#1944444
project 2009

Whetstone Associates

Technical Memorandum

To: Peter Gintautas, COGCC **4143A**

From: Susan Wyman, P.E., P.G.

Date: **May 22, 2009**

Subject: Aquifer Pumping Test - North Fork Ranch - Dasko Well

A pumping and recovery test was conducted at the Dasko Well (Lot 44, North Fork Ranch) on May 1, 2009. The test was conducted using the homeowner's submersible pump, which is permanently set in the well at 166 ft below top of casing (btoc).

The Dasko well (DWR permit #191184) was drilled to 170 ft below ground surface in 1995 by Bill Grande of Sharpe Drilling Co. The geologic log is summarized in Table 1. The well was completed using 5-inch PVC casing, and screened from 130 to 170 ft. The well pumps directly to a pressure tank in the basement of the residence, and the pressure tank feeds the interior water lines and outside spigot. The pump was activated by fully opening the outside spigot, which depressurized the pressure tank and activated the submersible pump. Ms. Marcia Dasko was present during the testing, and assisted by measuring flow rates during the pumping portion of the test.

The well was pumped for 32.5 minutes at an average pumping rate of 6.35 gpm. Flow rates were measured using a five-gallon bucket and a stopwatch. Flow rates decreased from 6.7 gpm at the start of the test to 5.3 gpm at the end of pumping (Table 2). The drawdown water level at the end of pumping was about five feet above the top of the pump.

Water levels were measured using an electronic water level sounder and recorded manually in a bound field book. The static water level at the beginning of the test was 58.0 feet below top of casing (btoc) and the level was drawn down to 161.18 ft btoc at the end of the test (Table 3). Drawdown did not reach equilibrium (Figure 1), indicating that the pumping rate was too high for the well to sustain. The data were evaluated using the program Aqtesolv (Duffield, 1997) and the Neuman and Theis solutions for unconfined aquifers (Neuman, 1974 and Theis, 1935). The data were also evaluated in an Excel spreadsheet using the Jacob straight-line recovery solution (Jacob, 1946).

Results of the analysis indicate that the hydraulic conductivity of the alluvium surrounding the Dakso well is relatively low, ranging from 9.9×10^{-6} cm/sec based on a Theis recovery analysis to 1.1×10^{-5} cm/sec based on a Neuman unconfined analysis for a partially penetrating well (Table 4). The geometric mean hydraulic conductivity from the four test methods that were used to evaluate the data was 9.7×10^{-6} cm/sec.

The predicted type curves for the four methods provide a reasonable match to the measured data during the later portions of the drawdown test and early portions of the recovery test. Deviations from the curve in early time (typically the first six minutes of pumping) are attributed to well loss and turbulence, as greater drawdown occurred than predicted by the method. Deviations from the curve in late time could result from aquifer boundary conditions in the valley fill alluvium, as the water level recovered more slowly than predicted.

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Assuming a porosity of 30% and a hydraulic gradient of 0.06, the aquifer velocity would be 0.0067 ft/day in the vicinity of the well.

Table 1. Geologic Log

Depth (ft)	Lithology
0-8	Sandy soil
8-18	Brown sandstone
18-25	Gray shale
25-43	Brown/gray mud/silt
43-70	Gray sandstone
70-102	Brown & gray mud/silt
102-170	Gray/green sandstone

Table 2. Flow Rates Measured During Dasko Well Pumping Test

Time (min)	Pumping rate (gpm)	Comments
0:00:00	6.67	Pump on
0:07:30	6.98	
0:15:25	6.52	
0:16:30	6.38	
0:18:25	6.12	
0:23:00	6.00	
0:25:00	5.88	
0:27:30	5.56	
0:29:00	5.45	
0:31:00	5.26	
0:32:30	0	Pump off

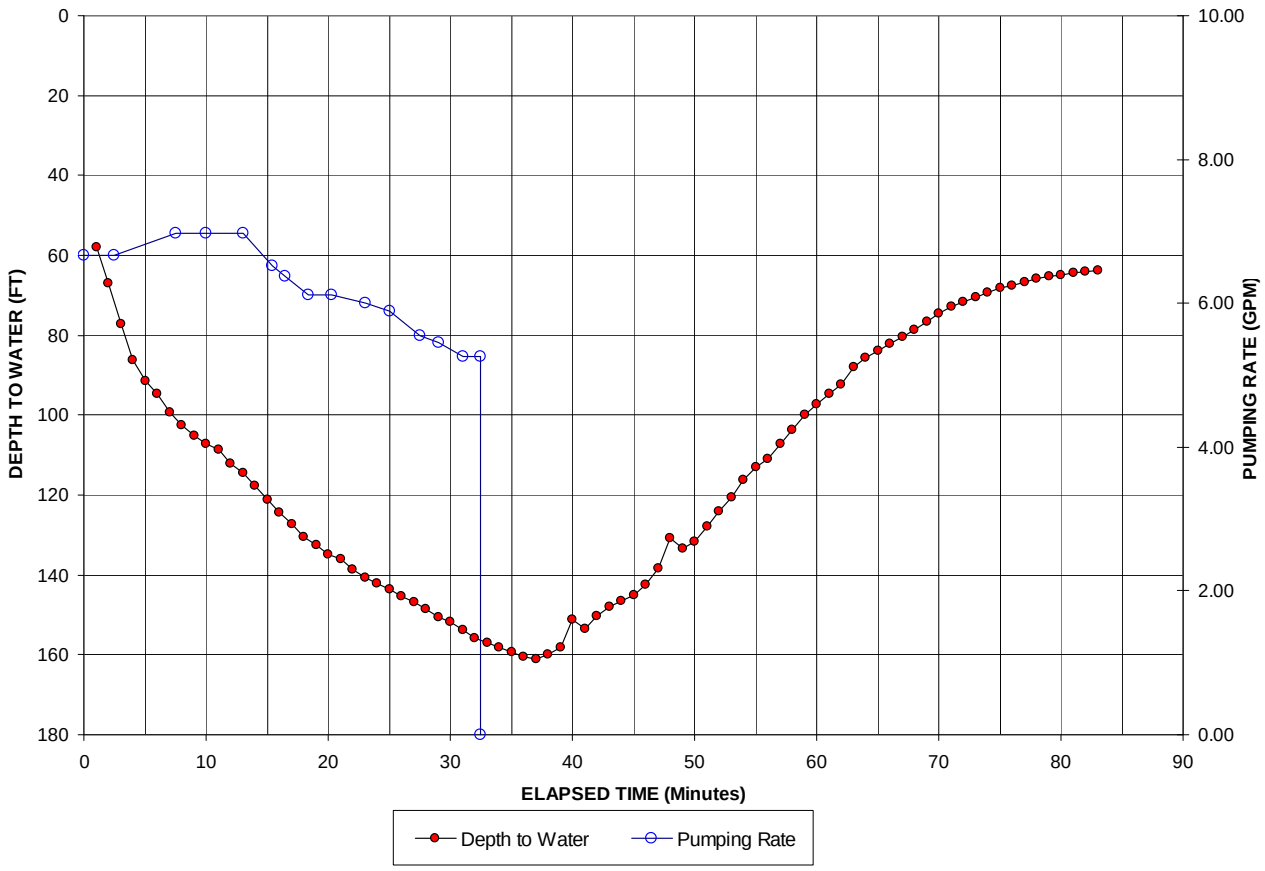

Figure 1. Depth to Water and Pumping Rate

Table 3. Depth to Water Measured During Dasko Well Pumping Test

PROJECT:	COGCC North Fork Domestic Ranch	
WELL:	Dasko Well	
DATE:	Friday, May 1, 2009	
HYDROLOGIST:	Susan Wyman, Whetstone Associates	
PUMP:	Submersible	
PUMP DEPTH:	166	ft below ground surface
STATIC WATER LEVEL:	58.0	ft below top of casing
PUMPING RATE:	6.35	gpm (time-weighted average)

Pumping Rate (gpm)	Elapsed Time (hr:mm:ss)	Elapsed Time (minutes)	Depth to Water	Drawdown (feet)	Comments
6.67	0:00:00	0.0	**(feet)**	0.00	Open spigot, pump on
	0:00:36	0.6	58.00	9.00	
	0:01:20	1.3	67.00	19.20	
6.67	0:02:30	2.5	77.20	28.20	
	0:03:18	3.3	86.20	33.52	
	0:04:19	4.3	91.52	36.72	
	0:04:46	4.8	94.72	41.40	
	0:05:30	5.5	99.40	44.57	
	0:06:10	6.2	102.57	47.05	
	0:06:45	6.8	105.05	49.15	
6.98	0:07:30	7.5	107.15	50.77	
	0:08:15	8.3	108.77	54.17	
	0:09:00	9.0	112.17	56.59	
6.98	0:10:00	10.0	114.59	59.71	
	0:11:10	11.2	117.71	63.17	
	0:12:00	12.0	121.17	66.25	
6.98	0:13:00	13.0	124.25	69.38	
	0:14:05	14.1	127.38	72.45	
6.52	0:15:25	15.4	130.45	74.62	Discharge now murky
6.38	0:16:30	16.5	132.62	76.80	
	0:17:05	17.1	134.80	78.02	Light red/brown murky
6.12	0:18:25	18.4	136.02	80.68	
	0:19:30	19.5	138.68	82.72	
6.12	0:20:15	20.3	140.72	84.08	
	0:21:00	21.0	142.08	85.45	
	0:22:00	22.0	143.45	87.20	
6.00	0:23:00	23.0	145.20	88.85	
	0:24:00	24.0	146.85	90.62	
5.88	0:25:00	25.0	148.62	92.62	Pump gurgling
	0:26:10	26.2	150.62	93.87	
5.56	0:27:30	27.5	151.87	95.66	
5.45	0:29:00	29.0	153.66	97.69	
	0:30:00	30.0	155.69	98.97	
5.26	0:31:00	31.0	156.97	100.17	
	0:32:00	32.0	158.17	101.45	
	0:32:00	32.0	159.45	102.55	
0	0:32:30	32.5	160.55	103.18	Pump off
	0:34:00	34.0	161.18	101.85	Water level recovery
	0:34:30	34.5	159.85	100.23	"
	0:35:00	35.0	158.23	93.06	"
	0:36:00	36.0	151.06	95.62	"
	0:37:15	37.3	153.62	92.33	"
	0:38:00	38.0	150.33	89.87	"
	0:38:30	38.5	147.87	88.44	"
	0:39:00	39.0	146.44	86.99	"
	0:40:00	40.0	144.99	84.37	"
	0:41:30	41.5	142.37	80.32	"
	0:42:00	42.0	138.32	72.83	"
	0:43:15	43.3	130.83	75.51	"
	0:44:00	44.0	133.51	73.65	"
	0:45:00	45.0	131.65	69.97	"
	0:46:00	46.0	127.97	66.07	"
	0:47:00	47.0	124.07	62.52	"
	0:48:15	48.3	120.52	58.31	"
	0:49:15	49.3	116.31	55.15	"
	0:50:00	50.0	113.15	52.83	"
	0:51:15	51.3	110.83	49.20	"
	0:52:30	52.5	107.20	45.76	"
	0:54:00	54.0	103.76	41.80	"
	0:55:00	55.0	99.80	39.22	"
	0:56:00	56.0	97.22	36.73	"
	0:57:00	57.0	94.73	34.44	"
	0:59:00	59.0	92.44	29.92	"
	1:00:00	60.0	87.92	27.75	"
	1:01:00	61.0	85.75	25.84	"

Table 3. Depth to Water Measured During Dasko Well Pumping Test (Continued)

Pumping Rate (gpm)	Elapsed Time (hr:mm:ss)	Elapsed Time (minutes)	Depth to Water	Drawdown (feet)	Comments
	1:02:00	62.0	83.84	24.09	Water level recovery
	1:03:00	63.0	82.09	22.39	"
	1:04:00	64.0	80.39	20.70	"
	1:05:30	65.5	78.70	18.54	"
	1:07:00	67.0	76.54	16.55	"
	1:08:30	68.5	74.55	14.82	"
	1:09:30	69.5	72.82	13.74	"
	1:11:00	71.0	71.74	12.40	"
	1:12:30	72.5	70.40	11.25	"
	1:14:00	74.0	69.25	10.26	"
	1:15:00	75.0	68.26	9.64	"
	1:17:00	77.0	67.64	8.66	"
	1:19:00	79.0	66.66	7.83	"
	1:21:00	81.0	65.83	7.15	"
	1:22:00	82.0	65.15	6.87	"
	1:24:30	84.5	64.87	6.24	"
	1:26:30	86.5	64.24	5.95	"
	1:28:00	88.0	63.95	5.72	"

Table 4. Pumping Test Results

Saturated Thickness		Analytical	Transmissivity	K	K
(ft)	(cm)	Method	(ft^2/day)	(ft/day)	(cm/sec)
112	3414	Neuman Unconfined (Partial Penetration)	2.64	0.024	8.33E-06
112	3414	Quick Neuman (Partial Penetration)	3.47	0.031	1.09E-05
40	1219	Theis Recovery -Late Time	1.13	0.028	9.93E-06
40	1219	Jacob Recovery -Late Time	1.12	0.028	9.87-06
Geomean			**1.84**	**0.027**	**9.68E-06**

REFERENCES

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Hem, John D., 1985. Study and Interpretation of the Chemical Characteristics of Natural Water, Third Edition, U.S. Geological Survey Water Supply Paper 2254. 263 pp.

Jacob, C., 1944. Notes on Determining Permeability by Pumping Tests Under Water Table conditions. United States Geological Survey Open File Report.

Neuman, S.P., 1974. Effect of Partial Penetration on Flow in Unconfined Aquifers Considering Delayed Gravity Response, Water Resources Research, vol. 10, no. 2, pp 303-312.

Theis, C., 1935, The Relationship Between the Lowering of the Piezometric Surface and the Rate and Duration of a Well Using Groundwater Storage. Am. Geophys. Union Trans., vol. 16. pp. 519-524.

ATTACHMENT 1

PUMPING TEST ANALYSES

Jacob Recovery Analysis

EARLY TIME, Partial Penetration:

s =	94	ft
s_o =	64	ft
T =	**7.5**	**ft^2/day**
T =	**0.08**	**cm^2/day**
b =	40.0	ft
K =	**0.19**	**ft/day**
K =	**6.58E-05**	**cm/sec**

$$T = \frac{2.3 \cdot Q}{4 \cdot \pi \cdot (s - s_o)}$$

$$T = \frac{2.3 \cdot (Q \text{ gpm}) \cdot \left(\text{ft}^3 / 7.48 \text{ gal} \right) \cdot \left(1440 \text{ min} / day \right)}{4 \cdot \pi \cdot (s - s_o \text{ ft})} = T \text{ ft}^2/\text{day}$$

$$K = \frac{T}{b}$$

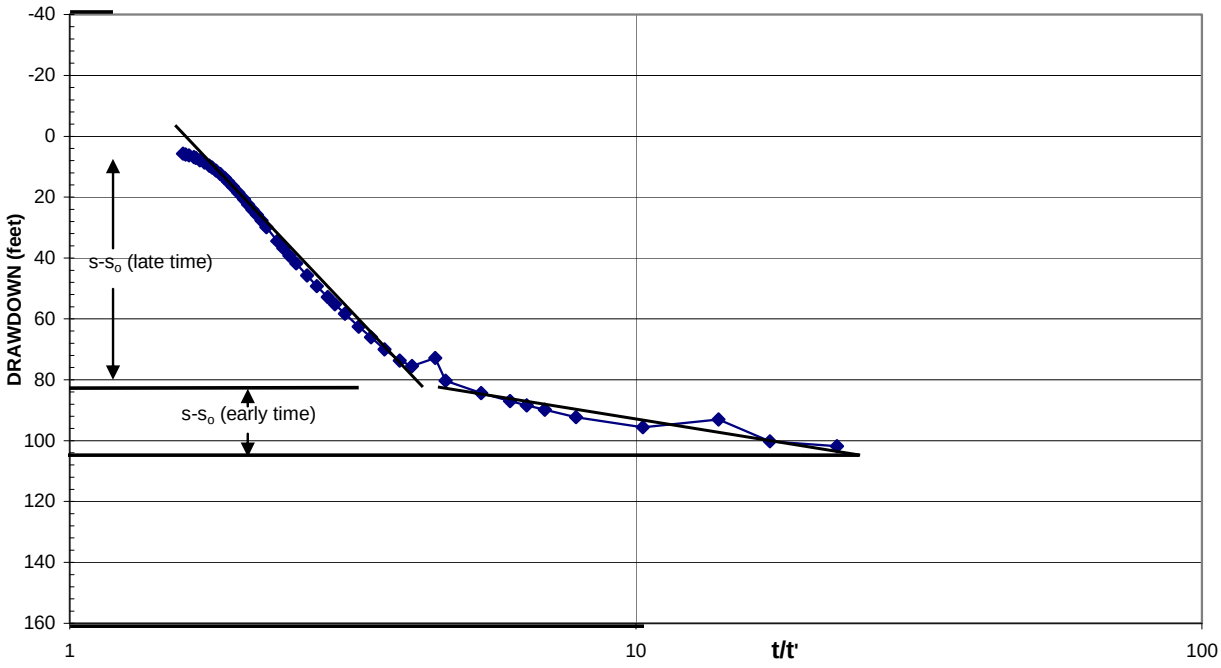
LATE TIME, Partial Penetration:

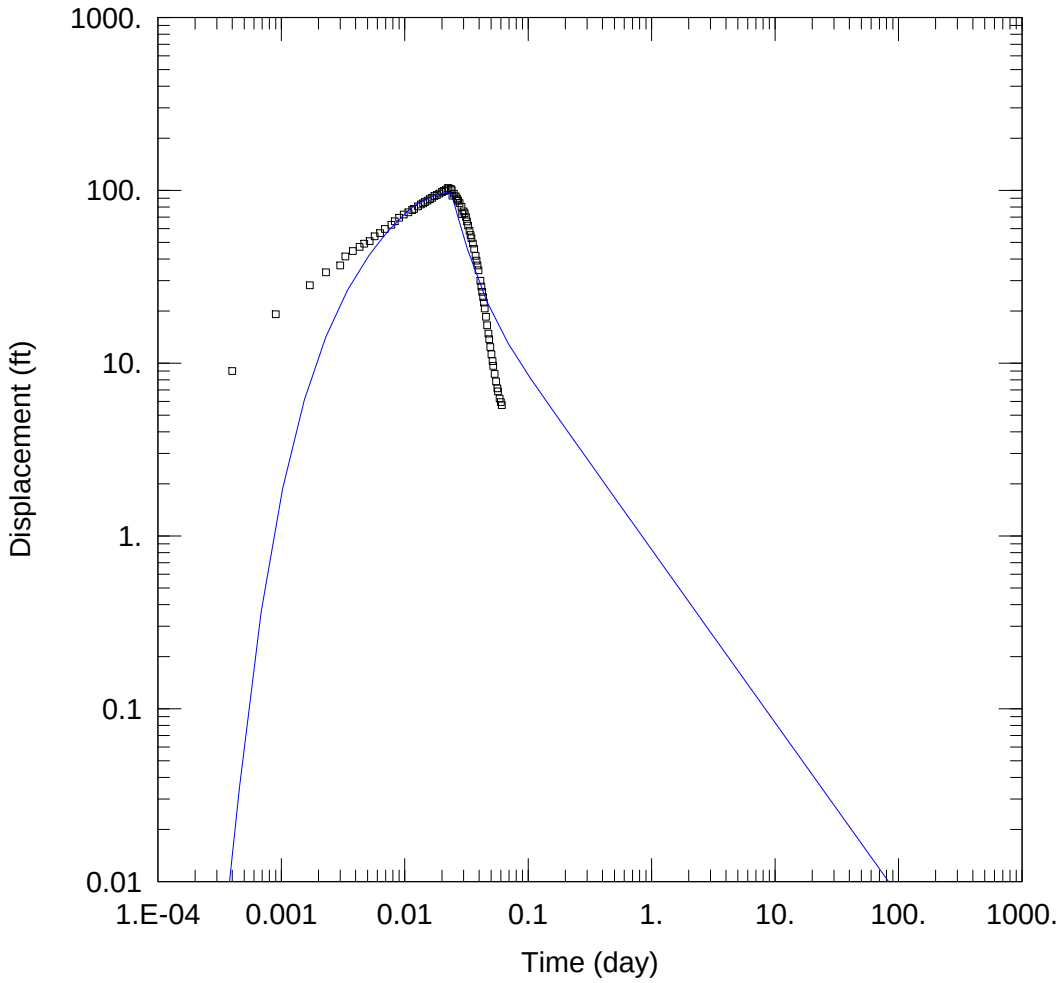
s =	160	ft
s_o =	-40	ft
T =	**1.1**	**ft^2/day**
T =	**0.01**	**cm^2/day**
b =	40.0	ft
K =	**0.03**	**ft/day**
K =	**9.87E-06**	**cm/sec**

$$T = \frac{2.3 \cdot Q}{4 \cdot \pi \cdot (s - s_o)}$$

$$T = \frac{2.3 \cdot (Q \text{ gpm}) \cdot \left(\text{ft}^3 / 7.48 \text{ gal} \right) \cdot \left(1440 \text{ min} / day \right)}{4 \cdot \pi \cdot (s - s_o \text{ ft})} = T \text{ ft}^2/\text{day}$$

$$K = \frac{T}{b}$$





DASKOWELL

Data Set: C:\PROJECTS\4143A-~1\NFR\PT\DASKONU1.AQT
Date: 05/20/09 Time: 16:51:36

PROJECT INFORMATION

Company: Whetstone Associates
Client: COGCC
Test Location: Las Animas County, CO
Test Well: Dasko Well
Test Date: 5/1/09

AQUIFER DATA

Saturated Thickness: 112. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Dasko	0	0

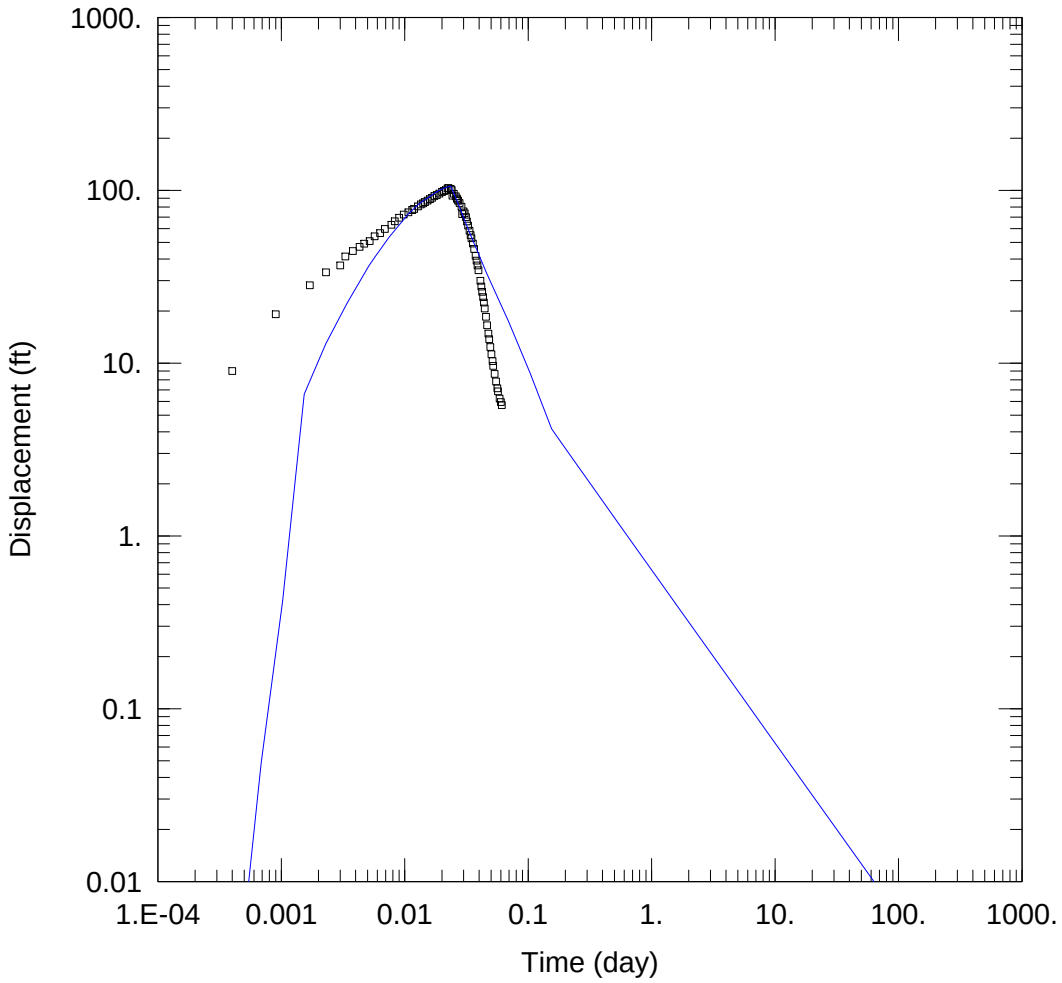
Observation Wells

Well Name	X (ft)	Y (ft)
▫ Dasko	0	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Neuman

T = 2.643 ft^2/day
S = 0.6663
Sy = 0.1
ß = 0.1



DASKOWELL

Data Set: C:\PROJECTS\4143A-~1\NFR\PT\DASKONUQ.AQT
Date: 05/21/09 Time: 11:27:53

PROJECT INFORMATION

Company: Whetstone Associates
Client: COGCC
Test Location: Las Animas County, CO
Test Well: Dasko Well
Test Date: 5/1/09

AQUIFER DATA

Saturated Thickness: 112. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Dasko	0	0

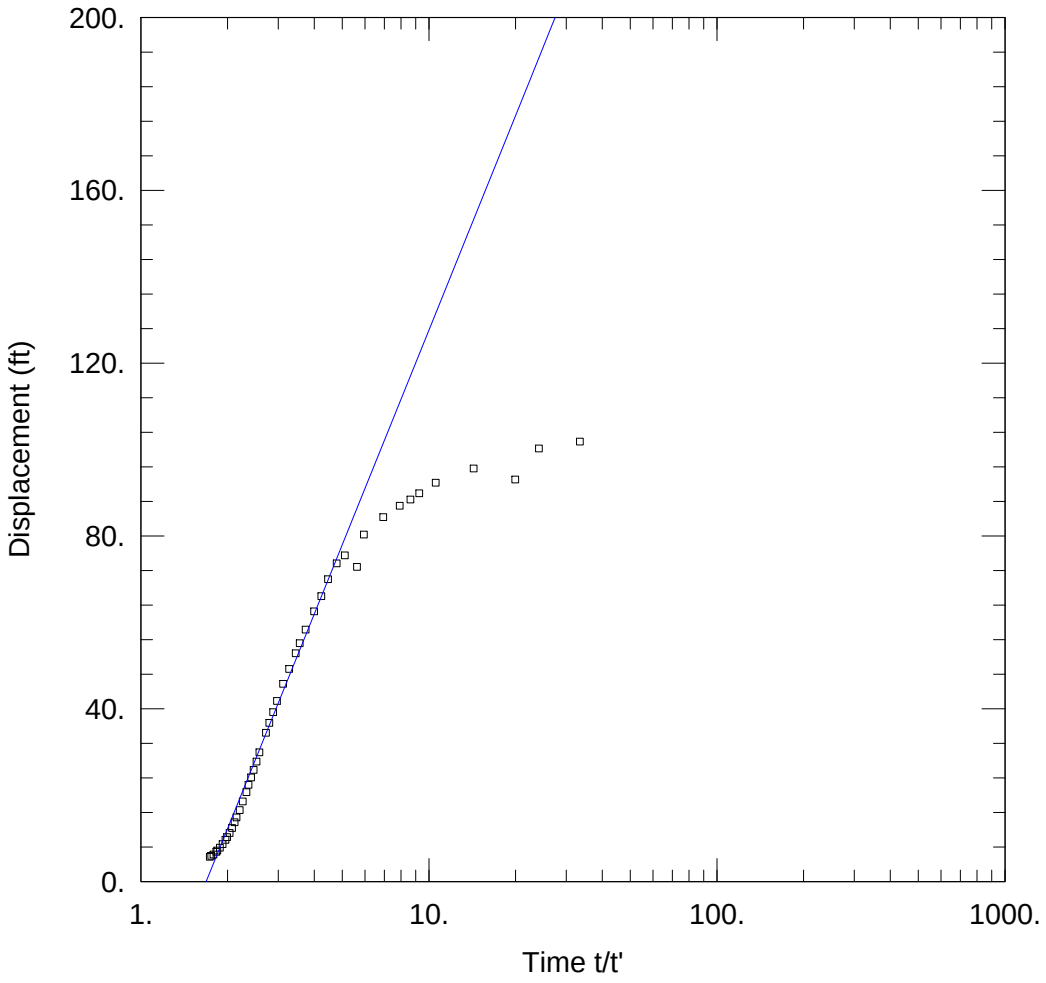
Observation Wells

Well Name	X (ft)	Y (ft)
▫ Dasko	0	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Quick Neuman

T = 3.469 ft^2/day
S = 1.196
Sy = 0.1
ß = 0.1



DASKOWELL

Data Set: C:\PROJECTS\4143A-~1\NFR\PT\DASKONTR.AQT
Date: 05/22/09 Time: 16:57:44

PROJECT INFORMATION

Company: Whetstone Associates
Client: COGCC
Test Location: Las Animas County, CO
Test Well: Dasko Well
Test Date: 5/1/09

AQUIFER DATA

Saturated Thickness: 112. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Dasko	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
▫ Dasko	0	0

SOLUTION

Aquifer Model: Confined
Solution Method: Theis (Recovery)

T = 1.125 ft^2/day
S' = 1.684