

ANNEX C8: FLOOD FLOW CALCULATIONS

Peak Flow for Mujib and Wala North Catchment using (SCS) Unit Hydrograph Method

10-Yr

$$q_p = 3.11 \frac{A}{t_c}$$

Watershed Characteristics

Catchment Area (km ²)	Length of Watercourse (km)	Ground Elevation at		Average Slope (m / m)	Curve Number CN	Runoff Coefficient	Kirpich Condition	Izzard Ret. Coeff.
		Divide	Outlet					
422.002	34.66	900	750	0.0056	75.0	0.25	3	0.046
	L _{ca} to Cent.						Kinematic Overl. Rou.	Kerby Manning
	14.69						0.01	0.3

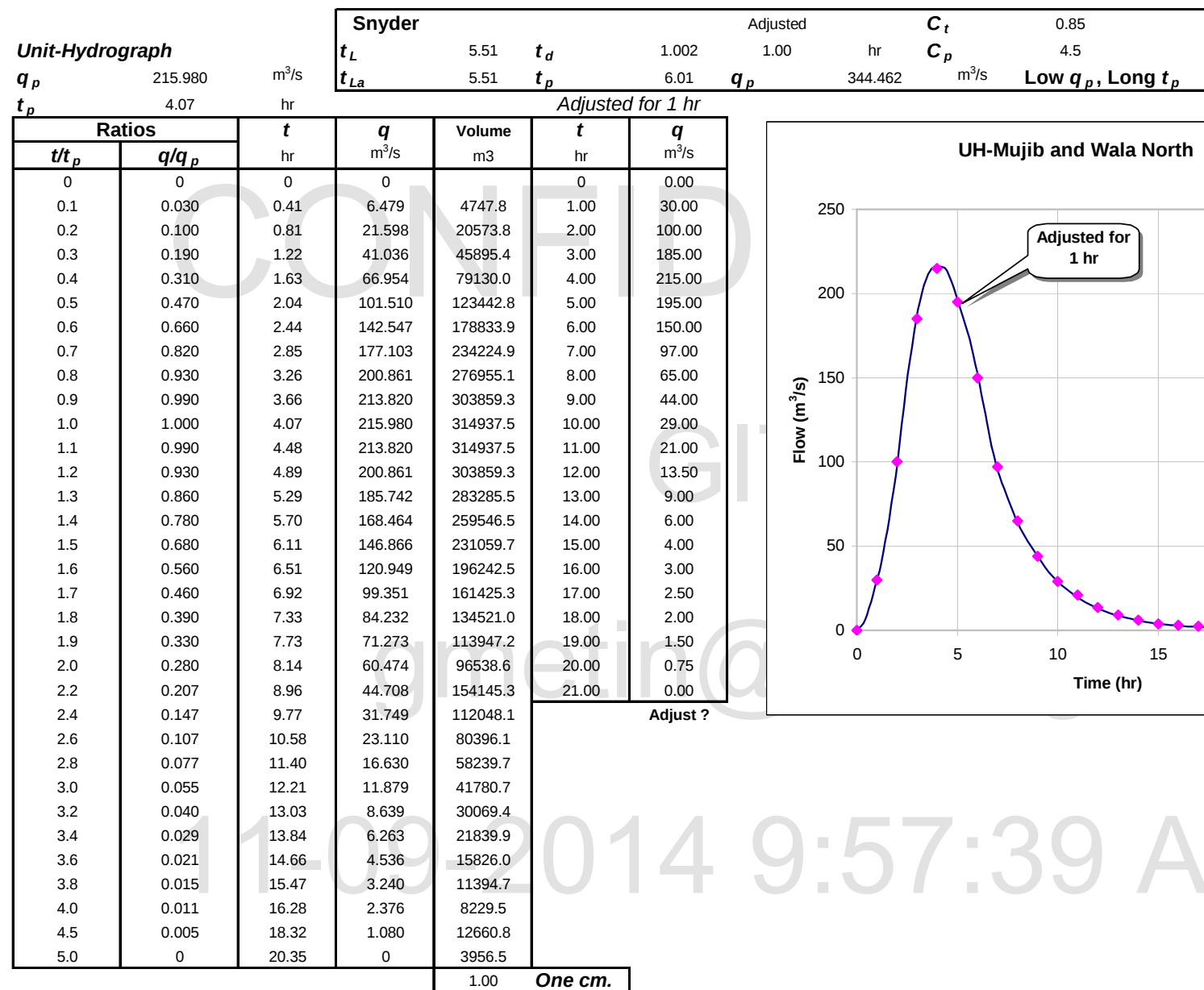
Time of Concentration Calculations

Time of Concentration (min)									Iteration for Kinematic and Izzard			
California Culverts	Kirpich	Kerby	Bransby Williams	SCS lag Eq.	Izzard	Kinematic	Federal Aviation	Min. Time of Conct.	Kinematic	Intensity	tc	
496.2	448.8	364.6	777.6	2175.6	3262.8	623.5	625.8	364.6	Izzard	1.6	3262.8	0.0
									6.076 hr			

Intensity Formula	1000-Yr		200-Yr		100-Yr		10-Yr		Record	
	a	b	a	b	a	b	a	b	Years	Period
Irbid School							186.250	0.5893	27	1971-1999

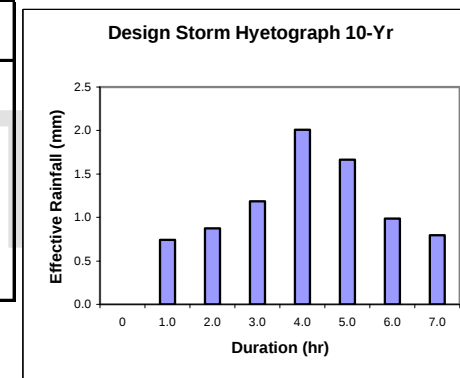
Station Effective Percentage

Irbid School		
100.0%	0.0%	0.0%



Storm Hyetograph 10-Yr

						0.2 S (mm)			
						16.9			
Time hr	Intensity mm/hr	Rainfall mm	Inc Rain mm	Inc Rain sort	Acc Rain	Acc Exc Rain	Excess Rain	Time hr	Design Storm
0	0	0						0	0
1.00	16.7	16.7	16.68	1.55	1.55	0	0	1.0	0.74
2.00	11.1	22.2	5.49	1.71	3.26	0	0	2.0	0.88
3.00	8.7	26.2	4.02	1.94	5.20	0	0	3.0	1.18
4.00	7.4	29.5	3.28	2.28	7.48	0	0	4.0	2.01
5.00	6.5	32.3	2.83	2.83	10.31	0	0	5.0	1.67
6.00	5.8	34.8	2.51	4.02	14.33	0	0	6.0	0.99
7.00	5.3	37.1	2.28	16.68	31.01	2.01	2.01	7.0	0.80
8.00	4.9	39.2	2.09	5.49	36.50	3.67	1.67		
9.00	4.6	41.1	1.94	3.28	39.79	4.86	1.18		
10.00	4.3	42.9	1.82	2.51	42.30	5.85	0.99		
11.00	4.1	44.7	1.71	2.09	44.39	6.72	0.88		
12.00	3.9	46.3	1.62	1.82	46.21	7.52	0.80		
13.00	3.7	47.8	1.55	1.62	47.83	8.26	0.74		



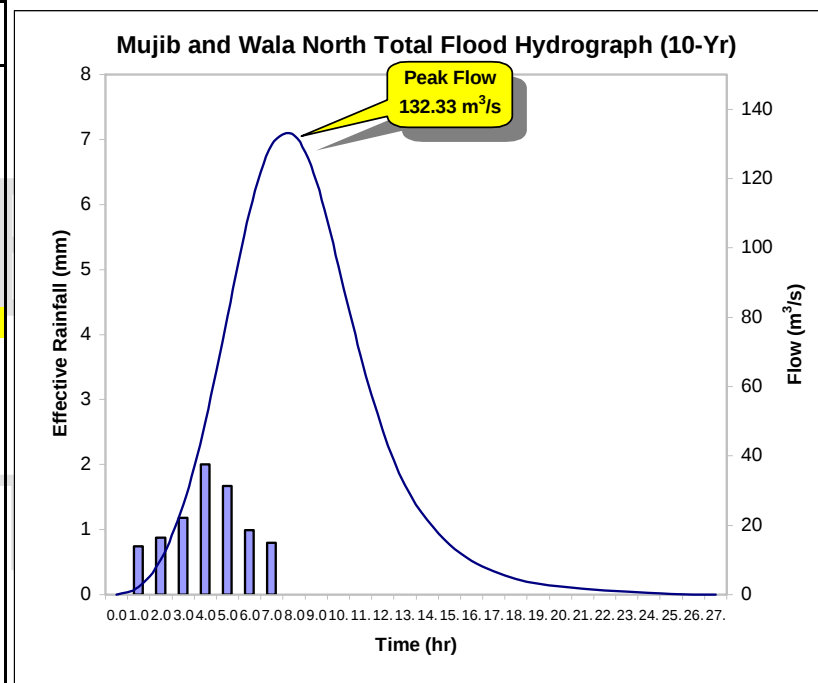
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Total Flood Hydrograph for 10-Yr Return Period

t hr	Design Storm (cm)	Unit Hydrograph q (m ³ /s)											
		30.000	100.000	185.000	215.000	195.000	150.000	97.000	65.000	44.000	29.000	21.000	13.500
0	0	0											
1.0	0.074	2.2209											
2.0	0.088	2.628	7.4030										
3.0	0.118	3.551	8.761	13.6955									
4.0	0.201	6.018	11.838	16.208	15.9164								
5.0	0.167	5.002	20.061	21.901	18.836	14.4358							
6.0	0.099	2.970	16.674	37.113	25.452	17.084	11.1045						
7.0	0.080	2.395	9.899	30.847	43.132	23.085	13.141	7.1809					
8.0	0.826		7.982	18.314	35.849	39.119	17.757	8.498	4.8119				
9.0	Sum (cm)			14.767	21.283	32.514	30.092	11.483	5.695	3.2573			
10.0					17.162	19.303	25.011	19.459	7.695	3.855	2.1469		
11.0						15.565	14.849	16.174	13.040	5.209	2.541	1.5546	
12.0							11.973	9.602	10.838	8.827	3.433	1.840	0.9994
13.0								7.743	6.434	7.336	5.818	2.486	1.183
14.0									5.188	4.356	4.835	4.213	1.598
15.0										3.512	2.871	3.502	2.708
16.0											2.315	2.079	2.251
17.0												1.676	1.336
18.0													1.078
19.0													
20.0													
21.0													
22.0													
23.0													
24.0													
25.0													
26.0													
27.0													

								Total (m ³ /s)
Hydrograph								
9.000	6.000	4.000	3.000	2.500	2.000	1.500	0.750	0
								2.221
								10.031
								26.008
								49.981
								80.236
								110.397
								129.679
								132.331
								119.091
								94.632
								68.932
								47.513
0.6663								31.667
0.788	0.4442							21.423
1.065	0.526	0.2961						14.480
1.806	0.710	0.350	0.2221					9.733
1.501	1.204	0.474	0.2628	0.1851				6.638
0.891	1.000	0.802	0.3551	0.2190	0.1481			4.494
0.718	0.594	0.667	0.6018	0.2960	0.1752	0.1110		3.163
	0.479	0.396	0.5002	0.5015	0.2368	0.1314	0.0555	2.300
		0.319	0.2970	0.4168	0.4012	0.1776	0.065707	1.678
			0.2395	0.2475	0.3335	0.3009	0.088787	1.210
				0.1996	0.1980	0.2501	0.150459	0.798
					0.1596	0.1485	0.125054	0.433
						0.1197	0.074244	0.194
							0.059867	0.060
								0.000



Peak Flow for Qatrana Catchment using (SCS) Unit Hydrograph Method

10-Yr

$$q_p = 3.11 \frac{A}{t_c}$$

Watershed Characteristics

Catchment Area (km ²)	Length of Watercourse (km)	Ground Elevation at		Average Slope (m / m)	Curve Number CN	Runoff Coefficient	Kirpich Condition	Izzard Ret. Coeff.
		Divide	Outlet					
59.877	9.94	850	750	0.0088	75.0	0.25	3	0.046
	L _{ca} to Cent.						Kinematic Overl. Rou.	Kerby Manning
	5.11						0.01	0.3

Time of Concentration Calculations

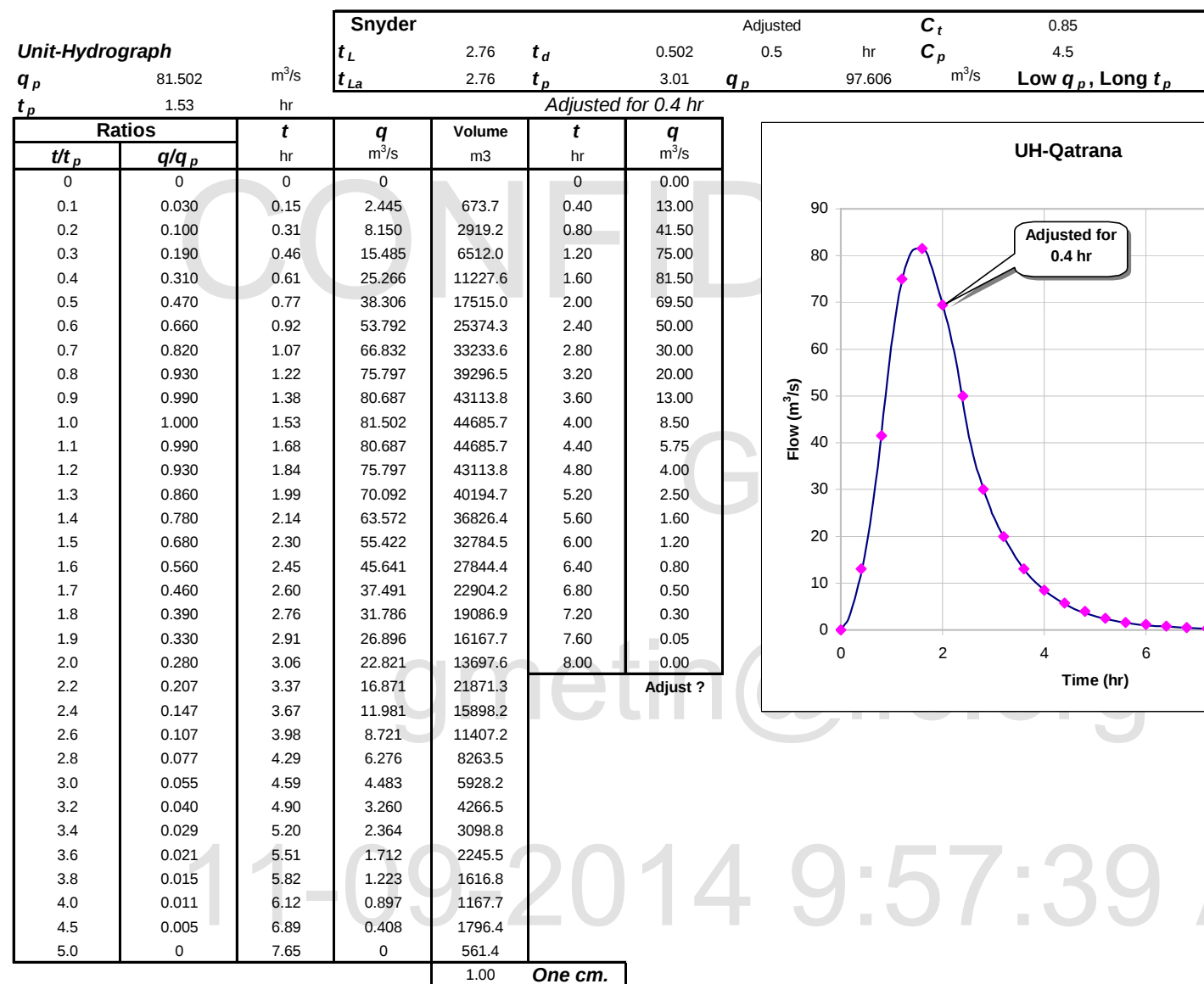
Time of Concentration (min)									Iteration for Kinematic and Izzard			
California Culverts	Kirpich	Kerby	Bransby Williams	SCS lag Eq.	Izzard	Kinematic	Federal Aviation	Min. Time of Conct.	Kinematic	Intensity	tc	
137.1	144.1	183.1	247.7	639.0	869.2	184.2	288.3	137.1	Izzard	9.7	184.2	0.0
										4.9	869.2	0.0

2.285 hr

Intensity Formula	1000-Yr		200-Yr		100-Yr		10-Yr		Record	
	a	b	a	b	a	b	a	b	Years	Period
El-Mazar							93.282	0.4343	27	1964-1998

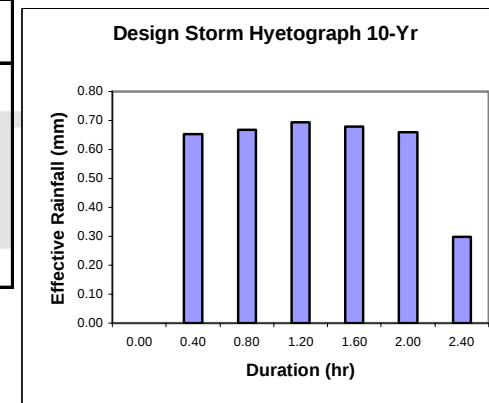
Station Effective Percentage

El-Mazar		
100.0%	0.0%	0.0%



Storm Hyetograph 10-Yr

Time hr	Intensity mm/hr	Rainfall mm	Inc Rain mm	Inc Rain sort	Acc Rain	0.2 S (mm)		Time hr	Design Storm
						Acc Exc Rain	Excess Rain		
0	0	0						0.00	0
0.40	23.5	9.4	9.38	1.91	1.91	0	0	0.40	0.652
0.80	17.4	13.9	4.51	2.10	4.01	0	0	0.80	0.669
1.20	14.6	17.5	3.58	2.36	6.37	0	0	1.20	0.694
1.60	12.8	20.6	3.09	2.77	9.13	0	0	1.60	0.679
2.00	11.7	23.3	2.77	3.58	12.71	0	0	2.00	0.660
2.40	10.8	25.9	2.53	9.38	22.10	0.30	0.297	2.40	0.297
2.80	10.1	28.2	2.36	4.51	26.60	0.99	0.694		
3.20	9.5	30.4	2.21	3.09	29.69	1.67	0.679		
3.60	9.0	32.5	2.10	2.53	32.23	2.34	0.669		
4.00	8.6	34.5	2.00	2.21	34.44	3.00	0.660		
4.40	8.3	36.4	1.91	2.00	36.44	3.65	0.652		



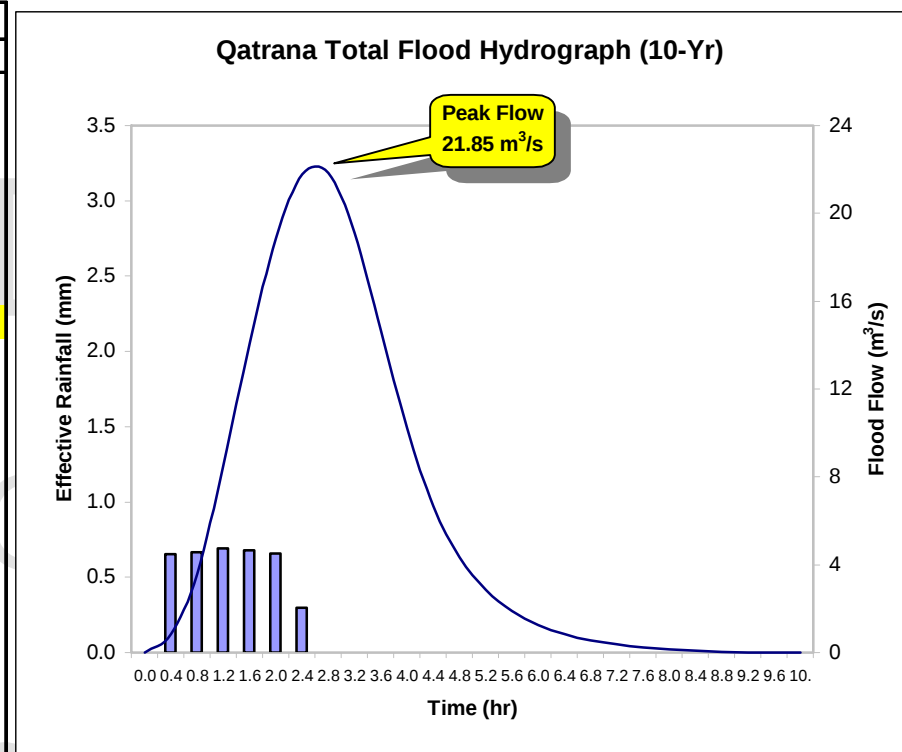
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Total Flood Hydrograph for 10-Yr Return Period

Total Flood Hydrograph for 20 yr Return period														
t	Design	Unit Hydrograph q (m ³ /s)												
hr	Storm (cm)	13.000	41.500	75.000	81.500	69.500	50.000	30.000	20.000	13.000	8.500	5.750	4.000	2.500
0	0	0												
0.40	0.065	0.8479												
0.80	0.067	0.869	2.7067											
1.20	0.069	0.903	2.776	4.8916										
1.60	0.068	0.883	2.882	5.016	5.3156									
2.00	0.066	0.858	2.820	5.208	5.451	4.5329								
2.40	0.030	0.386	2.739	5.096	5.659	4.648	3.2611							
2.80	0.365		1.232	4.950	5.537	4.826	3.344	1.9566						
3.20	Sum (cm)			2.227	5.379	4.722	3.472	2.006	1.3044					
3.60					2.420	4.587	3.397	2.083	1.338	0.8479				
4.00						2.064	3.300	2.038	1.389	0.869	0.5544			
4.40							1.485	1.980	1.359	0.903	0.568	0.3750		
4.80								0.891	1.320	0.883	0.590	0.385	0.2609	
5.20									0.594	0.858	0.578	0.399	0.268	0.1631
5.60										0.386	0.561	0.391	0.278	0.167
6.00											0.252	0.380	0.272	0.174
6.40												0.171	0.264	0.170
6.80													0.119	0.165
7.20														0.074
7.60														
8.00														
8.40														
8.80														
9.20														
9.60														
10.00														

						Total (m ³ /s)
1.600	1.200	0.800	0.500	0.300	0.050	Hydrograph
						0
						0.848
						3.576
						8.570
						14.097
						18.869
						21.789
						21.847
						19.111
						14.673
						10.215
						6.670
						4.330
						2.859
						1.887
0.1044						1.263
0.107	0.0783					0.848
0.111	0.080	0.0522				0.562
0.109	0.083	0.0535	0.0326			0.370
0.106	0.082	0.0555	0.0334	0.0196		0.239
0.048	0.079	0.0544	0.0347	0.0201	0.0033	0.147
		0.036	0.0528	0.0340	0.0208	0.081
			0.0238	0.0330	0.0204	0.038
				0.0148	0.0198	0.012
					0.0089	0.001
					0.0015	0.000
						0.000



Peak Flow for Mujib and Wala South Catchment using (SCS) Unit Hydrograph Method

10-Yr

$$q_p = 3.11 \frac{A}{t_c}$$

Watershed Characteristics

Catchment Area (km ²)	Length of Watercourse (km)	Ground Elevation at		Average Slope (m / m)	Curve Number CN	Runoff Coefficient	Kirpich Condition	Izzard Ret. Coeff.
		Divide	Outlet					
736.337	36.31	950	800	0.0274	75.0	0.25	3	0.046
	L _{ca} to Cent. 25.77						Kinematic Overl. Rou.	Kerby Manning
							0.01	0.3

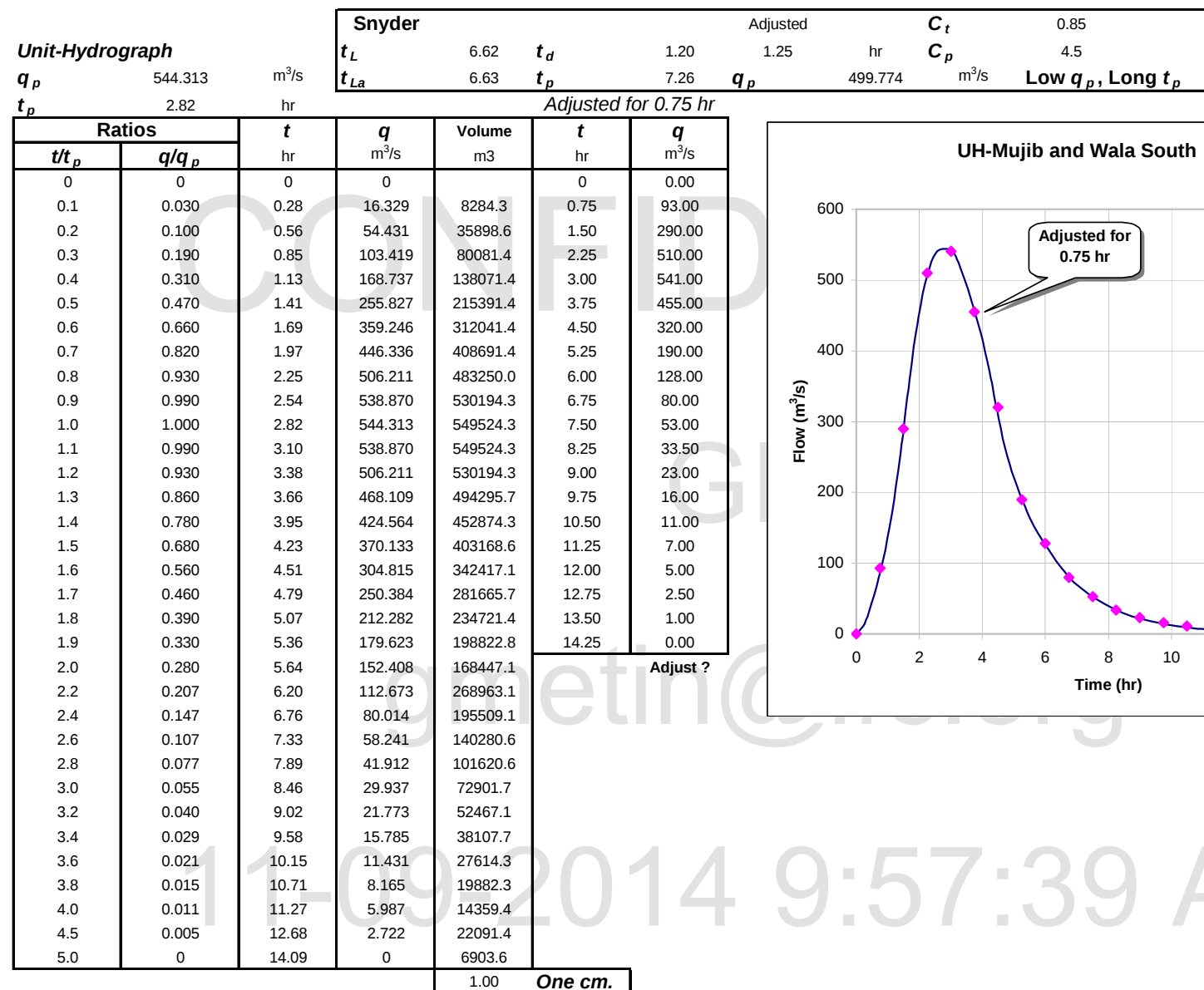
Time of Concentration Calculations

Time of Concentration (min)									Iteration for Kinematic and Izzard			
California Culverts	Kirpich	Kerby	Bransby Williams	SCS lag Eq.	Izzard	Kinematic	Federal Aviation	Min. Time of Conct.	Kinematic	Intensity	tc	
523.5	252.4	257.1	560.8	1020.8	2606.1	460.9	377.5	252.4	Izzard	2.9	460.9	0.0
									Izzard	1.0	2606.1	0.0
									4.207 hr			

Intensity Formula	1000-Yr		200-Yr		100-Yr		10-Yr		Record	
	a	b	a	b	a	b	a	b	Years	Period
Hasa Tan.							116.920	0.6020	26	1969-1999

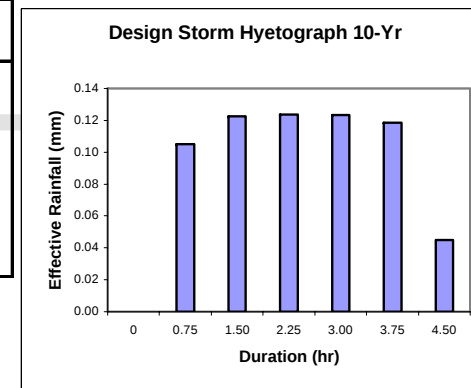
Station Effective Percentage

Hasa Tan.		
100.0%	0.0%	0.0%



Storm Hyetograph 10-Yr

						0.2 S (mm)			
						16.9			
Time hr	Intensity mm/hr	Rainfall mm	Inc Rain mm	Inc Rain sort	Acc Rain	Acc Exc Rain	Excess Rain	Time hr	Design Storm
0	0	0						0	0
0.75	11.8	8.9	8.87	0.77	0.77	0	0	0.75	0.105
1.50	7.8	11.7	2.82	0.86	1.63	0	0	1.50	0.123
2.25	6.1	13.7	2.05	0.97	2.60	0	0	2.25	0.124
3.00	5.1	15.4	1.67	1.14	3.75	0	0	3.00	0.123
3.75	4.5	16.8	1.43	1.43	5.18	0	0	3.75	0.119
4.50	4.0	18.1	1.27	2.05	7.22	0	0	4.50	0.045
5.25	3.7	19.2	1.14	8.87	16.09	0	0		
6.00	3.4	20.3	1.05	2.82	18.90	0.045	0.0448		
6.75	3.1	21.3	0.97	1.67	20.57	0.150	0.1049		
7.50	3.0	22.2	0.91	1.27	21.84	0.268	0.1186		
8.25	2.8	23.0	0.86	1.05	22.89	0.391	0.1226		
9.00	2.6	23.8	0.81	0.91	23.80	0.515	0.1236		
9.75	2.5	24.6	0.77	0.81	24.61	0.638	0.1232		



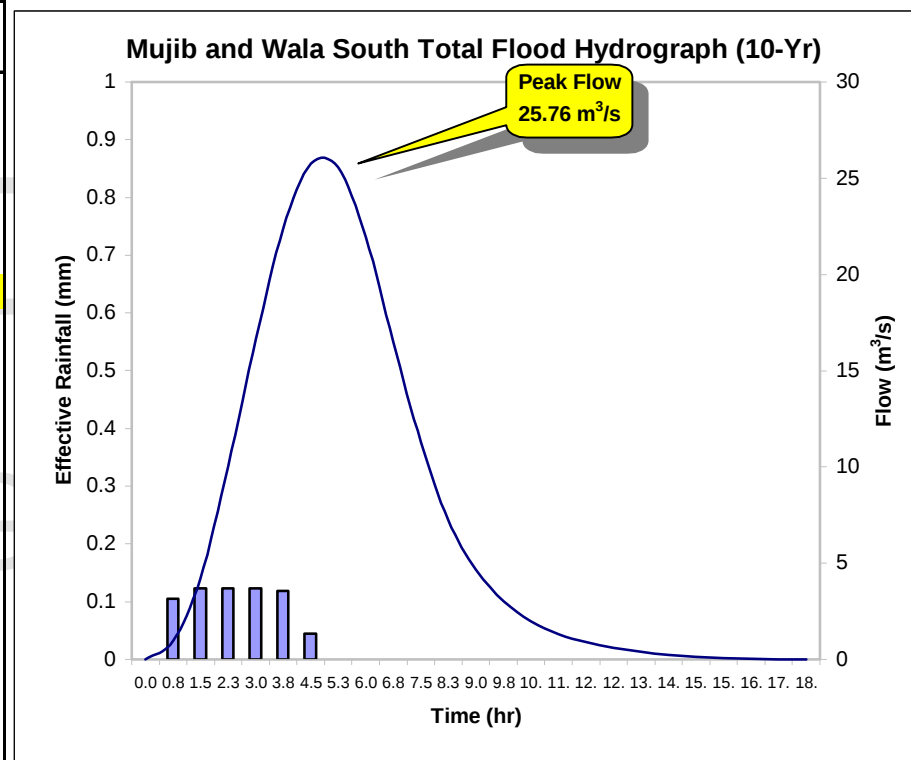
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Total Flood Hydrograph for 10-Yr Return Period

t hr	Design Storm (cm)	Unit Hydrograph q (m³/s)											
		93.000	290.000	510.000	541.000	455.000	320.000	190.000	128.000	80.000	53.000	33.500	23.000
0	0	0											
0.75	0.0105	0.9757											
1.50	0.0123	1.141	3.0424										
2.25	0.0124	1.149	3.557	5.3504									
3.00	0.0123	1.146	3.583	6.255	5.6756								
3.75	0.0119	1.103	3.573	6.302	6.635	4.7734							
4.50	0.0045	0.417	3.439	6.283	6.685	5.580	3.3571						
5.25	0.064		1.300	6.048	6.665	5.622	3.925	1.9933					
6.00	Sum (cm)			2.287	6.416	5.606	3.954	2.330	1.3428				
6.75					2.426	5.396	3.942	2.348	1.570	0.8393			
7.50						2.040	3.795	2.341	1.582	0.981	0.5560		
8.25							1.435	2.253	1.577	0.989	0.650	0.3514	
9.00								0.852	1.518	0.986	0.655	0.411	0.2413
9.75									0.574	0.949	0.653	0.414	0.282
10.50										0.359	0.629	0.413	0.284
11.25											0.238	0.397	0.283
12.00												0.150	0.273
12.75													0.103
13.50													
14.25													
15.00													
15.75													
16.50													
17.25													
18.00													

						Total (m ³ /s)
						Hydrograph
16.000	11.000	7.000	5.000	2.500	1.000	0
						0.976
						4.183
						10.056
						16.660
						22.386
						25.762
						25.554
						21.936
						16.521
						11.295
						7.255
						4.663
						3.040
0.1679						1.996
0.196	0.1154					1.324
0.198	0.135	0.0734				0.894
0.197	0.136	0.086	0.0525			0.602
0.190	0.136	0.086	0.0613	0.0262		0.391
0.072	0.130	0.086	0.0618	0.0307	0.0105	0.237
	0.049	0.083	0.0616	0.0309	0.0123	0.134
		0.031	0.0593	0.0308	0.0124	0.064
			0.0224	0.0296	0.0123	0.023
				0.0112	0.0119	0.004
					0.0045	0.000



Peak Flow for Hasa Catchment using (SCS) Unit Hydrograph Method

10-Yr

$$q_p = 3.11 \frac{A}{t_c}$$

Watershed Characteristics

Catchment Area (km ²)	Length of Watercourse (km)	Ground Elevation at		Average Slope (m / m)	Curve Number CN	Runoff Coefficient	Kirpich Condition	Izzard Ret. Coeff.
		Divide	Outlet					
115.981	10.50	900	880	0.0019	75.0	0.25	3	0.046
	L _{ca} to Cent.						Kinematic Overl. Rou.	Kerby Manning
	7.50						0.01	0.3

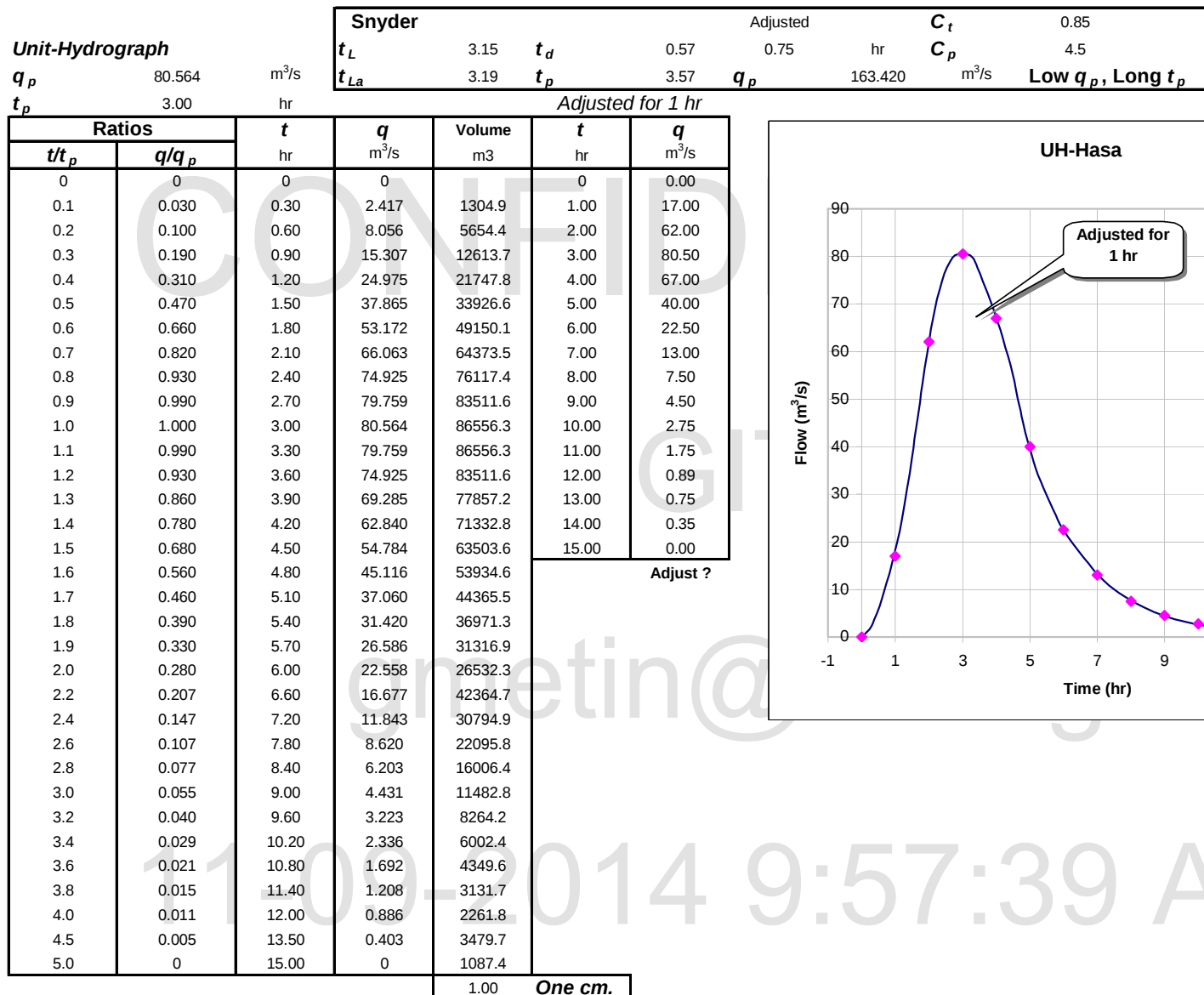
Time of Concentration Calculations

Time of Concentration (min)									Iteration for Kinematic and Izzard			
California Culverts	Kirpich	Kerby	Bransby Williams	SCS lag Eq.	Izzard	Kinematic	Federal Aviation	Min. Time of Conct.	Kinematic	Intensity	tc	
271.2	271.2	268.6	332.6	1436.4	5765.4	496.2	493.6	268.6	Izzard	0.6	5765.4	0.0
4.477 hr												

Intensity Formula	1000-Yr		200-Yr		100-Yr		10-Yr		Record	
	a	b	a	b	a	b	a	b	Years	Period
Hasa Tan.							116.920	0.6020	26	1969-1999

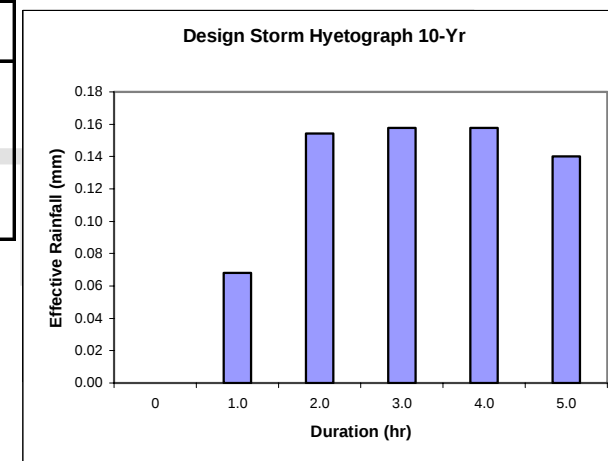
Station Effective Percentage

Hasa Tan.		
100.0%	0.0%	0.0%



Storm Hyetograph 10-Yr

Time hr	Intensity mm/hr	Rainfall mm	Inc Rain mm	Inc Rain sort	Acc Rain	0.2 S (mm)		Time hr	Design Storm
						Acc Exc Rain	Excess Rain		
0	0	0						0	0
1.00	9.9	9.9	9.94	1.09	1.09	0	0	1.0	0.068
2.00	6.5	13.1	3.16	1.28	2.37	0	0	2.0	0.154
3.00	5.1	15.4	2.29	1.60	3.98	0	0	3.0	0.158
4.00	4.3	17.3	1.87	2.29	6.27	0	0	4.0	0.158
5.00	3.8	18.9	1.60	9.94	16.21	0	0	5.0	0.140
6.00	3.4	20.3	1.42	3.16	19.37	0.068	0.068		
7.00	3.1	21.6	1.28	1.87	21.24	0.208	0.140		
8.00	2.8	22.7	1.18	1.42	22.66	0.363	0.154		
9.00	2.6	23.8	1.09	1.18	23.84	0.520	0.158		
10.00	2.5	24.9	1.02	1.02	24.86	0.678	0.158		

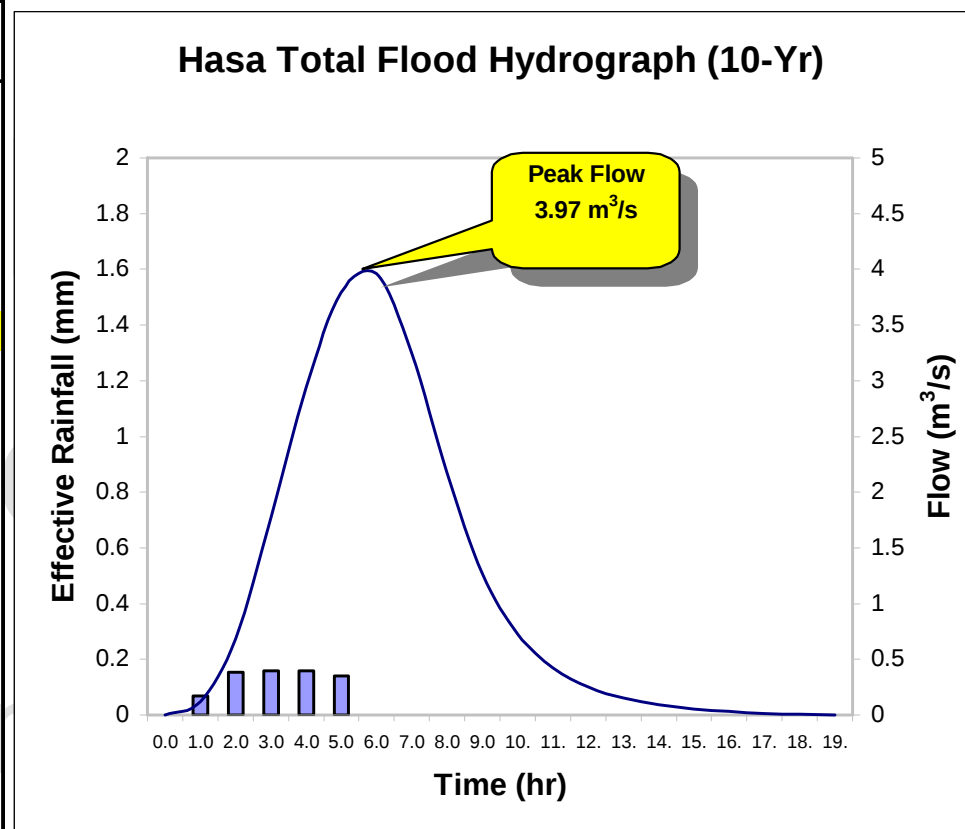


Total Flood Hydrograph for 10-Yr Return Period

t hr	Design Storm (cm)	Unit Hydrograph q (m^3/s)									
		17.000	62.000	80.500	67.000	40.000	22.500	13.000	7.500	4.500	2.750
0	0	0									
1.0	0.0068	0.1160									
2.0	0.0154	0.262	0.4231								
3.0	0.0158	0.268	0.957	0.5494							
4.0	0.0158	0.268	0.978	1.242	0.4573						
5.0	0.0140	0.238	0.978	1.270	1.034	0.2730					
6.0	0.068		0.869	1.269	1.057	0.617	0.1536				
7.0	Sum (cm)			1.128	1.056	0.631	0.347	0.0887			
8.0					0.939	0.631	0.355	0.201	0.0512		
9.0						0.560	0.355	0.205	0.116	0.0307	
10.0							0.315	0.205	0.118	0.069	0.0188
11.0								0.182	0.118	0.071	0.042
12.0									0.105	0.071	0.043
13.0										0.063	0.043
14.0											0.039
15.0											
16.0											
17.0											
18.0											
19.0											

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				Total (m ³ /s)
1.750	0.890	0.750	0.350	Hydrograph
				0
				0.116
				0.685
				1.774
				2.945
				3.792
				3.965
				3.251
				2.176
				1.267
				0.727
0.0119				0.426
0.027	0.0061			0.252
0.028	0.014	0.0051		0.153
0.028	0.014	0.012	0.0024	0.094
0.025	0.014	0.012	0.005	0.056
	0.012	0.012	0.006	0.030
		0.011	0.006	0.016
			0.005	0.005
				0.000



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10-Yr

$$q_p = 3.11 \frac{A}{t_c}$$

Catchment Area (km ²)	Length of Watercourse (km)	Ground Elevation at		Average Slope (m / m)	Curve Number CN	Runoff Coefficient	Kirpich Condition	Izzard Ret. Coeff
		Divide	Outlet					
		(masl)						
4033.623	73.87	1500	875	0.0077	75.0	0.25	3	0.046
	L _{ca} to Cent.						Kinematic Overl. Rou.	Kerby Manning
	31.29						0.01	0.3

Time of Concentration (min)									Iteration for Kinematic and Izzard			
California Culverts	Kirpich	Kerby	Bransby Williams	SCS lag Eq.	Izzard	Kinematic	Federal Aviation	Min. Time of Conct.		Intensity	tc	
686.4	710.9	481.9	1240.7	3398.8	8985.9	1359.7	821.7	481.9	Kinematic	1.5	1359.7	0.0
									Izzard	0.4	8985.9	0.0

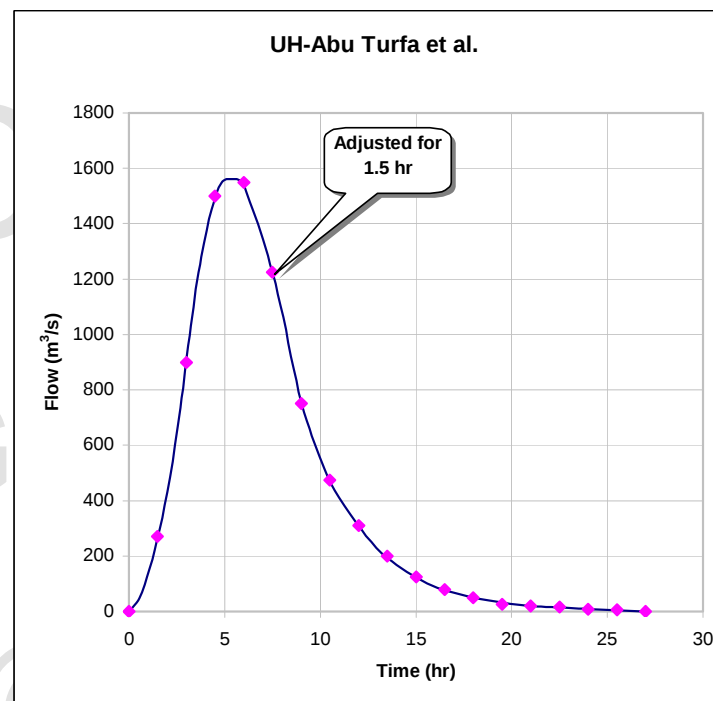
Intensity Formula	1000-Yr		200-Yr		100-Yr		10-Yr		Record	
	a	b	a	b	a	b	a	b	Years	Period
Ma'an							161.660	0.6994	21	1971-1999
Wadi Mousa							164.080	0.6054	30	1969-2001
Wadi Wala							177.930	0.6197	24	1971-1999

Ma'an	Wadi Mousa	Wadi Wala
57.9%	14.6%	27.4%

Unit-Hydrograph			Snyder				Adjusted		C_t		C_p		Low q_p , Long t_p	
q_p	1561.796	m ³ /s	t_L	8.68	t_d	1.58	1.75	hr						
t_p	5.38	hr	t_{La}	8.72	t_p	9.60	q_p	2080.585	m ³ /s					
Adjusted for 1.5 hr														
Ratios		t	q	Volume	t	q								
t/t_p	q/q_p	hr	m ³ /s	m3	hr	m ³ /s								
0	0	0	0		0	0.00								
0.1	0.030	0.54	46.854	45381.0	1.50	270.00								
0.2	0.100	1.08	156.180	196650.9	3.00	900.00								
0.3	0.190	1.61	296.741	438682.8	4.50	1500.00								
0.4	0.310	2.15	484.157	756349.7	6.00	1550.00								
0.5	0.470	2.69	734.044	1179905.5	7.50	1225.00								
0.6	0.660	3.23	1030.785	1709350.3	9.00	750.00								
0.7	0.820	3.77	1280.673	2238795.1	10.50	475.00								
0.8	0.930	4.30	1452.470	2647224.0	12.00	310.00								
0.9	0.990	4.84	1546.178	2904382.9	13.50	200.00								
1.0	1.000	5.38	1561.796	3010271.8	15.00	125.00								
1.1	0.990	5.92	1546.178	3010271.8	16.50	80.00								
1.2	0.930	6.46	1452.470	2904382.9	18.00	50.00								
1.3	0.860	7.00	1343.145	2707731.9	19.50	25.00								
1.4	0.780	7.53	1218.201	2480827.0	21.00	20.00								
1.5	0.680	8.07	1062.021	2208541.1	22.50	15.00								
1.6	0.560	8.61	874.606	1875747.3	24.00	7.20								
1.7	0.460	9.15	718.426	1542953.4	25.50	5.30								
1.8	0.390	9.69	609.100	1285794.5	27.00	0.00								
1.9	0.330	10.22	515.393	1089143.6	Adjust ?									
2.0	0.280	10.76	437.303	922746.6										
2.2	0.207	11.84	323.292	1473369.2										
2.4	0.147	12.91	229.584	1070991.2										
2.6	0.107	13.99	167.112	768451.3										
2.8	0.077	15.07	120.258	556673.4										
3.0	0.055	16.14	85.899	399352.6										
3.2	0.040	17.22	62.472	287412.9										
3.4	0.029	18.30	45.292	208752.5										
3.6	0.021	19.37	32.798	151269.9										
3.8	0.015	20.45	23.427	108914.4										
4.0	0.011	21.52	17.180	78660.4										
4.5	0.005	24.21	7.809	121016.0										
5.0	0	26.90	0	37817.5										
				1.00	One cm.									

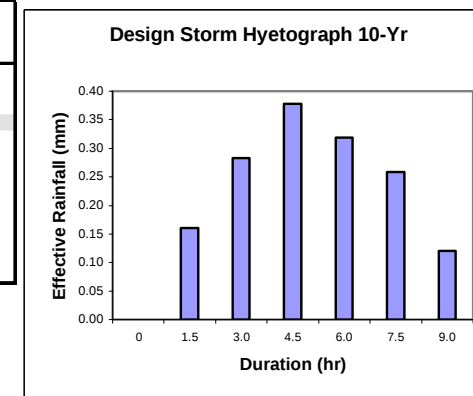
UH-Abu Turfa et al.

Time (hr)	Flow (m³/s)
0	0
0.54	46.854
1.08	156.180
1.61	296.741
2.15	484.157
2.69	734.044
3.23	1030.785
3.77	1280.673
4.30	1452.470
4.84	1546.178
5.38	1561.796
5.92	1546.178
6.46	1452.470
7.00	1343.145
7.53	1218.201
8.07	1062.021
8.61	874.606
9.15	718.426
9.69	609.100
10.22	515.393
10.76	437.303
11.84	323.292
12.91	229.584
13.99	167.112
15.07	120.258
16.14	85.899
17.22	62.472
18.30	45.292
19.37	32.798
20.45	23.427
21.52	17.180
24.21	7.809
26.90	0



Storm Hyetrograph 10-Yr

						0.2 S (mm) 16.9			
Time hr	Intensity mm/hr	Rainfall mm	Inc Rain mm	Inc Rain sort	Acc Rain	Acc Exc Rain	Excess Rain	Time hr	Design Storm
0	0	0						0	0.000
1.50	8.6	12.9	12.90	0.67	0.67	0	0	1.5	0.161
3.00	5.5	16.4	3.50	1.12	1.79	0	0	3.0	0.283
4.50	4.2	18.9	2.48	1.33	3.12	0	0	4.5	0.378
6.00	3.5	20.9	1.99	1.69	4.80	0	0	6.0	0.319
7.50	3.0	22.6	1.69	2.48	7.28	0	0	7.5	0.259
9.00	2.7	24.0	1.48	12.90	20.18	0.12	0.120	9.0	0.120
10.50	2.4	25.4	1.33	3.50	23.68	0.50	0.378		
12.00	2.2	26.6	1.21	1.99	25.67	0.82	0.319		
13.50	2.1	27.7	1.12	1.48	27.15	1.10	0.283		
14.50	2.0	28.4	0.70	1.21	28.36	1.36	0.259		
15.50	1.9	29.1	0.67	0.70	29.06	1.52	0.161		

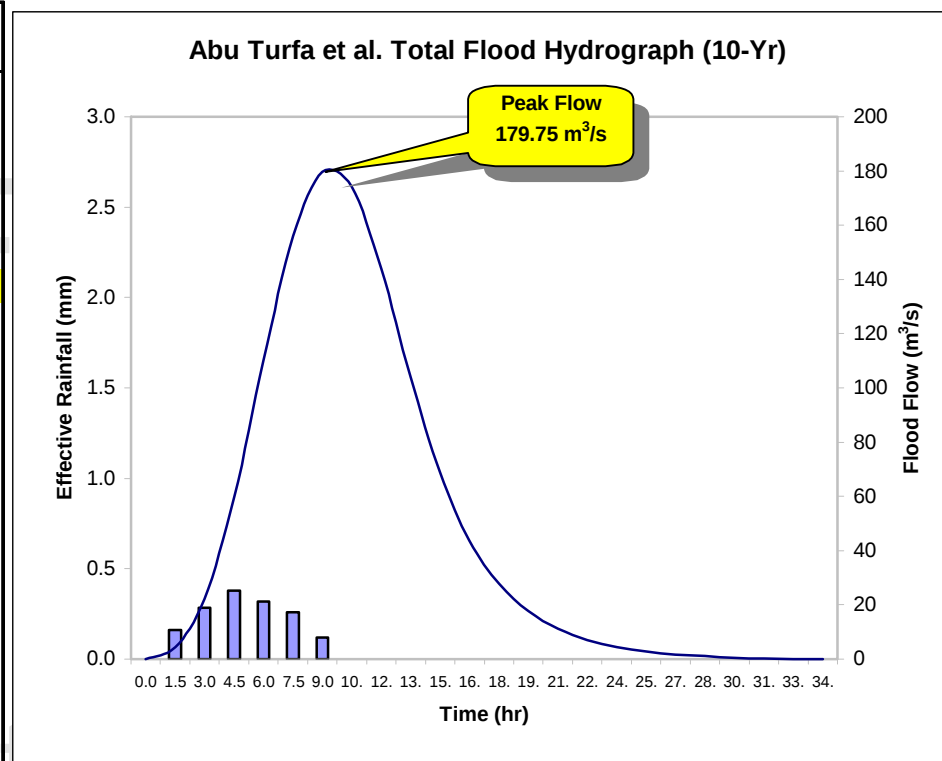


Total Flood Hydrograph for 10-Yr Return Period

Unit Hydrograph for 16-h Retain Period													
t hr	Design	Unit Hydrograph q (m ³ /s)											
	Storm (cm)	270.000	900.000	1500.000	1550.000	1225.000	750.000	475.000	310.000	200.000	125.000	80.000	50.000
0	0	0											
1.5	0.0161	4.3382											
3.0	0.0283	7.642	14.4608										
4.5	0.0378	10.214	25.472	24.1013									
6.0	0.0319	8.611	34.047	42.453	24.9047								
7.5	0.0259	6.991	28.705	56.744	43.868	19.6827							
9.0	0.0120	3.246	23.302	47.841	58.636	34.670	12.0506						
10.5	0.152		10.819	38.837	49.436	46.341	21.227	7.6321					
12.0	Sum (cm)			18.032	40.131	39.070	28.372	13.443	4.9809				
13.5					18.633	31.717	23.921	17.969	8.774	3.2135			
15.0						14.726	19.418	15.150	11.727	5.660	2.0084		
16.5							9.016	12.298	9.887	7.566	3.538	1.2854	
18.0								5.710	8.026	6.379	4.729	2.264	0.8034
19.5									3.727	5.178	3.987	3.026	1.415
21.0										2.404	3.236	2.552	1.891
22.5											1.503	2.071	1.595
24.0												0.962	1.295
25.5													0.601
27.0													
28.5													
30.0													
31.5													
33.0													
34.5													

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					Total (m ³ /s)
25.000	20.000	15.000	7.200	5.300	Hydrograph
					0
					4.338
					22.102
					59.787
					110.016
					155.991
					179.746
					174.292
					144.030
					104.227
					68.690
					43.591
					27.912
0.4017					17.735
0.708	0.3214				11.113
0.946	0.566	0.2410			6.921
0.797	0.757	0.425	0.1157		4.350
0.647	0.638	0.567	0.2038	0.0852	2.743
0.301	0.518	0.478	0.2724	0.1500	1.719
	0.240	0.388	0.2296	0.2005	1.059
		0.180	0.1864	0.1690	0.536
			0.0866	0.1372	0.224
				0.0637	0.064
					0.000



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Peak Flow for Batn El Ghol Catchment using (SCS) Unit Hydrograph Method

10-Yr

$$q_p = 3.11 \frac{A}{t_c}$$

Watershed Characteristics

Catchment Area (km ²)	Length of Watercourse (km)	Ground Elevation at		Average Slope (m / m)	Curve Number CN	Runoff Coefficient	Kirpich Condition	Izzard Ret. Coeff.
		Divide	Outlet					
66.281	16.92	1100	900	0.0119	75.0	0.25	3	0.046
	L _{ca} to Cent. 7.39						Kinematic Overl. Rou.	Kerby Manning
							0.01	0.3

Time of Concentration Calculations

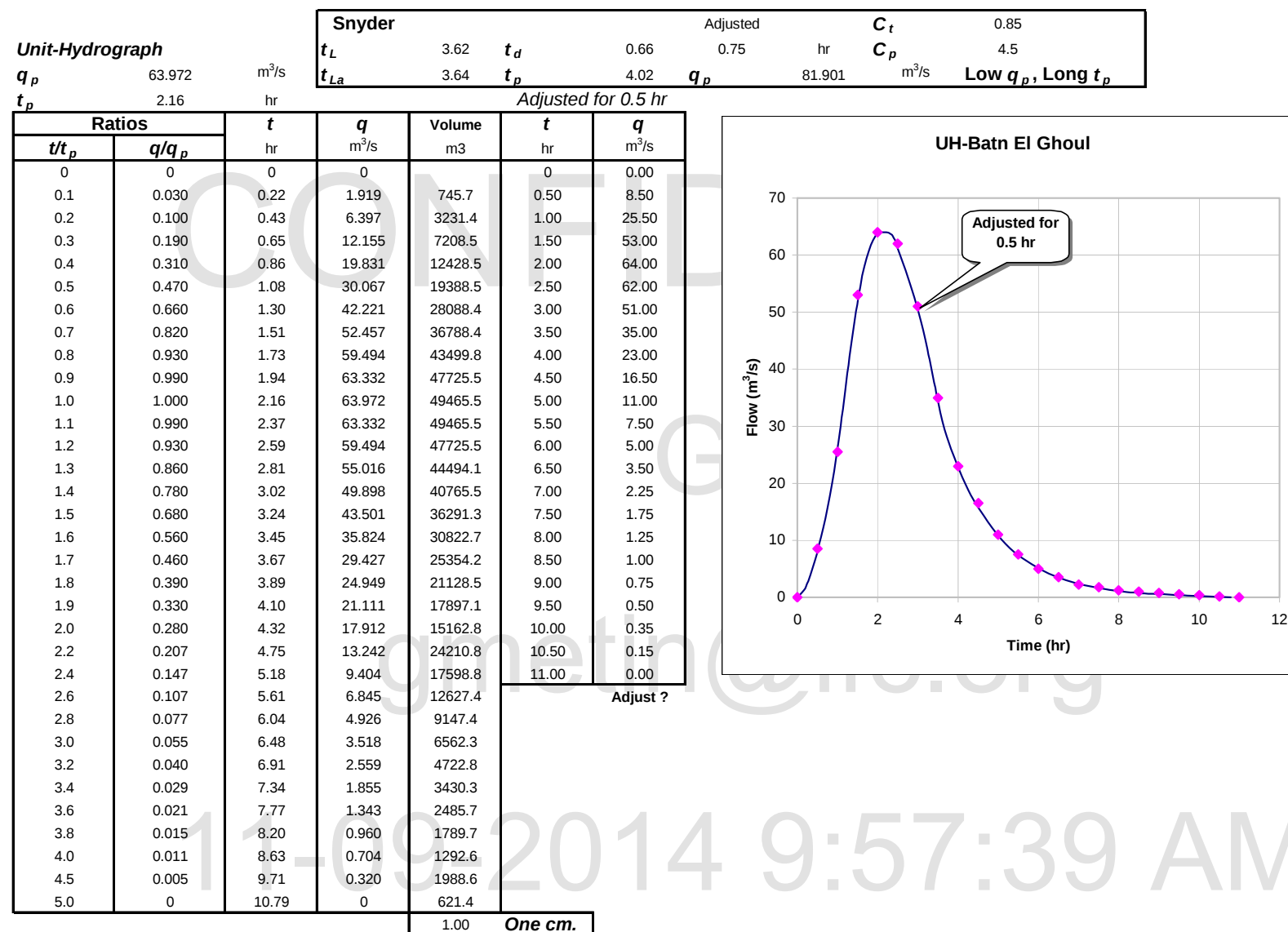
Time of Concentration (min)									Iteration for Kinematic and Izzard			
California Culverts	Kirpich	Kerby	Bransby Williams	SCS lag Eq.	Izzard	Kinematic	Federal Aviation	Min. Time of Conct.	Kinematic	Intensity	tc	
194.1	193.3	218.7	392.9	841.1	3954.9	333.1	340.2	193.3	Izzard	0.6	3954.9	0.0

3.222 hr

Intensity Formula	1000-Yr		200-Yr		100-Yr		10-Yr		Record	
	a	b	a	b	a	b	a	b	Years	Period
Aqaba Airp.							358.650	0.7783	25	1967-1991

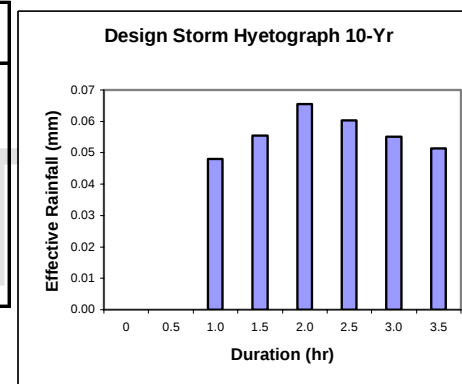
Station Effective Percentage

Aqaba Airp.		
100.0%	0.0%	0.0%



Storm Hyetograph 10-Yr

						0.2 S (mm)		16.9	
Time hr	Intensity mm/hr	Rainfall mm	Inc Rain mm	Inc Rain sort	Acc Rain	Acc Exc Rain	Excess Rain	Time hr	Design Storm
0	0	0						0	0
0.50	25.4	12.7	12.71	0.39	0.39	0	0	0.5	0.0001
1.00	14.8	14.8	2.11	0.45	0.85	0	0	1.0	0.048
1.50	10.8	16.2	1.39	0.53	1.38	0	0	1.5	0.055
2.00	8.6	17.3	1.07	0.66	2.04	0	0	2.0	0.065
2.50	7.3	18.2	0.88	0.88	2.91	0	0	2.5	0.060
3.00	6.3	18.9	0.75	1.39	4.31	0	0	3.0	0.055
3.50	5.6	19.6	0.66	12.71	17.01	0.0001	0.0001	3.5	0.051
4.00	5.0	20.1	0.59	2.11	19.12	0.06	0.055		
4.50	4.6	20.7	0.53	1.07	20.19	0.12	0.065		
5.00	4.2	21.2	0.49	0.75	20.94	0.18	0.060		
5.50	3.9	21.6	0.45	0.59	21.53	0.24	0.055		
6.00	3.7	22.0	0.42	0.49	22.02	0.29	0.051		
6.50	3.5	22.4	0.39	0.42	22.44	0.34	0.048		



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Total Flood Hydrograph for 10-Yr Return Period

t hr	Design Storm (cm)	Unit Hydrograph q (m^3/s)												
		8.500	25.500	53.000	64.000	62.000	51.000	35.000	23.000	16.500	11.000	7.500	5.000	3.500
0	0	0												
0.5	0.00001	0.0001												
1.0	0.0048	0.041	0.0002											
1.5	0.0055	0.047	0.123	0.0004										
2.0	0.0065	0.056	0.141	0.255	0.0005									
2.5	0.0060	0.051	0.167	0.294	0.308	0.0005								
3.0	0.0055	0.047	0.154	0.347	0.355	0.298	0.0004							
3.5	0.0051	0.044	0.141	0.320	0.419	0.344	0.245	0.0003						
4.0	0.034		0.131	0.292	0.386	0.406	0.283	0.168	0.0002					
4.5	Sum (cm)			0.272	0.353	0.374	0.334	0.194	0.111	0.0001				
5.0					0.329	0.342	0.308	0.229	0.127	0.079	0.0001			
5.5						0.319	0.281	0.211	0.151	0.091	0.053	0.0001		
6.0							0.262	0.193	0.139	0.108	0.061	0.036	0.0000	
6.5								0.180	0.127	0.100	0.072	0.042	0.024	0.0000
7.0									0.118	0.091	0.066	0.049	0.028	0.017
7.5										0.085	0.061	0.045	0.033	0.019
8.0											0.057	0.041	0.030	0.023
8.5												0.039	0.028	0.021
9.0													0.026	0.019
9.5														0.018
10.0														
10.5														
11.0														
11.5														
12.0														
12.5														
13.0														
13.5														
14.0														

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								Total (m ³ /s)
								Hydrograph
2.250 1.750 1.250 1.000 0.750 0.500 0.350 0.150								0
								0.0001
								0.041
								0.170
								0.452
								0.820
								1.201
								1.512
								1.666
								1.638
								1.414
								1.106
								0.799
								0.544
								0.369
0.0000								0.254
0.011	0.0000							0.172
0.012	0.008	0.0000						0.118
0.015	0.010	0.0060	0.0000					0.082
0.014	0.011	0.0069	0.0048	0.0000				0.058
0.012	0.011	0.0082	0.0055	0.0036	0.0000			0.042
0.012	0.010	0.0075	0.0065	0.0042	0.0024	0.0000		0.031
	0.009	0.0069	0.0060	0.0049	0.0028	0.001683	0.0000	0.022
		0.0064	0.0055	0.0045	0.0033	0.001940	0.000721	0.015
			0.0051	0.0041	0.0030	0.002291	0.000831	0.010
				0.0039	0.0028	0.002111	0.000982	0.005
					0.0026	0.001929	0.000905	0.003
						0.001799	0.000827	0.001
							0.000771	0.000
								0.000

