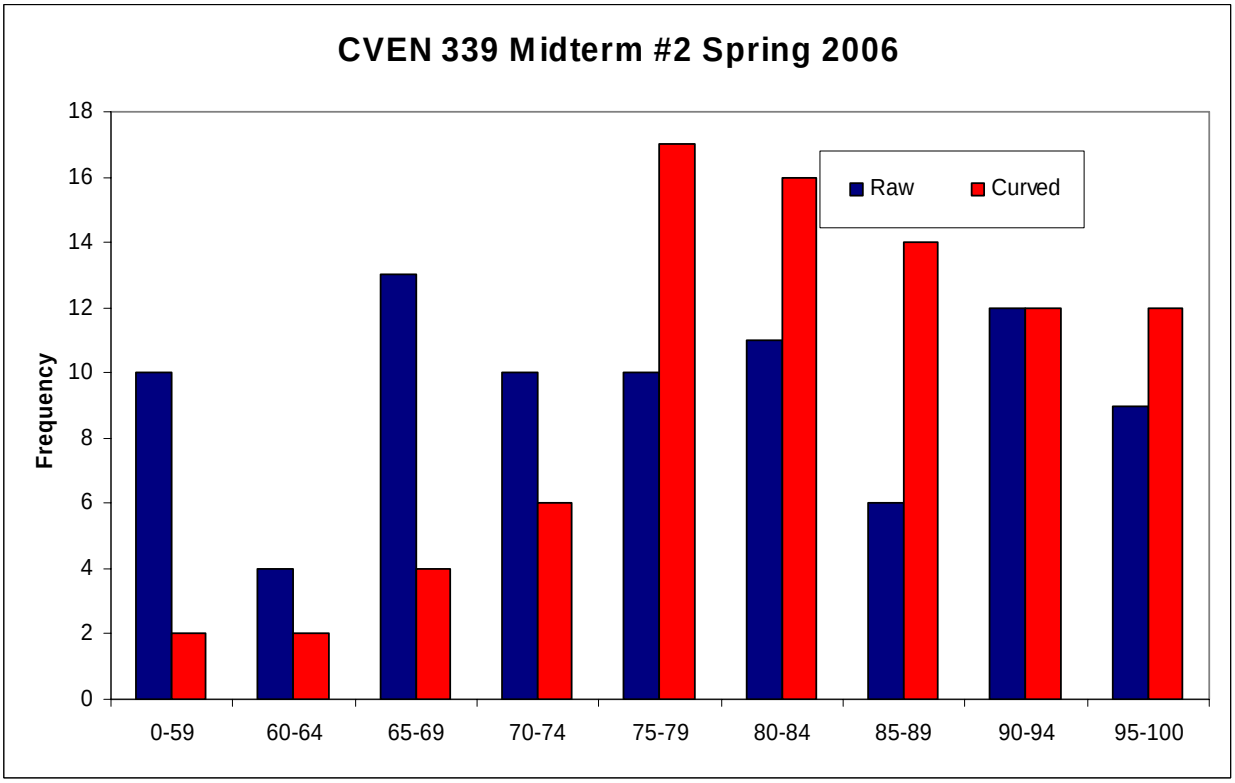
CVEN 339 – Spring 2006
Midterm Exam #2

	Raw	Curved
Median	77	83.4
Mean	76.4	83.0
St. Dev.	14.8	10.1
High	100	100
Low	31	52.0



Name: _____

CVEN 339 – Water Resources Engineering
Spring Semester 2006
Dr. Kelly Brumbelow, Texas A&M University

Exam #2

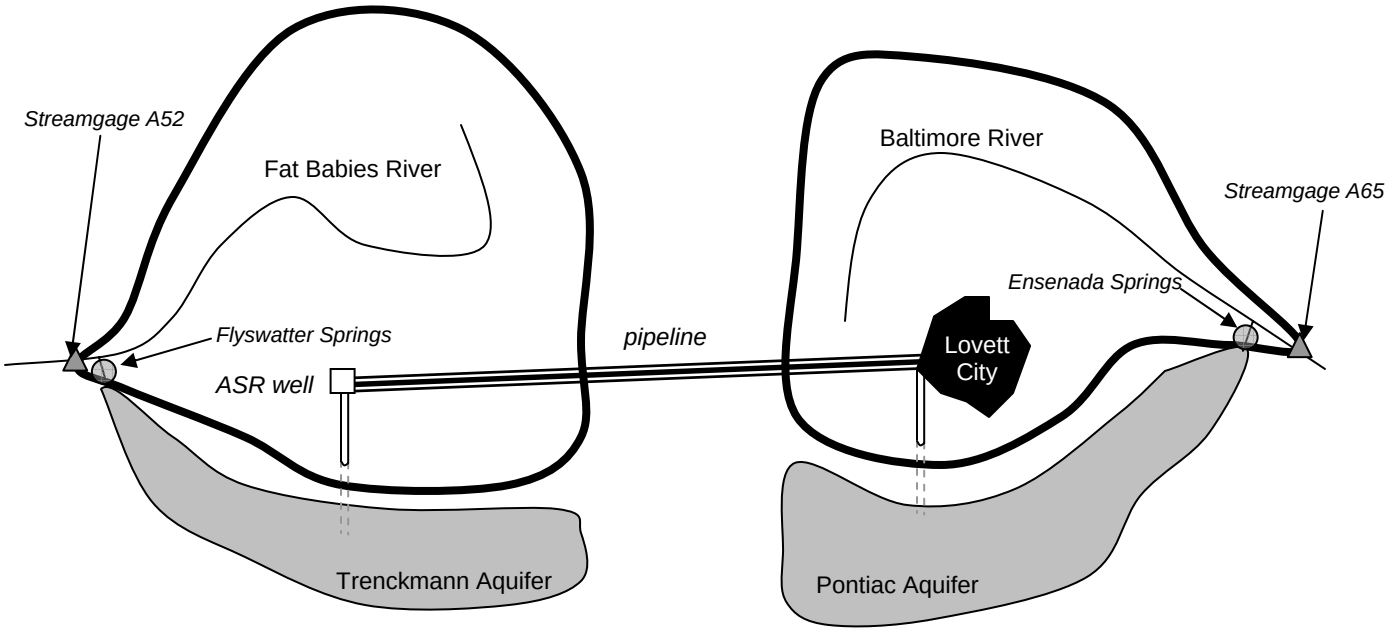
Open-book, Open-notes (6 pages, 2 questions); Time allowed: 60 mins.

1. Lovett City has historically obtained all its water supply from the Pontiac Aquifer, which lies beneath the city. However, it has recently been determined that an endangered population of magical guppies depends for its survival on water exfiltrating from the Pontiac Aquifer at Ensenada Springs. Therefore, the state environmental agency has capped the amount of water that Lovett City may remove from the Pontiac Aquifer each year at 100,000 acre-feet. Lovett City has responded by building an aquifer storage and recovery (ASR) project. In years when municipal water demand is lower than 100,000 acre-feet, this project allows the city to take the unused portion of its annual withdrawal from the Pontiac Aquifer, pump it through a 25 mile pipeline, and inject and store it in the nearby Trenckmann Aquifer. In years when municipal water demand is higher than 100,000 acre-feet, water is removed from the Trenckmann Aquifer and pumped to the city to supplement supply from the Pontiac. The volume of water removed from the Trenckmann might exceed the volume injected into it by Lovett City. (See the map on the next page)

Recently a lawsuit has been filed by the organization Saving Unprotected Precious Environmental Resources For Later Years (SUPERFLY) against Lovett City claiming that the city is depleting the storage of the Trenckmann Aquifer by its ASR withdrawals. A second lawsuit has been filed by Protecting Innocent Guppies From Environmental and Existential Turmoil (PIGFEET) against the city and the state environmental agency claiming that the Pontiac Aquifer is also being depleted. Lovett City has retained your services to analyze whether these contentions might be true. Both aquifers lie under surface watersheds and interact with them according to the data provided in the table on the next page. Aquifer boundaries and watershed boundaries are contiguous (i.e., no subsurface groundwater flows exist).

For the period 2001-2005:

a) *Is the volume of water in the Pontiac Aquifer being depleted?*
b) *Is the volume of water in the Trenckmann Aquifer being depleted?*
c) *If either or both aquifers are being depleted, is/are the decreases in storage caused* exclusively *by the actions of Lovett City? That is, if Lovett City did not exist, would the aquifers still be depleted?* (50 points)



The area of the Baltimore River watershed is 500 mi^2. The area of the Fat Babies River watershed is 800 mi^2. Both aquifers have infiltrative surface area equal to their overlying watersheds.

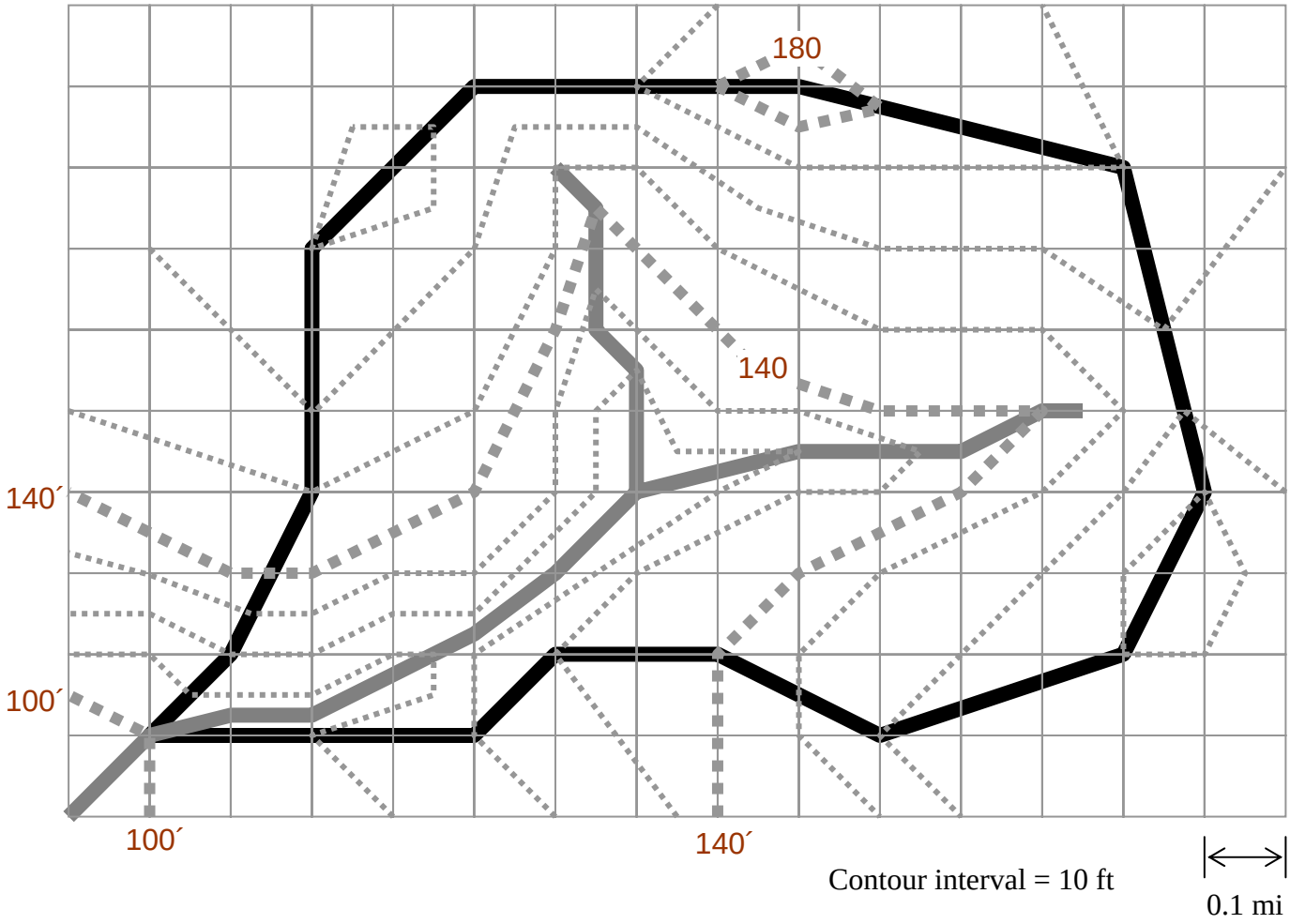
	Baltimore w/s		Fat Babies w/s		Springflow (ac-ft/yr)		Streamflow (ac-ft/yr)		ASR pumpage*
Year	P (in)	ET (in)	P (in)	ET(in)	Ensenada	Flyswatter	A65	A52	(ac-ft/yr)
2001	30.1	15.1	32.5	14.6	28,000	280,000	268,000	738,240	20,000
2002	28.2	16.8	30.6	15.2	21,000	275,000	203,400	669,240	15,000
2003	29.0	16.0	33.8	19.8	24,000	272,000	232,000	630,400	15,000
2004	24.8	18.7	20.2	19.7	18,000	250,000	115,600	262,800	-5,000
2005	23.1	19.0	18.7	17.1	15,000	220,000	80,600	260,960	-10,000

* ASR pumpage greater than 0 indicates water injected into Trenckmann Aquifer; values less than 0 indicate water removed from Trenckmann Aquifer.

In all years, Lovett City withdraws 100,000 ac-ft/yr from the Pontiac Aquifer.

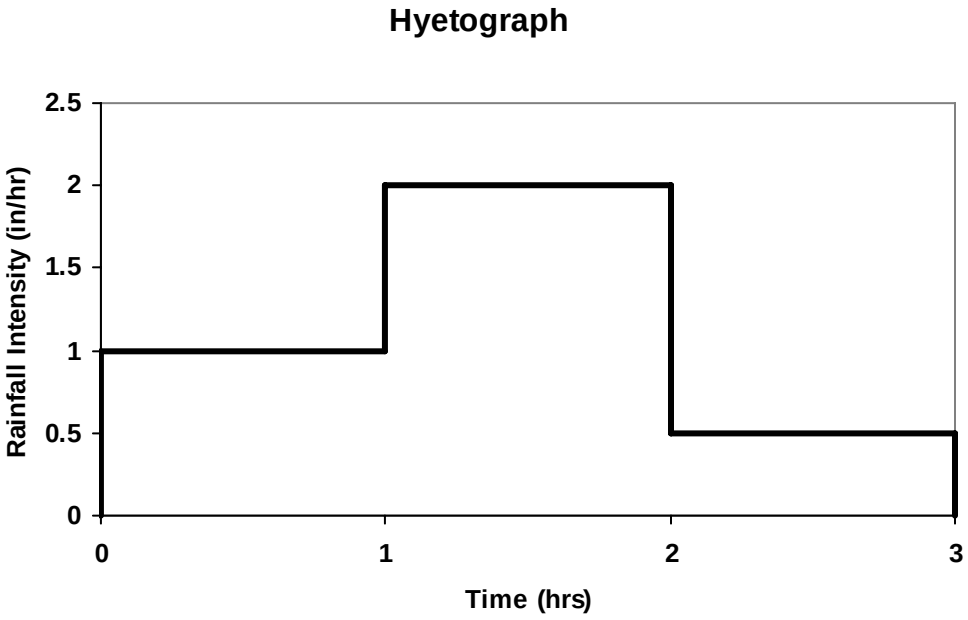
(Work space for #1)

2. Mapped below is a watershed along with topographic contour lines and a regular grid for determining distances and areas. The watershed is underlain by a hydrologic soil group C soil and is covered by woods with very high (~80%) vegetative ground cover. The storm shown in the hyetograph on the next page is forecast to occur on this watershed, and the soil will be very wet at the beginning of the storm. Base flow at the watershed outlet is 15 cfs. *Predict the peak flow of the total hydrograph occurring at the watershed's outlet as a result of this storm.* (50 points)



When determining average land slope Y (%) for the lag time calculation, you may approximate this value by dividing the elevation difference between the hydraulically farthest point and the outlet by the watershed hydraulic length:

$$Y = \frac{z_{hfp} - z_{outlet}}{l} \cdot 100$$


Hyetograph
Rainfall Intensity (in/hr)
2.5
2
1.5
1
0.5
0
0
1
2
3
Time (hrs)

(Work space for #2)