Utah State University
Department of Civil and Environmental Engineering
CEE 3430 Engineering Hydrology

Test 2 Retake   Date: 4/16/2012
D.G. Tarboton   Due: 4/20/12
                                                                       60 Points

This is a take home test. You may refer to the textbook, notes, solutions to homework and any other reference material that you have access to. You may use calculators or computers and may look up information on the internet. You are however honor bound not to ask anyone else for help in doing this test. You may ask the instructor for clarification.

Please turn your work in at class on Friday 4/20/2012 or by no later than **5 pm sharp** that day at ENGR 232.

1. Consider a 30 km^2 watershed with 60% of the area loam soil and 40% of the area clay loam soil. Use Green-Ampt parameters for these soils given in Mays Table 7.4.1 (page 317). Prior to a storm the volumetric moisture content was measured to be 0.25. Consider a storm where 2.5 cm of rainfall occurs in 1 hour. Calculate the following using the Green-Ampt approach.

   a) Calculate the time to ponding for each soil type (hr)   [4]
   b) Calculate the depth of infiltration excess runoff generated from this storm for each soil type (cm)   [4]
   c) Calculate the volume of direct runoff from this watershed for this storm (m^3)   [4]
   d) If the resulting hydrograph is in the form of a triangular hydrograph as illustrated in Mays figure 8.8.1 with t_b = 6 hr what is the peak discharge (m^3/s).   [4]
   e) The runoff ratio is defined as the ratio of the depth of runoff to the depth of rainfall. What is the runoff ratio for this storm?   [4]
   [20 points]

2. The following table lists a 30-min unit hydrograph

Time (min)	0	15	30	45	60	75	90	105	120	135	150
30 min UH (m^3/s/cm)	0	1.5	4.5	9	11.5	10.5	8	5	2.5	0.5	0

   a) Determine the area of the drainage basin   [5]
   b) Determine the 15-min unit hydrograph   [8]
   c) Determine the total runoff hydrograph from the following effective rainfall, assuming the baseflow is 4 m^3/s   [7]

Time (min)	0	15	30	45
Cumulative rainfall excess (cm)	0	1.2	3.0	3.4

                                                                                          [20 points]

3. A 150 km^2 total watershed has three precipitation gages in locations indicated

60 km^2
50 km^2
A
B
C
40 km^2
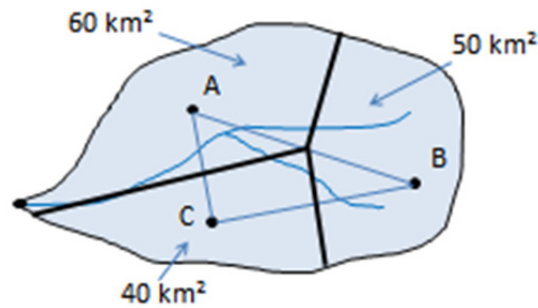
The rainfall that accumulated in each gage from an intense thunderstorm of 30 min duration

A (cm)	B (cm)	C (cm)
2	1.5	1

An outlet hydrograph measured at location C is

Time (min)	Discharge (m^3/s)
0	20
30	80
60	173
90	150
120	105
150	75
180	55
210	40
240	30
270	20

Assume a constant baseflow of 20 m^3/s

a) Calculate the area average precipitation from this storm [4]
b) Separate the baseflow from direct storm runoff using the assumed constant baseflow and calculate the volume (m^3) and depth (cm) of direct runoff from this storm [4]
c) Assume a constant rate of abstractions and calculate the ϕ-index for this storm (cm/h) [3]
d) Assuming that the rainfall intensity was roughly constant, estimate and plot the 30 min unit hydrograph for this watershed. Report the peak value (m^3/s). [3]
e) Suppose the precipitation at B was 2.5 cm. Estimate the total runoff hydrograph peak (including baseflow) in m^3/s. [3]
f) Suppose the precipitation at B was 0.5 cm. Estimate the total runoff hydrograph peak (including baseflow) in m^3/s. [3]

[20 points]