STATE OF COLORADO
OIL & GAS
CONSERVATION COMMISSION

May 26, 2009

Certified Mail Return Receipt Requested # 7008 1140 0000 3926 4720

Ms. Marcia Dasko
15301 Logging Canyon Road
Weston, CO 81091-9558

RE: Complaint 200204222
Water Well Analysis
Well Permit 191184
SENW 35 32S, 68W Las Animas County, Colorado

Dear Ms. Dasko:

In response to your concerns regarding possible impacts to water quality from coal bed methane (CBM) operations in the area near your home, the Colorado Oil and Gas Conservation Commission (COGCC) conducted a field visit to your property on February 24, 2009. Water samples were collected for general organic and inorganic water quality testing as well as for analysis of dissolved methane. A summary of the results of the chemical analyses is presented below. The analytical results are also compared to published water quality standards and to results of prior testing of water from your well.

FIELD TESTING

I visited your property on February 24, 2009 and you and I walked to your domestic water well so that I could determine if methane was venting from your water well. I determined that there was no methane venting from the casing of your water well before the pump was started. We started water flowing from your outdoor hydrant at approximately 5 gallons per minute at 14:05. We collected samples from your well using the hydrant installed near the well casing after pumping the well for 32 minutes. The water temperature had been stable at 49°F for eleven minutes at the time of sampling. The samples were shipped to Paragon Analytics in Fort Collins, CO and the samples were received on February 25, 2009.

Susan Wyman of Whetstone Associates visited your home on May 1, 2009 on behalf of the COGCC. She and you ran your pump while she measured the flow from the well and the drawdown during pumping. She also measured the rate of recovery after the pump was shut down. This testing was done in response to your concern that the water quantity as well as water quality might be impacted by CBM activities in the vicinity of your home.

COMPARISON OF INORGANIC ANALYTICAL RESULTS TO CDPHE INORGANIC STANDARDS

The Water Quality Control Commission (WQCC) of the Colorado Department of Public Health and Environment (CDPHE) has established “Domestic Use-Quality” human health standards and drinking water standards. Analytical data for the samples from your water well was compared to these standards. This information is summarized in Table 1 which is located in Attachment 1 and discussed in narrative form below. Please keep in mind that these “Domestic Use-Quality Standards” were established for **municipal public** drinking water supplies and often people use and consume ground water from private wells that exceed these standards. The analytical results were delivered to you previously. Table 1 also includes results from testing you had conducted in 2005 on water from your well as well as data from samples collected in February 2008

and data from samples collected in June 2008. The analytical reports from Paragon Analytics are included as Attachment 2.

- **Antimony (Sb):** The CDPHE human health standard for antimony is 0.006mg/l. Antimony is a contaminate metal.

  Antimony was not detected in the sample collected from your water well.

- **Arsenic (As):** The CDPHE human health standard for arsenic is 0.05 mg/l. Arsenic is a highly poisonous metal.

  Arsenic was not detected in the sample collected from your water well.

- **Barium (Ba):** The CDPHE human health standard for barium is 2.0 mg/l. Barium is a contaminate metal.

  Barium was detected in the sample collected from your water well at a concentration of 0.11mg/l which is below the CDPHE human health standard.

- **Beryllium (Be):** The CDPHE human health standard for beryllium is 0.004mg/l. Beryllium is a contaminate metal.

  Beryllium was not detected in the sample collected from your water well.

- **Cadmium (Cd):** The CDPHE human health standard for cadmium is 0.005 mg/l. Cadmium is a contaminate metal.

  Cadmium was not detected in the sample collected from your water well.

- **Chromium (Cr):** The CDPHE human health standard for chromium is 0.1 mg/l. Chromium is a contaminate metal.

  Chromium was not detected in the sample collected from your water well.

- **Lead (Pb):** The CDPHE human health standard for lead is 0.05 mg/l. Prolonged exposure to this metal can result in serious health effects.

  Lead was not detected in the sample collected from your water well.

- **Nickel (Ni):** The CDPHE human health standard for nickel is 0.1mg/l. Nickel is a contaminate metal.

  Nickel was not detected in the sample collected from your water well.

- **Selenium (Se):** The CDPHE human health standard for selenium is 0.05 mg/l. Selenium is a contaminate metal.

  Selenium was not detected in the sample collected from your water well.

- **Silver (Ag):** The CDPHE human health standard for silver is 0.05 mg/l. Excess amounts of silver may cause a permanent gray discoloration of the skin.

  Silver was not detected in the sample collected from your water well.

- **Thallium (Tl):** The CDPHE human health standard for thallium is 0.002 mg/l. Thallium is a contaminate metal.

  Thallium was not detected in the sample collected from your water well.

- **Uranium (U):** The CDPHE human health standard for thallium is 0.03 mg/l. Uranium can be present due to erosion of natural deposits of this element.

  Uranium was detected in the sample collected from your water well at a concentration of 0.00012mg/l which is below the CDPHE human health standard.

- **Fluoride (F**): The CDPHE human health standard for fluoride is 4.0 mg/l. Where fluoride concentrations are in the range of 0.7 mg/l to 1.2 mg/l health benefits such as reduced dental decay have been observed. Consumption of fluoride at concentrations of greater than 2.0 mg/l can result in mottling of teeth. Consumption of fluoride at concentrations greater than 4.0 mg/l can increase the risk of skeletal fluorosis or other adverse health effects. Fluoride occurs naturally in the ground water in many areas in Colorado at concentrations that exceed the drinking water standard.

  Fluoride was detected in the sample collected from your water well at a concentration of 0.6mg/l which is below the CDPHE human health standard.

- **Nitrate (NO_3):** The CDPHE human health standard for nitrate is 10.0 mg/l. Nitrate can cause cyanosis in infants; a household water supply should not contain nitrate concentration in excess of 10 mg/l.

  Nitrate was not detected in the sample collected from your water well.

- **Nitrite (NO_2):** The CDPHE human health standard for nitrite is 1.0 mg/l. Nitrite concentrations exceeding 1.0 mg/l should not be used for feeding infants.

  Nitrite was not detected in the sample collected from your water well.

- **Copper (Cu):** The CDPHE secondary drinking water standard for copper is 1 mg/l.

  Copper was not detected in the sample collected from your water well.

- **Chloride (Cl):** The CDPHE secondary drinking water standard for chloride is 250mg/l. Chloride concentrations in excess of 250 mg/l usually produce a noticeable taste in drinking water.

  Chloride was detected in the sample collected from your water well at a concentration of 8.4mg/l which is below the CDPHE drinking water standard.

- **Iron (Fe):** The CDPHE secondary drinking water standard for iron is 0.3mg/l. Small amounts of iron are common in ground water. Iron produces a brownish-red color in laundered clothing, can leave reddish stains on fixtures, and impart a metallic taste to beverages and food made with it. After a period of time iron deposits can build up in pressure tanks, water heaters, and pipelines, reducing the effective flow rate and efficiency of the water supply.

  Iron was not detected in the sample collected from your water well.

- **Manganese (Mn):** The CDPHE secondary drinking water standard for manganese is 0.05mg/l. Manganese produces a brownish color in laundered clothing, may stain fixtures and affect the taste of coffee or tea.

  Manganese was not detected in the sample collected from your water well.

- **Sulfate (SO_4):** The CDPHE sulfate secondary standard for human drinking water is 250mg/l. Although CDPHE does not have an agricultural standard for sulfate, other agencies recommend a concentration below 1,500 mg/l for livestock watering. Waters containing high concentrations of sulfate, typically caused by the leaching of natural deposits of magnesium sulfate (Epsom salts) or sodium sulfate (Glauber's salt), may be undesirable because of their laxative effects.

  Sulfate was detected in the sample collected from your water well at a concentration of 85mg/l which is below the CDPHE drinking water standard.

- **pH:** pH is the measure of the hydrogen ion concentration in water. The pH of water in its natural state is generally from 5.5 to 9.0. The CDPHE standard for domestic and agricultural water is a range of 6.5 to 8.5. Seven (7) represents neutrality, while values less than 7 indicate increasing acidity and values greater than 7 indicate increasing alkalinity.

  pH was measured in the water sample from your well with a value of 8.08 which is within the CDPHE drinking water and agricultural standards.

- **Total Dissolved Solids (TDS):** CDPHE's TDS standard for human drinking water is 500 milligrams per liter (mg/l). Although CDPHE does not have an agricultural standard for TDS, other agencies recommend concentrations below 1500 mg/l for irrigation, and below 5,000 mg/l for most livestock watering. TDS occurs naturally in the ground water in many areas of Colorado at concentrations that exceed the drinking water standard.

  TDS was measured in the water sample collected from your well at a concentration of 300mg/l which is below the drinking water standard.

- **Zinc (Zn):** CDPHE's Zn standard for human drinking water is 5 milligrams per liter (mg/l) and the agricultural standard is 2mg/l.

  Zinc was not detected in the water sample collected from your well.

The following parameters were also measured as part of the laboratory analysis although there are no CDPHE standards.

- **Sodium (Na):** People on salt restricted diets should be aware of the sodium concentration in the water they drink. A concentration of less than 20 mg/l is recommended by some for people on salt restricted diets or for people suffering from hypertension or heart disease. Sodium occurs naturally in the ground water in many areas of Colorado at concentrations that exceed this health advisory level.

  Sodium was detected in the water sample from your well at a concentration of 89mg/l which is above the recommended level.

- **Boron (B):**

  Boron was not detected in the sample collected from your water well.

- **Calcium (Ca):**

  The calcium concentration in the sample collected from your well was 20mg/l.

- **Magnesium (Mg):**

  The magnesium concentration in the sample collected from your well was 1.9mg/l.

- **Potassium (K):**

  Potassium was not detected in the sample collected from your water well.

- **Molybdenum (Mo):**

  The molybdenum concentration in the sample collected from your well was 0.0014mg/l.

- **Bicarbonate (HCO_3):**

  Bicarbonate alkalinity was measured in the sample collected from your well at a concentration of 150mg/l.

- **Bromide (Br):**

  Bromide was not detected in the sample collected from your water well.

METHANE GAS ANALYSIS

Methane was detected in the sample collected from your well at a concentration of 0.0022mg/l. The concentration of methane in the water produced from the well and entering your house from your well is below the threshold level of 1.1mg/l that could allow methane to accumulate in confined unventilated spaces and potentially be explosive.

VOLATILE ORGANIC COMPOUND ANALYSIS

A target list of sixty-nine volatile organic compounds (VOC) was utilized during analysis of water from your well. One of the 69 target compounds were detected in water samples from your well (chloroform). Chloroform is a disinfection byproduct of chlorination of water sources. No volatile tentatively identified compounds were detected in the water samples from your well.

SEMI-VOLATILE ORGANIC COMPOUND ANALYSIS

A target list of seventy-two semi-volatile organic compounds (SVOC) was utilized during analysis of water from your well. None of the 72 target compounds were detected in water samples from your well. One semi-volatile tentatively identified compound was detected in the water samples from your well. The analyst tentatively identified the TIC as an oxygenated hydrocarbon. The one semi-volatile TIC may be an artifact of the analytical process as the same TIC was present in the method blank prepared and analyzed with the sample from your well.

CONCLUSIONS

The inorganic chemistry of water from your well is not similar to coal bed methane (CBM) produced water and does not appear to have been impacted by CBM operations in the vicinity of your home. CBM produced water is typically much higher in sodium content that your well water is. CBM produced water typically has much greater levels of total dissolved solids than water from your well.

Table 1 shows a comparison of results from a sample collected from your well in 2005 by a private consultant to the results of three subsequent sampling and analysis events in 2008 and 2009. The overall chemistry of the water from your well has not changed. The water is predominantly of a sodium-bicarbonate character. Most parameters that were analyzed on all four occasions have similar concentrations with several lower in 2008 or 2009 than in 2005. However, the pH of water from your well was 7.7 when sampled in 2005 and the pH was 8.04 when measured at the laboratory in 2008. Total dissolved solids (TDS) concentration was identical in 2009 and in 2005. TDS is a good indicator of overall inorganic water quality. Only one of the more than 140 organic target analytes was detected in water from your well. The one reported volatile organic compound detected was chloroform which can form in wells that have been chlorinated to aid in disinfection. No analyte measured exceeds the groundwater standards of the state of Colorado. Higher pH may be an artifact of shock chlorinating your water well. Bacterial colonies and their metabolic processes in a well are capable of maintaining a pH close to 7 as that is their preferred growth habitat. Calcium concentrations have decreased since 2005. The decrease in calcium concentration in the water is likely due to the increase in pH with subsequent precipitation of calcium carbonate minerals. The concentration of dissolved methane is lower in your water well samples from 2009 than when first sampled in 2005.

The results of the pump test performed at your well by Whetstone Associates are included as Attachment 3. The pump test conducted in May 2009 is not directly comparable to the test performed shortly after the well was drilled in 1995 as Susan Wyman did not have a means of changing the pump rate wile the test ws underway as the driller did in 1995. The 2009 test does indicate the aquifer surrounding your well has relatively low rate of transmissivity of around 1-2ft^2/day. The mean hydraulic conductivity obtained from four modeling solutions to the observed data was just under $1x10^{-5}$cm/sec which translates to the groundwater movement rates of a few inches a day in the aquifer your well draws water from.

If you have any questions or would like to discuss these matters further, please contact me at 719-846-3091 or by email at peter.gintautas@state.co.us .

Sincerely,
Colorado Oil and Gas Conservation Commission

Peter Gintautas

Digitally signed by Peter Gintautas
DN: cn=Peter Gintautas, o=Colorado Oil and Gas Conservation Commision, ou, email=peter.gintautas@state.co.us, c=US
Date: 2009.05.26 15:49:48 -06'00'

Peter Gintautas
Environmental Protection Specialist

Attachments:
Attachment 1 - Table 1 - Analytical Summary
Attachment 2 - ALS Paragon Analytical Data
Attachment 3 - Whetstone Associates Pump Test Report

cc:
David Neslin, COGCC Director w/o attachments
Debbie Baldwin, COGCC Environmental Protection Manager w/o attachments
Margaret Ash, COGCC Environmental Protection Supervisor w/o attachments

TABLE 1
ANALYTICAL SUMMARY
Complaint 200204222
Dasko Water Well

Parameter	Water Well Sample					CDPHE Standards		
	Sample Date	Sample Date	Sample Date	Sample Date				
	04-May-05	06-Feb-08	10-Jun-08	24-Feb-09				
	Result	Result	Result	Result	Unit	Domestic	Agriculture	Units
Antimony	NA	ND	ND	ND	mg/l	0.006	NS	mg/l
Boron	ND	ND	ND	ND	mg/l	NS	0.75	mg/l
Copper	0.011	ND(<0.01)	ND(<0.015)	ND(<0.01)	mg/l	1	0.2	mg/l
Arsenic	ND	ND	ND	ND	mg/l	0.01	0.1	mg/l
Barium	0.17	ND(<0.1)	0.074	0.011	mg/l	2.0	NS	mg/l
Berylium	NA	ND	ND	ND	mg/l	0.004	0.1	mg/l
Cadmium	NA	ND	ND	ND	mg/l	0.005	0.01	mg/l
Calcium	29	13	12	20	mg/l	NS	NS	
Chromium	NA	ND	ND	ND	mg/l	0.1	0.1	mg/l
Iron	0.28	ND(<0.1)	ND(<0.1)	ND(<0.1)	mg/l	0.3	5	mg/l
Lead	ND	ND	ND	ND	mg/l	0.05	0.1	mg/l
Lithium	NA	ND	ND	0.01	mg/l	NS	NS	
Magnesium	3.3	1.2	1	1.9	mg/l	NS	NS	
Manganese	0.53	ND(<0.1)	ND(<0.01)	ND(<0.01)	mg/l	0.05	0.2	mg/l
Molybdenum	NA	0.0016	ND(<0.002)	0.0014	mg/l	0.035	NS	mg/l
Nickel	NA	ND	ND	ND	mg/l	0.1	0.2	mg/l
Potassium	0.8	ND(<1)	ND(<3)	ND(<1)	mg/l	NS	NS	
Selenium	NA	ND	ND	ND	mg/l	0.05	0.02	mg/l
Silver	NA	ND	ND	ND	mg/l	0.05	NS	mg/l
Sodium	85	80	88	89	mg/l	NS	NS	
Strontium	NA	0.31	0.28	0.48	mg/l	NS	NS	
Thallium	NA	ND	ND	ND	mg/l	0.002	NS	mg/l
Uranium	NA	0.00012	ND(<0.001)	0.00012	mg/l	0.03	NS	mg/l
Zinc	NA	ND	ND	ND	mg/l	5	2	mg/l
Chloride	6	6.2	7.4	8.4	mg/l	250	NS	mg/l
Nitrite	NA	ND	ND	ND	mg/l	1.0	10	mg/l
Nitrate	ND	ND	ND	ND	mg/l	10.0	100	mg/l
Total Nitrite/Nitrate	NA	ND	ND	ND	mg/l	10.0	100	mg/l
Fluoride	0.56	0.82	1.1	0.6	mg/l	4.0	NS	mg/l
Total Dissolved Solids	300	270	270	300	mg/l	400	*1500	mg/l
pH	7.7	8.04	8.1	8.08	No units	6.5 - 8.5	6.5 - 8.5	No units
Sulfate	77	67	66	85	mg/l	250	NS	mg/l
Bromide	NA	ND	ND	ND	mg/l	NS	NS	
Total Alkalinity	160	150	150	150	mg/l	NS	NS	
Bicarbonate	160	150	150	150	mg/l	NS	NS	
Carbonate	1	ND	ND	ND	mg/l	NS	NS	
Conductivity	NA	446	460	499	umhos/cm	NS	NS	
methane	0.72	0.0097	ND(<0.005)	0.0022	mg/l	NS	NS	
Total Organic Carbon	NA	ND(<1)	1.1	1.4	mg/l	NS	NS	

Notes

CDPHE	Colorado Department of Public Health and the Environment.
Domestic	Water Quality Control Commission 5 CCR 1002-41, Regulation No. 41 - The Basic Standards For Groundwater.
Agriculture	* Standards for agriculture complied from CDPHE and other of sources.
mg/l	milligrams per liter (ppm or parts per million).
µmhos/cm	micromhos per centimeter
NA	Not analyzed.
ND	Not detected.
NS	No Standard.
****	Health Advisory.
	Human health standard.
	Secondardy standard.

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.

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

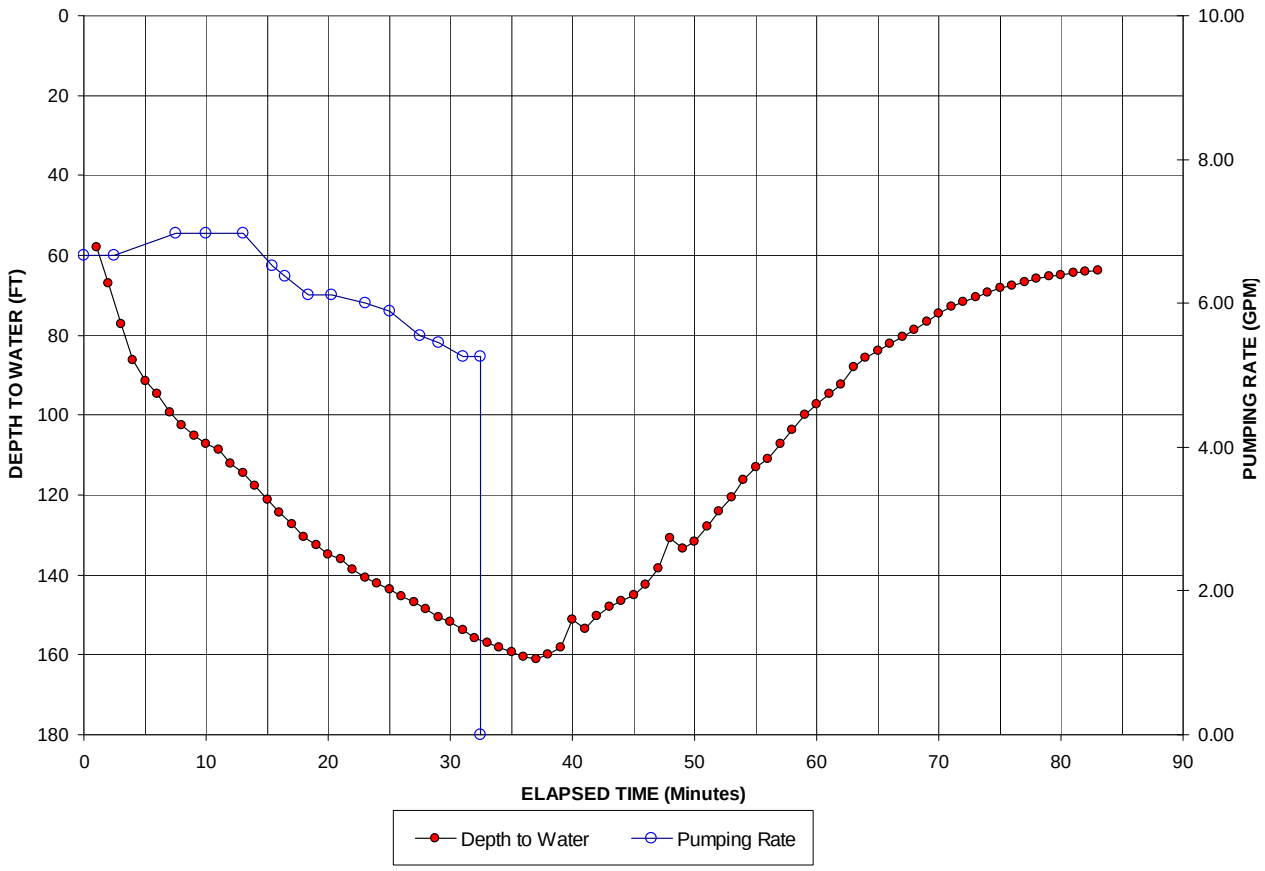


Figure 1. Depth to Water and Pumping Rate

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

Duffield. G.M., 1997. AQTESOLV® version 2.0, A computer program for the graphical analysis of pumping test data. HydroSOLVE, Inc.

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**

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

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

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

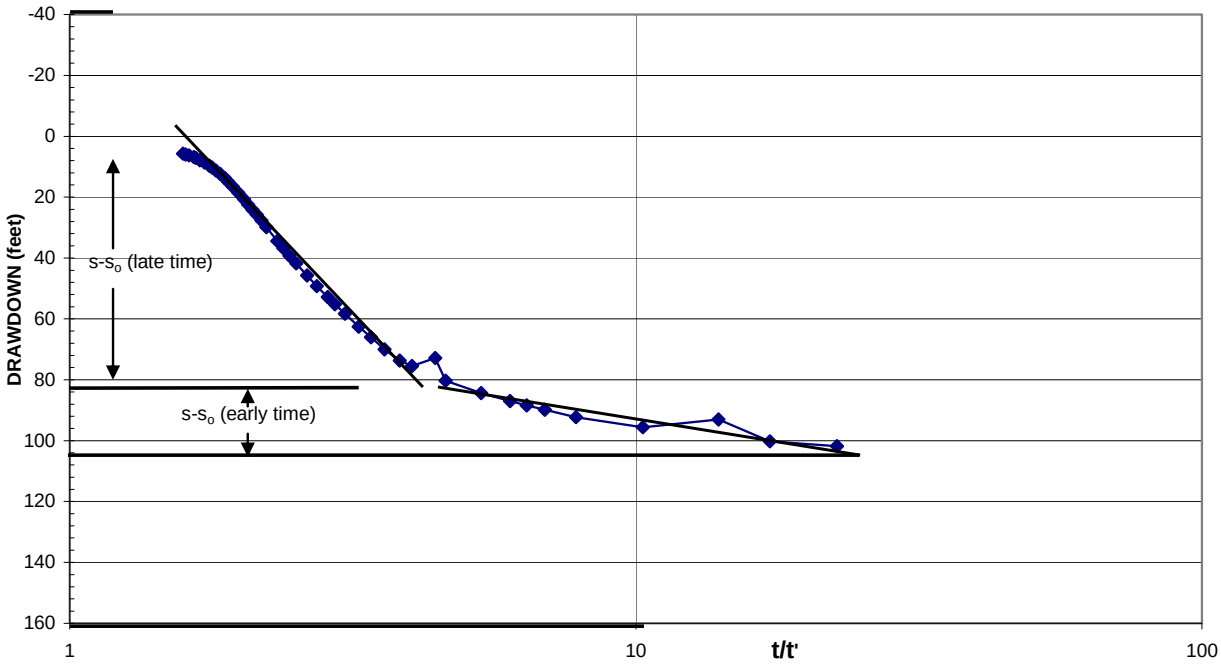
LATE TIME, Partial Penetration:

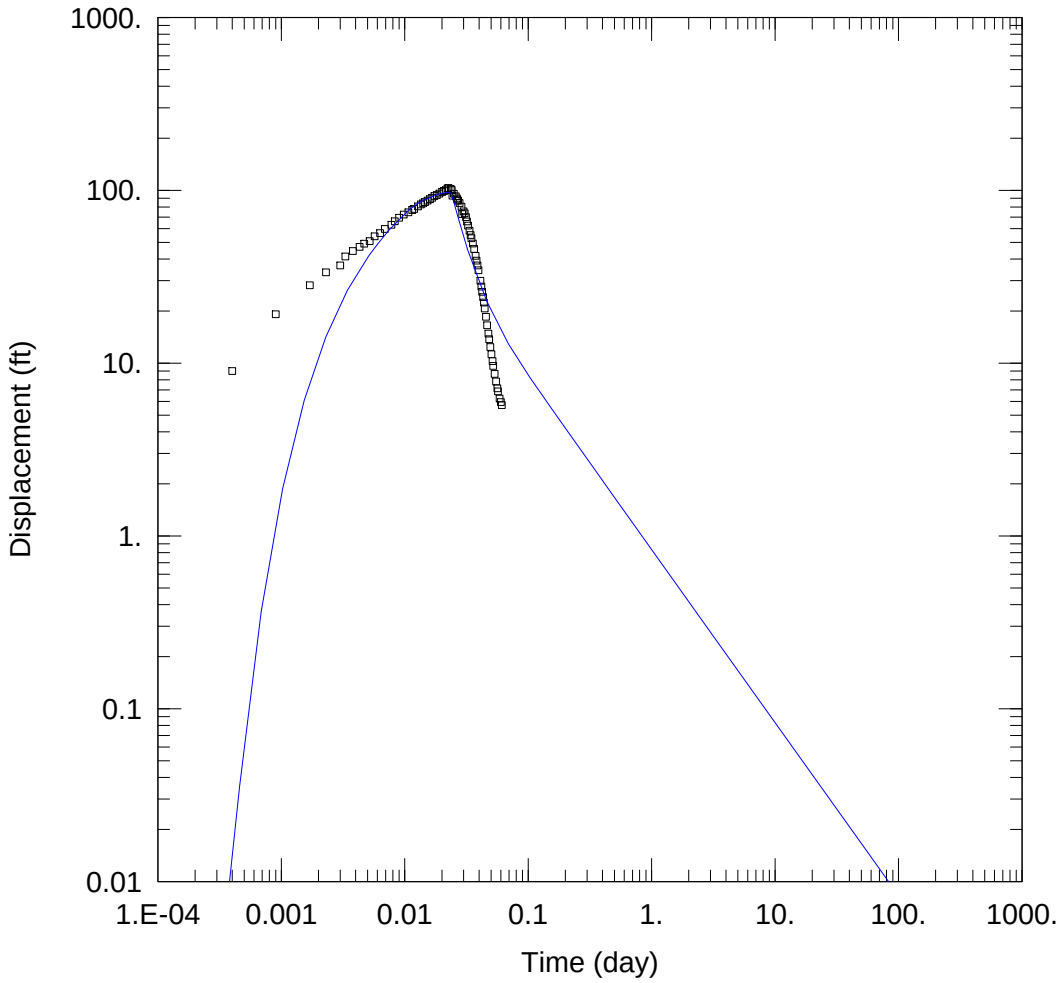
s =	160	ft
s_o =	-40	ft
T =	**1.1**	**ft^2/day**
T =	**0.01**	**cm^2/day**
b =	40.0	ft
K =	**0.03**	**ft/day**
K =	**9.87E-06**	**cm/sec**

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

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

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





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

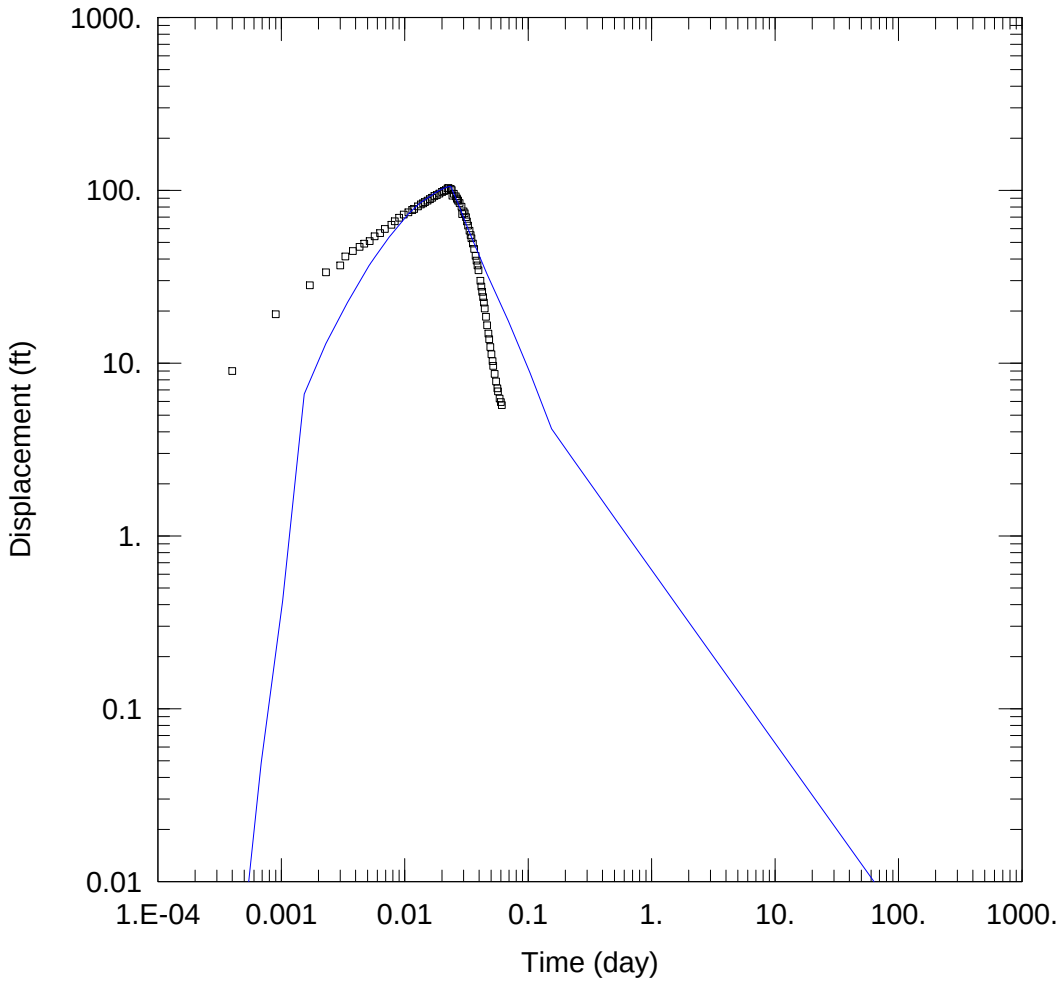
Observation Wells

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

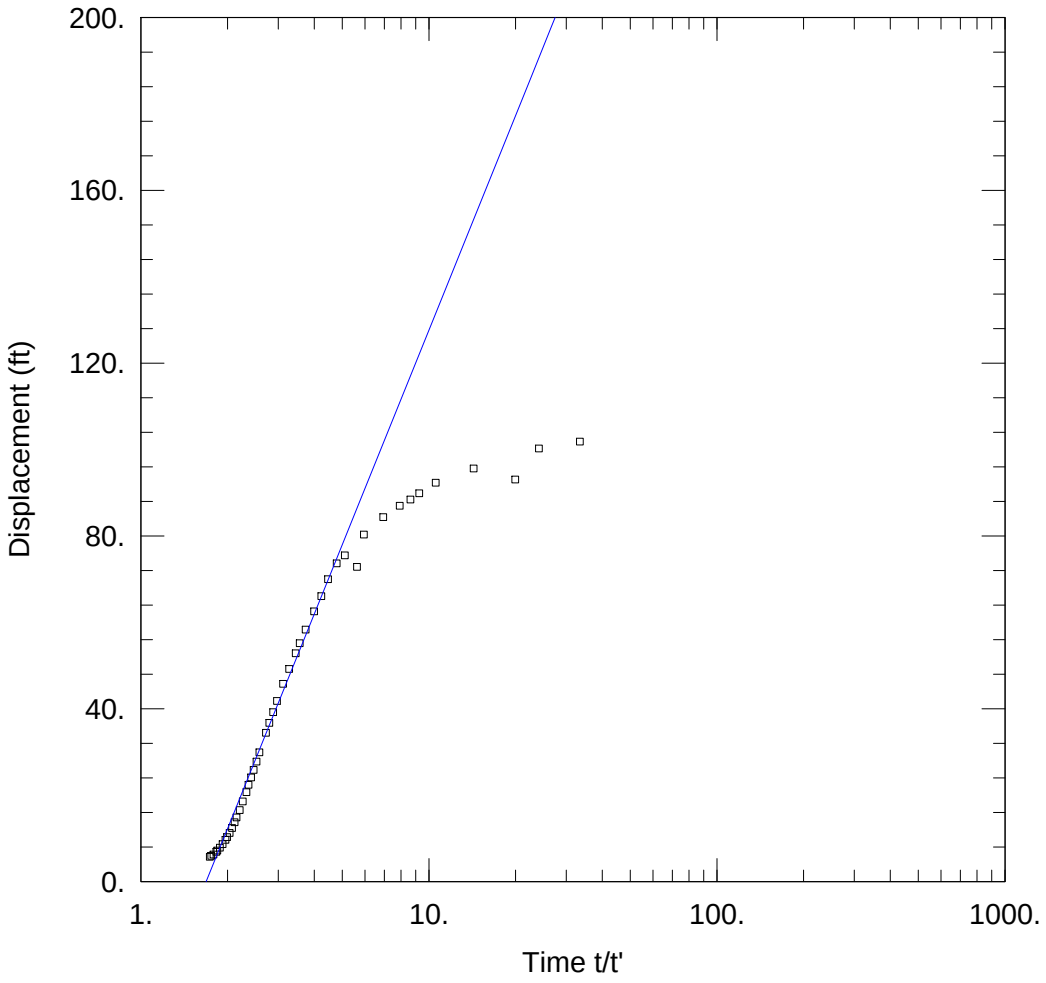
Observation Wells

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