CIVE 6361 Fall 1997 Exercise #4 Steady State Diffusion Solutions

1) The regional head in a confined aquifer is given as $h(x,y) = ax + by + c$ where a=0.001, b=0, c=100m. Prepare a head (and flowline) map of a rectangular portion of the aquifer in the region x = 0 to 10,000 meters, y = 0 to 10,000 meters.

2) Suppose the transmissivity of the aquifer is 10 m^2/day. Use the principle of superposition to map the effect of a single well located at the center of the region in problem #1. The well's radius is 1 meter and the redius of influence is 3000 meters. The discharge rate of the well is 100 m^3/d. Sketch flowlines on this second map. Recall that $r^2 = x^2+y^2$. For this second exercise, it is easier to compute drawdown from the well and subtract this drawdown from the regional head distribution in problem #1.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Regional Head Distribution				Pumping Well								
2	a	0.001			Q	0							
3	b	0			T	10							
4	c	100			R	3000							
5					x	5000.9							
6					y	5000.9							
7					Q/2πT	0							
8			x										
9		y	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
10		0	100	101	102	103	104	105	106	107	108	109	110
11		1000	100	101	102	103	104	105	106	107	108	109	110
12		2000	100	101	102	103	104	105	106	107	108	109	110
13		3000	100	101	102	103	104	105	106	107	108	109	110
14		4000	100	101	102	103	104	105	106	107	108	109	110
15		5000	100	101	102	103	104	105	106	107	108	109	110
16		6000	100	101	102	103	104	105	106	107	108	109	110
17		7000	100	101	102	103	104	105	106	107	108	109	110
18		8000	100	101	102	103	104	105	106	107	108	109	110
19		9000	100	101	102	103	104	105	106	107	108	109	110
20		10000	100	101	102	103	104	105	106	107	108	109	110

equipotential

flowline

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Regional Head Distribution				Pumping Well								
2	a	0.001			Q	100							
3	b	0			T	10							
4	c	100			R	3000							
5					x	5000.9							
6					y	5000.9							
7					Q/2πT	1.5915							
8			x										
9		y	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
10		0	100	101	102	103	104	105	106	107	108	109	110
11		1000	100	101	102	103	104	105	106	107	108	109	110
12		2000	100	101	102	103	104	105	106	107	108	109	110
13		3000	100	101	102	102.91	103.53	104.36	105.53	106.91	108	109	110
14		4000	100	101	102	102.53	102.8	103.25	104.8	106.53	108	109	110
15		5000	100	101	102	102.36	102.25	92.64	104.25	106.36	108	109	110
16		6000	100	101	102	102.53	102.8	103.25	104.8	106.53	108	109	110
17		7000	100	101	102	102.91	103.53	104.36	105.53	106.91	108	109	110
18		8000	100	101	102	103	104	105	106	107	108	109	110
19		9000	100	101	102	103	104	105	106	107	108	109	110
20		10000	100	101	102	103	104	105	106	107	108	109	110

Equipotential

flowline

$$s_w(x,y) = \frac{Q}{2\pi T} \ln\left(\frac{R^2}{\sqrt{(x-x_0)^2+(y-y_0)^2}}\right)$$

$$h(x,y) = h_R(x,y) - s_w(x,y) \qquad \left(\text{if } r^2 > R^2,\ s_w = 0\right)$$