CE 5362 Surface Water Modeling
Project 3

Problem Statement

Figure 1 is a sketch of a channel and tributary system with a road (bridge) crossing the main channel. The cross sections are surveyed and the sections are included in Figure 2

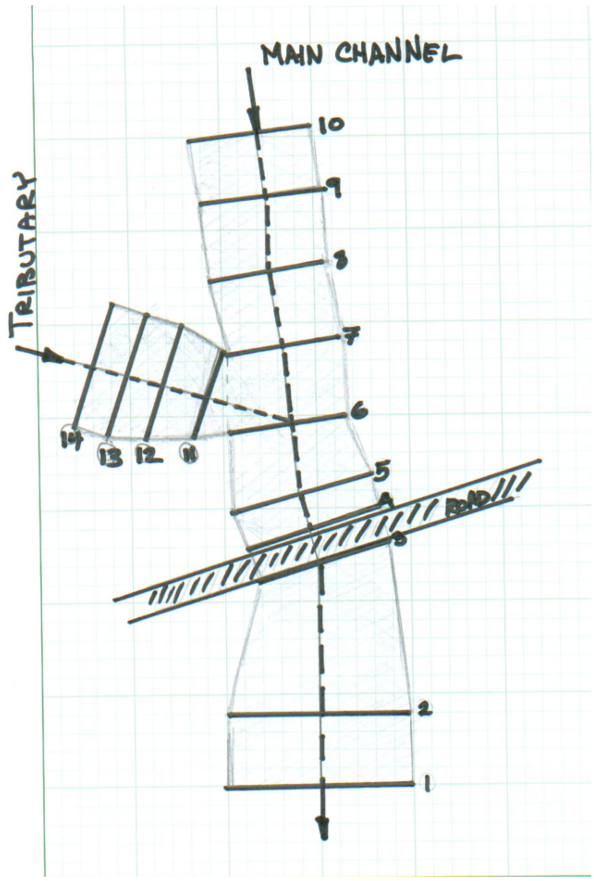
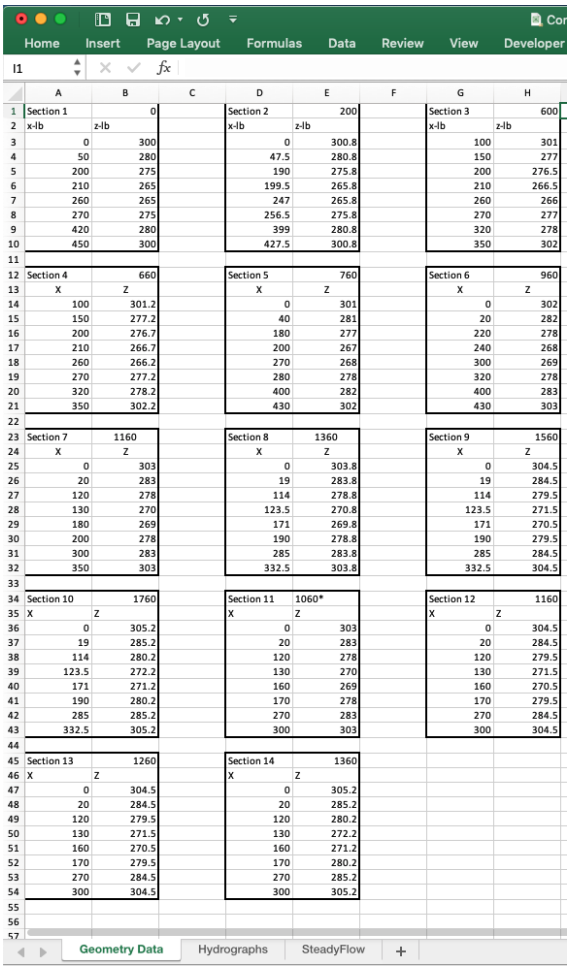


Figure 1: Plan view/schematic for example

Cross section 1 is the most downstream section; sections 10 and 14 are upstream sections. Roughness coefficients for the left-over-bank, channel, and right-over-bank are estimated as 0.10, 0.05, and 0.08 for the main channel portion of the system and 0.08, 0.05, and 0.08 for the tributary portion of the system.

Figure 2 is a screen capture of a data table that contains the location of the cross sections relative to the diagram (Section 1 is located at distance 0 from the outlet, Section 10 is located 1760 feet upstream of the outlet, etc.). The numbers to the right of each section title in the table are the distances upstream from section 1 and should be used as the section names in HEC-RAS. Section 11 connects to the main channel between Section 6 and 7, and



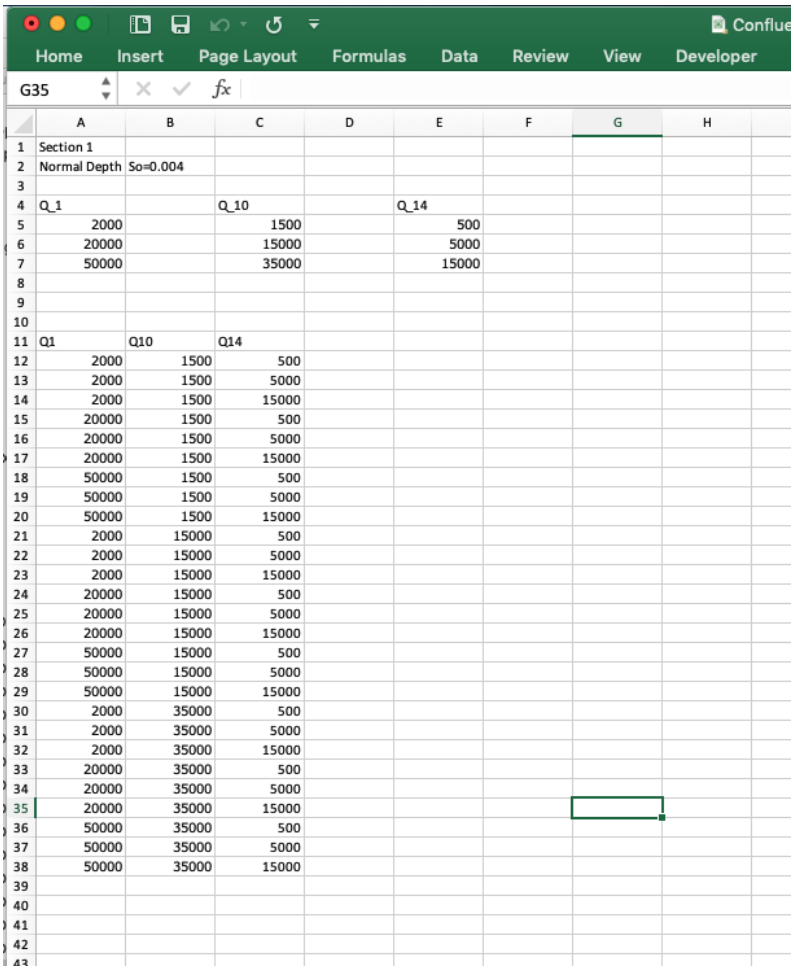
	A	B	C	D	E	F	G	H
1	Section 1	0		Section 2	200		Section 3	600
2	x-lb	z-lb		x-lb	z-lb		x-lb	z-lb
3	0	300		0	300.8		100	301
4	50	280		47.5	280.8		150	277
5	200	275		190	275.8		200	276.5
6	210	265		199.5	265.8		210	266.5
7	260	265		247	265.8		260	266
8	270	275		256.5	275.8		270	277
9	420	280		399	280.8		320	278
10	450	300		427.5	300.8		350	302
11								
12	Section 4	660		Section 5	760		Section 6	960
13	X	Z		X	Z		X	Z
14	100	301.2		0	301		0	302
15	150	277.2		40	281		20	282
16	200	276.7		180	277		220	278
17	210	266.7		200	267		240	268
18	260	266.2		270	268		300	269
19	270	277.2		280	278		320	278
20	320	278.2		400	282		400	283
21	350	302.2		430	302		430	303
22								
23	Section 7	1160		Section 8	1360		Section 9	1560
24	X	Z		X	Z		X	Z
25	0	303		0	303.8		0	304.5
26	20	283		19	283.8		19	284.5
27	120	278		114	278.8		114	279.5
28	130	270		123.5	270.8		123.5	271.5
29	180	269		171	269.8		171	270.5
30	200	278		190	278.8		190	279.5
31	300	283		285	283.8		285	284.5
32	350	303		332.5	303.8		332.5	304.5
33								
34	Section 10	1760		Section 11	1060*		Section 12	1160
35	X	Z		X	Z		X	Z
36	0	305.2		0	303		0	304.5
37	19	285.2		20	283		20	284.5
38	114	280.2		120	278		120	279.5
39	123.5	272.2		130	270		130	271.5
40	171	271.2		160	269		160	270.5
41	190	280.2		170	278		170	279.5
42	285	285.2		270	283		270	284.5
43	332.5	305.2		300	303		300	304.5
44								
45	Section 13	1260		Section 14	1360			
46	X	Z		X	Z			
47	0	304.5		0	305.2			
48	20	284.5		20	285.2			
49	120	279.5		120	280.2			
50	130	271.5		130	272.2			
51	160	270.5		160	271.2			
52	170	279.5		170	280.2			
53	270	284.5		270	285.2			
54	300	304.5		300	305.2			
55								
56								
57								

Figure 2: Tabular cross sections

that is the meaning of the "*" symbol in the table. The angle that the tributary forms with the main channel is about 60-degrees. X-LB and Z-LB are distance and elevation relative to the left bank of each section.

The road is cut into the surrounding grade so that the low chord of the bridge at the main channel is at elevation 290, and the roadway surface is at elevation 295 feet.

Figure 3 is a table of steady flow conditions to consider.



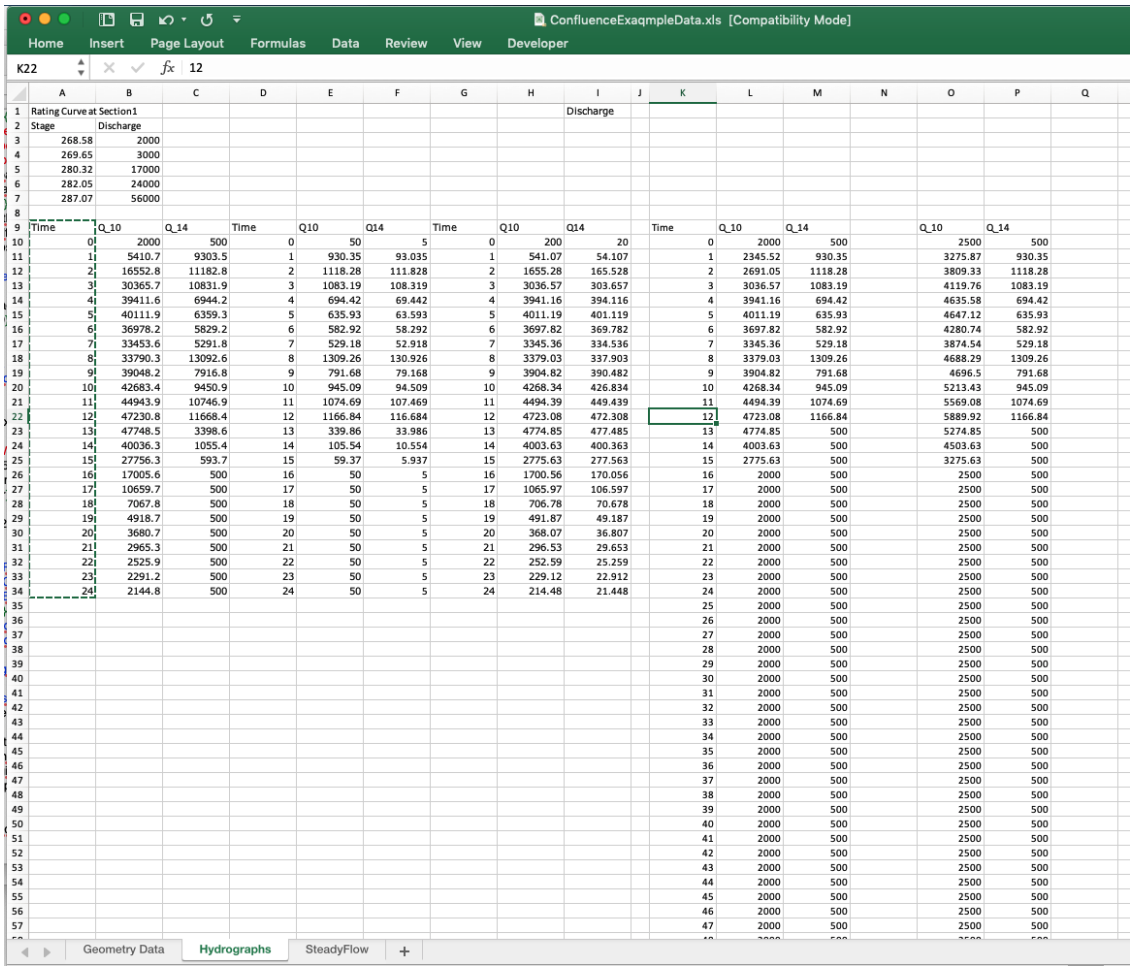
	A	B	C	D	E	F	G	H
1	Section 1							
2	Normal Depth	So=0.004						
3								
4	Q_1		Q_10		Q_14			
5	2000		1500		500			
6	20000		15000		5000			
7	50000		35000		15000			
8								
9								
10								
11	Q1	Q10	Q14					
12	2000	1500	500					
13	2000	1500	5000					
14	2000	1500	15000					
15	20000	1500	500					
16	20000	1500	5000					
17	20000	1500	15000					
18	50000	1500	500					
19	50000	1500	5000					
20	50000	1500	15000					
21	2000	15000	500					
22	2000	15000	5000					
23	2000	15000	15000					
24	20000	15000	500					
25	20000	15000	5000					
26	20000	15000	15000					
27	50000	15000	500					
28	50000	15000	5000					
29	50000	15000	15000					
30	2000	35000	500					
31	2000	35000	5000					
32	2000	35000	15000					
33	20000	35000	500					
34	20000	35000	5000					
35	20000	35000	15000					
36	50000	35000	500					
37	50000	35000	5000					
38	50000	35000	15000					
39								
40								
41								
42								

Figure 3: Steady flow conditions - various combinations

Determine if the current bridge low chord can accommodate the different flows. If flow cannot clear the low chord, treat the bridge as a large culvert and determine if the roadway surface is still passable (not flooded).

Repeat the analysis assuming the bridge abutments extend 100 feet into the left and right over-bank.

Figure 4 is a table of transient flow conditions to consider.



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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Rating Curve at Section1								Discharge								
2	Stage	Discharge															
3	268.58	2000															
4	269.65	3000															
5	280.32	17000															
6	282.05	24000															
7	287.07	56000															
8																	
9	Time	Q_10	Q_14	Time	Q10	Q14	Time	Q10	Q14		Time	Q_10	Q_14		Q_10	Q_14	
10	0	2000	500	0	50	5	0	200	20		0	2000	500		2500	500	
11	1	5410.7	9303.5	1	930.35	93.035	1	541.07	54.107		1	2345.52	930.35		3275.87	930.35	
12	2	16552.8	11182.8	2	1118.28	111.828	2	1655.28	165.528		2	2691.05	1118.28		3809.33	1118.28	
13	3	30365.7	10831.9	3	1083.19	108.319	3	3036.57	303.657		3	3036.57	1083.19		4119.76	1083.19	
14	4	39411.6	6944.2	4	694.42	69.442	4	3941.16	394.116		4	3941.16	694.42		4635.58	694.42	
15	5	40111.9	6359.3	5	635.93	63.593	5	4011.19	401.119		5	4011.19	635.93		4647.12	635.93	
16	6	36978.2	5829.2	6	582.92	58.292	6	3697.82	369.782		6	3697.82	582.92		4280.74	582.92	
17	7	33453.6	5291.8	7	529.18	52.918	7	3345.36	334.536		7	3345.36	529.18		3874.54	529.18	
18	8	33790.3	13092.6	8	1309.26	130.926	8	3379.03	337.903		8	3379.03	1309.26		4688.29	1309.26	
19	9	39048.2	7916.8	9	791.68	79.168	9	3904.82	390.482		9	3904.82	791.68		4696.5	791.68	
20	10	42683.4	9450.9	10	945.09	94.509	10	4268.34	426.834		10	4268.34	945.09		5213.43	945.09	
21	11	44943.9	10746.9	11	1074.69	107.469	11	4494.39	449.439		11	4494.39	1074.69		5569.08	1074.69	
22	12	47230.8	11668.4	12	1166.84	116.684	12	4723.08	472.308		12	4723.08	1166.84		5889.92	1166.84	
23	13	47748.5	3398.6	13	339.86	33.986	13	4774.85	477.485		13	4774.85	500		5274.85	500	
24	14	40036.3	1055.4	14	105.54	10.554	14	4003.63	400.363		14	4003.63	500		4503.63	500	
25	15	27756.3	593.7	15	59.37	5.937	15	2775.63	277.563		15	2775.63	500		3275.63	500	
26	16	17005.6	500	16	50	5	16	1700.56	170.056		16	2000	500		2500	500	
27	17	10659.7	500	17	50	5	17	1065.97	106.597		17	2000	500		2500	500	
28	18	7067.8	500	18	50	5	18	706.78	70.678		18	2000	500		2500	500	
29	19	4918.7	500	19	50	5	19	491.87	49.187		19	2000	500		2500	500	
30	20	3680.7	500	20	50	5	20	368.07	36.807		20	2000	500		2500	500	
31	21	2965.3	500	21	50	5	21	296.53	29.653		21	2000	500		2500	500	
32	22	2525.9	500	22	50	5	22	252.59	25.259		22	2000	500		2500	500	
33	23	2291.2	500	23	50	5	23	229.12	22.912		23	2000	500		2500	500	
34	24	2144.8	500	24	50	5	24	214.48	21.448		24	2000	500		2500	500	
35											25	2000	500		2500	500	
36											26	2000	500		2500	500	
37											27	2000	500		2500	500	
38											28	2000	500		2500	500	
39											29	2000	500		2500	500	
40											30	2000	500		2500	500	
41											31	2000	500		2500	500	
42											32	2000	500		2500	500	
43											33	2000	500		2500	500	
44											34	2000	500		2500	500	
45											35	2000	500		2500	500	
46											36	2000	500		2500	500	
47											37	2000	500		2500	500	
48											38	2000	500		2500	500	
49											39	2000	500		2500	500	
50											40	2000	500		2500	500	
51											41	2000	500		2500	500	
52											42	2000	500		2500	500	
53											43	2000	500		2500	500	
54											44	2000	500		2500	500	
55											45	2000	500		2500	500	
56											46	2000	500		2500	500	
57											47	2000	500		2500	500	

Geometry Data Hydrographs SteadyFlow +

Figure 4: Transient flow conditions

Determine if the current bridge low chord can accommodate the different flows.

If flow cannot clear the low chord, treat the bridge as a large culvert and determine if the roadway surface is still passable (not flooded).

Repeat the analysis assuming the bridge abutments extend 100 feet into the left and right over-bank.

Document in a brief report

1. How you chose to analyze the hydraulics (i.e. tool choices, assumptions, boundary conditions, etc.) — and why you made your choices.

2. Data preparation (i.e. how the hydrographs were digitized for analysis, etc.)

3. Results of the three steady flow cases.
4. Results of the transient (dynamic) flow case.
5. Serviceability of the bridge with and without abutments.
6. Speculation on the effect of the bridge on the channel system with and without abutments.