Florida International University
Department of Civil and Environmental Engineering
CGN5930: Unsteady Flows in Rivers and Pipe Networks
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Homework 2 / Mini Project 2, Spring 2019

Name of Student: ________________________________ **Due Date**: 03/06/2019

1. Consider the flow hydrographs shown in Table 1 for the upstream ends of upper reach and Tule Creek (see Figure 1).

   (a) Assuming that there is a waterfall at the downstream end of Lower Reach, provide recommendations to mitigate floods in the urban area adjacent to the Baxter River shown in Fig. 1 (e.g., provide locations and heights of levees to avoid/minimize flooding).

   (b) Assuming that the first 20 km river stretch downstream of Lower Reach has a near-constant cross-section and longitudinal slope, provide recommendations to mitigate floods in the urban area adjacent to the Baxter River shown in Fig. 1 (e.g., provide locations and heights of levees to avoid/minimize flooding). The average longitudinal slope of this 20 km river stretch is 0.0001.

   (c) Compare your results with the steady flow case (HW1/MP1) and discuss the similarities and differences.

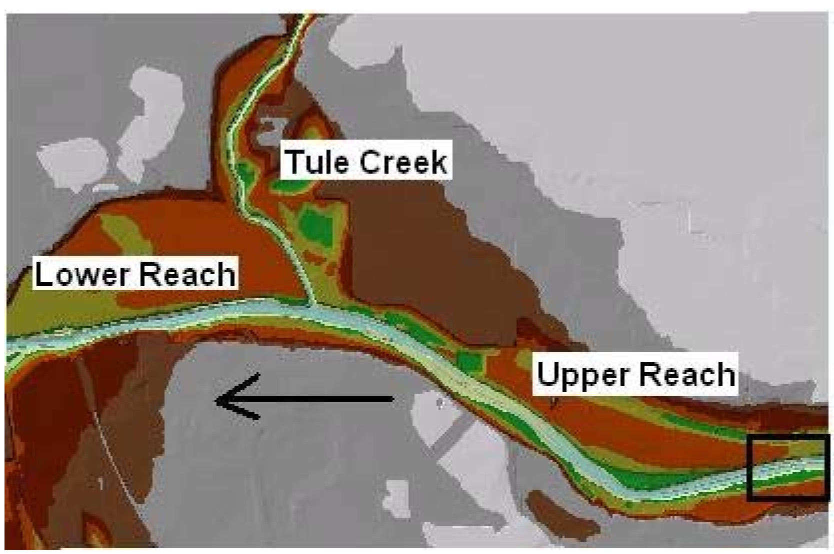

Figure 1: Plan view of Baxter River

- The data for the Baxter River can be downloaded from http://web.eng.fiu.edu/arleon/Teaching_unsteady_rivers.html

Table 1

Upstream End of Upper Reach		Upstream End of Tule Creek	
Time (min)	**Q (cfs)**	**Time (min)**	**Q (cfs)**
10	20000	10	400
20	20000	20	400
30	20000	30	400
40	20000	40	400
50	20000	50	400
60	20000	60	400
70	20000	70	400
80	20000	80	400
90	20000	90	400
100	20000	100	400
110	20000	110	400
120	20000	120	400
130	22000	130	475
140	24000	140	550
150	26000	150	625
160	28000	160	700
170	30000	170	775
180	32000	180	850
190	34000	190	925
200	36000	200	1000
210	38000	210	1075
220	40000	220	1150
230	42000	230	1225
240	44000	240	1300
250	46000	250	1375
260	48000	260	1450
270	50000	270	1525
280	52000	280	1600
290	54000	290	1675
300	56000	300	1750
310	58000	310	1825
320	60000	320	1900
330	62000	330	1975
340	64000	340	2050
350	66000	350	2125

360	68000	360	2200
370	70000	370	2275
380	72000	380	2350
390	74000	390	2425
400	76000	400	2500
410	78000	410	2575
420	80000	420	2650
430	82000	430	2725
440	84000	440	2800
450	86000	450	2875
460	88000	460	2950
470	90000	470	3025
480	92000	480	3100
490	94000	490	3175
500	96000	500	3250
510	98000	510	3325
520	100000	520	3400
530	102000	530	3475
540	104000	540	3550
550	106000	550	3625
560	108000	560	3700
570	110000	570	3775
580	112000	580	3850
590	114000	590	3925
600	116000	600	4000
610	118000	610	3925
620	120000	620	3850
630	122000	630	3775
640	124000	640	3700
650	126000	650	3625
660	124000	660	3550
670	122000	670	3475
680	120000	680	3400
690	118000	690	3325
700	116000	700	3250
710	114000	710	3175
720	112000	720	3100
730	110000	730	3025
740	108000	740	2950
750	106000	750	2875
760	104000	760	2800
770	102000	770	2725
780	100000	780	2650

790	98000
800	96000
810	94000
820	92000
830	90000
840	88000
850	86000
860	84000
870	82000
880	80000
890	78000
900	76000
910	74000
920	72000
930	70000
940	68000
950	66000
960	64000
970	62000
980	60000
990	58000
1000	56000
1010	54000
1020	52000
1030	50000
1040	48000
1050	46000
1060	44000
1070	42000
1080	40000
1090	38000
1100	36000
1110	34000
1120	32000
1130	30000
1140	28000
1150	26000
1160	24000
1170	22000
1180	20000
1190	20000
1200	20000
1210	20000

790	2575
800	2500
810	2425
820	2350
830	2275
840	2200
850	2125
860	2050
870	1975
880	1900
890	1825
900	1750
910	1675
920	1600
930	1525
940	1450
950	1375
960	1300
970	1225
980	1150
990	1075
1000	1000
1010	925
1020	850
1030	775
1040	700
1050	625
1060	550
1070	475
1080	400
1090	400
1100	400
1110	400
1120	400
1130	400
1140	400
1150	400
1160	400
1170	400
1180	400
1190	400
1200	400
1210	400

1220	20000		1220	400
1230	20000		1230	400
1240	20000		1240	400
1250	20000		1250	400
1260	20000		1260	400
1270	20000		1270	400

2. The initial flow conditions in an estuary are given by a velocity V_o = 3ft/s (0.914 m/s) and depth y_o = 8ft (2.44 m), as shown in the figure below. The boundary condition at the mouth of the estuary ($x = 0$), is given by

$$\boldsymbol{y} = 8 - 2\,\mathbf{cos}\left(\frac{\pi \boldsymbol{t}}{6} - \frac{\pi}{2}\right) \qquad \text{For } 0 \le t \le 3 \text{ hr}$$

in which "t" is time in hours and $\boldsymbol{y}$ is the depth in feet at the estuary mouth ($x = 0$). Find (a) the water depth profile at $t = 3$ hr, (b) at $t = 2$ hr, how far upstream will the river level just begin to start falling? (Neglect bed slope and resistance effects: $S_o = 0$, $S_f = 0$), (c) determine the time in hours required for the water depth to drop to 6.50 ft at a distance of 25,000 ft upstream of the estuary mouth.

3. If a dam with an upstream water depth of 50 ft breaks abruptly, estimate the time required for the surge to reach a community 5 miles downstream of the dam. What will the surge height be? Initially, the downstream river has a negligible velocity ($V \approx 0$) and a water depth of 5 ft. What factors would alter your estimates?

4. Water is initially at rest upstream and downstream of a sluice gate, which is completely closed in a rectangular channel. The upstream depth is 3.0 m and the downstream depth is 1.0 m. The gate suddenly is opened completely. Determine the solution of the water surface profile after 5, 10 and 30 minutes of gate opening.