4	8.6	0.6	2858	4556	4458	3.43	0.040	5	0.16	29	
109	85	1.6	0.05	143	4545	4540	3.49	0.102	U	1570	4497	4488	0.57	1.22	0.3570	Natural Ephem -2	42	1.0	5.6	8.3	0.7	1100	4540	4497	3.91	0.030	8	0.04	30	
110	153	1.6	0.13	300	4528	4524	1.33	0.583	U	1386	4524	4504	1.44	1.94	0.1986	Suburban	76	2.6	20.2	16.5	1.2	2245	4504	4494	0.45	0.030	4	0.16	57	
110	153	1.6	0.13													Conc. Rectangular	77	0.9	14.1	16.9	0.8	3181	4494	4482	0.38	0.015	5	0.16	10	
111	39	1.6	0.13	300	4540	4504	12.00	0.242	U	1114	4504	4490	1.26	1.81	0.1711	Suburban	19	1.1	3.5	6.9	0.5	433.3	4490	4472	4.15	0.035	6	0.02	26	
112	18	1.6	0.011	32	4539	4538	3.17	0.009								Suburban	9	0.8	2.0	5.1	0.4	2176	4538	4448	4.14	0.035	5	0.13	9	
113	121	1.6	0.13	300	4588	4562	8.67	0.276	U	374	4562	4534	7.49	4.41	0.0235	Suburban	60	1.8	9.5	11.3	0.8	1984	4534	4478	2.82	0.035	6	0.09	23	
113	121	1.6	0.13													Natural Ephem -1	61	1.6	21.4	24.9	0.9	2220	4478	4466	0.54	0.035	3	0.22	13	
114	122	1.6	0.13	300	4564	4547	5.67	0.327	U	2149	4447	4426	0.98	1.59	0.3743	Natural ephem -7	61	1.0	14.6	29.6	0.5	643.6	4426	4410	2.49	0.035	4	0.04	45	
115	33	1.6	0.13	55	4481	4477	7.27	0.076	U	99	4477	4472	5.05	3.63	0.0076	Natural -3	17	0.2	8.6	39.1	0.2	2015	4472	4440	1.59	0.035	2	0.29	22	
116	579	1.6	0.13	118	4559	4555	3.39	0.190	U	230	4555	4525	13.04	5.83	0.0110	Suburban	290	4.1	49.4	25.8	1.9	8857	4525	4454	0.80	0.035	6	0.42	37	
117	216	1.6	0.13	105	4504	4490	13.33	0.100	U	1742	4490	4426	3.67	3.09	0.1565	Natural ephem -7	108	1.8	48.3	53.9	0.9	2480	4426	4418	0.32	0.035	2	0.31	34	

Subcatchment ID	Upland (Sheet) Flow Travel Time								Shallow Concentrated Flow							Open Channel Flow														Tc
	Basin Area	2yr 24 hr Rainfall, P2	Manning's n	Length, L			Slope, s	Upland T1	Surface*	Length	El @ Top	El @ Bot	Slope	Velocity	Shallow T2	Channel Type	Design Flow	Flow Depth	Flow Area, a	Wetted Perimeter,p _w	Hydraulic Radius, r	Length	El @ Top	El @ Bottom	Slope	Mannings n	Velocity	Travel Time, T3		
	(ac)	(in)		(ft)	Slope, s	Slope, s	pct	(hr)	P or U	(ft)	(ft)	(ft)	pct	(ft/s)	(hr)		(cfs)	(ft)	(ft²)	(ft)	(ft)	(ft)	(ft)	(ft)	%		(ft/s)		(hr)	
0	1	2	3	4	Start	End	5	6	7	8	9	10	11	12	13	14	15	16	15	16	17	18	19	20	21	22	23	Calc.	24	25
101	55	1.6	0.013	234	4514	4502	5.13	0.044	U	829	4502	4480	2.65	2.63	0.0876	Natural Ephem -6	27.3133605	0.8	14.4	37.9	0.4	1095	4480	4472	0.73	0.035	2	0.16	18	
102	133	1.6	0.013	300	4532	4504	9.33	0.042	U	1214	4504	4466	3.13	2.85	0.1181	Conc. Rectangular	66.5083925	0.9	13.3	16.8	0.8	3011	4466	4454	0.40	0.016	5	0.17	20	
103	94	1.6	0.013	300	4530	4524	2.00	0.079	U	986	4524	4496	2.84	2.72	0.1007	Natural ephem -7	46.8329725	1.0	14.6	29.7	0.5	2381	4496	4461	1.47	0.035	3	0.21	23	
104	197	1.6	0.013	300	4582	4576	2.00	0.079	U	1325	4576	4532	3.32	2.94	0.1252	Natural Ephem -6	98.363611	1.1	29.6	54.5	0.5	2325	4532	4500	1.38	0.035	3	0.19	24	
105	378	1.6	0.013	300	4546	4535	3.67	0.062	U	1290	4535	4501	2.64	2.62	0.1367	Natural Ephem -6	188.800785	1.5	58.0	76.2	0.8	3898	4501	4468	0.85	0.035	3	0.33	32	
106	513	1.6	0.013	300	4522	4520	0.67	0.122	U	4660	4520	4465	1.18	1.75	0.7385	Natural Ephem -3	256.57748	2.2	41.5	33.2	1.3	4778	4465	4390	1.57	0.035	6	0.21	65	
107	258	1.6	0.013	300	4545	4535	3.33	0.064	U	906	4535	4500	3.86	3.17	0.0794	Natural ephem -7	129.190218	1.2	21.5	36.0	0.6	1150	4500	4440	5.22	0.040	6	0.05	12	
107	258															Natural -3	129.190218	0.9	39.0	55.7	0.7	4095	4440	4400	0.98	0.035	3	0.34	21	

Subcatchment ID	Upland (Sheet) Flow Travel Time								Shallow Concentrated Flow							Open Channel Flow														
	Basin Area	2yr 24 hr Rainfall, P2	Manning's n	Length, L	Slope, s		Slope, s	Upland T1	Surface*	Length	El @ Top	El @Bot	Slope	Velocity	Shallow T2	Channel Type	Design Flow	Flow Depth	Flow Area, a	Wetted Perimeter,p _w	Hydraulic Radius, r	Length	El @ Top	El @ Bottom	Slope	Mannings n	Velocity	Travel Time, T3	Tc	
	(ac)	(in)		(ft)	Slope, s	Slope, s	pct	(hr)	P or U	(ft)	(ft)	(ft)	pct	(ft/s)	(hr)		(cfs)	(ft)	(ft ²)	(ft)	(ft)	(ft)	(ft)	(ft)	%		(ft/s)	Calc.	(hr)	(min)
0	1	2	3	4	Start	End	5	6	7	8	9	10	11	12	13	14	15	16	15	16	17	18	19	20	21	22	23	24	25	
101	108	1.6	0.13	170	4539	4526	7.67	0.184	U	1237	4526	4506	1.62	2.05	0.1675	Natural ephem -7	54	1.3	23.4	37.6	0.6	1810	4506	4496	0.55	0.035	2	0.22	34	
102	127	1.6	0.05	39	4525	4524	2.57	0.041	U	252	4524	4518	2.38	2.49	0.0282	Suburban	64	2.1	12.7	13.1	1.0	3182	4518	4484	1.07	0.030	5	0.18	15	
103	8	1.6	0.13	70	4526	4520	8.57	0.087	P	106	4520	4516	3.77	3.95	0.0075	Suburban	4	0.6	1.2	4.1	0.3	543.8	4516	4504	2.21	0.030	3	0.05	8	
104	489	1.6	0.13	300	4566	4550	5.33	0.335	U	1020	4550	4522	2.74	2.67	0.1060	Natural Ephem -5	245	2.1	45.2	40.5	1.1	2999	4522	4480	1.40	0.035	5	0.15	36	
105	33	1.6	0.13	300	4550	4530	6.67	0.306	U	189	4530	4516	7.41	4.39	0.0120	Suburban	17	1.0	3.3	6.7	0.5	1210	4516	4484	2.65	0.030	5	0.07	23	
105	33															Suburban	17	1.5	7.0	9.7	0.7	563.2	4484	4482	0.36	0.030	2	0.07	4	
106	15	1.6	0.05	300	4493	4486	2.33	0.217	P	769	4486	4473	1.69	2.64	0.0807		-1												18	
107	18	1.6	0.05	117	4488	4484	3.43	0.087	U	209	4484	4482	0.96	1.58	0.0368	Grass Channel 2	9	0.3	2.2	7.9	0.3	1075	4482	4466	1.49	0.020	4	0.08	12	
108	54	1.6	0.011	170	4592	4588	2.35	0.041	U	113	4588	4570	15.93	6.44	0.0049	Suburban	27	1.2	4.1	7.4	0.6	2125	4570	4488	3.86	0.030	7	0.09	8	
109	105	1.6	0.011	14	4531	4530.5	3.51	0.005	U	480	4530	4502	5.83	3.90	0.0342	Urban	52	1.0	29.3	72.8	0.4	1825	4458	4456	0.11	0.015	2	0.28	19	
109	105	1.6														Grass Channel 2	53	0.6	4.8	10.2	0.5	719.7	4502	4458	6.11	0.020	11	0.02	1	
110	143	1.6	0.13	145	4574	4570	2.76	0.244	U	1789	4570	4478	5.14	3.66	0.1358	Natural Ephem -7	71	1.0	15.3	30.4	0.5	936	4478	4450	2.99	0.035	5	0.06	26	
110	143	1.6														Grass Channel 2	71	2.0	26.0	21.5	1.2	839.1	4450	4448	0.24	0.030	3	0.08	5	
111	352	1.6	0.13	242	4580	4574	2.48	0.383	U	595	4574	4530	7.39	4.39	0.0377	Natural Ephem -1	176	1.7	25.3	27.0	0.9	3130	4530	4438	2.94	0.035	7	0.12	33	
111	352															Natural -4	176	2.8	40.7	25.2	1.6	6045	4438	4405	0.55	0.035	4	0.39	23	
112	90	1.6	0.13	300	4638	4618	6.67	0.306	U	437	4618	4566	11.91	5.57	0.0218	Natural Ephem -2	45	1.2	7.3	9.3	0.8	5403	4566	4408	2.92	0.035	6	0.24	34	
113	95	1.6	0.13	24	4696	4692	16.67	0.028	U	527	4692	4658	6.45	4.10	0.0357	Natural Ephem -3	48	0.6	5.9	13.3	0.4	255	4658	4630	10.98	0.035	8	0.01	4	
113	95									419	4630	4588	10.02	5.11	0.0228	Natural Ephem -7	48	0.8	8.9	23.2	0.4	1691	4588	4492	5.68	0.035	5	0.09	7	
114	407	1.6	0.13	300	4613	4603	3.33	0.404	U	1525	4503	4472	2.03	2.30	0.1841	Natural Ephem -1	203	2.3	41.4	34.5	1.2	3059	4472	4440	1.05	0.035	5	0.17	46	
114	407															Natural Ephem -7	203	2.0	57.5	58.9	1.0	3916	4440	4412	0.71	0.035	4	0.31	18	

Subcatchment ID	Upland (Sheet) Flow Travel Time								Shallow Concentrated Flow						Open Channel Flow													Tc (min)	
	Basin Area	2yr 24 hr Rainfall, P2	Manning's n	Length, L			Slope, s	Upland T1	Surface*	Length	El @Top	El @Bot	Slope	Velocity	Shallow T2	Channel Type	Design Flow	Flow Depth	Flow Area, a	Wetted Perimeter,p _w	Hydraulic Radius, r	Length	El @ Top	El @ Bottom	Slope	Mannings n	Velocity		Travel Time, T3
	(ac)	(in)		(ft)	Slope, s	Slope, s	pct	(hr)	P or U	(ft)	(ft)	(ft)	pct	(ft/s)	(hr)		(cfs)	(ft)	(ft ²)	(ft)	(ft)	(ft)	(ft)	(ft)	%		(ft/s)		(hr)
0	1	2	3	4	Start	End	5	6	7	8	9	10	11	12	13	14	15	16	15	16	17	18	19	20	21	22	23	24	25
101	75	1.6	0.011	240	4836	4830	2.50	0.053	U	837	4830	4778	6.21	4.02	0.0578	Natural Ephem -2	37	1.0	5.1	7.9	0.6	2521	4778	4675	4.09	0.030	7	0.09	12
102	140	1.6	0.13	300	4794	4768	8.67	0.276	U	710	4768	4710	8.17	4.61	0.0428	Natural Ephem -2	70	1.5	9.3	10.4	0.9	2085	4710	4634	3.65	0.035	8	0.08	24
103	41	1.6	0.011	29	4647	4646	3.51	0.008	U	873	4646	4616	3.44	2.99	0.0810	Suburban	21	1.5	6.9	9.7	0.7	1771	4616	4606	0.56	0.030	3	0.16	15
104	21	1.6	0.011	34	4718	4717.5	1.46	0.014	U	408	4717.5	4676	10.18	5.15	0.0220	Natural Ephem -7	11	0.5	3.3	14.1	0.2	1281	4676	4624	4.06	0.035	3	0.11	9
105	44	1.6	0.011	300	4804	4752	17.33	0.029	U	590	4752	4686	11.19	5.40	0.0303	Natural Ephem -7	22	0.6	5.6	18.3	0.3	1121	4686	4624	5.53	0.040	4	0.08	8
105	44	1.6														Suburban	22	1.4	5.5	8.6	0.6	2953	4624	4590	1.15	0.030	4	0.21	12
106	38	1.6	0.011	15	4739	4738.5	3.43	0.005	U	507	4738	4688	9.87	5.07	0.0278	Urban	19	0.4	4.8	22.4	0.2	1623	4688	4652	2.22	0.020	4	0.11	9
106	38	1.6														Natural Ephem -7	19	0.5	4.1	15.8	0.3	570	4652	4622	5.27	0.030	5	0.03	2
107	58	1.6	0.011	56	4629	4628	1.79	0.019	U	1728	4628	4598	1.74	2.13	0.2257	Natural Ephem -7	29	1.0	14.0	29.0	0.5	1504	4598	4591	0.47	0.030	2	0.20	27
108	63	1.6	0.13	300	4693	4676	5.67	0.327	U	830	4676	4636	4.82	3.54	0.0651	Natural Ephem -1	31	1.0	10.0	17.1	0.6	1451	4636	4620	1.10	0.035	3	0.13	31
108	63															Natural Ephem -2	31	1.1	6.3	8.7	0.7	651	4620	4610	1.54	0.030	5	0.04	2
109	39	1.6	0.13	300	4693	4676	5.67	0.327	U	1133	4719	4662	5.03	3.62	0.0870	Urban	20	0.4	4.0	20.5	0.2	1167	4662	4618	3.77	0.020	5	0.07	29
110	58	1.6	0.13	300	4724	4700	8.00	0.000	U	1006	4700	4606	9.35	4.93	0.0566	Natural Ephem -3	29	0.8	7.9	15.2	0.5	921	4606	4594	1.30	0.030	4	0.07	8
111	216	1.6	0.13	300	4775	4746	9.67	0.264	U	335	4746	4726	5.97	3.94	0.0236	Natural Ephem -3	108	1.2	15.3	20.5	0.7	1337	4726	4686	2.99	0.030	7	0.05	20
111	216															Urban	108	0.8	19.8	58.3	0.3	2212	4686	4636	2.26	0.020	5	0.11	7
112	82	1.6	0.011	24	4617	4616.5	2.09	0.009	U	1792	4616	4588	1.56	2.02	0.2468	Natural -2	41	0.5	16.3	32.2	0.5	1548	4588	4578	0.65	0.030	3	0.17	26
113	168	1.6	0.13	218	4720	4700	9.18	0.209	P	986	4700	4618	8.32	5.86	0.0467	Urban	84	0.8	16.0	51.3	0.3	2300	4618	4564	2.35	0.020	5	0.12	23
113	168															Natural Ephem -2	84	2.6	23.1	16.1	1.4	602	4564	4562	0.33	0.030	4	0.05	3
114	52	1.6	0.011	36	4599	4598.5	1.41	0.014	U	2014	4598	4586	0.60	1.25	0.4492	Suburban	26	1.5	6.5	9.3	0.7	940	4586	4572	1.49	0.035	4	0.06	32
115	34	1.6	0.011	51	4683	4682.5	0.99	0.022								Suburban	17	1.0	3.0	6.4	0.5	1966	4682	4588	4.78	0.035	6	0.10	7
116	221	1.6	0.13	246	4759	4744	6.09	0.272	U	492	4744	4716	5.69	3.85	0.0355	Natural Ephem -5	110	1.4	20.3	27.2	0.7	3215	4716	4638	2.43	0.035	5	0.16	28
117	74	1.6	0.011	241	4752	4745	2.90	0.050	U	430	4745	4720	5.81	3.89	0.0307	Natural Ephem -7	37	0.7	7.5	21.3	0.4	809	4720	4676	5.44	0.035	5	0.05	8
117	74															Natural Ephem -3	37	0.7	7.0	14.4	0.5	811	4676	4652	2.96	0.030	5	0.04	3
118	309	1.6	0.13	300	4746	4732	4.67	0.353								Natural Ephem -3	155	1.6	24.7	25.8	1.0	5977	4732	4594	2.31	0.035	6	0.27	37
119	54	1.6	0.011	57	4673	4670	5.28	0.012	U	309	4670	4668	0.65	1.30	0.0660	Suburban	27	1.3	5.0	8.2	0.6	3699	4668	4584	2.27	0.030	5	0.19	16
120	66	1.6	0.13	300	4716	4712	1.33	0.583	U	561	4712	4636	13.55	5.94	0.0262	Suburban	33	1.3	5.3	8.5	0.6	1829	4636	4582	2.95	0.030	6	0.08	41
121	60	1.6	0.05	300	4604	4596	2.67	0.206	P	1306	4596	4569	2.07	2.92	0.1241	Suburban	30	1.5	6.9	9.6	0.7	576	4569	4562	1.22	0.030	4	0.04	22

T:\Projects\22241173_Gillette_Stormwater\Sub_00\10.0_Calculations_Analysis_Data\10.02_Hydrology\Tc_Calc.xls

Subcatchment ID	Upland (Sheet) Flow Travel Time							Shallow Concentrated Flow							Open Channel Flow											Tc
	2yr 24 hr Rainfall, P2	Manning's n	Length, L	El @Top	El @Bot	Slope, s	Upland T1	Surface*	Length	El @Top	El @Bot	Slope	Velocity	Shallow T2	Channel Type	Flow Area, a	Wetted Perimeter,p _w	Hydraulic Radius, r	Length	El @ Top	El @ Bottom	Slope	Mannings n	Velocity	Travel Time, T3	
	(in)		(ft)	(ft)	(ft)	pct	(hr)	P or U	(ft)	(ft)	(ft)	pct	(ft/s)	(hr)		(ft ²)	(ft)	(ft)	(ft)	(ft)	(ft)	pct		(ft/s)	(hr)	
1	2	3	4	Start	End	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
0	1.6	0.05	300	4980	4945	11.67	0.114	U	2750	4945	4820	4.55	3.44	0.2221	Agriculture	12	10	1.2	6440	4820	4680	2.1739	0.040	6	0.29	38
1	1.6	0.05	300	4620	4604	5.33	0.156	U	723	4604	4544	8.30	4.65	0.0432	Suburban	12	13	0.9	4174	4544	4526	0.4312	0.020	5	0.25	27
3	1.6	0.05	300	4660	4618	14.00	0.106	U	1020	4618	4558	5.88	3.91	0.0724	Suburban	12	13	0.9	1442	4558	4540	1.2483	0.020	8	0.05	14
4	1.6	0.05	300	4744	4706	12.67	0.110	U	3184	4706	4582	3.89	3.18	0.2778	Agriculture	12	10	1.2	1840	4582	4570	0.6522	0.040	3	0.15	32
5	1.6	0.05	300	4554	4553	0.33	0.473	U	1124	4553	4552	0.09	0.48	0.6488	Agriculture	12	10	1.2	3054	4552	4526	0.8513	0.040	4	0.22	81
6	1.6	0.05	300	4630.5	4629	0.50	0.402	U	1600	4629	4566	3.94	3.20	0.1388	Agriculture	12	10	1.2	5956	4566	4546	0.3358	0.040	2	0.69	74
7	1.6	0.05	300	4778	4760	6.00	0.149	U	509	4760	4716	8.64	4.74	0.0298	Agriculture	12	10	1.2	2539	4716	4654	2.4419	0.040	6	0.11	17
8	1.6	0.05	300	4776	4760	5.33	0.156	U	430	4760	4704	13.02	5.82	0.0205	Agriculture	12	10	1.2	5728	4704	4566	2.4092	0.040	6	0.25	25
9	1.6	0.05	300	4720	4700	6.67	0.143	U	956	4700	4640	6.28	4.04	0.0657	Agriculture	12	10	1.2	7895	4640	4572	0.8613	0.040	4	0.57	47
10	1.6	0.05	300	4810	4780	10.00	0.121	U	1860	4780	4670	5.91	3.92	0.1317	Agriculture	12	10	1.2	7875	4670	4578	1.1683	0.040	4	0.49	44
11	1.6	0.05	300	4574	4571	1.00	0.305	U	1464	4571	4560	0.75	1.40	0.2908	Agriculture	12	10	1.2	520	4560	4556	0.7692	0.040	4	0.04	38
12	1.6	0.05	300	4586	4583	1.00	0.305	U	2043	4583	4567	0.81	1.45	0.3914	Agriculture	12	10	1.2	120	4567	4566	0.4167	0.040	3	0.01	43
13	1.6	0.05	300	4632	4618	4.67	0.165	U	921	4618	4558	6.51	4.12	0.0621	Agriculture	12	10	1.2	3092	4558	4536	0.7115	0.040	4	0.25	28
14	1.6	0.05	300	4762	4744	6.00	0.149	U	150	4744	4728	10.67	5.27	0.0079	Agriculture	12	10	1.2	4945	4728	4572	3.1547	0.040	7	0.19	21
15	1.6	0.05	300	4836	4812	8.00	0.133	U	911	4812	4706	11.64	5.50	0.0460	Agriculture	12	10	1.2	7475	4706	4574	1.7659	0.040	6	0.38	33
16	1.6	0.05	300	4920	4816	34.67	0.074	U	1500	4816	4720	6.40	4.08	0.1021	Agriculture	12	10	1.2	5471	4720	4600	2.1934	0.040	6	0.25	25
17	1.6	0.05	300	4906	4824	27.33	0.081	U	1404	4824	4726	6.98	4.26	0.0915	Agriculture	12	10	1.2	4255	4726	4620	2.4912	0.040	7	0.18	21
18	1.6	0.05	300	4980	4925	18.33	0.095	U	770	4925	4875	6.49	4.11	0.0520	Agriculture	12	10	1.2	9348	4875	4650	2.4069	0.040	6	0.40	33
19	1.6	0.05	300	4945	4918	9.00	0.127	U	625	4918	4870	7.68	4.47	0.0388	Agriculture	12	10	1.2	5625	4870	4715	2.7556	0.040	7	0.23	24
20	1.6	0.05	300	4940	4890	16.67	0.099	U	1140	4890	4820	6.14	4.00	0.0792	Agriculture	12	10	1.2	7881	4820	4650	2.1571	0.040	6	0.36	32
21	1.6	0.05	300	4556	4555	0.33	0.473	U	723	4555	4552	0.41	1.04	0.1932	Agriculture	12	10	1.2	992	4552	4538	1.4113	0.040	5	0.06	43
22	1.6	0.05	300	4700	4698	0.67	0.358	U	3380	4698	4574	3.67	3.09	0.3038	Agriculture	12	10	1.2	820	4574	4557	2.0732	0.040	6	0.04	42
23	1.6	0.05	300	4572	4567	1.67	0.248	U	1814	4567	4556	0.61	1.26	0.4011	Agriculture	12	10	1.2	115	4556	4554	1.7391	0.040	5	0.01	39
24	1.6	0.05	300	4558	4557	0.33	0.473	U	191	4557	4556	0.52	1.17	0.0454	Agriculture	12	10	1.2	1032	4556	4550	0.5814	0.040	3	0.09	37
25	1.6	0.05	300	4638	4622	5.33	0.156	U	777	4622	4574	6.18	4.01	0.0538	Agriculture	12	10	1.2	198	4574	4560	7.0707	0.040	11	0.00	13
26	1.6	0.05	300	4712	4674	12.67	0.110	U	1699	4674	4588	5.06	3.63	0.1300	Agriculture	12	10	1.2	1141	4588	4566	1.9281	0.040	6	0.05	18
27	1.6	0.05	300	4554	4548	2.00	0.231	U	1000	4548	4546	0.20	0.72	0.3850	Agriculture	12	10	1.2	5327	4546	4529	0.3191	0.040	2	0.63	75
28	1.6	0.05	300	4554	4552	0.67	0.358	U	400	4552	4550	0.50	1.14	0.0974	Suburban	12	13	0.9	1108	4550	4548	0.1805	0.020	3	0.10	33

Tc Calc Explanations																											
BASIN 8																											
Subcatchment ID	Upland (Sheet) Flow Travel Time							Shallow Concentrated Flow							Open Channel Flow												
	2yr 24 hr Rainfall, P2	Manning's n	Length, L			Slope, s	Upland T1	Surface*	Length	El @Top	El @Bot	Slope	Velocity	Shallow T2	Channel Type	Flow Area, a	Wetted Perimeter,p _w	Hydraulic Radius, r	Length	El @ Top	El @ Bottom	Slope	Mannings n	Velocity	Travel Time, T3	Tc	
	(in)		(ft)	Slope, s	Slope, s	pct	(hr)	P or U	(ft)	(ft)	(ft)	pct	(ft/s)	(hr)		(ft ²)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)		(ft/s)	(hr)	(min)	
1	2	3	4	Start	End	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
0	1.6	0.04	150	4582	4548	22.67	0.042	P	3018	4548	4520	0.93	1.96	0.4282	Suburban	12	13	0.9	400	4520	4518	0.5000	0.030	3	0.03	30	
1	1.6	0.04	300	4752	4740	4.00	0.146	U	2907	4740	4580	5.50	3.79	0.2133	Suburban	12	13	0.9	900	4580	4550	3.3333	0.030	9	0.03	23	
2	1.6	0.04	300	4572	4562	3.33	0.157	U	289	4562	4562	0.03	0.30	0.2675	Suburban	12	13	0.9	1745	4562	4536	1.4842	0.030	6	0.08	30	
3	1.6	0.04	300	4576	4564	4.00	0.146	U	1938	4690	4536	7.95	4.55	0.1184	Suburban	12	13	0.9	848	4536	4530	0.7075	0.030	4	0.06	19	
4	1.6	0.04	300	4672	4671	0.33	0.396	U	350	4671	4668	0.86	1.49	0.0651	Suburban	12	13	0.9	3405	4668	4568	2.9369	0.030	8	0.12	35	
5	1.6	0.04	300	4668	4663	1.67	0.208	U	250	4663	4658	2.00	2.28	0.0304	Suburban	12	13	0.9	1319	4658	4606	3.9424	0.030	9	0.04	17	
6	1.6	0.04	300	4722	4706	5.33	0.130	U	1366	4706	4614	6.73	4.19	0.0906	Suburban	12	13	0.9	907	4614	4604	1.1025	0.030	5	0.05	16	
7	1.6	0.04	300	4724	4686	12.67	0.092	U	1158	4686	4616	6.04	3.97	0.0811	Suburban	12	13	0.9	270	4616	4600	5.9259	0.030	12	0.01	11	
8	1.6	0.04	300	4604	4596	2.67	0.172	U	1560	4596	4564	2.05	2.31	0.1875	Suburban	12	13	0.9	375	4564	4558	1.6000	0.030	6	0.02	23	
9	1.6	0.04	300	4608	4606	0.67	0.300	U	1533	4606	4552	3.52	3.03	0.1406	Suburban	12	13	0.9	955	4552	4550	0.2094	0.030	2	0.12	34	
10	1.6	0.04	300	4714	4686	9.33	0.104	U	1339	4686	4602	6.27	4.04	0.0920	Suburban	12	13	0.9	320	4602	4600	0.6250	0.030	4	0.02	13	
11	1.6	0.04	300	4604	4601	1.00	0.255	U	190	4601	4598	1.58	2.03	0.0260	Suburban	12	13	0.9	2073	4598	4566	1.5437	0.030	6	0.10	23	
12	1.6	0.04	300	4530	4527	1.00	0.255	U	2040	4527	4516	0.54	1.18	0.4783	Suburban	12	13	0.9	900	4516	4506	1.1111	0.030	5	0.05	47	
13	1.6	0.04	150	4602	4590	8.00	0.064	P	2189	4590	4530	2.74	3.37	0.1807	Suburban	12	13	0.9	1525	4530	4520	0.6557	0.030	4	0.11	21	
14	1.6	0.04	300	4538	4535	1.00	0.255	U	105	4535	4532	2.86	2.73	0.0107	Suburban	12	13	0.9	0	0	0	0	0.030	0	0	16	
15	1.6	0.04	300	4538	4536	0.67	0.300	U	613	4536	4526	1.63	2.06	0.0826	Suburban	12	13	0.9	155	4526	4524	1.2903	0.030	5	0.01	23	
16	1.6	0.04	150	4540	4538	1.33	0.130	P	300	4538	4530	2.67	3.32	0.0251	Suburban	12	13	0.9	794	4530	4526	0.5038	0.030	3	0.06	13	
17	1.6	0.04	300	4558	4554	1.33	0.227	U	1634	4554	4534	1.22	1.79	0.2543	Suburban	12	13	0.9	690	4534	4526	1.1594	0.030	5	0.04	31	
18	1.6	0.04	300	4742	4686	18.67	0.079	U	778	4686	4626	7.71	4.48	0.0482	Suburban	12	13	0.9	62	4626	4624	3.2258	0.030	9	0.00	8	
19	1.6	0.04	300	4732	4690	14.00	0.089	U	300	4690	4666	8.00	4.56	0.0183	Suburban	12	13	0.9	432	4666	4630	8.3333	0.030	14	0.01	7	
20	1.6	0.04	300	4752	4682	23.33	0.072	U	652	4682	4614	10.43	5.21	0.0348	Suburban	12	13	0.9	156	4614	4612	1.2821	0.030	5	0.01	7	
21	1.6	0.04	300	4628	4608	6.67	0.119	U	1513	4608	4578	1.98	2.27	0.1850	Suburban	12	13	0.9	166	4578	4560	10.8434	0.030	16	0.00	18	
22	1.6	0.04	300	4524	4523.5	0.17	0.522	U	1175	4524	4518	0.47	1.10	0.2957	Suburban	12	13	0.9	3171	4518	4506	0.3784	0.030	3	0.30	67	
23	1.6	0.04	300	4561	4553	2.67	0.172	U	385	4553	4546	1.82	2.18	0.0492	Suburban	12	13	0.9	645	4546	4540	0.9302	0.030	5	0.04	16	
24	1.6	0.04	300	4551	4550	0.33	0.396	U	495	4550	4548	0.40	1.03	0.1341	Suburban	12	13	0.9	982	4548	4528	2.0367	0.030	7	0.04	34	
25	1.6	0.04	300	4606	4602	1.33	0.227	U	222	4602	4596	2.70	2.65	0.0232	Suburban	12	13	0.9	1642	4596	4530	4.0195	0.030	10	0.05	18	
26	1.6	0.04	300	4600	4593	2.33	0.182	U	1330	4594	4548	3.46	3.00	0.1231	Suburban	12	13	0.9	0	0	0	0	0.030	0	0	18	
27	1.6	0.04	300	4558	4554	1.33	0.227	U	2324	4554	4530	1.03	1.64	0.3937	Suburban	12	13	0.9	0	4593	4548	0	0.030	0	0	37	

Subcatchment ID	Basin Area	Upland (Sheet) Flow Travel Time							Shallow Concentrated Flow							Open Channel Flow													Tc
		2yr 24 hr Rainfall, P2	Manning's n	Length, L			Slope, s	Upland T1	Surface*	Length	El @Top	El @Bot	Slope	Velocity	Shallow T2	Channel Type	Design Flow	Flow Depth	Flow Area, a	Wetted Perimeter,p _w	Hydraulic Radius, r	Length	El @ Top	El @ Bottom	Slope	Mannings n	Velocity	Travel Time, T3	
		(in)		(ft)	Slope, s	Slope, s	pct	(hr)	P or U	(ft)	(ft)	(ft)	pct	(ft/s)	(hr)		(cfs)	(ft)	(ft ²)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	%		(ft/s)	Calc.
0	1	2	3	4	Start	End	5	6	7	8	9	10	11	12	13	14	15	16	15	16	17	18	19	20	21	22	23	24	25
101	11	1.6	0.13	300	4791	4752	13.00	0.235	P	441	4752	4718	7.71	5.64	0.0217		-1.0												
102	33	1.6	0.13	300	4746	4720	8.67	0.276	U	227	4720	4707	5.72	3.86	0.0164	Natural Ephem -6	16.7	0.5	6.3	25.1	0.3	997.9	4707	4682	2.51	0.035	3	0.10	24
103	41	1.6	0.13	300	4789	4769	6.67	0.306	U	85	4769	4760	10.64	5.26	0.0045	Natural Ephem -6	20.4	0.5	5.8	24.0	0.2	2064	4760	4664	4.65	0.035	4	0.16	28
104	43	1.6	0.13	58	4790	4788	3.44	0.108	U	83	4788	4776	14.39	6.12	0.0038	Suburban	21.6	1.1	3.9	7.2	0.5	3005	4776	4688	2.93	0.030	6	0.15	16
105	89	1.6	0.13	300	4754	4742	4.00	0.376	U	425	4742	4728	3.30	2.93	0.0402	Natural Ephem -6	44.4	0.7	10.8	32.8	0.3	2394	4728	4628	4.18	0.035	4	0.16	35
106	55	1.6	0.13	300	4756	4742	4.67	0.353	U	100	4742	4736	6.01	3.95	0.0070	Natural Ephem -6	27.3	0.5	7.4	27.2	0.3	2209	4736	4640	4.35	0.035	4	0.17	32
107	57	1.6	0.13	300	4746	4728	6.00	0.320	U	1127	4728	4672	4.97	3.60	0.0870	Natural Ephem -6	28.7	0.6	9.3	30.6	0.3	866	4672	4650	2.54	0.035	3	0.08	29
108	148	1.6	0.13	47	4717	4713	8.60	0.062	U	100	100	99	1.00	1.61	0.0001	Natural -5	73.9	1.0	15.7	22.5	0.7	3209	4627	4580	1.46	0.030	5	0.19	15
108	148	1.6														Suburban	74.0	1.9	10.9	12.1	0.9	2226	4713	4627	3.86	0.040	7	0.09	5
109	147	1.6	0.13	300	4708	4696	4.00	0.376	U	566	4696	4672	4.24	3.32	0.0473	Natural Ephem -6	73.6	0.9	18.6	43.2	0.4	4064	4672	4564	2.66	0.035	4	0.29	43
110	61	1.6	0.13	300	4676	4642	11.33	0.248	U	1267	4642	4568	5.84	3.90	0.0903	Natural -5	30.4	0.9	12.9	20.7	0.6	1379	4568	4560	0.58	0.035	2	0.16	30
111	159	1.6	0.13	168	4711	4704	4.17	0.232	U	1389	4704	4638	4.75	3.52	0.1097	Suburban	79.6	1.9	10.4	11.9	0.9	836.3	4638	4606	3.83	0.035	8	0.03	22
111	159	1.6														Natural Ephem -6	79.6	0.9	21.9	46.8	0.5	2322	4606	4559	2.02	0.035	4	0.18	11
111	159	1.6														Natural -4	79.6	2.4	32.2	22.5	1.4	476.2	4559	4558	0.21	0.035	2	0.05	3
112	130	1.6	0.13	300	4832	4795	12.33	0.240	U	154	4795	4772	14.91	6.23	0.0069	Natural -4	65.2	1.1	9.3	12.7	0.7	2918	4772	4650	4.18	0.035	7	0.12	22
113	207	1.6	0.13	300	4746	4722	8.00	0.285	U	1143	4722	4654	5.95	3.94	0.0807	Natural Ephem -6	103.5	1.0	25.1	50.1	0.5	4282	4654	4552	2.38	0.035	4	0.29	39
114	223	1.6	0.13	200	4714	4702	6.00	0.231	U	94	4702	4692	10.68	5.27	0.0049	Natural Ephem -6	111.3	1.0	24.0	49.0	0.5	4758	4692	4544	3.11	0.035	5	0.28	31
114	223	1.6														Natural -4	111.3	2.5	33.8	23.0	1.5	1106	4544	4540	0.36	0.035	3	0.09	6
115	73	1.6	0.13	300	4668	4637	10.33	0.257	U	1173	4637	4574	5.37	3.74	0.0871	Suburban	36.4	1.6	8.0	10.4	0.8	970.9	4574	4558	1.65	0.035	5	0.06	24
116	132	1.6	0.13	112	4682	4664	16.03	0.098	U	1433	4664	4600	4.47	3.41	0.1167	Suburban	66.1	1.8	9.8	11.5	0.9	703	4600	4578	3.13	0.035	7	0.03	15
116	132	1.6														Natural Ephem -3	66.1	1.4	20.0	23.3	0.9	3490	4578	4552	0.74	0.035	3	0.29	18
117	16	1.6	0.13	77	4681	4677	5.19	0.114	P	567	4677	4636	7.23	5.47	0.0288	Suburban	8.0	0.7	1.6	4.6	0.3	471.8	4636	4608	5.93	0.035	5	0.03	10
118	10	1.6	0.13	57	4565	4563	3.53	0.104	U	1018	4563	4547	1.57	2.02	0.1398	Natural Ephem -5	5.0	0.4	3.0	10.9	0.3	859.2	4547	4540	0.81	0.035	2	0.15	23
119	116	1.6	0.13	300	4634	4624	3.33	0.404	U	693	4624	4590	4.91	3.57	0.0539	Conc. Rectangular	58.0	0.4	6.4	15.9	0.4	2529	4590	4538	2.06	0.013	9	0.08	32
120	60	1.6	0.13	300	4561	4553	2.67	0.442	U	1100	4554	4526	2.55	2.57	0.1187	Natural -3	29.9	0.7	31.5	52.1	0.6	4086	4526	4522	0.10	0.035	1	1.20	105
121	150	1.6	0.13	300	4560	4553	2.33	0.466	U	2510	4553	4532	0.84	1.48	0.4724	Natural -5	75.2	1.8	36.8	32.8	1.1	502.2	4522	4521	0.20	0.035	2	0.07	60
121	150	1.6														Suburban	75.0	2.4	17.4	15.3	1.1	1150	4532	4522	0.87	0.035	4	0.07	4
122	71	1.6	0.13	300	4644	4614	10.00	0.261	P	762	4614	4576	4.99	4.54	0.0466	Conc. Rectangular	35.3	0.5	8.0	16.1	0.5	1467	4576	4536	2.73	0.035	4	0.09	24
122	71	1.6														Natural -1	35.3	0.9	24.2	30.0	0.8	2546	4536	4532	0.16	0.035	1	0.49	29

BASIN 10

Tc Calc Explanations

Subcatchment ID	Upland (Sheet) Flow Travel Time								Shallow Concentrated Flow							Open Channel Flow													Tc
	Basin Area	2yr 24 hr Rainfall, P2	Manning's n	Length, L	Slope, s		Slope, s	Upland T1	Surface*	Length	El @Top	El @Bot	Slope	Velocity	Shallow T2	Channel Type	Design Flow	Flow Depth	Flow Area, a	Wetted Perimeter,p _w	Hydraulic Radius, r	Length	El @ Top	El @ Bottom	Slope	Mannings n	Velocity	Travel Time, T3	
	(ac)	(in)		(ft)	Slope, s	Slope, s	pct	(hr)	P or U	(ft)	(ft)	(ft)	pct	(ft/s)	(hr)		(cfs)	(ft)	(ft ²)	(ft)	(ft)	(ft)	(ft)	(ft)	%		(ft/s)	Calc.	
0	1	2	3	4	Start	End	5	6	7	8	9	10	11	12	13	14	15	16	15	16	17	18	19	20	21	22	23	24	25
101	3887	1.6	0.13	300	4965	4920	15.00	0.222	P	1205	4920	4855	5.39	4.72	0.0709	Natural Ephem -3	1943.5	5.7	235.4	78.4	3.0	21891.6	4855	4664	0.87	0.035	8	0.74	62
102	1153	1.6	0.13	300	4885	4820	21.67	0.191	U	509	4820	4790	5.89	3.92	0.0361	Natural Ephem -6	576.3	2.0	100.0	100.1	1.0	5857.81	4790	4682	1.84	0.035	6	0.28	31
102	1153															Natural Ephem -4	1943.5 *	2.4	560.2	468.7	1.2	15580.5	4682	4600	0.53	0.035	3	1.25	75
103	98	1.6	0.13	300	4834	4810	8.00	0.285	U	106	4810	4804	5.64	3.83	0.0077	Natural Ephem -6	48.9	0.7	11.6	34.1	0.3	3188.87	4804	4672	4.14	0.035	4	0.21	30
104	86	1.6	0.13	150	4766	4750	10.67	0.146	U	331	4750	4726	7.26	4.35	0.0211	Natural Ephem -6	42.9	0.6	10.2	31.9	0.3	1803.29	4726	4644	4.55	0.035	4	0.12	17
104	86															Suburban	42.9	1.6	8.1	10.5	0.8	1559.88	4644	4610	2.18	0.035	5	0.08	5
105	21	1.6	0.13	100	4892	4834	58.00	0.054	U	728	4834	4730	14.30	6.10	0.0331	Natural -3	10.5	0.1	4.0	36.0	0.1	947.954	4730	4660	7.38	0.035	3	0.10	11
106	22	1.6	0.13	14	4708	4707	7.00	0.026	U	155	4707	4704	1.93	2.24	0.0193	Natural -3	11.0	0.1	4.7	36.5	0.1	1541.45	4704	4630	4.80	0.035	2	0.18	14
107	213	1.6	0.13	300	4720	4693	9.00	0.272	U	690	4693	4668	3.62	3.07	0.0624	Natural Ephem -6	106.5	1.0	25.2	50.3	0.5	3707.65	4668	4576	2.48	0.035	4	0.24	35
108	17	1.6	0.13	206	4612	4595	8.24	0.209	U	715	4595	4572	3.22	2.89	0.0686		-1.0									0	0	17	
109	4	1.6	0.011	16	4680	4679	6.25	0.004	P	920	4679	4660	2.07	2.92	0.0875	Natural Ephem -3	1.9	0.1	0.6	6.4	0.1	175	4660	4642	10.29	0.035	3	0.02	6

BASIN 11

Tc Calc Explanations

Subcatchment ID	Basin Area	Upland (Sheet) Flow Travel Time							Shallow Concentrated Flow							Open Channel Flow													Tc
		2yr 24 hr Rainfall, P2	Manning's n	Length, L	Slope, s		Slope, s	Upland T1	Surface*	Length	El @Top	El @Bot	Slope	Velocity	Shallow T2	Channel Type	Design Flow	Flow Depth	Flow Area, a	Wetted Perimeter,p _w	Hydraulic Radius, r	Length	El @ Top	El @ Bottom	Slope	Mannings n	Velocity	Travel Time, T3	
		(in)		(ft)	Slope, s	Slope, s	pct	(hr)	P or U	(ft)	(ft)	(ft)	pct	(ft/s)	(hr)		(cfs)	(ft)	(ft ²)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	%		(ft/s)	Calc.
0	1	2	3	4	Start	End	5	6	7	8	9	10	11	12	13	14	15	16	15	16	17	18	19	20	21	22	23	24	25
101	1006	1.6	0.13	300	4925	4895	10.00	0.261	U	863	4895	4870	2.90	2.75	0.0872	Natural Ephem -3	503.2	3.0	71.6	43.4	1.6	9596	4870	4735	1.41	0.035	7	0.38	44
102	1303	1.6	0.13	300	4880	4860	6.67	0.306	U	872	4860	4795	7.45	4.40	0.0550	Natural Ephem -3	651.7	3.4	89.3	48.4	1.8	13795	4795	4615	1.30	0.035	7	0.53	53
103	447	1.6	0.13	300	4845	4790	18.33	0.204	U	1129	4790	4755	3.10	2.84	0.1104	Natural Ephem -3	223.5	2.2	41.6	33.2	1.3	7832	4755	4662	1.19	0.035	5	0.40	43
103	447															Natural Ephem -5	223.5	2.1	47.4	41.4	1.1	2371	4662	4644	0.76	0.030	5	0.14	8
104	116	1.6	0.13	300	4840	4778	20.67	0.195	U	382	4778	4748	7.85	4.52	0.0235	Natural Ephem -3	57.9	0.8	8.7	15.8	0.6	1262	4748	4680	5.39	0.035	7	0.05	16
104	116															Natural Ephem -5	57.9	1.1	13.8	22.5	0.6	1734	4680	4656	1.38	0.030	4	0.11	7
104	116															Suburban	57.9	1.9	11.1	12.2	0.9	1571	4656	4636	1.27	0.030	5	0.08	5
105	97	1.6	0.13	300	4860	4775	28.33	0.172	U	412	4775	4735	9.70	5.03	0.0228	Natural Ephem -3	48.5	0.9	9.7	16.6	0.6	2947	4735	4652	2.82	0.035	5	0.16	22
106	118	1.6	0.011	50	4835	4828	14.00	0.008	U	173	4828	4806	12.73	5.76	0.0083	Natural Ephem -2	58.9	1.0	5.3	8.1	0.7	437.5	4806	4768	8.69	0.030	11	0.01	2
106	118															Natural -5	58.9	0.8	12.3	20.3	0.6	2836	4768	4676	3.24	0.040	5	0.16	10
107	16	1.6	0.13	300	4868	4800	22.67	0.188	U	115	4800	4786	12.22	5.64	0.0056	Natural -3	7.9	0.1	3.1	35.4	0.1	1091	4786	4714	6.60	0.030	3	0.12	19
108	43	1.6	0.011	51	4726	4720	11.87	0.008	U	141	4720	4709	7.81	4.51	0.0087	Natural Ephem -1	21.5	0.7	4.9	12.1	0.4	1813	4709	4644	3.58	0.035	4	0.11	8
109	192	1.6	0.13	300	4782	4766	5.33	0.335	U	255	4766	4756	3.92	3.20	0.0222	Natural Ephem -2	96.2	1.6	10.5	11.0	1.0	1378	4756	4706	3.63	0.030	9	0.04	24
109	192															Natural Ephem -3	96.2	1.4	20.3	23.5	0.9	2640	4706	4666	1.52	0.035	5	0.15	9
110	80	1.6	0.13	300	4820	4778	14.00	0.228	U	246	4778	4764	5.68	3.85	0.0178	Suburban	39.8	1.1	3.3	6.7	0.5	1395	4764	4672	6.59	0.020	12	0.03	17
110	80															Natural -5	39.8	0.9	12.7	20.6	0.6	2784	4672	4634	1.36	0.040	3	0.25	15
111	87	1.6	0.011	33	4738	4736	6.12	0.007	U	218	4736	4698	17.47	6.74	0.0090	Suburban	43.5	1.5	6.3	9.2	0.7	1737	4698	4622	4.37	0.035	7	0.07	5
112	34	1.6	0.011	15	4741	4740.5	3.29	0.005	U	378	4740	4708	8.46	4.69	0.0224	Natural Ephem -3	16.8	0.5	3.7	10.9	0.3	1268	4708	4644	5.05	0.035	5	0.08	6

BASIN 12		Tc Calc Explanations																													
		Upland (Sheet) Flow Travel Time								Shallow Concentrated Flow								Open Channel Flow													
		Basin Area	2yr 24 hr Rainfall, P2	Manning's n	Length, L		Slope, s	Upland T1	Surface*	Length	EI @Top	EI @Bot	Slope	Velocity	Shallow T2	Channel Type	Design Flow	Flow Depth	Flow Area, a	Wetted Perimeter,p _w	Hydraulic Radius, r	Length	EI @ Top	EI @ Bottom	Slope	Mannings n	Velocity	Travel Time, T3	Tc		
Subcatchment ID	(ac)	(in)		(ft)	Slope, s	Slope, s	pct	(hr)	P or U	(ft)	(ft)	(ft)	pct	(ft/s)	(hr)		(cfs)	(ft)	(ft ²)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	%	(ft/s)		(min)		
0	1	2	3	4	Start	End	5	6	7	8	9	10	11	12	13	14	15	16	15	16	17	18	19	20	21	22	23	Calc.	24	25	
101	3583	1.6	0.13	300	4910	4850	20.00	0.197	U	1725	4850	4800	2.90	2.75	0.1744	Natural -5	1792	5.8	272.5	86.5	3.2	30046	4800	4644	0.52	0.035	7	1.27	98		
102	876	1.6	0.13	300	4832	4822	3.33	0.404	U	380	4822	4782	10.53	5.23	0.0202	Natural Ephem -1	438	2.7	58.8	41.1	1.4	8176	4782	4626	1.91	0.035	7	0.30	44		
102	876	1.6														Natural -5	438	3.1	90.6	50.4	1.8	3029	4626	4608	0.59	0.035	5	0.17	10		
103	281	1.6	0.13	300	4798	4767	10.33	0.257	U	270	4767	4744	8.52	4.71	0.0159	Natural Ephem -3	140	1.6	24.3	25.6	0.9	5422	4744	4636	1.99	0.035	6	0.26	32		
104	733	1.6	0.13	300	4845	4820	8.33	0.280	U	1128	4820	4740	7.09	4.30	0.0729	Natural -4	366	3.4	55.5	29.3	1.9	12205	4740	4614	1.03	0.035	7	0.51	52		
105	321	1.6	0.13	300	4753	4712	13.67	0.230	U	373	4712	4692	5.36	3.74	0.0277	Natural -1	160	1.1	29.2	31.2	0.9	3744	4692	4602	2.40	0.040	6	0.19	27		
105	321	1.6														Natural ephem -7	161	2.2	70.2	65.0	1.1	3639	4602	4595	0.19	0.030	2	0.44	27		
106	184	1.6	0.13	300	4770	4766	1.33	0.583	U	767	4766	4724	5.47	3.77	0.0565	Natural Ephem -6	92	1.3	39.9	63.2	0.6	5134	4724	4696	0.55	0.035	2	0.62	75		
107	100	1.6	0.13	300	4674	4655	6.33	0.313	U	1386	4655	4608	3.39	2.97	0.1296	Suburban	50	1.9	10.3	11.8	0.9	760	4608	4596	1.58	0.035	5	0.04	29		
107	100	1.6														Natural -5	50	1.0	16.0	22.7	0.7	1148	4596	4586	0.87	0.035	3	0.10	6		
108	339	1.6	0.13	300	4792	4784	2.67	0.442	U	135	4784	4770	10.37	5.20	0.0072	Natural Ephem -6	169	1.1	31.4	56.1	0.6	3846	4770	4636	3.48	0.035	5	0.20	39		
108	339	1.6														Natural -1	169	0.9	25.0	30.2	0.8	3976	4734	4604	3.27	0.035	7	0.16	10		
109	105	1.6	0.13	235	4812	4792	8.53	0.228	U	819	4792	4734	7.08	4.29	0.0530	Natural Ephem -3	53	0.8	7.8	15.1	0.5	2130	4734	4604	6.10	0.035	7	0.09	22		
110	264	1.6	0.13	300	4708	4682	8.67	0.276	U	1023	4682	4632	4.89	3.57	0.0797	Natural ephem -7	132	1.3	26.2	39.7	0.7	1958	4632	4584	2.45	0.035	5	0.11	28		
110	264	1.6	0.13													Natural -4	132	2.9	42.9	25.9	1.7	3437	4584	4572	0.35	0.040	3	0.31	19		
111	262	1.6	0.13	300	4788	4752	12.00	0.242	U	360	4752	4717	9.72	5.03	0.0199	Natural Ephem -3	131	1.6	25.1	26.0	1.0	7010	4717	4606	1.58	0.035	5	0.37	38		
112	99	1.6	0.13	300	4710	4674	12.00	0.242	U	419	4674	4636	9.07	4.86	0.0240	Suburban	49	1.6	8.0	10.4	0.8	1357	4636	4596	2.95	0.035	6	0.06	20		
112	99								U	1666	4596	4572	1.44	1.94	0.2389																
113	3110	1.6	0.013	300	4865	4850	5.00	0.054	U	3379	4850	4752	2.90	2.75	0.3415	Natural -5	1555	5.9	281.6	87.9	3.2	17101	4752	4672	0.47	0.040	6	0.86	75		
113	3110	1.6	0.013													Natural -5	1555	6.2	315.1	93.0	3.4	5773	4762	4742	0.35	0.040	5	0.32	19		
114	1576	1.6	0.13	300	4780	4775	1.67	0.534	U	2612	4775	4745	1.15	1.73	0.4196	Natural Ephem -3	788	4.4	146.6	61.9	2.4	19879	4745	4644	0.51	0.035	5	1.03	119		
115	849	1.6	0.13	300	4860	4820	13.33	0.232	U	545	4820	4805	2.75	2.68	0.0566	Natural -5	424	2.4	57.9	40.6	1.4	13557	4805	4620	1.36	0.030	7	0.51	48		
116	29.6	1.6	0.13	235	4670	4658	5.10	0.281	P	1108	4658	4612	4.15	4.14	0.0743																
117	5.7	1.6	0.05	69	4649	4648.5	0.73	0.107								Urban	3	0.2	1.1	10.8	0.1	125.93	4648	4645	2.38	0.020	3	0.01	7		
117																Natural Ephem -5	0	2.4	57.9	40.6	1.4	248	4645	4630	6.04	0.030	14	0.00	0		
121	1104.0	1.6	0.13	235	4812	4792	8.53	0.228	U	819	4792	4734	7.08	4.29	0.0530	Natural -1	552	2.2	67.0	39.5	1.7	5261	4734	4636	1.86	0.035	8	0.18	27		
121	1104.0															Natural Ephem -4	552	1.4	187.3	271.0	0.7	8121	4636	4572	0.79	0.035	3	0.77	46		
122	1017.0	1.6	0.13	300	4845	4820	8.33	0.280	U	1128	4820	4740	7.09	4.30	0.0729	Natural Ephem -4	509	1.3	158.5	249.3	0.6	14175	4740	4592	1.04	0.035	3	1.23	95		
122	1017.0															Natural Ephem -6	509	2.9	207.0	144.0	1.4	2909	4592	4586	0.21	0.035	2	0.33	20		
123	9485.0	1.6	0.13	300	4960	4900	20.00	0.197	U	3759	4900	4710	5.05	3.63	0.2879	Natural Ephem -4	4743	3.3	1093.5	654.8	1.7	31521	4810	4644	0.53	0.035	4	2.02	150		
123	9485.0															Natural Ephem -4	4743	3.5	1239.1	697.1	1.8	19611	4644	4570	0.38	0.035	4	1.42	85		