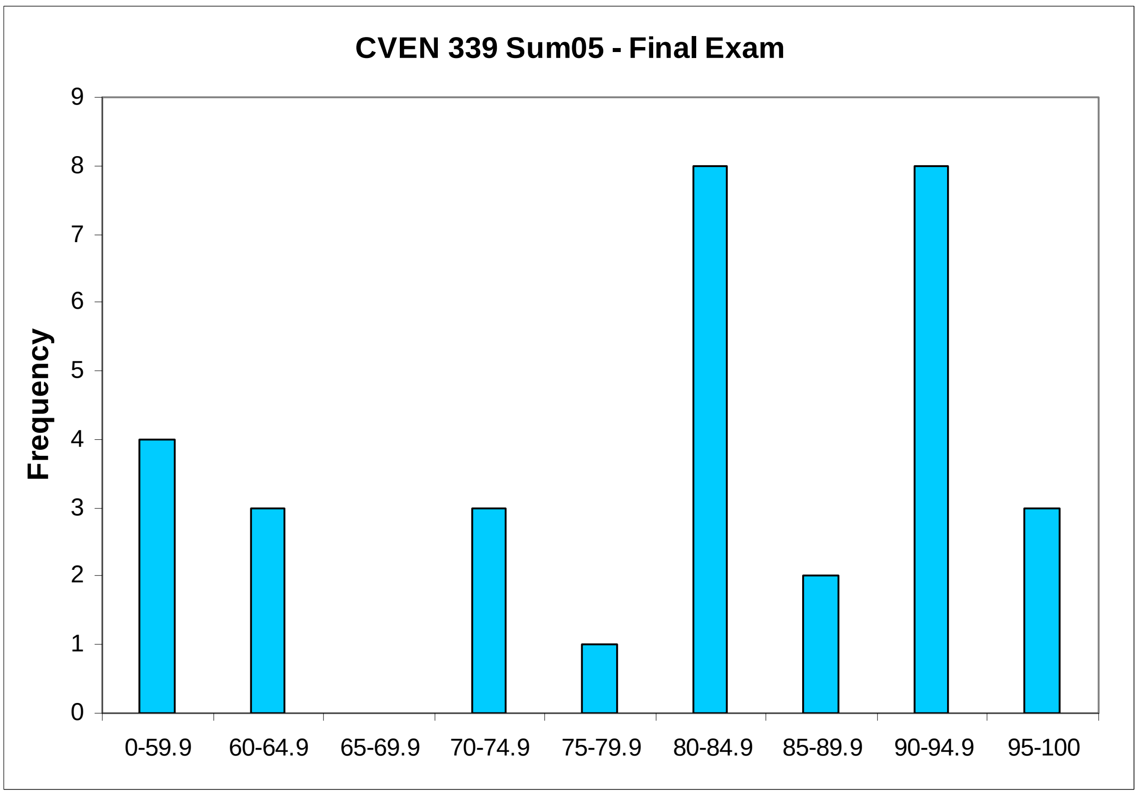
CVEN 339 – Summer 2005 – Exam #1

120 minutes allowed

Median	82
Mean	78.9
Std. Dev.	15.9
High	98



Name: ____________________

CVEN 339 – Water Resources Engineering
Summer Semester 2005
Dr. Kelly Brumbelow, Texas A&M University

Final Exam

Open-book, Open-notes (7 pages, 2 questions)

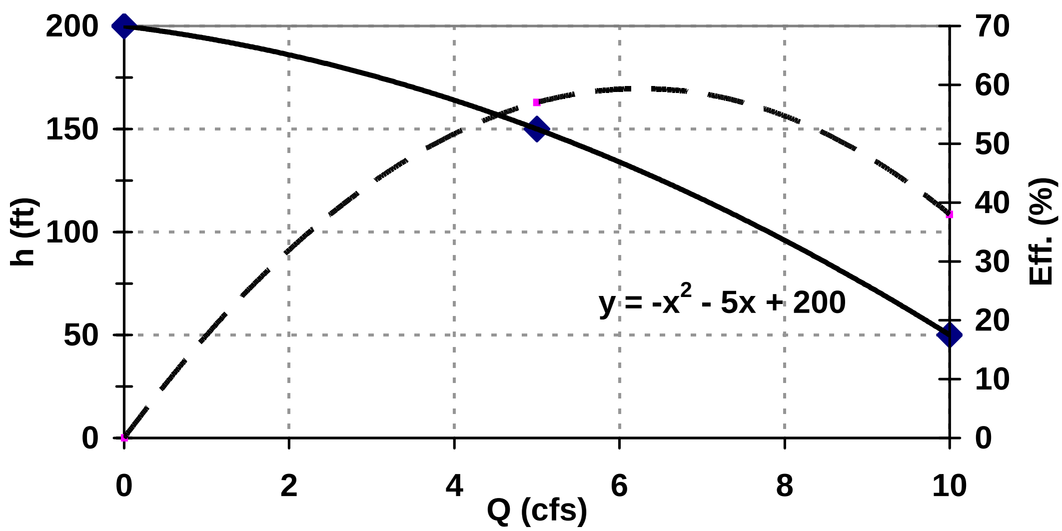
1. A confined aquifer (see diagram on next page) has an undisturbed piezometric surface elevation of 377.7 ft above mean sea level (msl). A well is drilled into the aquifer from a point where ground elevation is 435.1 ft msl, and water from the well will be pumped up to an elevated storage tank (water surface in tank at 521.4 ft msl). Along the axis of the well the boundary between the aquifer and the upper confining layer is at elevation 226.8 ft msl, and the boundary between the aquifer and the lower confining layer is 187.2 ft msl. Saturated hydraulic conductivity for the aquifer is 0.583 ft/hr. The well casing diameter is 24 inches.

A submersible well pump is installed in the well at an elevation of 200.6 ft msl. The manufacturer supplies the pump characteristic curve shown below. The well pump is connected to the surface by a 4 inch diameter galvanized iron pipe.

After well drawdown has fully developed, the aquifer and well will be in a steady state condition. However, you should remember that the amount of drawdown and the well flowrate are dependent on each other and must be solved simultaneously. Minor losses in the well pipe are negligible. You may assume the well's radius of influence to be 5,600 ft.

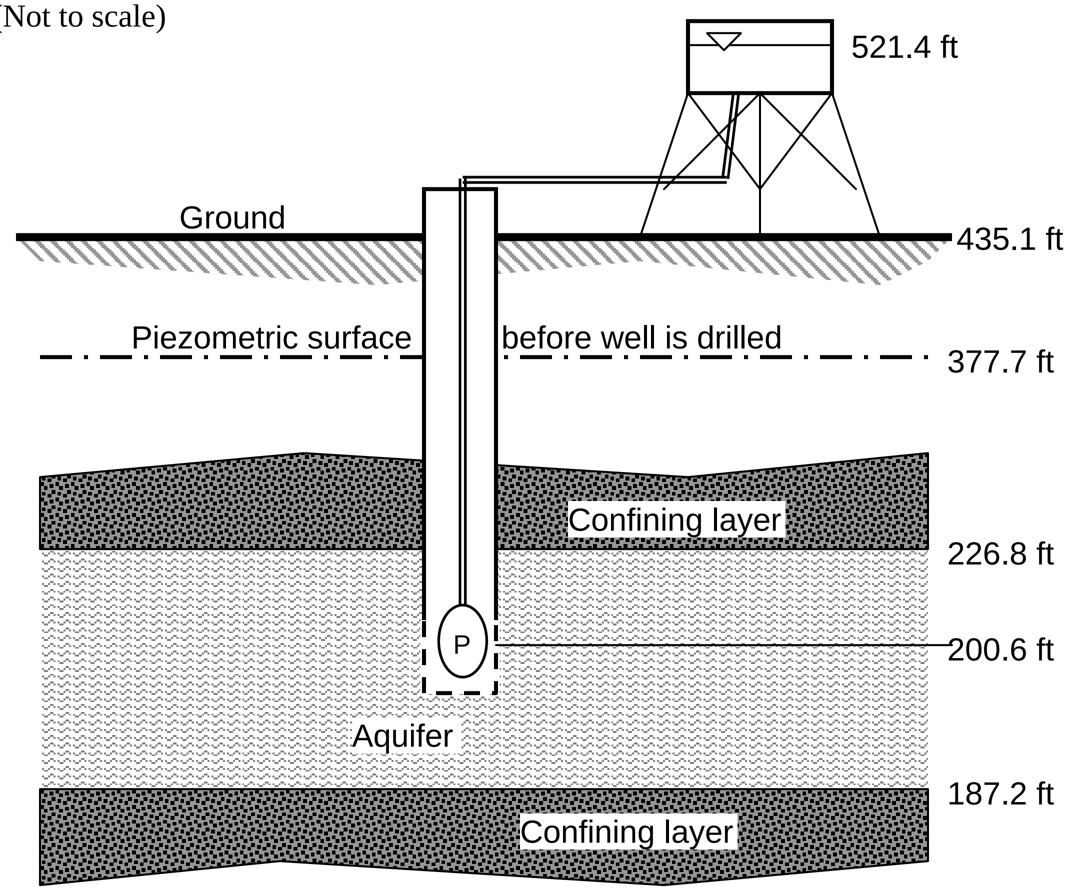
(a) *What will be the flowrate into the tank when the well pump is first started?*
(b) *Once steady state is reached, what will be the flowrate into the tank?*
(c) *Once steady state is reached, what will be the drawdown of the piezometric surface at the well?*
(d) *If electricity costs this well operator $0.09/kWh and the pump motor efficiency is 55%, what will be the cost to pump an acre-foot of water to the storage tank once steady-state is reached?* (1 ft•lb/sec = 1.356 W)

(50 points)



h (ft)
Eff. (%)
Q (cfs)
y = -x^2 - 5x + 200

(Not to scale)



521.4 ft
Ground
435.1 ft
Piezometric surface before well is drilled
377.7 ft
Confining layer
226.8 ft
P
200.6 ft
Aquifer
187.2 ft
Confining layer

2. A watershed located in Austin, Texas, is 125 acres in area and heavily urbanized (mostly tattoo parlors, body piercing studios, and tea shops). Time of concentration for the watershed is 15 minutes. All runoff from this watershed enters an open drainage channel drawn in cross-section on the next page (labeled “existing”). No base flow is present. A street bridge crosses the channel as shown.

The channel will soon be re-engineered and made larger as shown in the drawing marked “proposed” (next page). The street bridge will again cross the channel as indicated. Given below are the IDF curves for Travis County, Texas, and the runoff coefficients included in stormwater design standards for the City of Austin, Texas, which is in Travis County. Attached is a sheet of Weibull probability paper; in this problem you are to assume that runoff flows from this watershed can be modeled using the Weibull distribution.

(a) What are the expected peak runoff flow rates for the 2, 5, 10, 25, 50, and 100 year events for this watershed?

(b) Plot peak runoff flow rate versus frequency of exceedence on the Weibull probability paper. (Note that you will <u>not</u> compute plotting position by the m/(N+1) formula).

(c) What return period runoff event will currently flood the street bridge spanning the channel?

(d) After the channel is modified, what return period event will flood the street bridge?

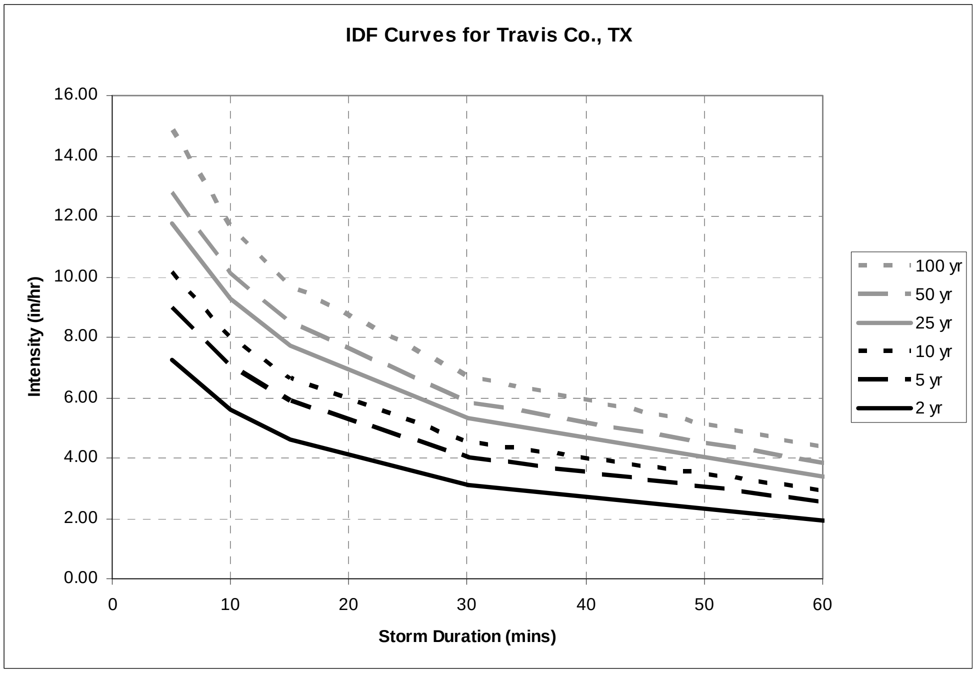
(50 points)

TABLE 15.1.1
Runoff coefficients for use in the rational method

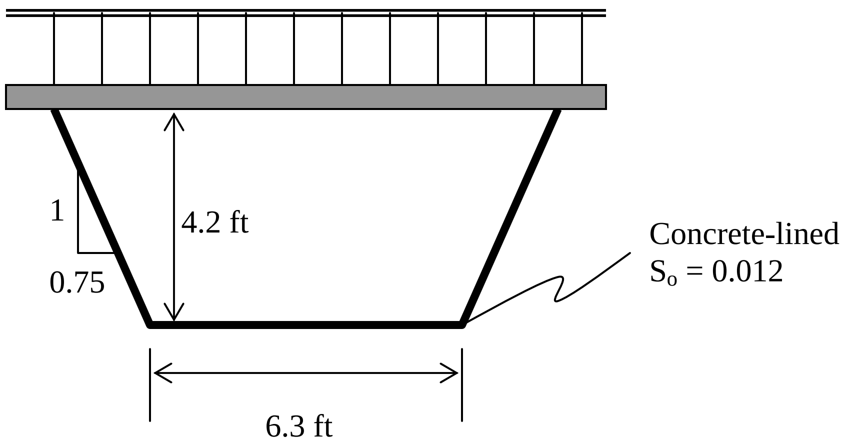
Character of surface	Return Period (years) 2	5	10	25	50	100	500
Developed							
Asphaltic	0.73	0.77	0.81	0.86	0.90	0.95	1.00
Concrete/roof	0.75	0.80	0.83	0.88	0.92	0.97	1.00
Grass areas (lawns, parks, etc.)							
Poor condition (grass cover less than 50% of the area)							
Flat, 0–2%	0.32	0.34	0.37	0.40	0.44	0.47	0.58
Average, 2–7%	0.37	0.40	0.43	0.46	0.49	0.53	0.61
Steep, over 7%	0.40	0.43	0.45	0.49	0.52	0.55	0.62
Fair condition (grass cover on 50% to 75% of the area)							
Flat, 0–2%	0.25	0.28	0.30	0.34	0.37	0.41	0.53
Average, 2–7%	0.33	0.36	0.38	0.42	0.45	0.49	0.58
Steep, over 7%	0.37	0.40	0.42	0.46	0.49	0.53	0.60
Good condition (grass cover larger than 75% of the area)							
Flat, 0–2%	0.21	0.23	0.25	0.29	0.32	0.36	0.49
Average, 2–7%	0.29	0.32	0.35	0.39	0.42	0.46	0.56
Steep, over 7%	0.34	0.37	0.40	0.44	0.47	0.51	0.58
Undeveloped							
Cultivated Land							
Flat, 0–2%	0.31	0.34	0.36	0.40	0.43	0.47	0.57
Average, 2–7%	0.35	0.38	0.41	0.44	0.48	0.51	0.60
Steep, over 7%	0.39	0.42	0.44	0.48	0.51	0.54	0.61
Pasture/Range							
Flat, 0–2%	0.25	0.28	0.30	0.34	0.37	0.41	0.53
Average, 2–7%	0.33	0.36	0.38	0.42	0.45	0.49	0.58
Steep, over 7%	0.37	0.40	0.42	0.46	0.49	0.53	0.60
Forest/Woodlands							
Flat, 0–2%	0.22	0.25	0.28	0.31	0.35	0.39	0.48
Average, 2–7%	0.31	0.34	0.36	0.40	0.43	0.47	0.56
Steep, over 7%	0.35	0.39	0.41	0.45	0.48	0.52	0.58

Note: The values in the table are the standards used by the City of Austin, Texas. Used with permission.

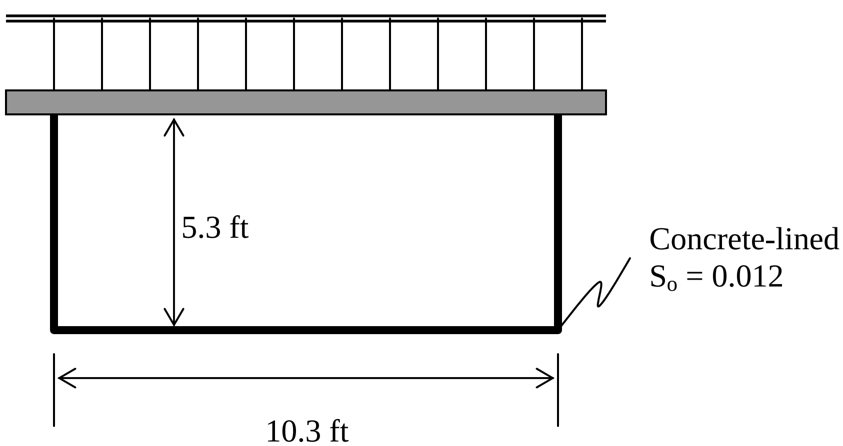
(From Chow, et al. 1988)



EXISTING



PROPOSED



Weibull Probability Paper